

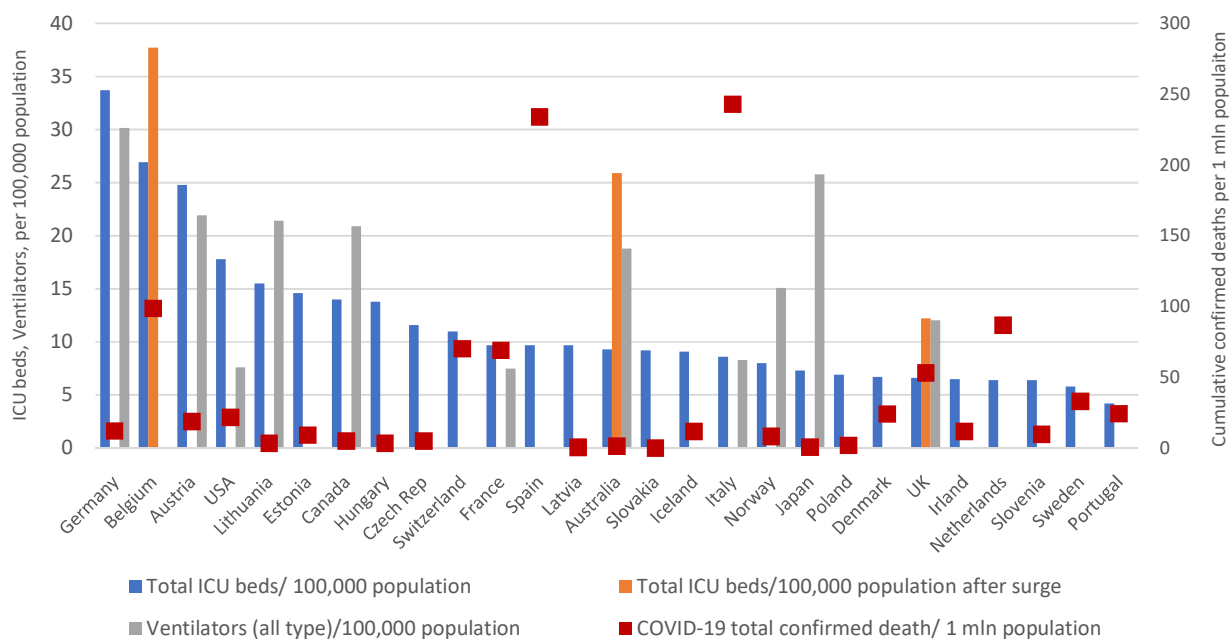
COVID-19 Hospitalization

Health system capacity and particularly ICU bed, ventilators and human resource capacity is critical for adequate response when it comes to the COVID-19 case management at the health facility level.

The ICU capacity in the selected countries is presented in the Figure 1. The countries as ordered by the total ICU bed rate (decreasing order) that is based on 2012 survey¹ for the European countries and other new sources for some countries². Ventilators capacity includes total ventilators (anesthesiologic, transport that could explain higher than ICU beds rate). For Belgium, Australia and UK ICU beds rate after surge is given. Germany (baseline figure) has almost three-fold per capita bed and ventilators capacity compared to UK even after surge. Italy, Spain with high death rates are in the same range of capacity.

The figures represent national data, therefore does not reflect geographical differences in the capacity (especially in the big courtyers) and inflates lethal outcomes (e.g. New York compared to the other states in US).³

Figure 1 Total ICU beds, ventilators per 100,000 population and total confirmed deaths per 1 mln population in selected countries



Human resource capacity is crucial, however it was not possible to obtain ICU workforce data for the interested countries. As a proxy indicator total physician and nurse rates per 1,000 population is presented below.⁴ Italy and Spain have the lower nursing capacity compared to some other western European countries (Norway, Switzerland, Germany), Australia and USA. USA had moderately high nursing rate. As per standard care (before surge) the ICU doctor to patient ratio was 1:10 and ICU

