The London School of Economics and Political Science

Assessing the performance of the Slovak and the Czech health systems: a case study examining the double transition and beyond

Lucia Kossarova

A thesis submitted to the Department of Social Policy of the London School of Economics for the degree of Doctor of Philosophy

London, April 2014

Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it). The copyright of this thesis rests with the author. Quotation from it is permitted, provided that full acknowledgement is made. This thesis may not be reproduced without my prior written consent. I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

I declare that my thesis consists of 63,600 words including tables and footnotes, excluding appendices and bibliography.

Statement of conjoint work

I confirm that a modified version of Chapter 2 will be a jointly co-authored paper with Dr. Joan Costa-i-Font who provided support during the analysis. Chapter 3 was published in the journal of *Health Policy and Planning* as a jointly authored paper with Professor Walter Holland who provided advice during data analysis and Professor Elias Mossialos who provided the idea. In these papers the literature background, analysis, discussion and conclusions were carried out and written by me.

Abstract

Measuring health system performance is essential for improving health and quality of care. It is relevant in any context, but especially in countries whose health care systems have undergone major changes. The 1989 transition from communism to democracy in Czechoslovakia followed by the 1993 split into two independent countries (the Czech Republic and Slovakia) have been studied extensively but little research has addressed the effects of these events on health and the quality of care provided. The overarching objective of this thesis is to examine pre- and post-transition health system performance at three levels: i) overall health and well-being, ii) quality of the health care system, and iii) quality of outpatient care. This is a policy piece intended to demonstrate the usefulness of various performance indicators, while applying a range of quantitative methods from different disciplines to unique datasets. The macro level findings suggest that the transition was not detrimental to overall health and well-being in neither of the two countries as demonstrated by a small continued height increase. Slovakia showed a larger capacity to benefit from the transition. The overall quality of the health care systems is measured by 'avoidable' mortality and also shows improvements. For some 'avoidable' mortality conditions Slovakia continues to lag behind the Czech Republic, while for others it outperforms its neighbour. The thesis also provides evidence on the absence of a significant relationship between health care inputs and 'avoidable' mortality. Finally, the assessment of the quality of outpatient care in Slovakia, using preventable hospitalisations and selected processes of care, shows that inappropriate care may be provided for asthma and diabetes. The findings also indicate a link between appropriate and inappropriate care and preventable hospitalisations. Overall, the results of this thesis provide the basis for policy makers to better understand the changes in health outcomes and quality of care in these two settings but also to inform future quality improvement efforts.

Acknowledgements

I would like to thank to all those who have supported me in different ways during this journey: supervisors, family and friends. I would especially like to thank my supervisors Professor Alistair McGuire, Professor Elias Mossialos and Dr. Joan Costa-i-Font. To Alistair for his continuous support and guidance; to Elias, for believing in me and providing me the opportunity to pursue this PhD; and to Joan, for his energy and enthusiasm. I am also thankful to Professor Walter Holland for his encouragement, wisdom and support.

I am extremely thankful to my friends Irini Papanicolas, Azusa Sato, Zeynep Gurguc, Noemi Nemes, Sotirios Vandoros, Jon Cylus, who were always there to listen and give advice when I had my moments of desperation. I could not have done this without you. A special thank you goes to Champa Heidbrink for her continuous support. I would also like to thank Ivan Poprocky, Monika Bakova, Martin Visnansky, Peter Heidinger, Ondrej Kosata, Juraj Betak, Daniela Oslejova for their support.

I am eternally grateful to my husband, for standing by my side in the most difficult moments, his love, patience, humour and encouragement. Thank you Carla and Aleca, my beautiful twin daughters, for helping me keep everything in perspective and lighting up my days. I would also like to thank Rita who helped us survive the 'twin shock' and was there for us so I could finish this thesis.

Most of all, I would like to thank my family. To my parents and brother: your love and continuous encouragement made it possible for me to pursue this PhD. Thank you for always being there for me.

To Mom

Table of Contents

Declaration 2

Statement of conjoint work 2

Abstract 3

Acknowledgements 4

Table of Contents 6

List of Figures 8

List of Tables 9

List of Abbreviations 11

Chapter 1. Thesis motivation and background 13

1.1. Introduction 13

1.2. Motivation and thesis objective 15

1.3. The socio-economic and political transitions of Slovakia and the Czech Republic 17

1.4. The health care systems of Slovakia and the Czech Republic before and after the two transitions 20

1.5. Framework for measuring health system performance 26

1.6. Rationale for indicator selection 35

1.6.1. Height: an indicator of well-being and overall health system performance 49

1.6.2. 'Avoidable' mortality: an indicator of health care performance or overall quality of care 54

1.6.3. Hospitalisations for Ambulatory Care Sensitive Conditions: an indicator of the quality of ambulatory care 60

1.7. Data 69

1.8. Research questions and thesis contribution 71

Chapter 2. Using height to assess overall well-being and health system performance before and after Czechoslovakia's transition and break up 76

2.1. Introduction 76

2.2. Data and methods 78

2.3. Results 87

2.4. Discussion and conclusion 113

Chapter 3. Using 'avoidable' mortality to measure health care performance in the Czech Republic and Slovakia between 1971 and 2008 118

3.1. Introduction 118

3.2. Data and methods 120

3.3. Results 123

3.4. Discussion and conclusion 134

Chapter 4. Examining the relationship between health care inputs and 'avoidable' mortality 144
4.1. Introduction 144
4.2. Data and methods 150
4.3. Results 157
4.4. Discussion and conclusions 166
Chapter 5. Examining the quality of ambulatory care in Slovakia using outcome and process indicators 172
5.1. Introduction 172
5.2. Data and methods 179
5.3. Results 189
5.4. Discussion and conclusion 209
Chapter 6. Conclusions and policy implications 216
6.1 Overall answer to the research question and main contributions 218
6.2 Key findings of individual chapters 222
6.2.1 Conclusions of Chapter 2 222
6.2.2 Conclusions of Chapter 3 224
6.2.3 Conclusions of Chapter 4 226
6.2.4 Conclusions of Chapter 5 229
6.3 Limitations 231
6.4 Policy and future research recommendations 233
Appendix A – Appendix to Chapter 1 245
Appendix B – Appendix to Chapter 2 278
Appendix C – Appendix to Chapter 4 283
Appendix D – Appendix to Chapter 5 289
Bibliography 300

List of Figures

Figure 1. Framework for assessing health system performance 30
Figure 2. Life expectancy at birth 39
Figure 3. Real GDP per capita, PPP$ 40
Figure 4. Total expenditure on health as % of GDP 41
Figure 5. Health expenditures per capita 42
Figure 6. Infant deaths per 1000 births and neonatal deaths per 1,000 live births 43
Figure 7. Diseases of circulatory system and malignant neoplasms, 0-64, age-standardised death rate per 100,000 43
Figure 8. External cause (injury and poison) 0-64; and diseases of the respiratory system, all ages, age-standardised death rate per 100,000 43
Figure 9. Relationships involving stature 51
Figure 10. Conceptual framework for ACSHs 66
Figure 11. Distribution of the population by age categories 81
Figure 12. Height by age cohorts, gender and country in 2003 88
Figure 13. Height by income tercile, age group, gender and country, 2003. Poorest (q1), middle (q2), top (q3) 90
Figure 14. Slopes of height on years under democracy in Czech Republic and Slovakia across income terciles 97
Figure 15. Slopes of height on income by country and whether or not the person spent time growing up under independence 103
Figure 16. Slopes of height on years under independence in Czech Republic and Slovakia across income terciles 107
Figure 17. Mortality from 'avoidable' and non-avoidable causes in the Czech Republic and Slovakia, 0-64 years 124
Figure 18. Mortality from selected 'avoidable' causes where public health programmes or primary care are most important 126
Figure 19. Regional SMRs from selected 'avoidable' causes where public health programmes or primary care are most important, 1996 to 2007 127
Figure 20. Mortality from 'avoidable' causes where most important interventions are provided at the hospital level 129
Figure 21. Regional standardised mortality ratios from selected 'avoidable' causes where public hospital care is most important, 1996-2007. 131
Figure 22. Regional mortality trends: age-standardised mortality rates per 100,000 inhabitants for 'avoidable' and 'other' cause 159
Figure 23. Regional trends - doctor, nurse and bed supply per 10,000 inhabitants. 160
Figure 24. Regional variations in average age-standardised 'avoidable' mortality rates for the period of 1996-2007 161
Figure 25. Number of diabetes and asthma patients by age category in year 2002 .. 189
Figure 26. Mean number of hospitalisations by age category and year 192
Figure 27. Mean number of hospitalisations by region and year 193
Figure 28. Number of patients with at least one hospitalisation by age category 197
Figure 29. Mean number of hospitalisations by age category and year for patients with at least one hospitalisation 199
Figure 30. Proportion (%) of hospitalised diabetes patients who received appropriate care 201
Figure 31. Proportion (%) of hospitalised asthma patients who received appropriate and inappropriate care 202
Figure 32. Search results 260
Figure 33. Conceptual framework for ACSHs 263
Figure 34. Height by age group, and gender and country, 2005 278

List of Tables

Table 1. Measures of population health 38
Table 2. Examples of process and outcome indicators for different areas of care 48
Table 3. Overview of data sources and variables 70
Table 4. Summary of research questions 72
Table 5. Variable description 82
Table 6. Mean height by gender and country, 2003 89
Table 7. Average height by terciles, gender and country 90
Table 8. OLS regressions of years lived under democracy as a dummy variable on height with different controls 93
Table 9. OLS regressions of years lived under democracy as a continuous variable on height with different controls 95
Table 10. OLS regressions of years lived under democracy on height with different controls – male 98
Table 11. OLS regressions of years lived under democracy on height with different controls – female 99
Table 12. OLS regressions of years lived under democracy as a continuous variable adjusted for "quality" of democracy 100
Table 13. OLS regressions of years lived under independence as a dummy variable on height with different controls 102
Table 14. OLS regressions of years lived under independence as a continuous variable on height with different controls 105
Table 15. OLS regressions of years lived under independence on height with different controls – male 108
Table 16. OLS regressions of years lived under independence on height with different controls – female 109
Table 17. OLS regressions of years lived under democracy as a continuous variable on height with different controls – individuals aged 50 and less 110
Table 18. 'Avoidable' causes of death selected for analysis 122
Table 19. Trends in condition specific 'avoidable' mortality 133
Table 20. 'Avoidable' causes of death selected for analysis 151
Table 21. Descriptive statistics of dependent and explanatory variables 158
Table 22. Results for 'avoidable' and other mortality 163
Table 23. Results for selected 'avoidable' mortality conditions 165
Table 24. ICD-10 codes used for identifying hospitalisations 182
Table 25. Patient level independent variables constructed based on clinical guidelines 184
Table 26. Summary of procedure and ATC codes used to design variables 186
Table 27. Diabetes - number of services 190
Table 28. Asthma - number of services 191
Table 29. Summary statistics for appropriate care variables for all diabetes and asthma patients 194
Table 30. Diabetes – percentage of all diabetic patients receiving appropriate care by year 195
Table 31. Asthma – percentage of all asthma patients receiving appropriate care by year 196
Table 32. Overview of patients with and without hospitalisation between 2002 and 2008 196
Table 33. Characteristics of patients with and without hospitalisation 198
Table 34. Summary statistics for appropriate care variables for diabetes and asthma patients with at least one hospitalisation 200
Table 35. Relationship between (in)appropriate care and hospitalisations of diabetic patients 204

Table 36. Relationship between (in)appropriate care and hospitalisations for asthma patients 206
Table 37. Development of the concept of 'avoidable' mortality 245
Table 38. Eurostat list of conditions and their use in some lists of 'avoidable' deaths 247
Table 39. Ambulatory care sensitive and marker conditions 249
Table 40. Summary of assessment of ACSC admissions indicator 251
Table 41. Summary of factors that explain ACSHs rates, 1970 – 2005 253
Table 42. Main criteria for study inclusion 257
Table 43. Narrative synthesis approach 261
Table 44. Summary of studies included in the review 265
Table 45. Summary of results 274
Table 46. Descriptive statistics 278
Table 47. Democracy as a dummy variable 279
Table 48. Democracy as a continuous variable 279
Table 49. Democracy as a continuous variable – male 280
Table 50. Democracy as a continuous variable – female 280
Table 51. Independence as a dummy variable 281
Table 52. Independence as a continuous variable 281
Table 53. Independence as a continuous variable – male 282
Table 54. Independence as a continuous variable – female 282
Table 55. IV results for 'avoidable' and other (non-avoidable) mortality 283
Table 56. IV results for selected 'avoidable' mortality conditions 284
Table 57. IV results for 'avoidable' and other (non-avoidable) mortality using health activity as the dependent variable 286
Table 58. Results for 'avoidable' and other (non-avoidable) mortality using health activity as the explanatory variable 287
Table 59. Diabetes: using "bad care" variables in the previous 2 years 289
Table 60. Diabetes: using "bad care" variables in the previous 3 years 290
Table 61. Diabetes: using "bad care" variables in the previous 4 years 291
Table 62. Using count variables – Poisson and NB fixed effects 292
Table 63. Asthma: using "bad care" variables in the previous 2 years 294
Table 64. Asthma: using "bad care" variables in the previous 3 years 295
Table 65. Asthma: using "bad care" variables in the previous 4 years 296
Table 66. Astma: using count variables – Poisson and NB fixed effects 297
Table 67. Diabetes: including age as a continuous variable – Poisson and NB fixed effects 298
Table 68. Asthma: including age as a continuous variable – Poisson and NB fixed effects 299

List of Abbreviations

ACSCs	Ambulatory Care Sensitive Conditions
ACSHs	Ambulatory Care Sensitive Hospitalisations
AHRQ	Agency for Healthcare Research and Quality
AMIEHS	Avoidable Mortality in the European Union Project
DALE	Disability Adjusted Life Expectancy
DRG	Diagnostic Related Groups
EB	Eurobarometer
EC	European Community
EU	European Union
FE	Fixed Effects
GDP	Gross Domestic Product
GHIC	General Health Insurance Company
GINA	Global Initiative for Asthma
GP	General Practitioner
HbA1c	Glycated Haemoglobin
HiT	Health Systems in Transition
IHIS	Institute of Health Information and Statistics
IOM	Institute of Medicine
IV	Instrumental Variables
MoH	Ministry of Health
NB	Negative Binomial
NHIC	National Health Information Center
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Square
OOP	Out-of-Pocket
PYLL	Potential Years of Life Lost

RE	Random Effects
SABA	Short Acting Beta Agonists
SHI	Social Health Insurance
SMR	Standardised Mortality Ratio
UN	United Nations
WB	World Bank
WHO	World Health Organization
WHS	World Health Survey

Chapter 1. Thesis motivation and background

1.1. Introduction

Measuring performance and quality is of great importance in any area, but especially so in health care where it is essential to know whether best possible care is being provided and steps are being taken to avoid unnecessary mistakes, illness or deaths. Probably the most important role of performance measurement is to hold the different stakeholders accountable by enabling them to make an informed decision (Smith, Mossialos, Papanicolas et al., 2009) and to enable health improvement initiatives. While there were some earlier efforts, it was the World Health Report (2000) on health system performance that drew wide attention to this important area and highlighted the complexities involved in performance measurement (Almeida, Braveman, Gold et al., 2001; Navarro, 2000; World Health Organization, 2000). Since the publishing of this report, performance measurement has become a rapidly growing aspect of health systems (Smith, Mossialos, Papanicolas, et al., 2009).

Measuring health system performance and health outcomes is a complex task. The European Union (EU), the Organization for Economic Co-operation and Development (OECD), the World Health Organization (WHO) and other international bodies are actively involved in providing data and tools for policymakers in the countries to try to effectively measure, compare and consequently improve their health systems (Papanicolas & Smith, 2013). In addition, there are increasingly more local performance assessment initiatives as well. Certainly, the most important ultimate goal is the overall health and well-being of individuals and populations, the distribution of these, and whether or not over time improvements can be observed. However, the fact that health and well-being are

broadly determined by a range of socio-economic, political, and environmental factors, as well as a person's individual characteristics and behaviours, not only the quantity and quality of health care provided (World Health Organization), raises issues on how best to measure health, the contribution of health care systems to changes in health outcomes, and the quality of the health care system.

Studying health system performance and quality of care is relevant in any context. However, it is especially important in countries whose health care systems are exposed to major institutional changes that can exert significant effects (improve or deteriorate) on well-being and population health. One such major historical, political, economic, social and institutional change was the 1989 transition to liberal democracy and market economy in the Eastern European region, and the Soviet Union, followed by many of the countries gaining independence for the first time. Overall, the transition created winners and losers amongst the countries and at the different levels of the society (McKee, 2004).

The transition in the countries of central and Eastern Europe (e.g. Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia) has been more successful than in the rest of the region, mainly because of different starting conditions including better infrastructure, economic growth, social cohesion, and greater exposure to the international scientific and policy community. Thus, where economic and political transition were more successful, so was the health transition (McKee, 2004). Nevertheless, during this period most of the countries initially experienced a deterioration in health outcomes (Cornia & Paniccià, 2000; Figueras, McKee, Cain et al., 2004) and struggled with structural changes, reduced budgets, lack of appropriately trained staff and rising poverty levels (Figueras, McKee, Cain, et al., 2004) before any significant improvements could be noticed. Given this context, the following questions arise: How have the health systems of these countries been

performing since the transition? Have they been providing high quality care to their populations? The broader socio-economic and political transition as well the specific health care systems have become not only an important study area for researchers but also an essential area to be evaluated and understood by policy makers so that lessons can be learned across the entire region.

1.2. Motivation and thesis objective

Czechoslovakia is a particularly interesting case study and unique amongst the countries of central and Eastern Europe as it can be argued that the two countries - Slovakia and the Czech Republic – shared very similar health policies and health systems until the period of the two transitions: first, the fall of communism in 1989 and then the separation in 1993 when they set out on their own paths. Therefore, they also make a fascinating and important natural experiment that should allow us to better understand the impact of the transition, the different reform policies implemented and the move from one set of institutions to another.

It was during this post-transition period when both Slovakia and the Czech Republic embarked on major reforms, including health care, and began to implement their own country-specific policies. In both countries, there was increased privatisation accompanied by increasing health expenditures, which makes one wonder how the two countries were performing in terms of achieving health outcomes and improving quality of care (Tomasik, 2012). Most of the reforms focused on health financing and service provision, with only limited evidence on how the different changes have been reflecting on the overall health of the population and quality of care provided, both at the aggregate and individual levels. This thesis is a policy piece that aims to contribute to the literature by addressing this gap using public health and health service research theories, a range of methods that draw on different disciplines (e.g.

epidemiology and demography, health economics and political science) and apply several unique datasets and performance indicators.

The overarching goal of this thesis is to assess health performance and quality of care in Slovakia with respect to the Czech Republic since the 'double transition' (1989 and 1993) using a selection of three methodologically more appropriate outcome indicators at the different levels of the health system. For clarity and consistency purposes, the analysis is guided by a conceptual health system performance framework. This framework should enable a common understanding of what is meant by a "health system", encompass its different dimensions, and guide the selection of appropriate indicators from the macro to the micro level. A fully comprehensive assessment of performance of any health care system would be truly far reaching. The framework followed here allows assessment to be undertaken at different levels, but cannot claim to be fully comprehensive. Following this framework it is nonetheless possible to assess different individual dimensions of the Czech and Slovakian health systems performance, providing invaluable information on the main direction of travel. The thesis starts from the macro assessment of overall health and well-being (Chapter 2), then narrows down to the assessment of the quality of the two health care systems (Chapter 3 and 4) and ends by an in-depth review of the quality of outpatient care in Slovakia (Chapter 5).

Overall, this thesis provides an insight into the health system performance of Slovakia and Czech Republic since the two transitions, rather than an in-depth analysis of health reforms. This type of an assessment is especially timely as in the last decades, there has been a move away from assessing costs and activity to assessing quality with an emphasis on both efficient use of resources and on the effectiveness of health care (Campbell, Roland, & Buetow, 2000). The findings emerging from this piece of research will be a unique contribution to the body of

evidence addressing the health system effects since the two transitions. Furthermore, the results can serve as a useful information basis to policy makers not only to initiate future health performance assessment initiatives necessary to improve the quality of the health care systems, but also health and well-being overall.

The next sections of this introductory chapter are structured as follows. First, a review of the 1989 socio-economic and political transition from communism to democracy and the 1993 independence is provided. This includes a summary of the key changes in the health systems of the two countries. Then a conceptual health system performance assessment framework is selected to guide the health system assessment process in Slovakia and the Czech Republic and facilitate the selection of health outcome indicators. Third, the in-depth literature review and rationale for the selection and use of three methodologically more appropriate indicators – height, 'avoidable' mortality and hospitalisations for Ambulatory Care Sensitive Conditions (ACSCs) – is provided. Fourth, the data used in this thesis is reviewed. The chapter ends with an overview of the research questions and a thesis outline.

1.3. The socio-economic and political transitions of Slovakia and the Czech Republic

While the fall of the communist regime was similar across the region, Czechoslovakia's separation into two countries and thus a double transition makes these countries a unique natural experiment and case studies. Czechoslovakia fell under the Soviet influence, and hence became a socialist economy, in 1948. The latter implied a ban on civil and political liberties alongside media censorship and production plans and quotas (Janik, 2010). For about forty years, the population of Czechoslovakia lived under such a regime with some attempts to bring change after

the so-called Prague spring.[1] However, in 1989 the communist regime fell all across Eastern Europe and the democratisation process began. Among the most important reforms were the introduction of a market economy by means of a set of regulations inspired by the principles of liberal economy including privatisation of large public enterprises and attempts to change the prevailing authoritarian culture.

Although initially the steps taken in the two federations of Czechoslovakia were similar, in 1992 a peaceful secession process was designed by the two main political leaders to create two separate countries in 1993. Gradually the form and speed of the democratisation and liberalisation reforms began to differ. The Czech Republic initially implemented aggressive economic reforms in combination with socio-economic entitlements, and the political system was stable and democratically sound. In Slovakia the first years after the break-up were characterised by authoritarian rule which left the country economically and politically isolated (Inglot, 2009; Meszaros, 1999). By 1998 the rapid progress in the Czech Republic slowed down, while the reverse happened in Slovakia with the defeat of Meciar; it appeared that the Czech Republic was ready to join the EU while Slovakia's chances appeared meagre. The period between 1989 and 2004 was characterized by some as the 'transformation shock' (Inglot, 2009). However, both countries reached an externally required level of political and economic transition and joined the EU in 2004. This confirms the view that "the two neighbours are not polar opposites, for the road to post-communist reform has proved unpredictable for both" (Meszaros, 1999).

The degree of decentralization in Czechoslovakia was limited (Bookman, 1992). Czechoslovakia became a federation in 1969 with a constitutional agreement that regions would grant to the centre only those responsibilities they would be willing to

1 In 1968 the "Prague Spring" marked a short-lived period of liberalisation and democratization with reforms but quickly ended with the Warsaw Pact troops' invasion; any attempts for reforms were crushed and oppression under Soviet Communism continued for the next 20 years (Janik 2010).

surrender. The economic jurisdiction, as well as social policies were shared between the regions and the centre. However, in 1971 a new re-centralisation process emerged which implied that social welfare policies were returned and joined jurisdiction matters became under the power of the federal government. The centralising trend continues until 1990 when regional decentralisation was enacted before the break up in 1992. Czechs and Slovaks have small linguistic and cultural differences; however, economically Slovakia was always inferior to the Czech Republic; the Slovaks "perceive themselves as less developed than the Czechs and they blamed the union" (Bookman, 1992, p.92). Some argue that the secessionist movement was primarily motivated by economic factors (Bookman, 1992; Pavlínek, 1995) while others focused on the role of history, political culture and ethnic nationalism (Innes, 2001; Kirschbaum, 1993; Olson, 1993).

The events if 1989 and 1992 can be regarded as a "double bang", a rare case in history where two large forces coincided (Bookman, 1992). It was first a transition from centrally planned to a market economy and then the secession of Slovakia that happened virtually simultaneously. Some even suggest that it was a "triple transition": democratisation, marketization, and a national transformation (Leff, 1996). The institutional consolidation was rather smooth in the Czech Republic but less so in Slovakia. The Czech welfare state was relatively stable since 1993 given its solid institutional inheritance; Slovakia on the other hand was severely disadvantaged throughout the 1990s in terms of policy leadership and necessary social expertise, coupled with rapid institutional changes departing from those of Czechoslovakia's past and in search of its new own national welfare state (Inglot, 2009; Potucek & Radicova, 1997). Institutional reforms that come out of a transition to a market economy (Collins & Rodrik, 1991) lead to social changes which include stimulation of risk taking, altering the attitudes towards work under socialism, which encompass additional effects of globalisation and more generally increase in

standards of living. Secession and transition, however, are argued to ease the pain of these processes as there is an overlap between them in the aftermath of the two events.

The two transitions affected all parts of the economy, including the health care systems. In the following section an overview of Slovakia's and the Czech Republic's health care systems before and after the transition and independence is provided.

1.4. The health care systems of Slovakia and the Czech Republic before and after the two transitions

The different socio-economic and political transition processes have also reflected in changing policies and health systems in the two countries. The Slovak and the Czech health care systems were very similar before the fall of the regime and the split up, after which the two countries embarked on their own reform paths. Up until 1990 the health systems of the two federations had the same structure and were financed through a tax based system where all the services were provided by the state (Institute of Health Information and Statistics Czech Republic, 2006). During this period adoption of modern diagnostics and therapeutic practices, as well as access to innovative pharmaceuticals was limited and focus was mainly on improving structural indicators such as the numbers of hospitals, beds and physicians (Szalay, Pažitný, Szalayová et al., 2011).

After 1989 both countries began to conceptualize a new health system with social health insurance (SHI) as the main pillar and with private provision (primary care, specialist care, pharmacies), provider choice, competition and decentralization as its key components. As the Slovak economy was in deep depression in the early transition years, the move to SHI was considered to be rather bold (Szalay, Pažitný,

Szalayová, et al., 2011). The official goals in both countries continued to be universality, equity and free access to health services at the point of delivery with the ultimate goal of improving the health status of the population (Bryndova, Pavlokova, Roubal et al., 2009; Szalay, Pažitný, Szalayová, et al., 2011).

Changes in the health systems between 1990 and 1992 were very similar in the two countries; only after the dissolution of the two federations in 1993 did they slowly began to differ. While Slovakia initially lagged behind the Czech Republic, both countries moved towards a compulsory SHI with multiple purchasing funds, financed by individuals, employers and the state, with voluntary health insurance and out-of-pocket expenditure playing a small role (Bryndova, Pavlokova, Roubal, et al., 2009; Szalay, Pažitný, Szalayová, et al., 2011). Devolution and decentralization of public health functions and administration followed, even though at a slower pace (Bryndova, Pavlokova, Roubal, et al., 2009; Szalay, Pažitný, Szalayová, et al., 2011). The initial reforms led to the financial difficulties of insurance companies, mainly caused by the overutilisation of health services under the fee-for-service schemes, inadequate risk compensation schemes, insufficient contribution levels, and inefficiencies at all levels of the system. These financial difficulties continued through much of the 1990s and 2000s in both countries (Bryndova, Pavlokova, Roubal, et al., 2009; Szalay, Pažitný, Szalayová, et al., 2011). Below are some key specifics to the health systems of the Czech Republic and Slovakia.

The Czech Republic

In the early 1990s the Czech Republic was transitioning to the SHI system with numerous health insurance funds. Similar to Slovakia, the health insurance funds contracted providers on the fee-for-service basis which led to costs increasing unsustainably and changes in the contributions and provider payment mechanism.

Presently hospitals in the Czech Republic are reimbursed according to a combination of Diagnostic Related Groups (DRGs), individual contracts and global budgets. General Practitioners (GPs) do not act as true gatekeepers and are paid by a combination of capitation and fee-for-services, and outpatient specialists by fee-for-service with a limit. In 2003 large-scale decentralization of public administration occurred (Bryndova, Pavlokova, Roubal, et al., 2009). After 2005 some of the major changes introduced included risk-adjustment for redistribution of SHI contributions, an annual ceiling to SHI contributions for all, the introduction of user fees, increased transparency in pharmaceutical price setting, and highly specialized care into specially designed health care centres to improve the quality of care. However, none of the reforms were of the scale and intensity as the overhaul of the 2002-2006 reforms in Slovakia.

Another step in the area of quality of care as of 2009 was the development of a national set of health care quality indicators and the Professional Forum's (an advisory body to the Ministry of Health (MoH) and health insurance funds) task to develop comprehensive sets of standards of clinical treatment, quality indicators, reimbursement, personnel and technical matters, and patient impact analysis (Bryndova, Pavlokova, Roubal, et al., 2009). The future reforms in the Czech Republic aim to focus on patient rights, health care provision and further refinements to the SHI system in order to achieve financial sustainability and maintain high quality care in difficult economic times. Overall, the Czech system is characterized by universal coverage, a broad benefits package, relatively low health expenditures as percentage of Gross Domestic Product (GDP) compared to Western Europe, low out of pocket (OOP) payments distributed relatively evenly across household income deciles, sufficient human resources even though with regional disparities, and high utilisation rates in ambulatory care as well as hospitals (Bryndova, Pavlokova, Roubal, et al., 2009).

Slovakia

In Slovakia during the 1990s the institutional and regulatory frameworks were weak and plagued with corruption which led to debts and bankruptcies in the health insurance market. At the same time, hospital facilities were deteriorating and not reflecting the needs of the population. Physicians were dissatisfied with low wages which led to lower quality of care and increased corruption (Szalay, Pažitný, Szalayová, et al., 2011). During 2002-2006 debts were cleared and systematic reforms focusing on cost-stabilisation, limiting the scope of benefits, and increasing private spending were implemented. A reform package with six new laws was enacted in 2004 with an overall focus on individual responsibility for health, rather than the state's (Szalay, Pažitný, Szalayová, et al., 2011).

Unlike in the Czech Republic, the health care reforms in Slovakia during this period were part of broader reforms in public finances and the business environment – by some labeled as "Slovakia's neo-liberal turn" (Fisher, Gould, & Haughton, 2007). The laws introduced new regulatory and institutional frameworks leading to adjustments in the financing, delivery and governance of the health system, and an overall change in the roles and relationships of all the health care actors (Szalay, Pažitný, Szalayová, et al., 2011). User fees implemented in 2003 (abolished in 2006) seemed to have decreased physician visits and drug prescriptions without limiting access to necessary care, but little evidence is available whether access for necessary and appropriate treatment was truely maintained. The motivation and pay for health professionals continued to be unsatisfactory, putting to question the quality of care provided (Hlavačka, Wágner, & Riesberg, 2004).

The 2006-2010 government shifted back towards more state involvement and responsibility. The institutional and regulatory framework was not really affected, but

user fees were abolished and health insurance companies were not allowed to make profit. The government between 2010-2012 was aligned with the goals of the 2002-2006 government and built on their reform plans. Among other goals in the area of quality, the support of standard diagnostic and treatment protocols and evidence based medicine, as well as a hospital accreditation system was key (Szalay, Pažitný, Szalayová, et al., 2011).

Ambulatory care providers in Slovakia negotiated individual contracts with insurance funds to determine the range and volume of services covered, as well as the fee for one point (each procedure has an assigned point value). General practitioners are paid by a combination of capitation and fee-for-service. The idea was that GPs act as gatekeepers to avoid unnecessary specialist visits as well as to ensure coordination of treatment and thus improve quality; however, capitation payments do not motivate GPs to coordinate and manage patients effectively (Szalay, Pažitný, Szalayová, et al., 2011). Specialists are paid with fee-for-service with a maximum volume of points[2] beyond which the specialist may not be reimbursed. In addition, differentiated prices depending on selected quality and effectiveness parameters have been introduced as well as a digressive fee per point. Quality initiatives in ambulatory care focus mainly on structural indicators such as education and premises, where processes are left to the discretion of the providers (Szalay, Pažitný, Szalayová, et al., 2011). Hospitals in Slovakia are paid by a form of the diagnostic related group (DRG) system based on the type of hospital and specialty.

The recent Health System in Transition (HiT) report (Szalay, 2011) in Slovakia noted that the Slovak health system continues to be a "system in progress" which is based on universal coverage, compulsory health insurance with selective contracting and

[2] Every procedure is worth a certain amount of points. A point has a financial value given by the insurance company. The fee paid to the provider for a procedure is equal to the number of points of the procedures times the financial value of the point.

flexible pricing, and a broad benefits package. There continues to be high utilisation of ambulatory care services coupled with high hospital bed availability with relatively low occupancy rates. The technical infrastructure of hospitals is outmoded. Key challenges remain financial sustainability and the improvement of the health status of the Slovak population and quality of care. The authors of the HiT report note that this should be done through the implementation of clinical guidelines and protocols, and the development of useful quality of care indicators actively used for measuring quality. These could then make health provision more accountable, possibly link provider payment to quality and even make quality information publicly available so that patients can make informed decisions when selecting providers (Szalay, Pažitný, Szalayová, et al., 2011).

A review of quality measurement and improvement concludes that in Slovakia "systematic approaches to quality of care are still at a basic stage of development" (Legido-Quigley, McKee, Nolte et al., 2008, p. 168) and securing quality of care while ensuring financial sustainability remains a challenge (Szalay, Pažitný, Szalayová, et al., 2011). While many clinical guidelines have been adopted, their uptake is sporadic and the extent to which quality of health care initiatives are implemented is not evaluated (Legido-Quigley, McKee, Nolte, et al., 2008). However, there were government intentions of supporting standard diagnostic and treatment protocols and evidence based medicine as well as recommendations to improve quality of care by implementing clinical guidelines (Szalay, Pažitný, Szalayová, et al., 2011).

It is the historical context of Czechoslovakia, the different health reform paths in the two countries and lack of focus on assessing the quality of health care that motivate this thesis to assess how Slovakia's health system has performed relative to the Czech Republic's before and since the two transitions, as well as to study quality of care more specifically in Slovakia. Thus the goal in the first part of the thesis is to

understand how the two countries perform on overall health and well-being, as well as quality of care relative to each other. The second part of the thesis takes a more in-depth look at the quality of care in Slovakia where these types of initiatives and evidence are limited. The next section provides a conceptual performance assessment framework to guide this research and the structure of the thesis.

1.5. Framework for measuring health system performance

A conceptual framework for measuring health system performance is necessary to guide the assessment in Slovakia and the Czech Republic before and after the transition period. Choosing a suitable framework for this research will facilitate the understanding and conceptualisation of a health system, its key goals and dimensions, and consequently the selection of appropriate performance indicators to assess how the two health systems are performing on selected goals and dimensions. In particular, the objective in this thesis is to assess overall health and well-being, together with quality of care at the different levels of the system. The framework selected in this section will help conceptualise how health and quality of care are linked in the context of the entire health system.

As a first step, it is essential to define what is meant by a "health system" or "health care system" and its "key objectives" so that throughout the thesis it is clear what aspects of the two health systems are being assessed and compared. Various definitions are available for "health (care) system", which go from the narrowest ones focusing only on the health care system to those encompassing broad determinants of health (i.e. the boundaries of the health system). Arah et al. (2006) defined a *health system* as "all activities and structures that impact or determine health in its broadest sense within a given society", a definition that is consistent with the WHO's definition of a health system ("all the activities whose primary purpose is to promote, restore or

maintain health"). *Health care* was defined more narrowly as the "combined functioning of public health and personal health care services". Parallel to these definitions, Arah et al. (2006) further defines *health performance* as a much broader concept where non-health care determinants, health care, contextual information are all considered to be important determinants of population health. By many others as well as in this thesis, this is frequently referred to as 'health system performance'. On the other hand, *health care performance* is only "the maintenance of an efficient and equitable system of health care without emphasizing an assessment of the non-health care determinants …that is, the direct functioning of the delivery system of health care is evaluated vis-à-vis its established public goals for the level and distribution of the benefits and costs of personal and public health care" (Arah, Westert, Hurst et al., 2006). This thesis will first assess *health system performance* in the two countries before and after the transitions to obtain a broad understanding of the developments in the two countries (Chapter 2). Then *health care performance* more specifically will be studied in the Czech Republic and Slovakia (Chapter 3 and 4), with a more in-depth analysis of quality of care in Slovakia (Chapter 5).

Reflecting the definitions of a health system and its boundaries, different conceptualisations of the health system are available. The most widely used international frameworks (Aday, Begley, Lairson et al., 1998; Arah, Westert, Hurst, et al., 2006; Atun & Menabde, 2008; Commonwealth Fund, 2006; Hsiao, 2003; Hurst & Jee-Hughes, 2001; IHP, 2008; Murray & Frenk, 2000; Sicotte, Champagne, Contandriopoulos et al., 1998; World Health Organization, 2000) were recently reviewed to assess their usefulness for health system performance assessment (Papanicolas, 2013). The review shows that while some frameworks have a narrow focus on health care and others include non-health care determinants and the broader environment as well, all the frameworks agree on the broad objectives of a health system, as proposed by the WHO 2000 report – health, responsiveness,

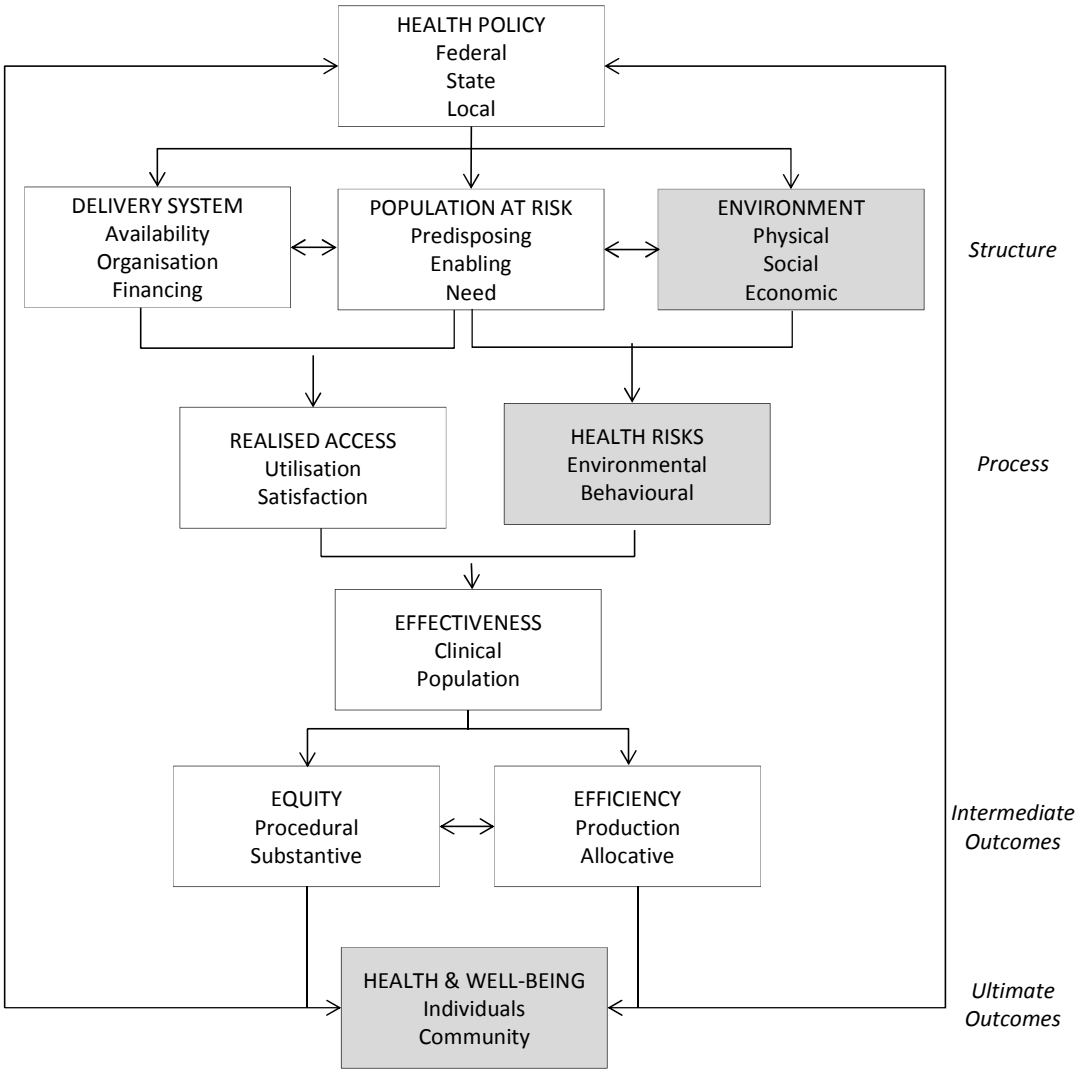
financial protection, productive and efficient system – where improving health and well-being is the most important common goal of all. However, there is more disagreement on other or intermediate goals (e.g. access, efficiency, equity, coverage, safety, quality etc.) where there are significant differences in conceptualisation, especially for quality of care, which is why it will be important to clearly define this dimension in this study. Furthermore, the frameworks may differ in how they outline the organisational structure of the health care system. Again, the review concludes that there are five broad elements considered in all the frameworks: i) service provision; ii) financing; iii) resource allocation; iv) leadership/governance; and v) risk factors. The review concluded that over time, there has been convergence in how health systems are conceptualized with little gains from creating new frameworks. As a result, the framework that has been selected to guide this piece of research will also be based on one of these existing frameworks.

There is no one perfect framework for health system performance assessment; however, based on the different criteria of the review and the purpose of this study, a modified version of the Aday framework (Aday, Begley, Lairson et al., 1993; Aday, Begley, Lairson, et al., 1998; Aday, Begley, Lairson et al., 2004) was considered to be the most suitable framework for several reasons (Figure 1). First, it allows for conceptualizing the health system broadly where different non-health care factors (e.g. social, economic and other environmental) are considered to be potentially important determinants of well-being and population health (see Environment in Figure 1).[3] As one of the goals in this thesis is to assess health performance at the macro level accounting for all the different determinants of health and well-being, this framework is appropriate.

[3] The original version of this framework (Aday, 1993) did not recognize the influence of social and individual determinants of health (see shaded Environment and Health Risks in Figure 1).

Second, the framework's explicit ultimate goals are health and well-being, with the intermediate goals being effectiveness, efficiency and equity. This thesis aims to assess overall health and well-being, as well as effectiveness (or quality of care). Third, the framework is organised in terms of Donabedian's structure ("availability, organisation, financing of health care programs; the characteristics of populations to be served by them; and the physical, social and economic environments to which they are exposed"), process ("transactions between patients and providers in the course of actual care delivery, as well as the environmental and behavioural transactions exacerbating health risks") and outcomes ("the consequences of policies for the health and well-being of patients and the public") (Aday, Begley, Lairson, et al., 2004). Given that the goal of this thesis to examine health system performance in Czech Republic and Slovakia at different levels going from macro to micro level, the structure – process - outcome elements of the framework allow for this type of an analysis with the appropriate indicators. The macro level focuses on the population perspective and broad determinants of health and well-being, while the micro level has a clinical perspective studying the factors that influence a patient's health at the system (i.e. health care system), institutional (i.e. organisational entity such as hospital, clinic or health maintenance organisation) or individual level (i.e. clinical decision making and treatment).

Figure 1. Framework for assessing health system performance



Source: (Aday, Begley, Lairson, et al., 2004; Aday, Begley, Lairson et al., 1999; World Health Organization, 2012)

The structure of the framework allows for a continuum in the assessment of performance. It shows how health policy in a given country is influenced by the health and well-being of the patients and population at large, and at the same time determines the structure of the health care system (see Delivery System in Figure 1) which interacts with other socio-economic and physical factors (see Environment in Figure 1). Public health responses are also included in the "Delivery System" component of the framework. These two structural aspects of the framework, interact with the "Population at Risk" element determined by various predisposing (e.g. genetics, age), enabling and need factors. The interaction of these various structural

elements give rise to two types of processes: realised access (utilisation, satisfaction) and health risks (behavioural and environmental) which then lead to three intermediate outcomes - effectiveness, efficiency and equity – with the effectiveness goal considered to be more important as it feeds into evaluating efficiency and equity. The ultimate goal is improved health and well-being of individuals and the community at large, which in turn should again determine the necessary health policies.

It is important to clarify the relationship between health and well-being in this framework, as the first part of the thesis aims to measure well-being in the Czech Republic and Slovakia. The WHO defines health in broad terms as "a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity". While the definition is broad, the focus in the previous years has been mainly on the *health* aspect of this definition; *well-being* as such was largely ignored (World Health Organization, 2013); however, since the WHO 2012 European health report, well-being has gained importance so that the objectives of Health 2020, the new European policy framework, "to improve the health and well-being of populations, reduce health inequities, and ensure sustainable people-centered health systems" can be achieved. This new framework builds on the European health report from 2009, the focus of which was health system strengthening through cost-effective interventions and performance assessment (World Health Organization, 2013).

Just like numerous definitions of health exist, well-being is also a complex concept determined by numerous factors. Well-being has an objective and a subjective element: the objective includes people's living conditions and their opportunities to realize their potential and is measured through, for example, income, education or mortality rates, among others; the subjective element includes people's experiences of their own lives measured with different methods that capture how people report

their own perceptions (World Health Organization, 2013). The World Health Organization (2013) carried out a review of several different conceptualisations of well-being and found that in all the frameworks health was conceptualized as part of well-being, both as a determinant and an outcome. Also, both health and well-being are determined by health systems, as well as the broader political, economic and social contexts and other intermediary factors. In the context of our framework the "Environment" is an important determinant of well-being.

The conceptualisation of *effectiveness also* deserves some attention so that confusion around the terminology is avoided in the thesis. In Aday's framework *effectiveness* is defined through Donabedian's definition as "the degree to which improvements in health now attainable are actually attained" (Donabedian, 1993). It is evaluated at the *population* ("improving the health of populations and communities through medical and/or nonmedical service") and the *clinical* ("improving the health of individual patients through medical care services") levels; so in other words, again at the macro and micro levels which can be assessed through different structure, process and outcome indicators. The clinical perspective is often focused on health care at the system, institution and patient level, in particular how the predisposing, enabling and need factors ("Population at Risk") interact with the health care delivery system (e.g. availability, organisation) and result in particular medical interventions and outcomes. The population perspective also accounts for all those individuals in the population who have not received medical care and focuses on how the interaction between policies at the individual and population level, and the medical and non-medical determinants of health affect the level and distribution of health (Aday, Begley, Lairson, et al., 2004).

Aday et al. (2004) are mainly concerned with *effectiveness* as a broad concept referring to the degree to which potentially attainable health objectives are being

reached. So then *quality* is an attribute of the health care process and again *effectiveness* more specifically an attribute of the health outcome. They define *quality* as "that part of the gap between efficacy, or what is achievable, and effectiveness, or what is achieved, that can reasonably be attributed to health care itself" (Aday, Begley, Lairson, et al., 2004, p.67) and note that "evidence-based medical care focuses on the use of the best available efficacy and effectiveness evidence to inform decisions about patient care and guide health care policy" (Lohr, Eleazer, & Mauskopf, 1998). Overall, "quality assessment deals with evaluating the process of health care in the service of ultimately improving health outcomes" and appropriateness is "the subset of quality that concerns determining whether the right thing was done for the patient" (Aday, Begley, Lairson, et al., 2004).

It should be noted that there are many other definitions for quality of care. Definitions of quality may differ in the breadth and focus, or the dimensions that define it (Legido-Quigley, McKee, Nolte, et al., 2008) but they may all be suitable depending on the level of the system at which they are to be used and the nature and scope of the responsibilities of the person who is defining them (Donabedian, 1988). Donabedian, a pioneer in the area of quality of care, wrote in his last book that "some believe quality in health care is too abstract and nebulous a concept to be precisely defined or objectively measured" (Donabedian, 2003, p. xxxi). Yet, he correctly stated that if quality was so difficult to define and measure, it would be difficult to "set it apart as a goal an individual or an organisation can aspire to". Quality of care is usually defined through a range of dimensions including: effectiveness, efficiency, access, safety, equity, appropriateness, timeliness, acceptability, responsiveness, satisfaction, continuity, efficacy, relevance and others (Campbell, Roland, & Buetow, 2000; Council of Europe, 1998; Department of Health, 1997; Donabedian, 1980; Institute of Medicine, 1990; Roberts, Hsiao, Berman et al., 2004; World Health Organization, 2000). Hence effectiveness – or whether services and interventions

have the intended effect - is usually a key component of quality of care in most of these definitions. Sometimes these dimensions of quality of care are also viewed as key processes or intermediate goals of the health system, as highlighted in our framework. For example, in our framework *access* (see "Realised Access" in Figure 1) is a key process necessary to achieve *effectiveness* (intermediate outcome). In this way access is viewed as an element of effectiveness, just like it is often an element of quality of care.

Therefore, quality of care can be viewed by some as a concept that is equal to effectiveness, and may be studied at the population level to assess the overall quality or performance of the health care system or at the individual level to assess clinical quality of care. The purpose of the above section was not to go into depth on this terminology but rather to highlight the different possible interpretations of the concepts in the literature and the importance of clarifying the focus for the purpose of this research. Thus, in this thesis quality of care and effectiveness also refer to the same broad concept. Quality of care (the term used predominantly throughout the thesis) is assessed at the population (or macro) level to capture health care performance (Chapter 3 and 4) and at the clinical (or micro) level capturing the quality of ambulatory care (Chapter 5). Efficiency and equity are elements of quality of care at the population level.

In order to assess overall health or health system performance, and quality of care at the different levels of the system, appropriate indicators need to be selected. The next section will therefore discuss what types of indicators can be used for this purpose, which are the ones that have been applied in Slovakia and the Czech Republic to date, their main weaknesses and why three alternative outcome indicators (height, 'avoidable' mortality, hospitalisations for ACSCs) are methodologically more suitable

for gaining an insight into the performance of the two countries since the transition and independence.

1.6. Rationale for indicator selection

Outcome and process indicators

A range of structure, process and outcome indicators are available to assess how a health system is performing on its key goals and dimensions, which all have important methodological advantages and disadvantages. One can either decide to combine a number of indicators into a composite indicator or study selected indicators together to evaluate the health system, as was also proposed by Donabedian in the 1970s (Donabedian, 2005 reprint of Donabedian, 1966). Donabedian's contribution was to focus on measuring the outcomes (health status or survival), processes (the care supplied to the patient) or the structure (health care setting) of the health system (Donabedian, 2005). Outcome indicators usually suffer from the problem of attribution where changes in health outcomes are likely to be influenced by many factors outside the control of the health care system or organisation. As a result, adjusting for the various factors and risks whether at the population or clinical level is essential (Iezzoni, 2003); in addition, good or bad outcome may be achieved regardless of the particular (good or bad) process. However, as overall outcome indicators are more meaningful for stakeholders and can directly measure health goals (Smith, Mossialos, Papanicolas, et al., 2009), this thesis will largely apply these.

Process indicators, on the other hand, may be too specific on particular aspects of care and ignore others, be easily manipulated or become outdated fast. However, they can be easily measured without major bias or error, are easier to interpret and overall

more sensitive to quality of care (Smith, Mossialos, Papanicolas, et al., 2009). Therefore, some process indicators will also be used in the last chapter of this thesis to examine specific aspects of quality of care. While both process and outcome indicators have their critics, if used together they can provide valid information about the effectiveness and quality of care provided (Brook, McGlynn, & Cleary, 1996). This thesis will rely mainly on health outcome and some process indicators to gain an insight into the health system performance and quality of care of the Czech Republic and Slovakia before and after the transition period.

Outcome indicators are usually used to assess overall health system performance by examining health status and well-being. A broad range of methods and indicators exists to measure well-being which depend on the way well-being is conceptualised. For example, both the OECD and the United Nation's (UN) work on well-being emerged from a long-standing debate that the traditional indicators such as GDP per capita may not be the most appropriate to measure well-being as higher average incomes may not necessarily result in improved well-being (World Health Organization, 2013). According to the 2011 OECD report, the most important aspects that shape people's lives and well-being are: income and wealth, jobs and earnings, housing conditions, health status, work life-balance, education and skills, social connections, civic engagement and governance, environmental quality, personal security and subjective well-being. These domains are then measured through selected indicators. For example, income and wealth are captured through household net adjusted disposable income per person and household financial net wealth per person, while health is measured through life expectancy and self-report health status (Organization for Economic Cooperation and Development, 2011). Overall, however, the field of measuring well-being lacks clear definitions and rigorous assessment methods; at the same time it presents numerous potential measures which results in

the inability to choose the most appropriate ones, as well the difficulty to combine and interpret these indicators (World Health Organization, 2013).

Extensive literature has also been devoted to how to best measure population health. The main challenge is related to identifying indicators where changes in health outcomes can be directly attributed to changes in the quality of the health care system. In order to properly capture the contribution of the health care system to changes in health outcomes, suitable data needs to be identified and secured, appropriate indicators selected and methods that control for variations outside the control of the health system applied. "One vitally important element in performance measurement therefore is how to attribute causality to observed outcomes or attribute responsibility for departures from approved standards of care" (Smith, Mossialos, Papanicolas, et al., 2009, pg.12). Only indicators that account for these challenges, and measure what they were designed to measure, can be considered credible and effective performance measures. In general, traditional population health measures (Table 1) such as standardised mortality rates or life expectancy suffer from the key methodological challenge of the difficulty of assessing the extent to which variations in the health outcome indicator can be attributed to variations in the health system (Smith, Mossialos, Papanicolas, et al., 2009).

Table 1. Measures of population health

Mortality Indicators	Data and methodological issues
Generic mortality-based indicators: • age-standardised death rates • life expectancy	• Broad indicator of health • Mask contributions of specific causes • Exclude morbidity • Need further disaggregation by age and cause
Age specific mortality indicators: • infant or perinatal mortality	• Susceptible to variations in recording and reporting practices • Rely on precise definitions not always adhered to in practice (perinatal mortality) • Are influenced by factors outside the health system (infant mortality) • Are based on small numbers • Complex interpretation of underlying causes
Cause-specific mortality indicators: • age-standardised mortality from specific causes (ischaemic heart disease, cancer etc.)	• Data quality and coding • Capture influence of broader health determinants • Need to be interpreted in context of risk factor and disease prevalence, and policies in other sectors
5-year survival: • cancer	• Variations in coverage and diagnostic practices • Lead-time bias • Need to account for staging • Has to be viewed alongside mortality and incidence rates
Summary measures: • HALE, DALYs, YLL	• Controversial methodology (age and disability weighting)

Source: Adopted from (Karanikolos, Khoshaba, Nolte et al., 2013)

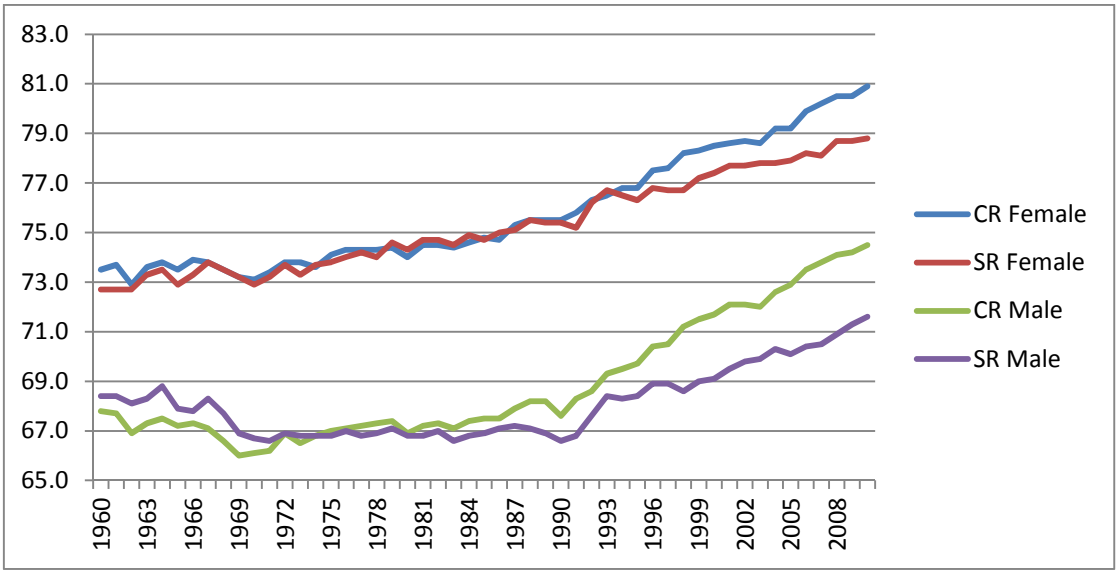
Overall, it is these standard indicators that have been usually monitored in the context of the Czech Republic and Slovakia. In the section that follows, these are reviewed to obtain a broad overview of health, well-being and quality of care developments in the two countries.

Reviewing standard indicators in the Czech Republic and Slovakia

Already during the communist period, the two countries differed in their level of economic and social development. Life expectancy and mortality rates, suggest that despite both countries exhibiting improvements, Czechs continue to outperform the Slovaks even after the transition (Figure 2) (Ginter, Simko, & Wsolova, 2009). Improved life expectancy at birth has been influenced by improved living standards

and health services, as well as the absence of any major disruptive events (e.g. regime change, revolution etc.) (Institute of Health Information and Statistics Czech Republic, 2006). The same is suggested by the Human Development Index (HDI), which also includes income and education in addition to life expectancy, and ranks Slovakia closely behind the Czech Republic (United Nations Development Programme).

Figure 2. Life expectancy at birth

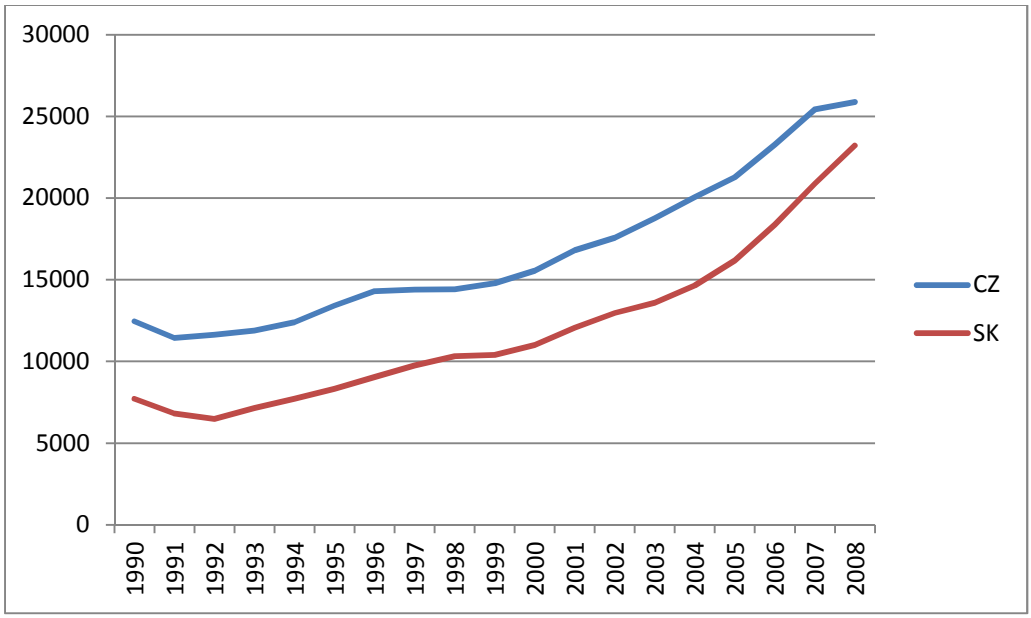


Source: OECD Health Data 2012 (http://stats.oecd.org/Index.aspx?DataSetCode=SHA)

Basic economic indicators (Figure 3) suggest that the Czech Republic has been performing better during communism and has continued to outperform Slovakia in many well-being indicators. Overall, an analysis of the economic situation (income, inequality and poverty) found that in the initial years after the transition in both countries were painful and reflected in a decline of overall welfare (Cox & Mason, 1999; Milanovic, 1998). Changes in income inequality between 1987-1988 and 1993-95 measured by the GINI coefficient showed that inequality increased in the Czech Republic but did not change in Slovakia. The shape of the change also differed: in Slovakia no income quintile gained or lost more than 1 percentage point; in the Czech

Republic, the loss of 1-2 percentage points was concentrated in the bottom three quintiles, the fourth quintile experiencing a very small loss and the top quintile benefited the most. However, it has to be noted that given the overall income decline in both countries, the losers were losing more severely and the winners were not necessarily gaining in real income (Milanovic, 1998).

Figure 3. Real GDP per capita, PPP$

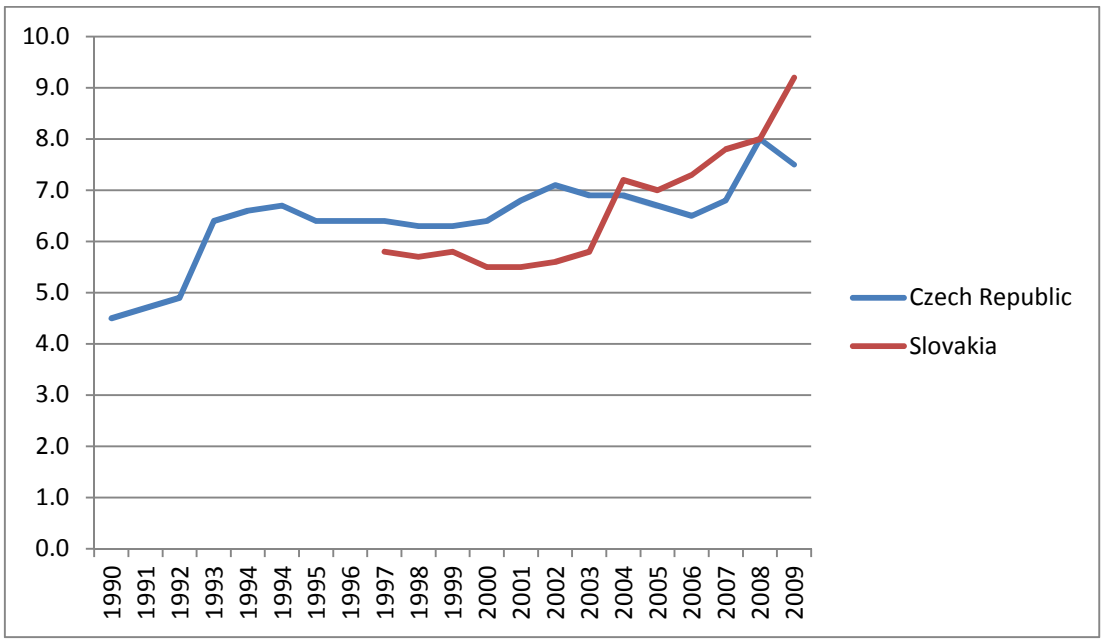


Source: OECD Health Data 2012 (http://stats.oecd.org/Index.aspx?DataSetCode=SHA)

While still lower than in many other European Union countries, health expenditure as a percentage of GDP (Figure 4) has been increasing in the last decades both in Slovakia (9.2% in 2009) and the Czech Republic (7.5% of GDP in 2009) (OECD, 2010). In the last years Slovakia has been spending more on health care as a percentage of GDP than the Czech Republic and has also shown a substantially sharper increase. Expenditures per capita have been increasing similarly in both countries, with Slovakia reaching US$2,000 per capita in the last years (Figure 5). It has been argued that in Slovakia at these levels of expenditure, equal and universal access has been maintained with somewhat more limited access in rural areas and for the Roma living in remote settlements (Ecohost/ Masaryk University, 2000;

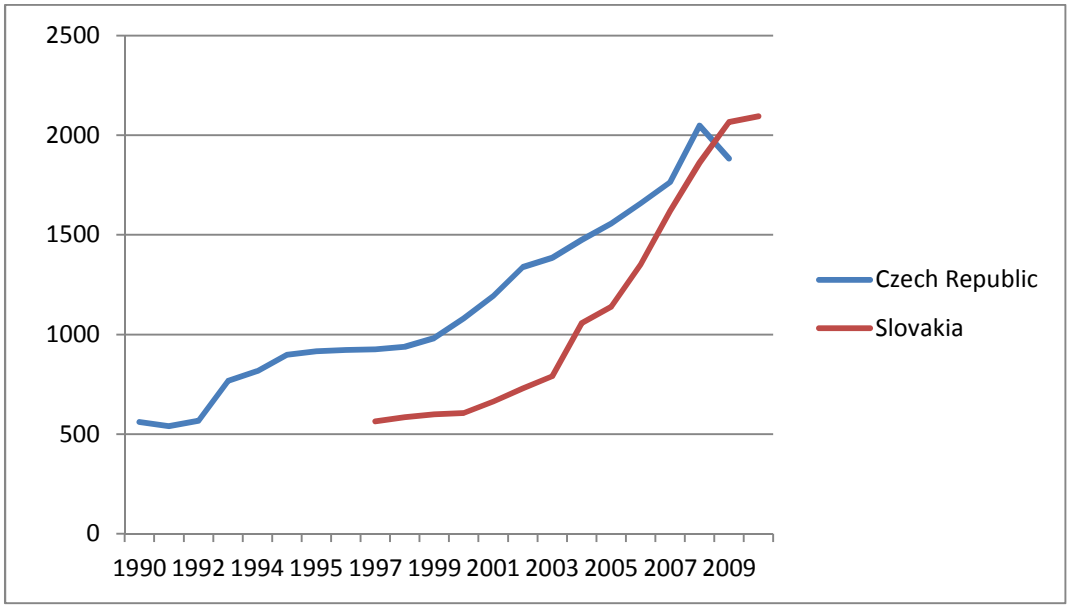
Hlavačka, Wágner, & Riesberg, 2004; The World Bank, 2002). In terms of the distribution of health expenditures, in the Czech Republic in 2008 hospital care (50.9%) followed by ambulatory care (25.5%) and drug expenditures (17.3%) represented the highest shares of total expenditure (Bryndova, Pavlokova, Roubal, et al., 2009). In Slovakia in 2010 expenditures were distributed quite differently: ambulatory care including diagnostics (34%), followed by drug expenditures (30%) and tertiary or inpatient care (27%) (Szalay, Pažitný, Szalayová, et al., 2011) . Overall, health expenditure data can reveal only a limited amount of information about the quality of care provided to patients. For many years in Slovakia the proportion going to drugs represented the highest portion of the budget. Drug expenditures have been high both because of patient demands for the most modern, and usually expensive drugs, and overprescribing by providers under the aggressive influence of pharmaceutical companies and their advertising (Hlavačka, Wágner, & Riesberg, 2004). While drugs expenditures as a proportion of total health expenditures have now decreased it is dififcult to conclude how the quality of care provided was affected.

Figure 4. Total expenditure on health as % of GDP



Source: OECD Health Data 2012 (http://stats.oecd.org/Index.aspx?DataSetCode=SHA)
Note: Data for the initial years for Slovakia were not available from the OECD

Figure 5. Health expenditures per capita



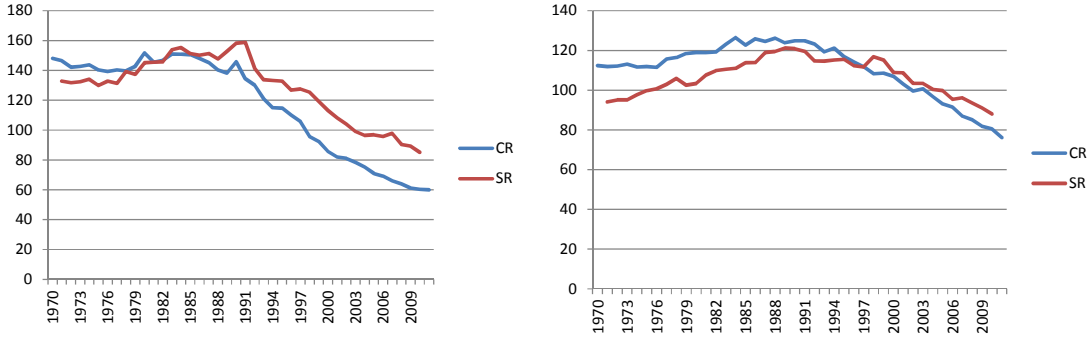
Source: OECD Health Data 2012 (http://stats.oecd.org/Index.aspx?DataSetCode=SHA)

A limited number of indicators have been used in Slovakia and the Czech Republic to capture the overall quality of the health care system. In Slovakia, some argue that the reforms seem to have been "implemented without significant adverse effects on the population's health" (Hlavačka, Wágner, & Riesberg, 2004). However, there is only little evidence that analyses trends in health outcomes and processes as the focus has been on structural indicators. Standard health outcome indicators have been monitored (Figure 6) where declines in infant and neonatal deaths suggest possible improvements in the quality of care provided. The top causes of death in both countries - diseases of the circulatory system, malignant neoplasms, mortality attributable to external causes (injury and poisoning) and diseases of the respiratory system (Figure 7 and 8) – have also been declining in both countries, with Czech Republic performing better than Slovakia. These mortality indicators as well as other standardly available ones, while informative, do not provide in depth insight of the extent to which declines can be attributed to changes in the quality of health care.

Figure 6. Infant deaths per 1000 births and neonatal deaths per 1,000 live births

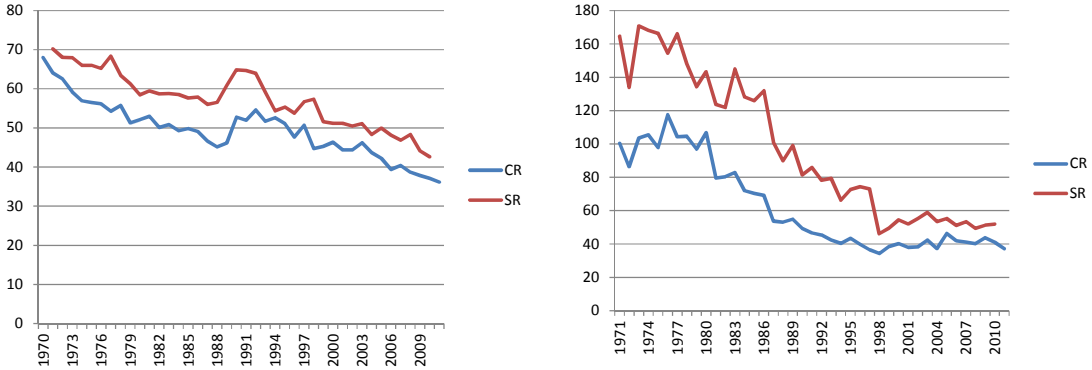
Source: WHO European Health for All Database

Figure 7. Diseases of circulatory system and malignant neoplasms, 0-64, age-standardised death rate per 100,000



Source: WHO European Health for All Database

Figure 8. External cause (injury and poison) 0-64; and diseases of the respiratory system, all ages, age-standardised death rate per 100,000



Source: WHO European Health for All Database

Due to the weaknesses discussed above and other methodological challenges (Komlos & Snowdon, 2005; Masseria, Allin, Sorenson, Papanicolas, & Mossialos, 2007; Milanovic, 1998; Murray, Salomon, & Mathers, 2000), this thesis will draw on three

alternative indicators – height, 'avoidable' mortality and hospitalisations for ACSCs – to measure overall health and well-being and quality of care. The rational for these is briefly discussed in the next section before an in-depth literature review on their application is provided.

Alternative indicators

First, this thesis will use adult height as a possible alternative measure of health and well-being to GDP or life expectancy. As height is determined during childhood and adolescence, average adult height mainly captures a population's health conditions during childhood (Hatton, 2013). While biologists have been interested in the indicators for a long time, increasingly heights are of interest to economists and demographers as well. Throughout the 20th century an extensive amount of studies of human growth were carried out (Steckel, 2009). It is considered to be an indicator of life-time health and given that taller populations are also generally richer, it has been used to understand their standards of living (Bozzoli, Deaton, & Quintana-Domeque, 2009). A separate body of literature looks at well-being through the concept of "biological standard of living", defined by Komlos in the 1990s, where a population's biological processes are affected by socioeconomic and epidemiological factors. Similarly to the OECD and the UN, this approach is also built on the fact that quality of life is determined by more than just economic power, focusing in particular on health (Koch, 2012). In this context, physical stature has been used to measure the biological status of the population as it is regarded an indicator of "how well the human organism fared during childhood and adolescence in its socio-economic and epidemiological environment" (Komlos & Snowdon, 2005). Human height may therefore be used as a retrospective marker of wellbeing and living standards both over long term intervals as well as short term cyclical variations, and thus serve as a complement to conventional indicators (Cvrcek, 2006; Komlos, 2009; Komlos &

Baten, 1998; Komlos & Snowdon, 2005; Persico, Postlewaite, & Silverman, 2004) as it can address some of their weaknesses.

