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Ahead of Future Waves of Covid-19: A Regional Perspective on Health Risks and Healthcare Resources in Germany and Poland



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Drawing on the most fundamental conclusions from the early research on the Covid-19 pandemic, in this policy paper we examine the regional prevalence of a number of risk factors related to severe consequences of Covid-19. Using the examples of Germany and Poland, two neighbouring countries which have generally dealt relatively well with the outbreak in recent months, we show that there is significant regional variation both in the distribution of health status and healthcare resources. Highly differentiated demographic and epidemiological risks related to the pandemic between as well as within Germany and Poland call for a decentralised evaluation of risks and point out the need to consider an application of regionally focused policy reactions such as lockdowns and social distancing regulations. The cross-country regional perspective adds a valuable angle to the analysis of challenges raised by the Covid-19 pandemic and should urgently be considered regarding any possible consequences of future outbreaks of the virus.

Introduction

In the first five months of 2020 the Covid-19 crisis has grown from a local epidemic outbreak in the Chinese city of Wuhan to a global pandemic, which by the end of May, according to official statistics, took the lives of over 370 thousand people and has been detected in nearly all countries around the world. In the initial phase of the pandemic, the healthcare systems of many countries were pushed to the brink of collapse, and in the severely hit regions even the need of “prioritizing” patients with a high chance of survival became reality. In most European countries the total number of identified cases has continued to grow throughout the month of May, but the rate of growth generally decreased, and in some countries, such as Austria or Slovenia, only a handful of cases were identified in the last two weeks of May. As a result, countries eased the social and economic lockdown, and in many parts of Europe life is beginning to portray a certain restricted semblance of pre-Covid-19 normality. At least in this part of the world, it seems that the first wave of the pandemic is behind us: the “hammer” is over, the “dance” has begun. Thus now that the spread of the virus is slowing down and we are in a phase of smaller local outbreaks, it is time to take a step back and use the information available to draw lessons before the arrival of a potential second wave, which according to many epidemiologists is likely to happen later this year.

Drawing on the most fundamental conclusions from the early research on the Covid-19 pandemic and taking a cross-country perspective, in this policy paper we examine the prevalence of a number of risk factors related to severe consequences of Covid-19 from a regional perspective. In our analysis we focus on Germany and Poland — two neighbouring countries which differ in the demographic structure of their populations as well as with respect to their healthcare infrastructure. Epidemiological research suggests that the risk of serious health complications as well as the risk of dying as a result of Covid-19 grows rapidly with age and is much higher among people with pre-existing health conditions such as cardiovascular conditions, diabetes, hypertension, chronic pulmonary disease and malignancy (Emami et al. 2020). Thus, the prevalence of these risk factors might serve as an indicator for the need of (in-hospital) health care in times of larger outbreaks. We then extend the analysis by a discussion of regional statistics on systemic features of healthcare resources reflecting the potential for addressing the pandemic. One can generally say that both in Germany and Poland the first wave of the pandemic, while placing additional heavy strain



on healthcare in some regions, has not led to the collapse of healthcare provision. Yet, regions with lower level of service are at greater risk of healthcare rationing, thus further raising the likelihood of severe consequences to the local populations in the future.

We begin this policy paper with a discussion of the key demographic and epidemiological risk factors related to severe health consequences of Covid-19 (Section 1), which is followed by a presentation of the regional distribution of Covid-19 cases in Germany and Poland, as reflected in official statistics at the end of May 2020 (Section 2). We then discuss regional differences in the proportion of people aged 65+ and in the rates of the relevant comorbidities by showing regional statistics on the main causes of death (Section 3). This is complemented in Section 4 by a discussion of the regional distribution of healthcare resources as indicated by the number of hospital beds and the number of doctors. All aspects of our analysis are presented at the level of "powiat" for Poland and "Kreise" for Germany, referred to below as "counties". There are 380 counties in Poland (including township with county status) and 401 counties in Germany, which in the international Nomenclature of Territorial Units for Statistics (NUTS) correspond to the former NUTS level 4 (former LAU 1) and NUTS level 3 respectively.

As we demonstrate, there are significant differences both across and within the two countries with respect to the relevant demographic and epidemiological risk factors. At the same time there is high heterogeneity across Germany and Poland in the resources of the respective healthcare systems. We show that the cross-country regional perspective adds an additional valuable angle to the analysis of challenges raised by the Covid-19 pandemic. Epidemiologists have modelled various scenarios of future Covid-19 waves including recurring small outbreaks, a new "monster wave" or even a persistent crisis (Moore et al. 2020). Whatever the shape of future outbreaks, the pandemic is expected to persist until "herd immunity" is reached, be it through successful vaccination or through developing immunity in response to illness. Thus, regions potentially facing more serious consequences of the pandemic need to be brought to the attention of central governments as they prepare to address the challenge of future outbreaks of the Covid-19.