¹<https://link.springer.com/article/10.1007/s00134-012-2627-8>

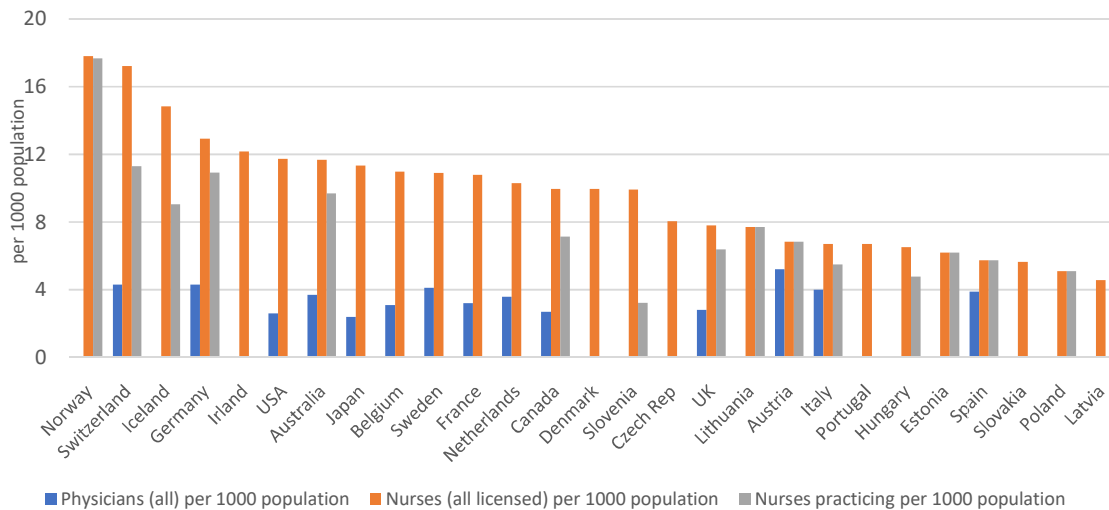
²The sources for each country in indicated in the supporting excel file

³<https://www.cdc.gov/nchs/nvss/vsrr/COVID19/index.htm>

⁴<https://data.oecd.org/health.htm>;

nurse to patient ratio was 1:1 and 1:2, that increases to 1:24 ICU doctor to patient ratio and to 1:4 ICU nurse to patient ratio after surge.⁵

Figure 2 Total physicians, licensed nurses and practicing nurses per 1,000 population



Country examples

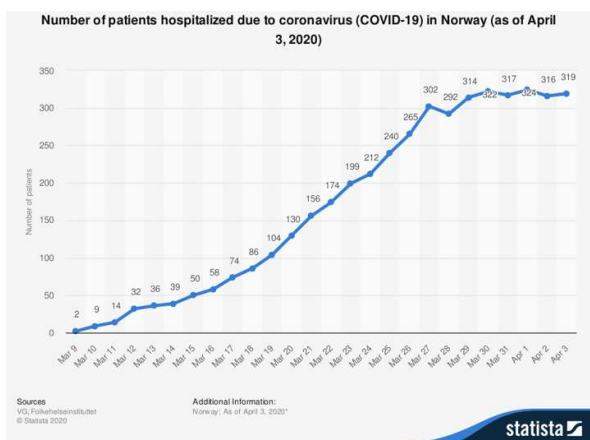
Below we present hospitalization data from two Nordic countries (Norway and Denmark) and Belgium and Netherlands. German data was not possible to obtain. The search could be expanded to Estonia, Lithuania, Ireland, Island and other countries with low death rates see *Figure 5*.

Norway

The number of people who were confirmed infected by COVID-19 in Norway had reached a total of 5,352 as of April 3, 2020. Testing rate is one of the highest in the Europe (19,528 per 1 mln population) leading to high incidence rate (100.75 per 100,000 population) see *Figure 4*.

The number of patients who were hospitalized due to COVID-19 in Norway increased rapidly until the end of March, when the increase started to slow down. There were a total of 319 patients hospitalized as of April 3, 2020.

As of April 4, a total of 163 patients have received intensive care in Norwegian hospitals so far, 106 of whom were still being cared for in intensive wards⁶ indicating that as of now 33% of hospitalized cases are treated at ICU. In Norway total ICU capacity is 8.0 per 100,000⁷ (around 425 beds), meaning that currently 25% ICU capacity is used for COVID-19 patients management.