Height captures a wide range of determinants and is frequently used in the area of economic development and economic history to assess changes in overall standard of living. Heights are available in settings were standard income data, mortality or morbidity information is lacking or of dubious quality (Deaton, 2007; Steckel, 1995). Information derived from average adult heights is particularly reliable because the person's height reflects his or her living conditions from conception to maturity and is not simply a snapshot during particular years; furthermore, height data is usually available for the neglected groups and lends itself to international comparisons as it is uniformly measured (Koch, 2012; Komlos & Kriwy, 2002). Evidence suggests that authoritarian regimes such as the former East Germany reported conventional standard of living information such as income unreliably (Koch, 2012). Information on height was not politically sensitive (unlike, e.g. infant mortality) and may have been the only exact indicator of welfare strain in Czechoslovakia under early communism (Cvrcek, 2006). Nevertheless, issues with measurement of height or use of self-reported height need to also be carefully considered. In the context of the framework in Figure 1, height measures overall health system performance by capturing health and well-being together, and all its broad determinants. In this thesis it is therefore proposed as an all-encompassing indicator of retrospective health and well-being in the Czech Republic and Slovakia, both before and after the transition and independence.

Next, the thesis proposes the use of 'avoidable' mortality' indicators which capture premature deaths for certain conditions that are considered to be largely avoidable if timely and effective health care is provided (Holland, 1988; Nolte & McKee, 2004).

The application of the concept of 'avoidability' dates back to at least the early 20th century when, in the United Kingdom, in 1928 confidential enquiries were made into maternal deaths to first identify errors and areas where improvements could be made to avoid unnecessary deaths (Holland, 2009); in the United States similar enquiries were carried out in the early 1930s and also led to important reductions in maternal mortality rates (New York Academy of Medicine, 1933). The WHO in a report describing the methods of investigation of maternal mortality and morbidity stated that while there is no formal proof of the effectiveness of such enquiries 'the lessons derived will enable health care practitioners and health planners to learn from the past' (Holland, 2009; World Health Organization, 2004). The concept was later expanded by Rutstein and colleagues in 1976 (Rutstein, Berenberg, Chalmers et al., 1976), who suggested measuring quality of care through untimely deaths which should not occur in the presence of timely and good quality care. 'Avoidable' mortality indicators have increasingly been used to address the main weakness of standard population measures where changes in health outcomes cannot be directly attributed to changes in the quality of care provided. Therefore, 'avoidable' mortality indicators will be used to capture health care performance or overall quality of care at the system level.

As changes in 'avoidable' mortality only provide a macro snapshot of the quality of the entire health care system, it will be important to study quality of care provided at the micro levels of the system. The focus in this thesis will be the further examination of quality of care in Slovakia, where evidence is almost entirely lacking. This is necessary as only with more in-depth analysis can we gain a better understanding of where there are gaps in quality and room for improvement. Most of the literature has been focused on measuring the quality of primary care (Lester & Roland, 2009) or the hospital sector (McKee & Healy, 2002). Recently, given the rising burden of chronic diseases, increasing attention has also been paid to the domain of chronic

care (McKee, Bain, & Nolte, 2009). However, only little attention has been on the quality of ambulatory care overall, including primary and specialist outpatient services for both acute and chronic conditions.

Measuring the quality of ambulatory (or outpatient) care is important for several reasons. First, health care is generally more expensive to provide in inpatient than outpatient settings and there are potential savings that can be made from reduced hospital admissions (Kovner & Knickman, 2008); the hospital sector usually absorbs as much as 50% of national expenditure of the health care system (Rechel, Wright, Edwards et al., 2009). Besides the cost of hospital care, a hospital admission is likely to cause disruptions in the patient's life, as well as in his or her family's (Rechel, Wright, Edwards, et al., 2009). Also, repeated hospitalisations may lead to the overall deterioration of the patient's condition (Chu, Chan, Lin et al., 2004). Therefore, quality ambulatory care and reduced hospital admissions is not only a potential cost-reduction strategy but also an obligation towards the patients by those who design and regulate the health care system.

Most of the process and outcome indicators that measure the performance of some domains of the health system do not capture the performance of ambulatory care in its entirety (Table 2). The purpose of the final chapter of this thesis will therefore be on one particular indicator – hospitalisations for ambulatory care sensitive conditions (ACSCs) – that has received only little attention in earlier research. ACSCs are conditions for which timely and effective ambulatory care can help reduce the risks of hospitalisation by preventing the onset of an illness or condition, controlling an acute episodic illness or condition, or managing a chronic disease or condition (Ansari, 2007a).

Table 2. Examples of process and outcome indicators for different areas of care

Area of Care	Process Indicators	Outcome Indicators	
Primary Care	Diet and exercise counselling (diabetes) Patients with diabetes should have an annual eye and visual exam (diabetes) Pharmacotherapy for uncontrolled mild hypertension (hypertension)	The percentage of patients with diabetes whose last blood pressure was 145/85 mgHg or less	Hospitalisations for ambulatory care sensitive conditions (acute, chronic, vaccine preventable)
Chronic Care (Includes primary, specialist and inpatient care)	Frequency of regular HbA1c tests (diabetes) Long-acting agents for patients with frequent use of short-acting beta-agonists (asthma)	Rate of diabetes related blindness or amputation The percentage of patients age 16 years and over on drug treatment for epilepsy who have been convulsion free for last 12 months recorded in last 15 months Avoidable admission for chronic conditions	
Specialist Outpatient Care	Inhaled corticosteroids for patients receiving long term systemic corticosteroid therapy (asthma) Screening for high-risk patients starting at age 40 years of age (colorectal cancer) Women who have a hysterectomy for post-menopausal bleeding should have been offered a biopsy of the endometrium within 6 months prior to the procedure (hysterectomy) Rule out cancer, fracture, infection, cauda equina syndrome, and neurologic causes (Acute low back pain)	Rate of diabetes related blindness or amputation Hospitalisations for acute and chronic conditions	
Hospital Care	Aspirin at arrival (AMI) Initial antibiotic timing (within 4 hours) (Pneumonia)	30-day mortality Emergency readmission within 28 days of discharge	

Source: (McGlynn, 2009; McGlynn, Asch, Adams et al., 2003; McKee, Bain, & Nolte, 2009; McKee & Healy, 2002; Nolte & McKee, 2008b)

In the next sections an in-depth literature review on the three performance indicators used in this thesis to assess health system performance in the Czech Republic and

Slovakia is provided. These indicators should be viewed as complementary indicators which may address some of the weaknesses of standard health and well-being performance indicators. However, as all indicators, these also have their flaws.

1.6.1. Height: an indicator of well-being and overall health system performance

The concept

Physical stature is regarded an indicator of "how well the human organism fared during childhood and adolescence in its socio-economic and epidemiological environment" (Komlos & Snowdon, 2005). Thus the rate of growth of children is a reflection of the health of a population (Eveleth & Tanner, 1990), or the "mirror of the society" (Tanner, 1986). Height is determined by cumulative net nutrition during the period of growth, where net nutrition is the difference between the intake of nutrition (food) and the output through activity and disease (Bogin, 2001; Bozzoli, Deaton, & Quintana-Domeque, 2009; Eveleth & Tanner, 1990; Silventoinen, 2003). In turn, the caloric and protein intake during one's childhood and youth is also associated with income and the price of food (Komlos, 2009). Thus overall, "adult height is an indicator of both the economic and disease environment in childhood and as such at least a partial indicator of the health component of well-being"(Deaton, 2007, p.13232). However, whether or not adult height will be affected, depends on the complex interaction of factors, the period of growth during which they occur and how they influence nutritional intake (Steckel, 2009). A growing literature on economic and biological sciences reveals that in genetically stable societies, changes in adult height proxy the physical returns to psycho-socially beneficial health environments (Steckel, 1995). Indeed, improvements in certain socio-economic conditions could in

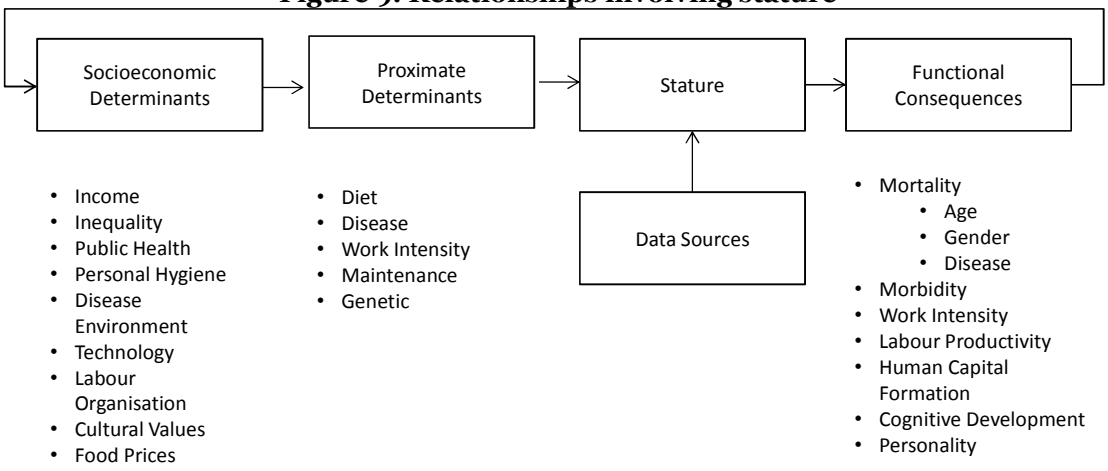
turn create the conditions to allow individuals during the years of growth to maximise their height potential.

Louis-Rene Villerme, a public health expert in France, made an observation in 1829 that captures the importance of environmental factors on height: *"Human height becomes greater and growth takes place more rapidly, other things being equal in proportion as the country is richer, comfort more general, houses, clothes and nourishment better and labour, fatigue and privation during infancy and youth less; in other words, the circumstances which accompany poverty delay the age at which complete stature is reached and stunt adult height."* (Tanner, 1981). Changes in height reflect the interaction between genetic and environmental factors during the period of growth (Eveleth & Tanner, 1976). Yet, although genes are important determinants of individual height, changes in average height across most populations are largely attributable to environmental factors (Steckel, 1995). More specifically, it has been estimated that approximately 20 percent of variation in height is due to environmental factors (Silventoinen, Kaprio, Lahelma et al., 2000; Stunkard, Foch, & Hrubec, 1986).

A review of the literature by Steckel (2009) summarises recent developments in height research and highlights the many factors investigated and the numerous debates on the interpretations of empirical findings within height research across the different disciplines (Steckel, 2009). The environmental factors include changes in the diet, disease, work intensity, maintenance, genetics (i.e. proximate determinants), as well as broader socioeconomic effects such as income, social inequality, public health, personal hygiene, disease environment, technology, labour organisation, cultural values, and food prices (i.e. socioeconomic determinants) (Steckel, 1995) (See Figure 9). Thus, as highlighted in the figure below, apart from genetics, an important causal pathway for changes in height includes improvements in the

proximate determinants, especially nutrition through reduced barriers to food, improved disease environment, and reduced work intensity resulting from positive changes in the social, political or economic environment.

Figure 9. Relationships involving stature



Source: Adopted from Steckel (1995)

The focus of this research is whether and how the changes in the broad political, economic and institutional environment in the former Czechoslovakia (i.e. "socioeconomic determinants" in Figure 9) are associated with changes in adult height.

Empirical evidence: institutional change and heights

There is evidence of a direct link through an improved diet in the Eastern European region. Prior to the transition, poor nutrition was a problem due to seasonal unavailability of certain foods and the opening of the boarders enabled easier access to fruits and vegetable consumption (McKee, 2004). This has been linked to declining deaths from cardiovascular diseases in the region, and Czechoslovakia in particular (Bobak, Skodova, Pisa et al., 1997). One can also envision institutional triggers that can result in improvement in heights (Sunder, 2003). Institutional effects are

generation specific influences reflecting exposure to similar contemporary time or space limitations (e.g. social norms, restrictions on freedom, etc.). Eveleth and Tanner (1976) in their summary of growth studies suggest "*if a particular stimulus is lacking at a time when it is essential for the child…the child's development may be shunted…*" (Eveleth & Tanner, 1976, p.222). However, there is evidence that for deprivation to have an effect on adult height, it has to be severe and long-term during key periods of growth as after short nutritional shocks normal height is usually restored (Steckel, 2009). In particular, evidence from developing countries on the environmental determinants suggests that unlike in developed countries, there is no relationship between child mortality or living conditions and adult height; the example of the African paradox is provided where low incomes, high disease environment and inappropriate nutrition is usual (Bozzoli, Deaton, & Quintana-Domeque, 2009; Deaton, 2007). Deaton (2007, p.13232), therefore, concludes that the relationship between population height and income (or income and health generally) is "inconsistent and unreliable". It is in this context that Chapter 2 aims to test whether in the Czech Republic and Slovakia the number of years a person has spent growing up under democracy and as part of an independent country (as opposed to communism and Czechoslovakia), after adjusting for income and other key variables, resulted in health and well-being benefits, and thus would show to be an important determinant of adult height.

A country's democratisation reshapes the institutional framework within which the economic actors manage their lives (North, 1991). Therefore, the introduction of structural reforms in a country's organisation might induce environmental health effects and ultimately enhance a positive effect on well-being in the long run (Costa-Font & Gil, 2008). More specifically, it can be reasonably expected that democracy should lead to institutional and environmental improvements that make children and adolescences' existence safer and healthier, and thus are expected to be positively

associated with height. As Amartya Sen also put it, a country should become fit through democracy (Sen, 1999). Consistently, adverse socio-economic developments in the society may lead to stagnation or deterioration in height, and such negative developments can also occur in democratic regimes. For example, in the United States in the second half of the 20th century, the American population went from being the tallest in the world to being among the most overweight, despite higher per capita income; the latter is largely attributed to the greater social inequality, incomplete health care insurance and fewer social safety nets than in Western and Northern Europe (Komlos & Baur, 2004).

Disentangling the effects of institutional changes in human height calls for the examination of some natural experiments. One of these experiments is the process of reunification of Germany and democratisation (Heineck, 2006; Hiermeyer, 2008; Komlos & Baur, 2004). Research carried out on living standards in East and West Germany had two important findings: i) despite proclamations of an officially classless society, important social differences in stature were identified in East Germany (Komlos & Kriwy, 2003); ii) West Germans were taller than East Germans (by approx. 1cm) throughout the second half of the twentieth century and the difference widened after the Berlin Wall was built (Komlos & Snowdon, 2005). Even though the difference in height is small, it was concluded that the West German welfare state with a mixed economy provided a superior biological standard of living to its children and youth than socialist East Germany (Hiermeyer, 2008; Komlos & Snowdon, 2005). Since unification there has been convergence between East and West German males but not females (Komlos & Kriwy, 2003). Other research show how height can be employed to assess whether there is convergence or divergence between regions or countries capturing changes in social welfare (A'hearn, Peracchi, & Vecchi, 2009; Arcaleni, 2006; Baten & Blum, 2012; Chanda, Craig, & Treme, 2008; Komlos, 2007; Meisel & Vega, 2007; Salvatore, 2004; Steckel, 2009).

The case of Czechoslovakia stands out as a unique natural experiment with the processes of democratisation followed by the country democratically splitting in two independent communities. It can be argued that both processes potentially improve well-being overall as they underpin an expansion collective self-determination, which would be expected to reshape each community's institutions. These new institutions would be tailored to their own specific welfare needs, foster freedoms and hence improve the environmental and institutional settings individuals grow up in, as well as further stability and conflict reduction. Whether the latter is indeed the case is an empirical question where the effect on height, the indicator of health and well-being, may reveal interesting similarities or differences between the Czech Republic and Slovakia. In this respect, this research adds to the body of evidence on the ability of political and economic liberalisation to improve health (Costa-Font & Gil, 2008; Nobles, Brown, & Catalano, 2010).

1.6.2. 'Avoidable' mortality: an indicator of health care performance or overall quality of care

The concept[4]

Explicitly the concept of 'avoidable' deaths was proposed by Rutstein and colleagues in 1976 (Rutstein, Berenberg, Chalmers, et al., 1976). The group outlined the method of measuring the quality of medical care[5] that counts cases of unnecessary disease,

[4] A version of this section has been published as the Methodological Note for the European Commission co-authored with Walter Holland (LSE Health), Ellen Nolte (RAND Europe) and Martin McKee (LSHTM).) The views expressed are those of the authors and do not necessarily represent those of the European Commission. The Methodological Note and this section draw on the extensive review prepared by Nolte and McKee (2004) and summarise some of its main findings.

[5] Rutstein and colleagues (1976) defined "quality" as the effect of care on the health of the individual and of the population (outcome). Improvement in the quality of care should be reflected in better health.

disability and untimely deaths. Rutstein and colleagues (1976) defined *medical care* in its broadest sense as "the application of all relevant medical knowledge, the basic and applied research to increase that knowledge and make it more precise, the services of all medical and allied health personnel, institutions and laboratories, the resources of governmental, voluntary and social agencies, and the co-operative responsibilities of the individual himself". Their list included around 90 conditions which they considered as sentinel health events. When selecting the conditions, they "assumed that if everything had gone well, the condition would have been prevented or managed". As Rutstein and colleagues acknowledged, "the chain of responsibility to prevent the occurrence of any unnecessary disease, disability, or untimely death may be long and complex; the failure of any single link may precipitate an unnecessary undesirable health event" (Rutstein, Berenberg, Chalmers, et al., 1976). As a result, often it may be difficult to establish who is responsible. For example, they cited deaths from diphtheria, measles and poliomyelitis for which the responsibility may lie in the state which may not have provided the necessary funding, the health officer who did not implement the program, the medical society that opposed community clinics, the physician who did not immunise the patient, the religious views of the family, or the mother who did not care to bring her child for immunisation (Rutstein, Berenberg, Chalmers, et al., 1976). However, they thought that in each death considered unnecessary and untimely the physician had the "initial and also some continuing responsibility". Similar examples can be derived for many other conditions. It was Rutstein's work that provided the basis for the concept and was followed by numerous publications, which applied the concept empirically, reviewed the list of conditions, adjusted the definition of medical care and its scope, as well as the age limits.

After the initial work carried out on maternal mortality in the early 20th century, and Rutstein and colleagues' extension of the concept of 'avoidable' mortality in 1976, the

concept and application of the indicator continued to be expanded (Appendix A). Interestingly there was no attempt to use Rutstein's methodology in the United States (Holland, 2009). Charlton and colleagues (Charlton, Hartley, Silver et al., 1983) in the United Kingdom narrowed the concept by excluding conditions which were considered to be outside the scope of medical care, e.g. road traffic accidents, and tobacco policy. They were the first to apply 'avoidable' mortality empirically at the population level and to examine national and international trends (Nolte & McKee, 2004), as well as the importance of disease incidence and social factors. At the same time they introduced an upper age limit for some conditions at 65 years.

In 1986 a major project was undertaken in the European Community (EC) which resulted in the publication 'European Community Atlas of 'Avoidable Death" under the EC Concerted Action Project on Health Services and 'Avoidable Deaths' (Holland, 1988, 1991, 1993, 1997). This project extended the work of Charlton and colleagues (1983) and used a definition of health services, which were interpreted to include primary care, hospital care and collective health services such as screening and public health services, e.g. immunisation. The original list also included conditions whose control mainly depended on primary prevention or health policies, which were outside the direct control of health services, e.g. lung cancer, liver cirrhosis or motor vehicle accidents; these were excluded from the most recent edition (Nolte & McKee, 2004).

Several country specific analyses resulted from the EC Atlas carried out by participating researchers, as well as in non-EC countries (Nolte & McKee, 2004). However, studies used different lists of 'avoidable' conditions, with varying age limits and methods of analysis. Lack of suitable data or insufficient numbers of deaths for some of the conditions may explain the differences in the methods applied (Mackenbach, Bouvier-Colle, & Jougla, 1990). In the 1980s, Mackenbach and

colleagues analysed the possible contribution of medical care innovations to mortality changes by analysing trends in mortality from selected conditions and found that "although the exact contribution of medical care innovations to changes in mortality cannot be determined, the impact of medical care on post-1950 mortality in the Netherlands could well have been substantial" (Mackenbach, Looman, Kunst et al., 1988). They used a stricter definition of medical care defining it as "the application of biomedical knowledge through a personal service system" building on Rutstein's list of conditions.

Further work has focused explicitly on differentiating and comparing levels of 'avoidable' mortality attributable to the health care system and to wider health policies usually not within the direct control of health services. While this distinction had been made in earlier publications (Holland, 1986; Rutstein, Berenberg, Chalmers, et al., 1976), this time, conditions were clearly split as indicators for the different areas of health care (Westerling, 1993; Westerling, Gullberg, & Rosén, 1996; Westerling & Smedby, 1992). Tobias and Jackson (2001), following an expert consensus exercise in New Zealand, partitioned the relative avoidability of death from conditions into proportions which are avoidable by primary, secondary, and tertiary actions (Tobias & Jackson, 2001). For example, avoidability of deaths from asthma was partitioned into primary, secondary and tertiary interventions with weights 0.1, 0.7, and 0.2, respectively, while tuberculosis received weights of 0.6, 0.35, and 0.05, respectively. According to this approach, death from tuberculosis is considered, largely, avoidable by primary prevention while death from asthma is primarily avoidable by secondary prevention through early detection and treatment. Finally, the work of Nolte & McKee (2004) looked at 'avoidable' mortality and changing life expectancy in the European Union in the 1980s and 1990s using an updated list of conditions taking into consideration advances in medical knowledge and technology.

Empirical evidence

As shown by Nolte and McKee (2004) numerous studies have applied the concept of 'avoidable' mortality empirically. As noted above, these studies vary in the selection of conditions which are considered avoidable by health care, definitions of medical care and/or health services, and age limits, thus limiting comparability of findings (Nolte & McKee, 2004). While some only looked at trends in 'avoidable' mortality others attempted to identify factors that might explain these trends or any variations. Given that the indicator is assumed to measure the effectiveness of health services, it might be expected that variations in 'avoidable' deaths could be linked to health care inputs; however, of those studies that did attempt to establish such link, most tended to capture only quantity but not the quality of health services and, perhaps unsurprisingly, could not establish a clear association between health care input and (population) health outcome. Nolte and McKee (2004) reviewed over 70 studies and grouped them into three categories as follows:

- Studies that examine geographic variation. These suggest that there is little association between geographical variation in 'avoidable' mortality and differences in quality or quantity of health services, as measured by routine data; geographical variations seem to be more closely related to socioeconomic conditions.
- Studies that examine variation between social groups. These suggest that population groups classified as being at social disadvantage because of ethnicity or socioeconomic characteristics tend to be at higher risk of death from 'avoidable' conditions.

- Studies that examine variation in 'avoidable' mortality over time. These tend to show consistent declines in 'avoidable' mortality that have been more rapid than declines in mortality from causes not considered 'avoidable'.

Only a handful of studies have focused on 'avoidable' mortality in Eastern Europe. These have found that amenable mortality was falling about 1-2 percent per year between mid-1970s and mid-1980s while non-amenable mortality remained more or less stable or even increased in Hungary, Poland and Lithuania (Gaizauskiene & Gurevicius, 1995; Nolte, Scholz, Shkolnikov et al., 2002). A study that looked at changes in 'avoidable' mortality in East Germany before and after the transition in 1990 found that in both periods amenable mortality was falling faster than non-amenable mortality; however, in Poland mortality from other causes fell faster in the 90s than in the 80s but also more rapidly than 'avoidable' mortality (Nolte, Scholz, Shkolnikov, et al., 2002). Nolte et al (2004) noted that while East Germany was going through rapid changes after unification, in Poland health care improvements in the country were substantially slower. One study that compared 'avoidable' mortality rates between 1979 and 1988 in Hungary with other countries, including Czechoslovakia, found that amenable mortality in the Western countries fell faster than mortality for all other causes in these two countries. In Hungary and the Czech Republic death rates from both groups of causes increased in the first part of the period studied and a decline in mortality from both types of causes could be observed from 1985; all-cause mortality declined more slowly and stayed stable toward the end of the period (Bojan, Hajdu, & Belicza, 1991).

Another study compared trends in 'avoidable' mortality between 1980 and 1997 in the Czech Republic and 15 countries of the EU (Treurniet, Boshuizen, & Harteloh, 2004). While the differences in trends in avoidable and non-avoidable mortality before and after 1989 were not statistically significant, both avoidable and non-avoidable

mortality declined with non-avoidable mortality at an increased annual rate after 1989 (from 1.8% to 2.7%) but still somewhat slower than 'avoidable' mortality (from 2.1% to 2.8%). The only study that analysed trends in 'avoidable' mortality by separate conditions in both the Czech and the Slovak Republic, including on the regional level, was the Atlas of Leading and Avoidable Causes of Death in Country of Central and Eastern Europe but only between 1985 and 1989 (Jozan & Prokhorskas, 1997). No study has been identified which would have analysed 'avoidable' mortality rates of the Czech and Slovak Republic before and after 1989 or in relation to the split of the Czech and Slovak Federation into two new countries; neither at the aggregate level nor by individual conditions. While most studies found that 'avoidable' mortality declines faster than mortality from other conditions, the study in Poland (Nolte, Scholz, Shkolnikov, et al., 2002) where 'avoidable' mortality declined at a slower rate than mortality from all other causes in the 90s provides the basis for the hypotheses that 'avoidable' mortality in the Czech Republic and Slovakia has decreased since 1989 but at a slower pace than mortality from other conditions. Furthermore, because the Czech Republic has higher life expectancy and performs better on standard mortality indicators, we further hypothesise that 'avoidable' mortality has decreased faster in the Czech Republic than in Slovakia since 1993.

1.6.3. Hospitalisations for Ambulatory Care Sensitive Conditions: an indicator of the quality of ambulatory care

The concept

ACSCs are "conditions for which hospitalisation is thought to be avoidable with the application of preventive care and early disease management usually delivered in the ambulatory setting. In theory, timely and effective ambulatory care can help reduce the risks of hospitalisation by preventing the onset of an illness or condition,

controlling an acute episodic illness or condition, or managing a chronic disease or condition. This has led to the concept of preventable or avoidable hospitalisation as an indicator of health outcomes for evaluating the quality of primary health care. ACSC rates have also been proposed as a measure of access to health care" (Ansari, 2007a). In this thesis, hospitalisations for ambulatory care sensitive conditions (ACSHs) will be used synonymously with preventable hospitalisations.

The above definition of ACSCs refers to both the role of ambulatory and primary care in preventing unnecessary hospitalisations. However, much of the available literature uses ACSH rates as a measure of *access* to primary care without providing a clear definition of primary care. It is therefore important to clarify that someone's chances of being hospitalised may depend on factors which are not only in the responsibility of primary care providers but a consequence of all the care provided by other outpatient specialists and health care staff, as well as appropriate coordination across the different levels of care, continuity, patient management and other factors. The definition of ambulatory care used here includes all the services provided on an outpatient basis, requiring no overnight hospital stay, including i) primary care, ii) emergency care and iii) ambulatory specialty care as well as diagnostics services, provided by a range of health care professionals (Kovner & Knickman, 2008). At the same time, it is an indicator that apart from access captures a range of quality of care dimensions such as effectiveness, efficacy, appropriateness and equity. This indicator is conceptually related to and has been developed on the basis of an indicator of population health – 'avoidable' mortality (Millman, 1993). Both 'avoidable' mortality and ACSHs are meant to be used as "screening tools" for potential problems in the health system to be further investigated; in other words, to provide a "snapshot" on the quality of the health system overall, or ambulatory care more specifically.

The first list of ACSCs was developed in the early 1990s in the United States by Weissman (Weissman, Gatsonis, & Epstein, 1992) with 12 conditions and Billings (Billings, Zeitel, Lukomnik et al., 1993) with 28 conditions when the Institute of Medicine (IOM) suggested that ACSHs be used as a measure of access to primary care (Millman, 1993). In general, ACSCs have been identified through consensus processes with panels of clinicians, using various methodologies and decision criteria (Ansari, 2007a). ACSCs can be classified into three broad categories: i) *vaccine-preventable* ACSCs where the vaccine prevents the occurrence of the condition (not actually the hospitalisation) and thus the incidence of preventable diseases (e.g. measles, rubella etc.); ii) *acute* ACSCs for which timely and appropriate care reduces morbidity and pain (e.g. dehydration/gastroenteritis, perforated ulcer, pelvic inflammatory disease, kidney infection etc.); and iii) *chronic* ACSCs where appropriate outpatient care reduces the effect of particular chronic disease and prolongs life (e.g. asthma, hypertension, angina, congestive heart failure, diabetes etc.). In addition to ambulatory care sensitive conditions, there are also "marker" conditions for which hospitalisations should not vary according to access and quality of outpatient care (e.g. appendicitis) (Appendix A, Table 39).

Many countries including Canada, the United States, United Kingdom, Italy, Spain and Australia have already developed their country specific lists and have been monitoring ACSHs during the last decade (Ansari, Laditka, & Laditka, 2006; Billings, Anderson, & Newman, 1996; Caminal, Starfield, Sanchez et al., 2004; CIFHI, 2008; Giuffrida, Gravelle, & Roland, 1999; Magan, Otero, Alberquilla et al., 2008; Rizza, Bianco, Pavia et al., 2007). While countries differ in how the indicator is applied and the lists of conditions being monitored, the fact that easily accessible and cheap administrative data may be used makes this indicator attractive to health policy and decision makers equally.

Admissions for *individual* ambulatory care sensitive conditions have been carefully evaluated and proposed as area level indicators by the Agency for Healthcare Research and Quality (AHRQ) in the United States as part of the Healthcare Cost and Utilization Project, an on-going Federal-State-private sector collaboration to build uniform databases from administrative hospital based data (AHRQ, 2001). The AHRQ evaluated the validity of admissions for all the ambulatory care sensitive conditions together[6] along several dimensions (Appendix A, Table 40). Given the limitations of the measure, the AHRQ recommended that ACSHs be used alongside other quality indicators as a "quality screen" which can provide initial information about potential problem in the health system that should be analysed in more depth (AHRQ, 2001 and 2004).

It is difficult to establish the appropriate rate of hospitalisations for ambulatory care sensitive conditions but a rate which is too high may indicate poor access to, underuse or inappropriate outpatient care or low threshold for admissions by the admitting physician. Overall, it is important to explore the causes of variations in admissions rates where the best benchmark would be comparisons with national, regional, or peer group means (AHRQ, 2001). Wennberg and colleagues (Wennberg, 1999, 2004; Wennberg, Fisher, Stukel et al., 2004) have extensively studied variations in health care utilisation and expenditures in the United States and showed the importance of understanding the factors that explain such variations, in particular, how the care provided for the same condition differs across regions. For example, if high rates persist in some regions over time, there may be some systematic differences in access to and appropriateness of the treatment. Overall, it is

[6] Most evidence applies to sets of conditions. The indicators included are: Perforated appendix, Diabetes short-term complication, Diabetes long-term complication, Chronic obstructive pulmonary disease, Hypertension, Congestive heart silure, Low Birth Weight, Dehydration, bacterial pneumonia, urinary tract infection, angina without procedure, uncontrolled diabetes, adult asthma and rate of lower-extremity amputation among patients with diabetes

essential to identify variations, and determine its causes so that unwarranted variation can be reduced by either increasing or decreasing utilisation.

Many of the ACSCs have clinical practice guidelines and studies have shown that better outpatient care can reduce patient complication rates of existing disease, including the complications leading to hospital admissions. Empirically, most of the hospital admission rates for ACSCs are correlated with each other, suggesting that common underlying factors influence many of the rates (AHRQ, 2007). However, exploring concrete aspects of clinical quality of care and how these are linked to hospitalisation levels requires a condition specific analysis. Yet, studies which look at sets of several ACSCs together have not been able to include clinical quality of care variables such as appropriate treatment.

Preventable hospitalisations have primarily been proposed as a single outcome-based measure of *access*, after acknowledging that evaluating all the different dimensions of access (availability, accessibility, affordability etc.) is often not feasible (Ansari, 2007b). In fact, most of the available literature focuses on ACSH rates as a measure of access to health care where different factors, predominantly socioeconomic, are used as a proxy of access to health care; an inverse relationship with ACSH rates suggests reduced access. In addition, the relationship of other variables (e.g. lifestyle factors, prevalence, environment etc.) and ACSHs have also been explored. The large amount of non-health system factors that have a relationship with ACSH rates may suggest that the reporting of ACSHs figures is not likely to foster change in the quality of services provided. However, if all the different factors are appropriately accounted for, changes in ACSH rates are likely to at least indicate potential weak areas in the health system and provide the initial motivation for further enquiries and potential for improvement.

Empirical evidence

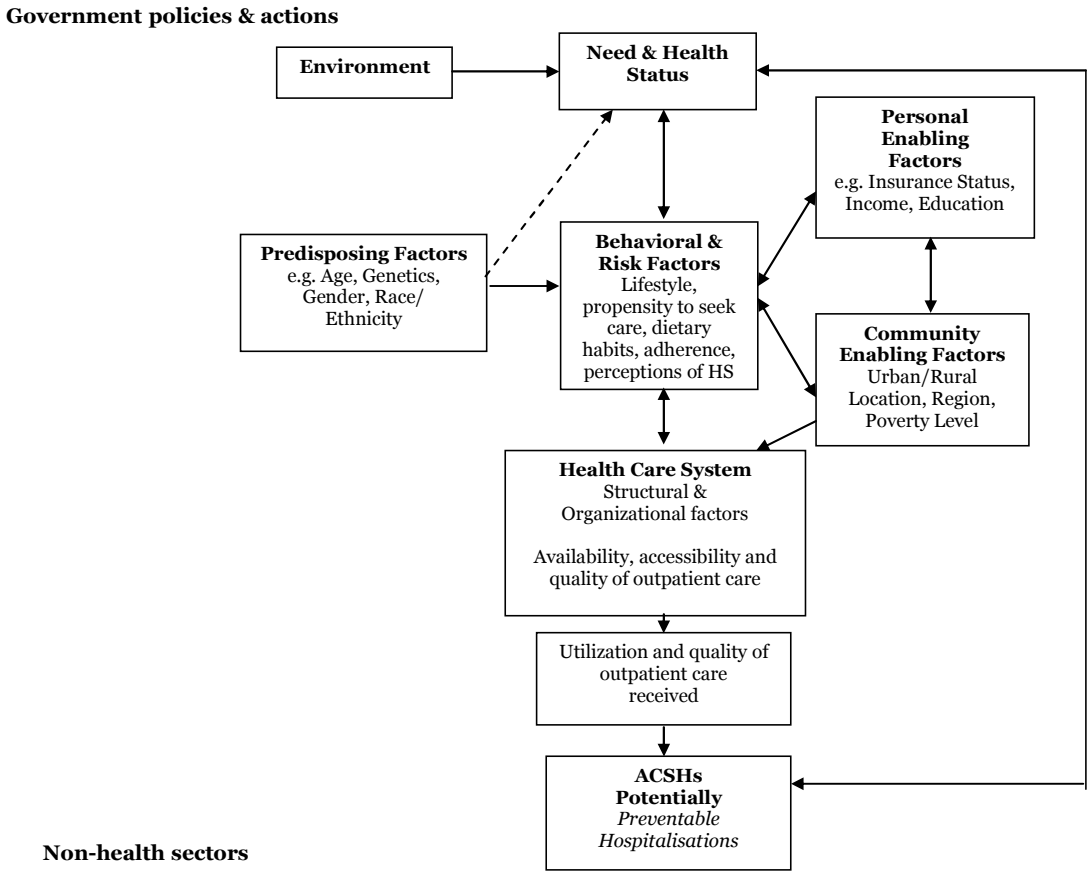
A systematic review (see Appendix A for the full review) has been carried out to bring together the existing body of evidence on the factors that explain ACSH rates. In this section the key findings and implications for the research carried out in Chapter 5 are briefly summarised. In the process of carrying out the initial literature search of the systematic review, a comprehensive literature review[7] (Ansari, 2007) has been identified which covers evidence from 1970 till August, 2005. The review explores the validity of ACSC admissions as proxy indicators of access to primary health care, and summarises all the different factors that are associated with ACSHs rates across geographic areas and population groups. The author of the review grouped the evidence along several areas: demographics, socio-economic status, "rurality", health system factors, prevalence, lifestyle factors, environment, adherence to medication, severity of illness and propensity to seek care. The results and main effects are summarised in Appendix A and further details can be found in the original article (Ansari, 2007).

Ansari concludes that ACSC admissions are valid proxy indicators of access to primary health care. ACSHs result from a number of key reasons including insufficiency and mal-distribution of primary health care resources, evidence of the existence of barriers to accessing primary care services (e.g. socioeconomic), problems with continuity of care and inefficient use of resources (e.g. may occur if the patient finds it easier or cheaper to go directly to the hospital instead of getting care in an ambulatory setting) (Ansari, 2007). Overall, the review reveals that socioeconomic factors seem to be the most important predictors of ACSHs. While some factors are addressed much more extensively (e.g. supply of physicians), others such as lifestyle, prevalence, adherence to medication, and in more general terms,

[7] From here onwards this literature review may be referred to as "Ansari review" only.

utilisation and clinical quality of care that patients are covered to a more limited extent. The Ansari review was systematically updated to encompass new evidence from 2005 until March 2009 to see whether an effect of any additional factors that influence ACSHs has since been identified. The results from the Ansari review as well as the systematic review were summarised in light of a conceptual framework which demonstrates the range of factors that may influence ACSHs (Figure 10).

Figure 10. Conceptual framework for ACSHs



Source: Adjusted based on (Andersen, 1995; Andersen, McCutcheon, Aday et al., 1983; Basu, Friedman, & Burstin, 2004; Chang, Mirvis, & Waters, 2008; The World Bank)

The fourteen new studies selected in the review focused on the same variables of interest[8] as in the Ansari review, as well as some new factors including age, gender, race, socioeconomic status (insurance status, poverty etc.), rurality, self-rated access,

[8] Variables controlled for/confounding variables are not included.

continuity of care, presence of rural clinic, physician supply, and physician visits. Overall, the variety of settings and chosen variables of interest, differences in ACSCs used, the target population, number and type of confounders, study designs, methods and data sources made it difficult to compare and assess the quality of studies, and to draw sound conclusions about the overall effects and strengths of associations of the different factors and ACSHs. However, despite these limitations, this systematic review together with the Ansari review provide interesting findings for future research and policy application of the ACSHs indicator. The newly identified studies again focused on demographic, socioeconomic and a few health system factors. Again, the focus was on factors which are easier to assess and measure rather than a complex approach using a conceptual framework. This may not be a problem as such, but may lead to incomplete conclusions about ACSHs as a measure of the quality of care. When the results are analysed against the factors included in the conceptual framework, the literature predominantly deals with predisposing factors, personal enabling factors and health system factors and how these explain ACSH rates, while other factors are not addressed.

Besides one study which included physician visits, no new evidence has been identified which would consider health services utilisation (intensity) and clinical quality of care variables, such as appropriate drug treatment for a specific condition[9] or adherence to the treatment prescribed. Yet it is important to acknowledge that including these types of variables may only be possible if ACSCs are monitored individually at the patient level. This has been done in condition specific studies, for example diabetes or asthma, where it has been established that hospitalisations for these conditions can be controlled with appropriate care. Also, none of the studies looked at the relationship between all the key factors together - predisposing (e.g. age, gender), enabling (e.g. income, insurance), behaviour and risk (e.g. adherence,

[9] Literature on determinants of hospitalisations for individual conditions has not been reviewed

smoking), utilisation (e.g. primary and specialist visits) and quality of care (e.g. type of drug treatment) – and ACSHs. Finally, the indicator of ACSHs continued to be applied mainly in the United States, as well as Canada, Australia and Spain but not in new country contexts such as the Eastern European region.

The systematic literature review revealed that the application of this indicator requires additional in depth research, especially, studies that focus on the effect of variables whose association with ACSHs is not well understood. In this review the focus was not on the condition specific literature (e.g. diabetes, asthma, and hypertension) which may identify a range of additional, especially clinical, factors associated with preventable hospitalisations. These may include, for example, appropriateness of clinical care according to evidence-based guidelines, adherence or others. Therefore, the focus of Chapter 5 will be on individual ambulatory care sensitive conditions and the relevant literature.

As has been mentioned above, Slovakia has gone through numerous health care reforms with only little assessment of the quality of care provided to patients. Based on variations in the availability of physician posts, some have argued that there is a little difference in accessibility or quality of care between rural and urban areas (Hlavačka, Wágner, & Riesberg, 2004). However, availability and proximity to services does not yet guarantee access and utilisation of effective care. The Slovak Government has only recently approved new quality indicators for hospital (e.g. readmission, repeat surgery etc.) and outpatient care (e.g. utilisation of preventive services) but their application is still in infancy (Legido-Quigley, McKee, Nolte, et al., 2008). This is despite the availability of linked administrative data that could be used to gain a better understanding of the medical care patients are accessing. Given the high utilisation of the health care system and the expenditure distribution, it is important to understand whether the ambulatory care patients currently receive is

effective in preventing adverse hospitalisations for ACSCs. Chapter 5 will therefore look at trends in hospitalisations for ACSCs, asthma and diabetes in particular, to see if they are unnecessarily high and may reflect on poor access to effective outpatient care. Based on the gap in the reviewed literature, the focus will be on appropriate care as a key determinant of unnecessary hospitalisations.

1.7. Data

The data used to carry out the analysis come from different data sources. Table 3 below provides an overview. The data sources will be briefly summarised below and then discussed in depth in the individual chapters. First, Chapter 2 used data from the 2003 World Health Survey (WHS), which is the baseline household survey for health status of populations and outcomes related to investments and functioning of health systems. The survey has information on self-reported height of individuals as well as information on other important variables that are controlled for including education, income, rural or urban location, employment and others. Next, in Chapter 3 and 4 mortality data classified by individual or small groups of diagnosis and age groups between 1971 and 2008 were obtained from the Statistical Office of the Slovak Republic and the Czech Statistical Office. For years 1971 to 1993 mortality data had to be collected manually from the Archives of the Statistical Office of the Slovak Republic. Data for the control variables at the regional level (GPD per capita, unemployment, pollution etc.) and instruments (number of dwellings completed in a year, number of car accidents per operated cars) were also obtained from the same organisations. Finally, data on health care inputs (number of beds, physicians, nurses) were obtained from the Institute of Health Information and Statistics of the Czech Republic (IHIS) and the National Health Information Center of Slovakia (NHIC). In Chapter 5 nationally representative administrative data from the largest public health insurance company (the General Health Insurance Company (GHIC))

in Slovakia from 2001 to 2008 is used. Patients were included in the study population if they received medical treatment (outpatient, inpatient, diagnostic) with the principal diagnosis for diabetes and asthma in 2002 were disease free in the previous year. All the patients have a unique identifier and were followed for the period of 2002-2008.

Table 3. Overview of data sources and variables

	Data Source	**Year**	**Dependent variable**	**Variables of interest and controls**
Chapter 2	World Health Survey Centre for Systematic Peace Eurobarometer (sensitivity analysis)	2003	Height	Gender Age Education Job Income Polity IV index Language Country
Chapter 3	Statistical Office of the Slovak Republic Czech Statistical Office	1971-2008	Age-standardised mortality	
Chapter 4	Statistical Office of the Slovak Republic Czech Statistical Office Institute of Health Information and Statistics of the Czech Republic The National Health Information Center of Slovakia	1996-2007	Age-standardised mortality	Beds Nurses Doctors GDP Pollution Unemployment Country
Chapter 5	Administrative data from the General Health Insurance Company	2002-2008	Number of hospitalisations	Age Sex Comorbidities HbA1c tests Urine tests Ophthalmologic visits Doctor visits Cholesterol tests Antidiabetic medication Corticoids SABA Antibiotics Flu shot Spirometry Asthma medication

1.8. Research questions and thesis contribution

To summarise, the main research question the thesis sets out to answer is: How have the health systems of Slovakia and the Czech Republic performed since the transition in 1989 and independence in 1993? The additional sub-research questions of the thesis are summarised in Table 4.

Based on the reviewed literature, the overall hypothesis of the thesis is that health, health system performance and quality of care in both countries have been improving since the transition. The thesis supports that the two transitions have resulted in a health and well-being benefit in both the Czech Republic and Slovakia reflected in a gain in height. Furthermore, this thesis hypothesises that health care performance, or quality of care in particular as measured by 'avoidable' mortality has also improved since the double transition in both countries where Slovakia falls behind the performance of the Czech Republic. Moreover, the thesis expects to find that the human and economic development that has occurred since 1989 will have resulted in declines in non-avoidable mortality; however, 'avoidable' mortality will have declined at a slower pace. Also, the thesis expects to find a relationship between health care inputs and 'avoidable' mortality, a better indicator of the contribution of health care to health outcomes. Finally, the thesis hypothesises that appropriate and inappropriate care are associated with hospitalisations for ambulatory care sensitive conditions.

Table 4. Summary of research questions

Overall research question: How have the health systems of Slovakia and the Czech Republic performed before and since the transition in 1989 and independence in 1993?		
Chapter	Research Goal	Sub-Questions
Chapter 2	Determine overall health system performance in Slovakia and the Czech Republic since the transition to democracy and independence using the indicator of height	Is there a height increase for those who grew up after the 1989 transition? Is there a height difference between the Czechs and the Slovaks? Who benefited more? Is there a height difference between females and males?
Chapter 3	Determine health care performance (overall quality of care) in Slovakia and the Czech Republic since the transition to democracy and independence using the indicator of 'avoidable' mortality	Has overall 'avoidable' mortality declined since the transitions reflecting improvements in quality of care? Has overall 'avoidable' mortality declined more rapidly than non-avoidable mortality? Has there been divergence or convergence between Slovakia and the Czech Republic? Are there regional variations in 'avoidable' mortality?
Chapter 4	Determine relationship between health care inputs and 'avoidable' mortality in Slovakia and the Czech Republic	Is there a negative relationship between health care inputs and 'avoidable' mortality? Do improved analytic methods provide more robust and consistent results?
Chapter 5	Determine quality of outpatient care in Slovakia using ACSHs and its associations with appropriate care	Are there variations in ACSHs? Do diabetic patients receive appropriate care as defined by clinical guidelines? Do asthma patients receive appropriate care as defined by clinical guidelines? Are selected process indicators for asthma and diabetes care negatively associated with ACSHs?

Chapter 1 is the background chapter which highlights the importance of measuring health system performance, especially in the context of the 1989 transition countries, and Czechoslovakia as a unique case study and natural experiment which split into two countries. The chapter provides the country context for Slovakia and the Czech Republic and their health systems, a conceptual framework to guide the measurement of health system performance in these two countries, and finally the rationale for selecting and using three more appropriate indicators to measure health system and health care system performance by examining changes in health, well-being and quality of care.

Chapter 2 examines changes in overall health system performance in the Czech Republic and Slovakia before and after the 1989 and 1993 transition. This chapter sets the stage for the entire thesis as its goal is to see whether the last twenty years have potentially resulted in any health and well-being improvements, and if so, what differences can be observed between the two countries. Evidence from developed countries suggests that changes in adult population heights can be regarded as indicators of health and well-being improvements in psycho-social environments during childhood. Heights also address the data and methodological challenges of other well-being indicators. Processes of transition to democracy and country break up stand out as ideal experiments to estimate the impact of changes in such environments on adult heights. The health care system is only one of the many determinants of change in height, so the focus of this chapter is to capture all the broad determinants of health, not only health care. A unique dataset containing records on individual heights in the Czech Republic and Slovakia is exploited to ascertain the retrospective welfare effects of the two distinct patterns of transition to liberal democracy and capitalism both countries followed after the split up of Czechoslovakia. The goal is to understand whether there has been a height gain for individuals who grew up under liberal democracy as opposed to communism.

Equally, the chapter aims to understand whether there is a height difference between the Czech and the Slovaks, as well as males and females, and the extent to which transition was an important determinant of these identified height gaps.

Chapter 3 aims to single out the contribution of the health care system and its quality to changes in health outcomes using the methodologically more appropriate indicator of 'avoidable' mortality in the two countries between 1971 and 2008. Age-standardised mortality rates for mortality from 'avoidable' and other (non-avoidable) causes have been calculated through indirect standardisation to study national and regional trends between 1971 and 2008. The chapter investigates a hypothesis of an overall decline in 'avoidable' mortality relative to non-avoidable mortality, as well as condition specific trends. Specifically, whether there has been convergence or divergence in trends between Slovakia and Czech Republic as an indicator of the quality and effectiveness of their health care systems. Finally, given the countries' regional heterogeneity, the chapter examines regional variations in 'avoidable' mortality and seeks to provide condition specific explanations for bad performance.

Chapter 4 focuses on the relationship between health care resources and 'avoidable' mortality. The consensus in the literature points out that health care resources do not consistently explain variations in health outcomes and instead other socio-economic and life-style variables should be investigated. However, the health outcome measures usually used in these studies capture a range of determinants where the quality of health care provision is only one of the many factors. This chapter sets out to test whether 'avoidable' mortality is an improved health outcome indicator that better captures the contribution of the health care system to see whether a negative relationship with health care inputs can be established. Some earlier evidence on the link between health care inputs and 'avoidable' mortality is inconclusive. This may reflect the fact that the potential endogeneity of physician supply and time

dependence of mortality rates have not been taken into consideration. Investigating the association between health care inputs and 'avoidable' mortality by using instrumental variables and dynamic panel modelling circumvents this problem. 'Avoidable' mortality rates were used as the health outcome measure, and the number of physicians, nurses and beds were used to capture health care inputs at the regional level.

Chapter 5 studies one particular aspect of health care performance, namely the quality of ambulatory care in Slovakia by examining potentially preventable hospitalisations for two ACSCs (asthma and diabetes) and the relationship with appropriate care. Anonymous patient level panel data from 2001-2008 from the administrative database of the largest public health insurance company in Slovakia is used. All newly diagnosed patients in 2002 and disease free in 2001 with asthma and diabetes are selected and followed for six years. Descriptive statistics are carried out to identify deficiencies in processes of care constructed on the basis of clinical guidelines. Then multilevel methods are applied to see whether appropriate and inappropriate processes of care are associated with variations in preventable hospitalisations for diabetes and asthma.

Chapter 6 concludes by summarising the overarching findings and contributions of the thesis, followed by results of individual chapters. It then provides recommendations for research and policy, and notes the limitations of this research.

Chapter 2. Using height to assess overall well-being and health system performance before and after Czechoslovakia's transition and break up

2.1. Introduction

The impact of the regime change from communism to democracy in 1989 and the split of Czechoslovakia in 1993 have usually been assessed with standard economic and health outcome indicators. The review of the literature in Chapter 1 found that the indicator of height is increasingly used to assess the overall well-being in a country as it is considered to be the "mirror of the society" (Tanner, 1986). It has been used to assess the impact of political regime change in several countries, including East and West Germany or Spain. This chapter therefore empirically examines the effect of political and economic liberalisation (and more specifically the transition from communism to a liberal democracy and further country break up of Czechoslovakia[10]) on a retrospective measure of health and well-being – adult human heights. The goal is to understand how institutional reforms have reflected in the expansion of overall standard of living, and how individual and political rights fared in Slovakia and the Czech Republic by studying changes in human stature. The assumption is that political and economic changes that occurred after 1989 in Czechoslovakia have overall benefited the society and should be reflected in a height increase. Heights are examined by income terciles and a number of covariates including gender, education, employment and others are controlled for. Furthermore, the goal is to explore whether there is a height difference between Slovaks and Czechs.

[10] For simplicity purposes, in the remaining of the chapter we will be using the term "democracy" even though we are referring more broadly to political and economic liberalisation.

However, testing for the height effects of wider political and economic liberalisation processes (such as the adoption of a liberal democracy and political break up) is a task that can be contentious on several grounds. First, the benefits from transition to a liberal democratic society as well as separation of Czechoslovakia are likely to come with a lag, in part because the effect of height enhancing processes is intermediated by other reforms (e.g., the development of social protection, implementation of liberalisation reforms etc). Evidence shows that during the time of transition, a deterioration in living standards was occurring in Eastern Europe before any visible improvements took place (Adeyi, Chellaraj, Goldstein, Preker, & Ringold, 1997; Garner & Terrell, 1998; Milanovic, 1998; Stillman, 2006; Svejnar, 2002). Second, identifying the effect of the break up is complex even though one could argue that both Slovakia and the Check Republic benefited (or suffered) from it. Both countries lost some scale benefits and at the same time they may have overcome the complexities of public decision making in multinational environments. In addition, the emergence of new countries in Easter Europe, including the Czech Republic and Slovakia, implied huge needs for institutional build-up since their national institutions were likely to be underdeveloped and with little experience of running their own affairs (Milanovic, 1998). Hence, the direction of the effect is empirically contested.

The literature comparing Czech Republic and Slovakia post-secession focuses mainly on the degree of similarity or difference in the political context and economy (Bartosova & Zelinsky, 2013; Meszaros, 1999) as well as social and health outcomes post 1993 (Potucek & Radicova, 1997). However, most of the analyses consider democratisation and secession effects together, which leads us to the third issue, the problem of correctly identifying the effect of the break up from that of democratisation as both have coincided. Instead, how the trajectories of both

countries differed after the transition to democracy and independence can be identified. Just like the literature on secession, the evidence on the democratic transition and its effects is even more extensive, covering all areas from economic welfare and institutional changes (Hausner, Jessop, & Nielsen, 1995; Inglot, 2008, 2009; Kostecki, Zukrowska, & Goralczyk, 2000; Milanovic, 1998; Whitefield, 1993; Winiecki & Kondratowicz, 1993) to health effects (Bobak & Feachem, 1992; Cornia & Paniccià, 2000; Ginter, Simko, & Wsolova, 2009; Lawson & Nemec, 2003; Stillman, 2006). Broadly speaking, the evidence points to the difficult transition years with Czech Republic having performed better than Slovakia on a range of aspects. Finally, an inescapable issue lies in distinguishing the effects of economic liberalisation which may bring reforms that improve access to food sources and new technologies from the introduction of democratic decision-making systems (Tavares & Wacziarg, 2001).[11] Difference by income terciles would be expected to contain some information that allows us to ascertain whether one effect over the other prevailed.

The next section contains detailed information on data and methods. Section four reports on the results and robustness checks. Finally, section five presents the discussion and conclusions of the chapter.

2.2. Data and methods

Data and variables

This study uses the data from the 2003 World Health Survey (WHS) which is the baseline household survey for health status of populations and outcomes related to investments and functioning of health systems. The survey identified all adult

[11] Indeed, while political liberalisation is assumed to involve those individuals who uphold democratic values in collective decision-making, economic liberalisation refers solely to the areas of economic activity and commerce.

population over age 18 years old as the sample and employed a probability sampling design where every single person had a known non-zero chance of being selected into the survey sample; either with single or multi-stage random cluster sampling. Individual probability sampling weights were applied to adjust for the probability of selection into the sample (World Health Organization, 2003). According to the WHS individual country reports provided by the WHO, the number of interviewed households was 935 (total 3913 - 24% of selected households) in the Czech Republic and 1811 (total of 2539 - 71% of selected households) in Slovakia; the number of interviewed individuals was 935 (total selected 949 – 99% of selected individuals) and 2461 (total selected 2471 – 99% of selected individuals), respectively. The household level figures for Czech Republic suggest that there may have been an important selection bias and therefore the sample may not correctly represent the Czech population. In particular, non-response bias may be the key concern where those who participated (potentially the healthier population) are different from non-participants (Delgado-Rodríguez & Llorca, 2004).

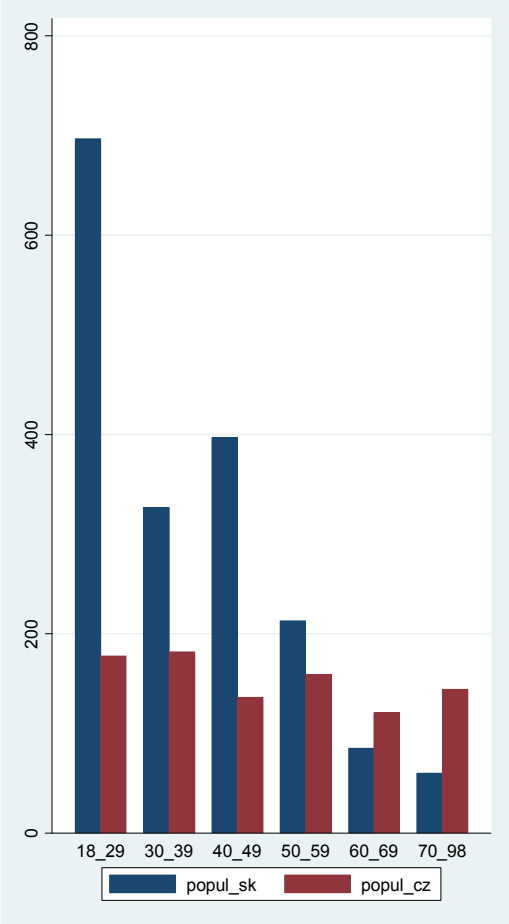
However, according to the official WHS country report of the Czech Republic, prepared by the Institute of Health Information and Statistics Czech Republic (Institute of Health Information and Statistics Czech Republic, 2004), the sample is representative of the population. The findings of the report were confirmed by the Director of the Institute through personal correspondence (Ing. Jiri Holub, March 14, 2014). According to this report, 1918 individuals were finally eligible and contacted, and responses were obtained from 935, resulting in a response rate of 55.1% (excluding individuals who could not be contacted for objective reasons), which is higher than the response rate in the report provided by the WHO. The same report states that while the structure of the respondents differs in some characteristics from the structure of the adult Czech population, it confirms previous findings and none of the important population groups were significantly under or overestimated. The

following differences were identified when compared to the overall Czech population. With respect to sex, there were somewhat more women and less men in the sample than the overall population (55.2% compared to 52% and 44.8% compared to 48%, respectively); with respect to age, women and men younger than 30 and men between 40-49 were somewhat underrepresented, while men over the age of 70 were somewhat overrepresented. Similarly, the report compares the WHS sample to the overall population for regional representation, ethnicity, family status, education, economic activity and employment, household composition and finds that the sample is broadly similar to the overall population. Perhaps, the most important finding is that lowest participation in the survey is seen by the least educated who may be suffering from worse health.

Furthermore, the report identifies the proportions of individuals out of a total of 1918 individuals who did not respond to the survey and the underlying reasons: the individual or the household was unwilling to participate (26.5%); the individual was not at home (13.2%); the individual was unsuitable (1.2%); the individual did not live at the address (6.2%); the individual could not be contacted (1%); the individual died (1.4%); and individuals were not contacted at all (1.8%). In addition, an analysis of homogeneity between the responders and the non-responders was carried out. More women, less men, more older people and citizens of smaller towns responded to the survey. While these differences can be adjusted for by using sampling weights, it remains difficult to adjust for other non-observable differences between respondents and non-respondents. For example, the healthiest or the least healthy may have been those who did not participate (Institute of Health Information and Statistics Czech Republic, 2004). In addition, the report notes that the complexity of the survey in terms of topics covered and time required to complete it, as well as implementation issues are potentially other relevant reasons for 26.5% unwilling to participate.

Therefore, the actual sample used in this study (after accounting for missing observations for height) contains 1806 Slovak and 920 Czech individuals. Distribution by age groups can be seen in Figure 11.

Figure 11. Distribution of the population by age categories



The survey includes information on self-reported height of the individuals as well as information on other important variables that are controlled for including education, income, rural or urban location, employment and others. The control variables are based on the conceptual framework of determinants of height defined by Steckel (1995). Table 5 below summarises the descriptive statistics for all the variables used in the analysis.

Table 5. Variable description

Variable	*Variable description*	*Obs*
height	=adult height in cm	2726
gend	=1 if male; 0 if female	2726
co	=1 if Czech Republic; 0 if Slovakia	2726
popul_cz	= number of Czechs	920
popul_sk	= number of Slovaks	1806
age70_98	=1 if the individual was born between 1910-1933; 0 otherwise	2726
age60_69	=1 if the individual was born between 1934-1943; 0 otherwise	2726
age50_59	=1 if the individual was born between 1944-1953; 0 otherwise	2726
age40_49	=1 if the individual was born between 1954-1963; 0 otherwise	2726
age30_39	=1 if the individual was born between 1964-1973; 0 otherwise	2726
age18_29	=1 if the individual was born between 1974-1985; 0 otherwise	2726
educ1	=1 if individual has primary education or less; 0 otherwise	2724
educ2	=1 if individual completed secondary education; 0 otherwise	2724
educ3	=1 if individual completed high school/equivalent education; 0 otherwise	2724
educ4	=1 if individual completed college or higher level education; 0 otherwise	2724
job1	=1 if individual is working; 0 otherwise	2702
income	estimated permanent income of individual	2596
qincome1	bottom income tercile	2596
qincome2	middle income tercile	2596
qincome3	top income tercile	2596
demage	Years spent under democracy before the age of 20	2726
indage	Years spent under independence before the age of 20	2726
demd	=1 if individual was raised at least 1 year under democracy before age 20; 0 otherwise	2726
indd	=1 if individual was raised at least 1 year in independent country before age 20; 0 otherwise	2726
dempolity	Years spent under democracy from 1993-2003, adjusted for the "quality of democracy" with the Polity IV democracy score	2726
language	=1 if individual reported a language; 0 otherwise	2726

Predicted permanent income *(income)* is used as a proxy for wealth or socio-economic development (Filmer & Pritchett, 1999; Komlos & Baur, 2004; Persico, et al., 2004) as the dataset did not contain other suitable income variable. A variable of *income* was created using factor analysis from a series of questions on the ownership of particular household objects (e.g. number of cars, TVs, rooms, ownership of phone, video camera, computer, access to internet etc.). Polychoric correlation was first carried out as the variables are constructed as counts or dummies followed by factor analysis to reduce the several correlated variables into one variable. The key steps in factor analysis are choosing the relevant variables and determining the number of factors. The ownership of the following variables were used as these are expected to better predict income: car, television, bike, video player, stereo, DVD player, washing machine, dishwasher, vacuum cleaner, fridge, cell phone, computer and internet. Several other variables were excluded due to high uniqueness values or because there was very little variation. The predicted income variable was then standardised and converted into three income thirds (poorest third, middle third and rich third). Given that nutrition is a function of income, a positive association between height and income is expected; however, it should also be noted that the height-income relationship is not stable in the face of epidemiological conditions; at a given income, improvements in public health, personal life style and childcare practices, the prevalence of disease may be reduced and physical growth enhanced (Peracchi, 2008; Steckel, 2009). Furthermore, the literature suggests that there are diminishing returns to nutrient intake suggesting that the height of the rich is expected to increase by less than is the decline in the height of the poor; this results in a net negative effect where holding income constant, increased inequalities imply that average height diminishes (Komlos, 2009). Therefore, it can be expected that the richest individuals benefited less from the transition than the poorest group.

Education (*educ*) is used as a proxy of individual abilities and a predictor of an individual's efficiency in health production (Costa-Font & Gil, 2008; D.S. Kenkel, 1991). It is presented in four categories from those with less than primary education completed all the way to those with a post-graduate degree completed. In addition, we control for urban and rural differences in height as those in urban areas are more likely to have easy access to resources (Costa-Font & Gil, 2008). The variable *job* captures the employment category of the individual which was aggregated into two major groups: employed and unemployed. A dummy variable was included to capture the country effect (*co*) – Slovakia and Czech Republic. Six age categories represent the effect of the different birth cohorts, where the 1974-1985 birth cohort was selected as the reference category. Finally, the variable *language* is a proxy variable for ethnicity. The variable cannot be interpreted as it stands given the large number of missing values which may not be missing randomly but instead may be capturing individuals belonging to one of the important ethnic minorities in Czech Republic and Slovakia (e.g. Roma, Hungarians). However, it was still considered important to be controlled for and was included as a dummy variable with the value of 1 if a language was reported by the individual and zero for all the missing values.

The key dependent variables are represented by the number of years a person has lived under democracy (*damage*) and independence (*indage*) before they reach 20 years of age. For democracy (1989), these are individuals aged 18 to 33 year in year 2003 (birth cohorts 1970 - 1985) who lived their first 20 years between 14 to 1 year under democracy (4 to 19 years under communism). All the older individuals lived all the years before they reach 20 years of age under communism. Similarly for independence (1993), individuals aged 18 to 30 in year 2003 (birth cohorts 1973-1985) lived their first 20 years between 11 to 1 year as part of an independent country (or 7 to 19 years as part of Czechoslovakia). These variables were first included as dummy variables with a value of 0 for those who were raised zero years under

democracy *(demd)* independent *(indd)* country and 1 otherwise. The purpose is to see whether being raised any amount of years under a democracy/ independence as opposed to none matters or it's rather the increasing number of years that has an impact.

Furthermore, the "quality" of the democratic years is also controlled for when an adjusted democracy variable is included to see whether the results are consistent. The type of democracy the two countries had immediately after the change of the regime versus several years later may change depending on the political situation and reforms implemented. Therefore the Polity IV[12] institutionalised democracy variable (*dempolity*) was used to adjust for the "quality" of the democratic years after 1993 for independent Slovakia and Czech Republic. In other words, whether someone was a child during the 1993-1997 democratic years may not be the same as growing up under the 2000-2003 democratic years and later. Under the Polity IV project, institutionalised democracy consists of three key elements: i) presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leader; ii) the existence of institutionalized constraints on the exercise of power by the executive; iii) the guarantee of civil liberties to all citizens in their daily lives and in acts of political participation. Other aspects of plural democracy, such as the rule of law, systems of checks and balances, freedom of the press, and so on are means to, or specific manifestations of, these general principles (Center for Systemic Peace). The "Polity Score" ranges from -10 (hereditary monarchy) to 10 (consolidated democracy) in any given year and was used to weigh the years spent under democracy. Both for Slovakia and the Czech Republic the scores were positive (7 and above) for the entire period under study so the weights

[12] The goal of the Polity IV project is to code the authority characteristics of states in the world system for purposes of comparative, quantitative analysis. It has become the most widely used resource for monitoring regime change and studying the effects of regime authority (Center for Systemic Peace).

used were between 0.7 and 1. These weighted years were then added up to obtain an adjusted democracy variable. For both types of democracy variables and independence variable a positive association with height was expected. However, as the independence and democracy variables are likely to be confounded and the changes the occurred as a result of one or the other transition cannot be appropriately controlled for, these are included in separate regressions.

Finally, the following interaction terms are also included: two-way interaction variables between country and years under democracy/independence, income and years under democracy/independence, income and country, as well as a three-way interaction between income terciles, years under democracy/independence. The goal is to see whether the effect of democracy was country or income group dependent, especially given the fact the Czech Republic was initially performing significantly better on many grounds than Slovakia. As the direct interpretation of three-way interactions is complicated, where the term is significant, additional visual analysis is carried out. This was done by graphing the slopes of height by one of the continuous variables, while allowing for the other two categorical variables to differ. Then the slopes were calculated followed by a test of differences in slopes (Institute of Research and Digital Education, 2013).

Methods

A classical ordinary least squares (OLS) regression model is applied to identify the effect of democracy and independence on the mean height of the population, as well as the other control variables on height. The model for the effect of democracy is as follows:

H = f (democracy, gender, country, age, education, job, income, language)

Alternatively, for independence it is:

H = f (independence, gender, country, age, education, job, income, language)

More specifically, the models can be expressed as:

$$Height_i = \beta_0 + \beta_1 democracy_i + \beta_2 gend_i + \beta_3 age_i + \beta_4 educ_i + \beta_5 job_i + \\ + \beta_6 income_i + \beta_7 co_i + \beta_8 language_i + \varepsilon_i \quad (1)$$

Or

$$Height_i = \beta_0 + \beta_1 independence_i + \beta_2 gend_i + \beta_3 age_i + \beta_4 educ_i + \beta_5 job_i + \\ + \beta_6 income_i + \beta_7 co_i + \beta_8 language_i + \varepsilon_i \quad (2)$$

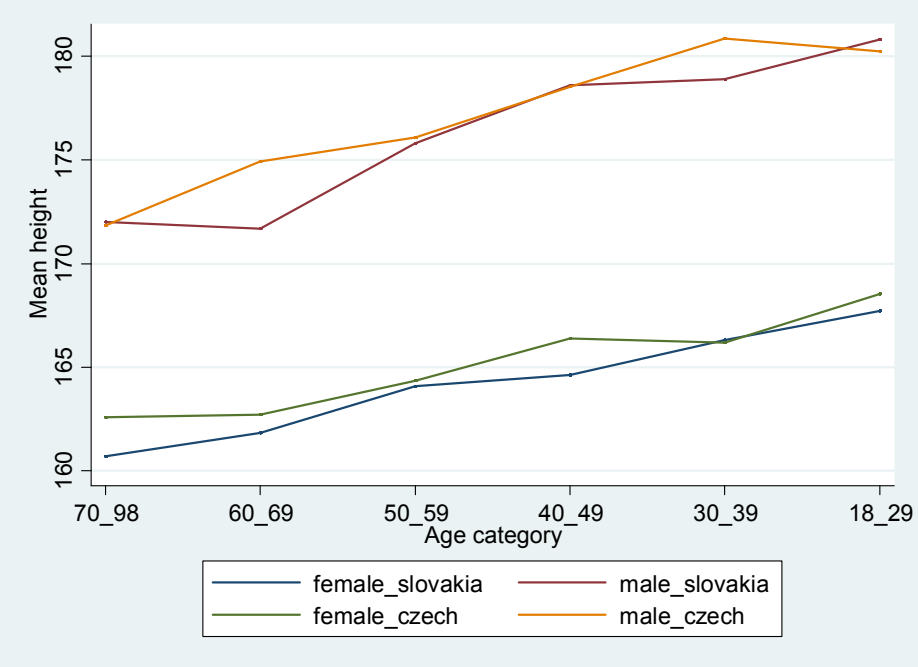
for observations i = 1...n, where democracy and independence are either a continuous variable *(demage* or *indage)* or a dummy variable *(demd* or *indd)* as described above; ε_{it} is the unobserved random error which captures random factors that may affect height.

2.3. Results

A height difference can be observed between males and females as well as between the Slovak and the Czech population by age cohorts (Figure 12). There is an increasing height trend across the age cohorts, where older generations are shorter than the younger ones. The largest difference between the two countries for males

appears to be for those aged 60-69 (born between 1934-1943) and then again for ages 30-39 (born 1964-1973); for females it is ages 79-98 (born between 1905-1933) and ages 40-49 (born between 1954-1963). Overall, the difference over age cohorts appears to be more important than the difference between the two countries.

Figure 12. Height by age cohorts, gender and country in 2003



The average height figures by age groups, gender and country used in Figure 12 are presented in Table 6. The range for Slovak males between the oldest and the youngest age groups is as much as 8.79cm, followed by Czech males (8.41cm), Slovak females (6.99cm) and Czech females (5.97).

Table 6. Mean height by gender and country, 2003

	SLOVAKIA		*CZECH*	
	Mean height	**Std. Dev.**	**Mean height**	**Std. Dev.**
WOMEN				
18_29	167.69	5.68	168.55	6.53
30_39	166.32	5.66	166.17	6.38
40_49	164.63	5.98	166.39	7.28
50_59	164.09	5.74	164.35	5.35
60_69	161.83	5.80	162.70	5.53
70_98	160.70	5.30	162.58	5.81
MEN				
18_29	180.79	7.44	180.24	7.46
30_39	178.88	7.27	180.84	6.95
40_49	178.61	6.85	178.52	7.45
50_59	175.82	5.67	176.09	6.51
60_69	171.67	9.67	174.92	6.16
70_98	172.00	6.91	171.83	6.14

Note: No adjustment with weights was carried out

The average height also differs across the income terciles within and across countries (Table 7 and Figure 13). The average height of the Slovak females in the lowest tercile is only 164.6cm, increasing to 166.1cm in the mid and top terciles. Slovak males' height gradually increases across tercile from 176.8cm to 178.6cm and 180.3cm respectively. Czech females are 164.4cm in the lowest tercile, 164.8cm in the mid and increases to 167.1cm in the top group. Finally, the poorest Czech males are 175.3cm, increasing to 177cm and 180.2cm in the mid and highest income terciles respectively.

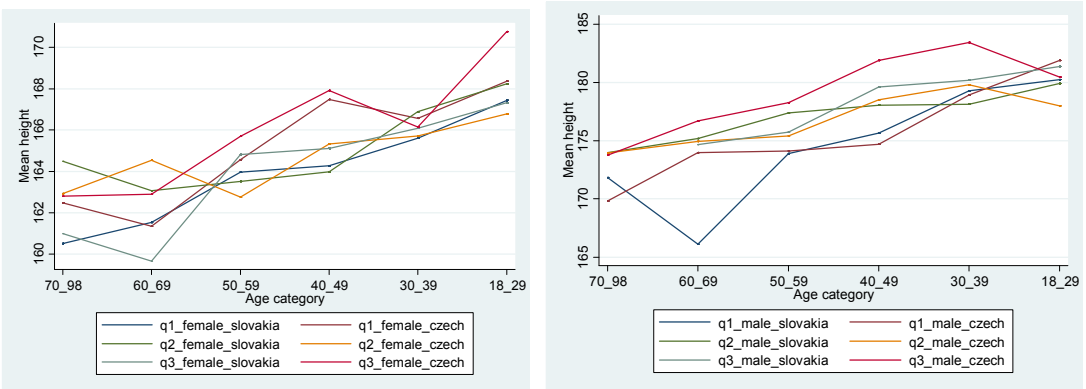
Table 7. Average height by terciles, gender and country

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
q1_female_SK	408	164.6237	2.242089	160.5122	167.4286
q1_male_SK	143	176.7851	3.970725	166.125	180.2407
q1_female_CZ	190	164.4199	2.497327	161.3428	168.36
q1_male_CZ	133	175.2617	4.065685	169.8333	181.9
q2_female_SK	352	166.1261	2.048122	163.0667	168.2391
q2_male_SK	202	178.599	1.371597	173	179.9302
q2_female_CZ	185	164.82	1.472075	162.7586	166.7778
q2_male_CZ	140	177.014	2.228076	173.9583	179.8182
q3_female_SK	380	166.0745	1.223809	159.6667	167.6667
q3_male_SK	234	180.312	1.734207	174.6667	181.3617
q3_female_CZ	123	167.0809	2.448351	162.8	170.75
q3_male_CZ	130	180.2097	2.761017	173.7778	183.4333

Note: No adjustment with weights was carried out

Figure 13 graphs the height difference across terciles by age cohorts where it can be seen that regardless of the income tercile, height increases from the oldest to the youngest generations. The graphs also suggest some variation in the mean height for males and females across the age cohorts and income terciles, with the richest Czechs being the tallest across cohorts.

