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Guidance to assist Member States in estimating hospital resources for reception of and care for coronavirus 2019 (COVID-19) patients

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Scope of this document

The aim of this document is to support public health preparedness planning with regard to hospital resources in preparation for reception of and care for COVID-19 cases.

Target audience

Public health authorities in the EU/EEA Member States

Background

In the scenario widespread and sustained transmission of COVID-19 in the EU/EEA (i.e. mitigation phase according to scenarios 3 and 4 from the previously circulated "Scenarios for a further increase in the spread of COVID-19" produced by ECDC), healthcare systems may be under growing pressure and surge capacity would thus be needed. The assessment of existing and surge capacity should thus be initiated by countries as early as possible already during the containment phase (corresponding to scenarios 1 and 2 in the "Scenarios for a further increase in the spread of COVID-19"). The ongoing influenza season should be considered in the needs assessment: epidemiological information from the current influenza season and projected needs in terms of hospital and ICU bed occupancy, ventilators, PPE equipment and healthcare workers' time should be used as a baseline scenario by the Member States to assess their hospital resource needs.
It is important for Member States to consider that global supply (e.g. PPE, medications, ventilators) may be affected by the current outbreak in Mainland China, one of the major producers and suppliers.

Here we provide a first crude estimate of the foreseen hospital resources need in case of sustained human-to-human transmission within the EU/EEA, in particular concerning needs for hospital beds, isolation capacity and access to mechanical ventilators, and compare it to estimates of the current hospital capacity in EU/EEA countries. It is important to consider that these estimates are subject to several assumptions and should only be used to obtain an overview of the EU/EEA hospital systems capacity in case of sustained COVID-19 circulation.

Suggested citation: European Centre for Disease Prevention and Control. Guidance to assist Member States in estimating hospital resources for reception and care for coronavirus 2019 (COVID-19) patients. ECDC: Stockholm; 2020.

Assessment of current capacity

Methodology

We conducted a simulation study to investigate the capacity of EU/EEA countries' hospital systems to cope with a fast increase in hospital resource needs (surge capacity). We assumed that the average proportion of patients hospitalised with COVID-19 and requiring intensive care for mechanical ventilation or other advanced care is on average 18%, following the results of a large study carried out in Hubei [1]. We also evaluated two additional scenarios with severity rates ranging between 5% and 30%, based on a literature review of descriptive clinical studies. This range was needed to account for the variability among European countries, due to differences in hospitalisation policies and capacity, age structure (older patients are at higher risk of severe disease) and society structure (lower population density than Wuhan).

As a proxy of hospital beds with access to mechanical ventilation, we used the number of Intensive Care Unit (ICU) beds in the countries, while acute beds other than ICU were assumed as a proxy of low-intensity care capacity. To estimate the number of ICU and non-ICU beds and the relative residual capacity (1 - bed occupancy rate), we employed data from the ECDC Point Prevalence Study (PPS) on Healthcare-Associated Infections and Antimicrobial Resistance in acute care hospitals in 2016-2017 [2,3]. The study collected data from a sample of hospitals in 28 EU/EEA Member States, including the number of acute beds, ICU beds, number of single occupancy rooms, number of airborne infection isolation (AII) rooms (with negative pressure and ante-room), and bed occupancy. We used data from wards included in the study when available and hospital denominator information otherwise.

We built country-level distributions for: ICU bed ratio, occupancy rates in ICU and non-ICU beds, ratio of single-room beds, and ratio of AII beds. These distributions represent different scenarios related to uncertainty around the extrapolation from the PPS sample to the whole countries and variability over time. Smaller countries or countries which provided less data for the PPS have more uncertainty around these estimates.

Finally, an increasing number of cases (COVID-19-infected patients requiring any form of hospitalisation) was simulated, and the country prevalence over the total population was calculated accordingly. Country prevalence scenarios (number of active COVID-19 cases per 100 000 population) were compared to the 14-days cumulative incidence per 100 000 population in affected countries and areas, assuming that all reported COVID-19 cases were hospitalised. For each scenario, we estimated patients needing ICU level care in order to have a median risk of 18% (ranging from 5% to 30%); we then estimated the probability of ICU patients exceeding a country's ICU capacity according to the estimated possible distribution of free beds. Similarly, it was done for the non-ICU beds. For the latter calculation, we assumed that overcapacity ICU patients would be shifted to non-ICU beds.

