

# Analyzing the economic burden of COVID-19 patient hospitalization and testing: a comparison between the Netherlands and Germany

Stephanie Buchegger<sup>1, 2\*</sup>

<sup>1</sup> Carinthia University of Applied Sciences, Austria

<sup>2</sup> JAMK University of Applied Sciences, Finland

## KEY WORDS

COVID-19  
 Cost analysis  
 Financial analysis  
 Europe  
 Patient hospitalization  
 COVID-19 tests

## ABSTRACT

This study is a retrospective comparative analysis of the financial burden on the health care systems of two European countries resulting from the COVID-19 pandemic. The first objective was to determine the financial burden of COVID-19 patient hospitalizations in the Netherlands and Germany, which was carried out over a period of 30 days around the pandemic peak and calculated per 100,000 inhabitants. The second objective was to evaluate the two countries' infection and diagnosis testing, via a one-day analysis, in terms of the optimum number of COVID-19 tests according to the World Health Organization (WHO) and also in terms of the economic impact on the health care system. All calculations were based on the statistical data of the Institute for Health Metrics and Evaluation (IHME) platform of the University of Washington. Results show that the financial burden of the COVID-19 patient hospitalizations was more than five times higher in the Netherlands than in Germany, due to a more severe pandemic and the higher costs of health care and medical care services in the Netherlands. Considering the financial impact of the extra COVID-19 tests on the 19<sup>th</sup> May 2020, Germany initiated more than thirty times as many diagnostic tests than the Netherlands and thus had an immense increase in health care expenditures, amounting to 1.8 Million Euros on that day. Study results draw attention to the high financial burden of the COVID-19 pandemic and show big differences between the health care economics of the Netherlands and Germany.

© 2020 JAMK Journal of Health and Social Studies by JAMK University of Applied Sciences.

## 1 Introduction

Europe is undergoing a severe economic challenge due to the novel coronavirus disease 2019 (COVID-19), which was completely unexpected and which is also a challenge to the European unity (Mauro, 2020). The effects of the COVID-19 pandemic vary in different countries. In some countries, decisions made by federal and local politicians, such as travel bans or social distancing, have helped to contain the spread of the disease (Felter, 2020). From a public health perspective, the health care system faces a major problem. The COVID-19 pandemic increased the number of patient hospitalizations significantly and with them, the costs of the health care system (Garfin, Silver, & Holman, 2020). When it comes to responding effectively to the COVID-19 pandemic, diagnostic tests represent important decision-

makers (Sharfstein, Becker, & Mello, 2020). Moreover, COVID-19 testing has probably become one of the most important tools in the pandemic. It enabled companies, universities and schools to reopen after the lockdown in different countries (Linda J. Blumberg, 2020). Focusing on public health surveillance, extensive testing is needed (Sharfstein et al., 2020). Apart from the differences in federal strategies for determining who should be tested and at what frequency, there are no guidelines for how this procedure should be financed (Linda J. Blumberg, 2020). A general benchmark for adequate COVID-19 testing of 10-30 tests per confirmed case, was announced by the World Health Organization (WHO) at the virtual press conference on the 30<sup>th</sup> March 2020 (Max Roser, 2020).

\* Corresponding author e-mail address: [stephanie.buchegger@gmx.at](mailto:stephanie.buchegger@gmx.at)

JAMK Journal of Health and Social Studies

Provided by JAMK University of Applied Sciences

URN: <http://urn.fi/urn:nbn:fi:jamk-issn-2490-029X-28>

Citation: Buchegger, S. (2020) Analyzing the economic burden of COVID-19 patient hospitalization and testing: A comparison between the Netherlands and Germany, JAMK Journal of Health and Social Studies, e67-e78.



## 2 Methodology

### 2.1 Analysis of the financial burden of COVID-19 patient hospitalizations in the Netherlands and Germany over a period of 30 days around the pandemic peak

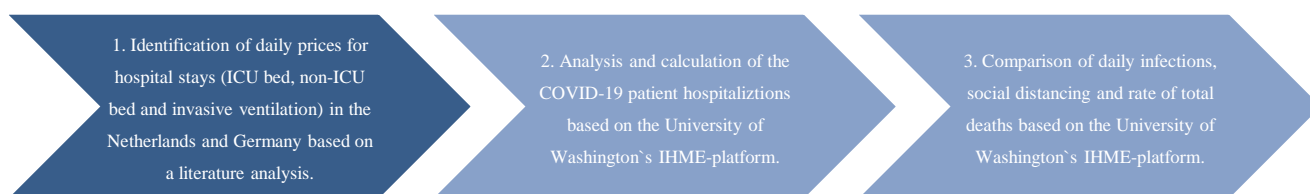
The daily prices for hospital stays in different categories (Intensive Care Unit (ICU) bed, non-ICU bed and invasive ventilation) in German and Dutch hospitals were identified in the first part of this study. Regarding the classification of hospital stays, ventilation represents an important aspect of ICU-costs which must be taken into consideration when analyzing the economic impact (Kaier, Heister, Wolff, & Wolkewitz, 2020). In order to present an up-to-date calculation in this analysis, only prices from publications in 2019 and 2020 were used. To ensure realistic cost categories, the prices in actual publications were compared to those in 2008. It should be noted that the cost categories of different hospital stays vary considerably, both nationally and internationally. This is explained by the different methods used in price calculations, as well as the availability and quality of data, which indicates a limitation of this study (Tan et al., 2012). The analysis and comparison of the health care resources and subsequently, the calculation of the financial burden resulting from COVID-19 patient hospitalizations, were conducted on the basis of the Institute for Health Metrics and Evaluation (IHME) platform of the University of Washington (Washington, 2020).

After the financial analysis, a comparison was made of the two countries in terms of daily COVID-19 infections. In order to obtain extra information, in addition to the economic results, the intensity of social distancing and the

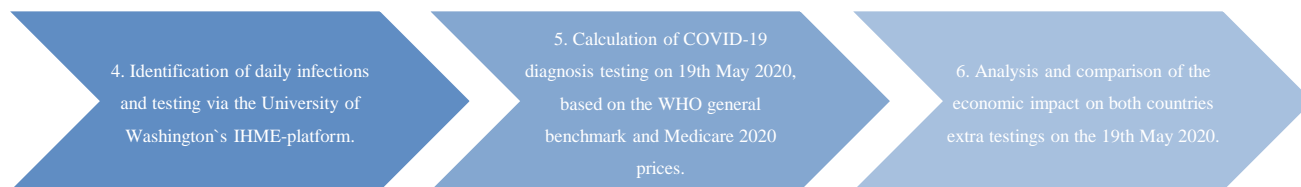
rate of total deaths per 100,000 inhabitants in both countries were investigated using the University of Washington's IHME-platform.

### 2.2 Analysis of the economic burden of COVID-19 diagnosis testing in the Netherlands and Germany by a one-day analysis

In the second part of this study, basic data about the infection rate and COVID-19 testing on the 19<sup>th</sup> May 2020 in the Netherlands and Germany, were again taken from the University of Washington's IHME-platform (Washington, 2020). The World Health Organization's (WHO) general benchmark for adequate COVID-19 testing, of 10–30 tests per confirmed case, was applied for this study (Max Roser, 2020). The price of the COVID-19 Center for Disease Control and Prevention Test (CDC test) is based on the Medicare 2020 price and amounts to \$51.31 (€46.43) for all commercial tests (MAC, May 19, 2020). In addition, it is noted that prices often do not include the cost of the provider's visit, facility fees or other services (Tami Luhby, 2020). Apart from the Medicare 2020 program, there is no federal price regulation of COVID-19 diagnostic tests. Furthermore, hospitals and laboratories can set their own rates, which is similar to other health care services. Hence, prices for COVID-19 diagnostic tests vary greatly in many cases and are often significantly higher than those permitted by Medicare 2020 (Nisha Kurani, July 15, 2020). An economic news report in Germany stated that a COVID-19 test might cost between €200 and €300, depending on estimates by industry experts and physicians (Anja Ettl, 31.01.2020).



