Intensive care units in England could run out of beds within two weeks, study finds

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Clinicians in Intensive Care Unit. Credit: Calleamanecer (WikiCommons)

Intensive care unit (ICU) occupancy is likely to increase dramatically over the next few weeks, suggests research published by a team at the University of Cambridge. Their work suggests that if the current exponential growth of COVID-19 infections continues, then within two weeks, five out of seven commissioning regions in England will have more critically ill COVID-19 patients than can be accommodated with ICU beds normally available.

Since emerging in November 2019, there have been over 267,000 confirmed cases of COVID-19 coronavirus and over 11,200 deaths (WHO figures 22 March). While COVID-19 generally causes mild symptoms, some patients may develop severe lung inflammation. This may be severe enough to require intensive care for advanced, invasive mechanical ventilation ('life support').

Mechanical ventilation is a specialized procedure that can only be provided on an intensive care unit. The number of intensive care beds is limited and the equipment and specialist staffing required makes it difficult to create more ICU beds easily/quickly. In Northern Italy, which has been particularly severely affected, the large volumes of patients has overwhelmed ICU capacity.

"If mechanical ventilation cannot be provided to patients who need it, they will die," says Dr. Ari Ercole from the Division of Anaesthesia at the University of Cambridge. "ICU capacity is a crucial concern as additional capacity takes time to create both in terms of staffing and equipment."

Dr. Ercole and colleagues from Cambridge's Division of Anaesthesia and Department of Computer Science and Technology have built a real-time computer model to try and make the earliest possible predictions of ICU demand in England. Their aim is to give an early warning of when or whether capacity will become critical and give as much advanced notice as possible to help build capacity.

Because of the urgent implications of the model's results, the team has made its study available online early. The research has not been peer-reviewed. All source code has been made freely-available online as has an online version of the model which is updated as data comes in.

The team used COVID-19 diagnoses from England as reported by *Public*

Health England and matched to NHS commissioning regions as its source data to obtain information on daily cases. They have assumed that the daily incidence of COVID-19 can be modeled as an exponential growth, in line with what has been observed in Italy. The most up-to-date information suggests the median length of time spent in an ICU is eight days.

The Cambridge model predicts that ICU demand in England could rise to levels which are impossible to supply with the current beds available very quickly—as early as within two weeks in some regions and with London at particular risk.

"If our assumptions are correct, ICU capacity may be complete overwhelmed very quickly in England," added Dr. Ercole, who is also a Fellow in Clinical Medicine at Magdalene College. "A large increase in ICU capacity is required extremely urgently if we are to be able to treat patients with life-threatening COVID-19 in the near future."

The model makes a number of assumptions about the outbreak which may limit its accuracy, but is based on the best available data at the earliest time.

The team used data published by *Public Health England*. While the researchers acknowledge this data does not recognise all cases within the wider population, it is likely to include the vast majority of severe cases, on which the models specifically focus. Changes over time in World Health Organization case definitions and in surveillance strategies may also overestimate ICU admission rates as milder cases were not identified initially and would artificially inflate the forecast numbers.

They have forecast the percentage of COVID-19 bed requirements in isolation. In reality, all ICUs will need to continue to provide 'business as usual' care for other types of patients. Since UK bed occupancy is

typically greater than 80% and may frequently exceed 100%, the researchers say it is clearly not the case that all open beds can simply be re-allocated for COVID-19 patients.

They have also assumed that all adult critical care beds can be used for level 3 or mechanically ventilated ICU patients, which may not be possible; some specialist ICUs may not be able to reconfigure at all.

More information: Jacob Deasy et al. Forecasting ultra-early intensive care strain from COVID-19 in England, (2020). DOI: 10.1101/2020.03.19.20039057

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