Regarding the capacity of single and AII beds, we assumed that non-ICU patients would be preferably quarantined in AII rooms, especially in the initial stages (containment phase, scenario 1 and 2) of the outbreak. When AII capacity were saturated, patients would be isolated in single rooms. Capacity saturation probability was computed starting from these assumptions.

Through this model, we evaluated the proportion of EU/EEA countries saturating their hospital capacity as a function of increases in prevalence of hospitalised COVID-19 patients. The data were not available for all countries in the PPS study. In particular, ICU and non-ICU capacity was calculated for 28 countries, single room capacity for 27 countries (missing for Czech Republic) and AII capacity for 24 countries (missing for Czech Republic, Greece, France and Republic of Ireland). Saturation proportion denominators change accordingly.

The model has a number of limitations. The capacity estimates are based on the PPS hospital samples, which are assumed to be representative of the countries' hospital distribution. The model also assumes that all hospital beds are available for any affected patient in the country (non-locality assumption). This limitation is mitigated by the observation that, at least in the initial phases of the outbreak, most of the cases will be concentrated in the major cities, where also most hospital capacity is present. Finally, we did not take into account a further decrease in hospital capacity due to the influenza season as the occupancy rates in the 2016-2017 ECDC PPS were measured outside the influenza season (April-June or September-November). Therefore, our estimates are based on the assumption that significant COVID-19 levels would be reached only in the declining phase of the influenza season.

Assessment of hospital capacity in the EU/EEA

We present our saturation estimates for ICU beds, non-ICU beds, AII, and single-room beds. In figure 1, dashed vertical lines represent a prevalence of 100 hospitalised cases per 100 000 population, which corresponds approximately to the situation of Hubei Province, and of 10 hospitalised cases per 100 000 population, corresponding approximately to the double of the current mainland China mid February. We also show uncertainty intervals representing a 5% and 30% ICU admission risk.

Assuming a Hubei-like scenario in all countries, the full European ICU and, especially, isolation capacity would be completely overwhelmed. At this level of the outbreak, 43% of countries would have also saturated their non-ICU capacity (Table 1). At a 5 per 100 000 population prevalence level (mainland China scenario), no country would have fully saturated their ICU capacity, 4% would have saturated their single-room capacity, and 75% their AII capacity.

Conversely (table 2), 50% and 100% of the countries would have saturated their ICU capacity with a prevalence of respectively 26.5 and 84.2 hospitalised patients per 100 000 population, while these figures go up to 104.4 and 265.0 per 100 000 population for non-ICU capacity. Regarding the isolation capacity, 50% and 100% of the countries would have saturated their AII at 2.9 and 10.9 hospitalised patients per 100 000, and their single-room bed capacity at 17.9 and 56.1 hospitalised patients per 100 000.

Fig. 1. Proportion of country with saturation of ICU, non-ICU, isolation and single-room beds as a function of the number of hospitalised COVID-19 patients per 100 000 population. The dashed vertical lines represent prevalence scenarios of 100 hospitalised cases per 100 000 population (similar to Hubei Province) and 10 hospitalised cases per 100 000 population (approximately twice the prevalence of mainland China). Uncertainty regarding severity rate (5% and 30% average severity scenarios) is represented by shaded bands. Severity-related uncertainty is low for non-ICU, isolation and single-bed room indicators due to the shift of patients from ICU to non-ICU in case of saturation.