**Figure 1** Methodology, retrospective comparative analysis of the financial burden of COVID-19 patient hospitalizations in the Netherlands and Germany.



**Figure 2** Methodology, retrospective comparative analysis of the economic impact of COVID-19 diagnostic testing in the Netherlands and Germany.

### 3 Results

In order to ensure realistic price calculations for COVID-19 hospitalizations, the prices were derived from scientific publications in 2019 and 2020 and compared to those for hospitalizations in 2008. The actual cost categories were in line with the available literature and thus applicable (Table 1). The economic calculations of the financial burden were

initiated on the basis of the daily prices for hospitalizations. The initial focus was on a total cost analysis of the COVID-19 hospital resource use during a period of 30 days around the pandemic peak and which was also calculated per 100,000 inhabitants (Table 2, 3). In the Netherlands, the COVID-19 pandemic was at its peak on the 7<sup>th</sup> April 2020. In Germany the COVID-19 pandemic peak was reached on the 13<sup>th</sup> April 2020 (Washington, 2020).

**Table 1** Daily prices of hospitalization for different categories (ICU bed, non-ICU bed, invasive ventilation) in the Netherlands and Germany.

| Hospital stay/day   | Netherlands  | Germany   |  |  |  |  |   |                                |         |        |         |         |
|---|--|---|--|--|--|--|---|--------------------------------|---------|--------|---------|---------|
| ICU bed (non-ventilated)                                      | €2,224.00 (Plate, Peelen, Leenen, & Hietbrink, 2019)   | €999.00 (Kaier, Heister, Wolff, & Wolkewitz, 2020)  |  |  |  |  |   |                                |         |        |         |         |
| non-ICU bed   | €463.00 (Plate et al., 2019)   | <p>€176.50</p> <table border="1"> <thead> <tr> <th>Price (\$)</th> <th>Price (€) for non-ICU bed (WHO, 2005)</th> <th>Exchange rate (\$), 28.07.2020, 13:00h</th> <th>Relative cost increase between 2003 and 2020 in Germany (Kaier, Heister, Wolff, &amp; Wolkewitz, 2020)</th> <th>Calculated price (€) for non-ICU bed 2020 with respect to a relative cost increase of +39.00%</th> </tr> </thead> <tbody> <tr> <td>\$150.00</td> <td>€127.50</td> <td>1.1729</td> <td>+39.00%</td> <td>€176.50</td> </tr> </tbody> </table> | Price (\$)   | Price (€) for non-ICU bed (WHO, 2005)  | Exchange rate (\$), 28.07.2020, 13:00h | Relative cost increase between 2003 and 2020 in Germany (Kaier, Heister, Wolff, & Wolkewitz, 2020) | Calculated price (€) for non-ICU bed 2020 with respect to a relative cost increase of +39.00% | \$150.00                       | €127.50 | 1.1729 | +39.00% | €176.50 |
| Price (\$)  | Price (€) for non-ICU bed (WHO, 2005)  | Exchange rate (\$), 28.07.2020, 13:00h  | Relative cost increase between 2003 and 2020 in Germany (Kaier, Heister, Wolff, & Wolkewitz, 2020) | Calculated price (€) for non-ICU bed 2020 with respect to a relative cost increase of +39.00%              |  |  |   |                                |         |        |         |         |
| \$150.00  | €127.50  | 1.1729  | +39.00%  | €176.50  |  |  |   |                                |         |        |         |         |
| invasive ventilation  | <p>€2,406.88</p> <table border="1"> <thead> <tr> <th>Price (€) for invasive ventilation in 2008 (Tan et al., 2008)</th> <th>Relative cost increase in ICU beds between 2008 (Tan et al., 2008) and 2019 (Plate et al., 2019)</th> <th>Calculated price (€) for intensive ventilation in 2019 with respect to a relative cost increase of +14.07%</th> </tr> </thead> <tbody> <tr> <td>€2,110.00</td> <td>+14.07%</td> <td>€2,406.88</td> </tr> </tbody> </table> | Price (€) for invasive ventilation in 2008 (Tan et al., 2008)   | Relative cost increase in ICU beds between 2008 (Tan et al., 2008) and 2019 (Plate et al., 2019)   | Calculated price (€) for intensive ventilation in 2019 with respect to a relative cost increase of +14.07% | €2,110.00                              | +14.07%  | €2,406.88   | €1,590.00 (Kaier et al., 2020) |         |        |         |         |
| Price (€) for invasive ventilation in 2008 (Tan et al., 2008) | Relative cost increase in ICU beds between 2008 (Tan et al., 2008) and 2019 (Plate et al., 2019)   | Calculated price (€) for intensive ventilation in 2019 with respect to a relative cost increase of +14.07%  |  |  |  |  |   |                                |         |        |         |         |
| €2,110.00   | +14.07%  | €2,406.88   |  |  |  |  |   |                                |         |        |         |         |

**Table 2** Hospital resource use during a 30-day period around the pandemic peak in the Netherlands per 100k inhabitants based on the University of Washington’s IHME-platform (Washington, 2020).

| Netherlands:                |             |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
|-----------------------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
|                             | DAY 1       | DAY 2      | DAY 3      | DAY 4      | DAY 5      | DAY 6      | DAY 7      | DAY 8      | DAY 9      | DAY 10     | DAY 11     | DAY 12     | DAY 13     | DAY 14     | PEAK DAY   |
| per 100k                    | 24.03.2020  | 25.03.2020 | 26.03.2020 | 27.03.2020 | 28.03.2020 | 29.03.2020 | 30.03.2020 | 31.03.2020 | 01.04.2020 | 02.04.2020 | 03.04.2020 | 04.04.2020 | 05.04.2020 | 06.04.2020 | 07.04.2020 |
| all beds needed             | 3.62        | 4.03       | 4.44       | 4.86       | 5.26       | 5.64       | 5.98       | 6.29       | 6.57       | 6.8        | 6.98       | 7.12       | 7.21       | 7.26       | 7.27       |
| ICU beds needed             | 2.69        | 3          | 3.3        | 3.6        | 3.89       | 4.17       | 4.42       | 4.64       | 4.84       | 5          | 5.13       | 5.23       | 5.29       | 5.33       | 5.33       |
| Non- ICU beds needed        | 0.93        | 1.03       | 1.14       | 1.26       | 1.37       | 1.47       | 1.56       | 1.65       | 1.73       | 1.8        | 1.85       | 1.89       | 1.92       | 1.93       | 1.94       |
| Invasive ventilators needed | 2.69        | 3          | 3.3        | 3.6        | 3.89       | 4.17       | 4.42       | 4.64       | 4.84       | 5          | 5.13       | 5.23       | 5.29       | 5.33       | 5.33       |
|                             | DAY 16      | DAY 17     | DAY 18     | DAY 19     | DAY 20     | DAY 21     | DAY 22     | DAY 23     | DAY 24     | DAY 25     | DAY 26     | DAY 27     | DAY 28     | DAY 29     | DAY 30     |
| per 100k                    | 08.04.2020  | 09.04.2020 | 10.04.2020 | 11.04.2020 | 12.04.2020 | 13.04.2020 | 14.04.2020 | 15.04.2020 | 16.04.2020 | 17.04.2020 | 18.04.2020 | 19.04.2020 | 20.04.2020 | 21.04.2020 | 22.04.2020 |
| all beds needed             | 7.24        | 7.17       | 7.08       | 6.96       | 6.83       | 6.67       | 6.5        | 6.31       | 6.13       | 5.93       | 5.73       | 5.52       | 5.32       | 5.11       | 4.91       |
| ICU beds needed             | 5.3         | 5.26       | 5.18       | 5.09       | 4.99       | 4.87       | 4.74       | 4.6        | 4.46       | 4.32       | 4.17       | 4.02       | 3.87       | 3.72       | 3.58       |
| Non- ICU beds needed        | 1.94        | 1.91       | 1.9        | 1.87       | 1.84       | 1.8        | 1.76       | 1.71       | 1.67       | 1.61       | 1.56       | 1.5        | 1.45       | 1.39       | 1.33       |
| Invasive ventilators needed | 5.3         | 5.26       | 5.18       | 5.09       | 4.99       | 4.87       | 4.74       | 4.6        | 4.46       | 4.32       | 4.17       | 4.02       | 3.87       | 3.72       | 3.58       |
| per 100k                    | ALL 30 DAYS |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| all beds needed             | 182.74      |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| ICU beds needed             | 134.03      |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| Non- ICU beds needed        | 49.5        |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| Invasive ventilators needed | 134.03      |            |            |            |            |            |            |            |            |            |            |            |            |            |            |

