



Article

Globalization and the Outbreak of COVID-19: An Empirical Analysis

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Abstract: The purpose of this study is to examine the relationship between the extension of globalization and coronavirus disease 2019 (COVID-19) case fatality rate (CFR) calculated on 28 July 2020 in more than 150 countries. Our regression analyses show that countries with higher levels of socio-economic globalization are exposed to higher levels of CFR. The positive association between the level of globalization of countries and their COVID-19 fatality rate remains robust, controlling for cross-country differences in economic development and demographics, health care costs, health care capacity, quality of governance and continental dummies.

Keywords: COVID-19; globalization; case fatality rate



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1. Introduction

The spread of the highly contagious coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome had affected 16,465,707 individuals and has taken the life of 653,862 persons in 192 countries by 28 July 2020 (ECDC 2020). However, the negative impact of the COVID-19 outbreak is not limited only to the loss of lives insofar as it has short and long-term socio-economic effects throughout the world. In our worldwide sample, we observe significant cross-country variation with respect to confirmed deaths to confirmed cases, known as case fatality rate (CFR), ranging from 0 to 16.5% (France) with an average level of approximately 3%. We aim to study the link between past records of countries in their level of globalization and how that can explain the variation of CFR in our global sample. In other words, is there a robust cross-country relationship between globalization and CFR? Does this association remain robust after controlling for factors that simultaneously affect both variables? While there are studies such as Shrestha et al. (2020) on the impact of COVID-19 on globalization, our study is the first cross-country regression analysis of the effect of earlier records of globalization on the outbreak of COVID-19 and its fatalities.

Figure 1 shows the positive correlation between CFR and the KOF Swiss Economic Institute Index of Globalization. The correlation coefficient is 0.36 and statistically significant.

There are currently several reports and studies addressing the economic consequences of the COVID-19 pandemic in different countries. The coronavirus outbreak has interrupted trade, supply chains and tourism—all of which have had an impact on the global economy (Ahani and Nilashi 2020). McKibbin and Fernando (2020) demonstrate that in the short run, even a controlled outbreak could significantly affect the global economy. Evenett (2020) provides a critical review of the initial trade policy response to COVID-19.

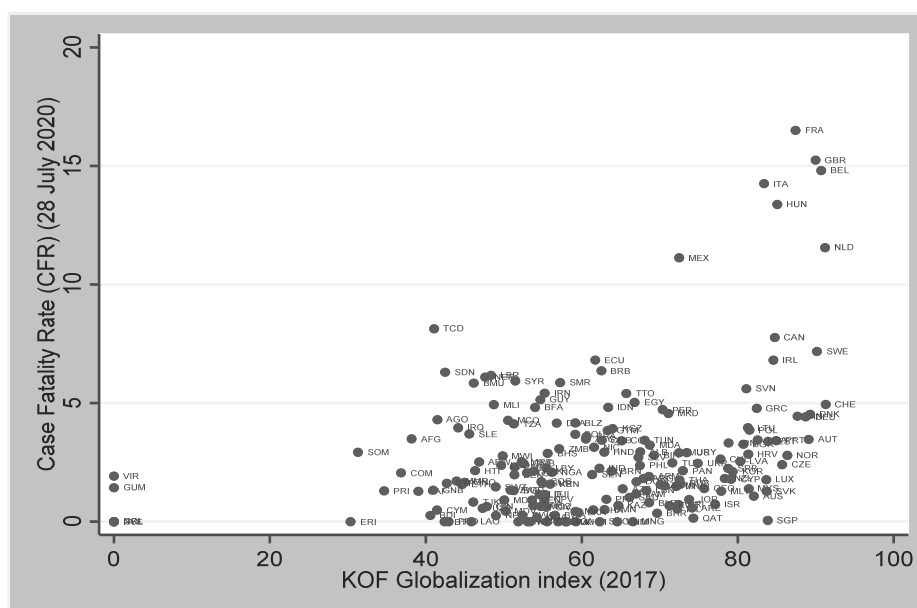


Figure 1. Association between case fatality rate (CFR) and the KOF Globalization Index. Source: The KOF Globalization Index from the latest available year (2017) (from 0 to 100- higher value indicates higher level of globalization) is from Gygli et al. (2019). CFR cumulated by 28 July 2020 is from European Centre for Disease Prevention and Control (ECDC 2020).