Figure 13. Height by income tercile, age group, gender and country, 2003. Poorest (q1), middle (q2), top (q3)



First the results where the key independent variable democracy is included in the analysis as a dummy variable (=1 for those who spent at least 1 year growing up under democracy and zero otherwise) are presented (Table 8). It can be seen that the sign and the significance of the variable changes depending on the model specification but is only positively significant in Models 3 and 7, similarly to the country effect. However, there is a significant income, gender and age cohort effect in all the models. As expected, the results show that males are taller than females, older generations are shorter relative to the youngest generation and income has a positive effect on height. The cohort effects show that anyone born before 1973 is significantly shorter than the youngest cohort born between 1974 and 1985 that we used as the reference category. When income was studied in income terciles (Model 6), height of the respondents in the poorest tercile and mid tercile is 1.97cm and 2.23cm less than the height of the richest tercile. Next, a range of different interactions were included (Model 3-7). In Model 3 the interaction between country and democracy was studied and results show that for Slovaks, height for those who were raised under democracy as opposed to communism is 1.504cm more; for Czechs, on the other hand, the height of those raised under democracy is 0.4cm less that for those raised under communism. Another way of interpreting this interaction is to say that under communism, height of Czechs was 1.4cm more than the height of Slovaks; for those who grew up under democracy, height of the Czechs is 0.5cm less than the height of Slovaks. In other words, these results seem to suggest that the Slovaks have benefited more from democracy.

In Model 4 the significant interaction between income and democracy was studied which shows that with a unit increase in income, height increases by 1.2cm for those under communism and only by 0.6 for those growing up under democracy; or that height is 0.3cm more for those growing up under democracy as opposed to communism when income equals zero and this difference decreases by 0.6 for each

additional unit of income. These results suggest that while for a given income height is more under democracy then communism, higher income benefits an individual more under communism. In Model 5 the interaction between income and country was studied and there was no significant effect. Finally, in Model 7 all the controls are included together and there is positive significant effect of democracy and country (Czechs), as well as gender, language, education and age cohorts, while the three-way interaction term is not significant. Increase in the years of education is associated with a significant increase in height when compared to the reference group of people with primary and less years of schooling. The log-likelihood ratio test comparing the restricted models to the less restricted models showed that adding interactions as well as controlling for education and employment resulted in a statistically significant improvement in the model fit compared to a model where only income is controlled for.

Table 8. OLS regressions of years lived under democracy as a dummy variable on height with different controls

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4	(5) Eq.5	(6) Eq.6	(7) Eq.7
demd	0.166	0.0363	1.504**	0.268	0.0554	-0.0204	1.631**
	(0.558)	(0.575)	(0.726)	(0.586)	(0.575)	(0.573)	(0.742)
co	0.389	0.388	1.415***	0.356	0.288	0.481	1.641***
	(0.291)	(0.296)	(0.429)	(0.297)	(0.314)	(0.296)	(0.433)
income		0.938***	0.912***	1.180***	0.744***		0.717*
		(0.145)	(0.145)	(0.191)	(0.248)		(0.388)
demd_co			-1.940***				-1.812***
			(0.588)				(0.631)
demd_inc				-0.574*			-0.831
				(0.293)			(0.509)
inc_co					0.287		0.453
					(0.298)		(0.434)
demd_inc_co							0.398
							(0.619)
language							1.029
							(4.310)
gend	13.19***	13.05***	13.01***	13.04***	13.04***	13.04***	12.59***
	(0.249)	(0.254)	(0.254)	(0.254)	(0.254)	(0.253)	(0.251)
geog							0.232
							(0.323)
age30_39	-1.364***	-1.266***	-1.039**	-1.289***	-1.276***	-1.436***	-1.188**
	(0.456)	(0.467)	(0.471)	(0.466)	(0.467)	(0.465)	(0.471)
age40_49	-1.762***	-1.685**	-1.428**	-1.719**	-1.678**	-1.763**	-1.325*
	(0.675)	(0.692)	(0.695)	(0.692)	(0.692)	(0.691)	(0.688)
age50_59	-5.323***	-5.148***	-5.042***	-5.095***	-5.131***	-5.256***	-4.838***
	(0.697)	(0.716)	(0.715)	(0.716)	(0.716)	(0.712)	(0.704)
age60_69	-5.707***	-5.219***	-5.195***	-5.117***	-5.191***	-5.415***	-4.734***
	(0.742)	(0.762)	(0.761)	(0.764)	(0.763)	(0.758)	(0.764)
age70_98	-7.588***	-6.836***	-6.833***	-6.707***	-6.800***	-7.083***	-6.015***
	(0.704)	(0.727)	(0.725)	(0.729)	(0.728)	(0.721)	(0.736)
educ2							1.534***
							(0.403)
educ3							1.376***
							(0.391)
educ4							1.999***
							(0.523)
job1							0.306
							(0.313)
qincome1						-1.977***	
						(0.327)	
qincome2						-2.252***	
						(0.304)	
Constant	167.6***	167.3***	166.3***	167.2***	167.3***	169.0***	163.5***
	(0.621)	(0.641)	(0.701)	(0.641)	(0.645)	(0.664)	(4.403)
Observations	2,726	2,596	2,596	2,596	2,596	2,596	2,572
R-squared	0.567	0.575	0.577	0.576	0.575	0.578	0.576

The complete sets of regressions where democracy is included as a continuous variable are summarised in Table 9. The results show that with an additional year spent under democracy while growing up there is a small significant positive association with height, contrary to the findings above where democracy was

included as a dummy variable. The effect of the other variables (education, gender, income) is still significant in the same direction even though the size of the coefficients differs somewhat. However, age cohort is only significantly negatively associated with the height of the youngest age cohort for individuals born before 1953. In other words, there is no significant difference in height between the three youngest cohorts, all of which grew up predominantly under communism. Again, the country effect is not consistently significant across the models and Model 6 shows that there is a significant effect by income terciles where the bottom and middle tercile are shorter than the top tercile. Also, there is a significant effect of job where those employed are significantly taller than the unemployed, and a significant education effect. Interactions are again included in models 3, 4 and 5 and only the interaction between country and democracy is significant (Model 3). Now democracy is a continuous variable so the interpretation is slightly different from before. With an additional year spent under democracy while growing up, height increases by 0.286cm for Slovaks and 0.148cm for Czechs. In other words, height is 1.141cm more for Czechs than Slovaks if a person spent zero years under democracy and this difference in height becomes smaller for each additional year under democracy (1.141-0.138*demage). Similarly as before, results indicate that democracy seems to be benefiting the Slovaks more than the Czechs. In Model 7 the three-way interaction is significant and the model is also preferred to the model with income only, based on the results of the likelihood ratio test.

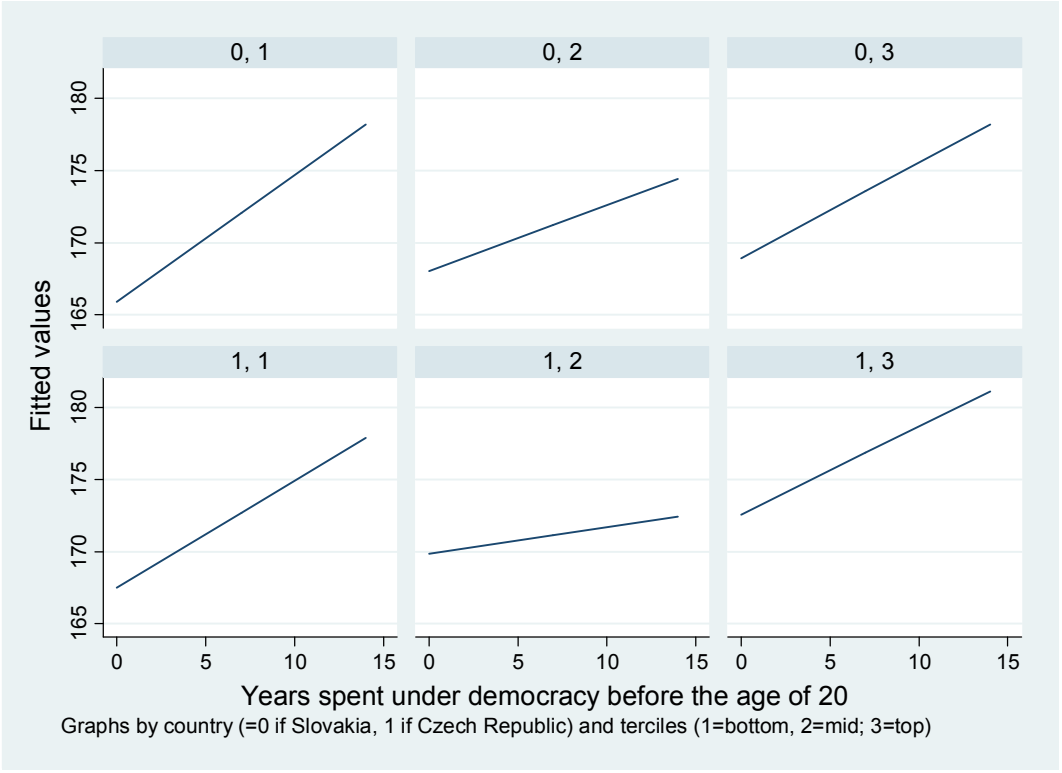
Table 9. OLS regressions of years lived under democracy as a continuous variable on height with different controls

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4	(5) Eq.5	(6) Eq.6	(7) Eq.7
demage	0.264***	0.217***	0.286***	0.221***	0.222***	0.202***	0.432***
	(0.0714)	(0.0735)	(0.0783)	(0.0754)	(0.0737)	(0.0734)	(0.110)
1.co#c.demage							-0.251**
							(0.105)
2.qincome							0.643
							(0.840)
3.qincome							1.353
							(0.843)
1o.co#1b.qincome							0
							(0)
1.co#2.qincome							-0.135
							(0.920)
1.co#3.qincome							0.358
							(0.933)
2.qincome#c.demage							-0.291***
							(0.112)
3.qincome#c.demage							-0.286**
							(0.111)
1o.co#1b.qincome#co.demage							0
							(0)
1.co#2.qincome#c.demage							0.0340
							(0.140)
1.co#3.qincome#c.demage							0.379***
							(0.137)
gend	13.12***	12.99***	12.97***	13.00***	12.98***	12.98***	12.49***
	(0.249)	(0.254)	(0.254)	(0.255)	(0.255)	(0.254)	(0.251)
language							1.065
							(4.279)
geog							0.196
							(0.322)
age30_39	0.933	0.662	0.521	0.668	0.685	0.390	-0.226
	(0.739)	(0.758)	(0.759)	(0.759)	(0.758)	(0.758)	(0.756)
age40_49	0.822	0.535	0.394	0.542	0.572	0.357	-0.149
	(0.834)	(0.856)	(0.857)	(0.857)	(0.857)	(0.854)	(0.855)
age50_59	-2.752***	-2.950***	-3.191***	-2.934***	-2.901***	-3.154***	-3.625***
	(0.848)	(0.868)	(0.872)	(0.871)	(0.869)	(0.867)	(0.874)
age60_69	-3.145***	-3.036***	-3.330***	-3.013***	-2.974***	-3.324***	-3.417***
	(0.882)	(0.902)	(0.909)	(0.906)	(0.904)	(0.901)	(0.945)
age70_98	-5.017***	-4.648***	-4.958***	-4.623***	-4.577***	-4.986***	-4.715***
	(0.853)	(0.874)	(0.882)	(0.880)	(0.876)	(0.873)	(0.929)
educ2							1.505***
							(0.405)
educ3							1.409***
							(0.397)
educ4							2.063***
							(0.528)
job1							0.630**
							(0.318)
dem_co			-0.138**				
			(0.0543)				
co	0.458	0.458	1.141***	0.454	0.342	0.542*	1.335**
	(0.290)	(0.296)	(0.400)	(0.297)	(0.313)	(0.296)	(0.637)
income		0.909***	0.894***	0.937***	0.679***		
		(0.145)	(0.145)	(0.179)	(0.248)		
dem_inc				-0.00755			
				(0.0284)			

inc_co					0.340		
					(0.298)		
qincome1						-1.924***	
						(0.326)	
qincome2						-2.184***	
						(0.305)	
Constant	165.0***	165.0***	164.7***	165.0***	165.1***	166.9***	161.8***
	(0.801)	(0.825)	(0.834)	(0.827)	(0.826)	(0.853)	(4.439)
Observations	2,726	2,596	2,596	2,596	2,596	2,596	2,572
R-squared	0.569	0.576	0.577	0.576	0.577	0.579	0.583

The fact that the interaction term between country, years under democracy and income terciles is significant, suggests that the slopes of height on years under democracy are not the same across countries and terciles (Figure 14). Many different comparisons can be made across the slopes, but only a few important ones are highlighted as follows. In Slovakia, there is a significant difference in the effect of years under democracy on height between the bottom and mid as well as the bottom and top tercile; the difference between the mid and top terciles is not significant. For the Czechs the difference is significant between the bottom and mid tercile, and the mid and top tercile. In the poor and mid terciles the Slovaks benefit more with increasing years of democracy while in the top tercile there is not difference between the two countries. These findings suggest that the effect of years spent under democracy has reflected in different height effects depending on the country and income tercile, where interestingly the flattest slopes can be observed for the mid-tercile.

Figure 14. Slopes of height on years under democracy in Czech Republic and Slovakia across income terciles



When the regression is decomposed by sex, the effects are quite different for men and women (Table 10 and 11). The interaction terms were excluded for the purpose of simplicity. For males, years under democracy is significantly associated with a height increase in all the models. The country effect shows that the Czech males are shorter than Slovak males. A large positive significant income effect both as a continuous variable and when included in income terciles can be noted, and there is significant positive education effect as years of completed education increase. However, the results for the birth cohorts show an important difference where actually the birth cohorts 1954-1963 and 1964-1973 are significantly taller than the youngest birth cohort 1974-1985; the oldest birth cohort is significantly shorter than the youngest birth cohort. In other words, there appears to be height gain between the youngest age cohort growing up under democracy and the previous generation.

Table 10. OLS regressions of years lived under democracy on height with different controls – male

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4
demage	0.428***	0.317**	0.301**	0.273**
	(0.125)	(0.127)	(0.127)	(0.134)
co	-1.538***	-1.729***	-1.592***	-0.785
	(0.539)	(0.537)	(0.531)	(0.542)
income		1.968***		1.742***
		(0.251)		(0.251)
geog				0.632
				(0.597)
language				6.520
				(7.379)
age30_39	3.473**	3.238**	3.039**	2.253*
	(1.350)	(1.365)	(1.354)	(1.356)
age40_49	3.876***	2.989**	2.727*	2.584*
	(1.501)	(1.518)	(1.504)	(1.531)
age50_59	-1.816	-2.268	-2.452	-2.788*
	(1.538)	(1.552)	(1.550)	(1.584)
age60_69	-1.386	-1.384	-1.833	-1.485
	(1.637)	(1.653)	(1.644)	(1.754)
age70_98	-4.168***	-3.565**	-3.895**	-3.087*
	(1.520)	(1.535)	(1.525)	(1.682)
educ2				2.277***
				(0.753)
educ3				1.383*
				(0.720)
educ4				2.559***
				(0.905)
job1				1.109*
				(0.573)
qincome1			-4.743***	
			(0.553)	
qincome2			-3.716***	
			(0.510)	
Constant	177.7***	177.8***	181.3***	168.1***
	(1.446)	(1.475)	(1.513)	(7.592)
Observations	1,025	976	976	967
R-squared	0.222	0.266	0.284	0.261

For women (Table 11), years spent under democracy while growing up is not significantly associated with a height increase in any of the regressions, while again there is a significant country effect; however, it is the Czech women who are taller than the Slovak women. Education also has a significant effect on height but whether or not women are employed does not seem to affect height. Here income is not significantly associated with an increase in height and when included in income terciles, it is only the middle tercile that is significantly shorter than the top tercile. All the cohorts of women born before 1953 are significantly shorter than the youngest cohort but there is no significant difference between the youngest cohort and the next

two older cohorts. So to summarise the gender specific results, it is democracy, income and job that matters for men while for women there is no income or democracy effect, but a strong country effect.

Table 11. OLS regressions of years lived under democracy on height with different controls – female

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4
demage	0.0967	0.0851	0.0971	0.107
	(0.0824)	(0.0849)	(0.0847)	(0.0883)
co	1.725***	1.811***	1.894***	2.107***
	(0.319)	(0.329)	(0.329)	(0.342)
income		0.0962		0.00384
		(0.167)		(0.170)
geog				0.0157
				(0.360)
language				-1.899
				(5.031)
age30_39	-1.018	-1.123	-1.185	-1.066
	(0.820)	(0.843)	(0.842)	(0.864)
age40_49	-1.493	-1.494	-1.357	-1.205
	(0.937)	(0.962)	(0.960)	(0.990)
age50_59	-3.742***	-3.950***	-3.935***	-3.620***
	(0.946)	(0.970)	(0.966)	(0.995)
age60_69	-4.861***	-4.915***	-5.062***	-4.543***
	(0.973)	(0.997)	(0.993)	(1.063)
age70_98	-5.563***	-5.580***	-5.843***	-4.960***
	(0.963)	(0.990)	(0.986)	(1.062)
educ2				0.884*
				(0.452)
educ3				1.710***
				(0.438)
educ4				1.885***
				(0.631)
job1				-0.153
				(0.370)
qincome1			0.422	
			(0.381)	
qincome2			-0.775**	
			(0.364)	
Constant	165.8***	165.8***	165.9***	166.1***
	(0.895)	(0.921)	(0.951)	(5.185)
Observations	1,701	1,620	1,620	1,605
R-squared	0.131	0.133	0.140	0.141

Finally, the complete sets of regressions where democracy is included as a continuous variable adjusted with the Polity IV score are summarised in Table 12. The results are very similar to those presented earlier without the adjustment. The significance of the coefficients does not change, only somewhat the magnitude depending on the Model.

Table 12. OLS regressions of years lived under democracy as a continuous variable adjusted for "quality" of democracy

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4	(5) Eq.5	(6) Eq.6	(7) Eq.7
dempolity	0.280***	0.230***	0.425***	0.217**	0.231***	0.217**	0.660***
	(0.0833)	(0.0854)	(0.108)	(0.0881)	(0.0854)	(0.0852)	(0.173)
1.co#c.dempolity							-0.448***
							(0.168)
2.qincome							0.375
							(0.798)
3.qincome							1.246
							(0.795)
10.co#1b.qincome							0
							(0)
1.co#2.qincome							0.0567
							(0.878)
1.co#3.qincome							0.379
							(0.885)
2.qincome#c.dempolity							-0.431**
							(0.186)
3.qincome#c.dempolity							-0.465**
							(0.184)
10.co#1b.qincome#co.dempolity							0
							(0)
1.co#2.qincome#c.dempolity							0.0892
							(0.218)
1.co#3.qincome#c.dempolity							0.663***
							(0.213)
gend	13.12***	13.00***	12.96***	12.99***	12.99***	12.99***	12.44***
	(0.250)	(0.255)	(0.254)	(0.255)	(0.255)	(0.254)	(0.251)
language							1.168
							(4.275)
geog							0.231
							(0.322)
age30_39	0.405	0.231	0.437	0.224	0.215	0.00724	-0.222
	(0.661)	(0.675)	(0.678)	(0.675)	(0.675)	(0.675)	(0.674)
age40_49	-0.0402	-0.173	0.0888	-0.178	-0.182	-0.283	-0.326
	(0.678)	(0.692)	(0.696)	(0.692)	(0.692)	(0.690)	(0.692)
age50_59	-3.585***	-3.632***	-3.475***	-3.658***	-3.630***	-3.767***	-3.799***
	(0.702)	(0.716)	(0.717)	(0.717)	(0.716)	(0.715)	(0.715)
age60_69	-3.964***	-3.704***	-3.603***	-3.741***	-3.690***	-3.923***	-3.575***
	(0.747)	(0.762)	(0.761)	(0.764)	(0.762)	(0.761)	(0.793)
age70_98	-5.833***	-5.311***	-5.225***	-5.354***	-5.290***	-5.581***	-4.872***
	(0.712)	(0.729)	(0.729)	(0.733)	(0.730)	(0.729)	(0.773)
educ2							1.533***
							(0.405)
educ3							1.399***
							(0.395)

educ4							2.096***
							(0.528)
job1							0.657**
							(0.317)
dempolity_co			-0.242***				
			(0.0827)				
co	0.256	0.287	0.982***	0.296	0.185	0.381	1.116*
	(0.293)	(0.298)	(0.381)	(0.298)	(0.315)	(0.298)	(0.615)
income		0.918***	0.895***	0.861***	0.721***		
		(0.145)	(0.145)	(0.171)	(0.248)		
dempolity_inc				0.0259			
				(0.0415)			
inc_co					0.292		
					(0.298)		
qincome1						-1.954***	
						(0.326)	
qincome2						-2.198***	
						(0.305)	
Constant	166.0***	165.9***	165.1***	165.9***	165.9***	167.6***	162.1***
	(0.599)	(0.615)	(0.661)	(0.616)	(0.620)	(0.642)	(4.394)
Observations	2,726	2,596	2,596	2,596	2,596	2,596	2,572
R-squared	0.569	0.576	0.578	0.576	0.576	0.579	0.584

The complete sets of regressions that look at the effect of years lived under independence are summarised in Table 13. The independence dummy (zero as opposed to at least 1 year spent in an independent country) does not have a significant effect on height in any of the models. A significant positive country effect can be observed only in Models 3 and 7. Similarly to years spend under democracy, the results show that all the generations born before 1973 are significantly shorter than the youngest generation. With increased education, there is a significant positive effect on height, while job is not significant. There is a positive overall income effect on height (Model 2-5), as well as by income terciles where those in the bottom and mid terciles are significantly shorter than people in the top tercile. Only the interaction term between years under independence and country is significant (Model 3) and the three-way interaction between country, independence and income (Model 7). The interaction in Model 3 suggests that for Slovaks, height for those who were raised in independent Slovakia as opposed to Czechoslovakia is 0.8cm more; for Czechs, on the contrary, the height of those raised in independent Czech Republic is 1cm less that for those raised in Czechoslovakia. Another way of interpreting this

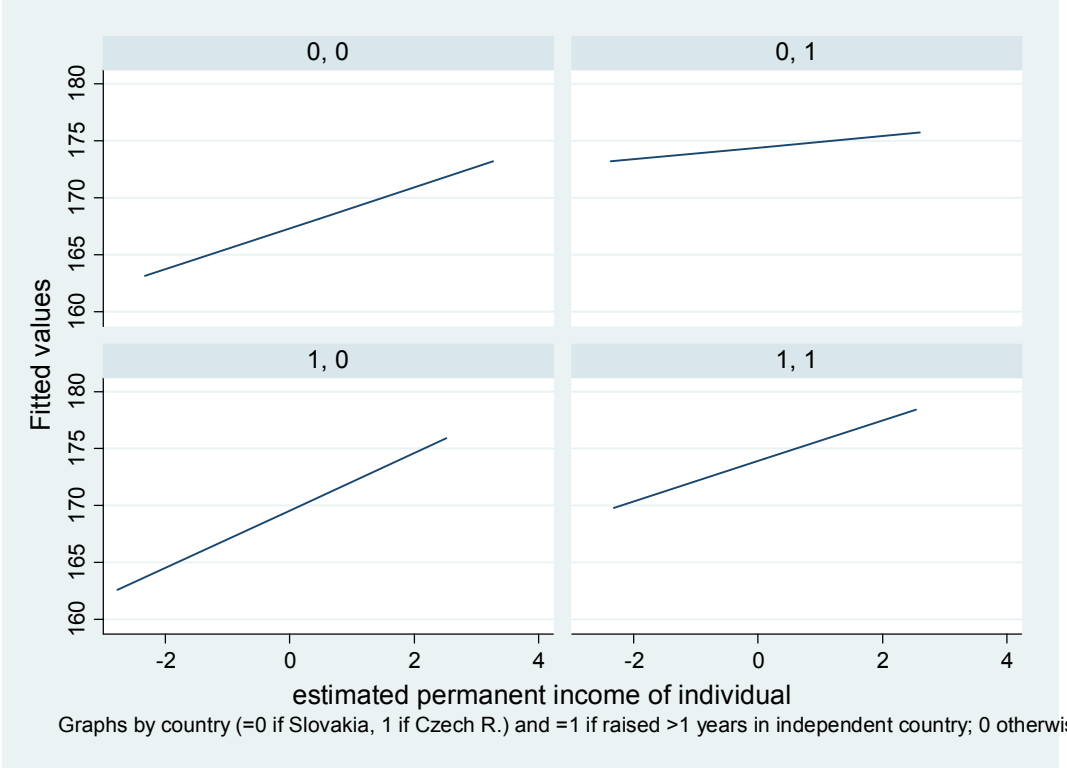
interaction is to say that being raised in Czechoslovakia, height of Czechs was 1.23cm more than the height of Slovaks; for those who grew up in independent countries, height of the Czechs was 0.5cm less than the height of Slovaks. So again, as with democracy, the Czechs seem to have lost out more from independence than Slovaks.

Table 13. OLS regressions of years lived under independence as a dummy variable on height with different controls

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4	(5) Eq.5	(6) Eq.6	(7) Eq.7
indd	-0.0933	-0.520	0.780	-0.394	-0.526	-0.764	0.888
	(0.727)	(0.746)	(0.863)	(0.763)	(0.746)	(0.746)	(0.877)
co	0.393	0.389	1.230***	0.379	0.289	0.481	1.478***
	(0.290)	(0.296)	(0.408)	(0.296)	(0.314)	(0.295)	(0.413)
income		0.944***	0.929***	1.029***	0.750***		0.838**
		(0.145)	(0.145)	(0.181)	(0.248)		(0.367)
indd_co			-1.753***				-1.857***
			(0.587)				(0.642)
indd_inc				-0.237			-1.048**
				(0.302)			(0.502)
inc_co					0.288		0.141
					(0.298)		(0.411)
indd_inc_co							1.279**
							(0.633)
gend	13.19***	13.05***	13.02***	13.05***	13.04***	13.03***	12.60***
	(0.249)	(0.254)	(0.254)	(0.254)	(0.254)	(0.253)	(0.251)
language							0.805
							(4.317)
geog							0.246
							(0.324)
age30_39	-1.521**	-1.709**	-1.553**	-1.690**	-1.733**	-2.052***	-1.726**
	(0.702)	(0.717)	(0.717)	(0.717)	(0.717)	(0.717)	(0.712)
age40_49	-2.021**	-2.237***	-2.017**	-2.224***	-2.256***	-2.503***	-1.950**
	(0.817)	(0.836)	(0.838)	(0.837)	(0.837)	(0.836)	(0.831)
age50_59	-5.583***	-5.699***	-5.599***	-5.655***	-5.706***	-5.990***	-5.465***
	(0.834)	(0.853)	(0.852)	(0.855)	(0.853)	(0.850)	(0.844)
age60_69	-5.967***	-5.769***	-5.735***	-5.708***	-5.765***	-6.148***	-5.341***
	(0.871)	(0.890)	(0.889)	(0.894)	(0.890)	(0.887)	(0.897)
age70_98	-7.848***	-7.384***	-7.368***	-7.315***	-7.373***	-7.815***	-6.634***
	(0.839)	(0.860)	(0.858)	(0.864)	(0.860)	(0.856)	(0.875)
educ2							1.576***
							(0.403)
educ3							1.346***
							(0.392)
educ4							1.962***
							(0.523)
job1							0.349
							(0.314)
qincome1						-2.007***	
						(0.327)	
qincome2						-2.277***	
						(0.305)	
Constant	167.9***	167.8***	167.0***	167.8***	167.9***	169.8***	164.4***
	(0.780)	(0.799)	(0.840)	(0.801)	(0.804)	(0.831)	(4.458)
Observations	2,726	2,596	2,596	2,596	2,596	2,596	2,572
R-squared	0.567	0.575	0.576	0.575	0.575	0.578	0.576

The significant interaction term between country, independence and income suggests that the slopes of height on income are not the same across countries and years under independence (Figure 15). Our calculations and the graphs below suggest that there is a significant difference in slopes of income on height for Slovaks under Czechoslovakia as opposed to an independent Slovakia; the difference is not significant for Czechs. Also, there is a significant difference between Slovaks and Czechs after independence, with a more important gain in height for Czechs as income increases. So once income is interacted with country and independence, the Czechs are benefiting more; when income was not accounted for, the Slovaks seem to have benefited more. The difference in slopes under Czechoslovakia between the Czech and Slovaks was not significant.

Figure 15. Slopes of height on income by country and whether or not the person spent time growing up under independence



Note: Top row represents Slovakia, bottom row Czech Republic.

Results where independence is included as a continuous variable are summarised in Table 14. Again it can be seen that with an additional year spent in independent Slovakia or Czech Republic while growing up there is a significant positive effect on height, contrary to the earlier findings where independence was included as a dummy variable. These results resemble the results for democracy. The effect of the other variables (education, gender, income, income terciles) is still significant in the same direction even though the size of the coefficients differs somewhat. Here again age cohort is only significantly negatively associated with the height of the youngest age cohort for those born before 1953. In other words, there is again no significant difference in height between the youngest generation growing up almost entirely in an independent country and those growing up under Czechoslovakia. The only interactions that are significant are the ones in Models 3 and the three-way interaction in Model 7. The interaction between independence and country in Model 3 shows that with an additional year spent in independent countries while growing up, height increases by 0.4cm for Slovaks and 0.2cm for Czechs. In other words, height is 1cm more for Czechs than Slovaks if a person spent zero years under independence and this difference in height becomes smaller by 0.153 for each additional year under independence (1-0.153*indage). In Model 7 the three-way interaction is significant and the model is also preferred to the model with income only, based on the results of the likelihood ratio test.

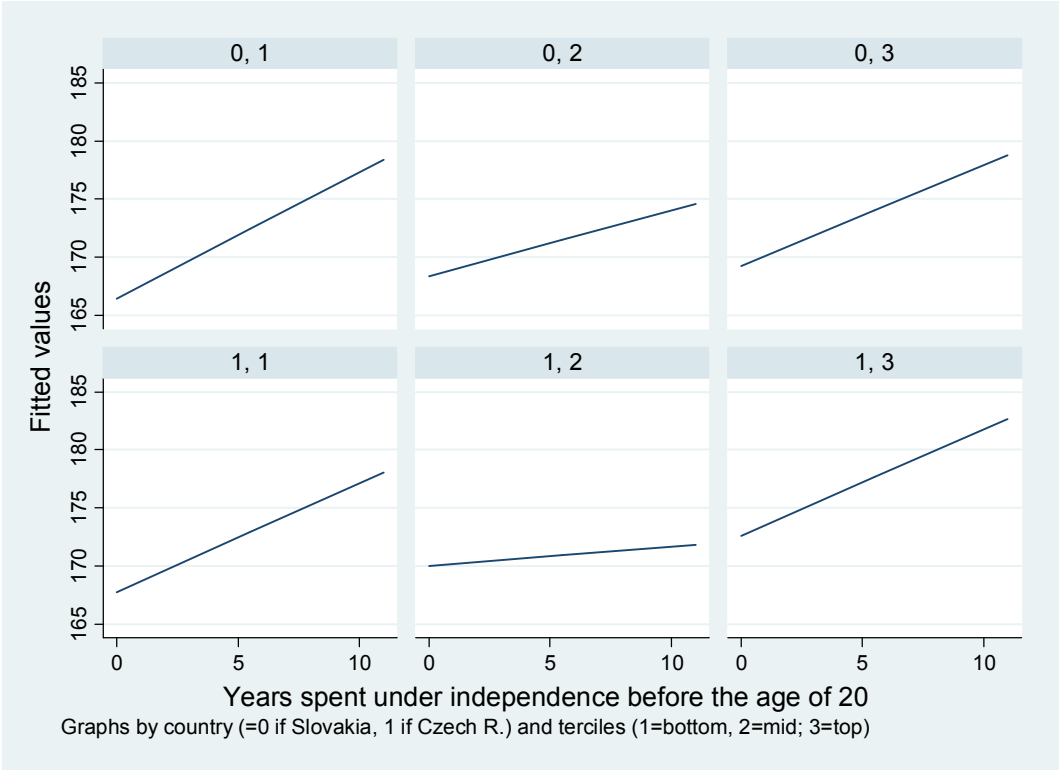
Table 14. OLS regressions of years lived under independence as a continuous variable on height with different controls

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4	(5) Eq.5	(6) Eq.6	(7) Eq.7
indage	0.318***	0.269***	0.345***	0.262***	0.274***	0.257***	0.534***
	(0.0790)	(0.0809)	(0.0882)	(0.0836)	(0.0810)	(0.0807)	(0.137)
1.co#c.indage							-0.314**
							(0.140)
2.qincome							0.439
							(0.805)
3.qincome							1.262
							(0.802)
10.co#1b.qincome							0
							(0)
1.co#2.qincome							-0.00719
							(0.884)
1.co#3.qincome							0.366
							(0.891)
2.qincome#c.indage							-0.352**
							(0.147)
3.qincome#c.indage							-0.368**
							(0.145)
10.co#1b.qincome#co.indage							0
							(0)
1.co#2.qincome#c.indage							0.0109
							(0.186)
1.co#3.qincome#c.indage							0.567***
							(0.180)
gend	13.10***	12.98***	12.96***	12.98***	12.97***	12.97***	12.44***
	(0.249)	(0.255)	(0.254)	(0.255)	(0.255)	(0.254)	(0.251)
geog							0.231
							(0.322)
language							1.169
							(4.274)
age30_39	0.848	0.645	0.509	0.639	0.660	0.426	-0.150
	(0.677)	(0.691)	(0.694)	(0.692)	(0.691)	(0.691)	(0.690)
age40_49	0.429	0.267	0.165	0.262	0.291	0.162	-0.252
	(0.699)	(0.712)	(0.713)	(0.712)	(0.712)	(0.710)	(0.709)
age50_59	-3.149***	-3.223***	-3.400***	-3.238***	-3.187***	-3.352***	-3.727***
	(0.714)	(0.728)	(0.732)	(0.730)	(0.729)	(0.727)	(0.731)
age60_69	-3.545***	-3.312***	-3.530***	-3.332***	-3.263***	-3.525***	-3.503***
	(0.755)	(0.769)	(0.775)	(0.772)	(0.770)	(0.768)	(0.807)
age70_98	-5.415***	-4.922***	-5.152***	-4.945***	-4.864***	-5.185***	-4.800***
	(0.720)	(0.736)	(0.743)	(0.740)	(0.738)	(0.735)	(0.787)
educ2							1.535***
							(0.405)
educ3							1.396***
							(0.395)
educ4							2.095***
							(0.528)
job1							0.655**
							(0.317)
ind_co			-0.153**				
			(0.0711)				
co	0.483*	0.481	1.001***	0.485	0.364	0.565*	1.157*

	(0.290)	(0.297)	(0.382)	(0.297)	(0.314)	(0.296)	(0.617)
income		0.908***	0.895***	0.880***	0.675***		
		(0.145)	(0.145)	(0.172)	(0.248)		
ind_inc				0.0109			
				(0.0375)			
inc_co					0.343		
					(0.298)		
qincome1						-1.930***	
						(0.326)	
qincome2						-2.182***	
						(0.304)	
Constant	165.4***	165.3***	165.0***	165.3***	165.4***	167.0***	162.0***
	(0.659)	(0.675)	(0.685)	(0.677)	(0.678)	(0.704)	(4.398)
Observations	2,726	2,596	2,596	2,596	2,596	2,596	2,572
R-squared	0.570	0.577	0.578	0.577	0.577	0.580	0.584

The fact that the interaction term between country, years under independence and income terciles is significant, suggests that the slopes of height on years under independence are not the same across countries and terciles (Figure 16 below). Again, several different comparisons can be made across the slopes. The analysis and the graphs show that for Slovaks, there is a significant difference of years under independence on height between the poorest and the mid and top terciles. For Czechs, there is a significant difference between the poorest and the middle tercile, as well as the middle and the top, but the poorest and the top tercile is only significant at 10%. When Czechs and Slovaks are compared by each income tercile, the slopes are significantly different in all cases, with the Slovaks having a steeper slope except in the top tercile where Czech gain more in height with increasing years of independence.

Figure 16. Slopes of height on years under independence in Czech Republic and Slovakia across income terciles



When the regression is decomposed by sex, similarly to the case of democracy, the effects are quite different for men and women (Table 15 and 16). For males, years under independence is significantly associated with a height increase in all the models. The country effect shows that the Czech males are significantly shorter than Slovak males, except in Model 4. A large positive significant income effect both as a continuous variable and when included in terciles can be noted. There is also an education and job effect where those who are employed and have completed more years of education are significantly taller than the unemployed and with only primary education or less. Again, the results for the birth cohorts have changed where it can be seen that the two birth cohorts born between 1954-1963 and 1964-1973 are significantly taller than the youngest birth cohort used as the reference category. On the other hand, the oldest birth cohort is significantly shorter than the youngest cohort.

Table 15. OLS regressions of years lived under independence on height with different controls – male

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4
Indage	0.550***	0.418***	0.402***	0.382***
	(0.137)	(0.138)	(0.137)	(0.147)
Co	-1.489***	-1.694***	-1.558***	-0.773
	(0.539)	(0.537)	(0.531)	(0.541)
Income		1.946***		1.721***
		(0.250)		(0.251)
Geog				0.647
				(0.597)
Language				6.571
				(7.369)
age30_39	3.626***	3.426***	3.262***	2.517**
	(1.236)	(1.237)	(1.227)	(1.226)
age40_49	3.542***	2.825**	2.614**	2.573**
	(1.257)	(1.257)	(1.245)	(1.264)
age50_59	-2.151*	-2.441*	-2.565**	-2.788**
	(1.301)	(1.299)	(1.298)	(1.321)
age60_69	-1.722	-1.561	-1.950	-1.427
	(1.417)	(1.418)	(1.410)	(1.511)
age70_98	-4.506***	-3.747***	-4.018***	-3.011**
	(1.281)	(1.280)	(1.271)	(1.424)
educ2				2.272***
				(0.751)
educ3				1.403*
				(0.719)
educ4				2.566***
				(0.903)
job1				1.247**
				(0.576)
qincome1			-4.716***	
			(0.552)	
qincome2			-3.665***	
			(0.510)	
Constant	178.0***	177.9***	181.3***	167.9***
	(1.191)	(1.200)	(1.244)	(7.527)
Observations	1,025	976	976	967
R-squared	0.225	0.269	0.286	0.264

Finally, for women, years spent under independence is not significantly associated with a height increase in any of the models while a significant positive country effect with Czech women being taller than Slovak women in all models can be observed. There is again a significant education effect while job is not significant for females. Income is not significantly associated with height only when it is included as income terciles where the women in the middle tercile are significantly shorter than the top tercile. The effect of the birth cohort is the same as in the aggregate model where all the cohorts are significantly shorter than the youngest cohort.

Table 16. OLS regressions of years lived under independence on height with different controls – female

VARIABLES	(1) Eq.1	(2) Eq.2	(3) Eq.3	(4) Eq.4
Indage	0.0772	0.0645	0.0767	0.0804
	(0.0919)	(0.0948)	(0.0945)	(0.0986)
Co	1.723***	1.808***	1.891***	2.101***
	(0.319)	(0.330)	(0.330)	(0.343)
Income		0.101		0.0105
		(0.167)		(0.170)
Geog				0.0277
				(0.360)
Language				-2.035
				(5.030)
age30_39	-1.323*	-1.414*	-1.497*	-1.425*
	(0.752)	(0.772)	(0.771)	(0.793)
age40_49	-1.920**	-1.893**	-1.791**	-1.693**
	(0.783)	(0.804)	(0.802)	(0.833)
age50_59	-4.169***	-4.346***	-4.364***	-4.111***
	(0.794)	(0.815)	(0.812)	(0.838)
age60_69	-5.287***	-5.310***	-5.490***	-5.052***
	(0.826)	(0.847)	(0.845)	(0.907)
age70_98	-5.989***	-5.975***	-6.269***	-5.469***
	(0.815)	(0.840)	(0.837)	(0.906)
educ2				0.892**
				(0.453)
educ3				1.707***
				(0.438)
educ4				1.850***
				(0.633)
job1				-0.183
				(0.369)
qincome1			0.403	
			(0.381)	
qincome2			-0.787**	
			(0.363)	
Constant	166.2***	166.2***	166.3***	166.8***
	(0.733)	(0.756)	(0.782)	(5.136)
Observations	1,701	1,620	1,620	1,605
R-squared	0.131	0.133	0.139	0.141

Robustness checks

Two main robustness checks are carried out. First, a reduced sample excluding individuals who are over the age of 50 was analysed as at older ages people's height begins to shrink. As a result the coefficients obtained may have been overestimated. The older individuals are also those who grew up their entire childhood and youth under communism. This double effect may have been biasing the results. The results show that with every additional year growing up under democracy there is a small

associated height increase, even when the older tail of the sample is excluded (Table 17). With every additional year growing up under democracy, there is between a 0.17 and 0.37cm height increase. As expected, the coefficients are somewhat lower in this analysis. Furthermore confirming our earlier results, while there is a small height increase with every additional year spent under democracy, there is no significant height difference between the youngest age cohort and the two oldest cohorts. The significance of all the other results is consistent with the main results and the magnitude is only slightly different.

Table 17. OLS regressions of years lived under democracy as a continuous variable on height with different controls – individuals aged 50 and less

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Eq.1	Eq.2	Eq.3	Eq.4	Eq.5	Eq.6	Eq.7
demage	0.171***	0.199***	0.285***	0.207***	0.204***	0.174**	0.356***
	(0.0294)	(0.0762)	(0.0828)	(0.0781)	(0.0762)	(0.0757)	(0.123)
1.co#c.demage							-0.295**
							(0.125)
2.qincome							-0.497
							(1.065)
3.qincome							0.822
							(1.023)
1o.co#1b.qincome							0
							(0)
1.co#2.qincome							-0.446
							(1.255)
1.co#3.qincome							0.0390
							(1.218)
2.qincome#c.demage							-0.188
							(0.127)
3.qincome#c.demage							-0.233*
							(0.123)
1o.co#1b.qincome#co.demage							0
							(0)
1.co#2.qincome#c.demage							0.0854
							(0.163)
1.co#3.qincome#c.demage							0.397**
							(0.156)
gend	14.20***	14.09***	14.04***	14.10***	14.08***	14.13***	13.53***
	(0.307)	(0.315)	(0.315)	(0.315)	(0.315)	(0.312)	(0.311)
language							1.019

							(4.268)
geog							0.580
							(0.406)
age30_39		0.717	0.563	0.727	0.744	0.294	-0.283
		(0.780)	(0.781)	(0.781)	(0.780)	(0.778)	(0.780)
age40_49		0.478	0.348	0.488	0.517	0.257	-0.236
		(0.883)	(0.882)	(0.883)	(0.882)	(0.877)	(0.886)
educ2							1.097*
							(0.614)
educ3							1.033*
							(0.601)
educ4							1.323*
							(0.764)
job1							0.578
							(0.373)
dem_co			-0.160***				
			(0.0608)				
co	0.266	0.298	1.282**	0.291	0.0177	0.385	1.657*
	(0.323)	(0.333)	(0.500)	(0.333)	(0.370)	(0.330)	(0.946)
income		0.884***	0.872***	0.964***	0.521*		
		(0.171)	(0.171)	(0.237)	(0.272)		
dem_inc				-0.0156			
				(0.0320)			
inc_co					0.599*		
					(0.349)		
qincome1						-1.203***	
						(0.400)	
qincome2						-2.641***	
						(0.350)	
Constant	165.6***	164.7***	164.2***	164.7***	164.9***	166.6***	162.2***
	(0.333)	(0.862)	(0.884)	(0.866)	(0.866)	(0.892)	(4.504)
Observations	1,917	1,816	1,816	1,816	1,816	1,816	1,805
R-squared	0.551	0.556	0.558	0.556	0.557	0.563	0.564

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Data from the 2005 Eurobarometer survey (Eurobarometer 64.3: Foreign Languages, Biotechnology, Organized Crime, and Health Items, November - December, 2005) was used to see whether the results show largely similar effects (See Appendix B). The Eurobarometer (EB) survey is a series of cross-national and cross-temporal comparative social science research that started in the early seventies. Representative national samples are interviewed in the European Union member states twice a year. The goal of the EB is to provide data for monitoring of public social and political attitudes in the European Union[13] (Economic and Social Data Service, 2005). This round of the EB survey asked respondents on foreign languages, biotechnology,

[13] For more information see the Leibniz Institute for the Social Sciences, Data Archive for the Social Sciences (GESIS) Eurobarometer Survey Series web pages.

organised crime and corruption, health consciousness, smoking, AIDS prevention, medical errors, and consumer rights. For the purpose of the analysis, the relevant data came from the demographic and other background information section, including the respondents' self-reported height, age, gender, occupation and urban/rural residence. The variables included are similar to the variables used in the analysis; however there was no data that would allow for a better proxy of income or wealth of the individuals. As a result, only the results from the basic model (Model 1) will be compared. Descriptive statistics can be found in Appendix B. Below the main results are summarised.

In the model where democracy is included as a dummy variable again no significant relationship was identified. In this model gender has a strong significant relationship just like with the WHS data. Contrary to the WHS results, there is a positive significant relationship for country in all the models, suggesting that the Czechs are taller than the Slovaks. When democracy is included as a continuous variable, there is again a positive significant association with height for every additional year lived under democracy. Confirming the main results, the age cohort effect is again only significant for the older generations starting for individuals born before 1955. Results were different in the analysis by gender where a significant height increase can be observed for women rather than men. When independence is examined, results follow the same pattern as for democracy with respect to the WHS results. Overall, the minor difference, especially the gender and the country effect, is likely to be explained by the difference in samples resulting from a different sampling method used by the EB survey where either multi-stage national probability samples or national stratified quota samples are implemented, as opposed to stratified random sampling in the WHS.

2.4. Discussion and conclusion

This chapter has looked at the changes in stature of the Czech and Slovak population after two important political, social, economic and institutional changes of the twentieth century Eastern Europe - the 1989 transition from the communist regime to democracy, and disintegration of Czechoslovakia in 1993 into two independent countries. Changes in height by gender groups were also examined. Overall, there results suggest that while there has been a significant height increase for every additional year spent under democracy (0.2-0.4cm; 0.18-0.36cm for sample younger than 50 to account for shrinkage) or as independent countries, this increase cannot be clearly attributed to the transition but rather to potential secular trends in height. Especially, as all those who grew up under democracy fall into the youngest age cohort and there was no significant difference in height between these individuals and the following two older age cohorts who grew up almost entirely under communism. So even though it cannot be inferred that political and economic liberalisation were directly beneficial, as perhaps shown in other studies in East and West Germany, and Spain among others (Costa-Font & Gil, 2008; Hiermeyer, 2008; Komlos & Kriwy, 2002; Komlos & Snowdon, 2005), the results suggest that the transition period did not have a detrimental effect on health and standard of living as heights have continued to increase in both countries. Given the difficulty of disentangling the effects of transition to democracy and the break up, the remaining of the discussion focuses on the results for democracy; results for independence were very similar. Most of the findings hold even when democracy is adjusted with the Polity IV index or the analysis is carried out with a different data set (Eurobarometer).

Even though Slovakia was under authoritarian rule in the initial years of democracy, the effect on height was still positive. The lack of significance when democracy was included as a dummy variable demonstrates that the height difference between those individuals who grew up entirely under communism and those who grew up between 1 to 14 years under democracy is not important. Despite the existing evidence of an initial deterioration in the standard of living in the transition countries (Leff, 1996; Milanovic, 1998), our results demonstrate that starting from 1990 there continues to be a small positive effect on well-being as measured by an increase in height.

Consistent with other studies in the region (Vignerová, Brabec, & Bláha, 2006) height also increased across the generations from the oldest to the youngest birth cohort, where older generations are shorter than the younger generations in both countries. In other words, over the course of the twentieth century, people have become on average taller. The effect is strongest for the birth cohorts born before 1953 where individuals are significantly shorter, suggesting that the inter-war period and the first decade after World War II had the strong negative effect on adult stature, consistent with the findings of other studies (Hatton, 2013).

When examining the results by income terciles height increases from the poorest to the richest tercile, for both men and women, implying that similarly to Germany (Komlos & Kriwy, 2003), social differences in height exist in both the Czech Republic and Slovakia. These findings are also consistent with the extensive evidence suggesting that inequalities were present already under communism and continued to widen in both countries after 1989 (Cox & Mason, 1999; Milanovic, 1998; Simai, 2006; Szamuely, 1996). There is also a significant education and gender effect. The level of education achieved is an important determinant of the individual's height. It is important to note that most of the height literature focuses on parental education as a key determinant (Christiaensen & Alderman, 2004; Fedorov & Sahn, 2005) so

the education of the individual in this context was a proxy for the individual's capabilities and the importance of schooling on health behaviour (Costa-Font & Gil, 2008; Donald S. Kenkel, 1991). There is no consistent country effect across the models.

The statistically significant interaction between country and years spent under democracy implies that the democracy effect was not the same in the two countries. While the Czechs are on average taller, the Slovaks seemed to have benefited more from the transition to democracy. This result confirms the general hypothesis that the one performing worse has a bigger capacity to benefit. Slovakia was the poorer federation during communism and also had a rougher transition in the initial years under authoritarian rule (Meszaros, 1999). Nevertheless, the Slovaks seem to have benefited from this transition more than the Czechs, which over years has brought an increase in their well-being and standard of living as measured by height.

The other interaction term between country, years spent under democracy and permanent income was also significant. The significance of this term and consequently the study of the different slopes imply that the years spent under democracy had a different effect on height depending on the country and income tercile. When comparing across countries, the Slovaks benefited more than the Czechs in the bottom and mid tercile with no difference in the top group. Furthermore, with increasing number of years under democracy the poorest in Slovakia benefited more in height than both the mid and top tercile. In the Czech Republic, the bottom tercile benefited more than the middle, and the middle less than the top tercile. As noted above, evidence of inequalities and poverty since transition has been documented. The transition brought along significant social changes where particular groups benefited – especially those who were benefiting under the previous regime – while others such as pensioners, workers, ethnic groups or women were

able to benefit much less; the cost of transition weighed most heavily on ordinary citizens who felt that they had too little influence on the political decisions that affected them (Leff, 1996; Simai, 2006). While the transition years may have impacted negatively on the most disadvantaged, they were still able to benefit in terms height, and more so than the richer groups.

The analysis revealed interesting findings when carried out separately for women and men. For men, the years spent growing up under democracy are significantly positively associated with height, even after controlling for different factors; for women there is no significant effect. The lack of a significant democracy effect for women actually suggests that the institutional and environmental effects during the transition did not bring substantial improvements for women compared to their position in the society under communism; in fact, women felt the erosion of their economic position after the transition with unemployment disproportionately affecting the females (Leff, 1996). Finally, education was an important determinant for both males and females, while income and employment are only significant for men.

There are several limitations to this study. First, the low response rate in the WHS data used for the Czech population may have introduced bias in the results, as non-response bias where responders may be significantly different from responders, is difficult to account for. At the same time, there may be small number bias (especially for some age cohorts) which could have affected the significance of the results. However, findings using the Eurobarometer data are largely consistent with the key findings and therefore mitigate this problem to some extent. Second, as has already been discussed earlier, using self-reported height allows for reporting bias. Overestimation of height may vary with a person's age and gender (Cavelaars et al., 2000; Ezzati, Martin, Skjold, Hoorn, & Murray, 2006; Giles & Hutchinson, 1991; Hill

& Roberts, 1998). In general, height is overestimated by both men and women, but especially by shorter individuals, men, heavier women and the error in reported height increases with age (Spencer, Appleby, Davey et al., 2002). There have been a range of studies examining the accuracy of self-reported height with varying conclusions; there seems to be wide individual variation between reported and measured heights in both sexes which makes it essential that heights are accurately measured in clinical practice and recorded (Cizmecioglu, Doherty, Paterson et al., 2005). Despite the potential for reporting error, the sample was not corrected for as precise information on the magnitude of the bias was not available, similarly to earlier studies (Costa-Font & Gil, 2008). In future studies, measured height should be used rather than self-reported height where possible. Third, accounting for shrinkage in the sensitivity analysis showed that while results were fully consistent with main results, the coefficients were somewhat overestimated. Therefore, future analysis should appropriately adjust for shrinkage in all the analysis. Fourth, as has already been mentioned, it was not possible to disentangle the effects of the 1989 transition to democracy and the 1993 disintegration of Czechoslovakia, even though both appeared to have a positive effect on stature. Finally, it is possible that any positive or negative effect from the political change came with a several years delay, and accounting for this lag in future analysis may result in somewhat different findings.

Chapter 3. Using 'avoidable' mortality to measure health care performance in the Czech Republic and Slovakia between 1971 and 2008

3.1. Introduction

The findings of Chapter 2 revealed that overall both Czech and Slovaks have benefited from the transition as their health and well-being has reflected in a height gain. However, this indicator, similarly to other health outcome indicators discussed in Chapter 1 captures country health system performance broadly, rather than the contribution of the health care system. As has been noted already, the effect of the regime change in 1989 and the breakup of Czechoslovakia in 1993 have been studied from numerous perspectives, including changes in the health status of the population and health outcomes (Bauer & Charlton, 1986; Bobak & Feachem, 1992; Bobak, Skodova, Pisa, et al., 1997; Ginter, 1996, 1998; Institute of Health Information and Statistics Czech Republic, 2006; Nemec & Lawson, 2005). However, most of this research uses standard health outcome indicators such as life expectancy at birth, infant mortality or overall mortality rates which suffer from the difficulty of attributing any improvements to health care system activities directly (Smith, Mossialos, Papanicolas, et al., 2009). Little research (Blazek & Dzurova, 2000; Burcin, 2009; Burcin & Kucera, 2008) has been carried out evaluating the quality and performance of the Czech and Slovak health care systems post 1989 and 1993 attempting to isolate the influence of other determinants such as socio-economic development or environmental changes. Therefore, this chapter applies the indicator of 'avoidable' mortality, which captures premature deaths for certain conditions that are considered to be largely avoidable if timely and effective health care is provided (Holland, 1988; Nolte & McKee, 2004) and where the role of other mortality

determinants are considered to be minor. While not all deaths can be avoided, the contribution of health services may avert a substantial proportion of deaths for the selected conditions.

As Chapter 1 has shown, only a handful of aggregate level studies have focused on 'avoidable' mortality in Eastern Europe for different periods between the 1950s and 1990s and have produced mixed results with regards to trends and rates of changes in 'avoidable' and non-avoidable mortality (Boys, Forster, & Jozan, 1991; Gaizauskiene & Gurevicius, 1995; Nolte, Scholz, Shkolnikov, et al., 2002; Treurniet, Boshuizen, & Harteloh, 2004). These mixed results suggest different patterns in health care improvements in different countries but may also be due to the application of different methods (e.g. conditions included, age limits and time periods studied). Moreover, three studies (Burcin, 2009; Burcin & Kucera, 2008; Jozan & Prokhorskas, 1997) analysed 'avoidable' mortality by separate conditions in both the Czech and the Slovak Republic at the regional level and one study only in Czech Republic at the aggregate level (Blazek & Dzurova, 2000), but neither has carried out a comparative analysis before and after the fall of the Communist regime and separation.

In this chapter the indicators of 'avoidable' mortality are used to assess the performance of the Czech and Slovak health care systems before (1971 – 1989) and after (1989 – 2008) the fall of the Communist regime. The aim is to find out how the countries' health care systems perform relative to each other in the latter period during which Czechoslovakia also split (1993) into two countries where each began to implement their own health policies and reforms likely to have influenced the performance of their health systems. To do so, national level mortality trends from a number of individual 'avoidable' causes of death in the two countries are examined, as well as trends of all 'avoidable' causes together compared to mortality from all the

other causes (also referred to as non-avoidable mortality). It is important to note that any observed trends in these two large groups of diseases are highly dependent on the selection of 'avoidable' causes of death. For the period from 1996-2007, regional variations in mortality from selected 'avoidable' causes are also examined.

3.2. Data and methods

Raw mortality data classified by individual or small groups of diagnosis and age groups from 1971 – 2008 were obtained from the Statistical Office of the Slovak Republic and the Czech Statistical Office. Data for the early years (1971-1993) were not available electronically and had to be manually collected from annual mortality reports archived by the Statistical Office of the Slovak Republic in Bratislava, Slovakia. This process involved several visits (between November 2008 and May 2010) to the Archive of the Statistical Office. Raw mortality data for these years were then transcribed and merged with mortality data available in electronic form.

For both countries deaths are classified according to the 8th , 9th and 10th revisions of the International Classification of Diseases (ICD-8, ICD-9, ICD-10) between 1971-1978, 1979-1993 and revision 1994-2008 respectively. 'Avoidable' causes of deaths within defined age groups have been selected based on the third edition of the EC Atlas of Avoidable Mortality (Holland, 1997), which defines 'avoidable deaths' as "deaths from specific diseases (within selected age groups) for which mortality should be wholly or substantially avoidable when appropriate medical care is sought and provided in good time". The general principle underlying the choice of each disease group applied in the EC Atlas was that each should have identifiable health care providers and effective interventions necessary to reduce mortality. The EC Atlas list of conditions has been widely accepted and applied in many country studies to monitor the performance of the health care system (Alfonso Sanchez, Sanchis

Noguera, del Bano, et al., 1993; Barry, 1992; Kunst, Looman, & Mackenbach, 1988; Westerling & Smedby, 1992). The same list was also applied in another Atlas that focused on Eastern European countries including the Czech Republic and Slovakia between 1985-89 (Jozan & Prokhorskas, 1997). Using an extended list of conditions that other researchers have suggested without a more in depth analysis of its applicability to the Czech and Slovak context was not considered appropriate. Furthermore, it was important to study only those conditions that have been included as 'avoidable' for the entire period under study.

The upper age limit was set at 64 years. While recent studies (Burcin, 2009; Gispert, Serra, Bares et al., 2008; Korda & Butler, 2006; Newey, Nolte, McKee et al., 2004; Nolte & McKee, 2004; Tobias & Jackson, 2001) have increased the age limit to 74 years due to increased life-expectancy, setting a stricter age limit for every diagnosis should enhance the validity of mortality as an indicator of health service outcome. Especially, since avoidability of a death for an older person becomes more controversial due to frequent comorbidities and cause-of-death certification increasingly questionable at older ages (Logminiene, Nolte, McKee et al., 2004). In fact, recent studies also chose to restrict their analysis to tighter age limits (James, Manuel, & Mao, 2006).

Seventeen conditions from which deaths are considered to be 'avoidable' by timely and effective health care services are selected. 'Health care services' are defined to include primary care, hospital care and collective health services such as screening and public health programmes, e.g. immunisation (Holland, 1997). Conditions whose control depends on primary prevention or health policies which are outside the direct control of health services, such as lung cancer or motor vehicle accidents are not included in our list. Also, it is important to note that the degree to which timely and effective health care service effect mortality from these conditions differs;

for some conditions, such as hypertensive & cerebrovascular diseases or ischaemic diseases other, non-health system factors are likely to play a much more important role than for appendicitis. Table 18 highlights the list of 'avoidable' conditions with the corresponding age limit.

Table 18. 'Avoidable' causes of death selected for analysis

Name of group	Age	ICD-8	ICD-9	ICD-10
Tuberculosis	5-64	010-019	010-018, 137	A15-A19, B90
Cancer of breast	25-64	174	174	C50
Malignant neoplasm of cervix uteri	15-64	180	180	C53
Malignant neoplasm of cervix uteri and body of uterus	15-54	180, 182	180, 179,182	C53, C54,55
Hodgkin's disease	5-64	201	201	C81
Chronic rheumatic heart disease	5-44	393-398	393-398	I05-I09
Hypertensive & cerebrovascular diseases	35-64	400-404, 430-438	401-405, 430-438	I10-I13, I15; I60-I69
Ischaemic heart disease	35-64	410-414	410-414	I20-I25
All respiratory diseases	1-14	460-519	460-519	J00-J99
Asthma	5-44	493	493	J45-J46
Peptic ulcers	25-64	531-533	531-533	K25-K27
Appendicitis	5-64	540-543	540-543	K35-K38
Abdominal hernia	5-64	550-553	550-553	K40-K46
Cholelithiasis and cholecystitis	5-64	574-575	574-575	K80-K81
Maternal mortality	All	630-678	630-676	O00-O99
Perinatal mortality	<1 week + still births	760-779	760-779	P00-P96
Total 'avoidable' deaths	0-64			

Source: Based on Holland, 1997

Age-standardised mortality rates (per 100,000 population) for all the 'avoidable' mortality causes separately have been calculated for both countries from 1971-2008 and all the regions from 1996-2007 by indirect standardisation to the total "Czechoslovakia" standard population. Perinatal mortality has been calculated per 1,000 total births (live and still births) and maternal mortality per 100,000 live births. Calculations were always confined to the appropriate age category. Perinatal

mortality rates were not standardised and deaths for gender- specific conditions (e.g. malignant neoplasm of cervix uteri) were age-standardised to the female population. Also, the analysis has been combined for the two sexes since avoidability of death should not depend on gender (Holland, 1997).

The regional maps show standardised mortality ratios (SMRs) representing the percentage ratio of the number of deaths observed in a particular region to the number expected from the total "Czechoslovakia" standard age-specific death rate between 1996 and 2007; analysis is restricted to this period due to data availability at the regional level. Standardised mortality ratio for all of "Czechoslovakia" is equal to one hundred so the SMR for a region indicates the extent to which that area differs from the "Czechoslovakia" average. Perinatal SMR is the percentage ratio of the crude perinatal death rate in the area studied to the crude perinatal death rate in the reference population.

Overall, trends and maps for conditions with only a few deaths in the age range studied (e.g. chronic rheumatic heart disease, asthma, appendicitis, maternal deaths etc.) should be interpreted with caution due to the small number problem. The observed results are variable and a small difference between the number of deaths which occur and the expected number based on standard age-specific rates may yield extreme SMRs (Holland, 1997).

3.3. Results

Between 1971-2008 age-standardised mortality from 'avoidable' causes decreased in both the Czech Republic and Slovakia (by 62% and 39% respectively) by more than mortality from other causes (15% and 0.7% respectively) (Figure 17). During this period, 'avoidable' deaths accounted on average for 35% and 34% of total deaths in

the age group of 0-64 years in the Czech Republic and Slovakia respectively. While in 1971 'avoidable' deaths accounted for as much as 41% (15,586 out of 38,448) and 39% (6,109 out of 15,797) in the Czech Republic and Slovakia respectively, in 2008 it was only 24% (6,234 out of 26,185) and 27% (4,287 out of 15,663). Throughout the entire period, mortality from other causes is higher than 'avoidable' mortality in both countries and Slovakia is lagging behind the Czech Republic. However, for 'avoidable' mortality Slovakia performs better during the initial years, then the two countries have a period with similar rates and from the early 90s, after the change of the regime and separation of the countries, the rates begin to diverge with Slovakia lagging behind, mainly due to higher rates of ischaemic heart disease and hypertension & cerebrovascular disease mortality.

Figure 17. Mortality from 'avoidable' and non-avoidable causes in the Czech Republic and Slovakia, 0-64 years

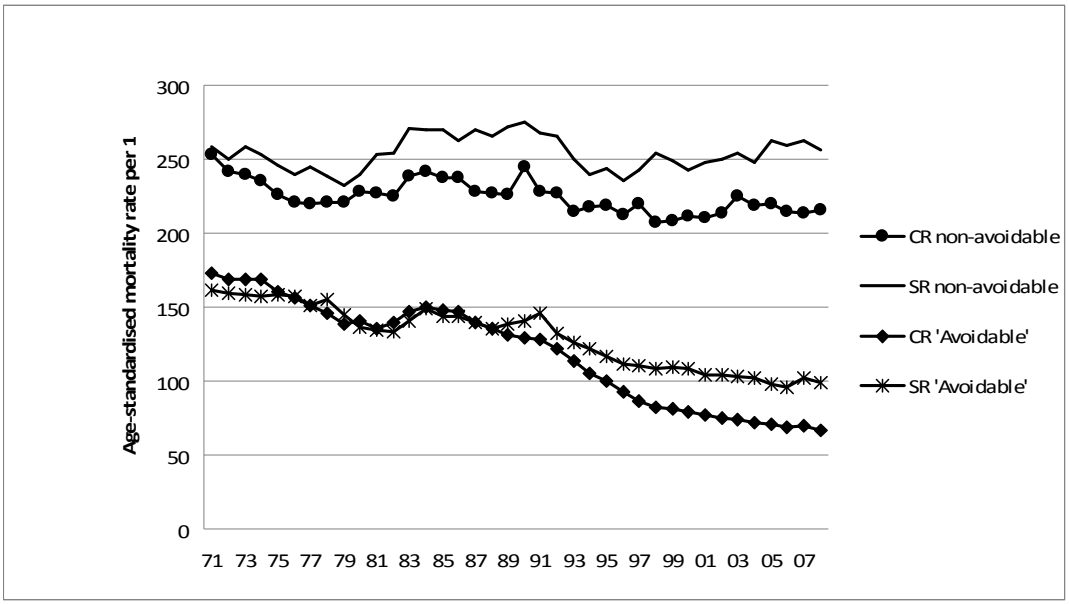
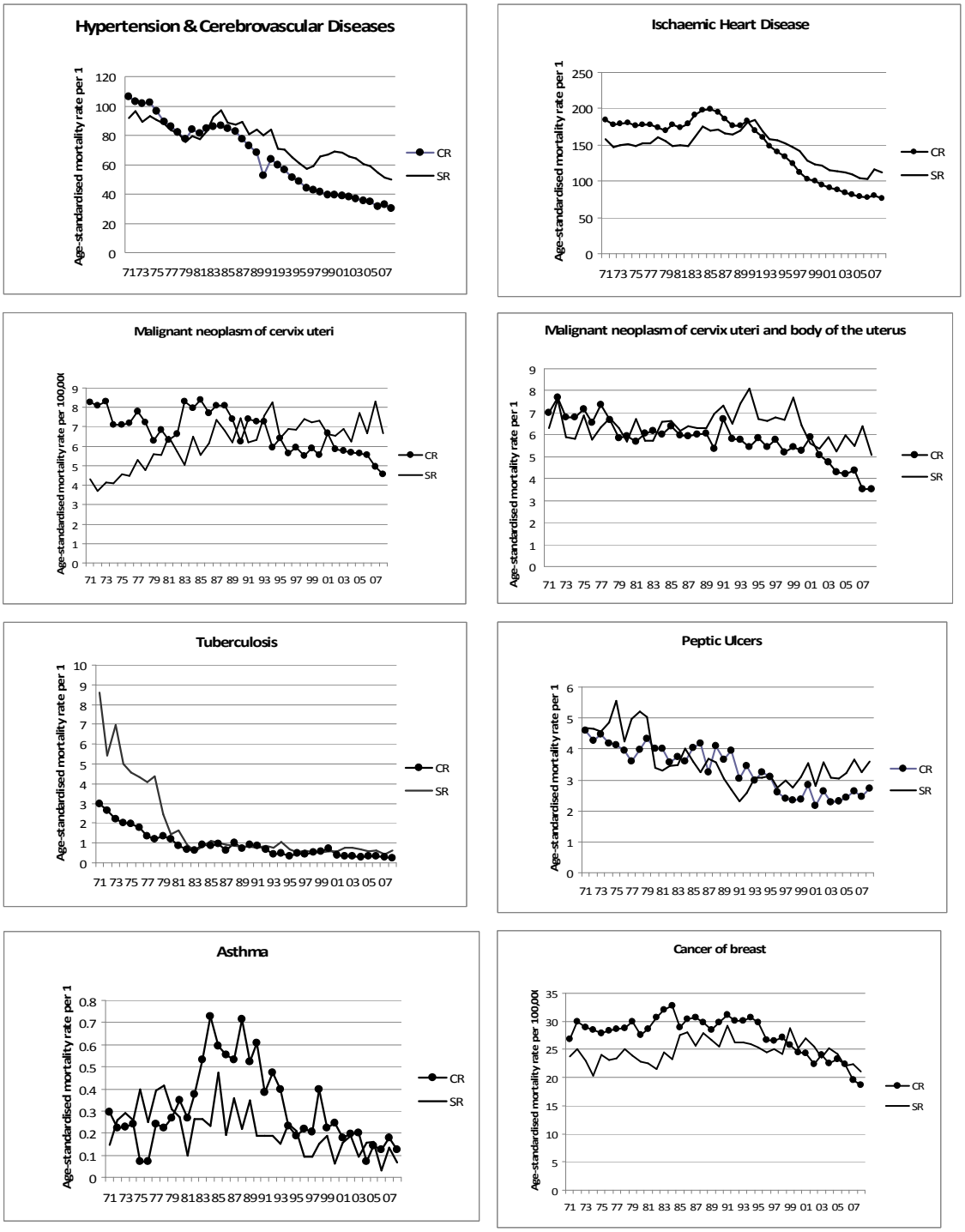


Figure 18 shows the group of conditions for which community public health action or primary care is considered to be most important in preventing unnecessary deaths. The two countries often began with different mortality rates in 1971 with starting rates also varying greatly by condition, from 0.1 deaths per 100,000 for asthma in

Slovakia to 184.4 deaths per 100,000 for ischaemic heart disease in the Czech Republic (Table 19). When looking more in-depth at individual conditions, mortality from cancer of breast and ischaemic heart disease appear to follow similar trends, where most of the decline in both countries occurred between 1989 and 2008, while between 1971 and 1989 there is an actual increase in deaths per 100,000 (Table 19). For both conditions, Slovakia performs better at first while in the second period it begins to lag behind the Czech Republic.

Mortality from malignant neoplasm of cervix and body of uterus in Slovakia improved only slightly over the entire period and somewhat more after 1989 (from 6.3 to 5.1 deaths per 100,000). On the other hand, in the Czech Republic a gradual and continuous decline can be observed by an overall 13% (from 7 to 6.1 deaths per 100,000) before 1989 and between 1990-2008 an additional decline of 34.6% (from 6.1 to 3.5 deaths per 100,000). In the case of tuberculosis, the most significant decline can be observed during the first period (1971-1989) in both countries, with Slovakia performing worse but closing the gap by the early 80s; between 1990 and 2008 mortality further declined by 72.5% in the Czech Republic. While mortality for peptic ulcer has been declining between 1971 and 1989 in both countries, after 1989 it continued to decline only in the Czech Republic and began to increase in Slovakia (Figure 18 and Table 19).

Figure 18. Mortality from selected 'avoidable' causes where public health programmes or primary care are most important



Maps in Figure 19 show that for the same conditions there are important regional variations. The extent to which individual regions differ from the "Czechoslovakia" standard (equal to 100) can be observed. For example, for cerebrovascular & hypertensive diseases as well as malignant neoplasm of cervix uteri and body of

uterus, regions in Slovakia are performing worse than those in Czech Republic. On the other hand, for asthma Slovakia performs better, even though the overall national age-standardised mortality rate is only 0.17 deaths per 100,000. Regions that show the worse performance for a number of conditions are Karlovarsky and Ustecky in the Czech Republic while in Slovakia the result differs across conditions.