1. Macro-Level Determinants of the Health-Related Consequences of Covid-19

At the initial stage of the pandemic, the WHO estimated the fatality rate of the Covid-19 disease at 3-4% (WHO 2020a). As the public health crisis developed, this general conclusion has been challenged given a high number of asymptomatic infections, low testing capacities in most countries and relatively low test accuracy for antibodies as well as PCR testing (Ghandi et al. 2020, Kandel et al. 2020, Manski & Molinari 2020). The available statistics should thus be treated more as "fatality-case" ratios, i.e. the ratios of deaths resulting from Covid-19 to the number of individuals tested positive. According to the most recent studies, this ratio differs substantially between countries, from as low as 0.04% in Qatar and 0.08% in Singapore to over 15% in Belgium or France (Oke & Heneghan 2020). Such high variation is unlikely to reflect "real" differences in the way the virus affects people in different countries, but is more likely to be a consequence of specific factors as the testing strategies, the demographic structure of the population, the characteristics



of the part of the population affected (e.g. young holiday makers vs. patients of care institutions), as well as the ability of the healthcare system to deal with a sudden surge in the number of hospitalisations.

There is mounting evidence that the probability of developing severe symptoms of the infection, of hospitalisation and finally of dying, increases significantly with age. According to some early estimates the fatality-case rates grow from 1.8-3.6% among people aged 60-69, through 4.8-12.8% among those aged 70-79, up to 13-20.2% among those 80+ (Roser et al. 2020). Higher hospitalization and fatality rates are also strongly correlated with underlying health conditions, in particular with cardiac disorders, chronic lung diseases, diabetes and cancer (ECDC 2020). This further puts older individuals, among whom these health conditions are most prevalent, at much greater risk as compared to the younger population.

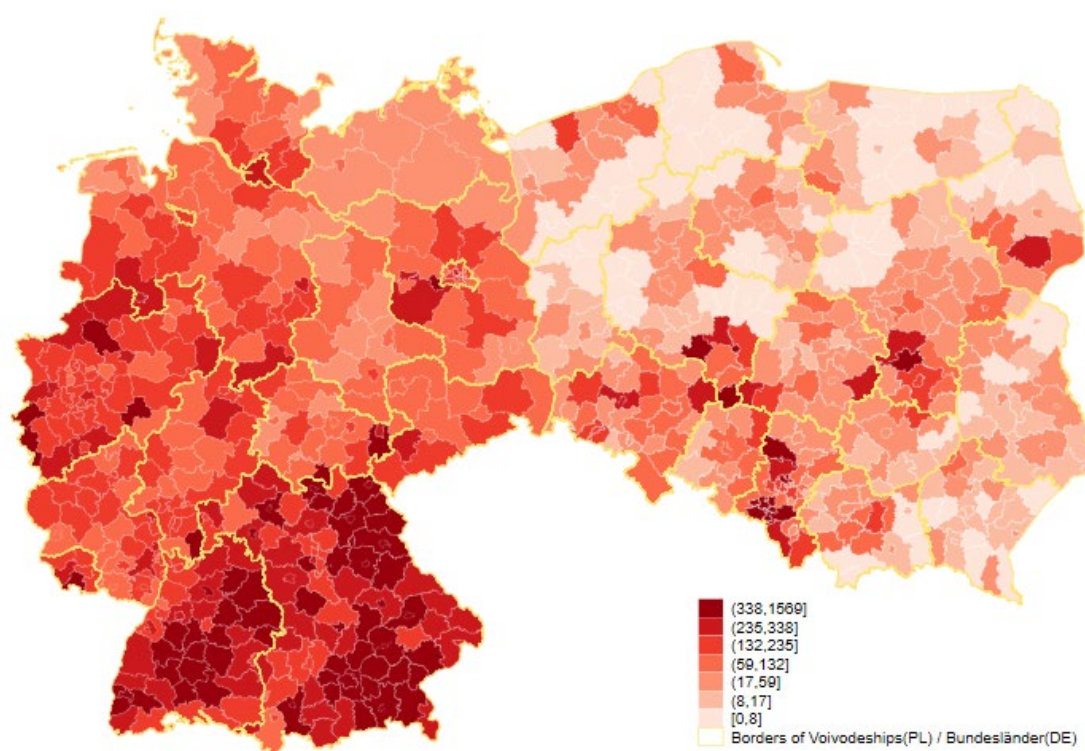
While the risk of severe consequences of Covid-19 substantially increases at older ages, several competing mechanisms are at play with regard to the role of the demographic structure for a potential spread of the virus. On the one hand, since levels of economic activity are generally lower among older people, their compliance with self-isolation rules is likely to be less sensitive to the intensity of economic activity at regional or country level. On the other hand, however, as social life now returns to a higher level of interaction, different forms of living arrangements of older individuals place certain groups at a particular risk. The first months of the pandemic in Europe have revealed high vulnerability of people living in long-term care facilities, many of which became Covid-19 clusters with high rates of mortality among their residents (Comas-Herrera et al. 2020; Gardner et al. 2020; McMichael et al. 2020). On the other hand, in countries characterised by low rates of institutionalization, older individuals are more likely to co-reside in households with children and younger adults (Myck et al. 2020), i.e. groups which in conditions of lifted lockdown restrictions will be exposed to the risk of infection. Studies at the early stages of the epidemic showed that intra-household transmission of the virus may be responsible for the majority of clusters (WHO 2020b). This implies that while the strategies to protect the most vulnerable groups may differ depending on the specific living arrangements, regions with a higher proportion of older people face an increased risk of severe health consequences of Covid-19 outbreaks.