⁵RAND health care. Critical Care Surge Response Strategies for the 2020 COVID-19 Outbreak in the United States. April 2020

⁶<https://www.newsenglish.no/2020/04/03/updates-here-as-corona-rages-on/>

Total number of hospitalized cases in Norway was not possible to obtain to calculate hospitalization rate, however it is assumed that the rate will be relatively low considering high testing rate.

Denmark

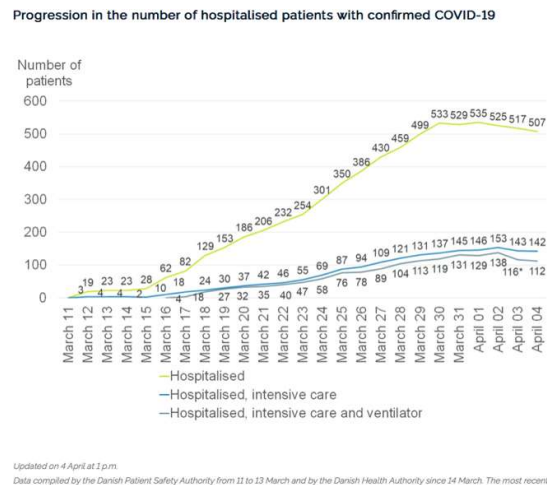
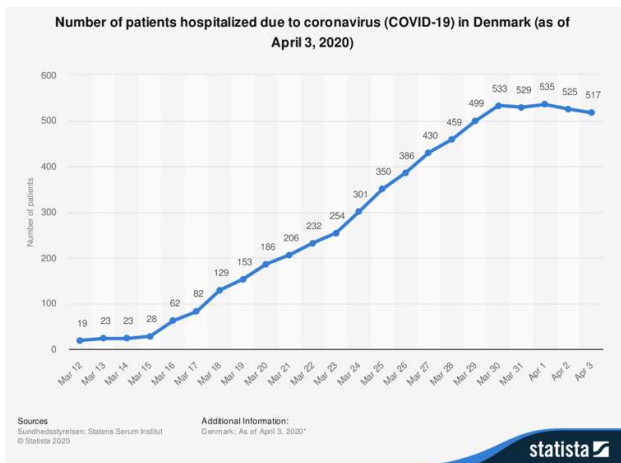
In Denmark the number of people who were confirmed on COVID-19 reached a total of 3,757 as of April 3, 2020 (65 per 100,000 population) that is relatively low among other European countries. It is also notable that the testing rate is at medium level (6,888 per mln population) compared to other European countries. On 11 March, there was change of strategy, which means that only people hospitalized with severe signs of respiratory illness or shortness of breath, will be tested. As a consequence, it is suspected that COVID-19 cases in the country are underreported.⁸

The number of hospitalizations due to the coronavirus (COVID-19) in Denmark increased since March 12, 2020, when 19 patients were hospitalized and peaked on April 1, 2020 when the number of patients had grown to 535. The following days, number started to decline and was down to 517 on March 3, 2020.

In Denmark *severe and critical patients are hospitalized* and all infected people with no or *mild symptoms* and are not considered particularly vulnerable *are placed in home quarantine* with daily contact from health professionals. Total number of hospitalized cases was not possible to obtain to calculate hospitalization rate, however it is assumed that it will be high due to underreporting of cases.

Among hospitalized cases about 30% are placed in ICU and 22% require ICU and ventilation (around 80% of ICU patients)⁹.

Denmark total ICU capacity is 6.7 per 100,000 population¹⁰ (around 390 beds), meaning that during highest load on April 2nd 40% of ICU capacity was used for COVID-19 patients.



As data on daily hospitalized cases in these two countries were available, we looked at the highest number of hospitalized cases at a time point (319 cases – Norway and 535 – Denmark). Norway with higher COVID-19 incidence rate (most likely due to high testing rate and not a disease burden) has lower hospitalization and death rates compared to Denmark. In both countries only severe cases are hospitalized and also ICU capacity has not been overwhelmed that could have led to high death rates. In Denmark (more severe picture) at a time point the hospitalization reached 92.4 per 1 mln population with about 30% placed in ICU.