**Table 3** Hospital resource use during a 30-day period around the pandemic peak in Germany per 100k inhabitants based on the University of Washington’s IHME-platform (Washington, 2020).

| Germany:                    |             |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
|-----------------------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
|                             | DAY 1       | DAY 2      | DAY 3      | DAY 4      | DAY 5      | DAY 6      | DAY 7      | DAY 8      | DAY 9      | DAY 10     | DAY 11     | DAY 12     | DAY 13     | DAY 14     | PEAK DAY   |
| per 100k                    | 30.03.2020  | 31.03.2020 | 01.04.2020 | 02.04.2020 | 03.04.2020 | 04.04.2020 | 05.04.2020 | 06.04.2020 | 07.04.2020 | 08.04.2020 | 09.04.2020 | 10.04.2020 | 11.04.2020 | 12.04.2020 | 13.04.2020 |
| all beds needed             | 1.58        | 6.11       | 1.94       | 2.13       | 2.31       | 2.47       | 2.62       | 2.77       | 2.89       | 3          | 3.09       | 3.17       | 3.22       | 3.26       | 3.27       |
| ICU beds needed             | 0.81        | 1.76       | 1          | 1.1        | 1.18       | 1.27       | 1.34       | 1.41       | 1.48       | 1.53       | 1.57       | 1.61       | 1.64       | 1.65       | 1.66       |
| Non- ICU beds needed        | 0.77        | 4.35       | 0.94       | 1.03       | 1.13       | 1.2        | 1.28       | 1.36       | 1.41       | 1.47       | 1.52       | 1.56       | 1.58       | 1.61       | 1.61       |
| Invasive ventilators needed | 0.8         | 0.89       | 0.98       | 1.07       | 1.16       | 1.24       | 1.31       | 1.38       | 1.44       | 1.49       | 1.53       | 1.65       | 1.59       | 1.6        | 1.6        |
|                             | DAY 16      | DAY 17     | DAY 18     | DAY 19     | DAY 20     | DAY 21     | DAY 22     | DAY 23     | DAY 24     | DAY 25     | DAY 26     | DAY 27     | DAY 28     | DAY 29     | DAY 30     |
| per 100k                    | 14.04.2020  | 15.04.2020 | 16.04.2020 | 17.04.2020 | 18.04.2020 | 19.04.2020 | 20.04.2020 | 21.04.2020 | 22.04.2020 | 23.04.2020 | 24.04.2020 | 25.04.2020 | 26.04.2020 | 27.04.2020 | 28.04.2020 |
| all beds needed             | 3.274       | 3.25       | 3.21       | 3.16       | 3.09       | 3.02       | 2.94       | 2.84       | 2.75       | 2.65       | 2.55       | 2.45       | 2.34       | 2.24       | 2.14       |
| ICU beds needed             | 1.65        | 1.64       | 1.62       | 1.59       | 1.56       | 1.52       | 1.48       | 1.43       | 1.38       | 1.33       | 1.28       | 1.23       | 1.17       | 1.12       | 1.07       |
| Non- ICU beds needed        | 1.624       | 1.61       | 1.59       | 1.57       | 1.53       | 1.5        | 1.46       | 1.41       | 1.37       | 1.32       | 1.27       | 1.22       | 1.17       | 1.12       | 1.07       |
| Invasive ventilators needed | 1.6         | 1.59       | 1.56       | 1.53       | 1.5        | 1.46       | 1.42       | 1.37       | 1.32       | 1.27       | 1.22       | 1.17       | 1.12       | 1.07       | 1.02       |
| per 100k                    | ALL 30 DAYS |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| all beds needed             | 85.73       |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| ICU beds needed             | 42.08       |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| Non- ICU beds needed        | 43.65       |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| Invasive ventilators needed | 38.88       |            |            |            |            |            |            |            |            |            |            |            |            |            |            |

**Table 4** Overview, hospital resource use in the Netherlands and Germany.

|   |
|---|
| <b>Total non-ICU hospital beds needed via 30 days around the pandemic peak per 100,000 inhabitants:</b> |
| Netherlands: 49.5      Germany: 43.65   |
| <b>ICU beds needed via 30 days around the pandemic peak per 100,000 inhabitants:</b>                    |
| Netherlands: 134.3      Germany: 42.08  |
| <b>Invasive ventilators needed via 30 days around the pandemic peak per 100,000 inhabitants:</b>        |
| Netherlands: 134.3      Germany: 38.88  |

In general, the hospital resources used for COVID-19 patient hospitalizations, around 30 days of the pandemic peak per 100k inhabitants, were higher in the Netherlands than in Germany which confirms that the COVID-19 pandemic was more severe in the Netherlands. In more detail, the number of ICU-beds needed and invasive ventilations per 100k inhabitants was more than three times higher in the Netherlands than in Germany, whereas the number of non-ICU beds needed per 100k inhabitants was similar (Table 4).

Furthermore, the total costs of COVID-19 patient hospitalizations per 100k inhabitants in the Netherlands and Germany, were analyzed and compared for the 30 days around their pandemic peaks. In consequence, the total costs of COVID-19 patient hospitalizations from the 24<sup>th</sup> March 2020 to the 22<sup>nd</sup> April 2020 per 100k inhabitants in the

Netherlands were €644,845.68 (Table 5). The total costs of COVID-19 patient hospitalizations from the 30<sup>th</sup> March to the 28<sup>th</sup> April 2020 per 100k inhabitants in Germany were €111,561.35 (Table 6).

Subsequently, the financial burden of COVID-19 patient hospitalizations was more than five times higher in the Netherlands than in Germany, due to the more severe pandemic and the higher costs of health care and medical care services in the Netherlands.

In addition, the daily prices for ICU-bed use are more than twice as high in the Netherlands than in Germany (Table 1). The number of confirmed COVID-19 infections in the Netherlands was higher than in Germany, which is also a significant confirmation that the COVID-19 pandemic was more severe in the Netherlands (Figure 3).