Similar arguments apply to the regions where incidence of the relevant comorbidities is particularly high. Systemic constraints related to healthcare played an important role at the height of the recent Covid-19 crisis in countries such as Italy or Spain where the number of patients in need of in-hospital treatment exceeded the capacities of the healthcare systems (Pasquariello & Stranges 2020, Remuzzi & Remuzzi 2020, Verelst et al. 2020). We thus argue that regions with populations facing highest risks related to the Covid-19 pandemic ought to be particularly vigilant to the spread of the disease and ensure that their healthcare infrastructure can respond adequately to future outbreaks.

2. The Regional Spread of Covid-19 infections in Germany and Poland

The first official case of the disease in Germany was confirmed on 27 January, while the first infection in Poland dates to 4 March. Since then 183 thousand Covid-19 infections have been identified in Germany and 23 thousand in Poland by the end of May 2020. The corresponding fatality-case ratio at that point stood at the average country levels of 4.69% and 4.47% respectively. The difference in the overall number of cases relates both to the greater spread of the virus and the more extensive testing conducted in Germany as well as to a simple difference in the size of population (83 vs. 38 million inhabitants). Importantly, when we take a regional perspective on the pandemic, as we can see in Figure 1, the distribution of the infection rate is far from homogenous. In Germany, the level of infection rates is much higher in some of the southern and western regions (Bavaria, Baden-Württemberg and North Rhine Westphalia), while in Poland the region of Silesia is a clear local “hot-spot” of the pandemic.

Figure 1. COVID-19 infections per 100 thousand inhabitants by county (as of 31 May 2020)



Source: own compilation based on data from Robert Koch Institute (RKI) and Federal Agency for Cartography and Geodesy (BKG) in case of Germany and data collected individually by Michał Rogalski (<https://www.micalrg.pl/>) from Voivodeship Offices, Voivodeship and Powiat Epidemiological-Sanitary Stations, media and materials sent on request and Head Office of Geodesy and Cartography (GUGiK) in case of Poland.

Note: Class 3, 4 and 5 cover 20% of the observations, the other classes 10% each.

In Germany, the first outbreaks were attributed to business travel and skiing tourism and the spread within certain communities went on via close contacts during large gatherings such as those at the time of carnival festivities and at church services, and also as a result of specific economic activities (e.g. delivery services or workers in slaughterhouses). Numerous cases have also been reported in institutionalised accommodation such as nursing and refugee homes. As Figure 1 shows, the counties with the highest rates of infections were located in Bavaria. By the end of May one of the Bavarian counties (Tirschenreuth) had an infection rate far higher than any other county – 1,568 infections per 100,000 inhabitants, when this rate was 891 and 890 in the next highest scoring counties of Straubing and Wunsiedel. At the same time the counties of Uckermark and Prignitz (in the region of Brandenburg), Friesland and Wilhelmshaven (Niedersachsen), Ostholstein (Schleswig-Holstein) and Rostock (Mecklenburg-Vorpommern) recorded infections rates of below 35 per 100,000 inhabitants.

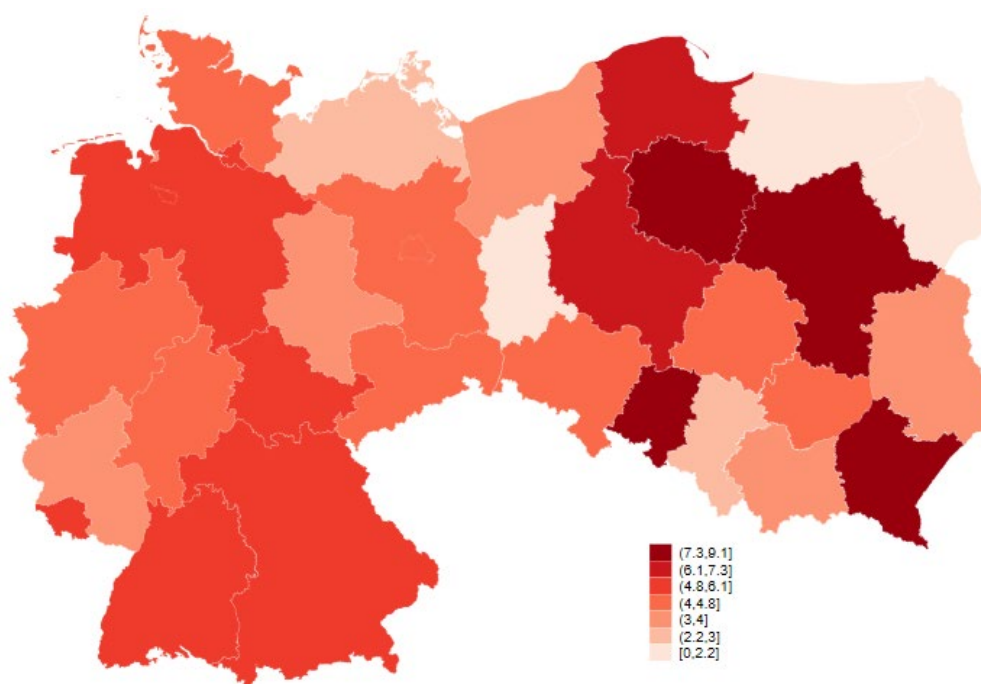
The origins of the first reported cases in Poland were also directly related to international travel – to Germany and Italy. Further local outbreaks were reported in hospitals and social welfare homes. The virus often spread between such institutions due to a transmission via medical and care personnel working in several institutions in parallel. Initially, only Warsaw and neighbouring counties stood out with regard to the infection rate, which could be due to higher mobility and population density in the first case, and local outbreaks in social welfare homes in the latter. However, about two months after the beginning of the pandemic, a major surge in new cases was recorded in the region of Silesia where the bulk of infections concentrated among mine workers. Often asymptomatic, infections were identified as a result of extensive screening of miners and their families. By the end of May, about one third of Poland's total infections were found in Silesia alone. Together with the cases reported in the Mazovian region (with Warsaw as capital), these two regions represented about half of the total number of infections in Poland. The highest infection rate in Poland exceeding 500 infections per 100,000 inhabitants was observed in the counties of Silesia (Bytom, Jastrzębie-Zdrój and powiat lubliniecki), Mazovia (powiat białobrzegi) and Greater Poland voivodship (powiat kępiński), while a handful of counties located throughout Poland (powiaty: bartoszycki, bieszczadzki, drawski, gołdapski, kolski, lidzbarski, międzyszycki, sejneński, żuromiński) have not recorded any infections.

