Are Mortality Improvements Associated with Increased Healthcare Utilization?

Evidence from the German Diagnosis Related Groups (G-DRG) Statistics

Anna-Kathleen Piereth[1], Marcus Ebeling[1,2]

1 Max Planck Institute for Demographic Research, Rostock, Germany
2 Unit of Epidemiology, Karolinska Institutet, Stockholm, Sweden

Abstract

Recent mortality improvements in developed countries are largely driven by successful secondary and tertiary disease prevention. Both aim to reduce severity and impact of diseases. Consequently, prevalence of multimorbidity is increasing because people are living longer with diseases and often develop more diseases at the same time. Multimorbid people require more complex medical care and are at greater risk of becoming sicker. Multimorbidity is also associated with increased healthcare needs. In view of these dynamics, it could be hypothesized that (further) improvements in mortality require more intensive healthcare utilization. We will test whether this hypothesis holds for the last 15 years in Germany and assess mortality improvements through the lens of Diagnosis Related Groups (DRGs). DRGs are created to group patients according to their disease and treatment patterns, and they are the main hospital reimbursement system in Germany and many other countries. We will combine the German DRG statistics (years 2007 to 2022) – a complete census of all cases treated in a hospital – with data from the Human Mortality Database, and examine to what extent rates of improvement in total and cause-of-death-specific death rates are associated with changes in the amount of utilized hospital care. Preliminary results show that strong mortality improvements were notably associated with relative increases in healthcare utilization. To the best of our knowledge, this is the first study that uses DRG data for demographic research, and the results will thus also reveal the potential of this internationally used coding scheme for demographic applications.

Introduction

Disease prevention has fuelled improvements in health and mortality in developed countries since more than one and a half centuries.[1] Preventive efforts moved from interventions targeting living conditions and fighting communicable diseases to interventions targeting individual health.[2–4] This has changed the disease panorama of populations and secondary and tertiary prevention became major drivers of mortality improvements.[3,2,5,4] Today, getting proper treatment has become the norm and individuals can live with chronic conditions such as hypertension and diabetes for a long time without substantial limitations.[6–8] Together with enhanced diagnostic possibilities, the progress has changed individual disease histories by making them longer and more complex, visible for instance in the increasing shares of frail individuals, the rise of multimorbidity or even in the ways how individuals die.[9–11]

Despite being an inherently successful achievement, effective secondary and tertiary disease prevention comes with a cost that is reflected in a population with more complex medical care needs and where many people are at greater risk of becoming even sicker. Generating mortality improvements may thus depend to a considerable part on meeting the increased healthcare needs of these populations. Recent findings already suggest that unmet healthcare needs have a considerable impact on individuals' health and survival and can result in health deterioration and excess mortality.[12-14]

In this study, we will test the hypothesis that (further) improvements in mortality require more intensive health care utilization. Based on the German Diagnosis Related Groups (G-DRG) statistics, we will investigate to what extent rates of mortality improvement are associated with higher and more intense utilization of inpatient hospital care in Germany (years 2007 to 2022).

DRGs are a patient classification system that groups hospital cases according to their main diagnosis, the procedures performed, and the degree of severity considering secondary diagnoses and patients' demographic characteristics. Due to their unique taxonomy, DRG codes allow for a multifactorial examination of patient profiles. This goes beyond the sole focus on diseases that is commonly applied when using ICD codes. Moreover, DRGs are used for reimbursement purposes and every DRG has a relative cost indicator. This makes them an extremely valuable indicator for the outlined research subject.[15-16] The G-DRG became the compulsory remuneration system for German hospitals in 2004. The G-DRG statistics in

specific but also DRG codes in general have sparsely been employed in research that takes demographic dynamics into account.[17-20]

Data and Methods

Even by international standards, services delivered in hospitals account for the largest proportion of healthcare expenditures in almost all EU countries. DRG systems have become the principal hospital reimbursement scheme in most high-income countries.[16] In Germany, the DRG system is of particular importance as it allocates around 80% of the total revenue to hospitals. This is internationally one of the highest shares in DRG-based payment schemes.[22] With about 1,200 different DRG codes, the German system offers enormous detail.[23] Each DRG code comes with a cost weight that reflects both the clinical severity and the economic expenses required per hospital case. We will use the cost weight as indicator for healthcare utilization.

In this study, we exploit data from the German DRG (G-DRG) statistics for the years 2007 to 2022.[24] The G-DRG statistics are case based and a complete enumeration of all inpatient episodes in Germany in a given year that are billed according to the G-DRG system. It thus covers more than 16 million hospital cases annually, and all ages.[25] Besides the DRG code for each episode, the data contain also a wide range of demographic and medical information. Data can be accessed through the German Research Data Center upon approval of a project plan. In our analysis, we combine the G-DRG statistics with information on death counts and exposures from the Human Mortality Database.