**Table 5** Total costs of COVID-19 patient hospitalizations around 30 days of the pandemic peak (from the 24<sup>th</sup> March 2020 to the 22<sup>nd</sup> April 2020) per 100k inhabitants in the Netherlands.

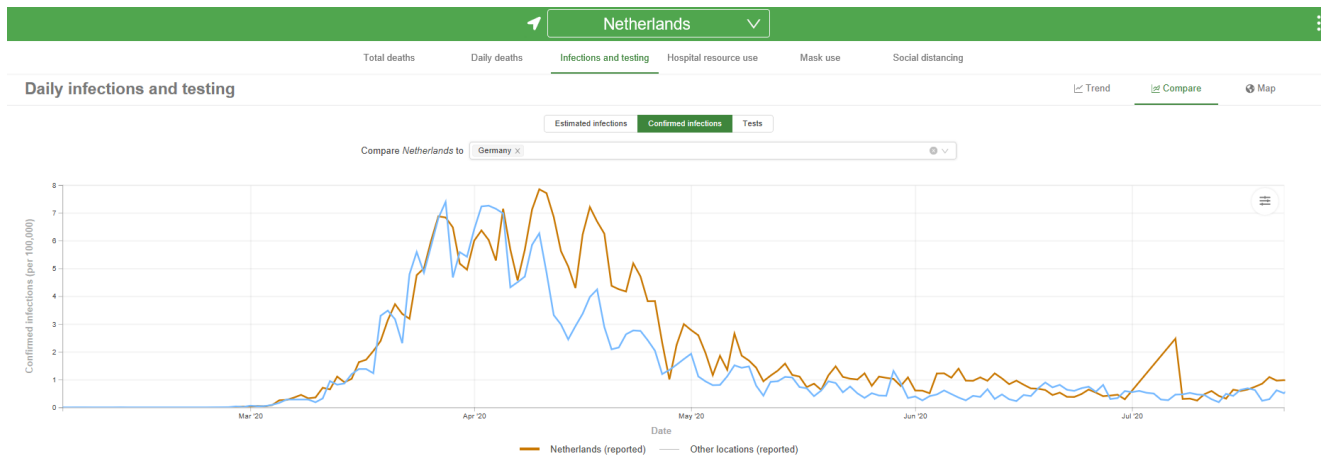
| Hospital resources use in 30 days around the pandemic peak | Total use | Price per day | Total costs of the <b>Netherlands</b> in 30 days around the pandemic peak per 100k inhabitants |
|--|-----------|---------------|--|
| Non-ICU hospital beds per 100k                             | 49.5      | 463.00 EUR    | 49.5 x 463.00 = 22,918.50 EUR  |
| ICU beds per 100k  | 134.3     | 2,224.00 EUR  | 134.3 x 2,224.00 = 298,683.20 EUR  |
| Invasive ventilators per 100k                              | 134.3     | 2,406.88 EUR  | 134.3 x 2,406.88 = 323,243.98 EUR  |

Total costs of COVID-19 patient hospitalizations per 100,000 inhabitants in the Netherlands were  
 22,918.50 EUR + 298,683.20 EUR + 323,243.98 EUR = **644,845.68 EUR**

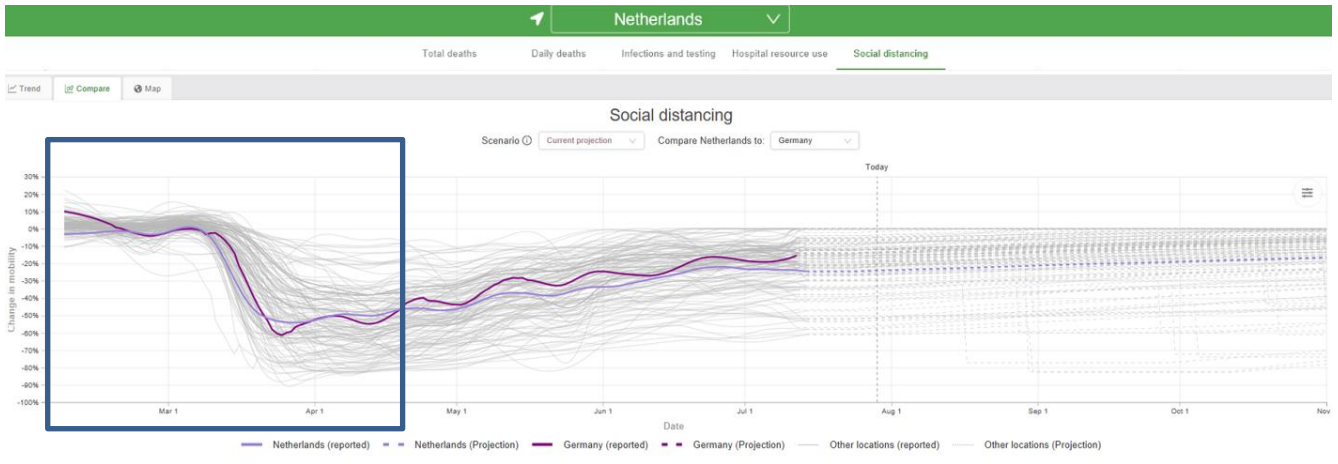
**Table 6** Total costs of COVID-19 patient hospitalizations around 30 days of the pandemic peak (from the 30<sup>th</sup> March to the 28<sup>th</sup> April 2020) per 100k inhabitants in Germany.

| Hospital resources use in 30 days around the pandemic peak | Total use | Price per day | Total costs in <b>Germany</b> in 30 days around the pandemic peak per 100k inhabitants |
|--|-----------|---------------|--|
| Non-ICU hospital beds per 100k                             | 43.65     | 176.50 EUR    | 43.65 x 176.50 = 7,704.23 EUR  |
| ICU beds per 100k  | 42.08     | 999.00 EUR    | 42.08 x 999.00 = 42,037.92 EUR   |
| Invasive ventilators per 100k                              | 38.88     | 1,590.00 EUR  | 38.88 x 1,590.00 = 61,819.20 EUR   |

Total costs of COVID-19 patient hospitalizations per 100,000 inhabitants in Germany were  
 7,704.23 EUR + 42,037.92 EUR + 61,819.20 EUR = **111,561.35 EUR**