Figure 19. Regional SMRs from selected 'avoidable' causes where public health programmes or primary care are most important, 1996 to 2007

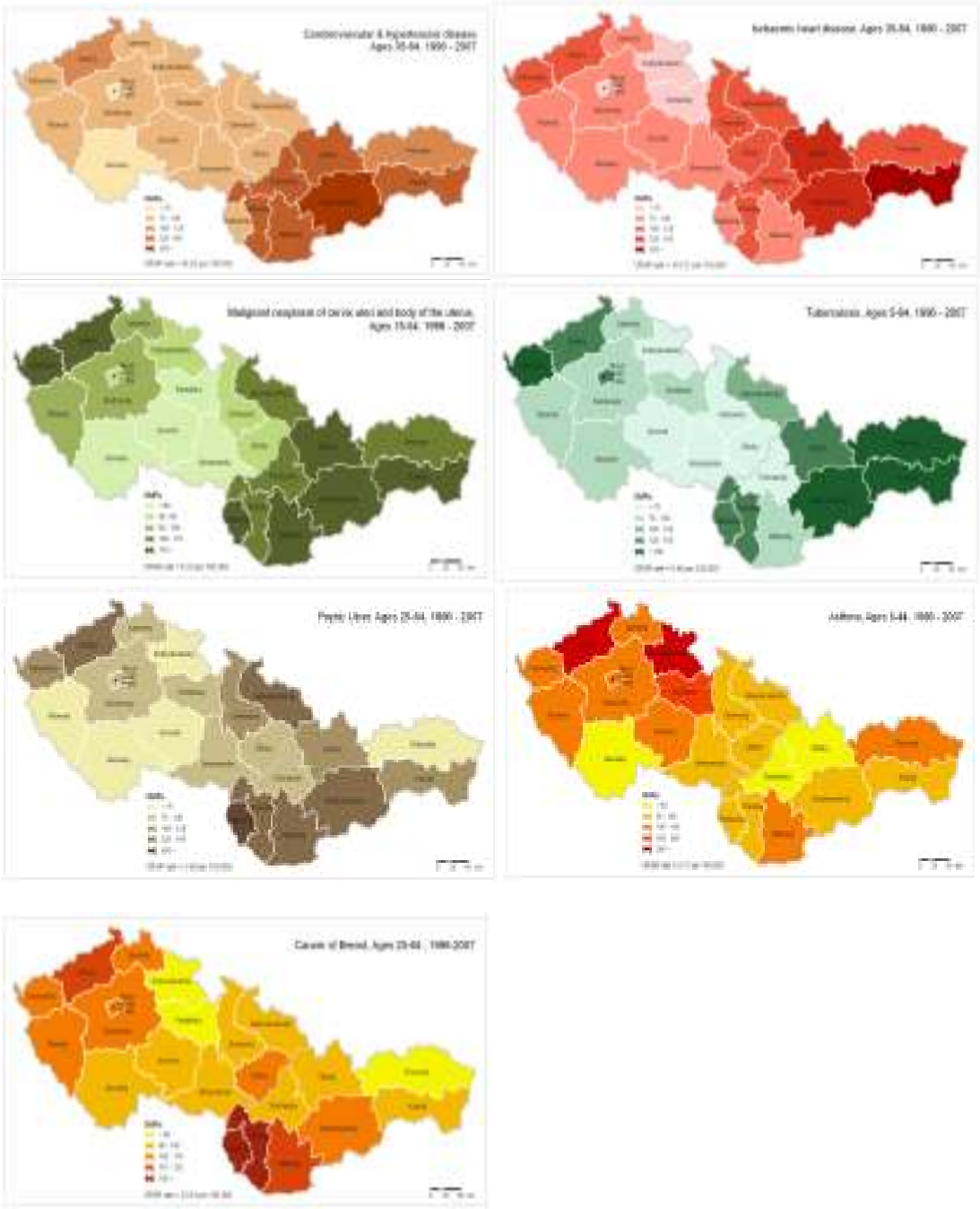
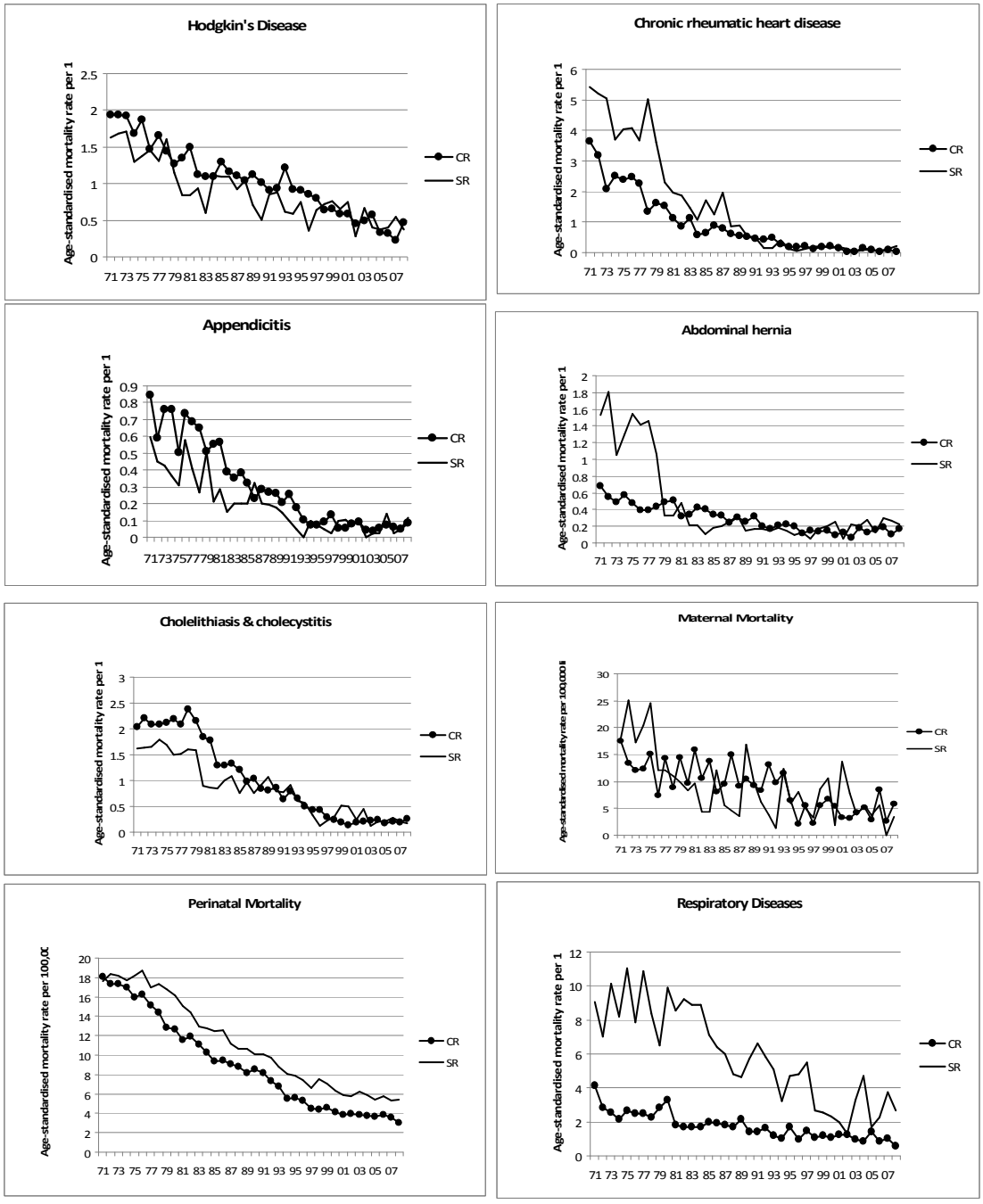


Figure 20 shows conditions for which health care services provided at the hospital level are considered to be most important in preventing unnecessary deaths. For most of the conditions mortality has been continuously declining throughout the entire period while for others the most important declines occurred before 1989 (e.g. Hodgkin's disease, chronic rheumatic heart disease, appendicitis, abdominal hernia, maternal mortality, perinatal mortality). When comparing the two countries, for some conditions Slovakia was initially performing worse (e.g. chronic rheumatic heart disease, abdominal hernia) while for others (e.g. Hodgkin's disease, appendicitis or cholelithiasis and cholecystitis) it was the Czech Republic. Only for perinatal and respiratory disease mortality does Slovakia continuously throughout the entire period perform worse that the Czech Republic.

Figure 20. Mortality from 'avoidable' causes where most important interventions are provided at the hospital level

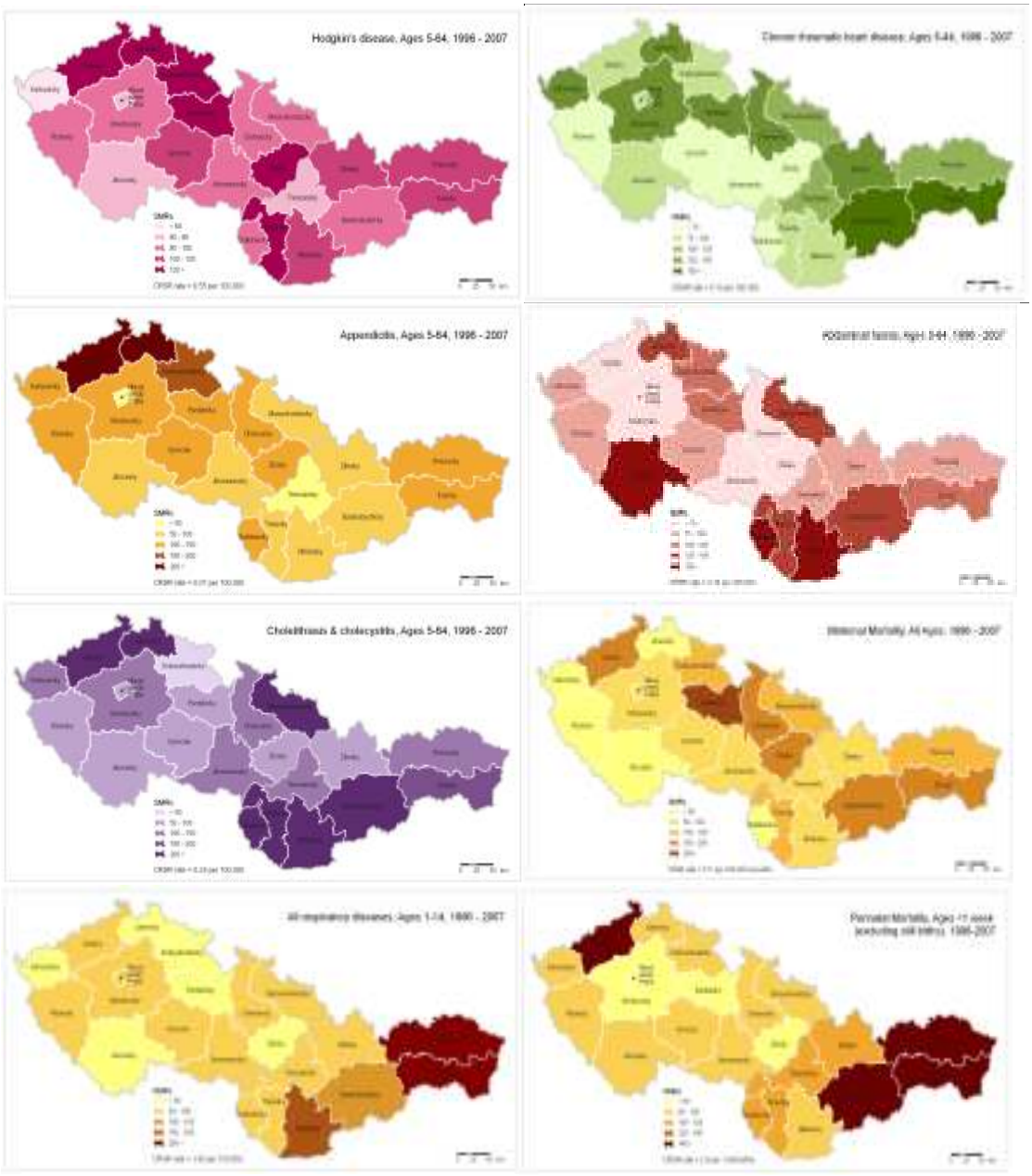


Note: For Respiratory Diseases interventions are equally important at the primary care and hospital level

Again, important regional variations for conditions where hospital care is considered to be most important can be noted (Figure 21). For example, for deaths for all respiratory diseases, two Eastern Slovak regions stand out with substantially worse performance, and SMRs more than double the "Czechoslovakia" rate. For

cholelithiasis and cholecystitis, it is the Southern Slovak regions where the mortality rates are double the “Czechoslovakia” rate. While there is some regional variation for appendicitis, only three western Czech regions perform much worse than the national average. Yet again it is important to note that the overall national rates for many of these conditions are already very low. Regions that show worse performance for several conditions are Ustecky and Liberecky in the Czech Republic and the Eastern and Southern regions in Slovakia.

Figure 21. Regional standardised mortality ratios from selected 'avoidable' causes where public hospital care is most important, 1996-2007.



Note: For Respiratory Diseases interventions are equally important at the primary care and hospital level

Table 19 shows the overall and annual percentage changes by condition. 'Avoidable' mortality in the Czech Republic declined from 173 to 131 (24%) between 1971-1989 and down to 67 deaths per 100,000 (48%) by 2008; in Slovakia the decline was from 162 to 138 (15%) between 1971-1989 and down to 99 deaths per 100,000 (29%) by 2008. On the other hand, non-avoidable mortality in Slovakia increased by 5% (from

258 to 272 deaths per 100,000) before 1989 and only declined by 6% (from 275 in 1990 to 257 deaths per 100,000) by 2008. In the Czech Republic, non-avoidable mortality also declined by 11% before 1989 (from 253 to 226 deaths per 100,000) and after 1989 similarly by 12% or 290 deaths per 100,000. Causes that made the largest contribution to total 'avoidable' mortality are ischaemic heart disease, cerebrovascular disease & hypertension, perinatal mortality and cancer of the breast.

During the period before 1989, the largest average annual increase can be seen for asthma in both countries (7.3% and 4.0% in the Czech Republic and Slovakia respectively) and decline for chronic rheumatic heart disease (4.5%) in the Czech Republic and tuberculosis in Slovakia (4.8%). After 1989 the largest average annual increase can be observed for peptic ulcers (1.8%) and abdominal hernia (1.5%) in Slovakia; annual decline is largest for chronic rheumatic heart disease (4.9%) in the Czech Republic and cholelithiasis and cholecystitis (4.1%) in Slovakia. The largest overall percentage reductions in the Czech Republic between 1971-1989 as well as 1990-2008 were made for chronic rheumatic heart disease (85% and 93% respectively). The largest overall percentage reductions in Slovakia between 1971-1989 were made for tuberculosis (91%); between 1990-2008 it was for cholelithiasis and cholecystitis (79%).

Overall, mortality from all 'avoidable' causes has been declining annually on average faster after 1989 with 2.5% in the Czech Republic and 1.5% in Slovakia compared to only 1.3% and 0.8% respectively before 1989. This compares with smaller improvements for non-avoidable mortality, which has also been declining annually on average faster in the post-Communist period but overall less rapidly than 'avoidable' mortality; in the Czech Republic it was declining annually on average by 0.6% both before 1989 and after 1989 while in Slovakia it was actually increasing by 0.3% before 1989 and afterwards declining by 0.3%.

Table 19. Trends in condition specific 'avoidable' mortality

Cause	Age	Total 'avoidable' deaths (1971-2008)		Age-standardised mortality per 100,000 in 1971		Percent change in age-standardised mortality between1971 and 1989				Percent change in age-standardised mortality between1990 and 2008				Average annual percentage change 1971-1989		Average annual percentage change 1990-2008	
		CR	SR	CR	SR		CR %		SR %		CR %		SR %	CR %	SR %	CR %	SR %
Tuberculosis	5-64	2,974	2,497	3.0	8.6	↓	-75.6	↓	-90.6	↓	-72.5	↓	-22.7	-4.0	-4.8	-3.8	-1.2
Cancer of breast	25-64	28,907	11,809	26.9	23.7	↑	6.1	↑	12.3	↓	-37.0	↓	-17.5	0.3	0.6	-1.9	-0.9
Malignant neoplasm of cervix uteri*	15-64	9,056	3,934	8.3	4.3	↓	-10.4	↑	44.7	↓	-26.9	↓	-10.4	-0.5	2.4	-1.4	-0.5
Malignant neoplasm of cervix and body of uterus*	15-54	7,643	4,075	7.0	6.3	↓	-13.1	↓	-0.5	↓	-34.6	↓	-27.2	-0.7	-0.03	-1.8	-1.4
Hodgkin's disease	5-64	3,362	1,319	1.9	1.6	↓	-42.2	↓	-56.6	↓	-54.3	↓	-26.4	-2.2	-3.0	-2.9	-1.4
Chronic rheumatic heart disease	5-44	2,037	1,649	3.6	5.4	↓	-84.8	↓	-83.4	↓	-93.1	↓	-62.7	-4.5	-4.4	-4.9	-3.3
Hypertensive and cerebrovascular diseases	35-64	93,531	48,296	106.0	91.8	↓	-35.7	↓	-8.2	↓	-43.1	↓	-38.2	-1.9	-0.4	-2.3	-2.01
Ischaemic heart disease	35-64	213,102	94,295	184.4	157.9	↓	-4.5	↑	7.7	↓	-58.3	↓	-37.8	-0.2	0.4	-3.1	-2.0
All respiratory diseases	1-14	1,322	2,594	4.1	9.1	↓	-48.3	↓	-48.7	↓	-59.1	↓	-53.5	-2.5	-2.6	-3.1	-2.8
Asthma	5-44	714	248	0.3	0.1	↑	75.7	↑	138.3	↓	-79.1	↓	-64.8	4.0	7.3	-4.2	-3.4
Peptic ulcers	25-64	6,927	3,314	4.6	4.7	↓	-20.5	↓	-35.2	↓	-31.6	↑	33.6	-1.1	-1.9	-1.7	1.8
Appendicitis	5-64	956	279	0.8	0.6	↓	-68.8	↓	-70.9	↓	-60.4	↓	-21.5	-3.6	-3.7	-3.2	-1.1
Abdominal hernia	5-64	950	621	0.7	1.5	↓	-63.0	↓	-90.1	↓	-47.0	↑	28.7	-3.3	-4.7	-2.5	1.5
Cholelithiasis and cholecystitis	5-64	3,289	1,155	2.0	1.6	↓	-59.8	↓	-34.1	↓	-69.8	↓	-78.5	-3.1	-1.8	-3.7	-4.1
Maternal mortality**	All	482	279	17.5	18.1	↓	-46.6	↓	-44.7	↓	-30.5	↓	-44.2	-2.5	-2.4	-1.6	-2.3
Perinatal mortality***	<1 week+still births	50,224	35,405	18.1	17.6	↓	-54.7	↓	-39.8	↓	-64.2	↓	-46.6	-2.9	-2.1	-3.4	-2.5
All avoidable causes	0-64	420,015	209,160	173.3	161.8	↓	-24.4	↓	-14.6	↓	-48.4	↓	-29.4	-1.3	-0.8	-2.5	-1.5
Other causes	0-64	790,006	412,889	253.4	258.4	↓	-10.8	↑	5.2	↓	-11.6	↓	-6.5	-0.6	0.3	-0.6	-0.3
Total deaths	0-64	1,210,021	622,049														

* overlap due to possible variation in coding practice: in some countries cancer of cervix uteri may be included in codes 179 and 182

**per 100,000 live births

***per 1,000 births (live & still)

3.4. Discussion and conclusion

The results show an encouraging, declining pattern for most of the 'avoidable' conditions, especially since 1989, suggesting improvements in the performance of both health care systems since the fall of the communist regime. The analyses of trends is consistent with the findings of earlier studies (Burcin & Kucera, 2008; Charlton, Lakhani, & Aristidou, 1986; Mackenbach, Looman, Kunst, et al., 1988; Niti & Ng, 2001; Poikolainen & Eskola, 1988; Tobias & Jackson, 2001; Treurniet, Boshuizen, & Harteloh, 2004) where 'avoidable' mortality has been falling faster than mortality from other causes, pointing towards the potential positive impact of medical care (Nolte & McKee, 2004). While several studies of 'avoidable' mortality in Eastern Europe in the 1970s and 1980s found that 'avoidable' mortality declined slower than mortality from other conditions which has remained stable or even increased (Gaizauskiene & Gurevicius, 1995; Nolte, Scholz, Shkolnikov, et al., 2002), this cannot be confirmed in the Czech Republic and Slovakia between 1971 and 2008.

Overall, divergence in total 'avoidable' mortality rates of the two countries (Figure 17) can be noted since the change of the regime in 1989 and the separation in 1993, when Slovakia began to lag behind the Czech Republic pointing towards potential deterioration in the performance of its health care system. In particular, Slovakia is mainly lagging behind due to its higher mortality rates for ischaemic heart disease and hypertension & cerebrovascular disease mortality which make the largest contribution to 'avoidable' mortality but are also largely preventable with effective and timely prevention and primary care. For non-avoidable conditions, on the other hand, Slovakia was lagging behind the Czech Republic throughout the entire period under study. This gap can be explained by socio-economic, environmental and life-style differences between the two countries. Since non- health system factors such as socioeconomic changes, environment or life-style influence both 'avoidable' and non-

avoidable conditions, any improvements or changes in 'avoidable' mortality are likely to be explained by changes in the provision of timely and effective care (Korda & Butler, 2006).

When studying the individual 'avoidable' mortality causes, however, the findings suggest that in a number of cases the two countries converge and Slovakia performs better than the Czech Republic. Analysis of individual conditions provides a more in depth understanding of how the respective health systems perform in specific areas; however, for some conditions, factors that are not part of the health care system may be equally or even more important. In the group of conditions where public health programmes or primary care are considered to be most important, results across the conditions vary significantly. It is especially important to study those conditions where mortality rates have been stagnant or the decline slowed down after 1989 (e.g. peptic ulcer or malignant neoplasm of cervix uteri and body of uterus in Slovakia). These findings raise questions about the medical care that is being provided for these conditions, what improvements can be made to prevent unnecessary deaths and whether other, non-medical care determinants, such as socio-economic, environmental or lifestyle need to be addressed instead.

For peptic ulcer, for example, mortality rates in both countries have declined between 1971-1989 but since 1990 they have increased in Slovakia (from 2.7 to 3.6 per 100,000) and in the Czech Republic they hover around an average of 2.7 deaths per 100,000. The initial declines may be explained by improvements in prevention, and diagnostic and therapeutic advancements since the 70s, as well as better and timely surgical interventions (Tesar, Foltan, & Huorka, 2002; Vecchia, Lucchini, Negri et al., 1993). Yet the lack of further decline is a reason for concern and a more in-depth understanding of health services provided for this condition is required. However, other risk factors may also need to be considered, including the consumption of

alcohol and cigarettes (Holland, 1997). Czech Republic followed by Slovakia ranked among the highest in alcohol consumption in 2002 and the proportion of unrecorded consumption of alcohol was also high (Popova, Rehm, Patra et al., 2007). In addition, a significant proportion of the population also smokes (Eurostat, 2004). Alcohol and smoking may therefore be some of the additional key factors explaining the observed trends apart from weaknesses in health service provision.

The relatively high mortality rates for malignant neoplasm of cervix uteri and body of uterus could be attributed mainly to the deficiencies in the organisation and performance of cervical screening (Potancok & Sadovsky, 2004; Vlasak, Plesko, Dimitrova et al., 1991), which are also likely to explain the gap between the two countries. While both countries have a nationwide organised screening programme since 2008, actual implementation remains an issue, especially getting the patients to show up for the visits. Even before the passing of the new legislation in Slovakia, preventive gynaecological examinations were legally guaranteed but only about 20% of woman population took advantage of them (Hupkova, 2008).

Until the early nineties some of the main factors behind unsatisfactory results in breast cancer mortality were late diagnosis, where patients sought medical care a few years after the first symptoms appeared (Konopasek, Novy, & Bauer, 1994). Overall, the importance of wide scale systematic education of the population, quick diagnosis with the necessary diagnostic equipment, a treatment strategy established by a multidisciplinary medical team, and respect for general onco-surgical guidelines have been stressed to avoid unnecessary deaths (Celko, 1996; Konopasek, Novy, & Bauer, 1994). Improvements in both countries since the early 90s are likely to be explained by early diagnosis, improved access to care, the introduction of new effective treatment (e.g. tamoxifen), shift toward more favourable stage distribution, and increased breast cancer awareness as national screening programmes were not in

place (Botha, Bray, Sankila et al., 2003; Tyczynski, Plesko, Aareleid et al., 2004). In addition, changes in other risk factors such as childbearing, breast-feeding, type of diet and obesity, use of alcohol and tobacco, oral contraceptives use and hormonal replacement therapy should be taken into consideration (Key, Verkasalo, & Banks, 2001; McPherson, Steel, & Dixon, 2000; Tyczynski, Plesko, Aareleid, et al., 2004).

Reductions in blood pressure related to diet, better control of hypertension, high cholesterol and smoking, enhanced access to pharmaceuticals and improvements in secondary cardiac care have resulted in declining hypertension and cerebrovascular mortality as well as mortality from ischaemic heart disease (Bruthans, Cífková, Lánská et al., 2012; Cífková, Škodová, Bruthans et al., 2010; Cifkova, Skodova, Lanska et al., 2004; Davídkovová, Kyselý, Kříž et al., 2013; Egnerova & Becezna, 1997; Ginter, 1998; Newey, Nolte, McKee, et al., 2004; Skodova, Pisa, Poledne et al., 1997). Also, increased consumption of anti-oxidants and decline in the consumption of animal fats, salt and spirits have been important (Bruthans, Cífková, Lánská, et al., 2012; Ginter, 1995).

However, further improvements can be made as treatment of hypertension is still not sufficient; between 1985 and 2001 less than 20% of those diagnosed in the Czech Republic had their blood pressure controlled (Cifkova, Skodova, Lanska, et al., 2004). Another study in Slovakia from 1995-2005 found that while mortality from the diseases of circulatory system, ischaemic heart disease and cerebrovascular disease in the age group between 25-64 have been declining, overall mortality from hypertension has doubled, largely due to the unfavourable prevalence of preventable risk factors such as untreated high blood pressure, overweight and obesity (Barakova & Riecansky, 2007) and deficiencies in the prevention and treatment of cardiovascular diseases (Bada, 2006; Jurkovicova, 2005). The same study suggests that only with better management of hypertension and interdisciplinary cooperation

can Slovakia close the gap with the Czech Republic and other EU countries. With respect to treatment, the number of angiograms, percutaneous coronary interventions, and stenting rates have been gradually increasing in both Slovakia and the Czech Republic but rates remain behind most Western European countries, especially in Slovakia (Cook, Walker, Hugli et al., 2007) In addition, while the causes of the different developments may not be well recognized, lower level of education, worse composition of the diet, higher consumption of distillates and tobacco, lower level of health care, and higher proportion of the Roma population in Slovakia may require further attention (Ginter, 2001).

For all the conditions where hospital level care is considered more important (e.g. Hodgkin's disease, appendicitis, maternal and perinatal mortality etc.), the declining mortality trends and convergence suggest improvements in the provision of timely and effective hospital care in both countries. These are encouraging trends likely to have resulted from significant improvements in the equipment of providers and available medicines since 1989 even though evidence on the changes in clinical aspects of quality are not available (Nemec & Lawson, 2005).

When looking at individual conditions, substantial improvements in perinatal mortality can be attributed to developments in the quality of neonatal care in two areas: prenatal diagnosis of congenital malformations and intensive care in newborns of extremely low birth weight (Stembera & Velebil, 2006). The overall lower neonatal hospital and human resource capacity in Slovakia (Chovancova, 2008) may explain the gap between the two countries. Higher rates of perinatal mortality in the Eastern regions of Slovakia may be linked to the large presence of the Roma population, their lifestyle and attitudes to health and health care services (Ecohost/ Masaryk University, 2000).

Large presence of the Roma population may also explain the higher mortality rates for respiratory disease deaths for children aged 1 to 14 in the two Eastern regions. Other studies found that the most common diagnosis for hospitalized Roma infants and toddlers in Slovakia were respiratory tract infections, among others or that Roma children had twice as many respiratory diseases as ethnic Czech children (Ecohost/ Masaryk University, 2000). As a result, specifically targeted prevention and treatment activities for this group may be necessary to make further reductions in mortality levels.

Overall, aggregate studies of 'avoidable' mortality can only "point towards weaknesses or failures of the health system which require further investigation and not as an absolute measure of health care quality" (Kossarova, Holland, Nolte et al., 2009). It is a tool to provide insights into the performance of the health system (James, Manuel, & Mao, 2006). Therefore, the next step for policy makers in both the Czech Republic and Slovakia would be to carry out in depth systematic investigations of the underlying reasons for observed trends according to existing and sound methodologies, as well understand local and central level policies, and how services targeted at the selected condition are being delivered and coordinated, starting from prevention, through diagnosis and treatment and management of the disease (Kossarova, Holland, Nolte, et al., 2009). While for a number of conditions problems appear to be obvious and implementation is the issue (e.g. cancer of cervix), for others further research is necessary. Also, in the future with regional level data becoming increasingly available, distribution of 'avoidable' mortality across socio-demographic and ethnic groups may be particularly useful. Especially, when one considers, for example, the large presence of the Roma population in some regions of Slovakia and the Czech Republic whose health and access to care is worse than that of the general population and therefore health services at this group need to be better targeted ((Ecohost/ Masaryk University, 2000; Koupilová, 2001).

There are several limitations of using 'avoidable' mortality as an indicator of health system performance, many of which have been summarised in an in-depth review of the concept by Nolte et al (2004); the most important ones will be considered below. First, 'avoidable' mortality was originally intended to assess the quality of care (Holland & Breeze, 1985) but has also been used to measure the contribution of health systems to population health. Many authors have attempted to explain observed variations in 'avoidable' mortality using a range of potential explanatory variables of which health care resources has been one. However, given the weak association between variations in 'avoidable' mortality and measures of health care provision (Kunst, Looman, & Mackenbach, 1988; Mackenbach, Kunst, Looman et al., 1988), some authors have questioned the usefulness of this indicator to measure the quality and effectiveness of health care services (Carr-Hill, Hardman, & Russell, 1987). It is important to clarify that most of the variables studied to explain variations in 'avoidable' deaths such as health expenditure, number of health staff or hospital beds, presence of health care facilities tend to only capture quantity but not quality of care (Nolte & McKee, 2004). At the same time, evidence from analyses undertaken in the former communist countries of central and eastern Europe (Koupilová, McKee, & Holcik, 1998; Nolte, Scholz, Shkolnikov, et al., 2002; Telishevska, Chenet, & McKee, 2001; Velkova, Wolleswinkel-van den Bosch, & Mackenbach, 1997) supports the link between health care resources and outcomes as measured by mortality. Overall, the weak or absent association with health care inputs may be attributable to (i) the use of variables which are measurable but not necessarily important; and/or ii) a time lag between changes in resources and changes in mortality and others (Nolte & McKee, 2004). However, the more frequently observed association with adverse socioeconomic factors has focused attention to timely access to medical care (Nolte & McKee, 2004).

Second, death from any particular condition, even if considered 'avoidable' is a result of many events (Rutstein, Berenberg, Chalmers, et al., 1976) and its prevention may not have been possible by the timely and effective provisions of health services. For example, severity of the disease at presentation to health services was not taken into account, which could be at a point when the death cannot be averted anymore. Severity of disease at presentation is a function of health seeking behaviour and thus partly outside the scope of health services; however it may also reflect access to care and should therefore, at least partially, be 'avoidable' by health services (Andreev, Nolte, Shkolnikov et al., 2003; Charlton, Hartley, Silver, et al., 1983). Third, incidence of the disease may affect the observed trends and has not been incorporated in the analysis. However, studies that have taken into account incidence find that regional variations remain and cannot be explained by incidence (Bauer & Charlton, 1986; Treurniet, Looman, van der Maas et al., 1999). Also, as Charlton and colleagues stated, "there is no reason for more deaths to occur from conditions such as acute appendicitis or hernia in areas where the condition may be more common" (Charlton, Holland, Lakhani et al., 1987). In other words, if there is higher incidence of a particular condition, the health system should adjust to the needs of the population.

Fourth, while the conditions have been split into those where primary care or hospital care are more important, for many of these conditions both effective and timely primary care and hospital services are necessary to prevent deaths (Holland, 1997). In addition, other non-health system factors including socio-economic conditions, lifestyle, behavioural (e.g. smoking, alcohol, adherence), environmental and others should be considered. Attributing 'avoidable' mortality outcomes to health care services exclusively can be done for selected conditions only (e.g. appendicitis) (Nolte & McKee, 2004). As non-avoidable mortality rates may also be affected by all these different non-health system factors, the gradient in 'avoidable' mortality is best seen

relative to that in non-avoidable mortality (Korda & Butler, 2006). Fifth, 'avoidable' mortality uses deaths but mortality may not always be the adequate indicator for the performance of the health system, especially for the elderly, where most of the focus is not on preventing death but on relieving pain and improving the quality of life (Holland, 2007).

Sixth, some of the identified differences between the two countries may be due to differences in diagnostic patterns and habits (Reid, 1962; Reid & Rose, 1964), death certification or coding of causes of death, even though these may not be so severe given the countries' common past and practices. In fact, these differences could even arise within one country in different regions. Problems in assigning ICD codes may result in misclassification of deaths and changes in trends; this is more likely to occur when new ICD coding is implemented. In both countries, there was a change from ICD-8 to ICD-9 coding in 1979 and from ICD-9 to ICD-10 coding in1994 but these do not appear to be so important in the overall analysis of trends. In general, assigning a single underlying cause of death for a person who has been suffering from multiple chronic conditions, particularly among older people, is often difficult and subject to variation even if the rules of certification and coding are well-understood and clearly formulated. Mortality data is also likely to underestimate the burden of disease for low-fatality conditions such as diabetes or other chronic disorders (Jougla, Papoz, Balkau et al., 1992; Ruzicka & Lopez, 1990). Thus, interpreting mortality statistics requires careful consideration of their limitations, and where possible, efforts should be made to improve their quality (Charlton in Hansluwka, Lopez, Porapakkham et al., 1986).

Next, most studies of 'avoidable' mortality have not addressed the potential negative impact of medical care. *Iatrogenesis* or medical errors, negligence and adverse effects have only recently become the focus of policy makers' attention (Nolte & McKee,

2004). Estimates for the United States suggest that up to 98,000 deaths annually may result from medical errors (Kohn, Corrigan, & Donaldson, 1999). In the United Kingdom, since 2001 the National Patient Safety Agency also monitors information about incidents which may have led to harming a patient or even death. However, incidents continue to be under-reported because the reporting and feedback environment is still one of "naming and shaming" (Cassidy, 2009; Health Committee, 2009; Healthcare Commission, 2008)

Finally, it should also be noted that there are certainly causes included in the category 'other' or non-avoidable conditions that have become avoidable in the course of time (e.g. diabetes). However, since we were studying trends from as early as 1971 when deaths from these conditions were not yet considered to be avoidable, including them would have been incorrect. Due to the changing concept of 'avoidability' (Nolte & McKee, 2004), it is important to revisit all the existing lists of 'avoidable' conditions and specify the date from which onwards a death from a particular condition has become avoidable, as has already been stressed by others earlier (Treurniet, Looman, van der Maas, et al., 1999). Given the advances that have been made in medical care, there are now new conditions that may be considered 'avoidable' as effective prevention or treatment has become available; at the same time, some conditions which have been used earlier may no longer be a good indicator due to low incidence and prevalence. Therefore, deriving conclusions about the quality of health care based on small numbers may not be entirely appropriate (Westerling & Smedby, 1992). At present the "AMIEHS" project - Avoidable mortality in the European Union: towards better indicators for the effectiveness of health systems –developed an agreed definition of 'avoidable' mortality for Europe, reviewed the evidence of how treatment has changed and derived a set of validated 'avoidable' mortality-based indicators of the effectiveness of health systems which can be used in routine surveillance systems.

Chapter 4. Examining the relationship between health care inputs and 'avoidable' mortality

4.1. Introduction

One of the weaknesses of the 'avoidable' mortality indicator highlighted in Chapter 1 more generally, as well as in Chapter 3 in more detail is the relationship with health care inputs, which led some to criticize it as an appropriate indicator for the quality and effectiveness of the health care system. However, the methodological weaknesses of the studies conducted to date using 'avoidable' mortality necessitate the re-examination of this relationship. Before, however, it is important to highlight the continuing debate on the link between health care inputs and health outcomes. As was noted in Chapter 1, the literature mainly looks at standard health outcome measures - perinatal mortality, infant mortality, different life expectancy measures, age/sex specific mortality rates, physiological measures of health status, self-reported health, as well as summary measures of population health (PYLL, DALE) - and their relationship with health care expenditures or health care inputs, including number of physicians, nurses, beds and others. A comprehensive review of the relationship between health care expenditures and other health care resources finds that these do not consistently explain variations in health outcomes and that other variables such as income and life-style appear more important (Nixon & Ulmann, 2006). Number of other studies focusing on health care inputs, in particular physician supply equally fail to establish a clear relationship with health outcomes or instead suggest that more doctors are associated with increased mortality (Auster, Leveson, & Sarachek, 1969; Cochrane, St Leger, & Moore, 1978; Newhouse & Friedlander, 1980; Prescott & Jamison, 1985; Starfield, Shi, Grover et al., 2005; Young, 2001), with the exception in rural areas where more doctors are associated with lower mortality levels (Robst &

Graham, 1997; Robst & Graham, 2004); the evidence similarly supports increased physician supply when the focus is on primary care physicians (Ricketts & Holmes, 2007; Shi, 1992, 1994; Shi, Macinko, Starfield et al., 2003; Starfield, Shi, & Macinko, 2005).

These findings suggest that health care expenditures or health care inputs may either not be true (or imperfect) determinants of health outcomes, or instead that health outcome measures used are not the most appropriate ones as health care provision is only one of the many determinants in any observed variations. Health expenditures are noisy measures of the economic use of health inputs (or activity indicators) as they not only vary with utilisation, but with prices. In contrast, risk adjusted expenditure measures, or price adjusted measures of utilisation are often difficult to estimate. Hence, some of the variability in health expenditure might not be attributed to health care activity. However, even when health expenditures are regarded as good proxies for activity, the question of how to measure health outcomes remains. This is where 'avoidable' mortality has been proposed as an indicator that should more accurately capture what happens in the health care system as opposed to standard health outcome measures that also capture the effect of non-health care system determinants such as lifestyle or socioeconomic status (Kossarova, Holland, & Mossialos, 2012). As 'avoidable' mortality has become an increasingly utilised indicator in the last decade, the debate surrounding the extent to which medical care truly contributes to variations in 'avoidable' mortality has also become more relevant. A review of a large number of studies (Nolte & McKee, 2004) found that socio-economic conditions appear to be the most important determinant. A recent large-scale European study[14] (Plug, Hoffmann, & Mackenbach, 2011) aimed to

[14] "Avoidable mortality in the European Union: Towards better indicators for the effectiveness of health systems" - AMIEHS

come up with amenable[15] mortality indicators for routine surveillance purposes to identify problems in the delivery of health care. They looked at the link between an at least 30% decline in age-standardised mortality[16] between 1979-2000 and the national introduction of a specific effective intervention that coincided with the identified decline during the same time, and found little or no association with only four conditions fulfilling all the criteria set out by the study. However, the criteria for the inclusion in the study were very strict[17] and there is clear evidence for many of the conditions that health care (combination of different interventions) has made an important difference to mortality, even though the impact of individual interventions cannot be quantified. Overall, while the project did not come up with indicators of health care system performance to be used for routine surveillance purposes, it did conclude that care must be exercised when amenable mortality data is being interpreted, considering all the different determinants that drive changes in death rates, health care being one of them. Therefore, health care certainly makes a difference but the extent to which it does so at population level is difficult to determine.

Most cross-section or time trend studies have been descriptive in nature, looking at trends in 'avoidable' mortality across countries (Holland, 1988, 1993; Kossarova, Holland, & Mossialos, 2012; Kunst, Looman, & Mackenbach, 1988; Mackenbach, 1991; Newey, Nolte, McKee, et al., 2004; Nolte & McKee, 2008a; Nolte & Scholz, 2004; Poikolainen & Eskola, 1988; Treurniet, Boshuizen, & Harteloh, 2004; Velkova, Wolleswinkel-van den Bosch, & Mackenbach, 1997; Weisz, Gusmano, Rodwin et al.,

[15] The study uses the term "amenable mortality" while this chapter uses 'avoidable' mortality. The two terms refer to the same concept.
[16] An indicator of amenable mortality is of little use of it causes no or only a few deaths each year. Therefore, the inclusion threshold selected in this study was at least 100 deaths in England and Wales in 2000. While it may be easy to identify conditions from which death rates are amenable to health care, it is more complicated to determine whether they make useful indicators (Plug, Hoffmann, & Mackenbach, 2011).
[17] Scientific evidence on the effectiveness of health care interventions and information about the time of national introduction was often lacking or inadequate.

2008) or variations within regions or smaller areas (Bauer & Charlton, 1986; Carr-Hill, Hardman, & Russell, 1987; Charlton, Hartley, Silver, et al., 1983; Charlton, Lakhani, & Aristidou, 1986; Lagasse, Humblet, Lenaerts et al., 1990; Mackenbach, Kunst, Looman, et al., 1988; Nolasco, Melchor, Pina et al., 2009; Piers, Carson, Brown et al., 2007; Sundmacher & Busse, 2011; Treurniet, Looman, van der Maas, et al., 1999; Westerling, 1993; Westerling, Gullberg, & Rosen, 1996). Both individual 'avoidable' causes (e.g. appendicitis, Hodgkin's disease, breast cancer) and deaths from selected 'avoidable' causes grouped together and compared to non-avoidable deaths have been examined to evaluate the performance of a health care system. The underlying rationale for this comparison is that non-health system factors such as socioeconomic characteristics or life-style influence all types of mortality, both 'avoidable' and non-avoidable, so any improvements in 'avoidable' mortality are likely to be due to changes in the provision of timely and effective care (Korda & Butler, 2006).

A handful of studies have tried to explicitly identify determinants of variations in 'avoidable' mortality. Since the idea behind the concept of 'avoidable' mortality is that timely and effective health care should prevent unnecessary deaths, researchers have tried to demonstrate the link between health care system variables thought to be capturing high quality care and variations in 'avoidable' mortality rates. Epidemiologic studies have used health care inputs, including health expenditures (Poikolainen & Eskola, 1988), numbers of health professionals (Kunst, Looman, & Mackenbach, 1988; Poikolainen & Eskola, 1988; Sundmacher & Busse, 2011), hospital beds (Kunst, Looman, & Mackenbach, 1988; Pampalon, 1993), hospitalisation rates (Pampalon, 1993) or a combination of these (Schwierz & Wubker, 2009) as a proxy for "timely and effective health care".

In the health economics literature, the concept of 'avoidable' mortality has only been applied to a limited extent (Heijink, Koolman, & Westert, 2012; Moreno-Serra & Wagstaff, 2010; Tang, Chin, & Rao, 2008). Some of these studies use selected indicators of 'avoidable' mortality such as perinatal (Babazono & Hillman, 1994; Wolfe & Gabay, 1987) or maternal mortality (Cochrane, St Leger, & Moore, 1978) as their dependent variable, even though the concept of 'avoidable' mortality is not explicitly referred to. Overall, all these studies suggest that the relationship between health care resources and 'avoidable' mortality is weak or inconsistent (Mackenbach, Bouvier-Colle, & Jougla, 1990; Nixon & Ulmann, 2006; Nolte & McKee, 2004) and that other socio-economic variables such as income and life-style appear more important. Some evidence of the relationship between health care inputs and 'avoidable' mortality can be found, mainly in the Eastern European region and Germany (Koupilová, McKee, & Holcik, 1998; Nolte, Scholz, Shkolnikov, et al., 2002; Sundmacher & Busse, 2011; Telishevska, Chenet, & McKee, 2001; Velkova, Wolleswinkel-van den Bosch, & Mackenbach, 1997).

However, most of these earlier studies in both disciplines have a number of weaknesses (Auster, Leveson, & Sarachek, 1969; Gravelle & Backhouse, 1987). First, many do not account for possible endogeneity between expenditures or other health care inputs and mortality (Anand & Bärnighausen, 2004; Cremieux, Ouellette, & Pilon, 1999; Or, 2000; Or, Wang, & Jamison, 2005), even though this is clearly vital to investigate. For example, one study that did allow for endogeneity found that health care expenditure had a strong impact on health outcomes in two programmes of care (cancer and circulatory diseases) (Martin, Rice, & Smith, 2008). Similarly, two studies in Germany that allowed for endogeneity of physician supply found that an increase in physician supply had a significantly positive effect on self-reported individual health (Gravelle, Morris, & Sutton, 2008) and on 'avoidable' cancer deaths (Sundmacher & Busse, 2011). Second, many studies are cross-sectional at the

national level and do not take into consideration dynamics, in other words the lag between expenditure and mortality (Gravelle & Backhouse, 1987). One study that did use dynamic modeling and accounted for endogeneity between GP supply and mortality failed to find a significant relationship (Aakvik & Holmas, 2006). On the other hand, a longitudinal study of fourteen European countries that also accounted for dynamic effects found a significant relationship between health care spending and 'avoidable' mortality (Heijink, Koolman, & Westert, 2012).

This chapter has several goals. First, given the lack of a clear relationship between standard health outcome measures and health care inputs, it uses the improved indicator of 'avoidable' mortality to see whether the relationship with health care inputs holds. Second, given the available evidence of a link between health care inputs and 'avoidable' mortality in Eastern Europe, analysis is carried out in Slovakia and the Czech Republic, two countries that have been subjected to a range of health care reforms since the transition from communism in 1989. The results will nicely complement the handful of studies that have tried to assess the performance of the two health care systems using indicators of 'avoidable' mortality (Blazek & Dzurova, 2000; Burcin, 2009; Burcin & Kucera, 2008; Jozan & Prokhorskas, 1997; Kossarova, Holland, & Mossialos, 2012). Generally these descriptive studies found that while there is still room for improvement, 'avoidable' mortality as measure of overall health care system performance has been gradually declining in both countries. Here the particular focus is on understanding regional variations in 'avoidable' mortality indicators and the association with health care inputs. Finally, the chapter contributes to the literature by applying different modelling techniques to see whether the results are robust. It has been shown in earlier studies that the application of different modelling techniques yields different results, and it is therefore necessary to be careful when interpreting these (Gravelle & Backhouse, 1987). Panel data estimation techniques with instrumental variables are used to

account for potential endogeneity between health care inputs and mortality as well as dynamic models to account for the inter-temporal nature of mortality.

4.2. Data and methods

Data and variables

Mortality data for 22 regions (8 regions in Slovakia; 14 regions in the Czech Republic) classified by individual or small groups of diagnosis and age groups between 1996 and 2007 were obtained from the Statistical Office of the Slovak Republic and the Statistical Office of the Czech Republic. Deaths are classified according to the 10th revision of the International Classification of Diseases (ICD-10) in both countries. 'Avoidable' causes of deaths within defined age groups have been selected based on the third edition of the EC Atlas of Avoidable Mortality (Holland, 1997). The Atlas defines 'avoidable deaths' as "deaths from specific diseases within selected age groups for which mortality should be wholly or substantially avoidable when appropriate medical care is sought and provided in good time". The EC working group chose those disease groups and conditions that had identifiable effective interventions and health care providers. For consistency purposes, the selected 'avoidable' causes of death (Table 20) are those included in Chapter 3. Similarly, an upper age limit of 64 years is applied and the analysis for the two sexes is combined since avoidability of death should not depend on gender (Holland, 1997). The remaining deaths not selected as 'avoidable' are classified as deaths from other causes or non-avoidable conditions.

Table 20. 'Avoidable' causes of death selected for analysis

Name of group	Age	ICD 10th revision
Tuberculosis	5-64	A15-A19, B90
Cancer of breast	25-64	C50
Malignant neoplasm of cervix uteri	15-64	C53
Malignant neoplasm of cervix and body of uterus	15-54	C53, C54, C55
Hodgkin's disease	5-64	C81
Chronic rheumatic heart disease	5-44	I05-I09
Hypertensive & cerebrovascular diseases	35-64	I10-I13; I115; I60-I69
Ischaemic heart disease	35-64	I20-I25
All respiratory diseases	1-14	J00-J99
Asthma	5-44	J45-J46
Peptic ulcers	25-64	K25-K27
Appendicitis	5-64	K35-K38
Abdominal hernia	5-64	K40-K46
Cholelithiasis and cholecystitis	5-64	K80-K81
Maternal mortality	All	O00-O99
Perinatal mortality	<1	P00-P96
Age range for total 'avoidable' deaths	0-64	
Age range for total mortality from other causes (non-avoidable)	0-64	

Source: Based on (Holland, 1997)
Notes: Perinatal mortality rates calculated per 1,000 total births (live and still births) and not standardised; maternal mortality calculated per 100,000 live births.

Two rounds of analysis are carried out. First, all the conditions from which deaths are considered to be 'avoidable' are grouped together and used as the aggregated 'avoidable' mortality dependent variable. In the second part of the analysis, the following disaggregated condition specific dependent variables are used: i) ischaemic heart disease; ii) hypertensive & cerebrovascular diseases; iii) remaining 'avoidable' mortality. Only those conditions for which number of deaths in a particular year exceeded 30 are included. Hypertensive and cerebrovascular disease have been combined due to potential case transfer (coding) between hypertension and cerebrovascular disease (Holland, 1997). In both rounds of analysis, deaths from

other causes are grouped together (referred to as non-avoidable/other mortality) and used as a control dependent variable given that non-health system factors rather than timely and effective provision of medical care are considered to be more important in explaining variations in mortality.

To measure timely and effective care, health care input variables are used as proxies. Number of physicians (*docs*), nurses (*nurs*) and beds (*beds*) - per 10,000 population - all of which have been used in earlier studies as important determinants of health outcomes (Cochrane, St Leger, & Moore, 1978; Dubois, McKee, & Nolte, 2006; Gerdtham, Søgaard, Andersson et al., 1992; World Health Organization, 2006) are used. These variables have been obtained from the Institute of Health Information and Statistics of the Czech Republic (IHIS) and the National Health Information Center of Slovakia (NHIC).

While timely and effective medical care as proxied by health care inputs is expected to be the key explanatory variable of variations in 'avoidable' mortality, for some conditions (e.g. ischaemic heart disease, hypertensive & cerebrovascular diseases) additional non-health system determinants need to be considered as explanatory variables. Whitehead and Dahlgren (1991) suggest non-health system determinants include socio-economic, cultural and environmental; living and working conditions (i.e. housing, health care services, water and sanitation, unemployment, work environment, education, agriculture and food production); social and community networks; individual lifestyle factors; and age, sex and constitutional factors (Whitehead & Dahlgren, 1991). Due to data availability, only some of these will be controlled for in our analysis.

Regional data on GDP per capita (*GDP*; adjusted to 2005 prices (OECD) and expressed in Czech crowns) and unemployment (to capture socio-economic

development), air pollution (in tons of basic pollutants per capita) to measure environmental influences have been obtained the Institute of Health Information and Statistics of the Czech Republic and the National Health Information Center of Slovakia. A seminal piece found increases in per capita GDP having positive effects on health (Pritchett & Summers, 1996). Newer evidence suggests that this relationship is influenced by degree of inequality and poverty (Biggs, King, Basu et al., 2010). Also, the relationship between income and health is not linear and may be characterised by diminishing returns to scale in rich countries, explained by higher consumption of alcohol, cigarettes, pollution and stress (Or, 2000) and it may be desirable to control for these factors. Another variable used to capture socio-economic development is unemployment (*unem*) where a positive relationship with mortality is expected. Finally, pollution (*pol*) is included, where again a positive relationship with mortality is anticipated. The relationship between pollution and health has been studied extensively in the recent years and the evidence suggests that more pollution is associated with worse health outcomes, in particular for respiratory and cardiovascular diseases (Brunekreef & Holgate, 2002; O'Neill, Jerrett, Kawachi et al., 2003; Ren & Tong, 2008).

Model and estimation methods

This chapter aims to examine the relationship between health care inputs and mortality from causes considered to be 'avoidable', controlling for a number of other factors. The starting model is an aggregate health production function where the health of the population at the regional level in Slovakia and the Czech Republic measured by 'avoidable' mortality is considered to be the outcome of the production process. Health care inputs measured by beds, doctors and nurses are the key variables of interest. Given that the size of the panel is small (twelve time periods and twenty two cases/regions), a pooled OLS regression is considered first which assumes

no correlation across the regions or time periods. Time effects as well as the two capital regions are two sources of heterogeneity that are controlled for. However, a pooled regression may not make best use of our data as even if the unobserved individual effect was uncorrelated with our regressors, this individual effect would give unbiased but inefficient results with incorrect standard errors; Alternatively, if the individual effect is correlated with the regressors, the pooled regression will be subject to the unobserved heterogeneity bias (Dougherty, 2007). Therefore, the following empirical panel data model is explored for every condition or groups of conditions:

$$AMR_{it}^{condition} = \beta_0 + \beta_1 beds_{it} + \beta_2 docs_{it} + \beta_3 nurs_{it} + \beta_4 GDP_{it} + \beta_5 unem_{it} + \\ + \beta_6 pol_{it} + \beta_7 time_{it} + \beta_8 country_{it} + u_i + \varepsilon_{it} \quad (1)$$

for i=1 ....N; t=1.....T, where i is the regional indicator and t the time indicator. $AMR_{it}^{condition}$ is the health outcome variable. $AMR_{it}^{condition}$ indicates regional age-standardised mortality rates per 100,000 population indirectly standardised to the total "Czechoslovakia" standard population for the following individual 'avoidable' conditions or groups of conditions: ischaemic heart disease, cerebrovascular & hypertension, all 'avoidable' causes, remaining 'avoidable' causes, non-avoidable causes. ε_{it} is the random disturbance term, u_i is the unobserved region-specific time invariant effect, *time* represents time dummies which are included to capture unobserved effects of changes over time and *country* is a dummy variable to capture the difference in performance between the Czech Republic and Slovakia. In addition, using factor analysis, the three health care input variables of interest (doctors, nurses, beds) are reduced into a common factor, labelled 'health activity' (*h_activ*). This is our variable of interest capturing health activity in a given region.

The basic model suffers from a number of problems. First, while a selection of non-health system factors is controlled for, there are other regional characteristics that cannot be measured but may be correlated with the explanatory variables. Therefore, regional fixed effects are used in this analysis. Second, the model does not account for the potential problem of endogeneity which has been noted as a problem in earlier studies (Auster, Leveson, & Sarachek, 1969), in particular the direction of causality between number of physicians and mortality can run in both directions, which if not controlled for will lead to biased estimates.

One solution to this problem is the use of instrumental variables ('instruments') through a within-groups instrumental variable model. It is important the instruments are properly selected both conceptually and technically. In other words, they need to be proper determinants of the endogenous explanatory variable being instrumented (physician supply), have the ability to predict the endogenous variable, and be uncorrolated with the error term so that they are related to the outcome of interest ('avoidable' mortality) or the dependent variable only through the variable being instrumented. After having tested a range of potential instruments, number of dwellings completed in a given year and length of roads and motorways were found to be both conceptually and statistically most appropriate and were used to instrument doctor supply. With increased number of dwellings and roads the number if physicians is likely to increase; however 'avoidable' mortality is not necessarily expect to be affected. The instruments may not be as appropriate for non-avoidable mortality. When using the reduced health activity as our explanatory variable, number of dwellings completed in a given year and car accidents per operated cars were chosen as most appropriate instruments. These instruments predict physician supply in a region but do not predict 'avoidable' mortality. The instruments have passed the relevance test using the Anderson canonical correlations likelihood-ratio test and the Sargan test of overidentifying restrictions in cases where

'avoidable' deaths are used as the dependent variable. An F-test of the first model in the two-stage regression was carried out to assess the validity of the instruments.

Third, the assumption that mortality is static has been made, which is another potential source of omitted variable bias (Aakvik & Holmas, 2006). While mortality is determined by a range of present factors, it is likely that current levels of mortality are also determined by past levels of mortality. To take account of this problem a dynamic panel data model is used. The Arellano and Bond (1991) model addresses the problem of autocorrelation arising between the lagged dependent variable and the error term. The third, dynamic model, for equation (1) can be specified as follows:

$$AMR_{i,t}^{condition} = \beta_0 + \gamma AMR_{i,t-1}^{condition} + \alpha_1 HI_{i,t} + \beta\ X_{i,t} + u_i + \varepsilon_{i,t}$$

for i=1 ....N; t=1.....T, where again *i* is the regional indicator and *t* the time indicator. $AMR_{i,t}^{condition}$ is the 'avoidable' mortality rate in the region *i* and time *t*. $AMR_{i,t-1}^{condition}$ is the mortality rate in region *i* in the previous year so the model allows for today's mortality levels to depend on past mortality. $HI_{i,t}$ is a vector of the health care inputs and includes number of doctors, nurses and beds (or health activity in Equation (2)) which are all treated as endogenous. $X_{i,t}$ represents all the other variables as specified in equation (1) and (2) including GDP, unemployment, pollution and country, as well as the year specific intercept term common to all regions. u_i is again the unobserved region-specific time invariant effect and $\varepsilon_{i,t}$ is the disturbance term. This equation is first- differenced to get rid of the regional fixed effect which may be correlated with our variables of interest but at the same time a new error term is obtained:

$$\Delta \varepsilon_{i,t} = \varepsilon_{i,t} - \varepsilon_{i,t-1}$$

This new error term is correlated with the lagged dependent variable

$$\Delta AMR_{i,t}^{condition} = AMR_{i,t-1}^{condition} - AMR_{i,t-2}^{condition}.$$

However, $AMR_{i,t-p}^{condition}$ and $\Delta AMR_{i,t-p}^{condition}$ are not correlated with $\Delta \varepsilon_{i,t}$ and are therefore valid instruments for periods p ≥ 2. Also, the lagged values $HI_{i,t-2}$, $HI_{i,t-3}$ of our endogenous variables are valid instruments for periods t = 3,4 ....T. The remaining variables are treated as exogenous.

4.3. Results

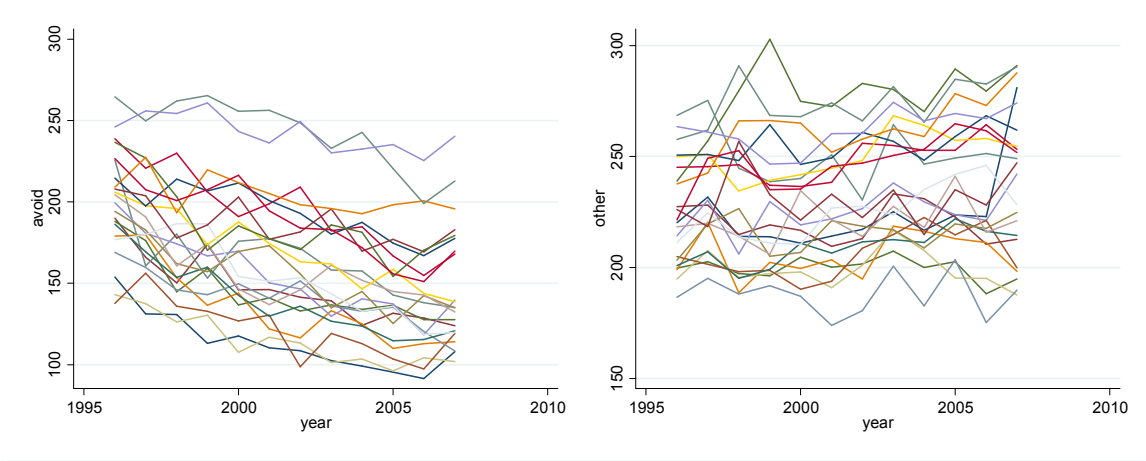
During the study period the mean age-standardised mortality rate for ischaemic heart disease was 102.973 per 100,000 inhabitants, followed by 46.665 per 100, 000 inhabitants for hypertension & cerebrovascular diseases. Mortality from the remaining 'avoidable' causes was 16.575 per 100,000 inhabitants (see Table 20 for conditions included in this category). Finally, 231.677 per 100,000 died from non-avoidable causes. Descriptive statistics of dependent and explanatory variables can be found in Table 21.

Table 21. Descriptive statistics of dependent and explanatory variables

Variable name	Description	Mean	Std. dev.
Dependent variables			
ihdcr	Age-standardised mortality rate for ischaemic heart disease	102.973	26.728
hypcercr	Age-standardised mortality rate for hypertension and cerebrovascular diseases	46.665	15.533
allcr	Age-standardised mortality rate for all remaining avoidable causes	16.575	3.208
other	Age-standardised mortality rate for other mortality causes (non-avoidable mortality)	231.677	27.446
avoid	Age-standardised mortality rate for all avoidable causes (ihdcr+hypcercr+allcr)	166.214	40.179
Explanatory variables			
doc	Doctors per 10,000 inhabitants	35.919	10.169
bed	Hospital beds per 10,000 inhabitants	68.577	14.808
nur	Nurses per 10,000 inhabitants	74.216	14.557
lgdp	Log of Gross Domestic Product per capita adjusted to 2005 prices in Czech crowns	12.228	0.338
unem	Unemployment rate	10.116	5.676
pol	Pollution in tons of pollutants per capita	0.638	0.772
sl	Slovakia = 1 Czech Republic = 0	0.364	0.482

The purpose of Figure 22 is to highlight regional trends rather than identify particular regions. As expected, a declining trend for 'avoidable' mortality reflecting improvements in health system performance can be observed while regional mortality rates for other, other (non-avoidable) causes has remained around the same levels or slightly increased.

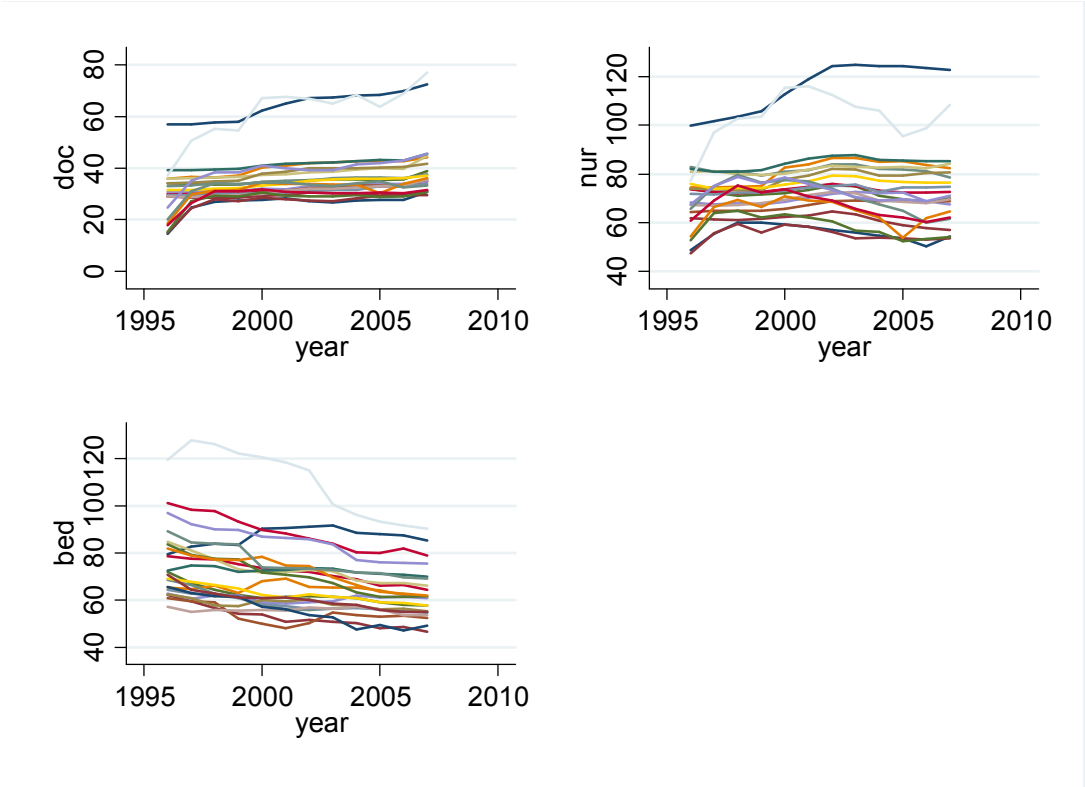
Figure 22. Regional mortality trends: age-standardised mortality rates per 100,000 inhabitants for 'avoidable' and 'other' cause



Note: Legend is omitted as the focus is on regional variation rather than the performance of individual regions

Gradual increase in the number of physicians per 10,000 habitants can be observed over time. In both capital cities, it is evident that there can be as much as three times the number of physicians than in other regions (Figure 23). For nurses per 10,000 inhabitants, there appears to be more variation both across regions and time. Finally, for beds per 10,000 inhabitants there is a continuous decline in all the regions. Again, the goal in this figure was to highlight general trends rather than the ability to identify trends in a particular region.

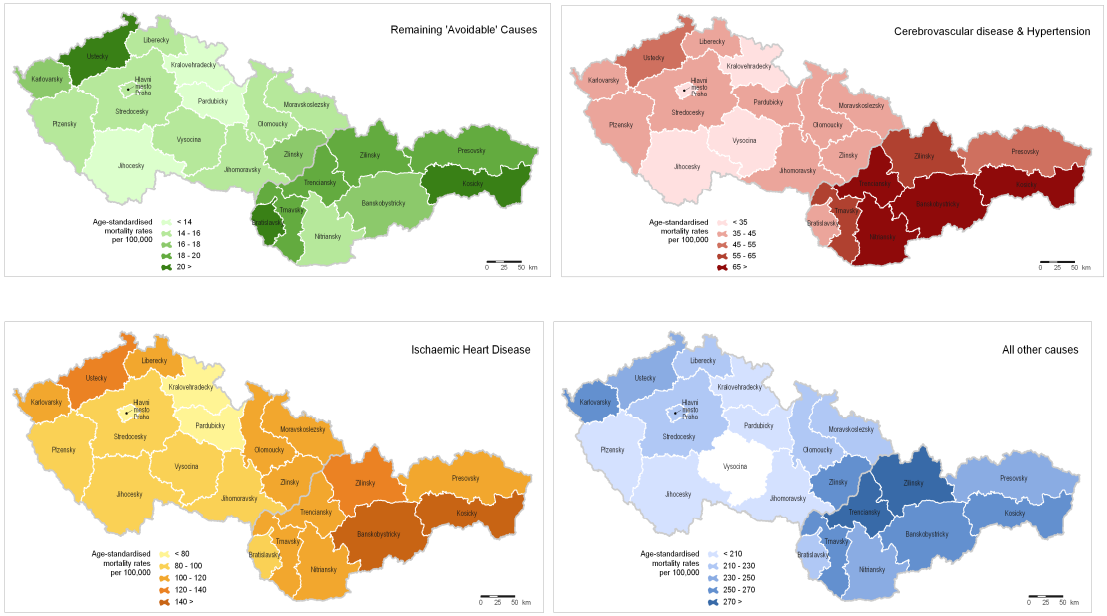
Figure 23. Regional trends - doctor, nurse and bed supply per 10,000 inhabitants



Note: Legend is omitted as the focus is on regional variation rather than the performance of individual regions

The maps in Figure 24 illustrate the regional variations of mean age-standardised 'avoidable' mortality rates for the three different groups of 'avoidable' mortality and for mortality from other causes. Particular regions in both the Czech Republic (Ustecky and Karlovarsky) and in Slovakia (Banskobystricky for all groups, as well as Kosicky and Presovsky) are the worst performers. High rates of remaining 'avoidable' mortality in the Bratislava region should also be noted; yet mortality for all other causes in the Slovak capital is in the second lowest category.

Figure 24. Regional variations in average age-standardised 'avoidable' mortality rates for the period of 1996-2007



Regression results

Table 22 presents results from the static OLS, fixed effects (FE) and the dynamic GMM models for all 'avoidable' mortality causes grouped together, compared to other mortality. First the OLS and FE models are discussed. Analysis for other cause mortality is used as control where a weaker effect of health care system inputs compared to socioeconomic variables on mortality was expected. The signs of coefficients do not differ as much as was expected a priori. For 'avoidable' mortality, the coefficients of interest do not show a significant relationship. Physician and bed supply display negative coefficients in the OLS model and positive coefficients in the fixed effects model, but are statistically not significant at conventional levels. For nurse supply, the coefficients are positive in both models suggesting that mortality rate increases with the number of nurses. While GDP has a negative coefficient as was

expected, it is not significant. Unemployment and pollution are positively and significantly associated with 'avoidable' mortality in the OLS model but the sign of the coefficients change in the fixed effects model and the relationship becomes insignificant.

However, as has already been suggested, these models are likely to be incorrectly specified due to endogeneity problems and possible dynamics that are not accounted for. Therefore, the instrumental variable model (see results of IV models for all dependent variables in Appendix C) with a reduced dataset was first examined. The results of the Hausman test showed no significant evidence of endogeneity in physician supply and the Anderson test of relevance suggested a weak instrument problem. Therefore, an instrumental variable model does not appear to be more suited than the static models. Then a dynamic model (see GMM in Table 22) was used to account for possible dynamics in the mortality rates. The specification tests in the dynamic models (Sargan test of over-identifying restrictions and test of serial correlation) were satisfactory. However, neither of the two lags of the dependent variables are significant, contrary to earlier findings (Aakvik & Holmas, 2006) suggesting no persistence in mortality rate over time. Further, there is no significant relationship between the combined health activity explanatory variable and 'avoidable' mortality (see Appendix C).

Table 22. Results for 'avoidable' and other mortality

	'Avoidable' mortality			Other mortality		
	OLS	FE	GMM	OLS	FE	GMM
L.avoid			-0.0288			
			(0.444)			
L.other						-0.0651
						(0.385)
doc	-0.179	0.0311	-2.981	-0.610	1.371**	-6.228
	(0.879)	(0.651)	(18.47)	(1.346)	(0.578)	(8.804)
nur	0.672	0.351	0.306	0.766	-0.485	5.923
	(0.687)	(0.482)	(9.989)	(1.108)	(0.429)	(5.479)
bed	-0.734	0.0662	-0.781	-0.934**	0.193	0.381
	(0.471)	(0.300)	(1.680)	(0.409)	(0.266)	(2.427)
lgdp	-16.20	-13.99	1.485	-21.49	-7.386	-134.2
	(16.83)	(10.76)	(36.06)	(15.59)	(9.561)	(142.8)
unem	2.612**	-0.506	1.352	2.405**	0.110	-0.116
	(1.034)	(0.429)	(5.113)	(0.936)	(0.382)	(5.983)
pol	13.80***	-0.274	168.6	8.840**	1.564	21.69
	(2.856)	(2.330)	(218.7)	(3.874)	(2.071)	(73.73)
sl	45.25***			31.12**		
	(12.61)			(13.02)		
_Iyear_1997	-12.07**	-10.85***		6.699*	4.624	
	(5.710)	(3.611)		(3.755)	(3.210)	
_Iyear_1998	-26.65***	-19.70***	25.67	-1.236	0.894	4.650
	(8.763)	(4.143)	(44.05)	(5.568)	(3.683)	(21.61)
_Iyear_1999	-34.90***	-20.98***	43.10	-8.994	-0.728	7.333
	(10.26)	(4.661)	(64.71)	(7.689)	(4.143)	(31.68)
_Iyear_2000	-38.43***	-26.54***	51.27	-10.20	-3.373	4.090
	(10.03)	(4.750)	(89.78)	(7.624)	(4.222)	(31.53)
_Iyear_2001	-46.62***	-32.76***	44.18	-9.848	-1.268	7.851
	(11.25)	(4.949)	(87.36)	(8.052)	(4.399)	(34.24)
_Iyear_2002	-49.46***	-35.48***	48.20	-6.985	1.020	17.93
	(12.27)	(5.230)	(97.32)	(8.763)	(4.649)	(44.59)
_Iyear_2003	-53.07***	-39.14***	38.00	3.841	10.76**	42.11
	(12.49)	(5.468)	(101.4)	(8.619)	(4.861)	(52.44)

_Iyear_2004	-51.85***	-41.66***	37.25	2.237	3.581	60.11
	(12.77)	(6.165)	(134.8)	(10.08)	(5.480)	(72.08)
_Iyear_2005	-54.94***	-47.46***	35.28	11.85	10.25*	78.49
	(13.80)	(6.612)	(152.7)	(9.808)	(5.877)	(82.41)
_Iyear_2006	-55.61***	-52.52***	32.75	12.22	5.956	84.13
	(13.54)	(7.108)	(171.8)	(11.01)	(6.318)	(92.60)
_Iyear_2007	-45.44***	-47.28***	51.22	21.79	8.237	108.3
	(15.01)	(8.576)	(211.2)	(13.01)	(7.623)	(118.0)
reg1	-4.060			52.56***		
	(22.16)			(15.47)		
reg15	2.580			40.42		
	(27.18)			(24.17)		
Constant	358.7*	342.0***	133.6	476.2**	290.1***	1,596
	(202.0)	(125.4)	(640.0)	(178.4)	(111.5)	(1,594)
Observations	264	264	220	264	264	220
R-squared	0.825	0.749		0.664	0.302	

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Table 23 presents results from the static OLS and fixed effects models and the dynamic GMM model for the separate groups of 'avoidable' mortality causes: ischaemic heart disease, hypertension & cerebrovascular diseases, remaining avoidable causes. We do not observe significant relationship between any of the three 'avoidable' mortality causes and the health care input coefficients of interest (doctors, nurses, beds). The lagged dependent variables in the dynamic models are also not significant; however, given the results for aggregated 'avoidable' mortality above, these findings are not surprising.