Figure 2 provides another angle on the aftermath of the epidemic in both countries – regional case fatality rates, calculated as a ratio of deaths to recorded infections and presented at a higher level of aggregation – the level of Bundesländer in Germany and Voivodship in Poland (due to the lack of comparable data on county level in Poland). Even though, as mentioned above, the country average death rates are very similar, the within-country regional differences are striking. As compared to Poland, the regional death ratios in Germany do not deviate much from the country average (4.7), with the lowest rate in the region of Mecklenburg-Vorpommern (2.6) and the highest one in the region of Saarland (6.0). On the other hand, the differences between Polish regions are substantial, with no deaths per 120 infections in the lubuskie region and the fatality rate exceeding 9.0 in the podkarpackie region. At this early stage of the pandemic such differences might reflect a number of factors and may not be systematically related to specific risks.



However, as we show below, the most clearly identified risk factors are far from evenly distributed both between and within the two countries, which in cases of broader outbreaks is likely to lead to significant systematic differentiation of risks at the regional level.

Figure 2. Covid-19 death rates by region (DE: Bundesländer, PL: Voivodeships) (as of 31 May 2020)



Source: own compilation based on data from Robert Koch Institute (RKI) and Federal Agency for Cartography and Geodesy (BKG) in case of Germany and data collected individually by Michał Rogalski (<https://www.micalrg.pl/>) from Voivodeship Offices, Voivodeship and Powiat Epidemiological-Sanitary Stations, media and materials sent on request and Head Office of Geodesy and Cartography (GUGiK) in case of Poland.

Note: Class 3, 4 and 5 cover 20% of the observations, the other classes 10% each.

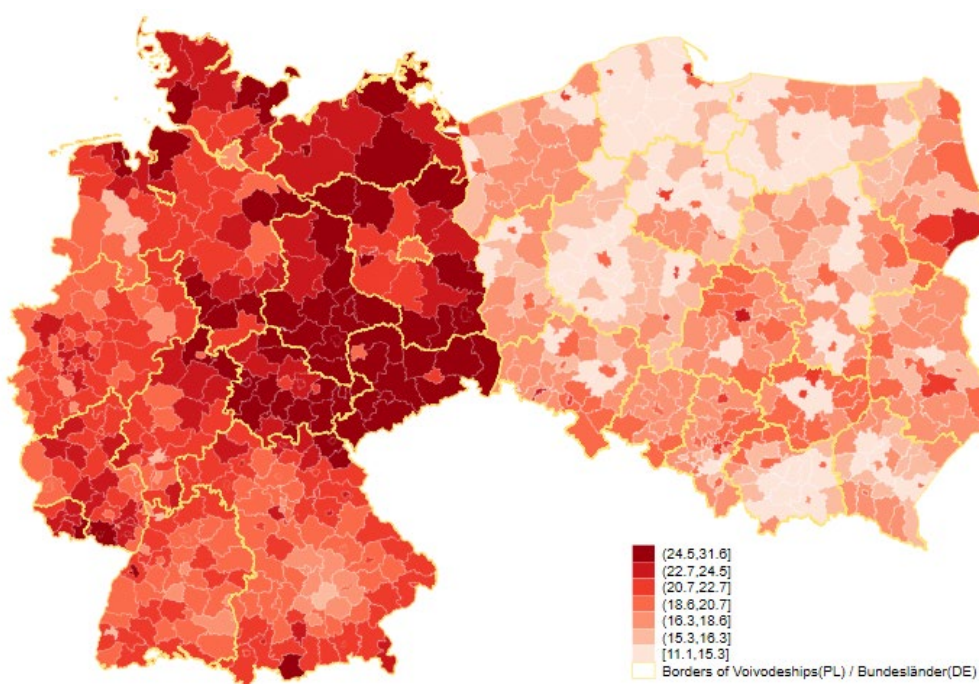
3. Demographic and Epidemiological Variation at Regional Level in Germany and Poland

There are significant differences in the age structure of the population with a substantially higher proportion of individuals in older age groups in Germany. While 17.5% of the Polish population is over 65 years old and 2.1% is aged 85+, the corresponding proportions in Germany amount to 21.4% and 2.7%. These average differences, however, conceal significant within country variation in the demographic composition, which – as we argue – is very relevant against the background of the potential consequences of the Covid-19 pandemic.