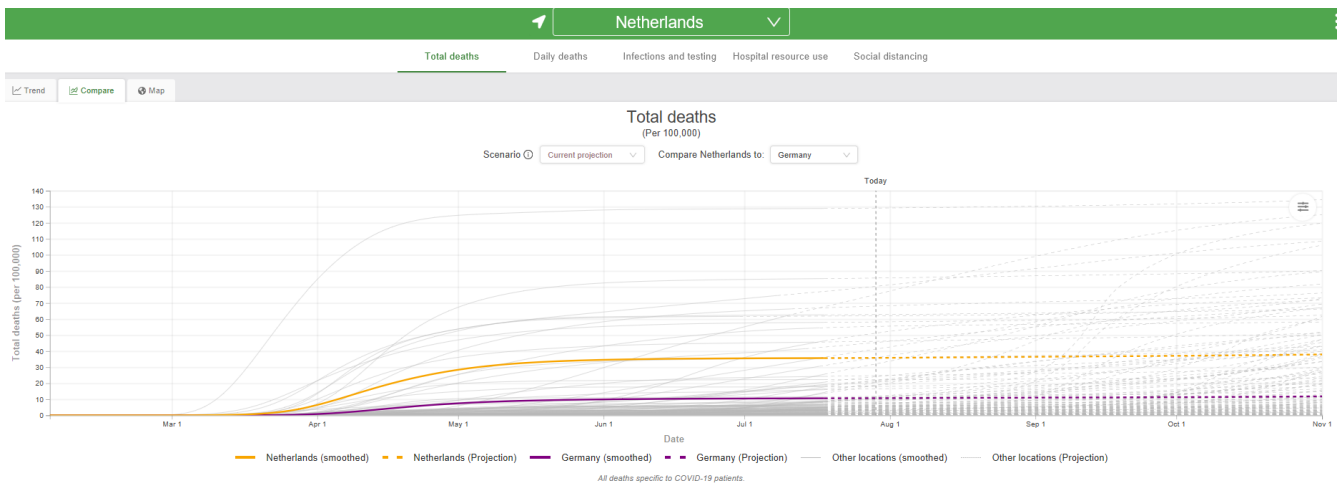
**Figure 3** Confirmed infections, Netherlands compared to Germany (Washington, 2020).



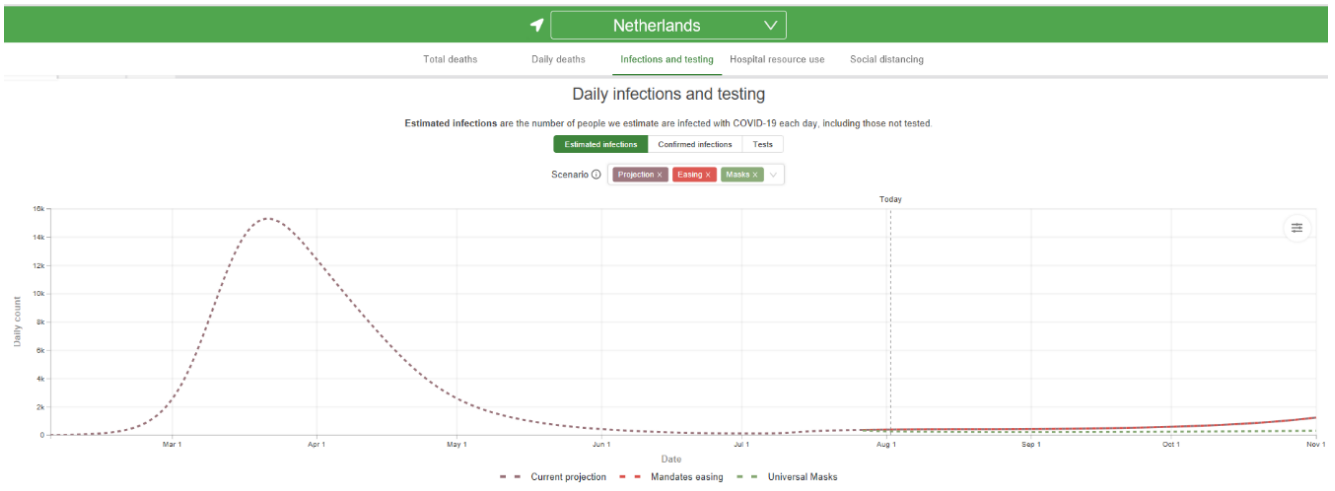
**Figure 4** Social distancing during the COVID-19 pandemic, Netherlands compared to Germany (Washington, 2020).

Moreover, the differences in the severity of the COVID-19 pandemic in the two countries can also be explained by the differences in social distancing at the beginning of April, before the pandemic reached its peak. The social distancing in Germany was more intensive than in the Netherlands, despite the relatively uniform approach (Figure 4).

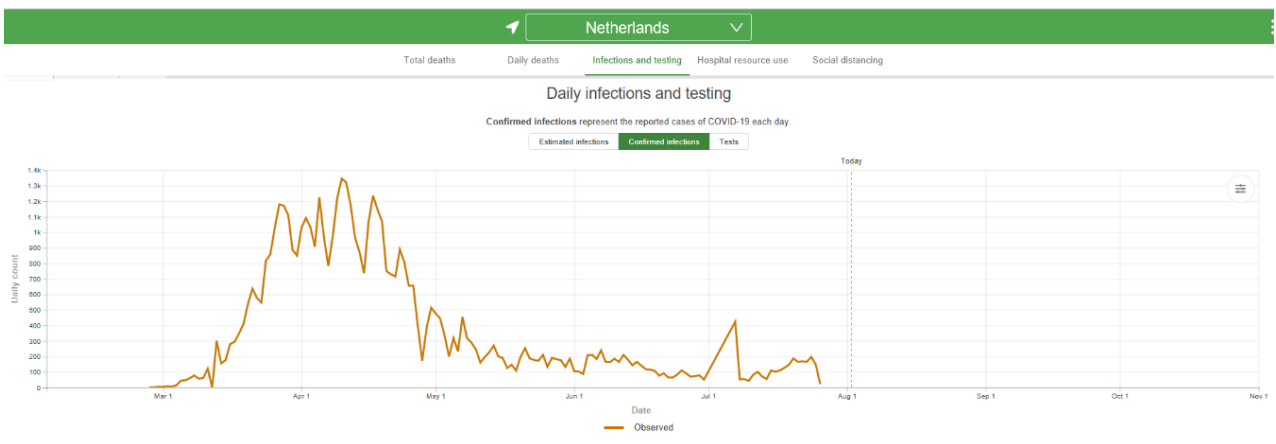
Furthermore, the higher severity of the COVID-19 pandemic in the Netherlands was reflected in the rate of total deaths (Figure 5). Nevertheless, in both countries, the number of COVID-19 diagnostic tests in the March and April period was lower than what would have been required, based on the estimated number of infections (Figures 6-11).



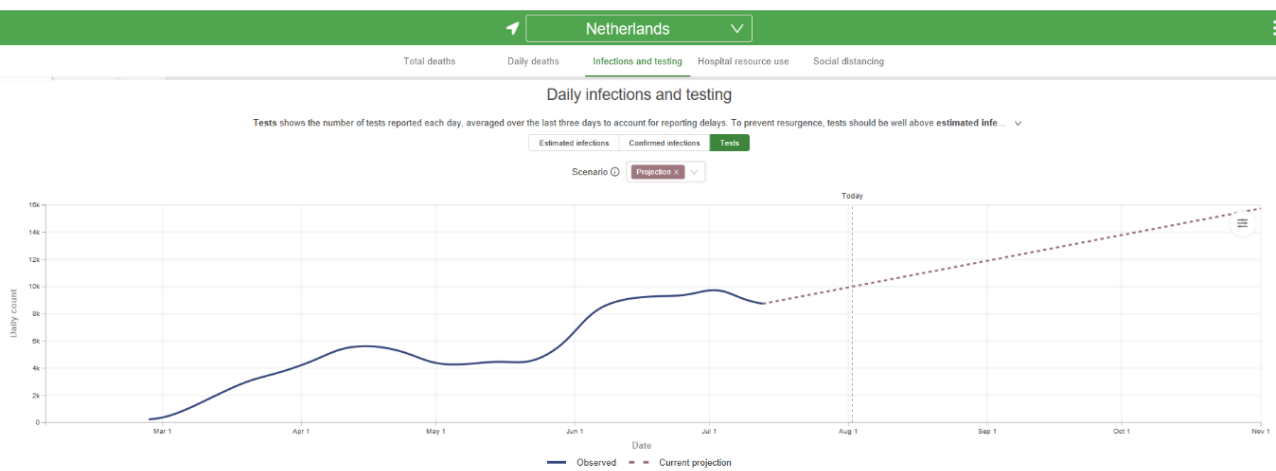
**Figure 5** Total deaths during the COVID-19 pandemic, Netherlands compared to Germany (Washington, 2020).