Table 23. Results for selected 'avoidable' mortality conditions

	IHD			HYP&CER			Remaining 'avoidable' causes		
VARIABLES	OLS	FE	GMM	OLS	FE	GMM	OLS	FE	GMM
L.ihdcr			0.0748						
			(0.285)						
L.hypcercr						-0.522			
						(0.404)			
L.allcr									-0.409
									(1.745)
Doc	-0.376	-0.373	-1.224	0.263	0.421	1.818	-0.0656	-0.0166	0.417
	(0.718)	(0.596)	(4.558)	(0.317)	(0.355)	(5.108)	(0.0954)	(0.117)	(8.900)
Nur	0.636	0.240	-0.783	0.00921	0.133	-0.615	0.0261	-0.0220	-0.127
	(0.552)	(0.442)	(2.295)	(0.266)	(0.263)	(4.478)	(0.0836)	(0.0870)	(4.502)
Bed	-0.357	0.287	-1.215	-0.364*	-0.250	-0.385	-0.0128	0.0291	0.0865
	(0.371)	(0.274)	(3.168)	(0.196)	(0.164)	(0.656)	(0.0418)	(0.0540)	(1.217)
Lgdp	-12.92	0.303	19.65	-2.092	-13.16**	12.35	-1.187	-1.128	-0.0469
	(14.24)	(9.851)	(84.29)	(6.021)	(5.874)	(88.54)	(1.614)	(1.940)	(27.60)
Unem	1.364	-1.265***	-0.0226	1.036***	0.842***	1.310	0.212**	-0.0831	-0.388
	(0.933)	(0.393)	(4.875)	(0.341)	(0.234)	(2.264)	(0.0860)	(0.0775)	(2.095)
Pol	10.20***	0.171	23.26	2.610	-0.291	0.891	0.990**	-0.154	4.109
	(2.772)	(2.134)	(99.66)	(1.661)	(1.272)	(22.39)	(0.360)	(0.420)	(18.47)
Sl	21.69**			22.42***			1.140		
	(9.341)			(5.356)			(1.853)		
_Iyear_1997	-9.673**	-7.958**		-2.212	-2.751		-0.184	-0.137	
	(4.166)	(3.307)		(2.640)	(1.972)		(0.661)	(0.651)	
_Iyear_1998	-22.30***	-15.42***	-5.215	-3.393	-3.911*	-4.594	-0.956	-0.368	1.014
	(6.824)	(3.795)	(37.21)	(3.157)	(2.263)	(12.17)	(0.810)	(0.747)	(6.637)
_Iyear_1999	-27.18***	-13.91***	-3.848	-6.840	-7.378***	-8.402	-0.881	0.313	2.385
	(8.156)	(4.269)	(67.47)	(4.085)	(2.545)	(17.09)	(1.051)	(0.841)	(10.72)
_Iyear_2000	-31.60***	-19.30***	-6.859	-5.665	-7.030***	-8.184	-1.162	-0.208	1.548
	(7.597)	(4.351)	(75.46)	(3.996)	(2.594)	(14.27)	(1.033)	(0.857)	(12.21)
_Iyear_2001	-36.77***	-23.03***	-10.83	-7.332	-8.336***	-9.492	-2.513**	-1.395	0.306
	(8.250)	(4.532)	(75.37)	(5.124)	(2.702)	(15.84)	(1.035)	(0.893)	(11.77)
_Iyear_2002	-38.28***	-25.01***	-12.45	-8.657	-9.094***	-12.57	-2.517**	-1.383	0.100
	(8.611)	(4.790)	(85.24)	(5.359)	(2.856)	(19.73)	(0.950)	(0.943)	(11.58)
_Iyear_2003	-40.88***	-28.28***	-20.63	-9.818*	-9.546***	-16.24	-2.377*	-1.315	-0.704
	(9.277)	(5.008)	(89.81)	(5.065)	(2.986)	(23.49)	(1.181)	(0.986)	(16.62)
_Iyear_2004	-38.65***	-30.17***	-25.83	-11.31**	-10.21***	-20.80	-1.884	-1.272	-1.108
	(10.29)	(5.647)	(94.90)	(4.736)	(3.367)	(36.71)	(1.158)	(1.112)	(23.62)
_Iyear_2005	-40.37***	-34.79***	-32.08	-12.65**	-11.05***	-24.05	-1.924	-1.621	-1.382
	(11.06)	(6.056)	(101.7)	(5.139)	(3.611)	(42.38)	(1.220)	(1.193)	(27.69)
_Iyear_2006	-39.20***	-37.78***	-35.14	-14.54**	-12.73***	-28.17	-1.869	-2.014	-3.043
	(10.54)	(6.510)	(102.9)	(5.370)	(3.882)	(47.49)	(1.282)	(1.282)	(35.38)
_Iyear_2007	-29.62**	-32.94***	-27.25	-13.69**	-11.54**	-32.93	-2.131	-2.797*	-5.201
	(11.48)	(7.855)	(115.0)	(6.106)	(4.683)	(59.30)	(1.405)	(1.547)	(52.95)
reg1	-6.293			-1.836			4.069**		
	(21.22)			(7.444)			(1.867)		
reg15	2.021			-6.977			7.536***		
	(27.41)			(9.185)			(2.470)		
Constant	253.3	110.2	39.47	75.18	199.3***	-74.86	30.19	32.56	13.85
	(171.0)	(114.9)	(880.4)	(72.59)	(68.48)	(943.4)	(18.84)	(22.62)	(326.1)
Observations	264	264	220	264	264	220	264	264	220
R-squared	0.703	0.691		0.795	0.388		0.537	0.300	

Robust standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1

4.4. Discussion and conclusions

The goal of this chapter was to assess whether the relationship between 'avoidable' mortality as a methodologically more appropriate indicator of health outcome, and health care inputs holds in the context of Slovakia and the Czech Republic, given earlier evidence that supports this relationship. 'Avoidable' mortality refers to deaths which could have been avoided if timely and effective medical care had been provided. Controlling for other factors, the chapter found no significant relationship between health care resources (measured by number of physicians, nurses and beds) and 'avoidable' mortality rates using: a) pooled OLS regression controlling for years b) fixed effects that incorporate unmeasured regional factors c) instrumental variable model treating physician supply as endogenous d) dynamic GMM model which allows for time persistence in mortality rates. Despite taking into consideration potential endogeneity and dynamics, significant relationship was not found.

These results contribute to the debate on the role of health care inputs in explaining variations in health outcomes in several ways. First, it is possible that a relationship cannot be established given that the supply of health services has reached a level where there are diminishing returns, mirroring Preston's relationship between income and economic development (Bloom & Canning, 2007).

Second, while health care inputs are an important element of the health care system, they do not seem to adequately capture what is happening in the health care system. Lack of a consistent association in numerous studies both with standard health outcome indicators and the results of this study confirm this finding. Capturing *quality* of care and not only *quantity* for the unit of interest (regions in this case) has been a challenge in earlier studies. Using quantity of health care resources as a proxy

for quality can only tell us so much about the provision of timely and effective medical care. For example, while there is a minimum network requirement in Slovakia, health care capacities (beds and physicians) in the regions are calculated per capita and do not consider health care needs of the population and effective use of resources; adequate accessibility is not a requirement; only a minimum number of providers is (Szalay, Pažitný, Szalayová, et al., 2011). In both countries, changes in bed, doctor and nurse supply were largely due to restructuring of health care facilities rather than a reflection of health needs (Rokosová M, 2005; Szalay, Pažitný, Szalayová, et al., 2011). Therefore, changes in supply can be observed while it cannot be concluded whether appropriate and timely care is being provided. If other countries are considered, Canada for example, 'avoidable' deaths declined between 1997 and 2002 (Nolte & McKee, 2008a) even though their physician-to-population ratio has been stable for over 20 years (Evans & McGrail, 2008), demonstrating that improvements in health care outcomes can be attained without increasing the physician-to-population ratio (Watson & McGrail, 2009). Under such circumstances, it is important to search for better indicators to capture timely access and provision of effective treatment for the group of 'avoidable' conditions. "Timely and effective medical care" has been difficult to measure with the data available in most countries, including the Czech Republic and Slovakia analysed in this study.

Third, the evidence from the recent AMIEHS study shows that while for many conditions important key interventions are available to avoid deaths, it remains complicated to ascertain the exact proportion that can be attributed to the selected medical interventions. That may explain why establishing a link with health care inputs may have been difficult. The results of this study were preceded by a debate on this issue. For example, a comprehensive literature review by Nolte & McKee (2004) found that up to 70% of stroke mortality can be avoided through better management of high blood pressure and improved care after a stroke; the remaining 30% can be

attributed to smoking, diet and physical activity (Nolte & McKee, 2004). The contribution of medical care to mortality from ischaemic heart disease is also controversial, although again available evidence suggests that its impact is considerable (Nolte & McKee, 2004), with about 45-70% of mortality attributable to secondary and tertiary care such as post-infarction treatment or coronary bypass grafting (Beaglehole, 1986; Bots & Grobbee, 1996; Bruthans, Cífková, Lánská, et al., 2012; Capewell, Beaglehole, Seddon et al., 2000; Capewell, Morrison, & McMurrey, 1999; Hunink, Goldman, Tosteson et al., 1997; Tobias & Jackson, 2001; Tunstall-Pedoe, Vanuzzo, Hobbs et al., 2000) and about 30-55% to primary prevention and risk factor mitigation such as smoking cessation, cholesterol reduction and control of high blood pressure (Bruthans, Cífková, Lánská, et al., 2012) (sometimes primary prevention was also included in the former category). These examples demonstrate, the difficulty in determining the exact contribution of health care, despite the broad understanding that it matters. The AMIEHS study (Plug, Hoffmann, & Mackenbach, 2011) concluded stating that "we remain convinced, on the basis of the totality of the evidence, that improvements in health care have been associated with substantial declines in deaths from many conditions". They further state that it is because apart from the timing of an innovation, the extent to which a population is covered by the innovation as well as the combined effect of the innovation with other health care factors need to also be considered. Therefore, the authors conclude that the 'absence of evidence' of the effectiveness of health care in reducing population-level mortality does not imply 'evidence of absence'.

Thus, even though 'avoidable' mortality is considered to better capture the contribution of health care systems and therefore have the potential to be used as indicator of the quality and performance of the health care system, range of other non-health system factors are still considered to be important determinants of changes in mortality rates (Plug, Hoffmann, & Mackenbach, 2011). Therefore,

variables that capture non-health determinants and may be key risk factors need also be included in future analysis. For example for cardiovascular mortality, risk factors such as nutrition (Cremieux, Ouellette, & Pilon, 1999), alcohol and smoking (Cochrane, St Leger, & Moore, 1978; Cremieux, Ouellette, & Pilon, 1999), as well as high cholesterol and blood pressure (Bruthans, Cífková, Lánská, et al., 2012; Cífková, Škodová, Bruthans, et al., 2010), physical inactivity, weight, hypertension control (Cífková, Škodová, Bruthans, et al., 2010), hyperlipidaemia and diabetes would all be important (Bruthans, Cífková, Lánská, et al., 2012; Cífková, Škodová, Bruthans, et al., 2010; Mendis, Puska, & Norrving, 2011). Another example is malignant neoplasm of cervix uteri, for which it would be sexual habits and social class, and for peptic ulcer, alcohol and smoking (Holland, 1997).

This chapter also used individual 'avoidable' mortality causes, in addition to aggregate 'avoidable' mortality as the key dependent variable. Only a few studies have previously explored 'avoidable' mortality in this respect (Sundmacher & Busse, 2011). The different conditions included in the analysis all have their specific health interventions at the primary or hospital care level which are essential to successfully prevent or treat the condition (Holland, 1997; Plug, Hoffmann, & Mackenbach, 2011). For example, in the case of malignant neoplasm of cervix uteri, it could be important to include variables that capture whether and how cervical cancer screening, cytology, surgery and radiation therapy have been provided. For peptic ulcer, anti-ulcer drugs and surgery for complications are important in preventing premature deaths[18]. Although important, explanatory variables that capture these key interventions were not included in our analysis due to data unavailability at the regional level. At the same time, due to insufficient numbers of deaths for these individual conditions, grouping them together makes the inclusion of condition specific quality of care

[18] Evidence from the AMIEHS project which has updated the list of 'avoidable' mortality conditions and interventions that make these deaths avoidable (Plug, Hoffmann, & Mackenbach, 2011) should be consulted.

explanatory variables complicated. Overall one needs to consider the trade-off between analysing individual 'avoidable' causes versus all 'avoidable' causes grouped together and the best suited variables to be used to capture high quality health care provision. At the aggregate level, proxy variables may be used for effective prevention, integration of care, treatment and other elements of health care services. Thus 'avoidable' mortality conditions should be studied individually for those conditions where sufficient numbers of deaths exist, as the results obtained will be more informative to policy makers.

Finally, contrary to earlier studies, this chapter has applied different analytical models to address problems, in particular endogeneity and dynamics. The analysis has shown that an instrumental variable model is not more appropriate than our fixed effects model. Even though earlier studies have suspected endogeneity of physician supply, in the case of Slovakia and the Czech Republic, endogeneity may not in fact be a problem as health care resource planning has not been based on health care needs (e.g. mortality, morbidity) of the population but per capita. Furthermore, the choice of instruments has always been a strongly contested topic (Angrist & Krueger, 2011). Using different and perhaps more appropriate instruments for physician supply instead of number of dwellings completed in a given year or length of roads and motorways may have led to different results. While these instruments have passed the Sargan test, conceptually there may be stronger and more appropriate instruments. However, due to data limitation no other suitable instruments could be identified for this analysis. There are also a number of important variables missing in the analysis, such that the coefficients in the dynamic model may be biased.

To conclude, health care inputs do not consistently explain health outcomes, even when an improved indicators such as 'avoidable' mortality is used. Variations in

'avoidable' mortality could possibly be explained when effective and high quality of care for individual conditions is captured with better quality data. Then with the use of more sophisticated analytical models accounting for endogeneity or dynamic influences, the existence of a significant negative relationship with 'avoidable' mortality may be shown. At the same time, non-health system determinants and other risk factors need to be better accounted for. While it is difficult to determine at the aggregate level the extent to which health care interventions prevent unnecessary deaths, the most recent evidence from the AMIEHS project continues to point to the fact that 'avoidable' mortality indicators may be most useful for an initial understanding of how the health care system is performing. Therefore, unnecessary and potentially 'avoidable' deaths should be used as it was originally intended - as a tool to provide insights into the quality and weaknesses of the health care system where further systematic investigations for the underlying reasons are necessary (Holland & Breeze, 1985; James, Manuel, & Mao, 2006; Kossarova, Holland, Nolte, et al., 2009; Plug, Hoffmann, & Mackenbach, 2011). In the future, applying more accurate explanatory variables to capture timely and effective interventions rather than health care inputs that do not sufficiently reveal to us how a health care system is working, is essential.

Chapter 5. Examining the quality of ambulatory care in Slovakia using outcome and process indicators

5.1. Introduction

Chapters 2, 3 and 4 have focused on the macro level, using health outcomes to measure health system performance first and then health care performance more specifically. This chapter moves to the assessment at the micro level by looking at the quality and effectiveness of one aspect of the health care system in Slovakia – ambulatory care – using individual patient level data. Diabetes and asthma are two of the several chronic ACSCs, which if treated by timely and effective ambulatory care should not result in unnecessary hospitalisations. As highlighted in Chapter 1, hospitalisations for ACSCs (ACSHs) or preventable hospitalisations have been suggested and used as a population level indicator of access and quality of outpatient care. Therefore, one goal has been an attempt to describe trends in ACSHs. In addition, studies have also tried to assess and validate to what extent variations in preventable hospitalisations are associated with different factors, especially age, sex, socio-economic conditions, health system factors and others. This evidence is summarised against an analytical framework in Chapter 1.

The evidence on the effectiveness of interventions aimed at reducing unplanned admissions on the population level remains limited (Ansari, 2007a; Purdy, 2010). Purdy (2010) identifies several interventions which may work in reducing avoidable admissions, including continuity and integration of care, patient self-management, acute assessment units or early review by a senior clinician in the emergency department, among others. The evidence on the association between higher quality of primary care, as measured by routine data and reduced rates of admission, is mixed

(Bottle, Gnani, Saxena et al., 2008; Downing, Rudge, Cheng et al., 2007; Purdy, 2010; Saxena, George, Barber et al., 2006). However, these studies are carried out at the aggregate level for groups of conditions where certain important factors, including condition specific appropriate care, cannot be examined. Information about the quality and appropriateness of care of individual patients is essential in order to make quality of care improvements (Shekelle & Roland, 2000, p.172). This chapter therefore aims to fill this gap in the literature using patient level data for diabetic and asthma patients. In particular, individual variations in potentially preventable diabetes and asthma hospitalisations will be analysed and whether the provision of (in)appropriate care can explain these variations.

In 2011 United Nations General Assembly launched a global campaign to tackle the increasing burden of premature deaths from non-communicable diseases, including chronic respiratory diseases, diabetes, cardiovascular diseases and cancers (UN News Centre, 2011). Diabetes and asthma are chronic conditions that can seriously affect a patient's quality of life. In 2012, over 35 million people had diabetes in Europe which is about 7.9% of the adult population (European Diabetes Leadership Forum Copenhagen, 2012a); in Slovakia prevalence in 2010 was 6.3% (National Health Information Centre, 2011). Asthma is the most common chronic disease among children and worldwide affects over 300 million people (Global Initiative for Asthma, 2012); adult prevalence in Slovakia is between 3-5% and among children as high as 6-7% (Hrubisko & Ciznar, 2010). Given the high morbidity and mortality for these conditions, prevention, early diagnosis and appropriate treatment are fundamental.

Parallel and in response to the UN global campaign, a number of disease specific initiatives have been emerging. In 2010 the Global Initiative for Asthma (GINA) embarked on the GINA Asthma Challenge which aims to reduce hospitalisations due to asthma by 50% by 2015, using the number of hospital admissions as the primary

marker of success (FitzGerald, Bateman, Hurd et al., 2011). Hospitalisations were selected as the main outcome measure as they are directly associated with mortality, are considered inconvenient for the patient, and together with medications are also a key driver of health care costs (Bahadori, Doyle-Waters, Marra et al., 2009; FitzGerald, Bateman, Hurd, et al., 2011). More importantly, asthma hospitalisations are highly responsive to interventions and decrease as access to care and controller treatment is provided (FitzGerald, Bateman, Hurd, et al., 2011). While emergency admissions are sometimes necessary for specialist management of severe exacerbation, about three quarters are preventable and usually represent a serious loss of control of a person's asthma (NHS RightCare, 2011). The hospitalisation reduction target may seem challenging but important reductions in admissions have already been achieved in Finland, through the coordination of access to a uniform package of care, involving education, pharmacotherapy and follow-up (Haahtela, Tuomisto, Pietinalho et al., 2006). For diabetes, the Copenhagen Roadmap presents practical and concrete initiatives to improve prevention, early detection, control and treatment. It is a result of extensive political and policy efforts to provide detailed steps for the National Diabetes Guidelines (European Diabetes Leadership Forum Copenhagen, 2012b). Diabetes can be considered an illness upon which there is widespread consensus on good practice patterns and international convergence for processes and outcome of care (Nicolucci, Greenfield, & Mattke, 2006). As with asthma, experts agree that diabetes can and should be effectively managed and people should be ensured access to safe and effective treatments which improve control, reduce long-term complications and prevent hospitalisations (European Diabetes Leadership Forum Copenhagen, 2012b).

Overall, there is consensus that the goal is to reduce the number of hospitalisations but as has been noted in Chapter 1, the appropriate number or rate of hospitalisations is not straightforward to determine. Especially, if detailed clinical information about

the patient is not available. It is rather the observed variation in hospitalisations that this chapter is interested in explaining, as large fluctuations may suggest that some patients are not receiving the best recommended care, or that health care resources are not being used appropriately (Evans, 1990; Mercuri & Gafni, 2011). Variations in the quality of health care in the United States have been subject to debate for some time (Wennberg & Gittelsohn, 1973) and have increasingly led to quality improvement strategies. A review of studies in the United States found that approximately 20% of patients received inappropriate care for their chronic condition (Schuster, McGlynn, & Brook, 1998). The Institute of Medicine (IOM) Committee on the Quality of Health Care in America also found that there is a large gap between the care patients *should* receive and the quality of care they *actually* receive (IOM, 2001). While the conclusions of the IOM Committee were for the United States, quality advocates largely agree that the same applies for other Western countries (Timmermans & Berg, 2003), and the European Union (Legido-Quigley, McKee, Nolte, et al., 2008). A review of quality measurement and improvement concludes that in Slovakia "systematic approaches to quality of care are still at a basic stage of development" (Legido-Quigley, McKee, Nolte, et al., 2008, p. 168) and securing quality of care while ensuring financial sustainability remains a challenge (Szalay, Pažitný, Szalayová, et al., 2011). While many clinical guidelines have been adopted, their uptake is sporadic and the extent to which quality of health care initiatives are implemented is not evaluated (Legido-Quigley, McKee, Nolte, et al., 2008). A 2008 report assessing the quality of diabetes care ranked Slovakia less favourable and showed that there is significant room for improvement (Health Consumer Powerhouse, 2008).

More generally, the key tools proposed to address quality of care gaps, variations in medical care and rising health care costs are performance standards, information technology and evidence-based clinical guidelines (de Jong, Groenewegen,

Spreeuwenberg et al., 2010; IOM, 2001; Timmermans & Berg, 2003). In particular, the focus is not on whether standards and evidence - based clinical guidelines should exist but what form they should take, and how they should be implemented to improve quality of care (Timmermans & Berg, 2003). Clinical guidelines ("codified rules defining appropriate care or high quality medical care" (Nigam, 2012)) are designed to help physicians decide on the most appropriate form of care for the patient, especially when in doubt. Guidelines may also set the minimum required treatment. However, the existence of clinical guidelines does not necessarily guarantee their uptake or use. A range of factors determines whether physicians will treat according to guidelines, including: the type of health problem; how the guidelines were developed; content of the guideline; source of dissemination; format or layout (Grol & Grimshaw, 2003). Evidence shows that most of the guidelines are just another source of reference for physicians about state-of-the-art practice and are often not adhered to. As such, guidelines still have a long way to go in terms of changing the day to day practice of providers (Timmermans & Berg, 2003). Therefore, extensive efforts are being undertaken to learn about how physicians' behaviour and medical practice can be changed (Grol & Grimshaw, 2003). Regardless of the extent of uptake, clinical guidelines can be used as baselines to assess the quality of care provided for a particular condition.

Several studies have looked at the extent to which appropriate medical care, measured through selected indicators for asthma and diabetes, are associated with hospitalisations. A systematic literature review on the extent to which quality indicators for diabetes care are related to patient outcomes presented mixed results (Sidorenkov, Haaijer-Ruskamp, de Zeeuw et al., 2011). The study found that while many structure and process indicators are widely accepted and may have content and face validity, and are feasible, they may not necessarily have predictive validity, i.e. high scores on process indicators may not necessarily be associated with better

patient outcomes (Sidorenkov, Haaijer-Ruskamp, de Zeeuw, et al., 2011). The authors grouped the papers according quality components. Studies that looked at structural indicators usually had a weak design and found no associations with outcomes or produced mixed results. Four studies considered to be of 'high quality' in the review measuring process indicators such as numbers of tests or visits showed mostly negative results. Overall, Sidorenkov et al (2011) argue that for many widely used quality indicators, there is insufficient evidence to conclude that they lead to better patient outcomes. However, these results often rely on studies of insufficient quality, or limited geographic variation, especially as many are based on the US. Sidorenkov et al (2011) calls for more evidence to support the argument that there is relationship between quality of diabetes care - as currently assessed - and patient outcomes. In the same year a study using multiple regression analysis assessing the association between indicators of quality of diabetic management and emergency hospital admissions for short-term complications of diabetes in the United Kingdom found that GP practices with better quality of diabetes care had fewer emergency admissions (Dusheiko, Doran, Gravelle et al., 2011).

For asthma, less evidence is available as quality of care indicators are not yet widely agreed on and applied. However, several studies found that adequate disease management and adherence to clinical guidelines by primary care providers is associated with less hospitalisations (Cloutier, Hall, Wakefield et al., 2005; FitzGerald & Quon, 2010; Fontes, Affonso, Calazans et al., 2011; Fuhrman, Dubus, Marguet et al., 2011; Rodrigo, Plaza, Bellido-Casado et al., 2009). Overall, two types of medication are used to treat asthma: i) controllers – used for everyday long term use with the goal of controlling asthma through anti-inflammatory effect; and ii) relievers – used when needed during exacerbations to ensure fast relief from symptoms (Hrubisko & Ciznar, 2010). However, excessive amount of reliever medication, in particular short acting beta agonists (SABA) may also suggest

inappropriate treatment (Gilberg, Laouri, Wade et al., 2003; Walters, Walters, & Gibson, 2009). While SABA are considered to be the most effective reliever medication, utilisation that exceeds two times per week is a warning that asthma control is worsening and there is need to begin or intensify anti-inflammatory treatment (Hrubisko & Ciznar, 2010). Furthermore, the use of oral corticosteroids and antibiotics (Breekveldt-Postmaa, Gerritsb, Lammersc et al., 2004) may suggest inappropriate care and be therefore positively associated with hospitalisations. If systemic glucocorticosteroids are taken for 5-10 days, they may prevent hospitalisation and reduce morbidity; however, if more than three treatments are given in a year, there is a need to consider and reassess the treatment plan as the patient may be receiving bad care (Hrubisko & Ciznar, 2010). Therefore, these medications will also be included in the analysis.

The goal of this chapter is to contribute to this body of evidence by examining both outcome and process quality of care indicators, and their relationship. This is done in three steps: first, by simply examining variations in ACSHs for diabetes and asthma; second, by analysing the extent to which appropriate treatment - measured through process indicators derived from clinical guidelines - is provided to asthma and diabetes patients. Process measures are direct measures of quality (Mant, 2001), especially those included in clinical guidelines. Process measures used are simple to interpret - the more people without the contraindication who receive the therapy, the better; those who do not receive it yet, need to receive it (Mant, 2001). A third step involved an evaluation of the relationship between individual level variations in ACSHs (outcome indicator) and (in)appropriate care (process indicators) using panel data techniques. Some argue that in order for process indicators to be valid, there must be a strong relationship between the process and outcome measures (Hammermeister, Shroyer, Sethi et al., 1995; Rubin, Pronovost, & Diette, 2001); however others state that such relationships are not necessary if process measures

are judged by clinical experts to be important to patient outcomes (Mant, 2001). Once the relationship is established, resources can be directed to those processes shown to have the greatest impact on patient outcomes (Hammermeister, Shroyer, Sethi, et al., 1995). However, even if such a relationship is not established, understanding whether processes of care suggested in clinical guidelines are adhered to is important so that improvements in quality of care can be implemented.

5.2. Data and methods

Data

This study uses nationally representative administrative data from the largest public health insurance company (the General Health Insurance Company (GHIC)) in Slovakia between 2001 and 2008. The individual patient level data was obtained after extensive personal negotiations with the GHIC.[19] During this period GHIC covered about 70% of the national market with approximately 3.4 million people insured. Patients were included in the study population if they obtained outpatient or inpatient care, including diagnostic tests for diabetes (ICD-10 code E10) and asthma (ICD-10 code J45) in 2002 and had no such claim in 2001 ("disease free"). Given the limitations of administrative data, which do not collect information on the illness severity, choosing patients based on the ICD-10 diagnosis has provided us with a very large sample where not all the individuals may actually suffer from diabetes or asthma. Therefore, an additional criterion has been applied whereby only patients with at least two diabetic (referred to as "diabetes patients" throughout the chapter) or at least one asthma (referred to as "asthma patients" throughout the chapter) medication in any given year are included in the sample (Renard, Bocquet, Vidal-Trecan et al., 2011). For diabetic patients, this included drugs listed with the

[19] The data was successfully obtained after 1 year.

Anatomical Therapeutic Chemical (ATC) code "A10"; for asthma patients the ATC code was "R03". Drugs were counted as prescriptions where some had multiple drug packages on them. Therefore, this study included a total of 10,561 diabetes patients with at least two anti-diabetic prescriptions in any given year; the total number of patients prior to the medication restriction with a diabetes ICD-10 code (E10) was 49,982. For asthma, there were a total of 2,508 asthma patients with at least one asthma prescription in any given year; the total number of patients prior to the medication restriction with an ICD 10 code (J45) for asthma was 67,128.

By following this process, patients who have died or left the insurance company, or who may have been either the oldest or the sickest were automatically excluded. At the same time those patients who are treated with life-style changes only, so potentially the healthiest, were also excluded. Patients with a unique identifier and their personal characteristics (age, sex, region of residence) were then followed for the period of 2002-2008 and data on all the medical care provided to them, including outpatient medical visits and procedures (primary or specialist care), hospitalisations, laboratory tests and medications, were collected. For each item the ICD-10 diagnosis is provided and the actual procedure or drug code could be identified through the GHIC's code book of medical procedures. Services or drugs provided during the hospitalisation could not be identified. Finally, the database does not provide information on test results or other patient behaviour information.

The dependent variable (*hosp*) is defined as the total number (a count variable) of ACSC diabetes or asthma admissions a patient has had in a given year (see Table 24 for the relevant ICD-10 hospitalisation codes used by condition). Patients who were not hospitalised at all during the period of the study were excluded from the panel data analysis as the focus was on the relationship between hospitalisations and quality of care variables. All the hospitalisations for these two chronic conditions

were included and counted as an adverse outcome even though some of these may actually have been necessary hospitalisations. For example, about 5-10% of asthma patients are classed as 'complicated', with so called "difficult to treat asthma", whose hospitalisations may be difficult to prevent (Hrubisko & Ciznar, 2010). Yet these patients cannot be identified in the dataset. As diabetic patients are likely to have first been diagnosed at hospital, these hospitalisation episodes were not counted within the main dependent variable.

Table 24. ICD-10 codes used for identifying hospitalisations

Diagnosis	ICD 10 Code	List of fourth character sub-divisions used
Insulin dependent diabetes mellitus	E10	.0 with coma .1 with ketoacidosis .2+ with renal complications Diabetic nephropathy (N08.3*) Intracapillary glomerulonephrosis (N08.3*) Kimmelstiel-Wilson syndrome (N08.3*) .3+ with ophthalmic complications cataract (H28.0*) retinopathy (H36.0*) .4+ with neurological complications amyotrophy (G73.0*) autonomic neuropathy (G99.0*) mononeuropathy (G59.0*) polyneuropathy (G63.2*) autonomic (G99.0*) .5 with peripheral circulatory complications gangrene peripheral angiopathy+ (I79.2*) ulcer .6 with other specified complications Diabetic arthropathy+ (M14.2*) Neuropathic diabetic arthropathy+ (M14.6*) .7 with multiple complications .8 with unspecified complications .9 without complications
Non-insulin dependent diabetes mellitus	E11	
Malnutrition related diabetes mellitus	E12	
Other specified diabetes mellitus	E13	
Unspecified diabetes mellitus	E14	
Asthma	J45	.0 predominantly allergic asthma
	J45	.1 nonallergic asthma
	J45	.9 asthma, unspecified
	J46	Status asthmaticus
	J47	Bronchiectatis
	J81	Pulmonary oedema

Source: (NHS Institute for Innovation and Improvement, 2012; The NYU Center for Health and Public Service Research of the Robert F. Wagner Graduate School of Public Service) and ACSCs ICD 10 codes obtained from personal e-mail communication with prof. Billings, J. on May 6, 2009

Independent variables were constructed based on relevant clinical guidelines for each chronic disease (see Table 25 below) (Hrubisko & Ciznar, 2010; Uliciansky, Mokan, Nemethyova et al., 2007). A number of different international clinical guidelines are available for both conditions. Usually, countries adopt these guidelines directly or adjust them. Slovakia first developed its own diabetes guidelines in 2007 (Uliciansky, Mokan, Nemethyova, et al., 2007) and asthma guidelines in 2010 (Hrubisko & Ciznar, 2010). In both cases the authors have built on widely used international clinical guidelines, translated certain sections directly and adjusted other parts to local circumstances. The guidelines set out algorithms for how to proceed with a patient's treatment depending on the severity of illness but also highlight basic steps for prevention or treatment for all patients regardless of severity of illness. These guidelines are used to construct process indicators of quality of care in our study. For diabetes, in addition to the existence of the clinical guidelines, there is international agreement and convergence on good practice and use of process and outcome indicators to assess and compare the quality of diabetes care (Health Consumer Powerhouse, 2008; Nicolucci, Greenfield, & Mattke, 2006). Asthma has received less attention in terms of quality of care process indicators, despite seemingly widespread agreement on appropriate treatment approaches within clinical guidelines. The predicted relationships between our dependent and independent variables are highlighted in Table 25.

Table 25. Patient level independent variables constructed based on clinical guidelines

Condition	Appropriate care	Source	Independent variables	Variable name	Notes	Predicted effect
Diabetes	Measure HbA1c at least 4/year Screening for nephropathy at least 1/year Ophthalmologic exam at least 1/year Doctor visit at least 2/year Cholesterol test at least 1/year	Slovak Guidelines for Diabetes (2007) OECD Quality Indicators Project (2006)	**Dummy variables** 1 if at least 4 HbA1c tests/year 1 if at least 1 urine test/year 1 if at least 1 ophthalmologic exam/year 1 if at least 2 visits/year	*qual_hba1c* *qual_urine* *qual_eye* *qual_visit*		Negative Negative Negative Negative
Asthma	Flu vaccination every year Spirometry at least 1/year Regular doctor visits (1-6 months; every 3 months once asthma is controlled) ***Possibly inappropriate care:*** Excessive use of short acting beta agonists (SABA) Excessive use of corticosteroids and antibiotics	Slovak Guidelines for Asthma (2010)	**Dummy variables:** 1 if at least 1 flu vaccine/year 1 if at least 1 spirometry/ year 1 if at least 2 visits/year **Count variables:** SABA Corticoids Antibiotics **Dummy variables:** 1 if more than 3 corticoid prescriptions/year	*qual_flu* *qual_tot_spir* *qual_visit* *saba* *cort* *antib* *bad_cort*	While the Slovak Guidelines were only prepared in 2010, the GINA guidelines from 2002 also used in Slovakia already recommended the same treatment	Negative Negative Negative Positive Positive Positive Positive

Dummy variables were constructed, where the value 'one' was given if the appropriate care criterion recommended was fulfilled, 'zero' otherwise. For all the variables, a negative association is expected between appropriate care and hospitalisations and a positive association between potentially inappropriate care and hospitalisations. Our variables of interest for diabetes are visits, glycated haemoglobin (HbA1c) tests, ophthalmologic exam and urinalysis. As has already been discussed above, the available evidence on the relationship between these process indicators and hospitalisations is mixed. For asthma our variables of interest are: number of visits, spirometry tests, whether or not the patient has received the flu vaccine in any given year. In line with the literature review in the previous section, the number of prescriptions for the following medications was also included in the analysis: SABA, antibiotics and corticoids. Finally, personal characteristics including age and sex (Melero Moreno, López-Viña, García-Salmones Martín et al., 2012), and comorbidities were controlled for. Comorbidities were defined as the total number of other (non-diabetes or asthma) ICD-10 codes for which the patient obtained any type of medical care. Analysis was carried out separately for asthma and diabetes with the specific indicators of quality of care. Table 26 below summarises the relevant procedure or ATC codes used to identify the visits, procedures or drugs of interest.

Table 26. Summary of procedure and ATC codes used to design variables

Variables	Procedure/ATC codes
Diabetes physician visits	First, only visits with the diabetes ICD codes identified in Table 24 were used. Then the following procedure codes identified a visit: 1, 4, 8, 60, 62, 63, 25, 3439 and 3440.
HbA1c tests	4587A
Cholesterol	3674, 3674A, 3675, 3675A, 3676, 3676A, 3677, 3677A
Ophthalmologic visit	Ophthalmologic codes: 1200, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1208, 1209, 1214,1215, 1216, 1217, 1218, 1220, 1222, 1225, 1226, 1227, 1228, 1229, 1230, 1240, 1241, 1242, 1244, 1246, 1246A, 1249, 1250, 1251, 1255, 1256, 1257, 1262, 1265, 1266, 1271, 1273A, 1273B, 1273D, 1273E, 1274, 1275, 1275A, 1275B, 1276, 1277, 1278, 1279, 1282, 1293, 1294. These ophthalmologic codes had to be used in conjunction with the following visit codes: 1, 4, 8, 60, 62, 63, 25, 3439 and 3440.
Urinalysis	3525, 3526
Insulin	A10A
Asthma physician visits	First, only visits with the asthma ICD codes identified in Table 24 were used. Then the following procedure codes identified a visit: 1, 4, 8, 60, 62, 63, 25, 3439 and 3440.
Spirometry	691, 690, 700, 723A, 723B, 3430, 5709, 5733A, 5766, 5769, 5770, 5771
Flu vaccine	J07BB
SABA	R03AC
Antibiotics	J01
Corticoids	H02

Evidence from Chapter 1 indicates that the relationship between primary care encounters and hospitalisations at the aggregate level has been mixed. However, some of the explanatory variables, especially visits or even tests, may be endogenous as sicker people may visit the doctor more often and therefore receive more tests, but they may also be hospitalized more often. In light of this, some studies have included number of visits as a control variable indicating severity for diabetes patients which can therefore be positively associated with hospitalisation (Lin, Huang, Wang et al., 2010). Other studies treat visits and tests as endogenous variables and use instruments to deal with the problem (Bech & Lauridsen, 2008; Fortney, Steffick, Burgess et al., 2005). These studies find that primary care encounters act as substitutes to inpatient services and are therefore negatively associated with hospitalisations. Our dataset is limited and does not provide for any suitable instruments, thus the approach that was taken to address endogeneity was to construct a variable that measures good or bad care from the predicted number of visits. Predicted visits have been estimated based on age, region, comorbidities and gender using a fixed effects model. The values have been normalised, and the difference between the actual visits and predicted visit was calculated. More visits than predicted indicate potentially "good" care or overprovision and fewer visits than predicted indicate potentially "bad" care. This variable is referred to as "predicted visits" throughout the chapter.

Estimation methods

This chapter examines the relationship between hospitalisations for diabetes and asthma and lack of appropriate treatment as defined in the clinical guidelines. Poisson and negative binomial models for panel data are appropriate when the dependent variable is a count variable. As count data are usually overdispersed, the use of panel-robust standard errors is required (Cameron & Trivedi, 2010).

The baseline model is as follows:

$$\log(hosp)_{it}^{condition} = \beta_i + \beta_0 + \beta_1 age\_cat_{it} + \beta_2 sex_{it} + \beta_3 comorb_{it} + \beta_4 X'_{it} + u_i + \varepsilon_{it}$$

for i=1 ....N; t=1.....T, where i is the individual indicator and t the time (year) indicator. $Hosp_{it}^{condition}$ is the health outcome variable measuring the number of hospitalisations an individual had in a given year for the selected chronic condition (diabetes or asthma) for patients who had at least one hospitalisation during the period of the study. X' denotes a vector of the appropriate care variables as presented in the section above. Age_cat is the age category that the individual falls within based on his or her age in the baseline year (2002), *sex* represents the sex of the individual and *comorb* the number of all unique ICD-10 codes for which the patients has received a drug, diagnostic test or treatment. ε_{it} is the random disturbance term, u_i is the unobserved individual-specific time invariant effect. In this model the main demographic characteristics are controlled for but there are several omitted variables which cannot be included. Among others, for asthma these include: exposure to allergens, viral infections, indoor and outdoor pollutants and workplace pollutants; foods; drugs; obesity; emotional stress, behavioural and lifestyle factors that influence adherence to treatment (Global Initiative for Asthma, 2012; Hrubisko & Ciznar, 2010) or social deprivation (Purdy, 2010). For diabetes again these are mainly behavioural and lifestyle factors (e.g. exercise, obesity, diet) (Uliciansky, Mokan, Nemethyova, et al., 2007) as well as socioeconomic status and education (Smith, 2007). Therefore, using individual fixed effects was considered to be the most appropriate method for the analysis even though this does not allow for examining the effect of variables that do not change over time (e.g. sex). Results are reported as incidence rate ratios (IRR) where a change in the independent variable is associated

with a change in the estimated incidence rate of hospitalisations by a factor of the magnitude of the IRR reported.

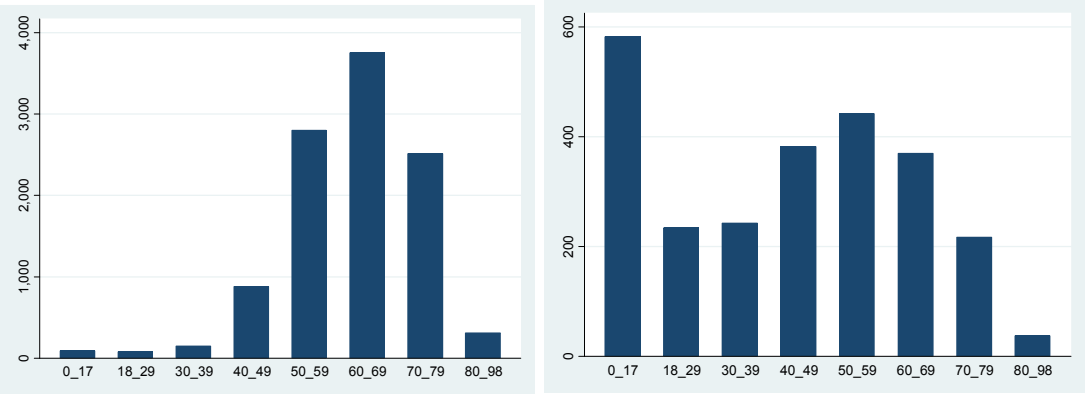
5.3. Results

Summary statistics for all diabetes and asthma patients

This study sample includes 10,561 diabetes patients and 2,508 asthma patients. The distribution of patients in the sample shows that most of the diabetes patients fall into the three categories between ages 50 to 79 while for asthma it is children and then the three age groups between 40 to 69 (Figure 25). The average age of the diabetic population in 2002 was 62 years with 60.4% females compared to only 39.6% males. Females with diabetes were, on average, older (63.7 years) than males (59.4 years). The average age of the asthma patients was 40.8 years with somewhat more females than males (60.1% versus 39.8%). Females were on average older (45.4 years) than males (33.6 years) but overall the asthma sample was younger than the diabetic sample.

Figure 25. Number of diabetes and asthma patients by age category in year 2002

a. Diabetes b. Asthma



Patients with diabetes had, on average, 4.8 visits per year and 10.5 comorbidities, while patients with asthma only had 3.15 visits but 11.9 comorbidities. With respect to condition specific medication prescriptions, patients with diabetes had, on average, 6.7 while patients with asthma only 4.8 per year. The average annual utilisation rate for ophthalmologic exams was 0.69, for HbA1c tests only 0.2, and for the flu vaccinations 0.03, all well below the recommended amount. However, for the spirometer tests it was around one annual test (1.02), consistent with the recommendations. In terms of inappropriate care, the average annual use of corticoids (0.12), antibiotics (0.12) and SABA (0.69) in the studied asthma population was low suggesting appropriate use. Finally, diabetes and asthma patients had an average of 0.04 hospitalisations in a year (Tables 27 and 28). It should be noted that the mean figures in the tables below are for the number of services rather than appropriate care variables which are discussed later.

Table 27. Diabetes - number of services

Variables	*Mean*	*Std. Dev*
HbA1c tests	0.21	0.64
Urine test	1.78	2.19
Ophthalmologic exam	0.69	1.67
Doctor visit	4.76	4.76
Cholesterol	1.86	2.91
Antidiabetic prescriptions	6.71	4.9
Hospitalisations	0.04	0.38

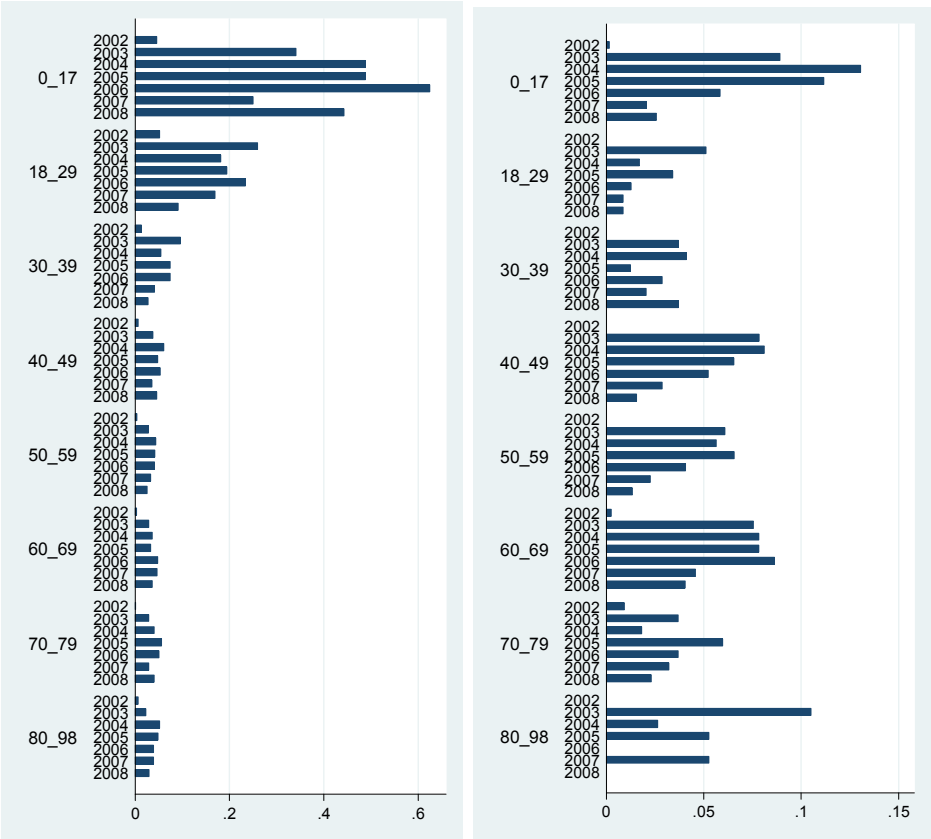
Table 28. Asthma - number of services

Variables	*Mean*	*Std. Dev*
Corticoids	0.12	0.68
SABA	0.69	1.66
Antibiotics	0.12	0.50
Flu shot	0.03	0.15
Spirometry	1.02	1.51
Doctor visit	3.15	3.28
Asthma prescriptions	4.77	4.77
Hospitalisations	0.04	0.35

The next two figures provide an overview of the mean number of hospitalisations by age groups and regions over the period of study. An important variation can be observed within all age groups over the years. The mean number of hospitalisations is the highest in the youngest age group for both conditions. It should be noted that for diabetes, the youngest age group had the smaller number of patients while for asthma it had the largest number of patients. Overall, the mean number of hospitalisations for asthma patients (max 0.13 in 2004) is in a lower range than for diabetes patients (max 0.63 in 2006).

Figure 26. Mean number of hospitalisations by age category and year

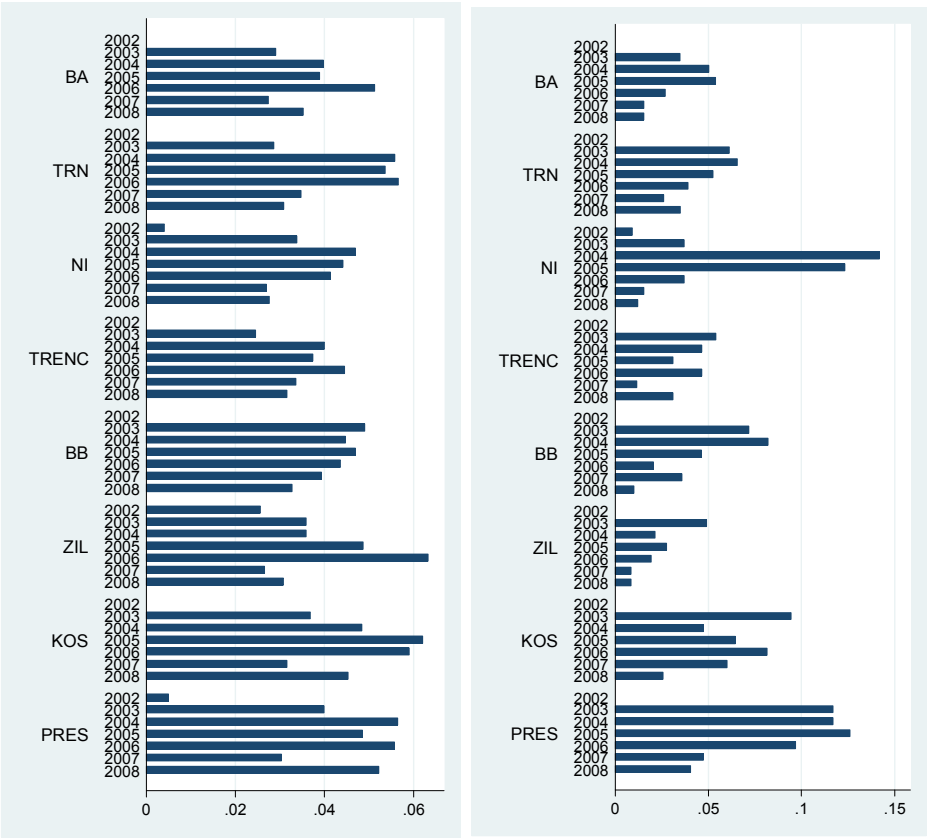
a. Diabetes b. Asthma



Again, a substantial variation can be observed in all regions over the years. For diabetes, the mean number of hospitalisations is the lowest in the Bratislava and Trencin region; for asthma, the mean number of hospitalisations is the highest in the Presovsky region.

Figure 27. Mean number of hospitalisations by region and year

a. Diabetes b. Asthma



Next, the variation in the appropriate care variables for diabetes and asthma is reviewed. The summary statistics in Table 29 suggest that for all variables, within variation for an individual over time is larger than variation between individuals.

Table 29. Summary statistics for appropriate care variables for all diabetes and asthma patients

Variable		*Mean*	*Std. Dev.*	*Min*	*Max*	*Observations*
Hospitalisations	overall	0.037808	0.377507	0	81	N = 73927
hosp	between		0.171321	0	12.7143	n = 10561
	within		0.336398	-12.6765	68.3235	T = 7
Ophthalmologic exam	overall	0.222003	0.415596	0	1	N = 73927
qual_eye	between		0.264497	0	1	n = 10561
	within		0.320573	-0.63514	1.07915	T = 7
HbA1c tests	overall	0.005181	0.071792	0	1	N = 73927
qual_hba1c	between		0.040222	0	0.8571429	n = 10561
	within		0.059467	-0.851962	0.862324	T = 7
Cholesterol tests	overall	0.394565	0.488760	0	1	N = 73927
qual_chlst	between		0.328398	0	1	n = 10561
	within		0.362008	-0.462578	1.25171	T = 7
Urine tests	overall	0.845496	0.361433	0	1	N = 73927
qual_urine	between		0.260838	0	1	n = 10561
	within		0.250206	-0.011647	1.70264	T = 7
Flu shots	overall	0.024892	0.155800	0	1	N = 17556
qual_flu	between		0.087609	0	0.857143	n = 2508
	within		0.128844	-0.832251	0.882035	T = 7
Spirometry	overall	0.469013	0.499053	0	1	N = 17556
qual_tot_spir	between		0.353779	0	1	n = 2508
	within		0.352047	-0.388129	1.32616	T = 7
Corticoids	overall	0.007405	0.085735	0	1	N = 17556
bad_cort	between		0.058837	0	0.857143	n = 2508
	within		0.062368	-0.84974	0.864548	T = 7
Visits	overall	0.621611	0.484999	0	1	N = 17556
qual_visit	between		0.294242	0	1	n = 2508
	within		0.385585	-0.23553	1.47875	T = 7

The proportion of patients who received appropriate care according to the recommended clinical guidelines is also analysed. For diabetes patients (Table 30), there is a high percentage that received at least two visits per year (between 89% and

93%), and a similar proportion (between 80% to 88%) that had at least one urine test per year. Fewer patients received the recommended number of cholesterol tests (between 34% and 44%) and ophthalmologic exams (between 19% and 27%) during the study period. There is a declining trend for both urine test and ophthalmologic exams. Less than one percent of patients with diabetes received the recommended minimum of four HbA1c tests in a year. As there are other methods of measuring glucose than the HbA1c test, the proportion of patients with a less strict criterion of at least one HbA1c test per year was assessed and the results suggest that the proportion, while still low, is significantly higher (from 6.5% in 2002 to 20% in 2008).

Table 30. Diabetes – percentage of all diabetic patients receiving appropriate care by year

Variables	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
HbA1c tests	0.1	0.5	0.3	0.5	0.8	0.7	0.7
Urine test	88	88	87	84	83	82	80
Ophthalmologic exam	27	23	24	23	21	20	19
Doctor visit	89	90	90	93	92	93	92
Cholesterol test	37	34	37	40	41	43	44

For asthma patients (Table 31), between 47 and 73 percent received the recommended at least two visits per year. For spirometry test the proportion of patients who received at least one spirometer test per year was lower (between 36% and 53%). As an indicator of potentially inappropriate care, patients who received three or more prescriptions of systemic corticoids in a year were analysed and the results show that only about one percent or less were treated in this way. However, very few patients received the recommend annual flu vaccination (between 0% and 5%).

Table 31. Asthma – percentage of all asthma patients receiving appropriate care by year

Variables	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Flu shots	0	2	5	5	3	1	2
Spirometry	36	46	50	53	51	46	46
Doctor visit	47	65	69	73	66	58	57
Corticoids	0	0.4	0.8	0.9	1	0.8	1

Summary statistics for hospitalised patients

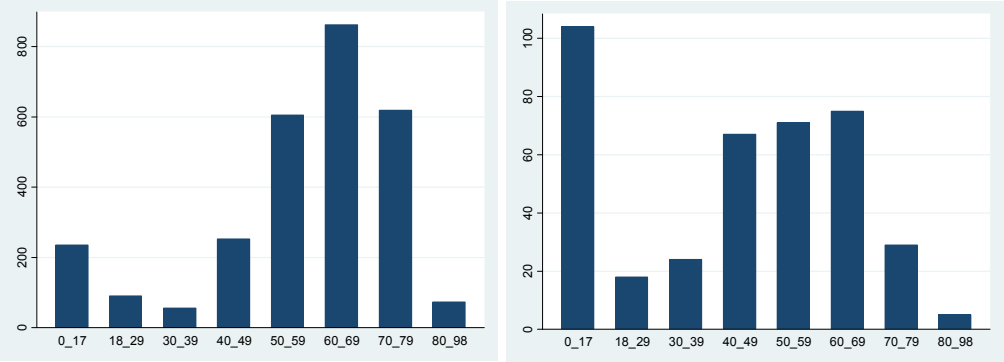
Approximately 15% of the total studied population (both for asthma and diabetes) had at least one or more hospitalisations between 2002 and 2008 (Table 32 below); in some years some patients had more than one hospitalisation while in other years it could be zero. The 1622 diabetes patients hospitalized at least once had a total of 2795 hospitalisations and the 393 hospitalized asthma patients had a total of 774 hospitalisations. Figure 28 provides an overview of the number of patients who have had at least one hospitalisation by age category. We can see that for diabetes it is people between age 60 and 69 while for asthma it is the youngest age group.

Table 32. Overview of patients with and without hospitalisation between 2002 and 2008

	Zero hospitalisations	***At least 1 hospitalisation***
Diabetes patients (N)	**8939**	**1622**
Proportion of total number of patients	85%	15%
Total number of hospitalisations	0	2795
Asthma patients (N)	**2115**	**393**
Proportion of total number of patients	84%	16%
Total number of hospitalisations	0	774

Figure 28. Number of patients with at least one hospitalisation by age category

a. Diabetes **b. Asthma**



Diabetic patients with at least one hospitalisation had on average more visits and tests than patients with no hospitalisation; however, they had a very similar amount of Hba1c tests and were younger than patients without a hospitalisation. Asthma patients with at least one hospitalisation were slightly older than patients with no hospitalisation, had more tests, visits, medications and comorbidities (see Table 33 below).

Table 33. Characteristics of patients with and without hospitalisation

	Zero hospitalisations	*At least 1 hospitalisation*
DIABETES	**Mean**	**Mean**
Hospitalisations	0	0.24
Age	65.4	62.3
Visits	4.5	6.4
Specialist	3.9	5.4
GP	0.55	1.1
Antidiabetic prescriptions	6.5	7.9
Eye	0.67	0.77
Blood	0.86	1
Urine	3.11	3.9
Hba1c	0.21	0.23
Cholesterol	1.75	2.43
Comorbidities	10.2	11.8
ASTHMA	**Mean**	**Mean**
Hospitalisations	0	0.3
Age	43.7	44.1
Visits	2.9	4.4
Specialist	2.2	3.5
GP	0.7	1
Antiasthma prescriptions	4.5	6.1
Spirometry	1	1.4
Flu	0.02	0.03
Corticoids	0.1	0.3
SABA	0.7	0.9
Antibiotics	0.1	0.3
Comorbidities	11.6	13.6

The next figure (Figure 29) provides an overview of the mean number of hospitalisations by age groups over the period of study for patients who were hospitalised at least once. While variation can be observed within and between age categories, the mean number of hospitalisations for asthma is now more similar across age groups; for diabetes, it is difficult to observe a clear trend.

Figure 29. Mean number of hospitalisations by age category and year for patients with at least one hospitalisation

a. Diabetes b. Asthma

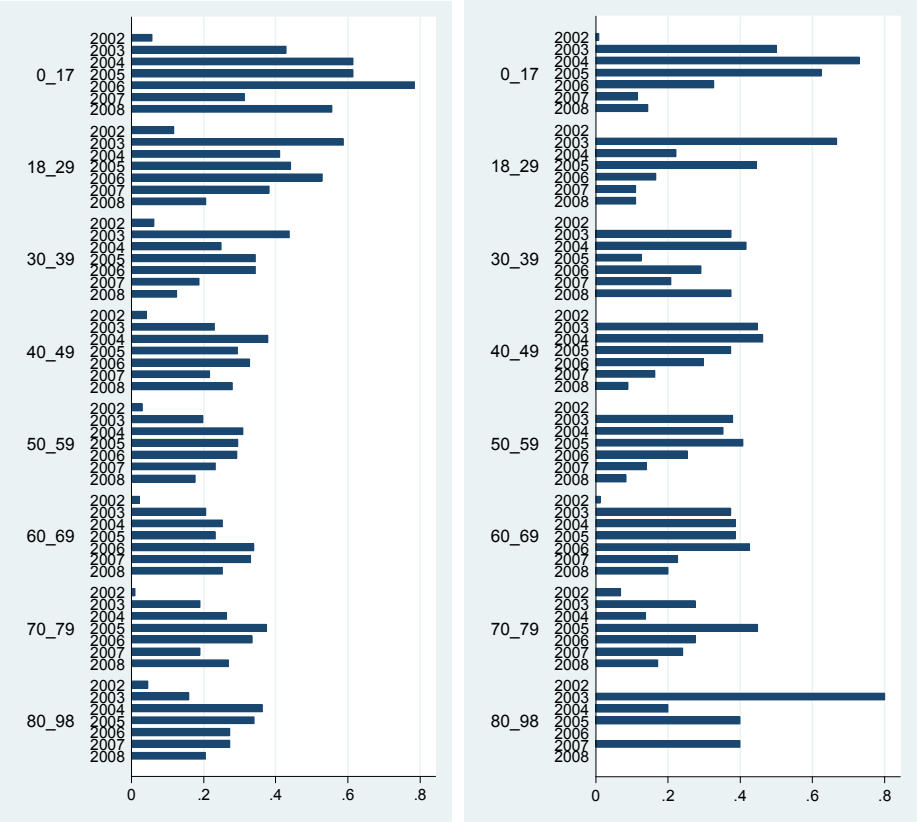


Table 34 summarizes the within and between variation in the appropriate care variables for diabetes and asthma. Apart from spirometry and overuse of corticoids, the results show that within variation for a patient over time is more important than variation between patients.

Table 34. Summary statistics for appropriate care variables for diabetes and asthma patients with at least one hospitalisation

Variable		*Mean*	*Std. Dev.*	*Min*	*Max*	*Observations*
Hospitalisations	overall	0.246169	0.936312	0	81	N = 11354
hosp	between		0.374008	0.142857	12.714290	n = 1622
	within		0.858413	-12.46812	68.531880	T = 7
Ophthalmologic exam	overall	0.235776	0.424502	0	1	N = 11354
qual_eye	between		0.267433	0	1	n = 1622
	within		0.329726	-0.621367	1.092919	T = 7
HbA1c tests	overall	0.007574	0.086705	0	1	N = 11354
qual_hba1c	between		0.053511	0	0.8571429	n = 1622
	within		0.068233	-0.84957	0.864717	T = 7
Cholesterol tests	overall	0.489783	0.499918	0	1	N = 11354
qual_chlst	between		0.305502	0	1	n = 1622
	within		0.395772	-0.36736	1.346926	T = 7
Urine tests	overall	0.844724	0.362183	0	1	N = 11354
qual_urine	between		0.236503	0	1	n = 1622
	within		0.274359	-0.012419	1.701867	T = 7
Flu shots	overall	0.030171	0.171088	0	1	N = 2751
qual_flu	between		0.103427	0	0.714286	n = 393
	within		0.136372	-0.684115	0.887314	T = 7
Spirometry	overall	0.531807	0.499078	0	1	N = 2751
qual_tot_spir	between		0.356615	0	1	n = 393
	within		0.349545	-0.32534	1.388949	T = 7
Corticoids	overall	0.021810	0.146090	0	1	N = 2751
bad_cort	between		0.100716	0	0.857143	n = 393
	within		0.105928	-0.83533	0.878953	T = 7
Visits	overall	0.725191	0.446499	0	1	N = 2751
qual_visit	between		0.249918	0	1	n = 393
	within		0.370188	-0.131952	1.582334	T = 7

The final two graphs (Figure 30 and 31) provide an overview of the proportion of diabetes and asthma patients hospitalised at least once during the period of the study who received appropriate care as recommended in the clinical guidelines. The focus is on variation in the proportion of patients (between variation) over time rather than within variation for particular patient, which will be the subject of the panel data analysis that follows. For diabetes, there is a declining trend for appropriate care in terms of urine and ophthalmologic tests, an increasing trend for cholesterol tests while the proportion of patients receiving HbA1c tests is very small. For asthma, there is declining trend of doctor visits and spirometries, with very few patients getting the flu vaccine. In terms of inappropriate care defined through excessive corticoid intake, very few patients appear to be treated inappropriately.

Figure 30. Proportion (%) of hospitalised diabetes patients who received appropriate care

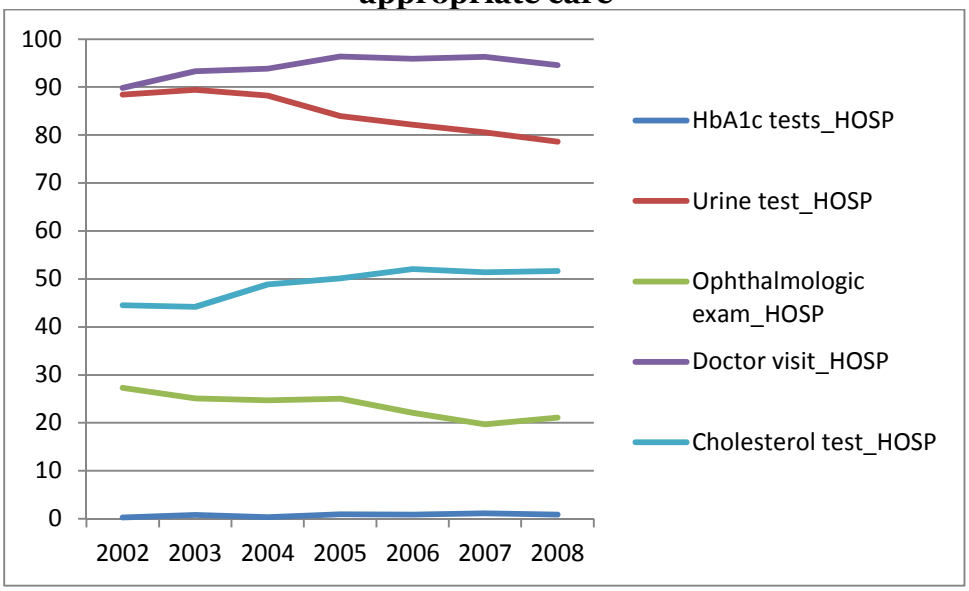
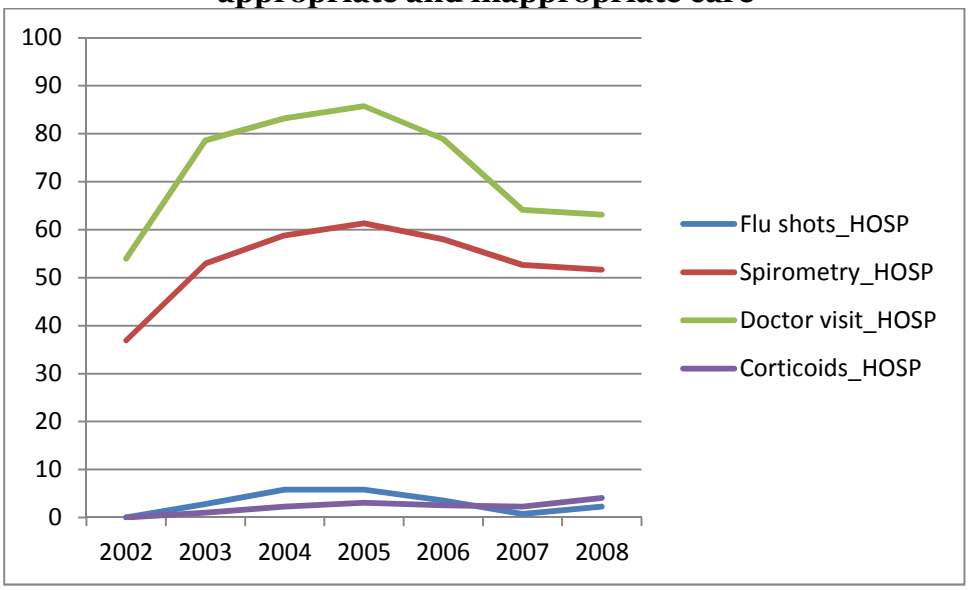


Figure 31. Proportion (%) of hospitalised asthma patients who received appropriate and inappropriate care



The next section presents the analysis of the relationship between hospitalisations and appropriate care provided for diabetes and asthma.

Poisson and Negative Binomial fixed effects regressions

Below the results of the Poisson (PFE) and Negative Binomial (NBFE) fixed effects regressions results for diabetes are presented for the group of patients who were hospitalised at least once during the period of the study (Table 35). Coefficients are Incidence Rate Ratios and have a multiplicative effect on hospitalisations. For example, the coefficient for the quality of care in terms of HbA1c tests is 1.740, suggesting that those who received at least four HbA1c tests per year as opposed to those who have not are expected to have a hospitalisation rate 1.74 greater; similarly, for those who have received the appropriate amount of ophthalmologic tests as opposed to those who have not are expected to have a hospitalisation rate 0.612 smaller (see Model 1). The output for the year dummies, for example, shows that the

hospitalisation incidence rate in year 2003 is 5.86 times the incident rate for the reference year (2002).

Whether or not predicted visits or actual visits (which we suggested may be endogenous) are included, the results remain consistent. In the first model (1&2), fewer actual visits than the predicted number of visits (potentially "bad" care) is negatively associated with hospitalisations which may suggest that these are the healthier patients and not necessarily those who receive inappropriate care. In the second model (3&4) this variable as well as visits are excluded, and the results are very similar. In the third model (5&6) a visits dummy variable (value 1 if the patient had at least two visits) was included and a positive association with hospitalisations was identified. Across the models, the results indicate that getting the recommend ophthalmologic exam is significantly negatively associated with hospitalisations. However, getting the recommended number of cholesterol and HbA1c tests is significantly positively associated with hospitalisations, while urine tests are also positively associated but only significant in the NBFE models. As expected, the number of antidiabetic medication and comorbidities is also significantly positively associated with hospitalisations across the three models, as these suggest more severe diabetes patients. Age was included in age categories and the results showed that there is no significant difference, despite the youngest age group having the highest mean number of hospitalisations. When age was included as a continuous variable, it was positively associated with hospitalisations, but not significant (see Appendix D). Finally, hospital lag which indicates whether the patient was hospitalized in the previous 12 months is significantly negatively associated with hospitalisations, possibly to be explained by our sample that includes only newly diagnosed patients who may be hospitalised more frequently initially and less so as time passes and their condition is better managed.

Table 35. Relationship between (in)appropriate care and hospitalisations of diabetic patients

VARIABLES	(1) PFE1	(2) NBFE1	(3) PFE2	(4) NBFE2	(5) PFE3	(6) NBFE3
comorb	1.056***	1.054***	1.054***	1.051***	1.053***	1.051***
	(0.00594)	(0.00516)	(0.00607)	(0.00509)	(0.00602)	(0.00509)
gender		1.187		1.124		1.126
		(0.389)		(0.369)		(0.370)
qual_eye	0.612**	0.777***	0.619**	0.783***	0.618**	0.779***
	(0.147)	(0.0527)	(0.146)	(0.0531)	(0.144)	(0.0529)
qual_hba1c	1.740**	1.694**	1.743**	1.687**	1.723**	1.675**
	(0.471)	(0.424)	(0.475)	(0.424)	(0.467)	(0.421)
qual_chlst	5.164***	6.721***	5.360***	7.002***	5.325***	6.956***
	(0.804)	(0.464)	(0.859)	(0.482)	(0.848)	(0.479)
qual_urine	1.155	1.808***	1.190	1.849***	1.144	1.793***
	(0.394)	(0.170)	(0.407)	(0.174)	(0.398)	(0.170)
badpred_visit	0.663**	0.541***				
	(0.121)	(0.0437)				
hosplag	0.601***	0.503***	0.602***	0.506***	0.599***	0.505***
	(0.115)	(0.0311)	(0.113)	(0.0313)	(0.111)	(0.0313)
antid	1.055***	1.048***	1.064***	1.059***	1.062***	1.058***
	(0.0119)	(0.00813)	(0.0103)	(0.00806)	(0.0103)	(0.00807)
insu		3.786***		4.161***		3.998***
		(1.804)		(1.953)		(1.842)
_Iage_cat_2	0.783	0.868	0.804	0.883	0.805	0.884
	(0.292)	(0.226)	(0.302)	(0.230)	(0.300)	(0.230)
_Iage_cat_3	0.581	0.710	0.597	0.698	0.596	0.699
	(0.360)	(0.340)	(0.374)	(0.332)	(0.372)	(0.332)
_Iage_cat_4	0.367	0.431	0.375	0.406	0.377	0.408
	(0.273)	(0.246)	(0.282)	(0.228)	(0.283)	(0.230)
_Iage_cat_5	0.341	0.461	0.355	0.433	0.350	0.430
	(0.277)	(0.273)	(0.292)	(0.252)	(0.287)	(0.249)
_Iage_cat_6	0.241	0.402	0.255	0.374*	0.249	0.369*
	(0.210)	(0.244)	(0.226)	(0.223)	(0.221)	(0.219)
_Iage_cat_7	0.221	0.397	0.235	0.354*	0.231	0.351*
	(0.204)	(0.247)	(0.220)	(0.216)	(0.216)	(0.213)
_Iage_cat_8	0.227	0.533	0.247	0.467	0.244	0.467
	(0.231)	(0.349)	(0.256)	(0.300)	(0.252)	(0.299)
_Iyear_2003	5.842***	6.239***	5.523***	5.790***	5.523***	5.781***
	(1.057)	(1.075)	(0.985)	(0.995)	(0.988)	(0.994)
_Iyear_2004	7.116***	8.246***	6.692***	7.386***	6.701***	7.374***
	(1.633)	(1.468)	(1.391)	(1.308)	(1.401)	(1.307)
_Iyear_2005	7.405***	8.041***	6.905***	7.297***	6.856***	7.249***
	(1.540)	(1.450)	(1.372)	(1.309)	(1.372)	(1.302)
_Iyear_2006	8.199***	8.794***	7.602***	7.986***	7.562***	7.931***
	(1.803)	(1.603)	(1.580)	(1.447)	(1.587)	(1.439)
_Iyear_2007	6.810***	5.775***	6.438***	5.388***	6.393***	5.338***
	(1.629)	(1.034)	(1.644)	(0.961)	(1.623)	(0.953)
_Iyear_2008	5.568***	5.902***	5.025***	5.155***	5.034***	5.152***
	(1.187)	(1.102)	(1.028)	(0.955)	(1.035)	(0.955)
qual_visit					1.712***	1.529***
					(0.324)	(0.249)
Constant		0.0321***		0.0257***		0.0183***

		(0.0214)		(0.0168)		(0.0122)
Observations	11,266	11,266	11,266	11,266	11,266	11,266
Number of v1	1,621	1,621	1,621	1,621	1,621	1,621

Standard errors in parentheses.
Coefficients are Incidence Rate Ratios.
*** p<0.01, ** p<0.05, * p<0.1

Similarly for asthma (Table 36 below), results are broadly consistent across the different models. In the first model (1&2), fewer actual visits than the predicted number of visits is negatively associated with hospitalisations which may again suggest that it is the healthier patients who visit the doctor less and are also hospitalised less frequently. In the second model (3&4) this variable was excluded and the results remained very similar. In the third model (5&6) a visits dummy (value 1 if the patient had at least 2 visits) was included and a positive association with hospitalisations was identified. Across the models, there is no significant association between hospitalisations and whether the patient gets the recommend flu vaccine or spirometer test or more than three corticoid prescriptions in a year. However, excessive usage of SABA, antibiotics and corticoids is significantly positively associated with asthma hospitalisations. Comorbidities are positively associated with asthma hospitalisations but are not significant in any of the models. Finally, hospital lag, which indicates whether the patient was hospitalized in the previous 12 months, is significantly negatively associated with hospitalisations.