Based on data from years 2007 to 2022, we will assess how rates of mortality improvement (ROMI) (measured as relative change of an age-specific death rate from one calendar year to another) are associated with the change in utilized healthcare measured via the change in the cost weight per capita. We will conduct this analysis for total age-specific death rates and cause-of-death-specific death rates as some diseases are more dependent on hospital care than others. Since our project proposal has just recently been accepted by the German Research Data Center, our preliminary results are based on data from an earlier project that spanned less calendar years and that had only age groups. We will use single ages.

Preliminary Results

The DRG-specific cost weight is a numeric indicator standardized to 1. Values higher than 1 represent complex clinical cases with higher utilization of resources. As shown in Figure 1, the median and third quartile of all cost weights listed in the DRG catalogues gradually increased from 2005 to 2023. This trend line is only seemingly interrupted in 2020 because the Care Staff Support Act induced the exclusion of nursing staff costs from the G-DRG system from 2020 on and, therefore, the reduction of cost weights that though rebound in 2021.[26]

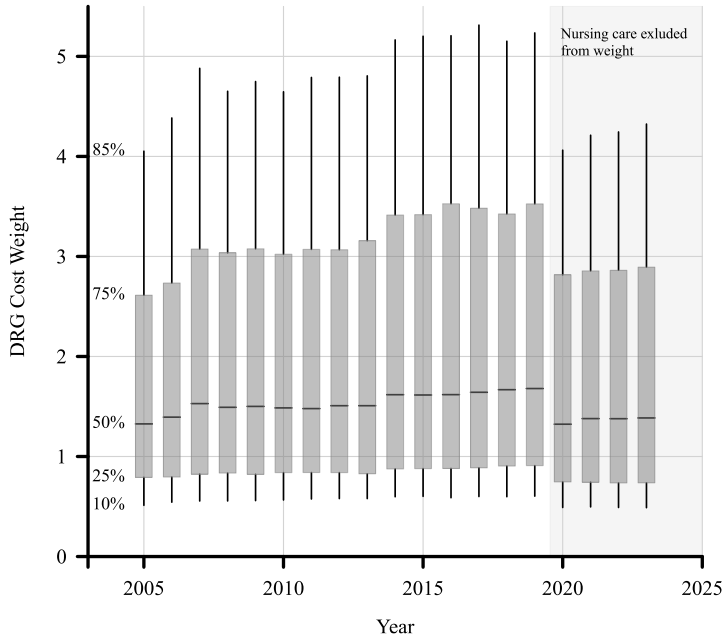

Figure 1: Distribution of cost weights in the DRG flat rate catalogues (2005–2023). Source: Authors' elaborations based on DRG flat rate catalogues.

Figure 2 reveals a steady rise of average cost weights per hospital day in all ages from 2010 to 2018. The increase in utilized hospital care per day suggests that a population with a growing share of multimorbid people needs more intensive hospital care. In other words, a hospital day has become more cost-weight intensive over time, a development that may reflects the increasing healthcare utilization and its pivotal role as factor for mortality improvements.

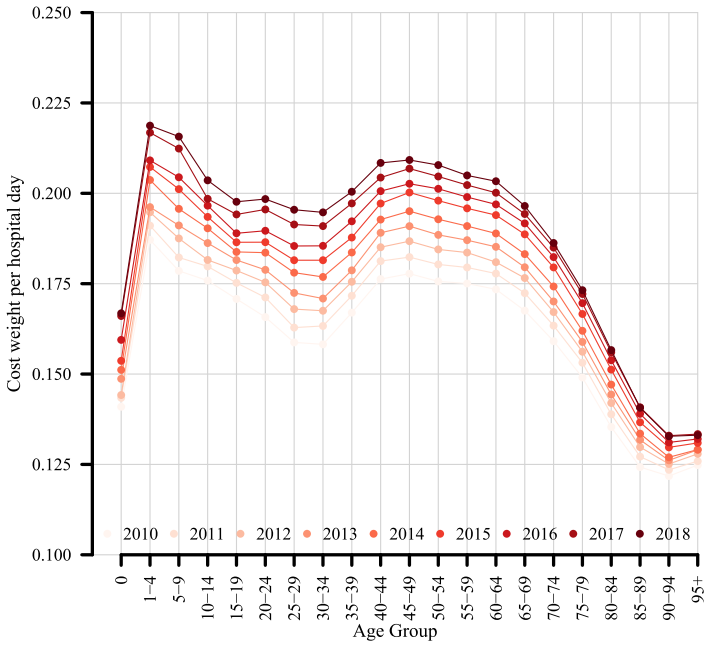

Figure 2: Development of the cost weight per hospital day in five-year age groups (2010–2018). Source: Authors' elaborations based on G-DRG statistics.