**Figure 6** Estimated infections, Netherlands (Washington, 2020).



**Figure 7** Confirmed infections, Netherlands (Washington, 2020).



**Figure 8** Tests, Netherlands (Washington, 2020).

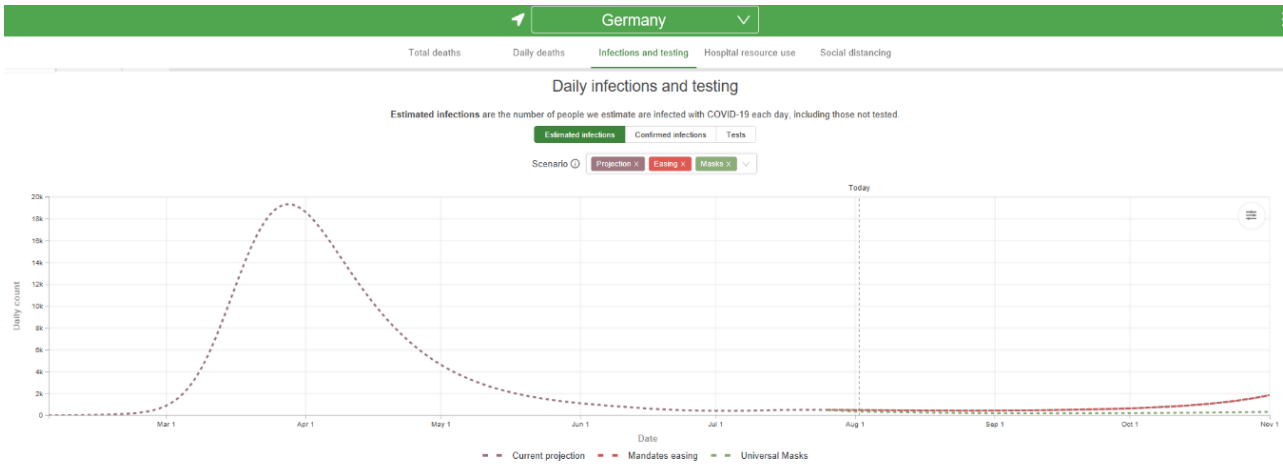


Figure 9 Estimated infections, Germany (Washington, 2020).

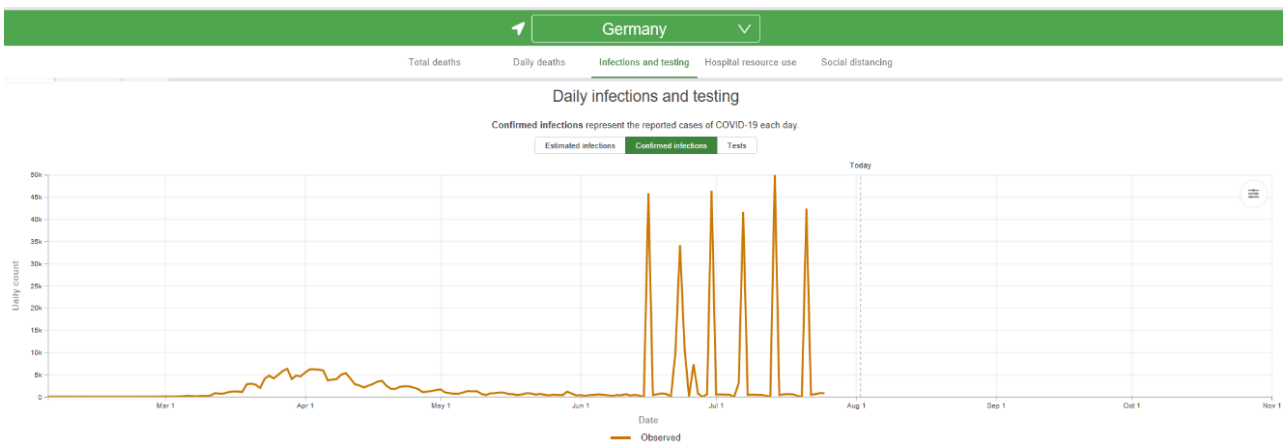


Figure 10 Confirmed infections, Germany (Washington, 2020).

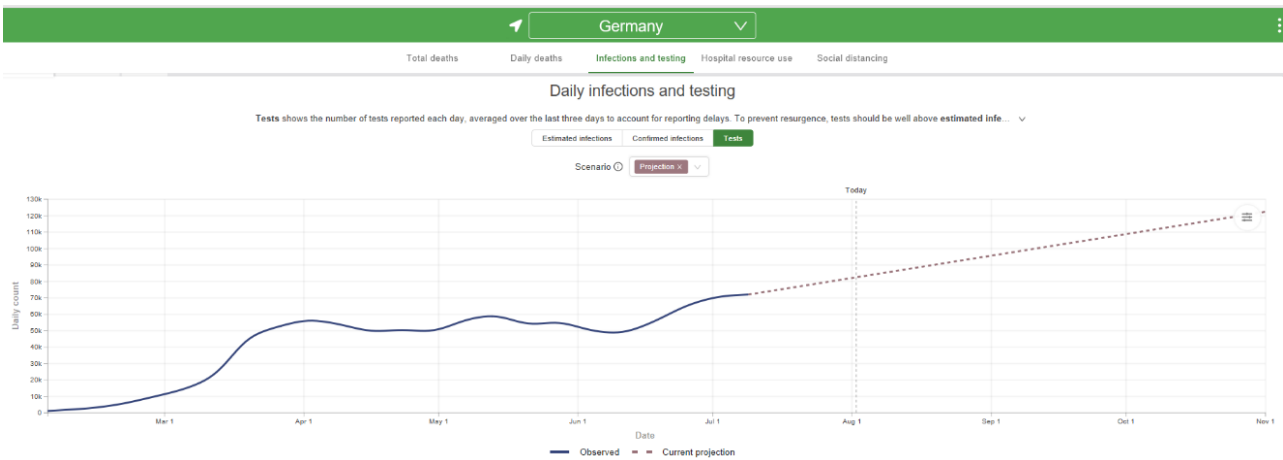


Figure 11 Tests, Germany (Washington, 2020).



According to the IHME-platform’s statistical observations, the number of initiated COVID-19 diagnostic tests has increased significantly since mid-March in both countries. 4,412.67 COVID-19 tests were performed on the 19<sup>th</sup> May 2020, in the Netherlands. Furthermore, there were 108 confirmed COVID-19 infections on that day. This raises the question of how to arrange an optimum number of tests in different countries. According to the WHO calculation schemes, the optimum number of COVID-19 tests in the Netherlands on the 19<sup>th</sup> May 2020 was between 1,080 tests (108 x 10) and 3,240 tests (108 x 30) (Washington, 2020) (Table 7). Consequently, the number of tests performed on the 19<sup>th</sup> May 2020 was higher than the optimum range of tests required. On that day, 1,172.67 extra tests (4,412.67 - 3,240) were performed. Moreover, according to the predicted statistical data on the IHME-platform, numbers will increase in the future which might involve an extra financial burden on the Netherlands’ health care system (Figure 8).