The COVID-19 outbreak caused a severe global recession in 2020 that was much worse than that triggered by the global financial crisis of 2008–2009 (IMF 2020). In a recent report, the Organization for Economic Cooperation and Development (OECD 2020) forecast that the COVID-19 outbreak reduced global GDP growth by -4.2% in 2020. So far, the outbreak has led to a drop in economic growth in China from 6.11% to 1.8% . Based on different scenarios of the impact by the pandemic on growth, the International Labour Organization (ILO) estimates that global unemployment could increase by almost 25 million (ILO 2020). In addition, Hassan and Gavilanes (2021) study the impact of the COVID-19 contamination rate on the returns of stock market indices and prices of selected commodities, such as gold, platinum, silver, West Texas Intermediate (WTI), and Brent oil. They show that a 1% increase in the virus contamination rate reduces stock market returns by 2.3% on daily basis. Based on their estimations, the largest drop is observed in oil barrel prices, wherein an increase in the virus spread rate causes a reduction of 4.08% and 3.26% in Brent and WTI oil prices, respectively.

As a result of the COVID-19 pandemic, many countries have banned or imposed restrictions on in-person social and cultural interactions and international trade exchanges. There is an increasing interest in understanding the main explanatory factors of cross-country differences in the pattern of COVID-19 confirmed cases and fatalities. The pandemic seems to be a major blow to the current form of globalization (Bremmer 2020), that slows its speed, if not reversing it (Bloom 2020), and even may create a new version of globalization which is more regulated (Hutton 2020). However, globalization, with worldwide flow of people, goods, money, information, and ideas in huge scale and speed, might also be responsible for allowing the speedy spread of the outbreak. For instance, since the spread of the COVID-19 disease relies heavily on human-to-human interactions, movement of people internationally could be a dominant driver of its outbreak (Farzanegan et al. 2020).

In our study, we assess the relationship between the globalization index and COVID-19 case fatality rate in more than 100 countries. We use multivariate regression analyses, controlling for other drivers of the COVID-19 outbreak. There are studies which have examined the negative influence of globalization on health risks (for a review, see Pang and Guindon 2004; Woodward et al. 2001). In a recent study, Farzanegan et al. (2020) highlight the role of tourism in the expansion of COVID-19. Our study adds to it by focusing on

the concept of globalization, which includes economic, social and political dimensions of globalization and integration of countries in the global community. Furthermore, we focus on case fatality rates, which is the proportion of people who die and have tested positive for the disease. To the best our knowledge, our research is among the first empirical studies that tests the link between globalization indicator and the COVID-19 outbreak (recently Sigler et al. (2020) show that globalization and settlement population characteristics are related to high human mobility which predict COVID-19 disease diffusion).

The paper proceeds as follows: Section 2 describes the data and the estimation method; Section 3 presents the findings; and Section 4 concludes.

2. Data and Methodology

We hypothesize that countries with higher levels of globalization are associated with a higher COVID-19 case fatality rate, *ceteris paribus*. To test this hypothesis, we use case fatality rate (CFR), which is the number of total confirmed deaths divided by the total number of confirmed cases (cumulated by 28 July 2020). We acknowledge that the CFR data are not perfect measures because fatalities may be reported differently between developed and emerging countries, and that the data may be of varying quality. A more reliable indicator is the infection fatality rate (IFR), which is the number of deaths from a disease divided by the total number of cases. However, this indicator cannot be accurately calculated since the total number of cases of COVID-19 is not known. One reason is that not every individual with COVID-19 is tested. Thus, we rely on case fertility rate in our analysis which is also widely cited in debates around countries’ experience with COVID-19, keeping in mind its difference with IFR (for more information see Ritchie and Roser 2020).

The data on CFR is regularly updated based on information of local government websites/health departments and is taken from ECDC (2020). We have calculated the cumulative numbers of death and confirmed cases by 28 July 2020.