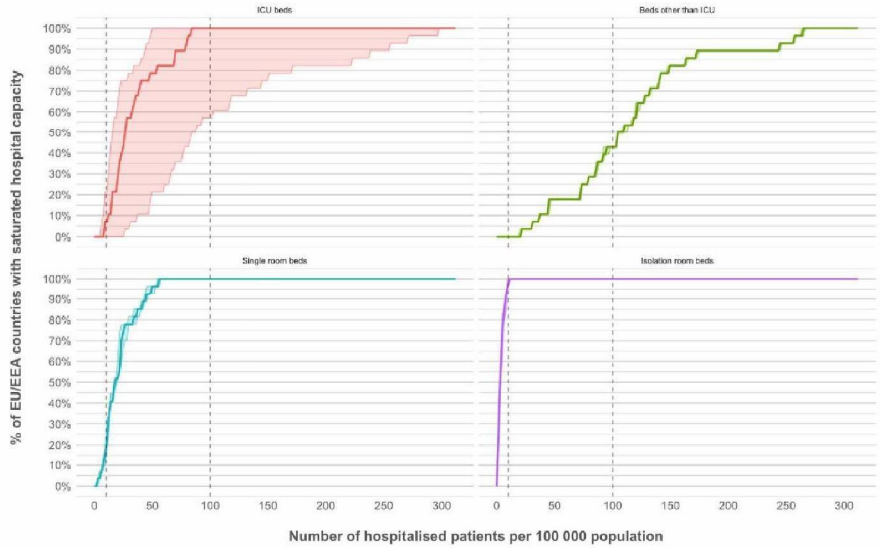

Table 1. Proportion of saturated EU/EEA countries for specified hospitalised patient prevalence scenarios.

	Proportion of countries with saturated capacity			
Number of hospitalised patients per 100 000 population	**ICU beds**	**Non-ICU beds**	**AII room beds**	**Single rooms beds**
5	0%	0%	75%	4%
10	7%	0%	96%	15%
20	21%	0%	100%	52%
50	79%	18%	100%	96%
100	100%	43%	100%	100%

Table 2. Hospitalised patient prevalence figures at which healthcare capacity is saturated in a specified proportion of EU/EEA countries.

	Number of hospitalised patients per 100 000 population			
Proportion of countries with saturated capacity	**ICU beds**	**Non-ICU beds**	**AII room beds**	**Single rooms**
10%	12.1	37.1	1.5	7.3
25%	19.5	73.3	1.5	11.3
50%	26.5	104.4	2.9	17.9
75%	40.5	140.3	4.7	25.3
100%	84.2	265	10.9	56.1

Discussion and options

These figures indicate a relatively high risk of surge capacity problems for the prevalence scenarios seen in Chinese provinces. This risk is especially high for smaller countries, countries with a lower number of beds per inhabitant, and countries with an already saturated hospital system.

The limited isolation capacity of many countries (i.e. AII and single-bed room capacity) compromises the containment phase of the outbreak, during which case isolation is essential. When single-bed rooms are not available, COVID-19 cases should be cohorted together in multiple-bed rooms separated from other patients [4,5].

Changes in ICU bed management plans during sustained outbreaks may include e.g. transferring less severe patients not in need of acute respiratory distress syndrome (ARDS) management infrastructure (e.g., mechanical ventilation) to Step Down Units (SDUs), increasing the number of beds in ICU wards and increasing the number of ventilators. Surge response plans (e.g., change in admission and discharge rules, allocation of more beds per room) may also be planned for non-ICU capacity in order to prepare for worst-case scenarios, which may happen relatively early in many EU/EEA countries. When no more rooms are available, home care for mild COVID-19 cases may be considered [6].

Healthcare personnel increase or task shift preparation is advised. Healthcare workers should receive training in COVID-19 patient management and isolation for every severity level in order to allow shifting to ICU case management if the baseline ICU personnel capacity is exceeded.

In a scenario of sustained community transmission, healthcare workers should also be urged to strictly adhere to standard IPC precautions, including hand hygiene and to take additional respiratory hygiene precautions for patients with symptoms of an acute respiratory infection. The risk for healthcare workers to acquire COVID-19 is particularly high [7], therefore countries may experience a further deficit of workforce. In addition, HCWs with high-risk exposure to COVID-19 may be required to self-isolate at home for 14 days, which may result in a critical shortage of HCWs especially during outbreaks. Finally, outbreaks of COVID-19 may also lead to closure of hospitals as a measure to contain the epidemic, further reducing the hospital capacity in the affected region.

This document does not detail estimations of the needs for PPE, which was covered in another ECDC document [8]. A next version of this document will include the hospital capacity estimates by country.

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