These figures should be interpreted considering various factors such as demographics, population density, civil compliance to the rules, social interaction patterns and COVID-19 containment

⁷<https://link.springer.com/article/10.1007/s00134-012-2627-8>

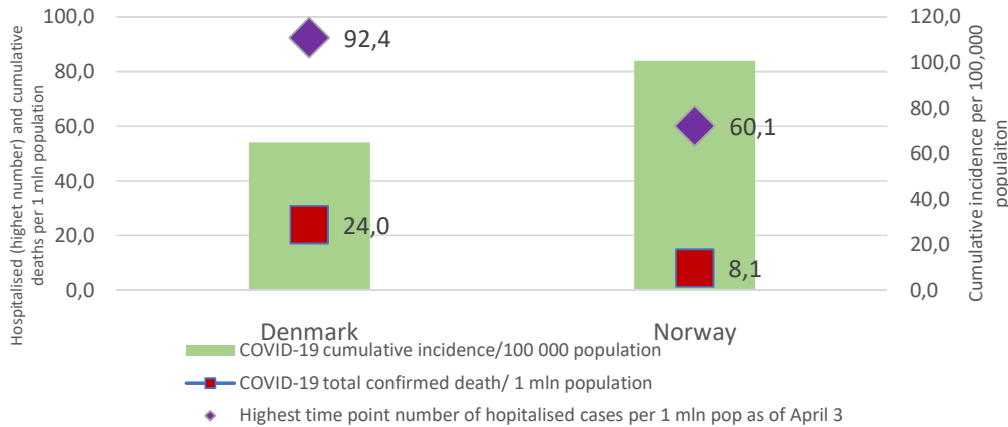
⁸Gram, Michael Hjøllund (12 March 2020). "Sundhedsstyrelsen skifter strategi: Ikke alle corona-symptomer skal testes". JP

⁹https://www.sst.dk/da/corona-eng/COVID-19-update_statistics-and-charts

¹⁰<https://link.springer.com/article/10.1007/s00134-012-2627-8>

measures. Both countries introduced strict measures however after initial increase of cases.¹¹¹² E.g. Norway introduced national lockdown on March 12 (when the cases peaked to 400), and in Denmark from March 13 (when cases peaked to 516).

Figure 3. COVID-19 total cumulative incidence/100,000 pop, total hospitalization highest rate and cumulative confirmed deaths / 1 mln population



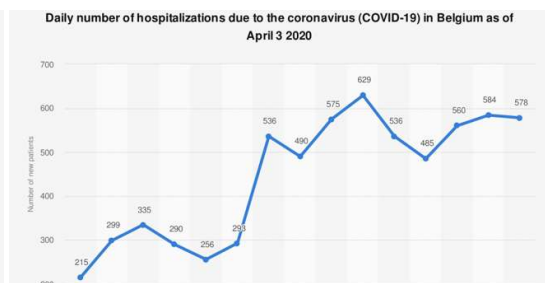
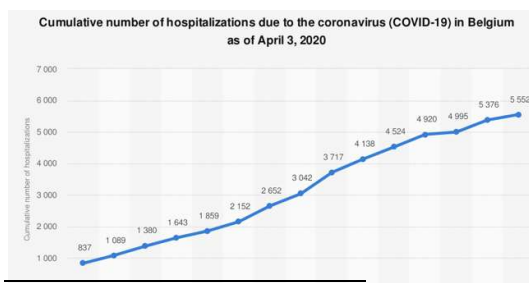
Belgium

Belgium has one of the highest COVID-19 incidence rates (238.7 per 100,000 population as of April 3rd) with a moderate testing rate (6,040 per 1 mln population). Confirmed death rates is also highest in Europe after Italy and Spain (98.6 per 1 mln population).

As of the 3d of April, 5,552 patients were admitted to Belgian hospitals (cumulative) that constitutes 33.1% hospitalization (from all confirmed cases). Currently only severe cases are hospitalized.