In Figure 3 we present shares of people aged 65+ in the general population by county in 2018. The counties with highest proportions of older individuals in Germany are concentrated in the east of the country. The variation in the proportion of those aged 65+ ranges between 15.7% in Frankfurt am Main (region Hessen)

and Freising (region Bavaria) and 31.5% in Suhl (region Thüringen). The ‘youngest’ of German counties resemble some of the oldest ones in Poland, where we find counties with the proportion of people aged 65+ as low as 11.2% or 12.1% (powiats kartuski and gdański, region Pomerania). Only in 15 counties in Poland (less than 4% of counties), the proportion of those aged 65+ exceeds 21% – which we find in about two thirds of counties in Germany. Similar differences are found regarding the proportion of those aged 85+ (not shown here), with a distinct concentration of the “oldest-old” in the eastern parts in both countries. However, while in Poland less than half of counties have a proportion of the 85+ population higher than 2%, this is the case in all but one county in Germany.

Figure 3. Share of people aged 65+ by county, 2018



Source: own compilation based on data from Eurostat and Federal Agency for Cartography and Geodesy (BKG) in case of Germany and Central Statistical Office (GUS) and Head Office of Geodesy and Cartography (GUGiK) in case of Poland.

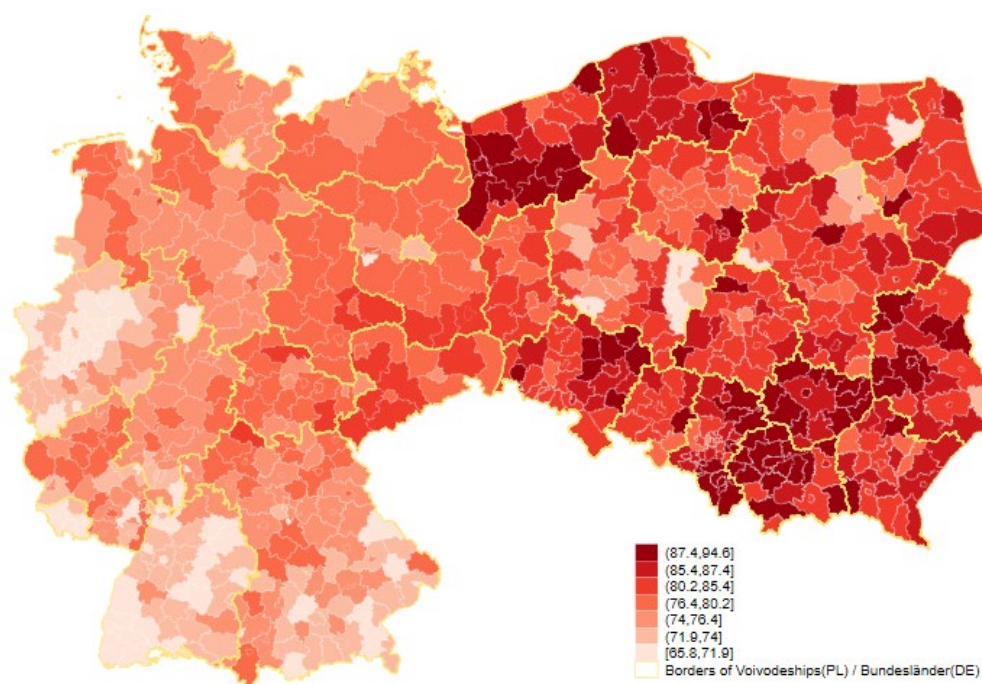
Note: Class 3, 4 and 5 cover 20% of the observations, the other classes 10% each.

When we compare the regional variation in the number of Covid-19 infections with the population’s age structure, it seems that the pandemic in both countries has so far affected the ‘younger’ regions. The spread of the virus has been relatively slow both in the eastern part of Germany and in the east of Poland. Thus, there is a negative correlation between the within-country spread of Covid-19 and the proportion of older age groups at the county level. This might be due to a higher level of travel and economic activity in younger regions of the two countries which – at least in the initial phase – limited further spread of the virus to the parts with higher proportions of older individuals.

Apart from older age several pre-existing medical conditions have also been identified as risk factors for severe consequences of Covid-19. Figure 4 displays the ratio of deaths due to a selected group of diseases in the total number of deaths among people aged 65+ to proxy the incidence of these health conditions

among the living population. The causes of death are coded according to the diagnostic criteria of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) compiled by the WHO. Deaths caused by external factors such as traffic accidents are excluded from the total of fatalities due to different reporting practise in Poland and Germany. Since no clear deviations in reporting deaths due to internal causes has been found, we assume this data is comparable between the two countries and we use deaths due to internal causes as a measure of total deaths in Figure 4. Causes that are especially relevant against the background of Covid-19 include deaths due to circulatory diseases, neoplasms and respiratory diseases (the level of data aggregation does not allow to single out deaths due to diabetes). In contrast to Figure 3, which showed much higher proportions of older people in Germany than in Poland, when it comes to health risks due to the specified conditions, the country picture is reversed. While the rate of deaths resulting from the selected conditions exceeds 90% of all deaths in the 65+ population in multiple counties across Poland (over 8% of all), it does not surpass 84% anywhere in Germany. Importantly, the regional distribution of death ratios in Germany due to the chosen conditions closely reflects the proportion of the older population and is concentrated in eastern parts of the country, in particular in the southern regions of the former East Germany. Epidemiological risks related to Covid-19 seem to be lower in the more prosperous regions in southern and western Germany, as well as in bigger cities such as Hamburg. In Poland there is no apparent relation between the selected health risks and the demographic structure of the regions. The highest proportion of deaths due to the selected conditions is found in the north-western regions and in the south-east, leaving central Poland with somewhat lower incidence rates of death due to these causes – at similar levels observed in many parts of Germany. Moreover, the within-country variation in the proportion of these deaths is much higher in Poland, where in sztumski county (Pomerania region) as many as 94.5% of deaths among 65+ can be attributed to the selected conditions, while in ełcki county (Warmia-Masuria region) this number was only 66.6%.