Table 36. Relationship between (in)appropriate care and hospitalisations for asthma patients

VARIABLES	(1) PFE1	(2) NBFE1	(3) PFE2	(4) NBFE2	(5) PFE4	(6) NBFE4
comorb	1.018*	1.018**	1.019*	1.019**	1.019*	1.020**
	(0.01000)	(0.00884)	(0.0104)	(0.00880)	(0.0103)	(0.00882)
gender		1.089		0.979		0.994
		(0.523)		(0.456)		(0.465)
qual_flu	0.769	0.914	0.724	0.860	0.735	0.896
	(0.234)	(0.237)	(0.233)	(0.224)	(0.235)	(0.233)
qual_tot_spir	0.906	0.918	0.987	1.018	0.962	0.928
	(0.119)	(0.116)	(0.132)	(0.126)	(0.133)	(0.118)
bad_cort	0.496	0.465	0.477	0.424*	0.478	0.440
	(0.285)	(0.232)	(0.278)	(0.216)	(0.279)	(0.223)
badpred_visit	0.595***	0.548***				
	(0.0698)	(0.0622)				
saba	1.154***	1.150***	1.170***	1.169***	1.165***	1.159***
	(0.0484)	(0.0357)	(0.0502)	(0.0362)	(0.0476)	(0.0358)
cort	1.145**	1.152***	1.152**	1.164***	1.150**	1.155***
	(0.0627)	(0.0567)	(0.0650)	(0.0578)	(0.0651)	(0.0574)
antib	1.073	1.052	1.094	1.069	1.091	1.067
	(0.0973)	(0.0658)	(0.108)	(0.0666)	(0.106)	(0.0667)
hosplag	0.601***	0.583***	0.594***	0.576***	0.596***	0.580***
	(0.0597)	(0.0638)	(0.0599)	(0.0632)	(0.0598)	(0.0637)
_Iage_cat_2	0.435	1.079	0.377	0.943	0.372	0.991
	(0.572)	(0.630)	(0.511)	(0.553)	(0.486)	(0.568)
_Iage_cat_3	0.364	1.415	0.299	1.153	0.291	1.268
	(0.547)	(0.781)	(0.461)	(0.627)	(0.435)	(0.689)
_Iage_cat_4	0.491	1.974	0.415	1.614	0.405	1.893
	(0.769)	(0.950)	(0.667)	(0.755)	(0.632)	(0.890)
_Iage_cat_5	0.725	2.762**	0.596	2.154*	0.581	2.596**
	(1.158)	(1.310)	(0.975)	(0.988)	(0.922)	(1.201)
_Iage_cat_6	0.645	1.652	0.561	1.333	0.533	1.565
	(1.071)	(0.842)	(0.955)	(0.653)	(0.884)	(0.772)
_Iage_cat_7	1.119	2.398	0.961	1.805	0.907	2.223
	(1.939)	(1.429)	(1.700)	(1.045)	(1.564)	(1.277)
_Iage_cat_8	1.583	2.730	1.409	2.100	1.285	2.214
	(2.983)	(2.889)	(2.686)	(2.174)	(2.398)	(2.329)
_Iyear_2003	33.59***	37.89***	36.57***	42.95***	35.42***	38.78***
	(21.06)	(21.96)	(22.91)	(24.99)	(22.27)	(22.54)
_Iyear_2004	40.86***	40.21***	45.69***	47.42***	44.52***	41.99***
	(26.89)	(23.47)	(29.96)	(27.76)	(29.79)	(24.57)
_Iyear_2005	38.51***	37.81***	43.60***	45.52***	42.24***	39.66***
	(25.33)	(22.11)	(28.51)	(26.68)	(28.22)	(23.24)
_Iyear_2006	26.45***	30.96***	29.20***	35.91***	28.76***	32.73***
	(16.92)	(18.15)	(18.67)	(21.11)	(18.44)	(19.22)
_Iyear_2007	14.30***	15.66***	15.14***	17.11***	15.21***	16.51***
	(9.256)	(9.290)	(9.802)	(10.18)	(9.855)	(9.809)
_Iyear_2008	10.96***	11.68***	11.34***	12.76***	11.46***	12.31***
	(7.231)	(6.982)	(7.469)	(7.649)	(7.538)	(7.365)
qual_visit					1.199	1.667***
					(0.308)	(0.237)

Constant		0.0388***		0.0283***		0.0196***
		(0.0278)		(0.0202)		(0.0141)
Observations	2,751	2,751	2,751	2,751	2,751	2,751
Number of v1	393	393	393	393	393	393

seEform in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Sensitivity analysis

For consistency purposes, the analysis was also run with independent variables constructed in several different ways considered to be appropriate as: i) dummy variables for "bad care" in the previous two, three of four years; ii) count variables (see Appendix D). "Bad care" is defined as the complete absence of tests or visits in the previous 2-3-4 years where a value of 1 is given if this condition is fulfilled. In this way, if a patient has not had any visits or tests done in the period of 4 years, it can be said the care is highly inappropriate. Some of the results for diabetes when using a dummy variable for "bad care" in the previous 2-3-4 years are consistent with the results above while others are not. Furthermore, bad care in terms of ophthalmologist visits is significantly positively associated with hospitalisations as in our original analysis except for bad care in the previous 4 years. Bad care in terms of HbA1c and urine tests is mainly positively associated with hospitalisations but not significant. In our original analysis the provision of these according to clinical guidelines was actually positively associated with hospitalisations. Finally, bad care in terms of cholesterol and visits is negatively associated with hospitalisations, but is significant only for cholesterol. Again, these results differ from our original results. The effect of predicted visits, previous hospitalisations and other control variables were consistent with our original results, except age which is now significantly negatively associated with hospitalisations (again, except in the case of 4 years). When simple count variables are used, the number of HbA1c tests is positively but not significantly

associated with hospitalisations, while additional cholesterol and urine tests as well as visits are significantly positively associated with hospitalisations, similarly to the main results. It is also interesting to note that specialist visits are significantly positively associated with hospitalisations while GP visits are not significant, suggesting that GP visits may potentially be a substitute to hospital care but specialist visits are not. Only ophthalmologist visits are significantly negatively associated with hospitalisations, again as the main result. The remaining variables (predicted visits, previous hospitalisations, number of antidiabetic medications, insulin, comorbidities and age) again have the same relationship as in our original model.

The results for asthma when using a dummy variable for "bad care" in the previous 2-3-4 years are consistent with our results for the control variables but the effect of the variables of interest is somewhat different from those in the main body of the chapter. While the above results showed no association between appropriate care (flu vaccine, spirometry tests and more than 3 prescriptions of corticoids), here bad care in terms of flu vaccines is positively associated with hospitalisations, but the significant effect disappears with bad care in the last 4 years. Similarly, bad care for spirometry tests is positively associated with hospitalisations in the last 2 years but the significant effect disappears with 3 and 4 years. Finally, number of SABA is strongly positively associated with hospitalisations, while numbers of corticoids and antibiotics are all positively associated with hospitalisations, but not always significant. When simple count variables are used, the association between flu vaccines, spirometer tests and hospitalisation is positive but usually not significant – results consistent with our analysis above. Number of antibiotics, corticoids and SABA show again a significant positive association with hospitalisations. The remaining variables have the same association. Thus overall, the sensitivity analysis suggests that for some variables the method of construction is important and has an

effect on the direction and significance of the association while for others results are robust across the models.

5.4. Discussion and conclusion

This study assessed elements of quality of care provided to asthma and diabetes patients in Slovakia in the post-transition period. The association between selected process indicators that capture appropriate care for these two conditions, as defined through clinical guidelines, and potentially preventable hospitalisations was reviewed. Overall, it was found that variables that capture inappropriate care are strongly positively associated with hospitalisations and as previous studies, mixed results for the relationship between appropriate care measured through number of visits and tests.

Approximately 15% of the newly diagnosed patients followed during the period between 2002 and 2008 had one or more hospitalisation. Whether 15% of patients having at least one hospitalisation is appropriate or inappropriate is difficult to determine without further investigation and disaggregation. However, a substantial proportion of the patients (85%) do appear to have good access and receive appropriate medical care that does not result in potentially unnecessary hospitalisations. The study also found that the mean number of selected tests (HbA1c, ophthalmologic exams, flu shot), regardless of the severity of a patient's condition, is substantially lower than recommended in the clinical guidelines. This is despite the fact that patients have frequent and more than the recommended number of visits to physicians for both conditions. For diabetes, a large proportion is not receiving the recommended number of HbA1c tests, ophthalmologic exams and cholesterol tests. However, it should be noted that other methods of measuring glucose levels are being utilised, which are not explicitly recommended in clinical

guidelines and therefore not measured in this study. These should be reviewed in the future to determine whether care provided is truly inappropriate, there are issues with coding or the underlying reasons for discrepancies between the care recommended in clinical guidelines and the form of care actually provided. Similarly, for asthma, very few patients receive the recommended flu vaccination and spirometer tests. Therefore, while many patients frequently visit their provider, a large proportion of them are not receiving the appropriate selected tests as defined in the clinical guidelines. It cannot be concluded with certainty if due to coding issues the frequency of these procedures is underestimated. Also, it is possible that patients are being treated appropriately but with the selection of indicators, only what is measurable is assessed. For example, in the 2008 Health Consumer Powerhouse assessment of diabetes care, Slovakia ranked low, yet it was partially due to missing data in the "access to care" sub-discipline, including various tests such as microalbuminuria control, HbA1 control and foot examinations (Health Consumer Powerhouse, 2008). A closer examination of why this data was not made available for the assessment (e.g. not tested, not coded or inappropriately coded, not easily reported) would be necessary.

The relationship between process indicators constructed based on clinical guidelines for the two conditions and an outcome indicator of quality of care – preventable hospitalisations for diabetes and asthma – was assessed for patients who had at least one hospitalisation during the period of the study. The results of the PFE and NBFE models for diabetes show a significant, negative relationship with ophthalmologic exams, one of the variables for quality care, but a significantly positive relationship with the other variables for appropriate care (number of HbA1c tests, cholesterol tests and urine tests in the negative binomial model only). The positive relationship between HbA1c, cholesterol and urine tests, as well as physician visits, suggests that it is likely that the sicker patients who have many visits and tests are also more

frequently hospitalized. This suggests potential endogeneity which it was not possible to control for in this study as instruments were not available at the patient level due to data limitations. Studies that controlled for endogeneity of visits found that GP visits were a substitute to inpatient care. While not controlling for endogeneity, this result was also identified in the in the robustness checks where specialist visits were significantly positively associated with hospitalisations while GP visits were not. In other words, more intense primary care may prevent unnecessary hospitalisations, as suggested by the concept of ambulatory care sensitive conditions. Similarly, for asthma, quality of care defined through the flu vaccination and spirometer test variables were not significantly associated with hospitalisations; however, excessive amount of SABA, corticoids and antibiotics were significantly positively associated with hospitalisations. These results suggest that taking steps to monitor why some patients are disproportionately treated by these medications and a review their treatment plans may lead to better care and reductions in future hospitalisations. Again, it is possible that some of these are the sicker patients. The lack of relationship with the flu vaccination is not necessarily surprising; even though the flu vaccine has been recommended in the guidelines, it is also stated that is not likely to protect patients from exacerbations of asthma and does not improve asthma control (Hrubisko & Ciznar, 2010).

While a stronger relationship between process and outcome measures gives greater validity, for some process measures that are considered important for the treatment of the patient, there is a weak relationship with outcomes. Nevertheless, providers consider these process indicators important as they have been included in their specializations' clinical guidelines. The relationship between good care and inferior outcomes is often identified because of confounding by indication – sicker patients with worse outcomes receive more or better care (Rubin, Pronovost, & Diette, 2001). This is particularly problematic for patients with chronic illnesses such as asthma, for

which measures of intrinsic disease severity are poor and it may therefore be difficult to find evidence to support valid process measures (Rubin, Pronovost, & Diette, 2001). Also, most feasible process measures are usually indicators for a very specific element of the care process rather than comprehensive measures of how care is delivered (Rubin, Pronovost, & Diette, 2001). Care for both asthma and diabetes are highly complex and the indicators used are only capturing a small element of the appropriate care that should be provided. This study was limited to measuring only data that was available, not necessarily indicators which would cover in a complex way the most important elements of asthma and diabetes care.

Several policy recommendations for the utilisation of preventable hospitalisations or quality of care process indicators for performance measurement are discussed. Firstly, preventable hospitalisations are an outcome indicator for the quality of ambulatory care. As per all outcome indicators, factors apart from quality of care determine whether or not a patient is hospitalized. Therefore, caution needs to be exercised when interpreting number of hospitalisations even though they provide an initial snapshot of the quality of ambulatory care provided. Excessive hospitalisations may be indicative of inappropriate care, result in unnecessary costs and require further investigation and analysis. Our study suggests that while only 15% of newly diagnosed patients were hospitalized at least once during the period under study, many more did not receive appropriate treatment as defined by clinical guidelines. So the evidence of a gap between the best possible care and actual care accessed as measured by the process indicators should be taken as a basis for action by both purchasers and providers to improve adherence to clinical guidelines and improve overall care provided to patients. It is important to acknowledge that not all measures recommended in the clinical guidelines are necessarily directly related to reductions in hospitalisations. Yet, clinical evidence suggests that they are important and their use should be encouraged. While some indicators are easily measureable and there is

a direct relationship with outcomes (e.g. excessive use of SABA, antibiotics, corticoids), with others there is no direct relationship (e.g. flu vaccine, spirometer test) and there are also those that cannot presently be measured (e.g. adherence and appropriate dosage, lifestyle counselling, and other provider specific factors).

Despite the availability of clinical guidelines, physician behaviour may not be simple to change and thus take a long time before full adherence to guidelines is reached. Explicit and implicit incentives in the system to provide treatment as well as physician practice style need to be reviewed and better understood to design appropriate interventions to improve quality of care provided. Overall, there is more positive evidence on effectiveness of professional-oriented interventions (education, reminders, feedback) than on those aimed at the organisation or the patient (Grol & Grimshaw, 2003). However, changes in clinical practice are only partly within doctors' control; it is the prevailing professional and organisational culture towards quality that determines the outcome to a large extent (Grol & Grimshaw, 2003). In this sense, unless such changes are made in Slovakia, improvements in the quality of care will be difficult to achieve. Overall, it is essential that physicians assume responsibility for quality improvement (Shekelle & Roland, 2000, p.171).

The present study has several limitations. First, only newly diagnosed patients were considered whose condition may initially require hospitalisations and high amount of tests before they are stabilised. Therefore, those patients who have been living with their chronic condition for an extended period of time are not being captured. By choosing only treated patients, the sick whose condition is managed without drug therapy were excluded as well as those who may have received highly inappropriate care and died. Second, the main focus of this analysis was on patients who were hospitalised at least once during the period of the study. However, there is also a large proportion of patients who were not hospitalised at all between 2002 and 2008.

Thus in the future additional analysis could be carried out attempting to understand the relationship between non-hospitalisations and potentially inferior quality of care provided to diabetes and asthma patients. Third, not all diabetes and asthma related hospitalisations are avoidable with high quality outpatient care but the data do not allow identifying the exact nature of the hospitalisation. As a result, the number of hospitalisations, our dependent variable, may be overestimated. On the other hand, secondary diagnoses were not included so the number of hospitalisations may be underestimated.

Fourth, issues surrounding data coding, recording and overall quality of the claims database should be highlighted. The data's primary purpose is for billing where the payment mechanisms in place potentially incentivise physicians to inappropriate provision and coding of procedures to maximize payment. Also, physicians may be coding procedures inaccurately due to habit. For example, every visit of a diabetic patient will be coded under the diabetes ICD code, even though the visit may have been for hypertension or a sprained ankle. Also, not all the tests, medications or visits may always be recorded and coded correctly. Finally, as the dataset was not prepared for quality of care assessment, data handling was required which may have resulted in researcher bias. It is also important to highlight again that the administrative data used lacked clinical and lifestyle information which made it difficult to adjust for important patient characteristics that could potentially influence hospitalisations For example, severity of illness which affects appropriate pharmacotherapy could not be assessed, neither alcohol or smoking habits. Also, information on an important health outcome such as mortality was missing. However, given that our focus was on newly diagnosed patients, mortality may not have been an appropriate outcome to assess as it is likely to have been a rare event. In the future, improved features of the database should allow for the monitoring of different aspects of appropriate care and better risk adjustment.

To summarise, this chapter provides additional evidence on the link between appropriate/inappropriate care and hospitalisations. It also serves to initiate debate on the quality of care provided in Slovakia and how different process and outcome measures can be used to measure it. While it is clear to most why it may be important to avoid unpleasant and costly hospitalisations, measuring quality of care at any level of the system is complex and highly controversial. However, small steps can be taken to reduce obvious deficiencies in quality. Simply obtaining an overview on the proportions of patients who do not receive a particular form of therapy is essential. Then, breaking down these results by provider and reviewing the treatment of individual patients based on medical records may reveal what improvements should and could be implemented. Finally, the wide availability of administrative data in Slovakia and other Eastern European countries call for their better utilisations for quality of care evaluations. While not without limitations, "current administrative data are probably most useful as screening tools that highlight areas in which quality should be investigated in greater depth." (Iezzoni, 1997). However, at present the full potential of this administrative data is not being utilised.

Chapter 6. Conclusions and policy implications

The goal of health system performance measurement is to ensure that health systems achieve their four key objectives: improve the health of their populations, respond to the individual needs and preferences of patients, provide financial protection and productively utilise resources (Smith, Mossialos, Papanicolas, et al., 2009). To reach these objectives, multiple other dimensions may be relevant, including access, quality of care or equity. Apart from using performance measurement to identify potential areas for improvement, it also serves to hold stakeholders accountable. Therefore, it is even more important in the times of fiscal constraint, rising health care expenditures coupled with ageing and increasing burden of chronic illnesses, which require governments to be more accountable to patients and provide effective and high quality care with limited resources (Papanicolas & Smith, 2013). Similarly, it is an essential tool for understanding the effect of major changes in any country's health system so that negative consequences on the quality of the services and consequently the populations' health and well-being can be averted. The key challenge remains how to best measure performance.

The political and socio-economic transition in the Eastern European region where numerous changes occurred within a short period of time has been a unique area of interest to both academics and policy makers. Czechoslovakia makes a particularly interesting case study as not only did it transition from communism to democracy in 1989 but in 1993 was also separated into two independent countries – the Czech Republic and Slovakia. The split of the countries provides for an excellent natural experiment to be studied as the two countries had very similar systems while being part of Czechoslovakia and embarked on increasingly different paths after the separation. During the period since the two transitions important health care reforms were implemented in each of the countries; however, there has been little concern

with a more in-depth assessment of health system performance. Therefore, the main goal of this thesis was to identify changes in health system performance in Slovakia relative to the Czech Republic before and after the 'double transition' so that relevant lessons can be learned. Consequently, the two countries can take steps towards identifying existing problems and implementing strategies for improvements. While health systems have multiple goals, this thesis focuses on those that are often considered to be the most important and where evidence in the two countries is limited: overall health and well-being and quality of care. In particular, the goal was to contribute to the literature by better understanding how changes in the quality of care may have reflected on changes in population health.

Assessing health system performance and quality of care can be done in multiple ways, using different structure, process and outcome indicators. This thesis applied a conceptual framework for health system performance assessment to guide the overall analysis, and a selection of methodologically more appropriate outcome and process indicators to evaluate the degree of progress the two countries have made before and since the fall of the communist regime and independence. In the context of the Czech Republic and Slovakia only standard well-being and health outcome measures have been applied to date with a very limited focus on measuring quality of care. In the recent years more refined indicators that address some of the methodological weakness of these standard indicators have increasingly been applied but not yet in Slovakia and the Czech Republic. Therefore, this thesis employed some of these indicators (height, 'avoidable' mortality, hospitalisations for ACSCs) to assess performance, using different unique datasets and a range of methods from different disciplines for cross- sectional and panel data.

The individual chapters provided empirical evidence at the different levels of the health system. Starting from the macro level, the first part of the analysis focused on measuring overall health system performance using the indicator of height to capture the health and well-being of the populations (Chapter 2). Height was selected to measure overall system performance capturing all the different determinants of health and well-being highlighted in the conceptual framework, including the political, economic and social environments, different health risks, as well as the contribution of the health care system. Moving one level down, the thesis assessed health care performance by looking at overall quality of care with the indicators of 'avoidable' mortality (Chapter 3). Here the goal was to capture the contribution of the quality of the health care system to changes in population health by applying indicators of 'avoidable' mortality. Consequently, given the improved properties of 'avoidable' mortality as a health outcome indicator for capturing the contribution and quality of the health care system called for investigating its association with health care inputs using some more advanced analytical methods that previous studies have not employed (Chapter 4). The last part of the thesis consisted of an analysis of Slovakia at the micro level using hospitalisations for two ACSCs as an indicator of the quality of ambulatory care and the associations with selected process measures (Chapter 5).

6.1 Overall answer to the research question and main contributions

The overall research question of this thesis what: how have the health systems of Slovakia and the Czech Republic performed before and since the transition in 1989 and independence in 1993? The thesis hypothesised that despite somewhat different socio-economic and health policies after the transition to democracy and separation, health system and health care system performance in the two countries has been

improving. The findings from Chapter 2 and Chapter 3 confirmed this hypothesis and also broadly reflected the results of how these countries have been performing on standard indicators (e.g. life expectancy, GDP per capita). Height has continued to increase in both countries and while the transition period does not seem to have a significant positive effect, there were no signs of deterioration on overall population health and well-being. Interestingly, there was no significant country effect to suggest that one country fared better than the other, regardless of the existing evidence on Czech Republic performing better on numerous indicators. This means that despite the somewhat different socio-economic conditions in the two countries, the broad and immediate determinants of height were very similar. It was rather the significant interaction between country and years under democracy that showed how Slovakia had a larger capacity to benefit from democracy – a country that was worse off under communism and the initial years of democracy, confirming our hypothesis that those who start worse off have a larger capacity to benefit. Finally, it was interesting to find that ultimately it was men who seemed to have benefited more from the transition than women.

Following these broad system level findings, the thesis focused on the quality of the health care systems as measured by the 'avoidable' mortality indicators. Chapter 3 hypothesised that improvements in the performance of the health care systems would be reflected in declining 'avoidable' mortality and the results confirmed this hypothesis. On the basis of the existing evidence the chapter further hypothesised that 'avoidable' mortality would decline slower than non-avoidable mortality but the findings contradicted this hypothesis; 'avoidable' mortality was actually declining faster than non-avoidable mortality in both countries. Contrary to the findings from Chapter 2, Chapter 3 found that the trajectories of progress have not been the same in the two countries when measuring the quality of the health care systems since the double transition; there is evidence of divergence with Slovakia lagging behind the

Czech Republic in the quality of care provided. Analysis by individual condition allowed a more specific understanding of a country's health care system performance. Here it became obvious that there are important differences across disease areas and lack of improvement or deterioration should lead to further investigation of the medical care provided and potential bottlenecks either in prevention, primary or hospital care. Depending on the condition, other risk factors such as smoking, alcohol consumption or diet should also be considered. However, while the analysis was condition specific, it was still carried out at the aggregate population level which can only point to initial weaknesses and further in-depth investigation and disaggregation is required, as will be highlighted in the policy recommendations section.

Given the key advantages of 'avoidable' mortality as an improved health outcome indicator compared to those usually used for capturing the contribution of health care services, Chapter 4 hypothesised a negative relationship between increased health care inputs and 'avoidable' mortality. However, the thesis did not confirm this hypothesis and concluded that despite having employed more advanced analytical methods, timely and effective care cannot be adequately captured by measuring quantity of health care resources such as beds or human resources. Instead, better quality of care proxies together with non-health system determinants, as also highlighted in Chapter 3, need to be accounted for in models that consider endogeneity and dynamics in health care quality and outcomes. Finally, the thesis hypothesised that both appropriate and inappropriate care are associated with hospitalisations for ambulatory care sensitive conditions, and the findings from Chapter 5 showed mixed associations. Variations in hospitalisations do not provide conclusive findings about the quality of ambulatory care in Slovakia but instead suggest that in some cases inappropriate care may be provided. Thus these variations, similarly to variations in 'avoidable' mortality at the system level, need to be further investigated to see if any could be avoided by providing more appropriate care and

avoid unnecessary or even harmful care. While there is little evidence of a strong relationship between appropriate processes of care and hospitalisations, there is nevertheless evidence that large proportions of patients do not receive appropriate care as recommended in the clinical guidelines both for asthma and diabetes.

Before the empirical findings from each individual chapter and policy recommendations are presented, the **main contributions of the thesis** are summarised below. The thesis:

- Demonstrated how population well-being, health and quality of care can be assessed to stimulate the country debate on health and quality improvement, applying various data sources, methods and indicators. This is especially important as it is an area that has been neglected in Slovakia and the Czech Republic during the post-transition period;
- Revealed the relationship between the indicator of height as a measure of health and well-being and the political and economic transition. Height has several advantages over traditional indicators of well- being and it was applied in an entirely new and unique country setting;
- Demonstrated the usefulness of the indicator of 'avoidable' mortality for a more in-depth assessment of the quality of the two health care systems. The use of individual 'avoidable' mortality indicators to compare quality of care during the pre and post-transition period has not been previously undertaken;
- Showed the absence of a relationship between 'avoidable' mortality, an improved health outcome indicator, and health care inputs using more advanced analytical methods that account for endogeneity and dynamics;
- Demonstrated the usefulness of hospitalisations for two ACSCs as an outcome indicator for the quality of ambulatory care in Slovakia and explored whether there is an association with processes of care. It also demonstrated how

administrative data, while not perfect, can be used to assess the quality of ambulatory care;

- Provided empirical evidence for population health and the quality of the Czech and Slovak health systems since transition and thus the necessary basis for further policy action in the area of quality assessment and improvement.

6.2 Key findings of individual chapters

6.2.1 Conclusions of Chapter 2

Chapter 2 began by analysing height as an all-encompassing indicator of retrospective well-being and health, which accounts for all the broad determinants of these as highlighted in the conceptual framework in Chapter 1. Height is an indicator that has been increasingly used to measure improvements in health and well-being. Therefore, this chapter started the assessment at the macro level where the quality of the health care system is only one of the many determinants of health and well-being. The goal of the chapter was to investigate whether the democratic transition and independence brought benefits or a deterioration in the health and well-being of the Slovak and Czech populations reflected in a change in adult heights. The chapter used the World Health Survey data which contains individual height information.

Using OLS regressions and controlling for a range of socio-economic factors as well as the "quality" of democracy, the main findings of this chapter indicated that with every additional year spent under democracy (or in independent Slovakia/Czech Republic while growing up in the first twenty years of an individual's life) there is a positive effect on height. However, there was no significant cohort effect between the youngest population – those who mainly grew up under democracy/independent country – and the following two older cohorts. This finding suggests that the height

increase for the "transitional" generation was not significantly different from the generations growing up under communism. Therefore, the political and economic liberalisation that came with the transitions did not bring about a significant improvement in well-being as measured by height in neither of the two populations; however, there was also no evidence of visible deterioration There is an overall birth cohort effect, which showed that people have become on average taller over the course of time in both countries but the improvements are most noticeable for the oldest population born during the early 20th century. Furthermore, the Chapter found that there are social differences in well-being reflected in different height increases across the income terciles. Height increases from the poorest to the richest tercile for both genders. In addition, there is also a significant education effect where the level of education achieved is an important determinant of the individual's height. However, there was no consistent country effect across the models suggesting that both Slovakia and the Czech Republic were experiencing similar levels of well-being as measured by height.

However, the findings also revealed that the effect of growing up under democracy was different for Slovakia and the Czech Republic as the interaction term was significant. Thus while the Czechs were on average taller, Slovakia which was the poorer neighbour during communism and was under authoritarian rule after transition seemed to have benefited more from the transition to democracy. Furthermore, the results also showed that years spent under democracy had a different effect on height depending on the country and income tercile. Existing evidence suggested that those benefiting from democracy were the same as those already benefiting during communism. However, the results suggest that while the transition years may have impacted negatively on the most disadvantaged, they were still able to benefit in height, and more so than the richer groups. Again, Slovaks in the bottom and mid tercile were benefiting more than the Czechs. Finally, analysis by

gender revealed that the increase in height seems to be driven by men: for every additional year growing up under democracy for men, there was a significant height increase, including a significant difference between the youngest age cohorts, even after controlling for different factors; for women there was no significant effect. These findings are not surprising as evidence shows that women under communism already fared relatively well and thus the transition did not bring significant changes to their well-being.

6.2.2 Conclusions of Chapter 3

Chapter 3 aimed to measure the quality of the health care system using different indicators of 'avoidable' mortality between 1971 and 2008. 'Avoidable' mortality is defined as deaths which could have been avoided if timely and effective medical care had been provided. Age-standardised mortality rates for mortality from 'avoidable' and other (non-avoidable) causes have been used to study national and regional trends. The chapter looked at overall trends but more importantly, condition specific mortality trends which provide more in-depth evidence about the quality of care provided in the two countries. Especially, given the results of Chapter 2 where the country effect was not a significant determinant of height difference, the goal was to see whether for specific 'avoidable' mortality indicators there is divergence or convergence between the two countries. Regional within country differences were also examined.

Overall, the results indicate that the quality of the health care system has been improving since 1989 and 1993 as reflected in declining 'avoidable' mortality. Furthermore, consistent with other studies 'avoidable' mortality has been declining faster than mortality from non-avoidable causes. As far as trends are concerned in the two countries, overall there has been divergence in aggregate 'avoidable' mortality

rates with Slovakia lagging behind the Czech Republic since the transition period suggesting the potential for improving the quality of care provided. The main driver of 'avoidable' mortality in Slovakia has been ischaemic heart disease, hypertension and cerebrovascular disease, conditions for which deaths could be largely prevented with effective and timely prevention and primary care. Trends for non-avoidable mortality where factors outside the health care system (e.g. socio-economic, environmental, lifestyle etc.) are also important show that Slovakia has been lagging behind during the entire period of study. Since these non- health care system factors affect both 'avoidable' and non-avoidable conditions, any improvements or changes in 'avoidable' mortality are likely to be explained by changes in the provision of timely and effective care (Korda & Butler, 2006).

Analysis of individual 'avoidable' mortality conditions revealed that in several cases the two countries converge or Slovakia outperforms the Czech Republic. This type of in-depth analysis better demonstrated where there is bad performance that needs to be corrected. For example, in the group of conditions where public health programmes or primary care are considered to be most important, results across the conditions vary significantly and questions about the medical care provided for those where mortality rates have been stagnant or the decline slowed down after 1989 and 1993 (e.g. peptic ulcer or malignant neoplasm of cervix uteri and body of uterus in Slovakia) should be raised to prevent unnecessary deaths. Among others, these include issues with screening, timely and effective diagnosis, treatment and coordination of care, but also non- health care system factors that can be influenced such as lifestyles that include excessive alcohol and cigarette consumption or diets that lead to overweight and obesity.

For all the conditions where hospital level care is considered essential (e.g. Hodgkin's disease, appendicitis, maternal and perinatal mortality etc.), there have been

significant improvements in the provision of timely and effective hospital care in both countries reflected in declining and converging mortality trends. These can be explained by improvements in the equipment of providers and availability of more sophisticated medicines. For example, enhancements in neonatal care (e.g. prenatal diagnosis of congenital malformations and intensive care in newborns of extremely low birth weight) (Stembera & Velebil, 2006) have contributed to declining perinatal mortality while the overall lower neonatal hospital and human resource capacity in Slovakia (Chovancova, 2008) may explain the gap between the two countries. Regional variations showed higher rates of perinatal mortality and mortality rates for respiratory disease deaths for children aged 1 to 14 in the Eastern regions of Slovakia, potentially linked to the large presence of the Roma population and their lifestyle and attitudes to health and health care services (Ecohost/ Masaryk University, 2000). Thus upon further in depth investigation and analysis, targeted health care interventions may be more appropriate.

6.2.3 Conclusions of Chapter 4

Chapter 3 again used indicators of 'avoidable' mortality to measure the contribution of the health care system by analysing trends in mortality rates and their associations with health care inputs. Extensive literature is dedicated to establishing a relationship between health care resources and health outcomes. Given that 'avoidable' mortality is considered to be an improved health outcome indicator which better captures the quality of the health care system rather than the contribution of non-health system determinants, Chapter 4 of the thesis aimed to establish a relationship between health care resources and 'avoidable' mortality. Earlier studies have tried to establish this relationship but the evidence is mixed. However, the methods used previously have not accounted for potential endogeneity of physician

supply and time dependence of mortality rates. Therefore in Chapter 4 instrumental variable and dynamic panel modelling have been employed to address these issues.

The chapter found no significant relationship between health care resources (measured by number of physicians, nurses and beds) and 'avoidable' mortality rates using: a) pooled OLS regression controlling for years b) fixed effects that incorporate unmeasured regional factors c) instrumental variable models treating physician supply as endogenous d) dynamic GMM models which allows for time persistence in mortality rates. Despite taking into consideration potential endogeneity and dynamics, no significant relationship was found. In fact, in the context of Slovakia and the Czech Republic, endogeneity may not be a problem as health care resource planning is not based on health care needs (e.g. mortality, morbidity) of the population but per capita. Even though the choice of instruments is always controversial, using different and perhaps more appropriate instruments for physician supply may have led to different results.

These results contribute to the debate on the role of health care inputs in explaining variations in health outcomes in several ways. First, it is possible that a relationship cannot be established given that the supply of health services has reached a level where there are diminishing returns. Second, while health care inputs are an important element of the health care system, confirming the findings of earlier studies, they do not seem to adequately capture what is happening in the health care system as they only measure quantity and not quality of care. Quantity of care does not seem to reveal sufficient information about the provision of timely and effective care and better indicators are necessary. Furthermore, the evidence from the recent AMIEHS study shows that while for many conditions important key interventions are available to avoid deaths, it remains complicated to ascertain the exact proportion that can be attributed to the selected medical interventions, explaining the absence of

a clear link with health care inputs. There are several examples (e.g. stroke, ischaemic heart disease) where medical care explains between 45-70% of mortality while the remaining proportion can be attributed to inappropriate lifestyle. So even though 'avoidable' mortality is considered to better capture the contribution of health care systems and therefore have the potential to be used as indicator of the quality of the health care system, range of other non-health system factors are still considered to be important determinants of changes in mortality rates (Plug, Hoffmann, & Mackenbach, 2011). Therefore, variables that capture non-health determinants and may be key risk factors (e.g. nutrition, alcohol, smoking, cholesterol, physical activity, weight and hypertension for cardiovascular mortality) need also be included in future analysis.

This chapter also contributed to the literature by attempting to use individual 'avoidable' mortality causes, in addition to aggregate 'avoidable' mortality as the key dependent variable. Only a few studies have previously explored 'avoidable' mortality in this respect. Such analysis allows for a more detailed specification of appropriate care and therefore a more precise analysis of the relationship between health care provision and mortality. For example, in the case of malignant neoplasm of cervix uteri, it could be important to include variables that capture whether and how cervical cancer screening, cytology, surgery and radiation therapy have been provided. Due to lack of this type of data at the regional level, only some of the conditions could be analysed separately and the remaining had to be grouped together. At the same time, insufficient numbers of deaths for these individual conditions made it necessary to group them together and thus impossible to include specific quality of care variables. The trade-off between individual condition specific analysis and aggregate 'avoidable' mortality should always be carefully considered.

6.2.4 Conclusions of Chapter 5

Building on the findings from Chapter 2 and 3, Chapter 5 went further by assessing the quality of ambulatory care in Slovakia where evidence to date was limited. More specifically, it undertook the analysis of in/appropriate provision of care for two ACSCs (asthma and diabetes). This was done by using selected process indicators as well as ACSHs as an outcome indicator to examine the quality and effectiveness of ambulatory care. The goal of this chapter was to also provide additional evidence on the link between appropriate/inappropriate care and hospitalisations. Anonymous country representative patient level data from the largest public health insurance company was used. The descriptive statistics together with the panel data regression results revealed interesting findings about the appropriateness of care provided. The findings below provide an insight into elements of quality of care provided for diabetes and asthma patients in Slovakia.

Approximately 15% of the newly diagnosed asthma and diabetes patients followed during the period of the study had one or more hospitalisation. It is difficult to say whether this proportion is too high or too low but it is a baseline that should be monitored and further analysed to provide more detailed information for health purchasers and policy makers. Certainly a large proportion of the patients (85%) have not been hospitalised at all between 2002-2008 and thus have avoided unnecessary costs and discomfort resulting from a hospitalisation. It should be further noted that all these patients are treated by medication as those who are only treated by lifestyle changes have been excluded from our sample. The results of Chapter 5 also indicate that the mean number of tests (HbA1c, ophthalmologic exams, flu shot) is substantially lower than recommended quantity in the clinical guidelines, even though patients appear to have an excessive number of visits to physicians for both conditions. These results either suggest that despite high number of physician

contacts appropriate care is not provided, or that the tests used in the analysis based on recommendations in clinical guidelines do not properly capture the provision of appropriate care.

The results of the association between selected process indicators that capture appropriate care for these two conditions defined on the basis of clinical guidelines and potentially preventable hospitalisations were mixed, as in previous studies. It should be noted that the study used a selection of processes, not all of which would in a complex way cover all of the most important elements of asthma and diabetes care. Variables that capture inappropriate care were strongly positively associated with hospitalisations and there were mixed results for the relationship between appropriate care measured through number of visits and tests, and hospitalisations. Where a negative relationship was identified, the results suggest that more appropriate care at the ambulatory care level is associated with fewer adverse events.

It is possible that where a positive relationship was identified, especially with visits, it was due to endogeneity problems as sicker patients are likely to have more tests and visits as well as hospitalisations. However, these patients may actually be receiving appropriate care. While some studies have controlled for endogeneity and found a negative relationship with GP visits, others did not control for endogeneity and treated visits as a proxy for severity of illness. Finally, potentially inappropriate care (e.g. excessive medications) was positively associated with hospitalisations, suggesting that further in depth inquires need to be undertaken to see whether these are the most severe patients or whether it is truly inappropriate care that results in further adverse events for the patient.

6.3 Limitations

As the different chapters used different data sources and methods, the detailed limitations were highlighted in the individual chapters. While some limitations could be overcome, others need to be acknowledged such that results are interpreted with care. Limitations can be separated into data and methodological limitations, both of which are outlined below.

Data limitations

The first limitation is related to the quality of data, each dataset having some shortcomings. In Chapter 2 the main limitation is the potentially low response rate identified for the WHS Czech data resulting in non-response bias. Furthermore, the use of self-reported height may have led to reporting bias. As was mentioned, overestimation of height may vary with a person's age and gender (Cavelaars et al., 2000; Ezzati, Martin, Skjold, Hoorn, & Murray, 2006; Giles & Hutchinson, 1991; Hill & Roberts, 1998) and the available evidence on the accuracy of self-reported height is mixed. In general, height is overestimated by shorter individuals, especially men and the error in reported height increases with age (Spencer, Appleby, Davey, et al., 2002). Overall, there seems to be wide individual variation between reported and measured heights in both sexes (Cizmecioglu, Doherty, Paterson, et al., 2005) so using accurately measured heights in a clinical setting which have been recorded consistently would be most appropriate. As sensitivity analyses have shown, while representative samples were used, the results seemed to have been somewhat affected by the sample employed, especially with regards to the country and gender effect. Therefore, a cautious interpretation of some of the results was recommended and that potentially the same analysis is carried out with additional samples. Thus despite the potential for reporting error, the sample was not corrected for as precise

information on the magnitude of the bias was not available. The key limitation of the mortality data used in Chapter 3 and 4 is related to the identification of the exact cause of death and the quality of death registration procedures. Individuals usually die of multiple causes and countries differ in how these are interpreted and recorded. Often, only one cause is registered, either the underlying disease (e.g. diabetes) or the cause of the death (e.g. stroke). While it cannot be ascertained, given the common past of Slovakia and the Czech Republic, the coding and registration procedures can be expected to be similar. Finally, in Chapter 5 the thesis relied on secondary data, in particular an administrative (claims) data set whose primary purpose is for billing and not for measuring performance. As such, it suffers from a number of limitations already discussed in Chapter 5. During the course of the research no other publication was identified which would have discussed the quality of this data. As the data was not prepared for quality of care assessment and has undergone data manipulation, it will therefore be important to present and discuss the findings with the purchasing organisation. Nevertheless, despite these limitations the data overall has served well to provide an insight into the performance and quality of the Slovak and the Czech health systems.

Methodological limitations

The goal of the thesis was to provide an insight into the health system performance of Slovakia and the Czech Republic. While it provides some answers, there are still more questions which remain unanswered. Especially, the 'avoidable' mortality indicators and ACSHs are indicators which require further investigation and disaggregation to provide definitive answers. It should also be mentioned again that while many deaths and hospitalisations are in theory avoidable, some will always occur as there are variations in medical need, use and implementation of the existing medical knowledge and the organisation health care across facilities or systems.

Nevertheless, these are outcome indicators which have improved properties compared to those previously used. The thesis also acknowledges that many different outcome and process indicators can be employed to assess health system performance and quality of care more specifically.

Overall, establishing a direct link between health care system activities and health outcomes continues to be a challenge, and this thesis has demonstrated this difficulty. While potential confounders have been risk adjusted for, it is important to acknowledge that due to data constraints it was not possible to control for all the important factors (e.g. lifestyle, clinical factors) and unobserved systematic variations may be causing the differences in health outcomes. The other key limitation concerns the ability to control for endogeneity and the quality of the instruments used. It is therefore important to interpret all the findings in light of these limitations and acknowledge that the results of this thesis are another step towards better quality assessment. Despite these limitations, the thesis answered the overall research question and the individual chapters met their research objectives.

6.4 Policy and future research recommendations

All the findings from the different chapters lead to some common general and country specific policy recommendations. These should be viewed in light of the limitations discussed in the previous section and the individual chapters. The following section highlights the key policy recommendations from this thesis, starting with the general ones and followed by a few country specific ones.

1. *Employ improved health outcome indicators to capture the quality of the health care system*

Overall, research in the area of performance assessment in Eastern Europe, and quality of care in particular, falls behind that of other countries. Chapter 3 demonstrated the utility of using 'avoidable' mortality indicators to obtain a clearer picture of the health care system performance. These are indicators that will provide an initial well-rounded snapshot of the health care system and can then be further disaggregated. 'Avoidable' mortality has advantages compared to standard mortality indicators and as such policy makers in Slovakia, the Czech Republic and other countries should utilise these to obtain a better understanding of the quality of care provided. While in this thesis the indicator was used at the national and regional level, the indicator can also be applied at the provider level (e.g. hospital). Similarly, hospitalisations for ACSCs can be used to monitor variations at regional or small area level, as well as for individual patients to identify weaknesses in the provision of outpatient care in selected areas or for groups of patients. Chapter 5 used patient level data and focused on several process of care indicators; however with a small area level analysis the relationship of preventable hospitalisations with broader health care system level factors as well as non-health system factors (e.g. prevalence of smoking, alcohol or inappropriate diets) can be explored, as highlighted in the conceptual framework. Large variations in ACSHs should serve as the warning flag, requiring more in-depth investigations of factors associated with such preventable hospitalisations. Collecting information on severity of illness, adherence to medication, information about smoking or eating habits or provider level characteristics (e.g. size of practice, type of contract, years of experience etc.) is therefore essential to better understand the true determinants of preventable hospitalisations. These types of analysis will then allow for improving access and quality of care provided at the system or provider level.

2. *Outcome measures have their limitations and should be used together with process measures to assess quality of care*

There is not one perfect outcome or process indicator. The strengths and weaknesses of any indicator need to be well-understood before it can be used for routine surveillance of quality of care and any action is taken to avoid potential negative consequences. For example, Chapter 2 and Chapter 3 have nicely demonstrated that while overall Slovakia seems to perform worse than the Czech Republic, for selected conditions in Chapter 3 the two countries perform very similarly or Slovakia even better. These results demonstrate that one should not easily jump to general conclusions about the quality of the health care system, as problems may be specific to a particular area.

In general, outcome and process indicators should be used together to obtain a more accurate picture of population health in the country, especially quality of care. Both outcome and process measures have their weaknesses. The main weakness of outcome measures is that even though risk adjustment is carried out, perfect risk adjustment is difficult and variations are not entirely due to variation in the quality of care provided. Therefore, using health outcome indicators to make regional representatives or providers accountable where factors outside their control determine variations is controversial. Based on trends in 'avoidable' deaths countries, regions or providers should be encouraged to actively take steps towards reducing mortality rates by improving the timeliness and effectiveness of medical services. Similarly, trends and variations in preventable hospitalisations should be understood so that the unnecessary ones are prevented where possible. However, these outcome measures provide only an insight into the performance of the health care system and will always capture the contribution of many different factors apart from the quality of care provided. Therefore, as demonstrated in Chapter 5, a range of process

measures that reveal a more detailed picture of actual care provided should also be used. Monitoring processes of care will ensure that these are carried out. However, it is essential that processes not monitored (and rewarded in an incentive scheme) are not neglected. It is important to note that depending on the choice of process measures, these may or may not comprehensively capture the quality of care provided. A stronger relationship between process and outcome measures gives process measures greater validity. Nevertheless, for some process measures that are considered important for the treatment of the patient there may be a weak relationship with outcomes. The selection of process measures to hold stakeholders accountable should therefore be carefully considered.

3. *Carry out further analysis at each level of the system to better identify quality problems and ensure action*

Designing an indicator to measure health system performance and collecting information without an appropriate follow up is futile. Therefore, the next step for policy makers in both the Czech Republic and Slovakia would be to carry out in depth systematic investigations of the underlying reasons for observed trends according to existing and sound methodologies, as well understand local and central level policies, and how services targeted at the selected condition are being delivered and coordinated, starting from prevention, through diagnosis and treatment and management of the disease. For example, as Chapter 3 indicated, for some conditions problems appear to be obvious and implementation is the issue (e.g. cancer of cervix), for others further research is necessary. Also, in the future with regional level data becoming increasingly available, distribution of 'avoidable' mortality across socio-demographic and ethnic groups may be particularly useful (e.g. Roma, retired).

Apart from maternal and perinatal mortality, there are few examples of systematic investigation, at local or national level, to identify the possible causes of failure of health care and what can be done to improve outcomes (Holland, 2003). It is this type of follow up that should be encouraged in the countries. To date, when data was used to improve services, it often resulted in identifying and a culture of blaming the individual practitioner rather than considering system deficiencies; other 'side-effects' tend to include inappropriate policy responses, lack of resources, lack of coordination of care as well as individual errors (Holland, 2009). For these reasons, it is highly recommended that systematic investigations of 'avoidable' deaths are carried out, following existing and sound methodologies. Methods of enquiry have been proposed for maternal mortality and summarised in the 2004 World Health Organization Report (World Health Organization, 2004). The WHO Report (2004) provides a range of approaches the applicability of which depends on the level of investigation, i.e. facility, community, district, regional or national level. Confidential enquiries comprise a systematic multi-disciplinary anonymous investigation of all or a representative sample of deaths occurring at an area, district, regional or national level; they aim to identify the numbers, causes and avoidable or remediable factors associated with deaths so identified (Lewis, 2003). Through lessons learned from each death and through aggregating the data, they provide evidence of where the main problems lie and what can be done in practical terms. Thus, confidential enquiries have the potential to highlight the key areas requiring recommendations for health sector and community action and can so guide the improvement of clinical outcomes (World Health Organization, 2004).

4. *Use existing data for performance assessment*

There is no doubt that health system performance assessment, in particular quality assessment, is an extremely challenging task. However, these difficulties should not

deter policy makers and purchasers from attempting to measure and understand what is happening in a country' health system and what is the quality of care provided. For this purpose, different data are available, which though not perfect as this thesis has demonstrated, can be a useful starting point. Certainly caution needs to be exercised when the results are interpreted, however, only if analysis is undertaken, can one identify where improvements in data need to be made to allow for better measurement and ultimately quality improvement in the future. It has been noted that "data on health status, quality and performance of health care providers do not meet the needs of policy-makers to make informed decision" (SK HiT). Only these types of analysis and conclusions that emerge from them will allow those in charge of data collection to collect data that will be of best use to policy makers.

The wide availability of administrative data in Slovakia and other Eastern European countries call for their utilisation for quality of care evaluations. "Current administrative data are probably most useful as screening tools that highlight areas in which quality should be investigated in greater depth." (Iezzoni, 1997). However, at present the full potential of this administrative data is not being utilised. ACSCs rely on easily accessible administrative data available from purchasing organisations or discharge data from hospitals which makes this indicator appealing and easy to use. Patient level panel data allows for the examination of variations in ACSHs and the factors influencing ACSHs over an extended period of time. While most administrative databases may lack clinical information about the patient (e.g. severity of the disease at presentation, behavioural risk factors), Chapter 5 has demonstrated that already basic demographic data, information about physician contacts and services provided (e.g. types of drugs prescribed, diagnostic tests carried out etc) may reveal some information about the quality of care provided to patients. In the future,

potential data linkages with other databases or survey could be considered as patients in Slovakia have a unique identifier.

5. *Make available disaggregated mortality data*

Mortality data is routinely collected in all the European Union countries. However, in order to be able to monitor 'avoidable' death rates and make international comparisons, detailed data on mortality by ICD codes on the regional level needs to be made available. Standardisation of data collection, diagnosis and coding, both between and within countries is necessary. Furthermore, appropriate analyses of comparability both between and within countries is needed on all these aspects at regular intervals. Care must be then taken to ensure the appropriate certification and coding of multiple causes of deaths, e.g. diabetes and arthrosclerosis. Since 1994, Eurostat has been collecting regional mortality statistics from member states for a total of 65 individual or groups of causes of death. This data cover several of the conditions that have been considered as 'avoidable' such as selected treatable cancers, ischaemic heart disease and cerebrovascular disease (Appendix B). However, much of the Eurostat mortality data set is not sufficiently disaggregated to allow for detailed analysis of 'avoidable' mortality. Thus, Eurostat data will not allow separate monitoring of conditions such as Hodgkin's disease (C81), appendicitis (K35-38), epilepsy (G40-G41), or medical errors resulting in patient death (Y60-69, Y83-84). If 'avoidable' mortality is to be monitored at European level drawing on Eurostat data, it will be necessary for Eurostat to collect mortality data that are sufficiently disaggregated.

6. *Use major reforms as an opportunity to reassess what is good/bad*

While policy makers may be tempted to conclude that the transition has only had a positive effect across the different conditions, chapter 3 has identified conditions where deterioration or lack of improvement was noted in the recent years. This finding has a much broader policy implication suggesting that not everything "old" was necessarily bad and everything "new" is entirely good. End of communism and political and economic liberalisation may have certainly brought many positive opportunities but did not remove all the problems in the health care systems. At the same time numerous reforms were implemented but these have also brought new challenges. For example, new provide payment mechanisms introduced may encourage a particular negative behaviour by the provider which needs to be corrected for. It is essential to continuously reassess performance and aim to maintain the good elements of the system while changing only those that underperform.

7. *Do not seek to establish a relationship between 'avoidable' mortality and health care inputs without better data*

Findings from Chapter 4 have shown that health care inputs do not consistently explain health outcomes, even when an improved indicator such as 'avoidable' mortality is used. While it is difficult to determine at the aggregate level the extent to which health care interventions prevent unnecessary deaths, the most recent evidence from the AMIEHS project continues to point to the fact that 'avoidable' mortality indicators may be most useful for an initial understanding of how the health care system is performing. However, there are many other important determinants (e.g. lifestyle) of 'avoidable' mortality that lie outside of the health care system which would need to be better accounted for in future research and analysis as

the exact contribution of medical care cannot be established. Also, quantity of resources cannot always be used as proxy for timely and effective care and therefore better data is required. Variations in 'avoidable' mortality, especially by individual conditions with sufficiently high number of deaths (i.e. ischaemic heart disease) could possibly be explained if quality of care, but especially other important determinants of mortality are captured with better data and then analytical models that account for endogeneity or dynamic influences are employed. Nevertheless, it is important to acknowledge that even with better data, not all variations in 'avoidable' mortality will be explained as there will be determinants of deaths which are difficult to identify or measure at the aggregate level.

8. *Use existing clinical guidelines as a basis for quality of care assessment*

Preventable hospitalisations are an outcome indicator for the quality of ambulatory care. As all outcome indicators, factors apart from quality of care determine whether or not a patient is hospitalized. Therefore, caution needs to be exercised when interpreting number of hospitalisations even though they provide an initial snapshot of the quality of ambulatory care provided. Excessive hospitalisations may be indicative of inappropriate care, result in unnecessary costs and require further investigation and analysis. Our study suggests that while only 15% of newly diagnosed patients were hospitalized at least once during the period under study, many more did not receive appropriate treatment as defined by clinical guidelines. Results also indicated higher rates in selected regions. So the evidence of a gap between the best possible care for asthma and diabetes patients and actual care provided as measured by the process indicators should be taken as a basis for action for a further review of care currently provided and strategies to improve it. It is important to acknowledge that not all steps recommended in the clinical guidelines

are necessarily directly related to reductions in hospitalisations. Yet, clinical evidence suggests that they are important and their use should be encouraged.

Another issue concerns the actual adherence to clinical guidelines. Associations of specialists have prepared clinical guidelines for both asthma and diabetes; clinical guidelines are available for other diseases as well. Physicians involved in the preparation of these guidelines together with representatives of purchasing organisations and other policy makers should decide on how to ensure that all providers concerned adhere to these guidelines. Overall, it is essential that physicians assume responsibility for quality improvement (Shekelle & Roland, 2000, p.171). Evidence shows that despite the availability of clinical guidelines, physician behaviour may not be simple to change and thus take a long time before full adherence to guidelines is reached. Explicit and implicit incentives in the system to provide treatment as well as physician practice style need to be reviewed and better understood to design appropriate interventions to improve quality of care provided. Overall, there is more positive evidence on effectiveness of professional-oriented interventions (education, reminders, feedback) than on those aimed at the organisation or the patient (Grol & Grimshaw, 2003). However, changes in clinical practice are only partly within doctors' control; it is the prevailing professional and organisational culture towards quality that determines the outcome to a large extent (Grol & Grimshaw, 2003). In this sense, unless such changes are made in Slovakia, improvements in the quality of care will be difficult to achieve.

9. *Review risk factors and care provided for peptic ulcer*

Analysis of individual 'avoidable' conditions provides a more in depth understanding of how the respective health systems perform in specific areas. Peptic ulcer is one of the conditions where mortality rates have been stagnant or the decline slowed down

after 1989 in both the Czech Republic and Slovakia. It is therefore essential to understand how prevention and treatment is provided to patients with peptic ulcer so that improvement strategies can be implemented. At the same time an analysis of important risk factors such as alcohol and cigarettes in this context should be undertaken.

10. *Review risk factors and care provided for malignant neoplasm of cervix uteri and body of uterus*

The relatively high mortality rates for malignant neoplasm of cervix uteri and body of uterus could be attributed mainly to the deficiencies in the organisation and performance of cervical screening (Potancok & Sadovsky, 2004; Vlasak, Plesko, Dimitrova, et al., 1991), which are likely to explain the gap between Slovakia and the Czech Republic. While both countries have a nationwide organised screening, uptake of screening is unsatisfactory, as in Slovakia only about 20% of woman population took advantage of these preventive examinations (Hupkova, 2008). Therefore the underlying reasons for low uptake should be better understood in both countries so that effective interventions to address this problem can be designed.

11. *Encourage further improvements in the prevention and treatment of hypertension*

While significant improvements have already been made, further progress is necessary in the treatment of hypertension. In the Czech Republic, large proportion of the patients do not have their blood pressure controlled (Cifkova, Skodova, Lanska, et al., 2004). In Slovakia, mortality from hypertension also remains a problem due to deficiencies in the prevention and treatment of cardiovascular diseases broadly (Bada, 2006; Jurkovicova, 2005), and untreated high blood pressure, overweight and

obesity more specifically (Barakova & Riecansky, 2007). With respect to treatment, the number of angiograms, percutaneous coronary interventions, and stenting rates have been gradually increasing in both Slovakia and the Czech Republic but rates remain behind most Western European countries, especially in Slovakia (Cook, Walker, Hugli, et al., 2007) Therefore, the design of effective strategies to better manage the risk factors, uptake of prevention and treatment in the different risk groups need to be a top priority in both the Czech Republic and Slovakia.

12. Design specific strategies for the uptake of care by the Roma population

This thesis found higher rates of perinatal and respiratory disease mortality for children in the two Eastern regions of Slovakia. These are regions where there is a significantly higher presence of the Roma population than in the remaining of the country. Previous evidence suggests that these unfavourable mortality rates may result from the lifestyle, attitudes to health and health care services of this ethnic group (Ecohost/ Masaryk University, 2000). Therefore, identifying the risk factors, as well as reasons for low uptake of prevention and treatment by the Roma population and then designing specifically targeted interventions may be necessary to make further reductions in mortality levels.

Appendix A – Appendix to Chapter 1

Table 37. Development of the concept of 'avoidable' mortality

Authors	Definition of Health Services	Number of conditions	Contribution	Upper age Limit
Rutstein et al. 1976	Includes "application of all relevant medical knowledge, the basic and applied research to increase that knowledge and make it more precise, the services of all medical and allied health personnel, institutions and laboratories, the resources of governmental, voluntary, and social agencies, and the co-operative responsibilities of the individual himself"	Over 90 conditions as 'sentinel health events'	Conditions divided into: i) even a single death justifies immediate enquiry (split to preventable/treatable) ii) not every single case is preventable or manageable but where appropriate care should be associated with lower incidence of that condition (split to preventable/treatable) Stresses that for each unnecessary untimely death the physician has the initial and some continuing responsibility.	None
Charlton et al. 1983	Excludes conditions which considered to be outside the scope of medical care (primary care, hospital care, public health programmes)	14 disease groups	First to apply concept empirically at the population level to analyse area variation in mortality in England & Wales (1974-78) Examines national and international trends between 1956 and 1978.	65 for some conditions and less for others
Poikolainen and Eskola 1986,1988	Excludes conditions which depended mainly on efforts outside the health services (e.g. lung cancer)	Extend by more than 70 amenable and 20 partly-amenable conditions	Analyse trends in Finland between 1969 - 1981 Drew up explicit list of "not amenable" conditions	Age limit set for all conditions; 65 for some conditions and less for others
European Community Atlas (Holland) 1988/91; 1993; 1997	Health care services include primary care, hospital care and collective health services such as screening and public health programmes, e.g. immunisation. Initially also includes conditions whose control depends on primary prevention (health) policies with action outside the direct control of health services; these were later excluded.	1st edition/1st volume of 2nd edition: 17 disease groups 2nd volume/ 2nd edition: expands by 8 conditions where role of health services in the reduction of mortality less certain 3rd edition: combination of causes from previous editions (total	Conditions that "provide warning signals of potential shortcomings in health care delivery" and conditions for which at least a proportion of deaths can be prevented. Stimulated a range of country –specific studies. Apply a range of causes of deaths.	Age limit set for all conditions; In the last edition: 65 for some conditions and less for others

Authors	Definition of Health Services	Number of conditions	Contribution	Upper age Limit
		of 16)		
Mackenbach, 1980s	Used a more restricted definition of medical care as "the application of biomedical knowledge through a personal service system"; exclude conditions for which effective intervention is outside the direct control of medical care system, including many forms of primary prevention	Based on EC project	Link trends in mortality to specific innovations in medical care	Could not identify clear evidence for age limits except for a few conditions
Westerling, 1992, 1993 & 1996	Indicators reflecting the outcome of medical care and those mainly reflecting the effect of national health policy	Based on Rutstein and EC project	First explicit comparison of "preventable conditions" vs "treatable conditions" and empirical application	65
Simonato, 1998	Primary prevention, reduction of exposures (includes measures outside the health services); secondary prevention, early detection and treatment; and tertiary prevention, improvement in treatment and medical care	Based on Rutstein, Charlton and EC project and additional new causes	Presents the following differentiation: 1) amenable to primary prevention 2) amenable to early detection and treatment 3) amenable to improved treatment and medical care	65
Tobias and Jackson, 2001	The concept of avoidability was extended to cover not only causes of death amenable to therapeutic intervention but also those responsive to individual and population-based preventive interventions	56 conditions Broadened list of conditions by reviewing literature of advances in health care since 1980s	Distinguishes 3 categories: (primary/secondary/tertiary prevention) with relative weights for each derived through expert consensus. Substantially broadened list of potentially "'avoidable'" conditions.	75
Nolte & McKee, 2004	Health care services include primary care, hospital care and collective health services such as screening and public health programmes, e.g. immunisation.	34 conditions Based on Charlton et al., Tobias and Jackson, Mackenbach	Updates list based on most recent advances in medical knowledge and technology Conditions selected considered indicators of the impact of health care	75

Source: Based on (Nolte & McKee, 2004 and Charlton, Hartley, Silver, et al., 1983; Holland, 1997; Poikolainen & Eskola, 1988; Simonato, Ballard, Bellini et al., 1998; Tobias & Jackson, 2001; Westerling, 1993)

Table 38. Eurostat list of conditions and their use in some lists of 'avoidable' deaths

Eurostat List of Causes of death	ICD 10	EC/ Holland	Nolte & McKee
Infectious and parasitic diseases	A00-B99		
Tuberculosis	A15-A19,B90	**X**	**X**
Meningococcal infection	A39		
AIDS (HIV-disease)	B20-B24		
Viral hepatitis	B15-B19		
Neoplasms	C00-D4		
Malignant neoplasms	C00-C97		
Malignant neoplasm of lip, oral cavity, pharynx	C00-C14		
Malignant neoplasm of oesophagus	C15		
Malignant neoplasm of stomach	C16		
Malignant neoplasm of colon	C18		**X**
Malignant neoplasm of rectum and anus	C19-C21		**X**
Malignant neoplasm liver and the intrahepatic bile ducts	C22		
Malignant neoplasm of pancreas	C25		
Malignant neoplasm of larynx and trachea/bronchus/lung	C32-C34		
Malignant melanoma of skin	C43	**X**	**X**
Malignant neoplasm of breast	C50	**X**	**X**
Malignant neoplasm of cervix uteri	C53	**X**	**X**
Malignant neoplasm of other parts of uterus	C54-C55	**X**	**X**
Malignant neoplasm of ovary	C56		
Malignant neoplasm of prostate	C61		
Malignant neoplasm of kidney	C64		
Malignant neoplasm of bladder	C67		
Malignant neoplasm of lymphatic/haematopoietic tissue	C81-C96		
Dis. of the blood(-forming organs), immunological disorders	D50-D89		
Endocrine, nutritional and metabolic diseases	E00-E90		
Diabetes mellitus	E10-E14		**X**
Mental and behavioural disorders	F00-F99		
Alcoholic abuse (including alcoholic psychosis)	F10		
Drug dependence, toxicomania	F11-F16,F18-F19		
Diseases of the nervous system and the sense organs	G00-H95		
Meningitis (other than 03)	G00-G03		
Diseases of the circulatory system	I00-I99		
Ischaemic heart diseases	I20-I25	**X**	**X**
Other heart diseases	I30-I33,I39-I52		
Cerebrovascular diseases	I60-I69	**X**	**X**
Diseases of the respiratory system	J00-J99	**X**	**X**
Influenza	J10-J11	**X**	**X**
Pneumonia	J12-J18	**X**	**X**
Chronic lower respiratory diseases	J40-J47		
Asthma	J45-J46	**X**	
Diseases of the digestive system	K00-K93		
Ulcer of stomach, duodenum and jejunum	K25-K28		
Chronic liver disease	K70, K73-K74		
Diseases of the skin and subcutaneous tissue	L00-L99		
Diseases of the musculoskeletal system/connective tissue Rheumatoid arthritis and osteoarthrosis	M00-M99 M05-M06,M15-M19		
Diseases of the genitourinary system	N00-N99		
Diseases of kidney and ureter	N00-N29		
Complications of pregnancy, childbirth and	O00-O99	**X**	**X**

Eurostat List of Causes of death	ICD 10	EC/ Holland	Nolte & McKee
puerperium			
Certain conditions originating in the perinatal period	P00-P96		
Congenital malformations and chromosomal abnormalities	Q00-Q99		
Congenital malformations of the nervous system	Q00-Q07		
Congenital malformations of the circulatory system	Q20-Q28	**X**	**X**
Symptoms, signs, abnormal findings, ill-defined causes	R00-R99		
Sudden infant death syndrome	R95		
Unknown and unspecified causes	R96-R99		
External causes of injury and poisoning	V01-Y89		
Accidents	V01-X59		
Transport accidents	V01-V99		
Accidental falls	W00-W19		
Accidental poisoning	X40-X49		
Suicide and intentional self-harm	X60-X84		
Homicide, assault	X85-Y09		
Events of undetermined intent	Y10-Y34		
TOTAL All causes of death	A00-Y89		

Table 39. Ambulatory care sensitive and marker conditions

Condition	ICD – 9 – CM Codes	Comments
Ambulatory Care Sensitive Conditions		
Congenital syphilis	090	Secondary diagnosis for newborns only
Immunisation-related and preventable conditions	033, 037, 045, 320.0, 390, 391	
Grand mal status and other epileptic convulsions	345	
Convulsions "A"	780.3	Age 0-5
Convulsions "B"	780.3	Age >5
Severe ENT infections	382, 462, 463, 465, 472.1	Exclude otitis media cases [382] with myringotomy with insertion of tube [20.01]
Pulmonary tuberculosis	011	
Other tuberculosis	012-018	
Chronic obstructive pulmonary disease	491, 492, 494, 496, 466.0	Acute bronchitis [466.0] only with secondary diagnosis of 491, 492, 494, 496
Bacterial pneumonia	481, 482.2, 482.3, 482.9, 483, 485, 486	Exclude case with secondary diagnosis of sickle cell [282.6] and patients < 2 months
Asthma	493	
Congestive heart failure	428, 402.01, 402.11, 402.91, 518.4	Exclude cases with the following surgical procedures: 36.01, 36.02, 36.05, 36.1, 37.5, or 37.7
Hypertension	401.0, 401.9, 402.00, 402.10, 402.90	Exclude cases with the following procedures: 36.01, 36.02, 36.05, 36.1, 37.5, or 37.7
Angina	411.1, 411.8, 413	Exclude cases with a surgical procedure [01-86.99]
Cellulitis	681, 682, 683, 686	Exclude cases with a surgical procedure [01-86.99], except incision of skin and subcutaneous tissue [86.0] where it is the only listed surgical procedure
Skin grafts with cellulitis	DRG 263, DRG 264	Exclude admissions from SNF/ICF
Diabetes "A"	250.1, 250.2, 250.3	
Diabetes "B"	250.8, 250.9	
Diabetes "C"	250.0	
Hypoglycemia	251.2	
Gastroenteritis	558.9	
Kidney/urinary infection	590, 599.0, 599.9	
Dehydration - volume depletion	276.5	Examine principal and secondary diagnoses separately
Iron deficiency anemia	280.1, 280.8, 280.9	Age 0 - 5 only, and examine principal and secondary diagnoses separately
Nutritional deficiencies	260, 261, 262, 268.0, 268.1	Examine principal and secondary diagnoses separately
Failure to thrive	783.4	Age < 1 only
Pelvic inflammatory disease	614	Women only denominator - exclude cases with a surgical procedure of hysterectomy [68.3-68.8]
Dental Conditions	521, 522, 523, 525, 528	
"Marker' Conditions		
Appendicitis with appendectomy	540, 541, 542	With principal procedure of 47.0 or 47.1
Acute myocardial infarction	410	Only cases with LOS > 5 days or disposition of death

Gastrointestinal Obstruction	560	
Fracture hip/femur	820	Age 45+ only

Source: The NYU Center for Health and Public Service Research (CHPSR) of the Robert F. Wagner Graduate School of Public Service; http://wagner.es.its.nyu.edu/chpsr/

Table 40. Summary of assessment of ACSC admissions indicator

Criterion	Definition	Summary for ACSCs in general
Face validity	Indicator must have sound clinical or empirical rationale for its use and should measure an important aspect of quality that is subject to provider or health care system control.	Early diagnosis and management for most conditions reduces ACSC admissions.
Precision	An adequate quality indicator should have relatively large variation among providers or areas that is not due to random variation or patient characteristics. This criterion measures the impact of chance on apparent provider or community health system performance.	All ACSC indicators are measured relatively precisely but also involve complications. The precision of avoidable hospitalisation rates is likely to depend on the size of the denominator.
Minimum bias	The indicator should not be affected by systematic differences in patient case-mix, including disease severity and comorbidity. In cases where such systematic differences exist, an adequate risk adjustment system should be possible using available data.	Previous studies have documented several characteristics that are associated with either the risk of an avoidable hospitalisation (at the individual level) or the avoidable hospitalisation rate (at the area level), including prevalence of the condition, race, socioeconomic status (SES), chronic disease and health of the population. These characteristics may be confounding factors, but also might be measuring subtle aspects of access to care. Overall, while a range of factors (SES, environmental, other) influence ACSHs, substantial part of the variation in rates across areas is unexplained by these factors.
Construct validity	The indicator should be related to other indicators or measures intended to measure the same or related aspects of quality. In general, better outpatient care (including, in some cases, adherence to specific evidence-based treatment guidelines) can reduce patient complication rates.	Most previous studies have assessed the validity of an entire set of ACSCs, rather than each condition alone, and have used SES as a marker of access to care. These studies have repeatedly shown strong correlations between household income and ACSHs, both at the individual level and the area level. Fewer studies have tested true measures of access to care.
Fosters true quality improvement	The indicator should be robust to possible provider manipulation of the system. In other words, the indicator should be insulated from perverse incentives for providers to improve their reported performance by avoiding difficult or complex cases, or by other responses that do not improve quality of care.	Despite the relationships demonstrated at the patient level between higher-quality ambulatory care and lower rates of admission with subsequent complication, there is generally little evidence on whether improvements in access to high-quality care can reduce ACSHs in an area. Such relationships are difficult to elucidate, because of the many intervening factors that also affect ACSH rates (see above). Yet, there is also little evidence that use of these quality indicators would have any undesirable effects on hospital activities.
Prior use, application	The indicator should have been used in the past or have high potential for working well with other indicators. Sometimes looking at groups of indicators together may provide a more complete picture of quality.	Application of indicators in a number of different settings

Source: AHRQ, 2001 and 2007

Systematic Literature Review

A systematic review has been carried out to bring together the existing body of evidence on the factors that explain ACSH rates. Applying a conceptual framework, such evidence should enable the better application of this indicator for the measurement of performance of outpatient care. Improvements in the access and quality of care should not only save costs but also avoid unnecessary hospital stays for patients. In the process of carrying out the initial literature search of the systematic review in the Medline and Embase databases, a comprehensive literature review[20] (Ansari, 2007) has been identified. The Ansari review covers evidence from 1970 till August, 2005; it explores the validity of ACSC admissions as proxy indicators of access to primary health care, and summarises all the different factors that are associated with ACSHs rates across geographic areas and population groups. The author of the review grouped the evidence along several areas. The results and main effects are summarised below (Table 41) and further details can be found in the original article (Ansari, 2007).

[20] From here onwards this literature review may be referred to as "Ansari review" only.