The base-line econometric model has the following form:

$$COVID19_CFR_i = \alpha + \sum_{j=1}^k \beta_j X_{j,i} + \gamma_1 Globalization_i + \epsilon_i \tag{1}$$

Here, *COVID19_CFR* is the COVID-19 case fatality rate in country *i*, *X_{j,i}* are *k* exogenous control variables affecting the COVID-19 case fatality rate, *Globalization_i* represents the globalization index in country *i* and is from the 2017 revised version of the KOF Index of Globalization, α is a constant and ϵ_i is the error term.

In our analyses, we use different sets of variables to check the robustness of our findings on the link between globalization and CFR. Table 1 presents summary statistics of all variables.

Table 1. Summary statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
confirmed deaths (% of confirmed cases) (CFR)	149	2.85	2.94	0.00	16.50
KOF globalization index in 2017	149	65.43	13.92	30.33	91.28
log of GDP per capita	149	8.69	1.46	5.44	11.58
log of population beyond 65 years of age (% total population)	149	1.91	0.73	−0.11	3.22
log of population density	149	4.29	1.37	0.64	8.95
average governance index	149	0.00	0.88	−1.60	1.84
log of hospital beds per 1000 population	149	0.77	0.88	−2.30	2.60
log of out-of-pocket spending on health per capita	149	5.27	1.15	1.45	7.59

The subscript *i* refers to country *i*, where there are more than 100 countries with confirmed deaths associated with COVID-19 and confirmed infections with the coronavirus.

To explain cross-country differences in CFR of COVID-19, we use the revised version of the KOF Index of Globalization as the main explanatory variable (Cygli et al. 2019). This composite index measures the economic, social and political dimensions of globalization. Based on 43 variables (instead of 23 variables in its original version as was introduced by (Dreher 2006), various dimensions of globalization including trade, finance, interpersonal, information, culture, and politics are covered. We examine the association between the aggregate globalization index and confirmed cases of COVID-19 and associated fatalities.

Potrafke (2015) provides a survey of various socio-economic effects of the KOF Globalization Index. He identified more than 100 studies which have used this index to measure a country's interaction with the rest of the world. His survey shows that globalization, on average, has more positive consequences for countries in terms of economic growth, gender equality, and human rights. On the negative side, globalization may fuel inequalities within a country. In our study, we explore a new dimension of globalization, which is the contagion level of COVID-19 across countries. We use dimensions of globalization from the latest reported year in 2017 by the KOF index. Under economic globalization, we consider trade and financial dimensions. Social globalization dimensions comprise of interpersonal and information categories. Finally, political dimensions consider the degree of integration of a country in global politics. The composite nature of the index is an added value, which helps us to better capture the concept of globalization. Earlier studies have examined the effect of some building blocks of globalization, such as international tourism. However, these elements are not able to fully capture the concept of globalization. This is also mentioned by developers of the KOF Index of Globalization (Dreher et al. 2008, p. 25): *"When a phenomenon like globalization encompasses several aspects that taken together may have an effect greater than the sum of their constituent parts, it appears logical to assess these effects together. Composite indices provide an excellent way to accomplish this since they provide a single statistic on which comparisons can be based, without the confounding effects of variation at lower levels of aggregation"*.

The set of control variables is inspired by Farzanegan (2020) and Farzanegan et al. (2020). We control for the logarithm of GDP per capita, logarithm of population beyond 65 years of age (% total population), logarithm of population density, average of the World Bank's six national governance sub-indices, logarithm of hospital beds per 1000 population, and logarithm of out-of-pocket spending on health per capita. In all models, we include continent dummies for Asia, Africa, Europe and America. These dummies reduce the risk of omitted variables due to regional specific factors (e.g., cultural and religious norms, or geographic location) which may also affect the spread of COVID-19. Control variables are obtained from the World World Bank (2020). In the following, we present a brief explanation of the control variables:

GDP per capita: this variable captures the available financial resources and state capacity in testing COVID-19 and recording such statistics. Poor economies may not be able to test and diagnose COVID-19 cases or may care less about the consequences of the outbreak of COVID-19 due to their lower opportunity costs (for a related study on the dynamic relationship between GDP and infectious diseases, see (Zhang et al. 2016)). We use log of GDP per capita (in purchasing power parity (PPP) prices) and the data are averaged values between 2010 to 2019.

