Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Short Communication

Healthcare indicators associated with COVID-19 death rates in the European Union

C. Mattiuzzi [a], G. Lippi [b, *], B.M. Henry [c]

[a] Provincial Agency for Social and Sanitary Services, Trento, Italy
[b] Section of Clinical Biochemistry, University of Verona, Verona, Italy
[c] Cardiac Intensive Care Unit, The Heart Institute, Cincinnati Children's Hospital Medical Center, Ohio, USA

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ABSTRACT

Objectives: Identification of environmental and hospital indicators that may influence coronavirus disease 2019 (COVID-19) mortality in different countries is essential for better management of this infectious disease.

Study design: Correlation analysis between healthcare system indicators and COVID-19 mortality rate in Europe.

Methods: For each country in the European Union (EU), the date of the first diagnosed case and the crude death rate for COVID-19 were retrieved from the John Hopkins University website. These data were then combined with environmental, hospital and clinical indicators extracted from the European Health Information Gateway of the World Health Organization.

Results: The COVID-19 death rate in EU countries (mean 1.9 ± 0.8%) was inversely associated with the number of available general hospitals, physicians and nurses. Significant positive associations were also found with the rate of acute care bed occupancy, as well as with the proportion of population who were aged older than 65 years, overweight or who had cancer. Total healthcare expenditure, public sector health expenditure and the number of hospital and acute care beds did not influence COVID-19 death rate.

Conclusions: Some common healthcare system inadequacies, such as limited numbers of general hospitals, physicians and nurses, in addition to high acute care bed occupancy, may be significant drivers of nationwide COVID-19 mortality rates in EU countries.

Although coronavirus disease 2019 (COVID-19) has spread around the world, there is a broad divergence in terms of COVID-19 mortality across different countries, as recently highlighted by Teixeira da Silva and Tsigaris.[1] In addition to identifying clinical and laboratory predictors of individual disease progression, it is also vital to recognise that environmental and hospital indicators may influence the impact of COVID-19, thus, in part, explaining the wide heterogeneity of death rates observed across different countries.

To investigate this matter further, the present study retrieved the date of the first diagnosed case and the crude death rate for COVID-19 for each country within the European Union (EU) from the John Hopkins University website.[2] These data were then combined with a number of environmental, hospital and clinical indicators extracted from the European Health Information Gateway (EHIG) of the World Health Organization (WHO).[3] More specifically, separate queries were made in the EHIG database, using the specific keywords (i.e. healthcare indicators) listed in Table 1, to retrieve data for each EU country. According to the WHO regional office for Europe, the information contained in the EHIG repository is derived from various reliable sources, including WHO/Europe's technical programmes and partner organisations, such as Eurostat, the Organisation for Economic Co-operation and Development and the United Nations.[3] The most recent available data of the EU healthcare indicators were imported into a Microsoft Excel file (Microsoft, Redmond, WA, United States) along with the country-specific COVID-19 crude death rates. After logarithmic data conversion, a multiple linear regression analysis was carried out to identify potentially independent associations; death rate (%) was set as the dependent variable, whilst environmental, healthcare and clinical indicators were

* Corresponding author. Section of Clinical Biochemistry, University Hospital of Verona, Piazzale L.A. Scuro, 10, 37134, Verona, Italy. Tel.: +39 045 8122970; fax: +39 045 8124308.
E-mail address: giuseppe.lippi@univr.it (G. Lippi).

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Table 1
Association between environmental, hospital and clinical indicators with coronavirus disease 2019 (COVID-19) mortality rate in European Union countries.