Figure 4. Share of deaths due to neoplasms, circulatory and respiratory diseases among people aged 65+ by county, 2016



Source: own compilation based on data from European Data Portal and Federal Agency for Cartography and Geodesy (BKG) in case of Germany and Central Statistical Office (GUS) and Head Office of Geodesy and Cartography (GUGiK) in case of Poland.

Note: Class 3, 4 and 5 cover 20% of the observations, the other classes 10% each.

4. Healthcare Resources at the Regional Level in Germany and Poland

The initial wave of the Covid-19 pandemic in several most affected countries resulted in a significant overburden of their healthcare capacities with a sudden wave of patients in need of in-hospital intensive care. While in some hospitals in Germany and Poland the first inflow of patients placed a heavy burden on the available resources, both healthcare systems have so far not been overwhelmed to the extent that was experienced in Italy, Spain, or some states of the USA. However, there are significant differences between the healthcare resources available in Germany and Poland and these differences might become apparent if the next waves of the pandemic result in much higher rates of infections. Health expenditure accounted for 11.3% of Germany's gross domestic product (GDP) in 2017, with an expenditure of 4,459€ per inhabitant. The spending in Poland was much lower and amounted to 6.5% of the GDP and an expenditure of 731€ per inhabitant (Eurostat 2020a). The differences are not as high in the absolute values of traditional healthcare indicators such as the number of hospital beds per 1,000 people (601.5 in Germany and 485.1 in Poland; Eurostat 2020b) or the number of doctors per 100.000 inhabitants (424.9 in Germany and 237.8 in Poland; Eurostat 2020c), but they are still notable.

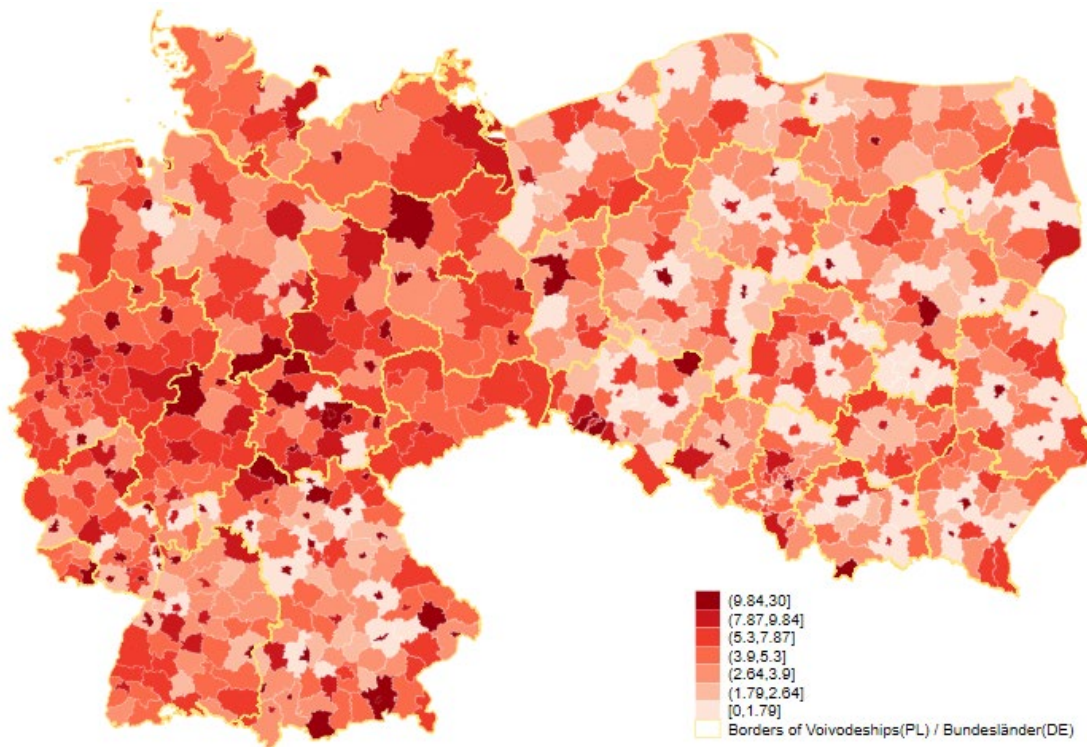
We show the regional distribution of hospital beds and practising doctors in Figures 5 and 6. As in the case of the demographic structure and epidemiological conditions, there are significant regional differences in the capacity of healthcare as measured by these indicators. In the latter case the data do not allow for a

direct cross-country comparison as the data in Germany only covers medical doctors who provide health services to patients with social health insurance in outpatient clinics. In Poland the data is limited to the medical doctors working directly with patients conditional on their primary workplace / main employer in case of multiple assignments (excluded if private practice is reported as such). This means that the data at hand only covers a proportion of all medical doctors - in Germany it captures 37% of all those with an active medical license (according to the German Medical Association) and in Poland 60% of licensed doctors as reported by the Polish Supreme Medical Chamber. As this data is not directly comparable across countries, the proportions in Figure 6 are presented in shades of blue and green for Germany and Poland respectively. However, the key dimension of the data we present is the high within-country variation in the level of medical staff across regions.