Figure 3 shows the mean annual rate of change in the DRG cost weight per capita and the death rates for five-year age groups between the years 2010 and 2018. For death rates, negative values reflect a mortality decline and vice versa. For the age-specific cost weight per capita, negative values reflect a decrease in healthcare utilization and vice versa. As it can be seen, an inverse pattern becomes apparent. That is, strong mortality improvements (negative values) were associated with increases in the cost weights per patient (positive values), while no mortality improvements – especially in the ages 55 to 84 – can be observed when the cost weight per capita did not change.

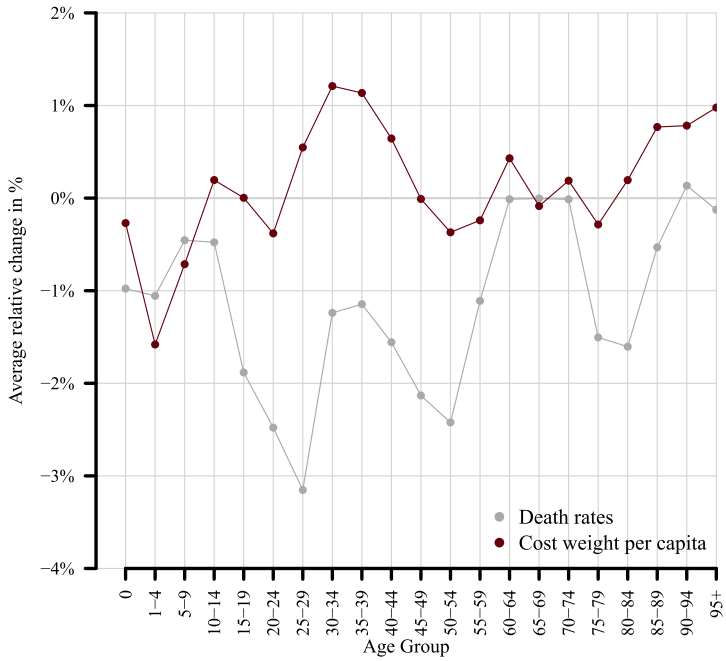

Figure 3: Changes in the cost weight per capita and death rates in five-year age groups from 2010 to 2018.

Source: Authors' elaborations based on G-DRG statistics and Human Mortality Database.

Outlook

In the next steps, we plan to extent the analysis to singles ages, include more calendar years and consider rates in cause-of-death-specific death rates. We will further analyze why the DRG cost weights change by considering main diagnoses and also the Major Diagnostic Categories (MDC) of the G-DRG system. One finding we may expect is that the average effective cost weight rises with mortality progress in different clinical pictures due to patients' multimorbidity. Beyond this, the analysis will show how DRG data can be employed in demographic research as DRGs are used worldwide such as in many European countries, the United States, Canada, Australia, and China.

References

1. Oeppen J, Vaupel JW. Broken limits to life expectancy. *Science*. 2002;296(5570):1029-1031

2. Vallin J, Meslé F. Convergences and divergences in mortality: a new approach of health transition. *Demographic Research*. 2004;S2:11-44. doi:10.4054/DemRes.2004.S2.2

3. Riley JC. *Rising Life Expectancy*. Cambridge University Press; 2001

4. Omran AR. The Epidemiologic Transition: a Theory of the Epidemiology of Population Change. *The Milbank Memorial Fund Quarterly*. 1971;49(4):509-538

5. Vaupel JW, Villavicencio F, Bergeron-Boucher MP. Demographic perspectives on the rise of longevity. *PNAS*. 2021;118(9). doi:10.1073/pnas.2019536118

6. Meyer AC, Drefahl S, Ahlbom A, Lambe M, Modig K. Trends in life expectancy: did the gap between the healthy and the ill widen or close? *BMC Med*. 2020;18(1):41. doi:10.1186/s12916-020-01514-z

7. Vaupel JW. Biodemography of human ageing. *Nature*. 2010;464(7288):536-542

8. Mehta N, Myrskylä M. The Population Health Benefits Of A Healthy Lifestyle: Life Expectancy Increased And Onset Of Disability Delayed. *Health Affairs*. 2017;36(8):1495-1502. doi:10.1377/hlthaff.2016.1569

9. Wennberg AM, Ebeling M, Ek S, et al. Trends in Frailty Between 1990 and 2020 in Sweden Among 75-, 85-, and 95-Year-Old Women and Men: A Nationwide Study from Sweden. *The Journals of Gerontology: Series A*. 2023;78(2):342-348. doi:10.1093/gerona/glac210

10. Skou ST, Mair FS, Fortin M, et al. Multimorbidity. *Nat Rev Dis Primers*. 2022;8(1):1-22. doi:10.1038/s41572-022-00376-4