Parameter	β coefficient (95% CI)	*P*-value
1st diagnosed case (date)	−284 (−1002 to 433)	0.380
Environmental indicators		
Mean yearly temperature (°C)	0.274 (−0.484 to 1.031)	0.421
Density (population/km^2)	−0.243 (−0.493 to 0.007)	0.055
Proportion of urban population (%)	−1.190 (−3.970 to 1.590)	0.345
People per room in occupied housing unit (number)	−0.384 (−1.595 to 0.826)	0.477
Gross domestic product (US$ per capita)	0.722 (−0.003 to 1.447)	0.051
Hospital indicators		
Total healthcare expenditure (US$ per capita)	−0.002 (−1.597 to 1.594)	0.998
Public sector healthcare expenditure (% of total health expenditure)	−0.737 (−1.737 to 0.264)	0.125
General hospitals (per 100,000)	−0.513 (−0.918 to −0.107)	**0.020**
Hospital beds (per 100,000)	0.037 (−0.786 to 0.860)	0.918
Acute care beds (per 100,000)	1.039 (−0.194 to 2.273)	0.056
Acute care bed occupancy (%)	3.639 (1.743–5.534)	**0.003**
Physicians (per 100,000)	−1.494 (−2.792 to −0.196)	**0.039**
Nurses (per 100,000)	−1.290 (−2.242 to −0.339)	**0.015**
Clinical indicators		
Estimated life expectancy at birth (years)	−9.036 (−19.270 to 1.198)	0.075
Population aged >65 years (%)	3.019 (0.448–5.590)	**0.027**
Age-standardised current tobacco smoking in people >15 years (%)	−0.943 (−2.817 to 0.930)	0.273
Age-standardised overweight in people >18 years (%)	6.886 (0.347–13.426)	**0.042**
Incidence of cancer (per 100,000)	0.577 (0.117–1.037)	**0.041**
People self-assessing health as good (%)	2.170 (0.797–3.543)	**0.007**

CI, confidence interval. Statistically significant associations are given in bold.

set as independent variables. Statistical analyses was carried out using Analyse-it (Analyse-it Software Ltd, Leeds, UK), with significance set at $P < 0.05$. The analyses were based on electronic searches in unrestricted, publicly available databases, and therefore, no informed consent or ethical committee approval was required.

The results of this investigation are summarised in Table 1. The COVID-19 death rate in EU countries (mean 1.9 ± 0.8%) varied between 0.6% in Cyprus and 3.6% in Bulgaria, and it was inversely associated with the number of available general hospitals, physicians and nurses. Significant positive associations with mortality were found with the rate of acute care bed occupancy, as well as with the proportion of the population who were aged >65 years, overweight or who had cancer. A positive association with mortality was also found with the proportion of the population self-assessing their health as good. Importantly, neither total healthcare expenditure, public sector health expenditure nor the number of hospital and acute care beds were found to influence COVID-19 mortality rate. Moreover, in the present analysis, no environmental parameters were found to have a significant influence on COVID-19 mortality (Table 1), although the association with gross domestic product per capita and population density were of borderline statistical significance.

Taken together, the results of this study suggest that some common healthcare system inadequacies, such as a limited number of general hospitals, physicians and nurses, along with high acute care bed occupancy, may be significant drivers of nationwide COVID-19 mortality rates in EU countries. Additional parameters that were found to be associated with increased COVID-19 death rate included, as expected, a high proportion of population aged >65 years, along with a high national burden of overweight individuals and cancer diagnoses. This is not surprising because these parameters have been repeatedly shown to individually contribute to a poor prognosis in COVID-19.[4] Notably, no significant associations of COVID-19 mortality were found with total healthcare expenditure, public sector health expenditure or availability of hospital and acute care beds.

It is now unquestionable that COVID-19 has imposed a remarkable burden on healthcare resources around the world, with significant concerns over the capacity to manage the huge number of COVID-19 cases that are diagnosed each day. According to this analysis, it seems that is not the total amount of money spent by national governments but rather the way this money is spent on healthcare and hospital organisation that may have the most significant influence on COVID-19 management and outcomes. In fact, it seems that even a large availability of hospital or acute care beds may be ineffective in reducing COVID-19 mortality if this is not combined with increased availability of physicians and nurses and improved hospital accessibility.

Author statements

Ethical approval

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Competing interests

None declared.

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