Demographic structure: the COVID-19 infects people, regardless of their age. However, evidence suggests that the infection rate is likely age-dependent (Suwanprasert 2020) and older people are at a higher risk of getting severe COVID-19 disease (Kluge 2020). A higher share of elderly in the population may also mean increased vulnerability to COVID-19. Analysis by Zhou et al. (2020) show in-hospital death due to COVID-19 is more likely for patients with older age. Early data from China suggest that the majority of coronavirus disease 2019 deaths have occurred among adults aged more than 60 years and among persons with serious underlying health conditions. Evans and Werker (2020) also argue that an uncontrolled virus could have a far lower death toll in a much younger pop-

ulation. We use an average share of population ages 65 and above in the total population, from 2010 to 2019, and expect it to have a positive correlation with fatalities of COVID-19.

Population density: a higher density of the population may mean more interactions among people and thus a higher risk of contagion. Tarwater and Martin (2001) found a significant effect of population density on the epidemic outbreak of measles or measles-like infectious diseases. We use the average values of population density between 2010 and 2019.

Governance index: governance and how it may play a role of managing the COVID-19 crisis is also important and needs to be taken into account. Countries which are more prone to corruption, political instability and lack of transparency and accountability of the state to the people may less effectively manage the expansion of COVID-19 and implementation of measures to control the crisis. We take a simple average of all six dimension of governance from the World Governance Indicators (WGI 2020) database for the period of 1996 to 2018. We expect that countries with better quality of governance are more able to dampen the COVID-19 fatalities rate, *ceteris paribus*.

Health system capacity: this variable has been a trending topic around the COVID-19 outbreak (Aleem 2020). We use the log of the number of hospital beds (per 1000 people), average values between 2010 and 2019, as a measure of health system capacity to reduce the negative consequences of COVID-19. Hospital beds include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers (World Bank 2020). In most cases, beds for both acute and chronic care are included (World Bank 2020). We expect to observe a negative correlation between the number of nurses and hospital beds with death numbers of COVID-19. Modern infrastructure, public health institutions, and efficient medical treatment control the number of infected individuals and keep them far below the critical threshold which is needed for endemic or even epidemic transmission (Murphy 2006).

Costs of health care: to control for the financial costs of health care for people, we use out-of-pocket expenditure on health per capita, PPP (current international \$) averaged from 2010 to 2019. Out-of-pocket payments are spending on health paid directly by households in each country. Its higher levels may indicate a higher burden of health care and thus higher vulnerability of individuals against COVID-19. Earlier studies show that ineffective health financing systems and lack of social protection networks are the main drivers of out-of-pocket health expenditure which consequently leads to consumption of a large portion of a household's budget (e.g., Van Doorslaer et al. 2006). We also control for the share of government spending on health (as % of total government spending) and/or logarithm of health spending per capita (in purchasing power parity (PPP) prices). Neither has a statistically significant effect on CFR, controlling for other discussed variables.

3. Results

We apply the ordinary least squares (OLS) estimation method with robust standard errors. The main variable of interest is the KOF globalization index. This ranges from a minimum of 30 (Eritrea) to a maximum of 91 (Switzerland) in our sample of 149 countries. In Model 1 in Table 2, we see that an increase in the KOF globalization index by 10 units (e.g., from the level of index in Russia, 72, to the level of USA, 82) is associated with an increase of CFR by 0.7 percentage points. This effect is largely robust to the inclusion of other control variables in eight other models in Table 2. In other words, the association between the globalization index and CFR is independent of the effect of other factors on CFR, such as demographic structure and health system capacity. The association between globalization in its three dimensions and case fatality rate of COVID-19 is highly statistically significant.

This finding supports our hypothesis that CFR is larger in countries that are more globalized and integrated in the global economy. It means that countries which have more human interactions with the rest of the world, for example, through international business, leisure travels and international trade of goods and services would experience a greater

CFR. To make it clearer, we provide two examples of countries successful in controlling COVID-19 cases and deaths: Australia and New Zealand. Both countries have restricted human mobility by closing their borders and have applied effective lockdowns within their respective countries.