Table 41. Summary of factors that explain ACSHs rates, 1970 – 2005

Factors	Association with ACSH rates	Effects identified	Comments
DEMOGRAPHICS			
AGE	YES	Younger (<=18) and Older (>=65) have higher rates Age 19-64 – steady rates	Age categories vary across studies and countries. Older age groups studied most extensively in US.
RACE	YES	Rates higher among Blacks than Whites (US), Hispanics than non-Hispanics, Aboriginal populations compared to non-Aboriginal (Australia), Maoris compared to non-Maoris (New Zealand) and Indian and Malays compared to Chinese (Singapore) Some studies found no association	
GENDER	MIXED		
SOCIOECONOMIC STATUS (SES)	YES	Overall, almost all studies found that at least 1 SES variable was statistically significant strong predictor of ACSHs, independently of other measured variables. Significant predictors of ACSHs: Income, Area-level poverty, Insurance, Education, occupation, insurance status For the *elderly* population, studies found mixed evidence for individual income and insurance status and ACSHs For *children*, insurance status, income and poverty showed a positive association with ACSHs	Socioeconomic measures have been used as predictors or covariates. There is no agreed single measure of SES, which makes it difficult to delineate how much of the observed relationships are due to barriers in access to care in potentially underserved populations, or from some other patient characteristics that are unrelated to the quality of care but vary systematically by SES.
RURALITY	YES	*Univariate analysis* Moderate to strong effect of rurality and higher ACSHs	Most studies focus on the effect of rural location of patients' residence on ACSH rates. Some studies performed separate analyses for rural and urban areas.
	MIXED	*Multivariate analysis* Mixed evidence	

Factors	Association with ACSH rates	Effects identified	Comments
			Some studies found a non-linear relationship between rurality and ACSHs.
HEALTH SYSTEM FACTORS			Most ACSH research has been devoted to the analysis of primary care supply Several studies of US Medicare beneficiaries have shown weak and inconsistent associations between access indicators and ACSH rates.
Primary care physician supply	MIXED	6 of 12 studies found that with lower PCP supply risk of ACSHs increases; 2 found the opposite effect; 2 did not detect an effect and 1 was difficult to interpret and 1 treated PCP supply as confounder	
Regular source of care	MIXED	Only few studies	
Self-rated access to care	YES	Good access inversely associated with ACSH rates; only a few studies	
Presence of subsidised primary care	MIXED	Only few studies	
Inpatient bed supply	YES	Higher supply of beds associated with higher ACSH rates	
Clinical thresholds for admission/ Physician practice style	UNCLEAR	Admission threshold lower for patients living in low income areas and with higher disease severity; another study found that effect of disease severity on ACSHs was small	
PREVALENCE	MIXED	Prevalence does not seem to play a significant role in determining ACSHs	
LIFESTYLE FACTORS	MIXED	Only 1 study.	Evidence from the US only
ENVIRONMENT	YES	Outdoor air pollution associated with increases in ACSHs	Few studies account for environmental impact due to lack of data.
ADHERENCE TO MEDICATION	YES	Lowest levels of hospitalisations for COPD, Diabetes, hypertension and CCF patients with high adherence	No studies looked at adherence in general but at relationship of individual ACSC admissions
SEVERITY OF ILLNESS	No clear evidence but	Variations in severity of illness for ACSCs have been observed between geographic areas, socioeconomic status, insurance, age, race and	Important factor in explaining variations in ACSHs between areas and populations

Factors	Association with ACSH rates	Effects identified	Comments
	important factor	gender. Therefore, risk adjustment for severity of illness should be carried out.	
PROPENSITY TO SEEK CARE	MIXED	Important predictor of health care utilisation in various studies; lower propensity to seek care has been observed among rural residents and elderly population. One study found no association with area ACSHs rates.	Propensity to seek care is determined by a number of other factors including attitudes toward health care, preferences and risk aversion.

Source: Ansari, 2007

Ansari concludes that ACSC admissions are valid proxy indicators of access to primary health care. ACSHs result from a number of key reasons including insufficiency and mal-distribution of primary health care resources, evidence of the existence of barriers to accessing primary care services (e.g. socioeconomic), problems with continuity of care and inefficient use of resources (e.g. may occur if the patient finds it easier or cheaper to go directly to the hospital instead of getting care in an ambulatory setting) (Ansari, 2007). Overall, the review reveals that socioeconomic factors seem to be the most important predictors of ACSHs. While some factors are addressed much more extensively (e.g. supply of physicians), others such as lifestyle, prevalence, adherence to medication, and in more general terms, utilisation and clinical quality of care that patients are covered to a more limited extent.

The Ansari review was systematically updated to encompass new evidence from 2005 until March 2009 to see whether an effect of any additional factors that influence ACSHs has since been identified.

Objectives

This review looks at available evidence on factors that explain ACSHs from August 2005 to date.

Criteria for selecting studies for the review

The following main question will be explored in this systematic review: What factors explain ACSHs in the adult population?

In addition, the following sub- question, which is of prime interest in the general framework of my research, will be explored: Have any utilisation and quality of outpatient care variables been explored as factors influencing ACSHs in the adult population?

The main question can be broken down into the following components:

Table 42. Main criteria for study inclusion

Types of participants	General population Adults over 18 years old
Types of interventions/tools	All risk factors
Types of outcome measures	Hospitalisations for groups of ACSCs
Type of study design	All study designs

Search strategy for identification of studies

The search strategy described in the Ansari review was partially reproduced. It searched Medline, Australasian Medical Index (AMI), grey literature on the World Wide Web and relevant references; however in this systematic review Medline, Embase and Econlit have been searched instead. AMI was not searched because of its exclusive focus on Australian studies and its replacement by two databases with a worldwide coverage was found to be more appropriate. A citation search for the Ansari review has been done in the Web of Sciences; however, no additional articles have been identified. These databases are expected to provide a solid coverage of the material for the purpose of this systematic review.

In the Ansari review the following free text phrases have been searched: "preventable/avoidable hospitalisation(s)/admission(s)/hospital admission(s), together with the phrase ambulatory care sensitive'". Details of how these search terms were applied are as follows:

In the literature review the following free text phrases have been searched in titles and abstracts: "preventable/avoidable hospitalisation(s)/admission(s)/hospital admission(s), together with the phrase ambulatory care sensitive'". However, the literature review did not provide further information about how these free text phrases are to be combined nor did it give the search results. The provided description suggests the following search strategy:

1. Preventable or avoidable
2. Hospitalisation(s) OR admission(s) OR hospital admission(s)
3. 1 AND 2
4. Ambulatory care sensitive
5. 3 AND 4
6. Limit 5 to year 2005-2009

However, this search strategy limited the results too much and excluded important studies when compared to broader searches. Then the following strategy was tested:

1. Preventable OR avoidable OR ambulatory care sensitive
2. Hospitalisation(s) OR admission(s) OR hospital admission(s)
3. 1 AND 2
4. Limit 3 to year 2005-2009

However, this search strategy yielded too many results instead. Finally, the following search strategy seemed most appropriate and was applied in the three databases:

1. Hospitali?ation*
2. Admission*
3. Hospital admission*
4. 1 OR 2 OR 3
5. Ambulatory care sensitive
6. 4 AND 5
7. Limit 6 to years 2005 – 2009

MESH terms have not been used because for most free text terms these were not available. Also, using free text terms for this search was likely to pick up a larger number of studies. Finally, search of the World Wide Web and review of references of the relevant articles have not been carried out due to time limitations.

The results of every search step in the Medline, Embase and Econlit databases are as follows:

I. MEDLINE

1. Hospitali?ation* - 99740
2. Admission* - 99466
3. Hospital admission* - 14567
4. 1 OR 2 OR 3 - 182134
5. Ambulatory care sensitive – 135
6. 4 AND 5 – 131
7. Limit 6 to years 2005 – 2009 – 59

II. EMBASE

1. Hospitali?ation* - 93379
2. Admission* - 108551
3. Hospital admission* - 59760
4. 1 OR 2 OR 3 - 185398
5. Ambulatory care sensitive – 96
6. 4 AND 5 – 94
7. Limit 6 to years 2005 – 2009 – 44
8. Of these 44 studies, 8 were not identified by MEDLINE

III. ECONLIT

1. Hospitali?ation* - 209
2. Admission* - 685
3. Hospital admission* - 184
4. 1 OR 2 OR 3 - 874
5. Ambulatory care sensitive - 11
6. 4 AND 5 - 9
7. Limit 6 to years 2005 – 2009 - 4
8. Of these studies, 1 was not identified by MEDLINE or EMBASE

Methods of the review

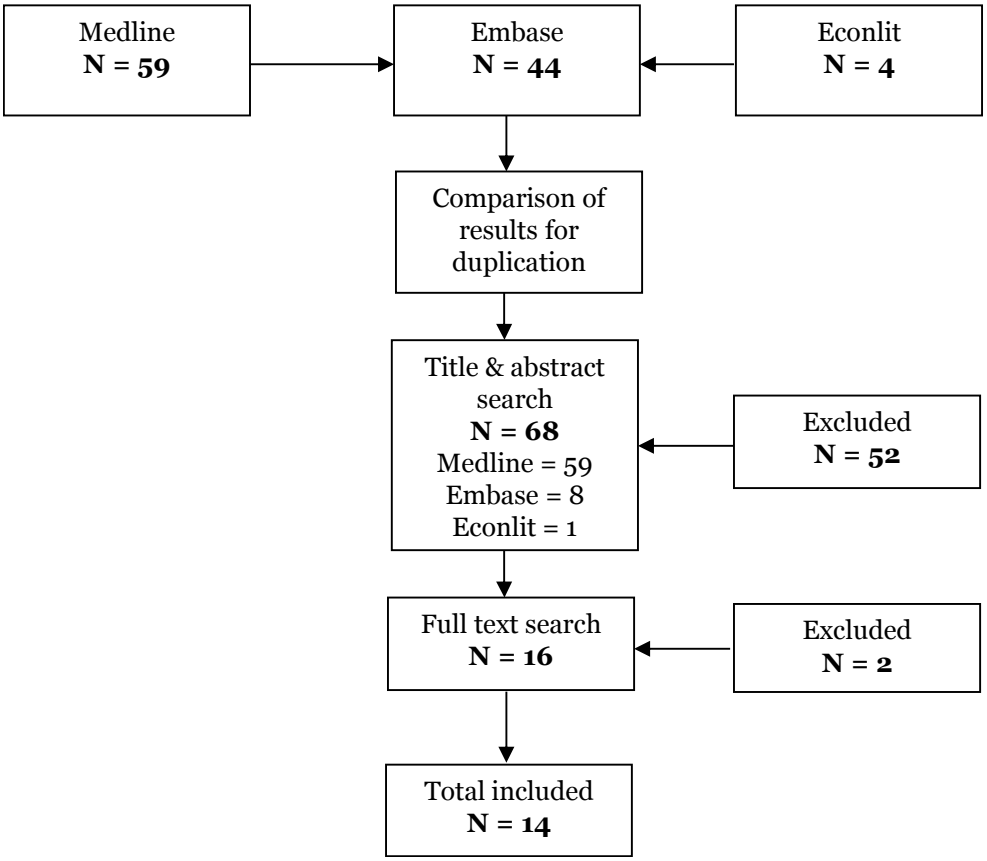
The general criteria for the literature search have been specified earlier. The following additional exclusion criteria have been applied:

1. Only English language studies
2. Only studies focusing on a set of ACSC conditions. This review looks at ACSHs as a set of indicators together since most of the evidence has the same focus. However, in future reviews it may be useful to look individual conditions as well depending on the purpose of the research being carried out.
3. Only studies for the general adult population. Application of this indicator for children requires specific adjustments. Also studies focusing on a highly specific population group or minority were excluded.

4. Only studies using administrative or billing data. Studies using medical records or other sources of data were excluded because these result in different data analysis and results.

Overall, 107 studies were identified through the search. After excluding duplicate articles and applying the strict inclusion criteria, 14 studies were included in this systematic review (Figure 32).

Figure 32. Search results



The review of the studies has been carried out using tools of the narrative synthesis method developed by the University of York. This method is usually used when quantitative synthesis is not applicable due to the heterogeneity of the studies. The Narrative Synthesis Methods Guidance has been requested from the University of York and obtained through personal correspondence. The framework and tools applied are summarised below:

Table 43. Narrative synthesis approach

Main elements of synthesis	Effectiveness Reviews	Implementation Reviews
1. Developing a theoretical model of how the interventions work, why and for whom	*Purpose:* • To inform decisions about the review question and what types of studies to review • To contribute to the interpretation of the review's findings • To assess how widely applicable those findings may be	*Purpose:* • To inform decisions about the review question and what types of studies to review • To contribute to the interpretation of the review's findings • To assess how widely applicable those findings may be
2.Developing a preliminary synthesis	*Purpose:* • To organise findings from included studies to describe patterns across the studies in terms of: ○ The direction of effects[1] ○ The size of effects	*Purpose:* • To organise findings from included studies in order to: ○ Identify and list the facilitators and barriers to implementation reported ○ Explore the relationship between reported facilitators and barriers
3. Exploring relationships in the data	*Purpose:* • To consider the factors that might explain any differences in direction and size of effect across the included studies	*Purpose:* • To consider the factors that might explain any differences in the facilitators and/or barriers to successful implementation across included studies • To understand how and why interventions have an effect
4. Assessing the robustness of the synthesis product	*Purpose:* • To provide an assessment of the strength of the evidence for: ○ Drawing conclusions about the likely size and direction of effect ○ Generalising conclusions on effect size to different population groups and/or contexts	*Purpose:* • To provide an assessment of the strength of the evidence for drawing conclusions about the facilitators and/or barriers to implementation identified in the synthesis. Generalising the product of the synthesis to different population groups and/or contexts

Source: Popay J, Roberts H, Sowden A, Petticrew M, Arai L, Rodgers M, Britten N, , Roen K, Duffy S. Guidance on the Conduct of Narrative Synthesis in Systematic Reviews: A Product from the ESRC Methods Programme. April 2006.

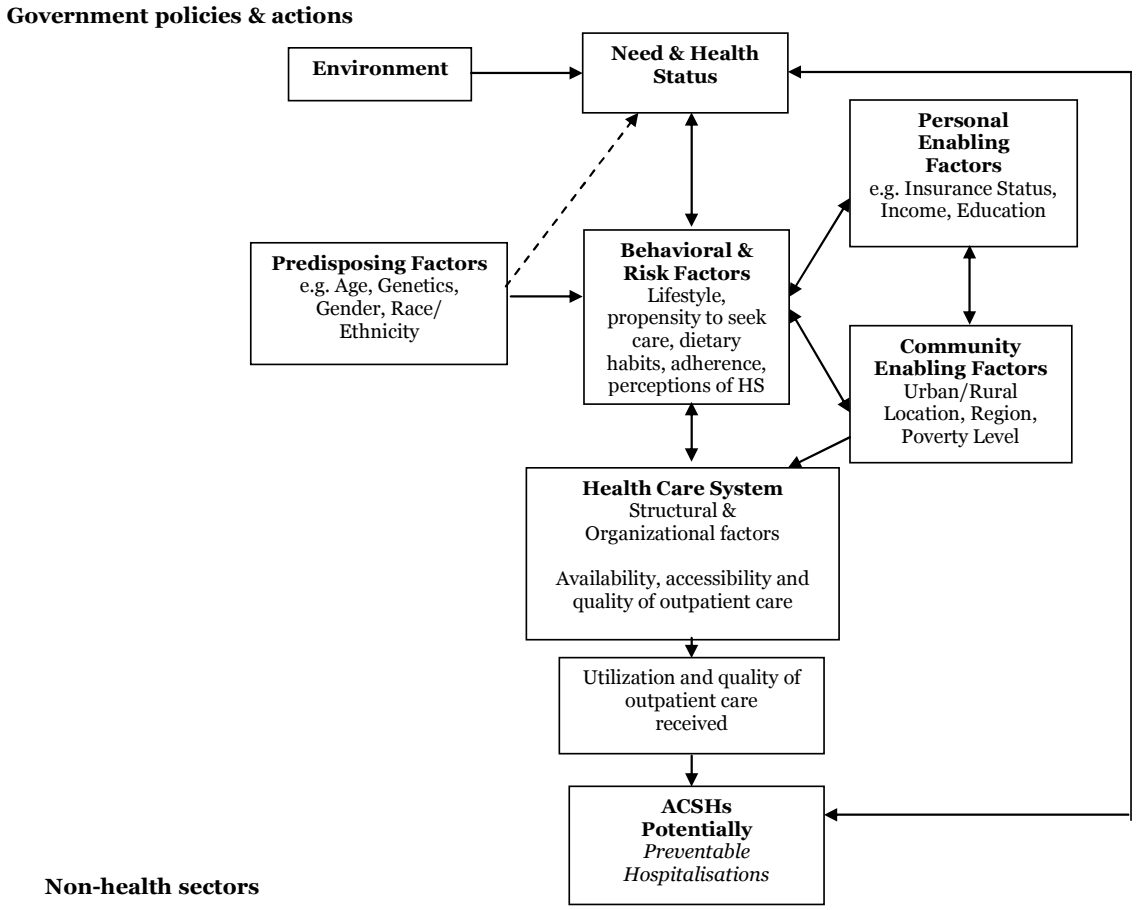
The main elements of the narrative synthesis framework are:

1. Developing a theory of how the intervention works, why and for whom
2. Preliminary synthesis: Data extraction and some quality assessment
3. Data analysis and results: Explore relationships within and across studies
4. Assess robustness of synthesis, comment on heterogeneity

The results from the Ansari review as well as the systematic review can be summarised in light of a conceptual framework adapted from models for access to care, in particular earlier behavioural models (Andersen, 1995; Andersen, McCutcheon, Aday, et al., 1983), supply-demand models (Basu, Friedman, & Burstin, 2004), Chang's model (Chang, Mirvis, & Waters, 2008) and the World Bank's health outcome model[21]. This framework does not, however, only focus on ACSCs as a measure of access since other variables not associated with access may have an effect on preventable hospitalisations. Figure 33 below summarises the conceptual framework that has been applied when reviewing the literature and shows which factors, and how these factors are likely to influence ACSHs.

[21] The World Bank, www.worldbank.org

Figure 33. Conceptual framework for ACSHs



Source: Adjusted based on Chang et al, 2008; Anderson, 1983 and 1995; Basu et al, 2004; World Bank

Any individual begins with the onset of a certain condition (need) which is influenced by the environment, behavioural and risk factors, as well as the person's predisposing factors such as genetic characteristics, age, gender or ethnicity. Then there are the behavioural and risk factors which include the person's lifestyle (e.g. exercise, eating and smoking habits), attitude towards taking medication and propensity to seek care. These are influenced both by predisposing as well enabling personal factors (e.g. insurance status, income) and enabling community factors (e.g. community poverty level); both provide the "means" to utilise services (Chang, Mirvis, & Waters, 2008). Depending on the person's perception of the health care system, its availability, quality and accessibility, individuals utilise health care. Finally, the number of times the person comes into contact with the outpatient health system (primary and/or specialist care), as well as the quality of care he or she receives, determine ACSH rates.

Therefore, while ACSH rates may be used as a measure of access to effective outpatient care, it is important to take into account all the different factors that may confound this relationship, to the extent that this is possible. Some of these variables (e.g. age, gender, ethnicity) may capture differences in preferences for and utilisation of outpatient treatment, or quality of treatment offered by providers and not just biological predispositions. For example, ethnicity may not be an important factor after additional variables such as patient attributes, lifestyle, level of poverty and others are included. Therefore, instead of risk adjustment, which may hide important gender or ethnic differences, these may be better accounted for through a stratified analysis where the results are examined separately; i.e., for women and men, different ethnic groups, etc.

In addition, some variables in the framework, for example genetics, may not only explain access to care, but through the concept of health need, may have a direct relationship to ACSHs (see dashed line in Figure 33). These are hospitalisations which are not preventable but need to be accounted for.

Fourteen new studies have been included and analysed as part of the systematic review. Information on key aspects which are relevant for analysis has been extracted and can be found in Table 44:

Table 44. Summary of studies included in the review

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
1.(Chang, Mirvis, & Waters, 2008)	USA, Tennessee 2002 - 2004	<1 18<	Unadjusted overall ACSHs rates Unadjusted chronic ACSHs rates Unadjusted acute ACSHs rates **Variable of interest:** Race Insurance coverage	Age Ethnicity Gender Country poverty levels Urban/rural Region of state Charlson index(health status) # hospital beds PCP/population unit	AHRQ, 2007 14 ACSCs	Hospitalized Black patients more likely than White experienced chronic ACSHs For acute conditions the risk was lower for Black patients after controlling for covariates Insurance a strong predictor of risk of hospitalisations Hospitalized uninsured Black patients faced highest relative risk for ACSHs compared to White uninsured Racial disparities exist also among those with similar	Hospital discharge records Areas resource file Unit of analysis: individual patient Logistic regression	Age, gender, Charlson Comorbidity Index may not fully account for underlying health care needs. Thus race and insurance variables may have picked up the effects of unobserved differences in health needs. Repeated admission of minority individuals Race and insurance may be correlated - stratification carried out

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
						insurance type		
2.(Bindman, Chattopadhyay, & Auerback, 2008)	USA 1998 - 2002	California Medicaid population Population covered: 4, 735 797 Adults aged 18 – 64 with a minimum of 1 month coverage between 1998 – 2002	Time to ACSHs **Variable of interest:** Medicaid interruption	Demographic characteristics: Age, Sex, Race/ethnicity Medicaid aid category (estimate for health status) Medicaid HC delivery model Other form of insurance Elixhauser comorbid condition	AHRQ 2001 list	Interruption in Medicaid insurance coverage associated with higher risk for ACSH Beneficiaries who were older, black or Hispanic; were eligible for Medicaid through Supplemental Security Program or aid categories other than TANF; or were receiving services through managed care had higher risk of ACSHs	Hospital patient discharge data linked to Medicaid eligibility file Retrospective cohort study Life-table technique + Cox proportional model	Lack of information about why interruptions occurred and whether beneficiaries changed to another insurance coverage Additional confounding possible due to patients' health status or other unmeasured factors No information on the use of ambulatory care services
3.(Magan, Otero, Alberquilla, et al., 2008)	Spain (universal coverage) 2001- 2003 34 health districts of Community of	65< Population covered: 5, 372 433	Age- and sex- ACSH rates combined for the 3 years Only ACSHs in public hospitals (71% of all hospitalisations in CM) **Variable of interest:**	None	List of conditions validated for Spain Acute Chronic Vaccine preventable	ACSH rates higher for men than woman in all age groups Considerable variation across the 34 districts	Hospital discharge data including administrative and clinical data Cross-sectional,	ACSH rates are being used as an indirect measure of access to and receipt of care Based on secondary data – limitations with

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
	Madrid (CM)		Gender				ecologic study	regard to validity of principal diagnosis at discharge and completeness of variables Study only in public hospitals Not possible to eliminate readmission because not all patients could be identified across the three databases Associations at the aggregate level in this study do not necessarily apply to individual level List of conditions validated for Spain but not for population of 65 and older Lack of control for confounders (# of doctors, income etc.)

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
4.(Saha, Solotaroff, Oster et al., 2007)	USA 1990-1993 1995 - 2000	Oregon residents 18-64	Age- and sex- adjusted ACSH rates **Variable of interest:** Payer (Insurance)	Age Sex Marker conditions Time Comorbidities		ACSH rates increased with increased insurance coverage likely due to increased access to inpatient care	Discharge database Retrospective time series analysis Logistic regression	Data sources may have biased the results (dynamic nature of insurance status hard to account for)
5.(Carter, Datti, & Winters, 2006)	USA 2000-2002	65<	ACSH rates **Variable of interest:** Age	Sex Race Nursing home Urgent visit Location of ED	Based on Millman, 1993	ACSH rates increase with age over 85, for those from nursing residency and urgent status; ACSH rates decrease for nonwhite older adults. However, older adults account disproportionately for ED visits	Ambulatory care survey Logistic regression	Adjustments for non-response bias Case-mix not adjusted for Sample includes only those actually visiting ED
6.(Ansari, Laditka, & Laditka, 2006)	Australia (Victoria) 1999-2000 32 geographically defined primary care partnerships	18<	Age- and sex-standardised ACSH rates **Variable of interest:** Self-rated access	<u>Access and health factors:</u> Disease burden Prevalence Propensity to seek care Primary physician supply per 1000 Urban/rural Accessibility/ remoteness index	Combination of Millman, 1993 and AHRQ (2001) Acute Chronic Vaccine preventable	Higher ACSH rates in areas with perceived problems accessing medical care, after controlling for prevalence, disease burden, propensity to seek care and	Hospital discharge data for all public and private acute care hospitals Victorian Population Health Survey	

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
				<u>Social determinants:</u> Income, Employment Education <u>Behavioural risk factors:</u> Smoking, Vegetable consumption, Alcohol, Physical activity		physician supply Rural residence may be a greater risk factor for ACSH than poor self rated access Positive association with ACSH: Low Income Low education Smoking Low physician supply	OLS	
7.(Laditka & Laditka, 2006)	USA 1997	19-64 65<	ACSHs rates **Variables of interest:** Race Ethnicity	Disease prevalence Unmeasured hospital effects (physician supply, treatment preferences and patients' preferences etc.)	Six conditions separately: Angina Asthma COPD CHF Hypertension Diabetes	ACSH rates for almost all conditions were higher for African Americans and Hispanics than for non-Hispanics, in both age groups and both males and females	Hospital discharge data Survey for prevalence Census for population estimates	Prevalence information relies on self-reporting Results may not be representative because States choose to participate in the Nationwide Inpatient Sample
8.(Menec, Sirski, Attawar et al., 2006)	Canada 1990 – 91 1006 - 97	Province of Manitoba 67<	ACSH rates **Variable of interest:** Continuity of care	<u>Demographics</u>: age, gender, marital status, education, mobility <u>Self-reported, health-related measures</u>: self-rated health, morbidity	Billings, 1993	High continuity of care associated with reduced odds of ACSHs	Survey data from representative sample Administrative data with	

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
				index, functional status, cognitive impairment			complete physician visits and hospitalisations Logistic regression	
9.(Zeng, O'Leary, Sloss et al., 2006)	USA 01-12/1996	65< (other exclusions specified in the study) 2% stratified random sample from 4 California counties with largest Medicare enrolment = 10,448 HMO 11,803 FFS enrolees	Probability of joining HMO Probability of ACSH Inpatient days for ACSCs **Variable of interest:** Medicare Health Maintenance Organization (HMO) enrolment	Selection Age, gender, eligibility for Medicaid, disability, death during study period, county of residence	15 ACSCs relevant to the elderly (McCall, Harlow, & Dayhoof, 2001)	Medicare HMO enrolees have lower ACHSs rates and fewer total inpatient days for 15 ACSCs than Medicare FFS beneficiaries. Selection of healthier beneficiaries into HMOs does not completely explain their lower ACSHs	Medicare enrolment data Hospital discharge data Discrete factor selection model	Computational complexity of discrete factor model can lead to unreliable estimates. Limited generalisabiity No access to quality of care information (e.g. timing of admission, care received inpatient/outpatient)
10.(Zhang, Mueller, Chen et al., 2006)	USA 1999 - 2001	Patients from 28 rural Nebraska counties designated as health	ACSH rates **Variable of interest:** Presence of rural clinic	Individual characteristics: Age, Gender County-level contextual factors: %persons in poverty,	Millman, 1993 Chronic Acute	Elderly patients residing in rural Nebraska HPSAs with at least one rural health clinic were significantly less	Hospital discharge data Area resource file Multilevel	Lack of data on individual rural health clinic visits for specific ACSCs Not all discharges may be reported.

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
		professional shortage areas (HPSAs) Age groups: 0-17 18-64 65<		%persons aged 65<, income per capita, hospital beds per capita, % person 25< with college education		likely to have ACSHs due to chronic condition	logistic regression	Inaccurate diagnoses due to nature of administrative databases. ACSHs should be used with other measures because some ACSHs may be due to non-primary care factors
11.(Mobley, Root, Anselin et al., 2006)	USA 1998 - 2000	FFS Medicare population >65	ACSH rates **Variable of interest:** Physician supply Physician visits Poverty among elderly Managed care penetration Availability of supplemental coverage Urban sprawl	Disease severity Demographics <u>Demand factors</u>: %elderly in poverty, %total population in poverty, relative isolation of elderly, <u>Supply factors:</u> availability and mix of physician specialties, non-physician clinicians <u>Intervening factors:</u> travel time, managed care prevalence, Medicare HMO, private sector HMO and PPO penetration and changes in these over	11 ACSCs	Elderly living in impoverished rural areas or in sprawling suburban placer are equally likely to be admitted for ACSCs. While greater availability of physicians does not matter, greater prevalence of non-physician clinicians and international medical graduated, relative to US medical	Medicare FS beneficiary data Demographic census data Facilities and utilisation data Practitioner data Market conditions data Ecological model of spatial	

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
				time; insurance industry concentration/prevalence of employer-sponsored retirement plan; private insurance market's concentration, prevalence of employer-sponsored retirement insurance; average price of a standard MediGap plan in the area		graduates, reduces ACSHs, especially in poor rural areas.	interaction	
12.(Bindman, Chattopadhyay, Osmond et al., 2005)	USA 1994 – 1999	California temporary assistance to needy families eligible Medicaid beneficiaries <65	Average monthly ACSH rates **Variable of interest:** Medicaid voluntary managed, mandatory managed and FFS care	Admission month Admission year Age Sex Race/ethnicity County of residence	Institute of Medicine, 1993 and Billings, 1993 List Control condition: Average monthly appendicitis rate	Medicare managed care compared to FFS care is associated with a large reduction in ACSH rates with a greater effect for minority groups Appendicitis hospitalisation rates were not significantly different across the 3 groups	Cross-sectional comparison Discharge data Eligibility file	
13. (Howard, Hakeem, Njue et al., 2007)	USA 1999-2002	Medicare population Aged 65 years and	ACS admission rates **Variables of interest:** Race	Gender	Based on Billings, 1993 Bacterial	Admissions for ACS conditions between African American and white patients	Discharge Data Census d Descriptive	Focus on people aged 65 and older No control for income and other

Study	Setting	Participants	Dependent variable & Factors of interest	Confounders	Conditions included	Result/Effect	Data source/Methods	Limitations of study acknowledged by original author(s)
		over	Year		pneumonia, CHF, Diabetes, COPD, dehydration, UTI, Angina, Asthma Control conditions: Appendicitis w/appendectomy, Fracture of hip/femur, gastrointestinal obstruction	differ but it is unclear why	statistics ata	social and economic factors Study measures hosp. for a population with greater prevalence of an ACS condition along with an equivalent risk of hospitalisation per person –therefore, the rate of hosp. will appear greater for that ethnic group
14. (Falik, Needleman, Herbert et al., 2006)	USA	1.6 million Medicaid beneficiaries	ACS hospitalisations ACS emergency visits **Variables of interest:** Regular source of care (community health centres vs. other Medicaid providers)	Insurance, scope of benefits, socioeconomic status, community resources, health status and comorbidity, demographics	19 ACSCs based on earlier studies	The community health centers compared with the other Medicaid providers experienced one third fewer sentinel ACS events	Retrospective analysis of claims data Logistic regression	

The findings of the reviewed studies are summarised in Table 45. The table highlights the variables of interest[22] that have been selected on the basis of the factors identified in the Ansari review; newly identified factors are included as well. The table also shows whether studies applied a conceptual framework as a starting point for analysing the effects of different variables of interest.

Table 45. Summary of results

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Association with ACSHs
Demographics															
Age					X										**YES**
Gender			X												**YES**
Race	X						X						X		**MIXED**
Socioeconomic status															
Insurance status	X	X		X					X			X			**YES**
Poverty among elderly											X				**YES**
Managed care penetration											X				**YES**
Availability of supplemental coverage											X				**YES**
Rurality															
Urban sprawl											X				**YES**
Health System Factors															
Self-rate access						X									**YES**
Continuity of care/regular source of care								X						X	**YES**
Presence of rural clinic										X					**YES**
Physician supply (providers other than GPs)											X				**YES**
Physician visits											X				**YES**
Prevalence, lifestyle factors, environment, adherence to medication, propensity to seek care, severity of illness															

[22] Variables controlled for/confounding variables are not included.

The literature search yielded highly heterogeneous studies which may partially be explained by the search strategy which did not focus only on certain variables of interest. A broad search may be more informative and useful for researchers or policy makers who are interested in the general application and use of the ACSH indicator. This is also suggested by the way the Ansari review was carried out, which did not include an in depth comparison of the studies but instead focused on the results of the studies.

Overall, the variety of settings and chosen variables of interest, differences in ACSCs used, the target population, number and type of confounders, study designs, methods and data sources made it difficult to compare and assess the quality of studies. Therefore, it was difficult to draw sound conclusions about the overall effects and strengths of associations of the different factors and ACSHs. However, despite these limitations, this systematic review together with the Ansari review provide interesting findings for future research and policy application of the ACSHs indicator.

Having carried out this review with the application of the conceptual framework described earlier revealed that most studies do not apply a structured approach to their analysis, which may impact on the overall quality of the study and its results. Similar to earlier studies, the newly identified studies have again been focusing on demographic, socioeconomic and a few health system factors. Also, the focus was on factors which are easier to assess and measure. This may not be a problem as such, but may lead to incomplete conclusions about ACSHs as a measure of the quality of care. When the results are analysed against the factors included in the conceptual framework, the literature predominantly deals with predisposing factors, personal enabling factors and health system factors and how these explain ACSH rates, while other factors are not addressed.

Besides one study which included physician visits, no new evidence has been identified which would consider health services utilisation (intensity) and clinical quality of care variables, such as appropriate drug treatment for a specific condition[23] or adherence to the treatment prescribed. Yet it is important to acknowledge that including these types of variables may only be possible if ACSCs are monitored individually at the patient level which has been done in condition specific studies, for e.g. diabetes or asthma, where it has been established that hospitalisations for these

[23] Literature on determinants of hospitalisations for individual conditions has not been reviewed

conditions can be controlled with appropriate care. Also, none of the studies looked at the relationship between all the key factors together - predisposing (e.g. age, gender), enabling (e.g. income, insurance), behaviour and risk (e.g adherence, smoking), utilisation (e.g. primary and specialist visits) and quality of care (e.g. type of drug treatment) – and ACSHs. Finally, the indicator of ACSHs continued to be applied mainly in the United States, as well as Canada, Australia and Spain but not in an entirely new country context.

Implications of the review and conclusions

This chapter has highlighted the importance of measuring the quality of ambulatory care with the indicator of preventable hospitalisations. The systematic literature review revealed that the application of this indicator requires additional in depth research, especially, studies that focus on the effect of variables whose association with ACSHs is not well understood. Also, it would be important if future studies carried out a more in depth review of the study designs, methods, data sources and ASCSs included in the available literature in order to allow for better evidence to policy makers. This chapter did not review the condition specific literature (e.g. diabetes, asthma, and hypertension) which may identify a range of additional, especially clinical, factors associated with preventable hospitalisations. These may include for example, appropriateness of clinical care according to evidence-based guidelines, adherence or others.

In order to make this indicator useful for policy makers on the country level, it is important that future studies focus on factors that are specific to the country's health system context in countries where to-date little or no research has been carried out. For example, in systems of social health insurance where entire populations are covered, exploring the association of insurance status with hospitalisations may not be relevant. Instead, coordination of care or adherence and their association with preventable hospitalisations may need to be measured. In addition, it is important to understand the hospital payment scheme which may influence the admission threshold and patient management of the admitting physicians.

Overall, hospitalisations for ACSCs can be useful to policy-makers in several ways. Hospitalisations for ambulatory care sensitive conditions can be used as an information and evaluation tool for planners and policy-makers for continuous monitoring of health services (Ansari, 2007a). ACSHs can also be used as an outcome

indicator for small area analysis as it provides researchers and policy-makers with a valuable tool for identifying communities or regions with greater problems in accessing primary health care compared to a reference (either state average or rates of ACSH admission in communities with similar demographics) (Ansari, 2007a). The indicator does not only reveal problems in accessing primary health care, but in fact, problems with the quality of the entire ambulatory care area of the health system. Large variations in ACSHs should serve as the warning flag, requiring more in depth investigations of factors associated with such preventable hospitalisations and careful consideration of future actions. Better understanding of country specific determinants of ACSHs will allow the countries to take necessary quality improvement actions at the provider or system level - actions related to barriers to accessing primary care in the community (Ansari, 2007a), access to specialist or other types of services, as well as the clinical quality of care provided by the different providers. As Ansari also noted (2007a), it is important to bear in mind the respective contributions and interplay between all facets of the health care system and how it influences hospitalisations rates. In addition, non-health system determinants of preventable hospitalisations as highlighted in the conceptual framework (e.g. behavioural and risk factors) may need to be addressed as well.

ACSCs can rely on easily accessible administrative or billing data available from purchasing organisations or discharge data from hospitals which makes this indicator more appealing and easy to use. Analysing patient level panel data allows for the examination of the factors influencing ACSHs over an extended period of time. While most administrative and billing databases may lack clinical information about the patient (e.g. severity of the disease at presentation, behavioural risk factors), basic demographic data, information about physician contacts and services provided (e.g. types of drugs prescribed, diagnostic tests carried out etc) may reveal a wealth of information about the quality of care provided to patients. If necessary, additional databases and surveys (e.g. censuses) may be used for supplementing the missing information.

Appendix B – Appendix to Chapter 2

Robustness Checks using Eurobarometer 2005 data

Figure 34. Height by age group, and gender and country, 2005

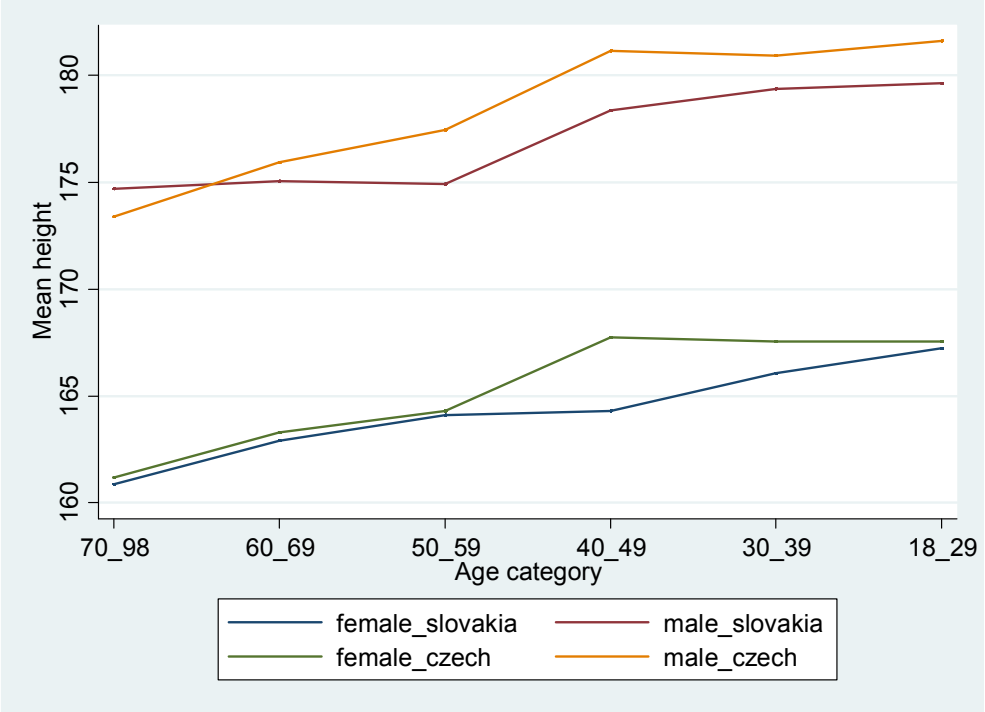


Table 46. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
height	1986	170.721	9.127407	130	201
age	2024	46.11117	16.18186	18	89
co	2024	.4916008	.500053	0	1
gend	2024	.4204545	.493754	0	1
geog	2024	.6205534	.4853692	0	1
demd	2024	.31917	.4662702	0	1
indd	2024	.2534585	.4350986	0	1
demage	2024	2.670949	4.760962	0	16
indage	2024	1.777174	3.656839	0	13
age18_29	2024	.1912055	.3933477	0	1
age30_39	2024	.1902174	.3925696	0	1
age40_49	2024	.1867589	.3898142	0	1
age50_59	2024	.1956522	.3967999	0	1
age60_69	2024	.1590909	.3658512	0	1
age70_98	2024	.0770751	.2667765	0	1

Table 47. Democracy as a dummy variable

VARIABLES	(1) Eq.1
demd	0.310
	(0.682)
co	1.332***
	(0.277)
gend	12.92***
	(0.277)
age30_39	-0.501
	(0.478)
age40_49	-0.901
	(0.803)
age50_59	-3.609***
	(0.813)
age60_69	-4.601***
	(0.827)
age70_98	-6.176***
	(0.874)
Constant	166.7***
	(0.755)
Observations	1,986
R-squared	0.563

Table 48. Democracy as a continuous variable

VARIABLES	(1) Eq.1
demage	0.184**
	(0.0752)
co	1.341***
	(0.277)
gend	12.91***
	(0.277)
age30_39	1.268
	(0.872)
age40_49	1.091
	(1.029)
age50_59	-1.618
	(1.037)
age60_69	-2.612**
	(1.048)
age70_98	-4.186***
	(1.085)
Constant	164.7***
	(0.992)
Observations	1,986
R-squared	0.564

Table 49. Democracy as a continuous variable – male

VARIABLES	(1) Eq.1
demage	0.0402
	(0.124)
co	1.679***
	(0.454)
age30_39	-0.00854
	(1.445)
age40_49	-0.278
	(1.713)
age50_59	-3.907**
	(1.728)
age60_69	-4.765***
	(1.767)
age70_98	-5.906***
	(1.832)
Constant	179.3***
	(1.644)
Observations	842
R-squared	0.121

Table 50. Democracy as a continuous variable – female

VARIABLES	(1) Eq.1
demage	0.313***
	(0.0922)
co	1.049***
	(0.341)
age30_39	2.293**
	(1.064)
age40_49	2.231*
	(1.251)
age50_59	0.420
	(1.260)
age60_69	-0.822
	(1.261)
age70_98	-2.680**
	(1.305)
Constant	163.3***
	(1.197)
Observations	1,144
R-squared	0.134

Table 51. Independence as a dummy variable

VARIABLES	(1) Eq.1
indd	-0.0434
	(0.686)
co	1.332***
	(0.277)
gend	12.92***
	(0.277)
age30_39	-0.633
	(0.628)
age40_49	-1.254
	(0.806)
age50_59	-3.963***
	(0.817)
age60_69	-4.954***
	(0.830)
age70_98	-6.530***
	(0.877)
Constant	167.1***
	(0.759)
Observations	1,986
R-squared	0.563

Table 52. Independence as a continuous variable

VARIABLES	(1) Eq.1
indage	0.224***
	(0.0840)
co	1.344***
	(0.277)
gend	12.90***
	(0.277)
age30_39	1.375
	(0.852)
age40_49	0.916
	(0.901)
age50_59	-1.793**
	(0.910)
age60_69	-2.787***
	(0.922)
age70_98	-4.361***
	(0.964)
Constant	164.9***
	(0.858)
Observations	1,986
R-squared	0.564

Table 53. Independence as a continuous variable – male

VARIABLES	(1) Eq.1
indage	0.0630
	(0.141)
co	1.677***
	(0.454)
age30_39	0.143
	(1.435)
age40_49	-0.178
	(1.525)
age50_59	-3.807**
	(1.542)
age60_69	-4.664***
	(1.586)
age70_98	-5.806***
	(1.658)
Constant	179.2***
	(1.446)
Observations	842
R-squared	0.121

Table 54. Independence as a continuous variable – female

VARIABLES	(1) Eq.1
indage	0.357***
	(0.101)
co	1.066***
	(0.341)
age30_39	2.255**
	(1.027)
age40_49	1.696
	(1.079)
age50_59	-0.116
	(1.089)
age60_69	-1.358
	(1.091)
age70_98	-3.214***
	(1.141)
Constant	163.8***
	(1.017)
Observations	1,144
R-squared	0.134

Appendix C – Appendix to Chapter 4

Table 55. IV results for 'avoidable' and other (non-avoidable) mortality

	'Avoidable' mortality				Other mortality			
VARIABLES	OLS	IV	FE	FE IV	OLS	IV	FE	FE IV
doc	-0.291	-1.887	-0.705	11.62	-0.513	-0.433	0.969	26.93
	(0.708)	(1.817)	(1.043)	(10.06)	(0.735)	(1.852)	(1.068)	(17.18)
nur	0.537	1.328	0.637	-4.091	0.260	0.221	-0.794	-10.45
	(0.445)	(0.938)	(0.557)	(3.790)	(0.462)	(0.956)	(0.583)	(6.469)
Bed	-0.669**	-0.559**	-0.0572	2.209	-0.712***	-0.717**	0.307	4.914
	(0.261)	(0.277)	(0.384)	(1.848)	(0.271)	(0.283)	(0.397)	(3.154)
Lgdp	0.471	11.37	18.28	27.69	-13.29	-13.84	15.35	28.41
	(14.44)	(18.06)	(19.37)	(27.43)	(14.99)	(18.41)	(19.83)	(46.82)
Unem	2.358***	2.120***	-0.417	-1.261	2.868***	2.880***	-0.263	-2.098
	(0.515)	(0.556)	(0.516)	(1.002)	(0.535)	(0.567)	(0.525)	(1.711)
Pol	1.932***	2.046***		-4.745	0.881***	0.875***	-0.734	-5.263
	(0.281)	(0.297)		(2.943)	(0.292)	(0.303)	(1.747)	(5.023)
Sl	53.90***	63.21***			26.21***	25.74**		
	(7.989)	(12.48)			(8.292)	(12.72)		
_Iyear_2002	-3.569	-4.021	-4.807	-8.420*	2.567	2.590	0.838	-4.428
	(4.912)	(4.758)	(2.946)	(4.667)	(5.098)	(4.850)	(3.095)	(7.967)
_Iyear_2003	-8.069	-7.861	-9.370***	-15.20**	12.92**	12.91***	9.655***	-1.296
	(4.993)	(4.817)	(3.374)	(6.313)	(5.182)	(4.911)	(3.466)	(10.78)
_Iyear_2004	-8.408	-6.758	-13.34***	-33.01**	10.81*	10.72*	0.221	-39.03
	(5.306)	(5.403)	(4.798)	(16.50)	(5.507)	(5.508)	(4.960)	(28.16)
_Iyear_2005	-12.38**	-10.31*	-20.12***	-44.28**	20.14***	20.04***	5.190	-42.04
	(5.535)	(5.767)	(5.673)	(19.83)	(5.745)	(5.879)	(5.933)	(33.85)
_Iyear_2006	-14.05**	-11.68*	-25.96***	-57.72**	20.69***	20.57***	-0.460	-63.47
	(5.805)	(6.128)	(6.706)	(25.97)	(6.025)	(6.247)	(6.991)	(44.33)
_Iyear_2007	-5.328	-1.582	-22.55**	-78.30*	30.68***	30.49***	0.0317	-111.8
	(6.611)	(7.499)	(9.181)	(44.84)	(6.862)	(7.644)	(9.616)	(76.54)
reg1	-9.730	-9.679			65.44***	65.43***		
	(16.90)	(16.29)			(17.54)	(16.61)		
reg15	-19.22	-13.52			48.20**	47.91**		
	(18.41)	(18.73)			(19.11)	(19.10)		
Constant	117.7	-26.05	-70.44		382.1**	389.3*	52.70	
	(180.1)	(230.5)	(233.0)		(187.0)	(235.0)	(237.7)	
Observations	154	154	154	154	154	154	154	154
R-squared	0.838	0.832	0.503	-0.037	0.685	0.685	0.256	-3.405
Number of v1			22	22			22	22

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 56. IV results for selected 'avoidable' mortality conditions

	IHD				HYP&CER				Remaining avoidable causes			
VARIABLES	OLS	IV	FE	FE IV	OLS	IV	FE	FE IV	OLS	IV	FE	FE IV
doc	0.196	-0.708	-0.241	9.766	-0.236	-0.365	-0.191	2.261	-0.251**	-0.815***	-0.102	-0.407
	(0.626)	(1.590)	(0.927)	(8.599)	(0.255)	(0.643)	(0.547)	(3.907)	(0.102)	(0.283)	(0.221)	(1.474)
nur	0.295	0.743	-0.0257	-3.750	0.137	0.201	0.370	-0.543	0.105	0.384***	0.0875	0.201
	(0.393)	(0.821)	(0.506)	(3.238)	(0.160)	(0.332)	(0.299)	(1.471)	(0.0638)	(0.146)	(0.121)	(0.555)
bed	-0.557**	-0.494**	0.181	1.957	-0.127	-0.119	-0.239	0.196	0.0154	0.0542	0.110	0.0559
	(0.231)	(0.243)	(0.345)	(1.579)	(0.0942)	(0.0982)	(0.203)	(0.717)	(0.0375)	(0.0432)	(0.0823)	(0.271)
lgdp	-12.81	-6.631	14.75	19.78	12.81**	13.69**	4.399	5.632	0.468	4.317	2.432	2.278
	(12.77)	(15.80)	(17.21)	(23.43)	(5.200)	(6.392)	(10.16)	(10.65)	(2.070)	(2.811)	(4.110)	(4.018)
unem	1.178**	1.043**	-0.782*	-1.489*	1.028***	1.009***	0.756***	0.583	0.152**	0.0678	-0.377***	-0.355**
	(0.456)	(0.487)	(0.456)	(0.857)	(0.185)	(0.197)	(0.269)	(0.389)	(0.0738)	(0.0866)	(0.109)	(0.147)
pol	1.387***	1.452***	-5.044***	-6.790***	0.380***	0.389***	2.225**	1.797	0.165***	0.205***	0.194	0.247
	(0.249)	(0.260)	(1.516)	(2.514)	(0.101)	(0.105)	(0.895)	(1.142)	(0.0403)	(0.0462)	(0.362)	(0.431)
sl	23.83***	29.10***			27.66***	28.41***			2.410**	5.696***		
	(7.067)	(10.92)			(2.877)	(4.419)			(1.145)	(1.943)		
_Iyear_2002	-1.447	-1.702	-4.899*	-6.929*	-2.078	-2.114	-0.950	-1.447	-0.0452	-0.204	-0.106	-0.0439
	(4.345)	(4.165)	(2.685)	(3.988)	(1.769)	(1.685)	(1.586)	(1.812)	(0.704)	(0.741)	(0.641)	(0.684)
_Iyear_2003	-4.898	-4.780	-7.715**	-11.94**	-3.309*	-3.292*	-2.299	-3.333	0.138	0.212	-0.0595	0.0693
	(4.416)	(4.216)	(3.007)	(5.394)	(1.798)	(1.706)	(1.776)	(2.450)	(0.716)	(0.750)	(0.718)	(0.925)
_Iyear_2004	-4.207	-3.273	-10.92**	-26.05*	-4.935**	-4.802**	-3.436	-7.142	0.734	1.317	-0.278	0.184
	(4.693)	(4.729)	(4.304)	(14.09)	(1.911)	(1.913)	(2.541)	(6.403)	(0.761)	(0.841)	(1.028)	(2.416)
_Iyear_2005	-6.675	-5.500	-17.09***	-35.29**	-6.415***	-6.248***	-4.316	-8.775	0.710	1.443	-0.761	-0.205
	(4.896)	(5.047)	(5.147)	(16.94)	(1.993)	(2.042)	(3.039)	(7.697)	(0.793)	(0.898)	(1.230)	(2.905)
_Iyear_2006	-6.263	-4.921	-20.19***	-44.48**	-8.526***	-8.335***	-6.448*	-12.40	0.739	1.575*	-1.589	-0.848
	(5.134)	(5.364)	(6.066)	(22.19)	(2.091)	(2.170)	(3.582)	(10.08)	(0.832)	(0.954)	(1.449)	(3.804)
_Iyear_2007	2.036	4.158	-17.61**	-60.71	-7.954***	-7.652***	-5.371	-15.93	0.590	1.912	-2.980	-1.664
	(5.848)	(6.563)	(8.343)	(38.31)	(2.381)	(2.655)	(4.926)	(17.41)	(0.948)	(1.167)	(1.993)	(6.569)
reg1	-2.673	-2.645			-10.28*	-10.27*			3.221	3.238		
	(14.95)	(14.26)			(6.087)	(5.767)			(2.422)	(2.536)		

reg15	-6.949	-3.724			-19.88***	-19.42***			7.610***	9.621***		
	(16.28)	(16.40)			(6.630)	(6.632)			(2.638)	(2.916)		
Constant	233.8	152.4	-43.13		-122.4*	-134.0	-30.39		6.305	-44.44	-20.53	
	(159.3)	(201.8)	(206.3)		(64.87)	(81.61)	(121.8)		(25.82)	(35.89)	(49.27)	
Observations	154	154	154	154	154	154	154	154	154	154	154	154
R-squared	0.665	0.660	0.329	-0.323	0.875	0.874	0.500	0.417	0.513	0.404	0.175	0.162
Number of v1			22	22			22	22			22	22

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 57. IV results for 'avoidable' and other (non-avoidable) mortality using health activity as the dependent variable

	'Avoidable' mortality				Other mortality			
VARIABLES	OLS	IV	FE	FE IV	OLS	IV	FE	FE IV
h_activ	-0.244	5.234***	0.478	-4.135	-0.847***	4.943**	-0.331	-9.231
	(0.299)	(1.984)	(0.681)	(5.723)	(0.310)	(2.084)	(0.692)	(7.696)
lgdp	10.42	-10.68	19.66	46.53	-2.518	-24.82	11.16	60.41
	(13.21)	(24.34)	(18.97)	(37.75)	(13.67)	(25.57)	(19.26)	(50.77)
unem	2.127***	-1.035	-0.362	1.102	2.607***	-0.735	-0.249	2.584
	(0.488)	(1.398)	(0.496)	(1.888)	(0.505)	(1.469)	(0.503)	(2.539)
pol	1.892***	1.983***		-4.118	0.855***	0.952*		-3.010
	(0.281)	(0.494)		(2.541)	(0.290)	(0.519)		(3.417)
sl	46.33***	85.80***			20.00***	61.71***		
	(5.900)	(17.24)			(6.105)	(18.11)		
_Iyear_2002	-3.714	-3.854	-4.978*	-6.856**	2.377	2.229	1.344	-0.207
	(4.990)	(8.761)	(2.933)	(3.470)	(5.164)	(9.203)	(2.978)	(4.667)
_Iyear_2003	-8.510*	-6.366	-10.07***	-13.55***	12.52**	14.78	10.55***	4.756
	(5.073)	(8.938)	(3.302)	(5.196)	(5.250)	(9.389)	(3.353)	(6.988)
_Iyear_2004	-9.875*	-9.268	-15.39***	-20.02***	9.562*	10.20	2.826	-4.791
	(5.314)	(9.333)	(4.391)	(6.870)	(5.499)	(9.804)	(4.460)	(9.239)
_Iyear_2005	-14.46***	-13.08	-22.64***	-30.17***	18.35***	19.81*	8.530	-3.614
	(5.492)	(9.653)	(5.152)	(9.608)	(5.683)	(10.14)	(5.232)	(12.92)
_Iyear_2006	-16.86***	-19.67*	-29.05***	-35.14***	18.21***	15.24	3.700	-5.547
	(5.716)	(10.08)	(6.017)	(8.907)	(5.915)	(10.59)	(6.110)	(11.98)
_Iyear_2007	-8.602	-23.20*	-27.32***	-27.43***	27.85***	12.42	6.434	10.43
	(6.442)	(12.41)	(7.968)	(9.368)	(6.666)	(13.03)	(8.092)	(12.60)
reg1	-14.55	-212.0***			60.07***	-148.6*		
	(16.80)	(74.98)			(17.38)	(78.76)		
reg15	-31.07*	-252.6***			36.53*	-197.6**		
	(18.11)	(83.63)			(18.74)	(87.85)		
Constant	0.386	22.96	-92.75		252.6	276.5	111.7	
	(162.7)	(285.8)	(225.2)		(168.4)	(300.2)	(228.7)	
Observations	154	154	154	154	154	154	154	154
R-squared	0.830	0.425	0.499	0.337	0.672	-0.147	0.246	-0.748
Number of v1			22	22			22	22

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 58. Results for 'avoidable' and other (non-avoidable) mortality using health activity as the explanatory variable

	'Avoidable' mortality			Other mortality		
VARIABLES	OLS	FE	GMM	OLS	FE	GMM
L.avoid			-0.247			
			(0.818)			
L.other						0.0611
						(1.659)
h_activ	0.0817	0.477*	-3.848	-0.290	0.562**	1.981
	(0.477)	(0.243)	(3.710)	(0.418)	(0.218)	(7.627)
lgdp	-9.857	-11.28	21.45	-13.09	-20.38***	-79.10
	(21.31)	(8.446)	(88.43)	(17.64)	(7.585)	(190.2)
unem	2.082**	-0.453	1.421	1.831*	-0.0257	-0.347
	(0.936)	(0.411)	(1.297)	(0.915)	(0.369)	(7.408)
pol	13.55***	-0.213	89.99	8.378*	1.686	6.465
	(3.112)	(2.293)	(87.31)	(4.246)	(2.060)	(48.18)
sl	36.95***			19.80*		
	(9.628)			(10.66)		
_Iyear_1997	-9.443**	-11.44***		9.412***	7.127**	-1.656
	(4.377)	(3.356)		(2.790)	(3.013)	(35.75)
_Iyear_1998	-21.49***	-20.62***	6.407	4.274	4.394	-7.060
	(5.533)	(3.648)	(16.06)	(4.414)	(3.276)	(19.08)
_Iyear_1999	-27.36***	-22.08***	10.71	-0.845	3.022	-4.592
	(6.707)	(4.035)	(22.37)	(6.668)	(3.623)	(14.75)
_Iyear_2000	-29.18***	-27.68***	18.69	0.0716	0.115	-10.67
	(6.096)	(4.064)	(30.04)	(6.245)	(3.649)	(20.86)
_Iyear_2001	-36.36***	-34.01***	11.48	1.662	2.268	-7.913
	(6.341)	(4.120)	(29.72)	(6.140)	(3.700)	(11.70)
_Iyear_2002	-39.04***	-36.93***	9.285	4.659	5.394	
	(7.775)	(4.196)	(30.63)	(6.621)	(3.768)	
_Iyear_2003	-42.83***	-40.85***	-1.630	15.11**	16.30***	13.31**
	(7.412)	(4.112)	(29.43)	(6.331)	(3.692)	(6.538)
_Iyear_2004	-42.72***	-43.83***	-9.021	11.83*	11.63***	13.88
	(7.641)	(4.142)	(34.61)	(6.223)	(3.720)	(19.12)
_Iyear_2005	-46.48***	-49.86***	-16.21	20.51***	19.41***	23.09
	(8.985)	(4.256)	(40.92)	(5.717)	(3.822)	(15.77)
_Iyear_2006	-48.16***	-55.09***	-21.88	19.57***	16.17***	21.99
	(9.787)	(4.518)	(48.35)	(5.688)	(4.058)	(17.90)
_Iyear_2007	-38.63***	-50.33***	-9.183	28.06***	21.10***	29.84
	(11.31)	(5.334)	(54.69)	(7.321)	(4.790)	(26.86)
reg1	-11.52			42.20**		
	(26.43)			(18.20)		
reg15	-18.77			12.74		
	(29.12)			(22.17)		
Constant	272.1	314.0***	90.97	365.5*	438.7***	1,063

	(257.9)	(98.77)	(822.0)	(210.2)	(88.70)	(1,760)
Observations	264	264	220	264	264	220
R-squared	0.815	0.748		0.629	0.287	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix D – Appendix to Chapter 5

Table 59. Diabetes: using "bad care" variables in the previous 2 years

VARIABLES	(1) PFE1	(2) PFE1	(3) PFE2	(4) PFE2	(5) PFE3	(6) PFE3
age	0.939**	0.949***	0.927***	0.938***	0.926***	0.936***
	(0.0248)	(0.0187)	(0.0246)	(0.0160)	(0.0247)	(0.0166)
gender		1.086		1.009		1.073
		(0.561)		(0.451)		(0.510)
comorb	1.058***	1.056***	1.054***	1.053***	1.054***	1.053***
	(0.00700)	(0.00532)	(0.00679)	(0.00522)	(0.00678)	(0.00523)
eye_bad	1.723*	1.246**	1.757*	1.267**	1.760*	1.269**
	(0.518)	(0.120)	(0.548)	(0.123)	(0.548)	(0.122)
hba1c_bad	1.093	1.108	1.109	1.116	1.109	1.116
	(0.131)	(0.127)	(0.134)	(0.128)	(0.134)	(0.128)
urine_bad	0.920	0.917	0.938	0.923	0.955	0.937
	(0.0776)	(0.0788)	(0.0778)	(0.0791)	(0.0798)	(0.0809)
chlst_bad	0.535***	0.445***	0.520***	0.434***	0.522***	0.435***
	(0.0892)	(0.0319)	(0.0890)	(0.0312)	(0.0891)	(0.0313)
badpred_visit	0.448***	0.442***				
	(0.0483)	(0.0463)				
hosplag	0.506***	0.403***	0.511***	0.409***	0.508***	0.407***
	(0.112)	(0.0262)	(0.114)	(0.0266)	(0.114)	(0.0265)
antid	1.065***	1.069***	1.074***	1.079***	1.073***	1.079***
	(0.00948)	(0.00840)	(0.00953)	(0.00839)	(0.00953)	(0.00839)
insu		3.422		3.140		3.439
		(3.591)		(2.548)		(3.096)
visit_bad					0.736	0.774
					(0.145)	(0.138)
Constant		47.35***		52.40***		60.91***
		(67.38)		(65.15)		(78.03)
Observations	7,062	7,062	7,062	7,062	7,062	7,062
Number of v1	1,421	1,421	1,421	1,421	1,421	1,421

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 60. Diabetes: using "bad care" variables in the previous 3 years

VARIABLES	(1) PFE1	(2) PFE1	(3) PFE2	(4) PFE2	(5) PFE3	(6) PFE3
age	0.964*	0.978**	0.949***	0.962***	0.948***	0.961***
	(0.0190)	(0.0103)	(0.0187)	(0.0105)	(0.0189)	(0.0106)
comorb	1.057***	1.059***	1.054***	1.055***	1.054***	1.055***
	(0.00737)	(0.00523)	(0.00720)	(0.00517)	(0.00720)	(0.00517)
gender		0.755		0.734		0.747
		(0.268)		(0.248)		(0.255)
eye_bad	2.012*	1.388***	2.073*	1.447***	2.078*	1.450***
	(0.765)	(0.173)	(0.808)	(0.180)	(0.809)	(0.181)
hba1c_bad	1.157	1.173	1.168	1.179	1.166	1.179
	(0.161)	(0.167)	(0.163)	(0.167)	(0.162)	(0.167)
urine_bad	1.018	1.025	1.026	1.026	1.040	1.035
	(0.0934)	(0.0918)	(0.0937)	(0.0911)	(0.0961)	(0.0929)
chlst_bad	0.773*	0.673***	0.769*	0.667***	0.772*	0.668***
	(0.104)	(0.0540)	(0.106)	(0.0534)	(0.107)	(0.0536)
badpred_visit	0.453***	0.442***				
	(0.0535)	(0.0486)				
hosplag	0.530***	0.430***	0.535***	0.438***	0.534***	0.437***
	(0.0949)	(0.0280)	(0.0953)	(0.0283)	(0.0952)	(0.0283)
antid	1.071***	1.072***	1.079***	1.080***	1.078***	1.080***
	(0.00964)	(0.00838)	(0.00960)	(0.00837)	(0.00961)	(0.00837)
insu		1.636		1.733		1.734
		(0.752)		(0.740)		(0.744)
visit_bad					0.840	0.895
					(0.141)	(0.136)
Constant		3.380		5.483**		5.625**
		(2.810)		(4.659)		(4.817)
Observations	7,062	7,062	7,062	7,062	7,062	7,062
Number of v1	1,421	1,421	1,421	1,421	1,421	1,421

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 61. Diabetes: using "bad care" variables in the previous 4 years

VARIABLES	(1) PFE1	(2) PFE1	(3) PFE2	(4) PFE2	(5) PFE3	(6) PFE3
age	0.968	0.989	0.962	0.978**	0.962	0.978**
	(0.0246)	(0.0105)	(0.0238)	(0.0103)	(0.0239)	(0.0103)
gender		0.470*		0.485**		0.482**
		(0.186)		(0.174)		(0.173)
comorb	1.042***	1.047***	1.044***	1.049***	1.044***	1.049***
	(0.00886)	(0.00615)	(0.00866)	(0.00604)	(0.00865)	(0.00605)
eye_bad	1.811	1.264	1.800	1.286	1.801	1.283
	(0.773)	(0.227)	(0.757)	(0.227)	(0.756)	(0.227)
hba1c_bad	1.196	1.126	1.245	1.147	1.245	1.148
	(0.270)	(0.241)	(0.285)	(0.246)	(0.286)	(0.246)
urine_bad	1.040	1.073	1.061	1.103	1.061	1.095
	(0.140)	(0.134)	(0.140)	(0.133)	(0.142)	(0.133)
chlst_bad	0.674***	0.640***	0.681***	0.624***	0.681***	0.622***
	(0.0710)	(0.0703)	(0.0747)	(0.0677)	(0.0749)	(0.0677)
badpred_visit	0.388***	0.378***				
	(0.0403)	(0.0348)				
hosplag	0.475***	0.368***	0.501***	0.392***	0.501***	0.393***
	(0.100)	(0.0281)	(0.103)	(0.0296)	(0.103)	(0.0297)
antid	1.059***	1.052***	1.081***	1.074***	1.081***	1.074***
	(0.0146)	(0.00981)	(0.0140)	(0.00968)	(0.0140)	(0.00968)
insu		1.161		1.475		1.480
		(0.548)		(0.632)		(0.635)
visit_bad					0.991	1.077
					(0.177)	(0.190)
Constant		3.802		2.857		2.832
		(3.438)		(2.522)		(2.495)
Observations	4,683	4,683	4,683	4,683	4,683	4,683
Number of v1	1,178	1,178	1,178	1,178	1,178	1,178

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 62. Using count variables – Poisson and NB fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	PFE1	NBFE1	PFE2	NBFE2	PFE3	NBFE3	PFE4	NBFE4
age	1.030	1.006	1.037*	1.013	1.030	1.005	1.019	1.001
	(0.0236)	(0.00870)	(0.0225)	(0.00867)	(0.0237)	(0.00866)	(0.0245)	(0.00887)
gender		0.654		0.704		0.594*		0.600*
		(0.197)		(0.213)		(0.178)		(0.181)
comorb	1.045***	1.045***	1.047***	1.048***	1.044***	1.044***	1.041***	1.041***
	(0.00628)	(0.00486)	(0.00642)	(0.00491)	(0.00636)	(0.00487)	(0.00614)	(0.00490)
eye	0.903*	0.951***	0.901*	0.949***	0.902*	0.950***	0.898*	0.943***
	(0.0524)	(0.0148)	(0.0525)	(0.0146)	(0.0519)	(0.0147)	(0.0511)	(0.0147)
hba1c	1.042	1.038	1.046	1.042	1.045	1.041	1.027	1.024
	(0.0523)	(0.0417)	(0.0520)	(0.0418)	(0.0522)	(0.0416)	(0.0515)	(0.0408)
chlst	1.190***	1.207***	1.186***	1.203***	1.186***	1.204***	1.178***	1.195***
	(0.0157)	(0.00961)	(0.0153)	(0.00960)	(0.0160)	(0.00962)	(0.0161)	(0.00964)
tot_urine	1.080**	1.086***	1.074**	1.078***	1.077**	1.083***	1.062*	1.067***
	(0.0352)	(0.00780)	(0.0341)	(0.00769)	(0.0352)	(0.00780)	(0.0328)	(0.00769)
hosplag	0.636**	0.533***	0.634**	0.527***	0.641**	0.537***	0.623**	0.518***
	(0.117)	(0.0332)	(0.120)	(0.0329)	(0.118)	(0.0335)	(0.120)	(0.0325)
antid	1.101***	1.107***	1.095***	1.100***	1.098***	1.104***	1.088***	1.093***
	(0.00841)	(0.00655)	(0.00806)	(0.00654)	(0.00864)	(0.00656)	(0.00863)	(0.00658)
insu		3.515***		3.329***		3.458***		2.558**
		(1.544)		(1.482)		(1.491)		(1.035)
badpred_visit			0.685**	0.585***				
			(0.113)	(0.0460)				
visit					1.013	1.012***		
					(0.0123)	(0.00324)		
sasvisit							1.090***	1.092***
							(0.0124)	(0.00915)
pasvisit							1.000	1.000
							(0.00419)	(0.00303)

Constant		0.0926***		0.0796***		0.0972***		0.119***
		(0.0582)		(0.0498)		(0.0609)		(0.0764)
Observations	11,266	11,266	11,266	11,266	11,266	11,266	11,266	11,266
Number of v1	1,621	1,621	1,621	1,621	1,621	1,621	1,621	1,621

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 63. Asthma: using "bad care" variables in the previous 2 years

VARIABLES	(1) PFE2	(2) NBFE2	(3) PFE1	(4) NBFE1	(5) PFE3	(6) NBFE3
age	0.818***	0.995	0.828***	1.002	0.843***	1.002
	(0.0212)	(0.00807)	(0.0226)	(0.00877)	(0.0228)	(0.00877)
comorb	1.015	1.004	1.014	1.004	1.012	1.003
	(0.0105)	(0.00841)	(0.0102)	(0.00850)	(0.0107)	(0.00849)
gender		1.038		1.214		1.149
		(0.475)		(0.585)		(0.587)
flu_bad	13.56***	8.230***	11.40***	6.642***	10.82***	6.659***
	(4.395)	(2.508)	(3.684)	(2.023)	(3.545)	(2.033)
tot_spir_bad	1.541**	1.300**	1.661***	1.470***	1.696***	1.503***
	(0.278)	(0.173)	(0.291)	(0.198)	(0.288)	(0.203)
saba	1.166***	1.187***	1.144***	1.155***	1.143***	1.151***
	(0.0482)	(0.0355)	(0.0463)	(0.0348)	(0.0469)	(0.0346)
cort	1.098**	1.063	1.095**	1.059	1.033	0.996
	(0.0479)	(0.0432)	(0.0465)	(0.0427)	(0.0407)	(0.0386)
antib	1.178*	1.137**	1.143	1.108*	1.123	1.078
	(0.114)	(0.0697)	(0.102)	(0.0680)	(0.0875)	(0.0748)
hosplag	0.799**	0.669***	0.787**	0.665***	0.800*	0.682***
	(0.0902)	(0.0672)	(0.0888)	(0.0670)	(0.0961)	(0.0686)
badpred_visit			0.533***	0.466***		
			(0.0601)	(0.0513)		
visit					1.093***	1.115***
					(0.0191)	(0.0137)
Constant		0.155***		0.191***		0.0911***
		(0.0893)		(0.112)		(0.0548)
Observations	2,751	2,751	2,751	2,751	2,751	2,751
Number of v1	393	393	393	393	393	393

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 64. Asthma: using "bad care" variables in the previous 3 years

VARIABLES	(1) PFE2	(2) NBFE2	(3) PFE1	(4) NBFE1	(5) PFE3	(6) NBFE3
age	0.780***	1.003	0.797***	1.009	0.810***	1.009
	(0.0435)	(0.00762)	(0.0458)	(0.00854)	(0.0479)	(0.00867)
comorb	1.015	1.004	1.013	1.005	1.010	1.003
	(0.00987)	(0.00832)	(0.00962)	(0.00840)	(0.0102)	(0.00839)
gender		1.175		1.340		1.298
		(0.474)		(0.581)		(0.588)
flu_bad	2.931***	1.293*	2.481***	1.126	2.511***	1.215
	(0.796)	(0.177)	(0.688)	(0.154)	(0.715)	(0.168)
tot_spir_bad	1.103	0.936	1.158	1.027	1.158	1.026
	(0.176)	(0.131)	(0.185)	(0.144)	(0.189)	(0.145)
saba	1.236***	1.239***	1.206***	1.199***	1.202***	1.200***
	(0.0487)	(0.0365)	(0.0454)	(0.0353)	(0.0459)	(0.0353)
cort	1.089*	1.068	1.088*	1.069*	1.016	0.999
	(0.0515)	(0.0429)	(0.0496)	(0.0423)	(0.0410)	(0.0384)
antib	1.173	1.167**	1.134	1.133**	1.141*	1.130*
	(0.125)	(0.0718)	(0.102)	(0.0688)	(0.0805)	(0.0747)
hosplag	0.645***	0.714***	0.645***	0.706***	0.653***	0.710***
	(0.0612)	(0.0755)	(0.0603)	(0.0747)	(0.0639)	(0.0750)
badpred_visit			0.490***	0.427***		
			(0.0557)	(0.0460)		
visit					1.104***	1.121***
					(0.0174)	(0.0133)
Constant		0.610		0.786		0.357**
		(0.249)		(0.336)		(0.158)
Observations	2,751	2,751	2,751	2,751	2,751	2,751
Number of v1	393	393	393	393	393	393

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 65. Asthma: using "bad care" variables in the previous 4 years

VARIABLES	(1) PFE2	(2) NBFE2	(3) PFE1	(4) NBFE1	(5) PFE3	(6) NBFE3
age	0.934*	1.012	0.940	1.018*	0.940	1.017*
	(0.0351)	(0.00861)	(0.0361)	(0.0101)	(0.0362)	(0.0104)
comorb	1.007	1.008	1.007	1.009	1.004	1.006
	(0.0110)	(0.00842)	(0.0109)	(0.00850)	(0.0113)	(0.00850)
gender		1.134		1.277		1.228
		(0.474)		(0.578)		(0.576)
flu_bad	1.065	0.868	1.019	0.820	1.079	0.870
	(0.204)	(0.120)	(0.198)	(0.115)	(0.212)	(0.123)
tot_spir_bad	0.976	0.909	0.985	0.954	1.020	0.982
	(0.150)	(0.139)	(0.152)	(0.147)	(0.153)	(0.152)
saba	1.238***	1.241***	1.201***	1.199***	1.204***	1.204***
	(0.0479)	(0.0359)	(0.0445)	(0.0348)	(0.0448)	(0.0349)
cort	1.095**	1.080**	1.092**	1.081**	1.021	1.010
	(0.0499)	(0.0424)	(0.0470)	(0.0417)	(0.0413)	(0.0385)
antib	1.245**	1.204***	1.189*	1.159**	1.197**	1.156**
	(0.137)	(0.0738)	(0.110)	(0.0701)	(0.0840)	(0.0761)
hosplag	0.853	0.806**	0.826*	0.778**	0.832	0.789**
	(0.0926)	(0.0822)	(0.0885)	(0.0790)	(0.0950)	(0.0803)
badpred_visit			0.450***	0.421***		
			(0.0492)	(0.0450)		
visit					1.111***	1.119***
					(0.0182)	(0.0133)
Constant		0.571		0.750		0.348**
		(0.230)		(0.318)		(0.152)
Observations	2,751	2,751	2,751	2,751	2,751	2,751
Number of v1	393	393	393	393	393	393

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 66. Astma: using count variables – Poisson and NB fixed effects

VARIABLES	(1) PFE2	(2) NBFE2	(3) PFE1	(4) NBFE1	(5) PFE3	(6) NBFE3	(7) PFE4	(8) NBFE4
age	0.942***	1.004	0.941***	1.010	0.960**	1.014	0.962*	1.015
	(0.0184)	(0.00730)	(0.0196)	(0.00823)	(0.0192)	(0.00908)	(0.0195)	(0.00953)
comorb	1.008	1.006	1.008	1.006	1.004	1.005	1.006	1.006
	(0.0110)	(0.00830)	(0.0109)	(0.00839)	(0.0113)	(0.00841)	(0.0111)	(0.00848)
gender		1.178		1.318		1.212		1.173
		(0.466)		(0.563)		(0.562)		(0.560)
flu	1.045	1.210	1.152	1.330	1.401	1.586*	1.383	1.569*
	(0.371)	(0.309)	(0.370)	(0.337)	(0.342)	(0.397)	(0.336)	(0.392)
antib	1.233*	1.160**	1.183*	1.125*	1.193**	1.140**	1.206***	1.154**
	(0.133)	(0.0723)	(0.111)	(0.0692)	(0.0869)	(0.0748)	(0.0842)	(0.0753)
cort	1.094**	1.074*	1.091**	1.070*	1.016	1.001	1.001	0.990
	(0.0487)	(0.0417)	(0.0466)	(0.0417)	(0.0415)	(0.0379)	(0.0438)	(0.0382)
saba	1.226***	1.228***	1.198***	1.196***	1.202***	1.202***	1.203***	1.202***
	(0.0469)	(0.0358)	(0.0439)	(0.0349)	(0.0447)	(0.0350)	(0.0450)	(0.0351)
tot_spir	1.090**	1.116***	1.038	1.055*	0.984	0.991	0.965	0.974
	(0.0380)	(0.0335)	(0.0339)	(0.0326)	(0.0374)	(0.0323)	(0.0364)	(0.0331)
hosplag	0.843*	0.761***	0.820**	0.734***	0.834	0.753***	0.828*	0.751***
	(0.0850)	(0.0765)	(0.0826)	(0.0738)	(0.0922)	(0.0755)	(0.0889)	(0.0752)
badpred_visit			0.461***	0.439***				
			(0.0506)	(0.0482)				
visit					1.114***	1.123***		
					(0.0188)	(0.0141)		
sasvisit							1.137***	1.140***
							(0.0236)	(0.0184)
pasvisit							1.072**	1.093***
							(0.0334)	(0.0234)
Constant		0.545		0.741		0.355**		0.354**
		(0.212)		(0.307)		(0.156)		(0.159)
Observations	2,751	2,751	2,751	2,751	2,751	2,751	2,751	2,751
Number of v1	393	393	393	393	393	393	393	393

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 67. Diabetes: including age as a continuous variable – Poisson and NB fixed effects

VARIABLES	(1) PFE1	(2) NBFE1	(3) PFE2	(4) NBFE2	(5) PFE3	(6) NBFE3
age	1.022	1.005	1.016	0.997	1.015	0.996
	(0.0187)	(0.00846)	(0.0198)	(0.00841)	(0.0196)	(0.00836)
comorb	1.054***	1.052***	1.052***	1.049***	1.052***	1.049***
	(0.00623)	(0.00503)	(0.00635)	(0.00499)	(0.00628)	(0.00498)
gender		1.128		1.074		1.076
		(0.353)		(0.337)		(0.336)
qual_eye	0.596**	0.760***	0.600**	0.763***	0.598**	0.759***
	(0.150)	(0.0510)	(0.149)	(0.0511)	(0.147)	(0.0509)
qual_hba1c	1.746*	1.678**	1.750*	1.680**	1.734*	1.671**
	(0.500)	(0.426)	(0.504)	(0.426)	(0.496)	(0.423)
qual_chlst	5.006***	6.456***	5.173***	6.691***	5.141***	6.648***
	(0.794)	(0.438)	(0.839)	(0.453)	(0.829)	(0.450)
qual_urine	1.143	1.765***	1.173	1.807***	1.124	1.749***
	(0.397)	(0.164)	(0.408)	(0.167)	(0.399)	(0.164)
badpred_visit	0.694**	0.588***				
	(0.106)	(0.0467)				
hosplag	0.660**	0.550***	0.661**	0.555***	0.657**	0.553***
	(0.121)	(0.0333)	(0.119)	(0.0336)	(0.117)	(0.0335)
antid	1.107***	1.113***	1.114***	1.120***	1.112***	1.118***
	(0.00839)	(0.00666)	(0.00871)	(0.00666)	(0.00879)	(0.00666)
insu		4.400***		4.322***		4.132***
		(2.081)		(1.967)		(1.845)
qual_visit					1.761***	1.582***
					(0.336)	(0.252)
Constant		0.0374***		0.0462***		0.0326***
		(0.0234)		(0.0289)		(0.0207)
Observations	11,266	11,266	11,266	11,266	11,266	11,266
Number of v1	1,621	1,621	1,621	1,621	1,621	1,621

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Table 68. Asthma: including age as a continuous **variable – Poisson and NB fixed effects**

VARIABLES	(1) PFE1	(2) NBFE1	(3) PFE2	(4) NBFE2	(5) PFE3	(6) NBFE3
age	0.943***	1.012	0.941***	1.006	0.952**	1.014*
	(0.0198)	(0.00844)	(0.0185)	(0.00754)	(0.0193)	(0.00835)
comorb	1.007	1.006	1.008	1.006	1.008	1.009
	(0.0109)	(0.00843)	(0.0111)	(0.00836)	(0.0117)	(0.00842)
gender		1.322		1.163		1.192
		(0.569)		(0.464)		(0.501)
qual_flu	1.154	1.347	1.071	1.256	1.105	1.326
	(0.374)	(0.343)	(0.390)	(0.323)	(0.379)	(0.338)
qual_tot_spir	1.013	1.047	1.194	1.267**	1.081	1.008
	(0.123)	(0.127)	(0.145)	(0.149)	(0.153)	(0.124)
bad_cort	0.542	0.452	0.490	0.384*	0.503	0.422*
	(0.347)	(0.231)	(0.324)	(0.206)	(0.332)	(0.220)
saba	1.200***	1.198***	1.231***	1.232***	1.213***	1.206***
	(0.0445)	(0.0351)	(0.0476)	(0.0361)	(0.0434)	(0.0351)
cort	1.135**	1.129**	1.148**	1.146***	1.140*	1.133**
	(0.0732)	(0.0574)	(0.0777)	(0.0593)	(0.0771)	(0.0581)
antib	1.182*	1.125*	1.233*	1.163**	1.214*	1.152**
	(0.110)	(0.0682)	(0.134)	(0.0711)	(0.124)	(0.0702)
badpred_visit	0.452***	0.427***				
	(0.0494)	(0.0465)				
hosplag	0.821*	0.727***	0.840*	0.749***	0.833*	0.727***
	(0.0846)	(0.0733)	(0.0858)	(0.0755)	(0.0902)	(0.0735)
qual_visit					1.669*	2.446***
					(0.471)	(0.330)
Constant		0.760		0.545		0.246***
		(0.317)		(0.214)		(0.104)
Observations	2,751	2,751	2,751	2,751	2,751	2,751
Number of v1	393	393	393	393	393	393

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Coefficients are Incidence Rate Ratios

Bibliography

Aakvik, A., & Holmas, T. H. (2006). Access to primary health care and health outcomes: the relationship between GP characteristics and mortality rates. *Journal of Health Economics, 25*, 1139-1153.