In Germany, there were 55,222.32 COVID-19 tests on the 19<sup>th</sup> May 2020. Furthermore, 513 COVID-19 infections were confirmed on that day. According to the WHO calculation schemes, the optimum number of COVID-19 tests in Germany would have been between 5,130 (513 x 10) and 15,390 (513 x 30) (Washington, 2020) (Table 8). Consequently, the number of tests on the 19<sup>th</sup> May 2020 was dramatically higher than the optimum range for required tests. 39,832.32 extra tests (55,222.32 – 15,390) were performed on that day, 2.5 times more than the optimum number of tests required by the WHO recommendations. Moreover, the future trend for COVID-19 tests is rising in

Germany, which might involve an extra financial burden on the health care system (Figure 11).

To continue this analysis, the economic impact of the extra COVID-19 tests on 19<sup>th</sup> May 2020 was analyzed. According to *Medicare 2020 COVID-19 Test Pricing*, the price of all commercial COVID-19 CDC-tests was \$54.31. (MAC, May 19, 2020) Converted into Euro at the 28<sup>th</sup> June 2020 exchange rate, the price for one test was €46.43 (Table 9).

There were 1,172.67 extra COVID-19 tests in the Netherlands on the 19<sup>th</sup> May 2020. By ignoring the costs of taking samples in hospitals and laboratories, the day’s costs for the extra tests were €54,447.07 (1,172.67 x €46.43). From the statistical prediction, the number of tests will increase in the future (Figure 8). The financial burden on the health care system from the COVID-19 pandemic, might be reduced in the Netherlands by optimizing the number of tests in accordance with the WHO recommendations.

There were 39,832.32 extra COVID-19 tests in Germany on the 19<sup>th</sup> May 2020. By ignoring the costs of taking samples in hospital and laboratories, the costs for these extra tests were €1,849,414.62 (39,832.32 x €46.43). In conclusion, the extra cost for out rated COVID-19 tests on one day in Germany, was almost 2 Million Euros. According to the statistical prediction, the number of tests will increase in the future (Figure 11). By optimizing the number of tests in accordance with the WHO recommendations, the financial burden of the COVID-19 pandemic on the health care system, might also be reduced in Germany.

Considering the extra tests on the 19<sup>th</sup> May 2020, Germany initiated over 30 times as many COVID-19 diagnostic tests than the Netherlands.

**Table 7** Daily COVID-19 infections and tests in the Netherlands based on the University of Washington’s IHME-platform (Washington, 2020).

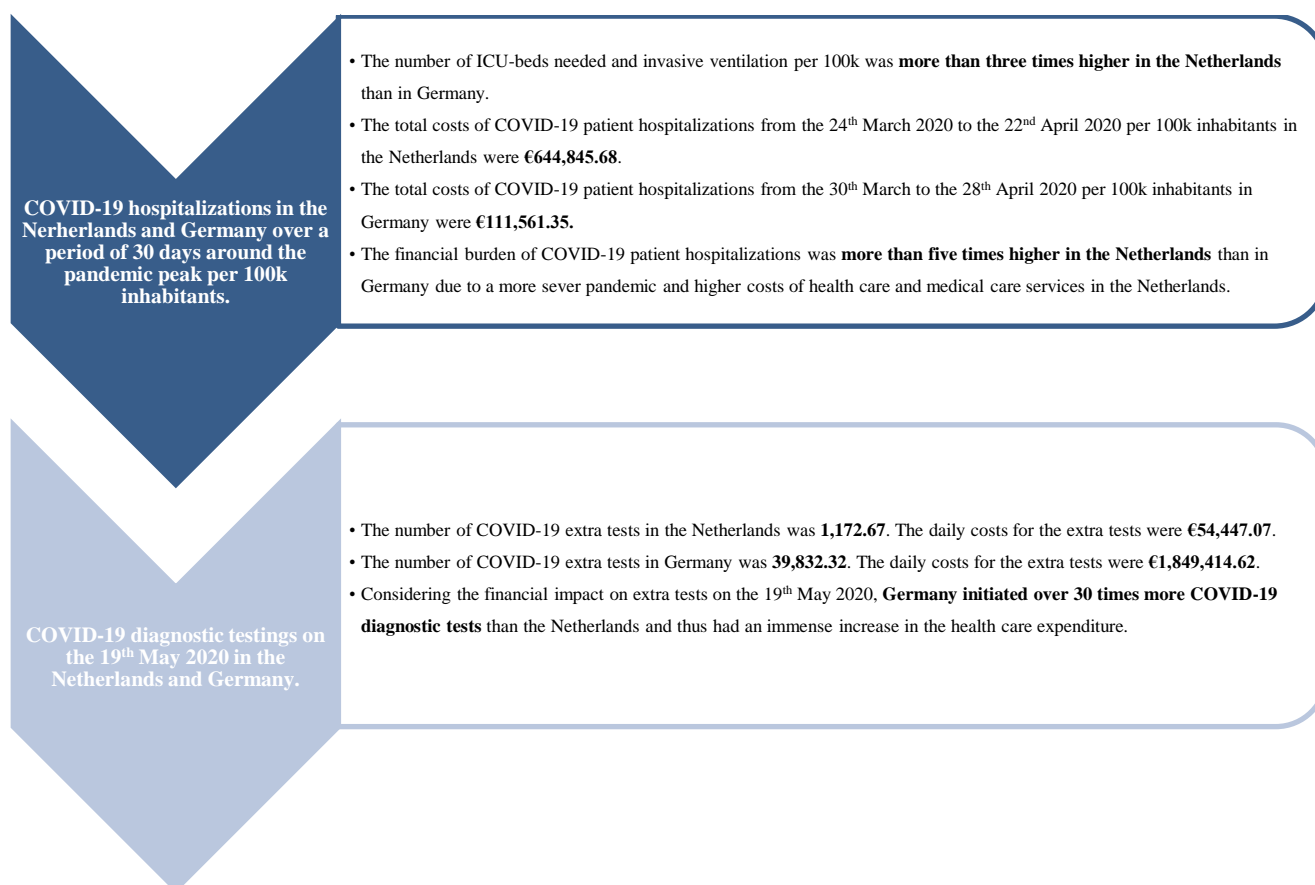
|                       |                                      |       |       |
|-----------------------|--------------------------------------|-------|-------|
| Day:                  | 19.05.2020                           |       |       |
| Country:              | Netherlands                          |       |       |
| Tests:                | 4,412.67                             |       |       |
| Estimated infections: | 865.44                               |       |       |
| Confirmed infections: | 108                                  |       |       |
|                       |                                      |       |       |
| Optimum test range:   | based on confirmed infections (WHO): |       |       |
|                       |                                      | from  | to    |
|                       |                                      | 1,080 | 3,240 |

**Table 8** Daily COVID-19 infections and testing in Germany based on the University of Washington’s IHME-platform (Washington, 2020).

|                       |                                      |       |        |
|-----------------------|--------------------------------------|-------|--------|
| Day:                  | 19.05.2020                           |       |        |
| Country:              | Germany                              |       |        |
| Tests:                | 55,222.32                            |       |        |
| Estimated infections: | 1,874.66                             |       |        |
| Confirmed infections: | 513                                  |       |        |
| Optimum test range:   | based on confirmed infections (WHO): |       |        |
|                       |                                      | from  | to     |
|                       |                                      | 5,130 | 15,390 |

**Table 9** Price of a COVID-19 CDC-test, Medicare 2020.

| Price (\$) of a COVID-19 CDC test | Exchange rate (\$), 28.07.2020 | Price (€) of a COVID-19 CDC test |
|-----------------------------------|--------------------------------|----------------------------------|
| \$54.31                           | 1.1729                         | €46.43                           |



**Figure 12** Result box, overview of the retrospective comparative analysis.

## 4 Conclusion

Using standardized cost accounting methods for average hospital unit costs is problematic, especially in cases of limited data availability and quality. Clinical cost accounting systems already differ between service providers. By implementing standardized cost accounting methods, it would be feasible to avoid possible distortions in the comparability of different service providers' services. Furthermore, cross-national comparisons are rarely carried out in the area of ICU occupancy. Cost comparisons are necessary and can provide important insights into different European countries' relative costs (Tan et al., 2012). Furthermore, economic evaluation could play an important role for decision makers in the health care system. Hence, valuable information could be provided on the relative efficiency of alternative health services.