Belgium had high ICU capacity (26.9 per 100,000 or 1891 ICU beds in total) before the COVID-19 crises with relatively high nurse supply. Additional 759 intensive care beds have been created to surge capacity, summing up to 2650 ICU beds (37 per 100,000 population).¹³

However, despite these capacities the Belgian system may not cope with the crises. The modeling exercise was performed on March 29 with the following assumptions: more than 80% of Belgians have stayed within their own commune (postal code) for the last two weeks, and that individual displacements of over 40 km have been reduced by 90% (current practice), around 5% of infected cases (new) will be hospitalized, and 15% or 20% of hospitalized patients require intensive care, mortality of hospitalized cases is 15% and 5 days from hospitalization to death. The modeling predicted peak in number of ICU patients is expected around on April 15th, with the number of ICU patients exceeding the capacity of the Belgian healthcare system of 2650 beds.¹⁴



¹¹ <https://www.garda.com/crisis24/news-alerts/322476/norway-new-coronavirus-containment-measures-implemented-march-12-update-3>

¹² <https://www.scandinaviastandard.com/covid-19-whats-happening-in-denmark/>

¹³ <https://www.info-coronavirus.be/en/news/hospitals-and-gps-to-beat-the-covid19-virus/>

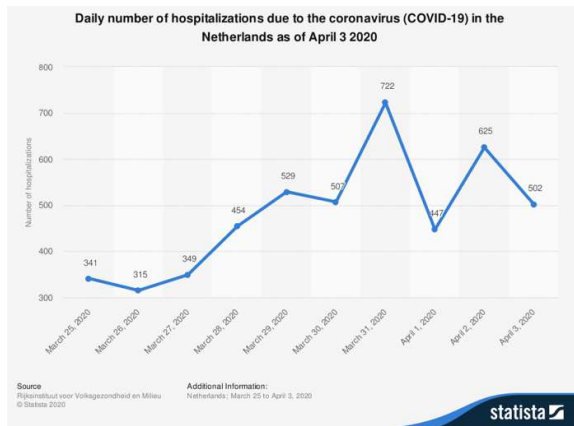
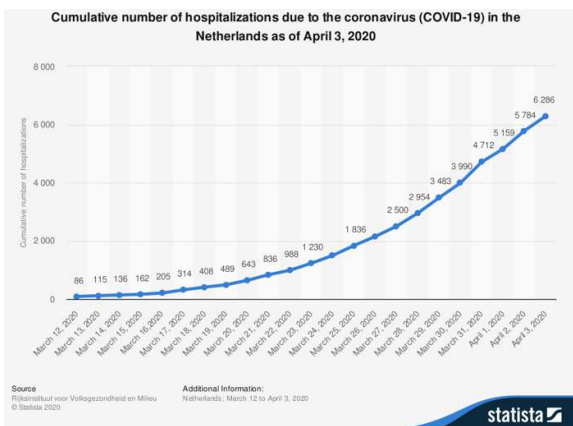
¹⁴ <https://www.medrxiv.org/content/10.1101/2020.03.29.20046730v1.full.pdf>

Netherlands

Netherlands epidemic (as per confirmed cases) is moderate in the Europe (91.2 per 100,000 population), however confirmed death rate per capita is fourth highest after Italy, Spain and Belgium (86.6 per 1 mln population). As the testing rate is one of the lowest among other European countries, we can assume that real infection spread is much higher.

As of the 3d of April, 6,286 patients infected by the 2019n-CoV virus were admitted to Dutch hospitals which is 40% of all confirmed cases.

To date, the ICUs have treated 1,817 Covid-19 patients (29% of hospitalized) of which 272 have died (4.3% of hospitalized and 15% of ICU admissions).¹⁵



¹⁵<https://nl.times.nl/2020/04/05/covid-19-new-reported-hospitalizations-fatalities-fall-death-toll-stands-1766>

Additional figures

Figure 4. COVID-19 cumulative incidence per 100,000 population and testing rate per 1 mln population in selected countries as of April 3 2020^{16,17}