In both countries there is an urban-rural divide of the healthcare capacities that is most pronounced in Poland and in the south-western regions of Germany. In Poland this originates partly from the task division at consecutive levels of local administration. Although county authorities are responsible for the broad network of hospitals, the major clinical hospitals are located in the biggest cities. The north-south difference that we observe in Germany is related to the fact that in northern regions many populated cities compose a county together with neighbouring municipalities, while in the southern and central parts they constitute an independent county. This brings out the contrast between cities and the localities around them, which is also noticeable in the case of Poland. For many areas this means that their inhabitants have to travel or be transported relatively long distances when in need for medical treatment, in particular in cases of specialised interventions. In 2016 there were four counties in Germany and as many as 24 counties in Poland with no hospitals.



Figure 5. Number of hospital beds per 1,000 inhabitants by county, 2016



Source: own compilation based on data from Federal Statistical Office and Statistical Offices of the Länder and Federal Agency for Cartography and Geodesy (BKG) in case of Germany and Central Statistical Office (GUS) and Head Office of Geodesy and Cartography (GUGiK) in case of Poland.

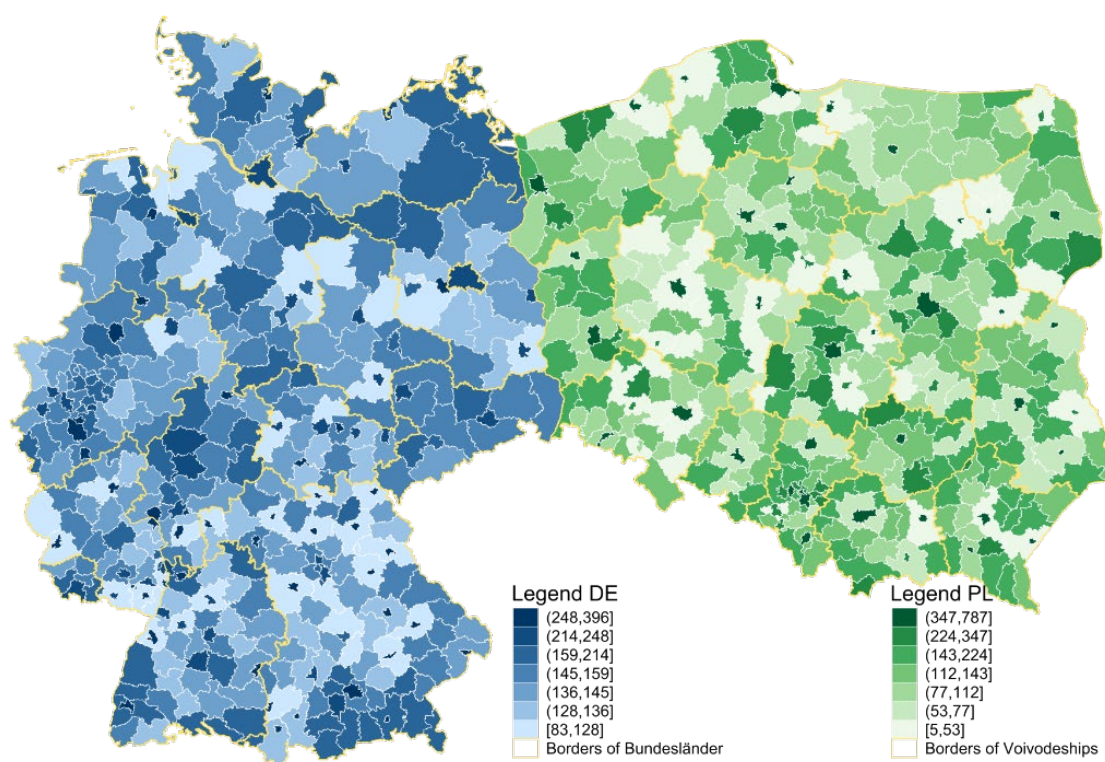
Note: Class 3, 4 and 5 cover 20% of the observations, the other classes 10% each.

The rural-urban divide is even more evident in Poland when we look at the number of medical doctors, as doctors are clustered in the biggest cities or counties with clinical hospitals (Figure 6). In 2018, three counties had 20 or less medical doctors per 100,000 inhabitants (powiat łomżyński in Podlaskie region, średzki in Lower Silesia and siedlecki in Mazovia), and in 30% of counties this number was below 100. Almost 10% of counties (all big cities and regional capitals) had at the same time 400 or more doctors per 100,000 inhabitants, two counties in South-East Poland – Lublin (Lubelskie region) and Rzeszów (Podkarpackie region) reported over 770 doctors. Thus, the striking feature of several regions in Poland is that besides a strong medical centre, there is a high number of municipalities around them with very low number of doctors. This is the case for example in Olsztyn in the north-east of Poland (region Warmia-Masuria) or Poznań in the west (Greater Poland region).