Our finding is also consistent with Farzanegan et al. (2020) who show a positive link between international tourism (as a component of globalization) and spread of COVID-19 cases and deaths across countries. Our results are also in line with Sigler et al. (2020) who found that a higher level of globalization is tied to human interaction and predicts COVID-19 diffusion in countries with a low number of total confirmed cases per million. Globalization has stimulated the mobility of people around the world and this may be one of the reasons behind the significant positive association between this variable and COVID-19 case fatality rates. For example, Mallapaty (2020) and Cain et al. (2020) provide a detailed discussion on the role of cruise tourism in the expansion of COVID-19. In their cross-country analysis, Farzanegan et al. (2020) show that countries with a 1% increase in inbound and outbound tourism over the last decade are correlated with 1.2% increase in the number of COVID-19 confirmed cases in 2020. Globalization has also increased urbanization and facilitated global interconnectedness. Wu et al. (2017), focusing on the case of China, also argue that globalization has stimulated pathogen spread among countries through the increase of trade and travel. There is also historical evidence of the role of global trade in the expansion of diseases and outbreak of pandemics. For example, the bubonic plague caused by the *Yersinia pestis* bacteria was transmitted from China to Europe through trade channels (Shrestha et al. 2020). Also, the influenza pandemic of 1918 which killed more than 50 million people worldwide, was the result of movement of armies in the First World War (Martini et al. 2019). Moreover, as reported by Shrestha et al. (2020), in the expansion of the Asian flu of 1957 to 20 countries, land and sea travel was the key channel of transmission. In addition, the Hong Kong flu (H3N2 strain of influenza A) pandemic spread significantly through air travel, which is stimulated by trend of globalization. In general, globalization, through stimulation of integration of economies and societies, has facilitated the outbreaks of infectious diseases, including the most recent example of COVID-19. For a detailed review on the globalization and infectious disease linkages, see the Saker et al. (2004) report for the World Health Organization. Based on the impacts of globalization on infectious diseases, Saker et al. suggest that there is a “need for appropriate forms of global governance on key issues to improve systems of prevention, control and treatment”.

We control for GDP per capita (PPP, US\$), as a proxy for the relative wealth of nations and economic activities in Model 2. This variable, when we control for the globalization channel and continental dummies, is statistically insignificant. Model 3 adds the logarithm of share of elderly population in total population. Its sign, as expected, is positive but insignificant in this model. When we control for full set of control variables in Model 8 and a reduced form in Model 9, the positive association between elderly population and CFR becomes statistically significant. A one standard deviation increase in the log of elderly population in total population is associated with an increase of 0.23 standard deviation in CFR in Model 8, which is the third largest impact after globalization index and logarithm of hospital beds (excluding regional dummies). Population density is controlled in Model 4 and then in the general specification (Model 8). While it is positively associated with CFR, its estimated coefficient is not statistically significant. Countries also differ in terms of their quality of formal institutions.

To control for the role of governance in shaping the COVID-19 case fatality rate, we take a simple average of six different (but highly correlated) dimensions of governance from the World Bank: control of corruption, regulatory quality, government effectiveness, political stability, rule of law and voice and accountability. We see that this index is negatively associated with CFR in Models 5 and 8 of Table 2. However, when we control for other factors, its negative effect does not reach the conventional statistical significance.

Table 2. Case fatality rate and globalization.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent Variable: Case Fatality Rate (CFR) %								
KOF globalization index	0.069 *** (3.24)	0.080 *** (3.00)	0.063 *** (2.76)	0.069 *** (3.31)	0.088 *** (3.16)	0.080 *** (3.59)	0.067 ** (2.34)	0.077 ** (2.33)	0.068 *** (3.00)
Log GDP per capita		-0.142 (-0.74)						0.245 (0.56)	
Log population+65 (in total population)			0.315 (0.91)					0.936 ** (2.13)	0.778 ** (2.15)
Log population density				0.024 (0.16)				0.012 (0.07)	
Governance index					-0.368 (-1.02)			-0.580 (-1.11)	
Log hospital beds per 1000 population						-0.562 ** (-2.24)		-0.840 ** (-2.37)	-0.730 *** (-2.68)
Log out of pocket spending on health per capita							0.050 (0.19)	0.007 (0.02)	
Asia	1.220 *** (2.93)	1.151 *** (2.68)	1.405 *** (3.08)	1.165 ** (2.40)	0.928 * (1.79)	1.103 *** (2.76)	1.218 *** (2.88)	1.222 ** (2.09)	1.522 *** (3.24)
Europe	3.069 *** (4.89)	2.964 *** (4.47)	2.976 *** (4.69)	3.030 *** (5.03)	2.787 *** (4.08)	3.301 *** (5.25)	3.055 *** (4.70)	2.856 *** (4.01)	3.141 *** (4.94)
Africa	2.566 *** (4.48)	2.429 *** (4.19)	2.790 ** (4.55)	2.525 *** (4.40)	2.348 *** (3.68)	2.282 *** (4.28)	2.604 *** (4.87)	2.684 *** (4.43)	2.749 *** (4.57)
America	2.870 *** (5.55)	2.827 *** (5.45)	2.904 *** (5.56)	2.833 *** (5.34)	2.664 *** (4.73)	2.720 *** (5.39)	2.854 *** (5.32)	2.475 *** (4.29)	2.759 *** (5.22)
Countries	149	149	149	149	149	149	149	149	149
R-sq.	0.22	0.22	0.22	0.22	0.22	0.24	0.22	0.25	0.25