Aday, L. A., Begley, C. E., Lairson, D. R., & Slater, C. H. (1993). *Evaluating the Medical Care System: Effectiveness,efficiency, and equity* (Vol. 1st). Chicago: Health Administration Press.

Aday, L. A., Begley, C. E., Lairson, D. R., & Slater, C. H. (1998). *Evaluating the Health Care System: Effectiveness,efficiency, and equity* (Vol. 2nd). Chicago: Health Administration Press.

Aday, L. A., Begley, C. E., Lairson, D. R., & Slater, C. H. (2004). *Evaluating the Health Care System: Effectiveness,efficiency, and equit* (Vol. 3rd). Chicago: Health Administration Press.

Aday, L. A., Begley, C. E., Lairson, D. R., Slater, C. H., Richard, A. J., & Montoya, I. D. (1999). A framework for assessing the effectiveness, efficiency, and equity of behavioral healthcare. *The American journal of managed care, 5*, 25-44.

Alfonso Sanchez, J., Sanchis Noguera, B., del Bano, M. J., Sabater Pons, A., Saiz Sanchez, C., & Cortina Greus, P. (1993). Testing a new health indicator: using avoidable causes of death and life expectancy for Spain between 1975-1986. *Eur J Epidemiol, 9*, 33-39.

Almeida, C., Braveman, P., Gold, M. R., Szwarcwald, C. L., Ribeiro, J. M., Miglionico, A., et al. (2001). Methodological concerns and recommendations on policy consequences of the World Health Report 2000. *Lancet, 357*(9269), 1692-1697.

Anand, S., & Bärnighausen, T. (2004). Human resources and health outcomes: cross-country econometric study. *The Lancet, 364*(9445), 1603-1609.

Andersen, R. M. (1995). Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior, 36*(3), 1-10.

Andersen, R. M., McCutcheon, A., Aday, L. A., Chiiu, G. Y., & Bell, R. (1983). Exploring dimensions of access to medical care *Health Serv Res, 18*(1), 49-74.

Andreev, E. M., Nolte, E., Shkolnikov, V. M., Varavikova, E., & McKee, M. (2003). The evolving pattern of avoidable mortality in Russia. *Int. J. Epidemiol., 32*(3), 437-446.

Angrist, J. D., & Krueger, A. B. (2011). Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments *Journal of Economic Perspectives, 15*(4), 69-85.

Ansari, Z. (2007a). The Concept and Usefulness of Ambulatory Care Sensitive Conditions as Indicators of Quality and Access to Primary Health Care. *Australian Journal of Primary Health, 13*(3), 91-110.

Ansari, Z. (2007b). A Review of Literature on Access to Primary Health Care. *Australian Journal of Primary Health, 13*(2), 80-95.

Ansari, Z., Laditka, J. N., & Laditka, S. B. (2006). Access to health care and hospitalization for ambulatory care sensitive conditions. *Med Care Res Rev, 63*(6), 719-741.

Arah, O. A., Westert, G. P., Hurst, J., & Klazinga, N. S. (2006). A conceptual framework for the OECD Health Care Quality Indicators Project. *International Journal for Quality in Health Care, 18*(suppl 1), 5-13.

Atun, R., & Menabde, N. (2008). Health systems and systems thinking. In R. Cooker, R. Atun & M. McKee (Eds.), *Health systems and the challenge of communicable diseases: Experience from Europe and Latin America*. Buckingham: Open University Press (European Observatory on Health Systems and Policies).

Auster, R., Leveson, I., & Sarachek, D. (1969). The Production of Health, an Exploratory Study. *The Journal of Human Resources, 4*(4), 411-436.

Babazono, A., & Hillman, A. L. (1994). A Comparison of International Health Outcomes and Health Care Spending. *International Journal of Technology Assessment in Health Care, 10*(03), 376-381.

Bada, V. (2006). Po 20 rokoch novy terapeuticky princip v liecbe ischemickej choroby srdca. *Via pract., 3*(11), 530-533.

Bahadori, K., Doyle-Waters, M., Marra, C., Lynd, L., Alasaly, K., Swiston, J., et al. (2009). Economic burden of asthma: a systematic review. *BMC Pulmonary Medicine, 9*(1), 24.

Barakova, A., & Riecansky, I. (2007). Development of hypertensive diseases in the context of mortality and morbidity of the circulatory system diseases in Slovak Republic. *Lek. Obzor, 56*(3), 94-102.

Barry, J. (1992). "Avoidable mortality" as an index of health care outcome: results from the European Community Atlas of "Avoidable death". *Ir J Med Sci, 160*, 490-492.

Basu, J., Friedman, B., & Burstin, H. (2004). Managed care and preventable hospitalization among Medicaid adults. *Health Serv Res, 39*(3), 489-510.

Bauer, R. L., & Charlton, J. R. H. (1986). Area variation in mortality from diseases amenable to medical intervention: The Contribution of differences in morbidity. *Int. J. Epidemiol., 15*(3), 408-412.

Beaglehole, R. (1986). Medical management and the decline in mortality from coronary heart disease. *Br Med J (Clin Res Ed), 292*(6512), 33-35.

Bech, M., & Lauridsen, J. (2008). Exploring the spatial pattern in hospital admissions. *Health Policy, 87*(1), 50-62.

Biggs, B., King, L., Basu, S., & Stuckler, D. (2010). Is wealthier always healthier? The impact of national income level, inequality, and poverty on public health in Latin America. [Article]. *Social Science & Medicine, 71*(2), 266-273.

Billings, J., Anderson, G. M., & Newman, L. S. (1996). Recent findings on preventable hospitalizations. *Health Affairs, 15*(3), 239-249.

Billings, J., Zeitel, L., Lukomnik, J., Carey, T. S., Blank, A. E., & Newman, L. (1993). Impact of socioeconomic status on hospital use in New York City. *Health Aff, 12*, 162 - 173.

Bindman, A. B., Chattopadhyay, A., & Auerback, G. M. (2008). *Interruptions in medicaid coverage and risk for hospitalization for ambulatory care-sensitive conditions*: Annals of Internal Medicine. 149(12)(pp 854-860), 2008. Date of Publication: 16 Dec 2008.

Bindman, A. B., Chattopadhyay, A., Osmond, D. H., Huen, W., & Bacchetti, P. (2005). The impact of Medicaid managed care on hospitalizations for ambulatory care sensitive conditions. *Health Serv Res, 40*(1), 19-38.

Bjerregaard, P., & Juel, K. (1990). Avoidable deaths in Greenland 1968-1985: Variations by region and period. *Arct Med Res, 49*, 119-127.

Blazek, J., & Dzurova, D. (2000). The Decline of Mortality in the Czech Republic during the Transition: A Counterfactual Case Study. In G. A. Cornia & R. Paniccià (Eds.), *The mortality crisis in transitional economies*. Oxford: Oxford University Press.

Bloom, D. E., & Canning, D. (2007). Commentary: The Preston Curve 30 years on: still sparking fires. *International Journal of Epidemiology, 36*(3), 498-499.

Bobak, M., & Feachem, R. (1992). Health status in the Czech and Slovak Federal Republic. *Health Plicy and Planning, 7*(3), 234-242.

Bobak, M., Skodova, Z., Pisa, Z., Poledne, R., & Marmot, M. (1997). Political changes and trends in cardiovascular risk factors in the Czech Republic, 1985-92. *Journal of Epidemiology and Community Health, 51*(3), 272-277.

Bojan, F., Hajdu, P., & Belicza, E. (1991). Avoidable mortality. Is it an indicator of quality of medical care in Eastern European countries? *Int J Qual Health Care, 3*(3), 191-203.

Bookman, M. Z. (1992). *The Economics of Secession*. New York: St. Martin's Press.

Botha, J. L., Bray, F., Sankila, R., & Parkin, D. M. (2003). Breast cancer incidence and mortality trends in 16 European countries. *European Journal of Cancer, 39*(12), 1718-1729.

Bots, M. L., & Grobbee, D. E. (1996). Decline of coronary heart disease mortality in The Netherlands from 1978 to 1985: contribution of medical care and changes over time in presence of major cardiovascular risk factors. *European Journal of Cardiovascular Prevention & Rehabilitation, 3*(3), 271-276.

Bottle, A., Gnani, S., Saxena, S., Aylin, P., Mainous, A., & Majeed, A. (2008). Association Between Quality of Primary Care and Hospitalization for Coronary Heart Disease in England: National Cross-sectional Study. *Journal of General Internal Medicine, 23*(2), 135-141.

Boys, R. J., Forster, D. P., & Jozan, P. (1991). Mortality from causes amenable and non-amenable to medical care: the experience of Eastern Europe. *BMJ, 303*, 879-883.

Bozzoli, C., Deaton, A., & Quintana-Domeque, C. (2009). Adult height and childhood disease. *Demography, 46*(4), 647-669.

Breekveldt-Postmaa, N. S., Gerritsb, C. M. J. M., Lammersc, J. W. J., Raaijmakersb, J. A. M., & Heringsa, R. M. C. (2004). Persistence with inhaled corticosteroid therapy in daily practice. *Respiratory Medicine, 98*, 752-759.

Brook, R. H., McGlynn, E. A., & Cleary, P. D. (1996). Quality of Health Care. Part 2: Measuring Quality of Care. *New England Journal of Medicine 335*(13), 966-970.

Brunekreef, B., & Holgate, S. T. (2002). Air pollution and health. *The Lancet, 360*(9341), 1233-1242.

Bruthans, J., Cífková, R., Lánská, V., O'Flaherty, M., Critchley, J. A., Holub, J., et al. (2012). Explaining the decline in coronary heart disease mortality in the Czech Republic between 1985 and 2007. *European Journal of Preventive Cardiology*.

Bryndova, L., Pavlokova, K., Roubal, T., Rokosova, M., Gaskins, M., & van Ginneken, E. (2009). Czech Republic: Health system review. . *Health Systems in Transition, 11*(1), 122.

Burcin, B. (2009). Avoidable mortality in the Czech Republic in 1990-2006. *Czech Demography, 50*(1), 15-31.

Burcin, B., & Kucera, T. (2008). Structural changes in mortality in the Czech Republic and Slovakia between 1991 and 2006. *Demografie, 50*, 173-185.

Cameron, A. C., & Trivedi, P. K. (2010). *Microeconometrics Using Stata*. Texas: A Stata Press Publication, StataCorp LP.

Caminal, J., Starfield, B., Sanchez, E., Casanova, C., & Morales, M. (2004). The role of primary care in preventing ambulatory care sensitive conditions. *European Journal of Public Health, 14*(3), 246-251.

Campbell, S. M., Roland, M. O., & Buetow, S. A. (2000). Defining quality of care. *Social Science & Medicine, 51*(11), 1611-1625.

Capewell, S., Beaglehole, R., Seddon, M., & McMurray, J. (2000). Explanation for the decline in coronary heart disease mortality rates in Auckland, New Zealand, between 1982 and 1993. *Circulation, 102*, 1511-1516.

Capewell, S., Morrison, C. E., & McMurrey, J. J. (1999). Contribution of modern cardiovascular treatment and risk factor changes to the decline in coronary heart disease mortality in Scotland between 1975 and 1994. . *Heart, 81*, 380-386.

Carr-Hill, R., Hardman, G., & Russell, I. (1987). Variations in avoidable mortality and variations in health care resources. *Lancet, 1*, 1789-1792.

Carstairs, V. (1989). Avoidable mortality in European countries - 1974-1978. *Scot Med J, 34*, 391-392.

Carter, M. W., Datti, B., & Winters, J. M. (2006). *ED visits by older adults for ambulatory care-sensitive and supply-sensitive conditions*: American

Journal of Emergency Medicine. 24(4)(pp 428-434), 2006. Date of Publication: Jul 2006.

Cassidy, J. (2009). Name and shame. *BMJ, 339*, 264-267.

Celko, A. M. (1996). Breast cancer epidemiology in Czech Republic. *Central European Journal of Public Health, 4*(2), 106-109.

Center for Systemic Peace. (2013). Polity IV Annual Time Series 1800-2011. *Integrated Network for Societal Conflict Research Data Page* Retrieved February, 2013, from http://www.systemicpeace.org/polity/polity4.htm; http://www.systemicpeace.org/inscr/inscr.htm

Chang, C. F., Mirvis, D. M., & Waters, T. M. (2008). *The effects of race and insurance on potentially avoidable hospitalizations in Tennessee*: Medical Care Research and Review. 65(5)(pp 596-616), 2008. Date of Publication: October 2008.

Charlton, J. R. H., Hartley, R., Silver, R., & Holland, W. (1983). Geographical variation in mortality from conditions amenable to medical intervention in England and Wales. *Lancet, 1*(8326), 691-696.

Charlton, J. R. H., Holland, W., Lakhani, A., & Paul, E. A. (1987). Variations in avoidable mortality and variations in health care. *Lancet, 1*, 858.

Charlton, J. R. H., Lakhani, A., & Aristidou, M. (1986). How have 'avoidable death' indices for England and Wales changed? 1974-78 compared with 1979-83. *J Public Health, 8*(4), 304-314.

Chovancova, D. (2008). Ako je to so starostlivostou o novorodencov na Slovensku? *Pediatria Pre Prax, 3*.

Chu, C. M., Chan, V. L., Lin, A. W. N., Wong, I. W. Y., Leung, W. S., & Lai, C. K. W. (2004). Readmission rates and life threatening events in COPD survivors treated with non-invasive ventilation for acute hypercapnic respiratory failure. *Thorax, 59*(12), 1020-1025.

CIFHI. (2008). *Health indicators*. Ottawa: Canadian Institute for Health Information.

Cífková, R., Škodová, Z., Bruthans, J., Holub, J., Adámková, V., Jozífová, M., et al. (2010). Longitudinal trends in cardiovascular mortality and blood pressure levels, prevalence, awareness, treatment, and control of hypertension in the Czech population from 1985 to 2007/2008. *Journal of Hypertension, 28*(11), 2196-2203 2110.1097/HJH.2190b2013e32833d34451.

Cifkova, R., Skodova, Z., Lanska, V., Adamkova, V., Novozamska, E., Petrzilkova, Z., et al. (2004). Trends in blood pressure levels, prevalence, awareness, treatment, and control of hypertension in the Czech population from 1985 to 2000/01. *Journal of Hypertension, 22*(8), 1479-1485.

Cizmecioglu, F., Doherty, A., Paterson, W. F., Young, D., & Donaldson, M. D. C. (2005). Measured versus reported parental height. *Archives of Disease in Childhood, 90*(9), 941-942.

Cloutier, M. M., Hall, C. B., Wakefield, D. B., & Bailit, H. (2005). Use of asthma guidelines by primary care providers to reduce hospitalizations and emergency department visits in poor, minority, urban children. *The Journal of Pediatrics, 146*(5), 591-597.

Cochrane, A., St Leger, A., & Moore, F. (1978). Health service'input'and mortality'output'in developed countries. *Journal of Epidemiology and Community Health, 32*(3), 200-205.

Collins, S. M., & Rodrik, D. (1991). *Eastern Europe and the Soviet Union in the World Economy*. Washington DC: Institute for International Economy.

Commonwealth Fund. (2006). *Framework for a high performance health system for the United States*. New York: The Commonwealth Fund.

Cook, S., Walker, A., Hugli, O., Togni, M., & Meier, B. (2007). Percutaneous coronary interventions: prevalence, numerical estimates, and projections based on data up to 2004. *Clinical Research in Cardiology, 96*(6), 375-382.

Cornia, G. A., & Paniccià, R. (2000). *The Mortality Crisis in Transitional Economies*. Oxford: Oxford University Press.

Costa-Font, J., & Gil, J. (2008). Generational effects and gender height dimorphism in contemporary Spain. *Economics & Human Biology, 6*(1), 1-18.

Council of Europe. (1998). *The development and implementation of quality improvement systems (QIS) in health care. Recommendation No. R (97) 17 adopted by the Committee of Ministers of the Council of Europe on 30 September 1997 and explanatory memorandum* Strasbourg Council of Europe Publishing.

Cox, T., & Mason, B. (1999). *Social and Economic Transformation in East Central Europe: Institutions, Property Relations and Social Interests*. Cheltenham: Edward Elgar Publishing Limited.

Cremieux, P.-Y., Ouellette, P., & Pilon, C. (1999). Health Care Spending as Determinants of Health Outcomes. *Health Economics, 8*(7), 627-639.

Cvrcek, T. (2006). Seasonal anthropometric cycles in a command economy: The case of Czechoslovakia, 1946–1966. *Economics & Human Biology, 4*(3), 317-341.

Davídkovová, H., Kyselý, J., Kříž, B., Vojtíšek, P., & Bobák, M. (2013). Trends in cardiovascular mortality and hospitalisations, and potential contribution of inhospital case-fatality rates to changes in national mortality in the Czech Republic 1994–2009. *Heart, 99*(6), 409-416.

de Jong, J. D., Groenewegen, P. P., Spreeuwenberg, P., Schellevis, F., & Westert, G. P. (2010). Do guidelines create uniformity in medical practice? *Social Science & Medicine, 70*(2), 209-216.

Deaton, A. (2007). Height, health, and development. *Proceedings of the National Academy of Sciences, 104*(33), 13232-13237.

Delgado-Rodríguez, M., & Llorca, J. (2004). Bias. *Journal of Epidemiology and Community Health, 58*(8), 635-641.

Department of Health. (1997). *A first class service - quality in the new NHS*. London: Department of Health.

Donabedian, A. (1980). *Explorations in quality assessment and monitoring. The definition of quality and approaches to its assessment*. Ann Arbor, MI: Health Administration Press.

Donabedian, A. (1988). The quality of care. How can it be assessed? *JAMA, 260*(12), 1743-1748.

Donabedian, A. (1993). Quality in Health Care: Whose Responsibility Is It? *American Journal of Medical Quality, 8*(2), 32-36.

Donabedian, A. (2003). *An Introduction to Quality Assurance in Health Care*. New York: Oxford University Press.

Donabedian, A. (2005). Evaluating the Quality of Medical Care. *The Milbank Quarterly, 83*(4), 691-729.

Dougherty, C. (2007). *Introduction to Econometrics* (3 ed.). New York: Oxford University Press.

Downing, A., Rudge, G., Cheng, Y., Tu, Y. K., Keen, J., & Gilthorp, M. S. (2007). Do the UK government's new Quality and Outcomes Framework (QOF) scores adequately measure primary care performance? A cross-sectional survey of routine healthcare data *BMC Health Services Research, 7*.

Dubois, C., McKee, M., & Nolte, E. (Eds.). (2006). *Human resources for health in Europe*: European Observatory on Health Systems and Policies. Open University Press.

Dusheiko, M., Doran, T., Gravelle, H., Fullwood, C., & Roland, M. (2011). Does higher quality of diabetes management in family practice reduce unplanned hospital admissions? *Health Services Research, 46*(1 Pt 1), 27-46.

Ecohost/ Masaryk University. (2000). *Health needs of the Roma population in the Czech and Slovak Republics*. London: London School of Hygiene and Tropical Medicine.

Economic and Social Data Service. (2005). SN 5526 -Eurobarometer 64.3: Foreign Languages, Biotechnology, Organized Crime, and Health Items. Retrieved February 12, 2013, from http://www.esds.ac.uk/findingData/snDescription.asp?sn=5526

Egnerova, A., & Becezna, A. (1997). Trendy predcasnej umrtnosti na kardiovaskularne choroby na Slovensku. *Lek. Obzor, 46*(1-2), 4-5.

European Diabetes Leadership Forum Copenhagen. (2012a).

European Diabetes Leadership Forum Copenhagen. (2012b). Copenhagen Roadmap: outcomes of the European Diabetes Leadership Forum from http://www.diabetesleadershipforum.eu/

Evans, R., & McGrail, K. (2008). Richard III, Barer-Stoddart and the Daughter of Time. *Healthcare Policy, 3*(3), 18-28.

Evans, R. G. (1990). The dog in the night-time: medical practice variations and health policy. In T. F. Andersen & G. Mooney (Eds.), *The challenges of medical practice variations* (pp. 117-152). London: Macmillan Press.

Eveleth, P. B., & Tanner, J. M. (1976). *Worldwide variation in human growth*: Cambridge University Press.

Eveleth, P. B., & Tanner, J. M. (1990). *World-Wide Variation in Human Growth* (2nd ed.). Cambridge: Cambridge University Press.

Falik, M., Needleman, J., Herbert, R., Wells, B., Politzer, R., & Benedict, M. B. (2006). Comparative Effectiveness of Health Centers as Regular Source of Care: Application of Sentinel ACSC Events as Performance Measures. *The Journal of Ambulatory Care Management, 29*(1), 24-35.

Figueras, J., McKee, M., Cain, J., & Lessof, S. (Eds.). (2004). *Health systems in transition: learning from experience*: World Health Organization on behalf of the European Observatory on Health Systems and Policies.

Fisher, S., Gould, J., & Haughton, T. (2007). Slovakia's neoliberal turn. *Europe-Asia Studies, 59*(3), 977-998.

FitzGerald, J. M., Bateman, E., Hurd, S., Boulet, L.-P., Haahtela, T., Cruz, A. A., et al. (2011). The GINA Asthma Challenge: reducing asthma hospitalisations. *European Respiratory Journal, 38*(5), 997-998.

FitzGerald, J. M., & Quon, B. S. (2010). The impact of asthma guidelines. *The Lancet, 376*(9743), 751-753.

Fontes, M. J., Affonso, A. G., Calazans, G. M., de Andrade, C. R., Lasmar, L. M., Nader, C. M., et al. (2011). Impact of an asthma management program on hospitalizations and emergency department visits. *J Pediatr 87*(5), 412-418.

Fortney, J. C., Steffick, D. E., Burgess, J. F., Maciejewski, M. L., & Petersen, L. A. (2005). Are primary care services a substitute or complement for specialty and inpatient services? [Article; Proceedings Paper]. *Health Services Research, 40*(5), 1422-1442.

Fuhrman, C., Dubus, J. C., Marguet, C., Delacourt, C., Thumerelle, C., de Blic, J., et al. (2011). Hospitalizations for asthma in children are linked to undertreatment and insufficient asthma education. *J Asthma, 48*(6), 565-571.

Gaizauskiene, A., & Gurevicius, R. (1995). Avoidable mortality in Lithuania. *Journal of Epidemiology and Community Health, 49*, 281-284.

Gerdtham, U. G., Søgaard, J., Andersson, F., & Jönsson, B. (1992). An econometric analysis of health care expenditure: a cross-section study of the OECD countries. *Journal of health economics, 11*, 63-84.

Gilberg, K., Laouri, M., Wade, S., & Isonaka, S. (2003). Analysis of medication use patterns: apparent overuse of antibiotics and underuse of prescription drugs for asthma, depression and CHF. *Journal of Managed Care Pharmacy, 9*(3), 232-237.

Ginter, E. (1995). Cardiovascular risk factors in the former communist countries. *Eur J Epidemiol, 11*, 199-205.

Ginter, E. (1996). The development of premature cardiovascular mortality in various regions of Europe. Period 1961-1990. *Noninvas Cardiol, 5*(4), 171-176.

Ginter, E. (1998). Vyvoj vcasnej kardiovaskularnej mortality v strednej Europe v poslednom desatroci. *Cardiol, 7*(3), 199-122.

Ginter, E. (2001). [Different trends in cardiovascular mortality in the Czech and Slovak Republics after the partition of Czechoslovakia in 1993]. *Cas Lek Cesk, 140*(20), 624-628.

Ginter, E., Simko, V., & Wsolova, L. (2009). Fall of the iron curtain: male life expectancy in Slovakia, in the Czech Republic and in Europe. *Central European Journal of Public Health, 17*(4), 171-174.

Gispert, R., Serra, I., Bares, M. A., Puig, X., Puigdefabregas, A., & Freitas, A. (2008). The impact of avoidable mortality on life expectancy at birth in Spain: changes between three periods, from 1987 to 2001. *Journal of Epidemiology and Community Health, 62*(9), 783-789.

Giuffrida, A., Gravelle, H., & Roland, M. (1999). Measuring quality of care with routine data: avoiding confusion between performance indicators and health outcomes. *British Medical Journal, 319*(7202), 94-98.

Global Initiative for Asthma. (2012). *Pocket Guide for Asthma Prevention and Treatment*: Global Initiative for Asthma.

Gravelle, H., & Backhouse, M. E. (1987). International cross-section analysis of the determination of mortality. *Social Science & Medicine, 25*(5), 427-441.

Gravelle, H., Morris, S., & Sutton, M. (2008). Are family physicians good for you? Endogenous doctor supply and individual health. *Health Services Research, 43*(4).

Grol, R., & Grimshaw, J. (2003). From best evidence to best practice: effective implementation of change in patients' care. *The Lancet, 362*(9391), 1225-1230.

Haahtela, T., Tuomisto, L. E., Pietinalho, A., Klaukka, T., Erhola, M., Kaila, M., et al. (2006). A 10 year asthma programme in Finland: major change for the better. *Thorax, 61*(8), 663-670.

Hammermeister, K. E., Shroyer, A. L., Sethi, G. K., & Grover, F. L. (1995). Why It Is Important to Demonstrate Linkages between Outcomes of Care and Processes and Structures of Care. *Medical Care, 33*(10), OS5-OS16.

Hansluwka, H., Lopez, A. D., Porapakkham, Y., & Prasartkul, P. (Eds.). (1986). *New developments in the analysis of mortality and causes of death*. Bangkok: Mahidol University - Institute of Population and Social Research; World Health Organization.

Hatton, T. J. (2013). How have Europeans grown so tall? *Oxford Economic Papers*.

Health Committee. (2009). *Patient safety: Sixth report of session 2008-09*. Retrieved from http://www.publications.parliament.uk/pa/cm200809/cmselect/cmhealth/151/151i.pdf.

Health Consumer Powerhouse. (2008). *Euro Consumer Diabetes Index*: Health Consumer Powerhouse.

Healthcare Commission. (2008). *State of Healthcare 2008*. London: Stationary Office.

Heijink, R., Koolman, X., & Westert, G. (2012). Spending more money, saving more lives? The relationship between avoidable mortality and healthcare spending in 14 countries. *The European Journal of Health Economics*, 1-12.

Hiermeyer, M. (2008). The trade-off between a high and an equal biological standard of living—Evidence from Germany. *Economics & Human Biology, 6*(3), 431-445.

Hlavačka, S., Wágner, R., & Riesberg, A. (2004). *Health care systems in transition: Slovakia*: WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies.

Holland, W. (1986). The 'avoidable death' guide to Europe. *Health Policy, 6*, 115-117.

Holland, W. (2003). Commentary: Should we not go further than description of avoidable mortality? *Int J Epidemiol, 32*, 447-448.

Holland, W. (2007). Tackling assessment of the performance of health services. *Eurohealth, 13*(4).

Holland, W. (2009). Measuring the quality of medical care. *Journal of Health Service Research and Policy, 14*, 183-185.

Holland, W. (Ed.). (1988). *European Community atlas of 'avoidable death'*. Commission of the European Communities Health Services Research Series No.3. Oxford: Oxford University Press.

Holland, W. (Ed.). (1991). *European Community atlas of 'avoidable death'* (2nd ed. Vol. I). Commission of the European Communities Health Services Research Series No.6. Oxford: Oxford University Press.

Holland, W. (Ed.). (1993). *European Community atlas of 'avoidable death'* (2nd ed. Vol. II). Commission of the European Communities Health Services Research Series No.9. Oxford: Oxford University Press.

Holland, W. (Ed.). (1997). *European Community atlas of 'avoidable death' 1985-89*. Oxford: Oxford University Press.

Holland, W., & Breeze, E. (1985). The performance of health services. In M. Keynes, D. A. Coleman & N. H. Dimsdale (Eds.), *The Political Economy of Health and Welfare: Proceedings of the twenty-second annual symposium of the Eugenics Society, London* (pp. 149-169): MacMillan Press.

Howard, D. L., Hakeem, F. B., Njue, C., Carey, T., & Jallah, Y. (2007). Racially disproportionate admission rates for ambulatory care sensitive conditions in North Carolina. *Public Health Reports, 122*(3), 362-372.

Hrubisko, M., & Ciznar, P. (2010). *Asthma Bronchiale: national guidelines for treatment*. Bratislava.

Hsiao, W. C. (2003). *What is a health system? Why should we care?* Cambridge: Harvard School of Public Health.

Hunink, M. G. M., Goldman, I., Tosteson, A. N. A., Mittleman, M. A., Goldman, P. A., Williams, L. W., et al. (1997). The recent decline in mortality from coronary heart disease, 1980-1990. *JAMA, 277*, 535-543.

Hupkova, H. (2008). Cervical cancer screening in Slovakia. *Central European Journal of Public Health, 16*(suppl.), S35-S36.

Hurst, J., & Jee-Hughes, M. (2001). *Performance measurement and performance management in OECD health systems*. Paris: Organisation for Economic Co-operation and Development Publishing (OECD Labour Market and Social Policy Occasional Paper, no.47).

Iezzoni, L. (1997). Assessing Quality Using Administrative Data. *Annals of Internal Medicine, 127*(2), 666-674.

Iezzoni, L. (2003). *Risk adjustment for measuring health care outcomes* (3 ed.). Chicago: Health Administration Press.

IHP. (2008). *Monitoring performance and evaluating progress in the scale-up for better health: A proposed common framework*: Document prepared by the monitoring and evaluating working group of the International Health Parternship and Related Initiative (IHP+), led by the WHO and World Bank.

Inglot, T. (2009). Czech Republic, Hungary, Poland and Slovakia: Adaptation and Reform of the Post-Communist 'Emergency Welfare States'. In A. Cerami & P. Vanhuysse (Eds.), *Post-communist welfare pathways : theorizing social policy transformations in Central and Eastern Europe* Basingstoke: Palgrave Macmillan.

Institute of Health Information and Statistics Czech Republic. (2004). *World Health Survey in the Czech Republic (Světové šetření o zdraví v České republice) by Mgr. Jiří Holub, Ing. Jakub Hrkal, Ing. Vlasta Pázlerová*.

Institute of Health Information and Statistics Czech Republic. (2006). *Trends in evolution of health data in the Slovak Republic and Czech Republic, 1994-2004*. Prague: Institute of Health Information and Statistics Czech Republic.

Institute of Medicine. (1990). *Medicare: A strategy for quality assurance* (Vol. 1). Washingont DC: National Academy Press.

Institute of Research and Digital Education. (2013). STATA FAQ: How can I use margins to understand a categorical by categorical by continuous 3-way interaction? (Stata 11). 2013, from http://www.ats.ucla.edu/stat//stata/faq/catcatcon.htm

IOM. (2001). *Crossing the quality chasm: a new health system for the 21st century*. Washington DC: National Academy of Sciences.

James, P. D., Manuel, D. G., & Mao, Y. (2006). Avoidable mortality across Canada from 1975 to 1999., *6*(137).

Janik, Z. (2010). Twenty Years after the Iron Curtain: The Czech Republic in Transition. *Juniata voices 10*(2010).

Jougla, E., Papoz, L., Balkau, B., Maguin, P., Hatton, F., & The Eurodiab Subarea, C. S. G. (1992). Death Certificate Coding Practices Related to Diabetes in European Countries--The 'EURODIAB Subarea C' Study. *Int. J. Epidemiol., 21*(2), 343-351.

Jozan, P., & Prokhorskas, R. (Eds.). (1997). *Atlas of leading and 'avoidable' causes of death in countries of Central and Eastern Europe*. Budapest: Hungarian CSO Publishing House.

Jurkovicova, J. (2005). *Vieme zdravo zit? Zdravotny stav slovenskej populacie 1999-2004 a prevencia kardiovaskularnych a civilizacnych ochoreni*. Bratislava: Lekarska Fakulta, Univerzita Komenskeho

Karanikolos, M., Khoshaba, B., Nolte, E., & McKee, M. (2013). Comparing Population Health. In I. Papanicolas & P. C. Smith (Eds.), *Health System Performance Comparison: an Agenda for Policy, Information and Research*. Berkshire: Open University Press.

Key, T. J., Verkasalo, P. K., & Banks, E. (2001). Epidemiology of breast cancer. *The Lancet Oncology, 2*(3), 133-140.

Koch, D. (2012). *Four Essays on the Biological Standard of Living in Europe and America in Historical Perspective*. Ludwig Maximilians University Munich, Munich.

Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (Eds.). (1999). *To err is human. Building a safer health system*. Washington DC: National Academic Press.

Komlos, J. (2009). Anthropometric history: an overview of a quarter century of research. *Anthropol Anz., 67*(4), 341-356.

Komlos, J., & Baten, J. (Eds.). (1998). *The Biological Standard of Living in Comparative Perspective*. Stuttgart: Franz Steiner Verlag.

Komlos, J., & Baur, M. (2004). From the tallest to (one of) the fattest: the enigmatic fate of the American population in the 20th century. *Economics & Human Biology, 2*(1), 57-74.

Komlos, J., & Kriwy, P. (2002). Social status and adult heights in the two Germanies. *Annals of Human Biology, 29*(6), 641-648.

Komlos, J., & Kriwy, P. (2003). The Biological Standard of Living in the Two Germanies. *German Economic Review, 4*(4), 459-473.

Komlos, J., & Snowdon, B. (2005). Measures of Progress and Other Tall Stories. *World Economics, 6*(2), 87-135.

Konopasek, B., Novy, F., & Bauer, J. (1994). Nedostatky v diagnostice a lecbe karcinomu prsu. *Prakticky Lekar, 74*(9).

Korda, R. J., & Butler, J. R. G. (2006). Effect of healthcare on mortality: Trends in avoidable mortality in Australia and comparisons with Western Europe. *Public Health, 120*(2), 95-105.

Kossarova, L., Holland, W., & Mossialos, E. (2012). 'Avoidable' mortality: a measure of health system performance in the Czech Republic and Slovakia between 1971 and 2008. *Health Policy and Planning*.

Kossarova, L., Holland, W., Nolte, E., & McKee, M. (2009). *Measuring 'avoidable' mortality*: Research Note, European Observatory on the Social Situation

Koupilová, I. (2001). Health needs of the Roma population in the Czech and Slovak Republics. *Social Science & Medicine, 53*, 1191-1204.

Koupilová, I., McKee, M., & Holcik, J. (1998). Neonatal mortality in the Czech Republic during the transition. *Health Policy, 46*, 43-52.

Kovner, A. R., & Knickman, J. R. (2008). *Jonas & Kovner's Health Care Delivery in the United States* (9th ed.). New York: Springer Publishing Company.

Kunst, A. E., Looman, C. W., & Mackenbach, J. P. (1988). Medical care and regional mortality differences within the countries of the European Community. *European J Population, 4*, 223-245.

Laditka, J. N., & Laditka, S. B. (2006). Race, ethnicity and hospitalization for six chronic ambulatory care sensitive conditions in the USA. *Ethnicity & Health, 11*(3), 247-263.

Lagasse, R., Humblet, P. C., Lenaerts, A., Godin, I., & Moens, G. F. G. (1990). Health and social inequities in Belgium. *Social Science & Medicine, 31*(3), 237-248.

Leff, C. S. (1996). *The Czech and Slovak Republics: Nation Versus State*. Boulder: Westview Press.

Legido-Quigley, H., McKee, M., Nolte, E., & Glinos, I. (2008). *Assuring the quality of health care in the European Union*: European Observatory on Health Systems and Policies.

Lester, H., & Roland, M. (2009). Performance measurement in Primary Care. In P. C. Smith, E. Mossialos, I. Papanicolas & S. Leatherman (Eds.), *Performance Measurement for Health System Improvement: Experiences, Challenges and Prospects*. Cambridge: Cambridge University Press.

Lewis, G. (2003). Beyond the Numbers: reviewing maternal deaths and complications to make pregnancy safer. *Br Med Bull, 67*(1), 27-37.

Lin, W., Huang, I.-C., Wang, S.-L., Yang, M.-C., & Yaung, C.-L. (2010). Continuity of diabetes care is associated with avoidable hospitalizations: evidence from

Taiwan's National Health Insurance scheme. *International Journal for Quality in Health Care, 22*(1), 3-8.

Logminiene, Z., Nolte, E., McKee, M., Valius, L., & Gaizauskiene, A. (2004). Avoidable mortality in Lithuania: 1991-1999 compared with 1970-1990. *Public Health, 118*(3), 201-210.

Lohr, K. N., Eleazer, K., & Mauskopf, J. (1998). Health policy issues and applications for evidence-based medicine and clinical practice guidelines. *Health Policy, 46*(1), 1-19.

Mackenbach, J. P. (1991). Health care expenditure and mortality from amenable conditions in the European community. *Health Policy, 19*(2-3), 245-255.

Mackenbach, J. P., Bouvier-Colle, M. H., & Jougla, E. (1990). "Avoidable" mortality and health services: a review of aggregate data studies. *Journal of Epidemiology and Community Health, 44*, 106-111.

Mackenbach, J. P., Kunst, A. E., Looman, C. W., Habbema, J. D., & van der Maas, P. J. (1988). Regional differences in mortality from conditions amenable to medical intervention in The Netherlands: a comparison of four time periods. *J Epidemiol Community Health, 42*(4), 325-332.

Mackenbach, J. P., Looman, C., Kunst, A., Habbema, J., & van der Maas, P. (1988). Post-1950 mortality trends and medical care: gains in life expectancy due to declines in mortality from conditions amenable to medical interventions in the Netherlands. *Social Science Medicine, 27*, 889-894.

Magan, P., Otero, A., Alberquilla, A., & Ribera, J. M. (2008). Geographic variations in avoidable hospitalizations in the elderly, in a health system with universal coverage. *BMC Health Serv Res, 8*, 42.

Malcolm, M. (1994). Avoidable mortality and life expectancy in New Zealand. *J Epidemiol Comm Health, 48*, 211.

Mant, J. (2001). Process versus outcome indicators in the assessment of quality of health care. *International Journal for Quality in Health Care, 13*(6), 475-480.

Manuel, D. G., & Mao, Y. (2002). Avoidable mortality in the United States and in Canada, 1980-1996. *Am J Public Health, 92*, 1481-1484.

Martin, S., Rice, N., & Smith, P. C. (2008). Does health care spending improve health outcomes? Evidence from English programme budgeting data. *Journal of Health Economics, 27*(4), 826-842.

McCall, N., Harlow, J., & Dayhoof, D. (2001). Rates of hospitalization for ambulatory care sensitive conditions in the Medicare+Choice population. *Health Care Financ Rev, 22*, 127-145.

McGlynn, E. A. (2009). Measuring Clinical Quality and Appropriateness. In P. C. Smith, E. Mossialos, I. Papanicolas & S. Leatherman (Eds.), *Performance Measurement for Health System Improvement: Experiences, Challenges and Prospects*. Cambridge: Cambridge University Press.

McGlynn, E. A., Asch, S. M., Adams, J., Keesey, J., Hicks, J., DeCristofaro, A., et al. (2003). The Quality of Health Care Delivered to Adults in the United States. *The New England Journal of Medicine, 348*(26), 2635-2645.

McKee, M. (2004). Winners and losers: the consequences of transition for health. In J. Figueras, M. McKee, J. Cain & S. Lessof (Eds.), *Health systems in transition: learning from experience*: World Health Organization on behalf of the European Observatory on Health Systems and Policies.

McKee, M., Bain, C., & Nolte, E. (2009). Chronic care. In P. C. Smith, E. Mossialos, I. Papanicolas & S. Leatherman (Eds.), *Performance Measurement for Health System Improvement: Experiences, Challenges and Prospects*. Cambridge: Cambridge University Press.

McKee, M., & Healy, J. (Eds.). (2002). *Hospitals in a changing Europe*: European Observatory on Health Care Systems Series. Open University Press.

McPherson, K., Steel, C. M., & Dixon, J. M. (2000). Breast cancer - epidemiology, risk factors, and genetics. *British Medical Journal, 321*, 624-628.

Melero Moreno, C., López-Viña, A., García-Salmones Martín, M., Cisneros Serrano, C., Jareño Esteban, J., & Ramirez Prieto, M. T. (2012). Factors related with the higher percentage of hospitalizations due to asthma amongst women: the FRIAM study. *Arch Bronconeumol., 48*(7), 234-239.

Mendis, S., Puska, P., & Norrving, B. (Eds.). (2011). *Global Atlas on Cardiovascular Disease Prevention and Control.* . Geneva: World Health Organization.

Menec, V. H., Sirski, M., Attawar, D., & Katz, A. (2006). *Does continuity of care with a family physician reduce hospitalizations among older adults?* : Journal of Health Services Research and Policy. 11(4)(pp 196-201), 2006. Date of Publication: Oct 2006.

Mercuri, M., & Gafni, A. (2011). Medical practice variations: what the literature tells us (or does not) about what are warranted and unwarranted variations. *Journal of Evaluation in Clinical Practice, 17*(4), 671-677.

Meszaros, A. I. (1999). Divergent neighbors: The Czech Republic and Slovakia since independence. *Harvard International Review, 21*(2), 30-33.

Milanovic, B. (1998). *Income, Inequality, and Poverty during the Transition from Planned to Market Economy*. Washington, D.C.: World Bank.

Millman, M. (1993). Access to health care in America. Washington, D.C.: Institute of Medicine, National Academy Press.

Mobley, L. R., Root, E., Anselin, L., Lozano-Gracia, N., & Koschinsky, J. (2006). *Spatial analysis of elderly access to primary care services*: International Journal of Health Geographics. 5, 2006. Article Number: 19. Date of Publication: 15 May 2006.

Moreno-Serra, R., & Wagstaff, A. (2010). System-wide impacts of hospital payment reforms: Evidence from Central and Eastern Europe and Central Asia. *Journal of Health Economics, 29*(4), 585-602.

Murray, C. J., & Frenk, J. (2000). A framework for assessing the performance of health systems. *Bulletin of the World Health Organisation, 78*(6), 717-731.

National Health Information Centre. (2011). *Health Statistics Yearbook of the Slovak Republic 2010*. Bratislava: National Health Information Centre

Navarro, V. (2000). Assessment of the World Health Report 2000. *Lancet, 356*(9241), 1598-1601.

Nemec, J., & Lawson, C. (2005). Health policy in Slovakia and the outcomes of health care reforms: 1989 - 2003. *Journal of Comparative Policy Analysis, 7*(1), 49-71.

New York Academy of Medicine. (1933). *Maternal Mortality in New York: a study of all puerperal deaths 1930-32*. New York: New York Academy of Medicine: Committee on Public Health Relations. The Commonwealth Fund.

Newey, C., Nolte, E., McKee, M., & Mossialos, E. (2004). *Avoidable mortality in the enlarged European Union*. Brussels: In ISS Statistics 2-meeting. Inproving the performance of health systems in the enlarged European Union.

Newhouse, J. P., & Friedlander, L. J. (1980). The Relationship between Medical Resources and Measures of Health: Some Additional Evidence. *The Journal of Human Resources, 15*(2), 200-218.

NHS Institute for Innovation and Improvement. (2012). Indicator Construction: Managing Variation in Emergency Admissions. from http://www.productivity.nhs.uk/Indicator/608/For/National/And/25th/Percentile

NHS RightCare. (2011). *The NHS Atlas of Variation in Healthcare: Reducing unwaranted variation to increase value and improve quality*: NHS Righcare.

Nicolucci, A., Greenfield, S., & Mattke, S. (2006). Selecting indicators for the quality of diabetes care at the health systems level in OECD countries. *International Journal for Quality in Health Care, 18*(suppl 1), 26-30.

Nigam, A. (2012). Changing health care quality paradigms: The rise of clinical guidelines and quality measures in American medicine. *Social Science & Medicine*, 1-5.

Niti, M., & Ng, T. P. (2001). Temporal trends and ethnic variations in amenable mortality in Singapore 1965-1994: the impact of health care in transition. *Int J Epidemiol, 30*, 966-973.

Nixon, J., & Ulmann, P. (2006). The relationship between health care expenditure and health outcomes. *The European Journal of Health Economics, 7*(1), 7-18.

Nolasco, A., Melchor, I., Pina, J. A., Pereyra-Zamora, P., Moncho, J., Tamayo, N., et al. (2009). Preventable avoidable mortality: Evolution of socioeconomic inequalities in urban areas in Spain, 1996-2003. *Health & Place, 15*(3), 732-741.

Nolte, E., & McKee, M. (2004). *Does health care save lives? Avoidable mortality revisited*. London: The Nuffield Trust.

Nolte, E., & McKee, M. (2008a). Measuring The Health Of Nations: Updating An Earlier Analysis. *Health Aff, 27*(1), 58-71.

Nolte, E., & McKee, M. (Eds.). (2008b). *Caring for people with chronic conditions: A health system perspective*: Open University Press.

Nolte, E., & Scholz, R. (2004). Progress in health care, progress in health? Patterns of amenable mortality in Central and Eastern Europe before and after political transition. *Demographic research special collections, 2*(6), 139-162.

Nolte, E., Scholz, R., Shkolnikov, V., & McKee, M. (2002). The contribution of medical care to changing life expectancy in Germany and Poland. *Social Science Medicine, 55*, 1907-1923.

North, D. C. (1991). Institutions. *The Journal of Economic Perspectives, 5*(1), 97-112.

O'Neill, M. S., Jerrett, M., Kawachi, I., Levy, J. I., Cohen, A. J., Gouveia, N., et al. (2003). Health, wealth, and air pollution: advancing theory and methods. *Environ Health Perspect, 111*(16), 1861-1870.

OECD. (2010). OECD Health Data 2010. http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_PROC

Or, Z. (2000). Determinants of health outcomes in industrialised countries: a pooled, cross-country, times-series analysis. *OECD Economic Studies, 30*.

Or, Z., Wang, J., & Jamison, D. (2005). International differences in the impact of doctors on health: multilevel analysis of OECD countries. *Journal of Health Economics, 24*, 531-560.

Organization for Economic Cooperation and Development. (2011). *How's Life?: Measuring well-being*: OECD Publishing.

Pampalon, R. (1993). Avoidable mortality in Québec and its regions. *Soc Sci Med, 37*, 823-831.

Papanicolas, I. (2013). International Frameworks for Health System Comparison. In I. Papanicolas & P. C. Smith (Eds.), *Health System Performance Comparison: an Agenda for Policy, Information and Research* (pp. 31-74). Berkshire: Open University Press.

Papanicolas, I., & Smith, P. C. (2013). Health System Performance Comparison: an Agenda for Policy, Information and Research

Pavlínek, P. (1995). Regional development and the disintegration of Czechoslovakia. *Geoforum, 26*(4), 351-372.

Peracchi, F. (2008). Height and Economic Development in Italy, 1730-1980. *American Economic Review, 98*(2), 475-481.

Persico, N., Postlewaite, A., & Silverman, D. (2004). The Effect of Adolescent Experience on Labor Market Outcomes: The Case of Height. *National Bureau of Economic Research Working Paper Series, No. 10522*.

Piers, L. S., Carson, N. J., Brown, K., & Ansari, Z. (2007). Avoidable mortality in Victoria between 1979 and 2001 *Australian and New Zealand Journal of Public Health 31*(1), 5-12.

Plug, I., Hoffmann, R., & Mackenbach, J. e. (2011). *AMIEHS. Avoidable mortality in the European Union: Towards better indicators for the effectiveness of health systems*. EU Public Health Program 2007106.

Poikolainen, K., & Eskola, J. (1988). Health services resources and their relation to mortality from causes amenable to health care intervention: a cross-national study. *Int J Epidemiol, 17*, 86-89.

Popova, S., Rehm, J., Patra, J., & Zatonski, W. (2007). Comparing alcohol consumption in central and Eastern Europe to other European countries. *Alcohol & Alcoholism, 42*(5), 465-473.

Potancok, B., & Sadovsky, O. (2004). Current state of cervical carcinoma screening in Slovakia and proposal of mass screening practice. *Prakticka Gynekologia, 11*(1), 4-11.

Potucek, M., & Radicova, I. (1997). Splitting the welfare state: the Czech and Slovak cases. *Social Research, 64*(4), 1449-1587.

Prescott, N., & Jamison, D. T. (1985). The distribution and impact of health resource availability in China. *The International Journal of Health Planning and Management, 1*(1), 45-56.

Pritchett, L., & Summers, L. H. (1996). Wealthier is Healthier. *The Journal of Human Resources, 31*(4), 841-868.

Purdy, S. (2010). *Avoiding hospitali admissions: what does research evidence say?* : The King's Fund.

Rechel, B., Wright, S., Edwards, N., Dowdeswell, B., & McKee, M. (Eds.). (2009). *Investing in hospitals of the future*: World Health Organization, on behalf of the European Observatory on Health Systems and Policies.

Reid, D. D. (1962). Diagnostic standardization in geographic comparisons of morbidity. *American Review of Respiratory Diseases, 86*, 850-854.

Reid, D. D., & Rose, G. A. (1964). Assessing the comparabiity of mortality statistics. *British Medical Journal, 2*, 1437-1439.

Ren, C., & Tong, S. (2008). Health effects of ambient air pollution--recent research development and contemporary methodological challenges. *Environ Health, 7*(56).

Renard, L., Bocquet, V., Vidal-Trecan, G., Lair, M.-L., Couffignal, S., & Blum-Boisgard, C. (2011). An algorithm to identify patients with treated type 2 diabetes using medico-administrative data. *BMC Medical Informatics and Decision Making, 11*(1), 23.

Ricketts, T. C., & Holmes, G. M. (2007). Mortality and Physician Supply: Does Region Hold the Key to the Paradox? *Health Services Research, 42*(6p1), 2233-2251.

Rizza, P., Bianco, A., Pavia, M., & Angelillo, I. (2007). Preventable hospitalization and access to primary health care in an area of Southern Italy. *BMC Health Services Research, 7*(1), 134.

Roberts, M. J., Hsiao, W., Berman, P., & Reich, M. R. (2004). *Getting Health Reform Right: a Guide to Improving Performance and Equity*. New York: Oxford University Press.

Robst, J., & Graham, G. G. (1997). Access to health care and current health status: do physicians matter? *Applied Economics Letters, 4*(1), 45-48.

Robst, J., & Graham, G. G. (2004). The relationship between the supply of primary care physicians and measures of health. *Eastern Economic Journal, 30*(3), 467-486.

Rodrigo, G. J., Plaza, V., Bellido-Casado, J., Neffen, H., Bazús, M. T., Levy, G., et al. (2009). The study of severe asthma in Latin America and Spain (1994-2004): characteristics of patients hospitalized with acute severe asthma. *J Bras Pneumol, 35*(7), 635-644.

Rokosová M, H. P., Schreyögg J, Busse R. (2005). *Health care systems in transition: Czech Republic*: Copenhagen, WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies.

Rubin, H. R., Pronovost, P., & Diette, G. B. (2001). The advantages and disadvantages of process-based measures of health care quality. *International Journal for Quality in Health Care, 13*(6), 469-474.

Rutstein, D. D., Berenberg, W., Chalmers, T. C., Child, C. G., Fishman, A. P., & Perrin, E. B. (1976). Measuring the quality of medical care. A clinical method. *N Engl J Med, 294*(11), 582-588.

Ruzicka, L. T., & Lopez, A. D. (1990). The use of cause-of-death statistics for health situation assessment: national and international experiences. *World Health Stat Q, 43*(4), 249-258.

Saha, S., Solotaroff, R., Oster, A., & Bindman, A. B. (2007). Are preventable hospitalizations sensitive to changes in access to primary care? The case of the Oregon Health Plan. *Med Care, 45*(8), 712-719.

Saxena, S., George, J., Barber, J., Fitzpatrick, J., & Majeed, A. (2006). Association of population and practice factors with potentially avoidable admission rates for chronic diseases in London: cross sectional analysis. *JRSM, 99*(2), 81-89.

Schuster, M. A., McGlynn, E. A., & Brook, R. H. (1998). How Good Is the Quality of Health Care in the United States? *The Milbank Quarterly, 76*(4), 517-563.

Schwierz, C., & Wubker, A. (2009). Determinants of avoidable deaths from ischaemic heart diseases in East and West Germany. Rheinisch-Westfalisches Institut fur Wirtschaftsforschung, Ruhr-Universitat Bochum, Universitat Dortmund, Universitat Duisburg-Essen.

Sen, A. K. (1999). Democracy as a universal value. *Journal of democracy, 10*(3).

Shekelle, P. G., & Roland, M. (2000). Measuring Quality in Health Care. In N. D. Finkelstein (Ed.), *Transparency in Public Policy: Great Britain and the United States*. London: MacMillan Press LTD.

Shi, L. (1992). The relationship between primary care and life chances. *Journal of health care for the poor and underserved, 3*(2), 321-335.

Shi, L. (1994). Primary care, specialty care, and life chances. *International Journal of Health Services, 24*(3), 431-458.

Shi, L., Macinko, J., Starfield, B., Wulu, J., Regan, J., & Politzer, R. (2003). The relationship between primary care, income inequality, and mortality in US States, 1980–1995. *The Journal of the American Board of Family Practice, 16*(5), 412-422.

Sicotte, C., Champagne, F., Contandriopoulos, A. P., Barnsley, J., Béland, F., Leggat, S. G., et al. (1998). A conceptual framework for the analysis of health care organizations' performance. *Health services management research : an official journal of the Association of University Programs in Health Administration / HSMC, AUPHA, 11*(1), 24-41; discussion 41-28.

Sidorenkov, G., Haaijer-Ruskamp, F. M., de Zeeuw, D., & Denig, P. (2011). A Longitudinal Study Examining Adherence to Guidelines in Diabetes Care According to Different Definitions of Adequacy and Timeliness. [Article]. *PLoS ONE, 6*(9).

Silventoinen, K., Kaprio, J., Lahelma, E., & Koskenvuo, M. (2000). Relative effect of genetic and environmental factors on body height: differences across birth cohorts among Finnish men and women. *American Journal of Public Health, 90*(4), 627-630.

Simai, M. (2006). Poverty and Inequality in Eastern Europe and the CIS Transition Economies. *Working Papers, United Nations, Department of Economics and Social Affairs*,

Simonato, L., Ballard, T., Bellini, P., & Winkelmann, R. (1998). Avoidable mortality in Europe 1955-1994: a plea for prevention. *J Epidemiol Community Health, 52*(10), 624-630.

Skodova, Z., Pisa, Z., Poledne, R., Berka, L., Cicha, Z., Emrova, R., et al. (1997). Decline of the cardiovascular mortality rate in the Czech Republic in 1984 - 1993 and its possible causes. *Casopis Lekaru Ceskych, 136* (12).

Smith, J. (2007). *Diabetes and the Rise of the SES Health Gradient*. Cambridge: NATIONAL BUREAU OF ECONOMIC RESEARCH.

Smith, P. C., Mossialos, E., Papanicolas, I., & Leatherman, S. (2009). *Performance Measurement for Health System Improvement: Experiences, Challenges and Prospects*. Cambridge: Cambridge University Press.

Spencer, E. A., Appleby, P. N., Davey, G. K., & Key, T. J. (2002). Validity of self-reported height and weight in 4808 EPIC–Oxford participants. *Public Health Nutrition, 5*(04), 561-565.

Starfield, B., Shi, L., Grover, A., & Macinko, J. (2005). The effects of specialist supply on populations' health: assessing the evidence. *Cancer, 103*(20.93), 23.18.

Starfield, B., Shi, L., & Macinko, J. (2005). Contribution of Primary Care to Health Systems and Health. *Milbank Quarterly, 83*(3), 457-502.

Steckel, R. H. (1995). Stature and the Standard of Living. *Journal of Economic Literature, 33*(4), 1903-1940.

Steckel, R. H. (2009). Heights and human welfare: Recent developments and new directions. *Explorations in Economic History, 46*(1), 1-23.

Stembera, Z., & Velebil, P. (2006). [Analysis of stagnation of perinatal mortality in the Czech Republic]. *Ceska Gynekol, 71*(2), 87-91.

Stunkard, A. J., Foch, T. T., & Hrubec, Z. (1986). A twin study of human obesity. *Journal of American Medical Association (JAMA), 256*, 51-54.

Sunder, M. (2003). The making of giants in a welfare state: the Norwegian experience in the 20th century. *Economics & Human Biology, 1*(2), 267-276.

Sundmacher, L., & Busse, R. (2011). The impact of physician supply on avoidable cancer deaths in Germany. A spatial analysis. *Health Policy, 103*, 53-62.

Szalay, T., Pažitný, P., Szalayová, A., Frisová, S., Morvay, K., Petrovič, M., et al. (2011). Slovakia: Health system review. *Health Systems in Transition, 13*(2), 1-200.

Tang, K. K., Chin, J. T. C., & Rao, D. S. P. (2008). Avoidable mortality risks and measurement of wellbeing and inequality. *Journal of Health Economics, 27*(3), 624-641.

Tanner, J. M. (1981). *A history of the study of human growth*. Cambridge: Cambridge University Press.

Tanner, J. M. (1986). Growth as a mirror for the conditions of society: Secular trends and class distinctions. In A. Demirjian (Ed.), *Human Growth: A Multidisciplinary Review* (pp. 3-34). London: Taylor and Francis.

Tavares, J., & Wacziarg, R. (2001). How democracy affects growth. *European Economic Review, 45*, 1341-1378.

Telishevska, M., Chenet, L., & McKee, M. (2001). Towards an understanding of the high death rate among young people with diabetes in Ukraine. *Diab Med, 18*(3-9).

Tesar, T., Foltan, V., & Huorka, M. (2002). Pharmacoeconomics in the therapy of peptic ulcer. *Ceska Slov Farm., 51*(2), 78-83.

The NYU Center for Health and Public Service Research of the Robert F. Wagner Graduate School of Public Service. Retrieved April 8, 2013, from http://wagner.nyu.edu/faculty/billings/acs-algorithm.php

The World Bank. from www.worldbank.org

The World Bank. (2002). *Poverty and welfare of Roma in the Slovak Republic*. Bratislava.

Timmermans, S., & Berg, M. (2003). *The gold standard: the challenge of evidence-based medicine and standardization in health care* Philadelphia: Temple University Press.

Tobias, M., & Jackson, G. (2001). Avoidable mortality in New Zealand, 1981-97. *Aust N Z J Public Health 25*, 12-20.

Tomasik, T. (2012). We don't know if health system changes in eastern Europe have improved quality. *BMJ, 344*.

Treurniet, H. F., Boshuizen, H. C., & Harteloh, P. P. M. (2004). Avoidable mortality in Europe (1980-1997): a comparison of trends. *J Epidemiol Community Health, 58*(4), 290-295.

Treurniet, H. F., Looman, C. W., van der Maas, P. J., & Mackenbach, J. P. (1999). Variations in 'avoidable' mortality: a reflection of variations in incidence? *Int. J. Epidemiol., 28*(2), 225-232.

Tunstall-Pedoe, H., Vanuzzo, D., Hobbs, M., Mähönen, M., Cepatis, Z., Kuulasmaa, K., et al. (2000). Estimation of contribution of changes in coronary care to improving survival, event rates, and coronary heart disease mortality across the WHO MONICA Project populations. *Lancet, 355*, 688-700.

Tyczynski, J. E., Plesko, I., Aareleid, T., Primic-Zakelj, M., Dalmas, M., Kurtinaitis, J., et al. (2004). Breast cancer mortality patterns and time trends in 10 new EU member states: Mortality declining in young women, but still increasing in the elderly. *International Journal of Cancer, 112*(6), 1056-1064.

Uliciansky, V., Mokan, M., Nemethyova, Z., Tkac, I., Galajda, P., & Vozar, J. (2007). *Guidelines of the Slovak Diabetology Association for the Diagnosis and Treatment of Diabetes Mellitus Type II*.

UN News Centre. (2011). UN launches global campaign to curb death toll from non-communicable diseases. http://www.un.org/apps/news/story.asp?NewsID=39600&Cr=non+communicable+diseases

United Nations Development Programme. (2013). International Human Development Indicators. Retrieved February 14, 2013, from http://hdrstats.undp.org/en/tables/

Vecchia, C. L., Lucchini, F., Negri, E. V. A., Reggi, V., & Levi, F. (1993). The impact of therapeutic improvements in reducing peptic ulcer mortality in Europe. *Int. J. Epidemiol., 22*(1), 96-106.

Velkova, A., Wolleswinkel-van den Bosch, J., & Mackenbach, J. P. (1997). The east-west life expectancy gap: Differences in mortality from conditions amenable to medical intervention. *Int J Epidemiol, 26*.

Vignerová, J., Brabec, M., & Bláha, P. (2006). Two centuries of growth among Czech children and youth. *Economics & Human Biology, 4*(2), 237-252.

Vlasak, V., Plesko, I., Dimitrova, E., & Hudakova, G. (1991). Recent trends in uterine cervix cancer in Slovakia, 1968-1987. *Neoplasma, 38*(5), 533-540.

Walters, E. H., Walters, J. A. E., & Gibson, P. G. (2009). *Regular treatment with long acting beta agonists versus daily regular treatment with short acting beta agonists in adults and children with stable asthma (Review)*. London: The Cochrane Collaboration.

Watson, D., & McGrail, K. (2009). More Doctors or Better Care? *Healthcare Policy, 5*(1), 26-31.

Weissman, J. S., Gatsonis, C., & Epstein, A. M. (1992). Rates of avoidable hospitalization by insurance status in Massachusetts and Maryland. *Jama, 268*(17), 2388-2394.

Weisz, D., Gusmano, M. K., Rodwin, V. G., & Neuberg, L. G. (2008). Population health and the health system: a comparative analysis of avoidable mortality in three nations and their world cities. *Eur J Public Health, 18*(2), 166-172.

Wennberg, J. E. (1999). Understanding Geographic Variations in Health Care Delivery. *New England Journal of Medicine, 340*(1), 52-53 <53>.

Wennberg, J. E. (2004). Practice variations and health care reform: connecting the dots. *Health Aff (Millwood), Suppl Web Exclusives*, VAR140-144.

Wennberg, J. E., Fisher, E. S., Stukel, T. A., & Sharp, S. M. (2004). Use of Medicare claims data to monitor provider-specific performance among patients with severe chronic illness. *Health Aff (Millwood), Suppl Web Exclusives*, VAR5-18.

Wennberg, J. E., & Gittelsohn, A. (1973). Small area variations in health care delivery: a population-based health information system can guide planning and regulatory decision-making. *Science, 182*, 1102-1108.

Westerling, R. (1993). Indicators of "Avoidable" Mortality in Health Administrative Areas in Sweden 1974-1985. *Scand J Public Health, 21*(3), 176-187.

Westerling, R., Gullberg, A., & Rosen, M. (1996). Socio-economic differences in 'avoidable mortality' in Sweden 1986-1990. *Int J Epidemiol, 25*, 560 - 567.

Westerling, R., Gullberg, A., & Rosén, M. (1996). Socioeconomic Differences in 'Avoidable' Mortality in Sweden 1986-1990. *Int. J. Epidemiol., 25*(3), 560-567.

Westerling, R., & Smedby, B. (1992). The European Community 'avoidable death indicators' in Sweden 1974-1985. *Int J Epidemiol, 21*, 502-510.

Whitehead, M., & Dahlgren, G. (1991). What can be done about inequalities in health? *The Lancet, 338*(8774), 1059-1063.

Wolfe, B., & Gabay, M. (1987). Health status and medical expenditures: More evidence of a link. *Social Science & Medicine, 25*(8), 883-888.

World Health Organization. (2000). *The World Health Report 2000: Health Systems: Improving Performance*. Geneva: World Health Organization.

World Health Organization. (2003). World Health Survey.

World Health Organization. (2004). *Beyond the Numbers. Reviewing maternal deaths and complications to make pregnancy safer*. Geneva: WHO.

World Health Organization. (2006). *The World Health Report 2006: working together for health*. Geneva.

World Health Organization. (2012). *Measurement of and target-setting for well-being: an initiative by the WHO Regional Office for Europe. Second meeting of the expert group, Copenhagen, Denmark, 8-9 February 2012*. Copenhagen: WHO Regional Office for Europe.

World Health Organization. (2013). *The European health report 2012: charting the way to well-being*: World Health Organization Regional Office for Europe.

Young, F. W. (2001). An explanation of the persistent doctor-mortality association. *Journal of Epidemiology and Community Health, 55*(2), 80-84.

Zeng, F., O'Leary, J. F., Sloss, E. M., Lopez, M. S., Dhanani, N., & Melnick, G. (2006). The effect of medicare health maintenance organizations on hospitalization rates for ambulatory care-sensitive conditions. *Medical Care, 44*(10), 900-907.

Zhang, W., Mueller, K. J., Chen, L.-W., & Conway, K. (2006). The role of rural health clinics in hospitalization due to ambulatory care sensitive conditions: a study in Nebraska. *Journal of Rural Health, 22*(3), 220-223.