Testing for COVID-19 remains a key strategy for identifying active cases and monitoring the outbreak of the disease (Nisha Kurani, July 15, 2020). Testing strategies provide important data about the virus and allow a better understanding of the disease to be reached (Max Roser, 2020). However, from an economic perspective, the costs of diagnostic COVID-19 testing cannot be ignored (McAleer, 2020). This issue is emphasized because as the pandemic increases, the amount of testing will also increase (Nisha Kurani, July 15, 2020). Not least, because several tests from different laboratories have become more available. Consequently, the fact that COVID-19 testing is more beneficial in some scenarios than in others, must be taken into consideration. Thus, two concepts have to be balanced; on the one hand, it is essential to resolve gaps in testing, while on the other hand, it needs to be considered, that more testing is not always preferable (Sharfstein et al., 2020).

This study provides insights into the financial burden which can be caused by one day of inappropriate testing and also draws attention to the differences in health care financing within Europe. Nevertheless, further economic analyses are necessary in order to estimate the financial impact on the health care system in a more defined scope.

Above all, economic findings should serve as a guideline for decisions about policy and practice. Public health authorities and the medical community should recognize the need and adapt policies to changed circumstances. It might be necessary to support robust and compassionate messages which allow not only the benefits and opportunities but also the limitations, to be recognized (Sharfstein et al., 2020). Ultimately, from an economic point of view, more consideration should be given to economic policies, to ensure a more efficient crisis management.

## Acknowledgement

I would like to give very special thanks to Dr. Arshia Amiri for his help and support in publishing this article. The idea for it came from a course in the JAMK University of Applied Sciences double degree program with Carinthia University of Applied Sciences, entitled "Financial Analysis of Health Crisis: Case Study of COVID-19 (course code: YS00BD17-3001)"; Dr. Amiri was the teacher in charge of the course.

## References

- Anja Ettel, C. T. (31.01.2020). Coronavirus: Krankenkassen übernehmen Kosten für Schnelltest. Retrieved from <https://www.welt.de/wirtschaft/article205486699/Coronavirus-Krankenkassen-uebernehmen-Kosten-fuer-Schnelltest.html>
- Felter, L. M. A. C. (2020). Comparing Six Health-Care Systems in a Pandemic. Retrieved from <https://www.cfr.org/backgrounder/comparing-six-health-care-systems-pandemic>
- Garfin, D. R., Silver, R. C., & Holman, E. A. (2020). The novel coronavirus (COVID-2019) outbreak: Amplification of public health consequences by media exposure. *Health Psychol*, 39(5), 355-357. doi:10.1037/hea0000875
- Kaier, K., Heister, T., Wolff, J., & Wolkewitz, M. (2020). Mechanical ventilation and the daily cost of ICU care. *BMC Health Serv Res*, 20(1), 267. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/32234048>. doi:10.1186/s12913-020-05133-5
- Linda J. Blumberg, S. C., Michael Simpson (2020). Imposing The Costs Of Workplace Coronavirus Testing On Group Plan Coverage Would Place An Excessive Burden On Essential Workers. Retrieved from <https://www.healthaffairs.org/doi/10.1377/hblog20200727.300119/full/>. doi:10.1377/hblog20200727.300119
- MAC (May 19, 2020). COVID-19 Test Pricing. Retrieved from <https://dhcf.dc.gov/sites/default/files/dc/sites/dhcf/publication/attachments/MAC%20COVID%20Lab%20Test%20Pricing%203-12-2020.pdf>
- Mauro, A. B.-Q. a. B. W. d. (2020). Europe in the Time of Covid-19: CEPR Press.

- Max Roser, H. R., Esteban Ortiz-Ospina and Joe Hasell. (2020). Coronavirus Pandemic (COVID-19). Retrieved from <https://ourworldindata.org/coronavirus-testing>
- McAlear, M. (2020). Is One Diagnostic Test for COVID-19 Enough? *Journal of Risk and Financial Management*, 13(4). doi:10.3390/jrfm13040077
- Nisha Kurani, K. P., Dustin Cotliar, Nicolas Shanosky, and Cynthia Cox. (July 15, 2020). COVID-19 Test Prices and Payment Policy Retrieved from <https://www.healthsystemtracker.org/brief/covid-19-test-prices-and-payment-policy/>
- PD Dr. J. Martin, C. N., M. Bauer, M. Weiß, A. Schleppers (01.05.2008). *Kosten der intensivmedizinischen Versorgung in einem deutschen Krankenhaus; Kostenträgerstückrechnung basierend auf der InEK-Matrix* Springer-Verlag, Der Anaesthesist, Zeitschrift für Anästhesie, Intensivmedizin, Notfall- und Katastrophenmedizin, Schmerztherapie Ausgabe 5/2008 Print ISSN: 0003-2417 Elektronische ISSN: 1432-055X. doi:10.1007/s00101-008-1353-7
- Plate, J. D. J., Peelen, L. M., Leenen, L. P. H., & Hietbrink, F. (2019). The intermediate care unit as a cost-reducing critical care facility in tertiary referral hospitals: a single-centre observational study. *BMJ Open*, 9(6), e026359. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/31167865>. doi:10.1136/bmjopen-2018-026359
- Sharfstein, J. M., Becker, S. J., & Mello, M. M. (2020). Diagnostic Testing for the Novel Coronavirus. *JAMA*. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/32150622>. doi:10.1001/jama.2020.3864
- Tami Luhby, C. (2020). CNN health - A coronavirus test could cost as little as \$20 or as much as \$850. Retrieved from <https://edition.cnn.com/2020/07/15/health/coronavirus-test-cost/index.html>
- Tan, S. S., Bakker, J., Hoogendoorn, M. E., Kapila, A., Martin, J., Pezzi, A., Hakkaart-van Roijen, L. (2012). Direct cost analysis of intensive care unit stay in four European countries: applying a standardized costing methodology. *Value Health*, 15(1), 81-86. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/22264975>. doi:10.1016/j.jval.2011.09.007
- Tan, S. S., Hakkaart-van Roijen, L., Al, M. J., Bouwmans, C. A., Hoogendoorn, M. E., Spronk, P. E., & Bakker, J. (2008). A microcosting study of intensive care unit stay in the Netherlands. *J Intensive Care Med*, 23(4), 250-257. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18508839>. doi:10.1177/0885066608318661
- Washington, U. (2020). The Institute for Health Metrics and Evaluation IHME. Retrieved from <http://www.healthdata.org/covid> [21.08.2020]
- WHO (2005). Estimates of Unit Costs for Patient Services for Germany. Retrieved from <https://www.who.int/choice/country/deu/cost/en/>