11. Ebeling M, Meyer AC, Modig K. Variation in End-of-Life Trajectories in Persons Aged 70 Years and Older, Sweden, 2018–2020. *Am J Public Health*. 2023;113(7):786-794. doi:10.2105/AJPH.2023.307281

12. Vogt C, Vaupel JW. The importance of regional availability of health care for old age survival – Findings from German reunification. *Popul Health Metr*. 2015;13(26):1-8. doi:10.1186/s12963-015-0060-2

13. Kondilis E, Tarantilis F, Benos A. Essential public healthcare services utilization and excess non-COVID-19 mortality in Greece. *Public Health*. 2021;198:85-88. doi:10.1016/j.puhe.2021.06.025

14. Ko H. Unmet healthcare needs and health status: Panel evidence from Korea. *Health Policy*. 2016;120(6):646-53. doi:10.1016/j.healthpol.2016.04.005

15. Tan SS, Geissler A, Serdén L, Heurgren M, van Ineveld BM, Redekop WK, Hakkaart-van Roijen L, EuroDRG group. DRG systems in Europe: variations in cost accounting systems among 12 countries. *Eur J Public Health*.2014;24(6):1023-8. doi:10.1093/eurpub/cku025

16. Mihailovic N, Kocic S, Jakovljevic M. Review of Diagnosis-Related Group-Based Financing of Hospital Care. *Health Serv Res Manag Epidemiol*. 2016;3:2333392816647892. doi:10.1177/2333392816647892

17. Messerle R, Schreyögg J. System-wide Effects of Hospital Payment Scheme Reforms: The German Introduction of Diagnosis-Related Groups. *Research Paper No. 26*. 2022; Hamburg Center for Health Economics

18. Bolczek C, Nimptsch U, Möckel M, Mansky T. Versorgungsstrukturen und Mengen-Ergebnis-Beziehung beim akuten Herzinfarkt – Verlaufsbetrachtung der deutschlandweiten Krankenhausabrechnungsdaten von 2005 bis 2015 [Health Care Provision and Volume-Outcome Relationship for Acute Myocardial Infarction: Long-Term Analysis of German Nationwide Hospital Discharge Data 2005-2015]. *Gesundheitswesen*. 2020;82(10):777-785. doi:10.1055/a-0829-6580

19. Richter D, Weber R, Eyding J, Bartig D, Misselwitz B, Grau A, Hacke W, Krogias C. Acute ischemic stroke care in Germany - further progress from 2016 to 2019. *Neurol Res Pract*. 2021;3(1):14. doi:10.1186/s42466-021-00115-2

20. Weber R, Eyding J, Kitzrow M, Bartig D, Weimar C, Hacke W, Krogias C. Distribution and evolution of acute interventional ischemic stroke treatment in Germany from 2010 to 2016. *Neurol Res Pract*. 2019;1:4. doi:10.1186/s42466-019-0010-8

21. OECD, European Union. Health at a Glance: Europe 2022: State of Health in the EU Cycle. 2022; *OECD Publishing*, Paris, doi:10.1787/507433b0-en

22. Cots F, Chiarello P, Salvador X, Castells X, Quentin W. Diagnosis-Related Groups in Europe: Moving towards transparency, efficiency and quality in hospitals. In R Busse, A Geissler, W Quentin, MM Wiley (Eds.), *European Observatory on Health Systems and Policies series*. Diagnosis-related groups in Europe: Moving towards transparency, efficiency and quality in hospitals. 2011;75-92. Open University Press.

23. InEK – Institute for the Remuneration System in Hospitals. DRG flat rate catalogues 2005–2021. 2023; https://www.g-drg.de/archiv (accessed 20 Oct 2023)

24. RDC of the Federal Statistical Office and Statistical Offices of the Federal States of Germany. Diagnosis Related Groups Statistics (DRG statistics) 2010 to 2021. DOI: [10.21242/23141.2007.00.00.1.1.0 to 10.21242/23141.2022.00.00.1.1.0], own calculations

25. RDC of the Federal Statistical Office and Statistical Offices of the Federal States of Germany (2021). Meta data report. Part II. Product-specific information on the use of DRG statistics 2021 for on-site use (EVAS-Nummer: 23141). Version 1. DOI: 10.21242/23141.2021.00.00.1.1.0 (KDFV), 10.21242/23141.2021.00.00.2.1.0 (GWAP). Wiesbaden

26. Bundesgesetzblatt: Gesetz zur Stärkung des Pflegepersonals. (Pflegepersonal-Stärkungsgesetz PpSG). 2018;1(45). http://www.bgbl.de/xaver/bgbl/start.xav?startbk=Bundesanzeiger_BGBl&jumpTo=bgbl118s2394.pdf (accessed 29 Oct 2023)