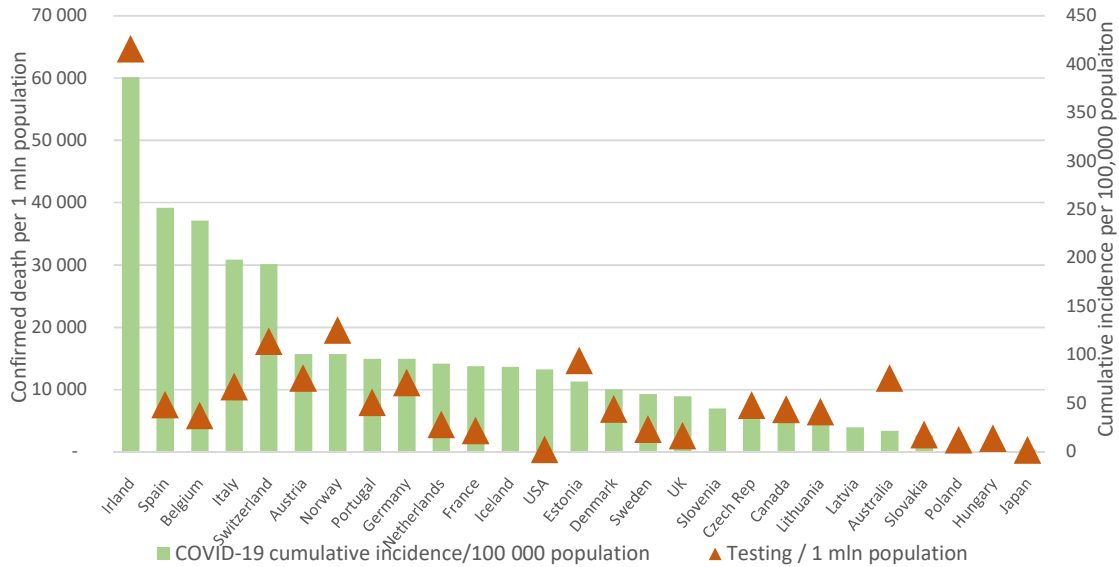
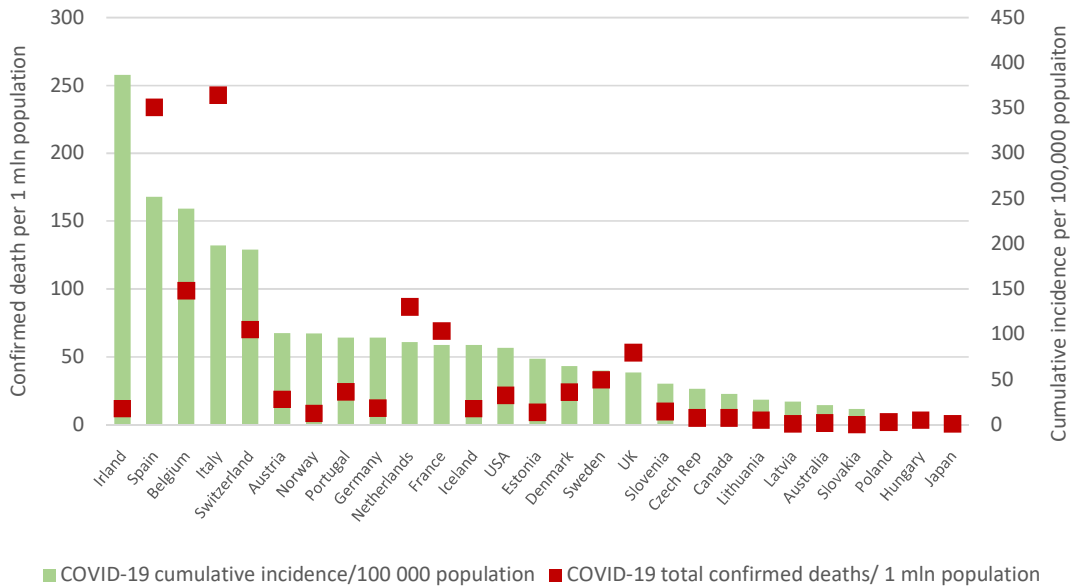


Figure 5. COVID-19 cumulative incidence per 100,000 population and confirmed deaths per 1 mln population in selected countries as of April 3 2020



¹⁶<https://ourworldindata.org/coronavirus>

¹⁷<https://www.worldometers.info/coronavirus/>