Since for Germany we only considered doctors working in outpatient clinics and excluded doctors working solely in hospitals and thus concentrated in major regional cities, the medical workforce seems spread out more equally (Figure 6) compared to the availability of hospital beds (Figure 5). However, in particular since in Germany the data covers a much lower proportion of medical doctors compared to Poland, even in the German counties with lowest statistics, the numbers of doctors are still much higher than in many rural areas throughout Poland.

Figure 6. Number of doctors per 100,000 inhabitants by county, 2018

A) in Germany doctors working in outpatient clinics B) in Poland doctors working directly with patients in primary workplace



Source: own compilation based on data from Federal Medical Registry (KBV) and Federal Agency for Cartography and Geodesy (BKG) in case of Germany and Central Statistical Office (GUS) and Head Office of Geodesy and Cartography (GUGiK) in case of Poland.

Note: Class 3, 4 and 5 cover 20% of the observations, the other classes 10% each.

Conclusion

The early evidence suggests that people over the age of 65 and those with pre-existing health conditions such as cardiovascular conditions, diabetes, hypertension, chronic pulmonary disease and cancer are at the highest risk of severe consequences of Covid-19. A well-equipped healthcare system is required to respond appropriately to increases in demand for healthcare in order to safeguard the population against the worst outcomes of the disease in potential future waves of the pandemic. This regards the issue of preventing Covid-19 related fatalities, but it also refers to the continued need to provide other general types of healthcare which are constantly required alongside the cases directly related to the pandemic.

Such a combination of health risks related to demographic, epidemiological and systemic factors results in potentially high regional variation of the scale of consequences of the spread of the Covid-19 pandemic. Using the example of Germany and Poland, two neighbouring countries which have generally dealt relatively well with the outbreak of Covid-19 in recent months, this policy paper shows that there is significant regional variation both in the distribution of health risks and healthcare resources. These

regional inequalities should be considered regarding the consequences of future outbreaks of the virus. The regional analysis of the first wave of the pandemic – with data until 31 May 2020 – suggests that in both countries the virus spread mainly in ‘younger’ regions (with low proportions of people aged 65+) with lower incidence of the relevant comorbidities. At the same time the number of cases in the two countries was low enough so that both the German and the Polish healthcare systems, notwithstanding the differences between them, were not overwhelmed by the inflow of Covid-19 patients.

Such a situation is by and large not guaranteed in the case of future waves of the pandemic. The virus is likely to spread beyond the best connected and most mobile regional populations, which has been the case so far in Germany and Poland. With respect to the demographic structure of the population, the places most at risk for severe health consequences due to Covid-19 are the counties of the former East Germany and those in the east of Poland, where we observe an outstandingly large proportion of people aged 65+. Similarly – looking at the incidence of relevant comorbidities, the northern and southern counties clearly stand out in Poland, and in this respect the health of the German 65+ population presents a much lower risk compared to the health status of the Polish counterparts.

How these two critical risk factors translate into health outcomes in future waves of Covid-19 depends on the readiness of the local healthcare system to provide support to patients requiring in-hospital and intensive care. Using regional data on the number of beds and medical doctors we have shown that in both countries there is a significant variation in healthcare resources. This variation is particularly visible in Poland with a substantial urban-rural divide and high concentration of healthcare resources and staff in larger cities. A rapid spread of the disease in future months could be devastating in Polish rural areas with poor medical infrastructure and high proportions of the population at risk.

The differences between and within the countries regarding the healthcare infrastructure lead to two crucial conclusions with regard to the potential consequences of future waves of Covid-19. First of all, it is clear that the German healthcare system – with the better hospital infrastructure and higher number of doctors, is overall better prepared to face a surge in Covid-19 cases. Secondly, there is a much higher proportion of counties in Germany with high level of medical resources and few localities standing out with much lower levels of hospital capacity or doctors compared to those with the highest values. This is not the case in Poland where the majority of counties have very low capacities of both hospital beds and doctors. While such inequalities in medical resources may be of less concern in ‘normal times’ when individuals from areas with poorer infrastructure might find a place in their nearest relevant hospital, in the case of a sudden increase in demand for hospitalisations such local medical centres might rapidly become overwhelmed. Additionally, moving patients to distant hospitals would place significant additional demand on medical transportation. In cases of rapid increases in the numbers of infected people problems are also likely to occur at the level of the basic diagnosis before the patients are classified for hospitalisation.

As shown in this policy paper the variance in the demographic structure of the population as well as in the main causes of death at older ages between Germany and Poland and within each of the two countries is substantial. In many regions these underlying demographic and epidemiological factors overlap with



relatively low general capacities of the healthcare system to deal with a sudden surge of hospitalisations (Kandel et al. 2020). Thus, the analysis presented in this policy paper points towards the need for a disaggregated regional level risk-management approach to future waves of the Covid-19 pandemic. Highly differentiated demographic and epidemiological risks related to the pandemic between as well as within Germany and Poland call for a decentralised evaluation of risks and point out the need to consider an application of regionally focused policy reactions such as lockdowns and social distancing regulations. If risks and the ability to respond to them vary significantly at the regional level, policies should consider and account for such variation to prepare for potential next outbreaks later this year or next year.

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