Notes: The dependent variable is the total number of confirmed deaths to total number of confirmed cases of COVID-19 (%) by 28 July 2020. The method of estimation is ordinary least squares with Huber-robust standard errors (t statistics are in parentheses) clustered at the country level. Significantly different from zero at * 90% confidence, ** 95% confidence, *** 99% confidence.

One highly relevant and significant control is the logarithm of hospital beds (per 1000 population). This variable is highly significant and shows a dampening effect on CFR in Models 6, 8 and 9. A one standard deviation increase in log of hospital beds is associated with a decline of 0.25 standard deviation in CFR in Model 8 (which is the second largest impact after globalization index). The log of out-of-pocket spending on health per capita (PPP, US\$), captures the degree of government involvement in the health care system and financial burden of health care on people. This variable is positively associated with CFR, as expected, but is not statistically significant.

In short, the nine models in Table 2 show that the index of globalization, the share of elderly population in total population and the number of hospital beds are three most relevant and robust determinants of cross-country variation of CFR.

4. Conclusions

In this study, using data from 149 countries and applying cross-sectional regressions, we find a significant and positive association between the KOF globalization index and the current level of accumulated COVID-19 case fatality rate. This finding is robust in different models and after control for other possible factors (e.g., health system infrastructures, demographic structure, and regional dummies) which may simultaneously affect both globalization and COVID-19 case fatality rates. The effect of globalization is not only statistically significant but also it has a meaningful size effect. Controlling for other factors, countries 10 units higher in the globalization index (with standard deviation of 14) in earlier years are predicted to have an approximately 0.8 percentage points higher level of COVID-19 case fatality rates (with standard deviation of 2.9).

Our results have important implications for policymakers. While globalization has a favorable impact on economic growth and employment, the adverse effect of the large number of confirmed COVID-19 cases could show its dark side during a disease pandemic. Therefore, policymakers should consider the health risks associated with the increasing trend of globalization of markets and societies. It is shown that the increasing trend of globalization and opening of trade borders in countries with a low quality of formal institutions and monitoring capacity as well as low levels of transparency of information and government accountability may even lead to more illicit trade and smuggling (Farzanegan 2009; Buehn and Farzanegan 2012). The latter types of trade are part of the shadow economy, which due to their hidden nature, are even more difficult to control with respect to diseases. For example, there is ample evidence that COVID-19 was first identified in a Wuhan seafood market where wild animals, such as marmots, birds, rabbits, bats and snakes, are traded illegally. The same situation was also seen in previous contagions like the Ebola and SARs viruses. The existence of large, unsanitary and weakly-regulated illicit wildlife markets in each of these cases provided an ideal environment for diseases (for more details, see Evans 2020 and Aguirre et al. 2020). Globalization combined with the weak quality of institutions amplify the speed of an outbreak.

Based on our empirical results, demographic structure and health infrastructure are among the most significant explanatory variables with references to COVID-19 case fatality rate. These results suggest that policymakers need to invest in the expansion of health infrastructure, such as increasing the number of modern hospital beds (considering the size of their population) and training and employing skilled medical staff (e.g., physicians, and nurses). Tracking the demographic developments of societies and planning for the health needs of the elderly are also important parts of the resistance package for future pandemics.

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