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Protecting workers aged 60–69 years from COVID-19

The initial estimates of the case fatality rate of coronavirus disease 2019 (COVID-19) from China and the published modelled estimates both show a very strong age-dependence.[1,2] In the UK, this pattern has been interpreted in public health terms as advice to cocoon (ie, isolate) those older than 70 years and those with underlying health conditions—but is this the right age cutoff?

Applying the infection fatality rate ratios from new estimates (which assume a constant attack rate by age) to the age structure of the population of the UK,[3] we can see how many deaths we would expect in each age group if there were 1 million infections (table). This shows that 70% of all deaths are in the over-70-years age group, so it is important that they are protected. However, nearly two thirds (64%) of the remaining deaths occur in the 60–69 years age group. This age group is not being particularly protected and includes many who are working on the frontline. Indeed, health-care workers have even been encouraged to come out of retirement to assist.

Based on the Chinese data,[1] each death corresponds to about two critical cases (needing intensive care) and six people who require hospitalisation. Both for humanitarian reasons and to prevent overload of the health service, shouldn't we be protecting people older than 60 years and ensuring that those in that age group who are currently not working from home are moved to jobs with minimal person contact, whether it is in the health service, schools, government, or the private sector?

	Proportion of UK population (%)	Infection fatality ratio (%)	Number of deaths if 1 million population infected	Proportion of deaths	Proportion of deaths if over 70s successfully cocooned
0–9	12%	0·00161%	2	<1%	<1%
10–19	11%	0·00695%	8	<1%	<1%
20–29	13%	0·0309%	41	<1%	1%
30–39	13%	0·0844%	112	1%	3%
40–49	13%	0·161%	206	2%	6%
50–59	13%	0·595%	803	8%	25%
60–69	11%	1·93%	2054	19%	64%
70–79	8%	4·28%	3535	33%	..
80+	5%	7·80%	3853	36%	..

Age group given in years. Infection fatality rates from Verity et al,[2] and the population structure of the UK in 2018 from the Office for National Statistics.[3] SARS-CoV-2=severe acute respiratory syndrome coronavirus 2.

Table: **Estimated deaths by age group if 1 million people in the UK population are infected with SARS-CoV-2**

My partner is older than 60 years and works in the health service. I declare no other competing interests.

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Projecting the demand for ventilators at the peak of the COVID-19 outbreak in the USA

The coronavirus disease 2019 (COVID-19) pandemic has been straining health-care systems worldwide. For countries still in the early phase of an outbreak, there is concern regarding insufficient supply of intensive care unit (ICU) beds and ventilators to handle the impending surge in critically ill patients. To inform pandemic preparations, we projected the number of ventilators that will be required in the USA at the peak of the COVID-19 outbreak.

Our estimates combine recent evaluations of COVID-19 hospitalisations[1] and data on the proportion of patients with COVID-19 in the ICU requiring ventilation (appendix p 2). At a basic reproduction number of 2·5,[1] 115 001 (IQR 101 006–131 770) invasive ventilators and 89 788 (78 861–102 880) non-invasive ventilators would be needed, on average, at outbreak peak (figure).

Considering that 29·0% of the existing 97 776 ICU beds in the USA are routinely occupied by patients without COVID-19 requiring invasive mechanical ventilation,[2,3] we calculated that 69 660 of the 98 015 invasive ventilators in the USA before outbreak start would be available for the COVID-19 response.[4,5] These available ventilators include additional units in stockpile or storage. Consequently, at least 45 341 (IQR 31 346–62 110) additional units would be needed for the surge at the peak. Of the

See **Online** for appendix

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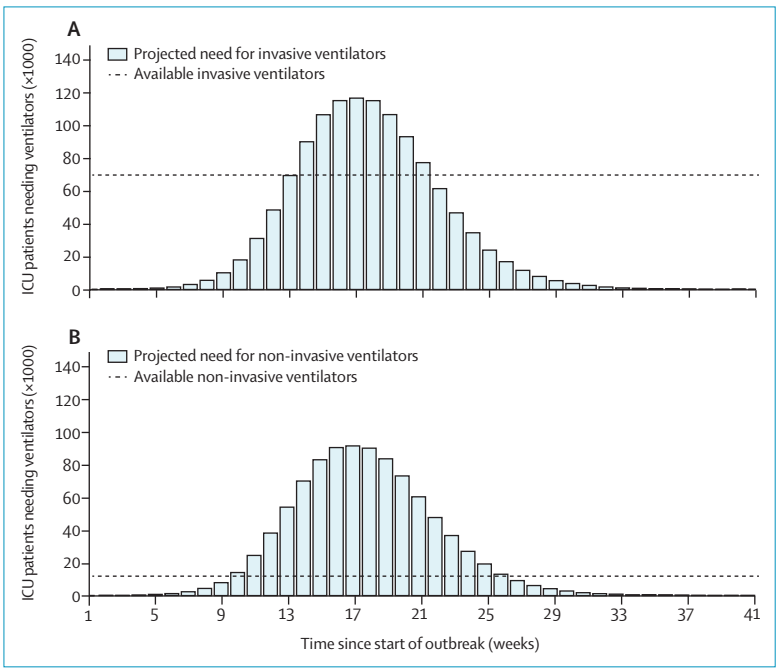

Figure: **Projected number of ICU patients requiring ventilators in the absence of any community interventions with R_0=2·5**

Temporal need for (A) invasive ventilators and (B) non-invasive ventilators among ICU patients during the outbreak. The solid line indicates the routine availability of ventilators before the start of the outbreak. ICU=intensive care unit. R_0=basic reproduction number.

22 976 non-invasive ventilators,[5] we estimated that 12 499 units would be available, assuming 54·4% availability as estimated for routinely used invasive ventilators (appendix p 1). For these non-invasive devices, a minimum of 77 289 (66 362–90 381) additional units would be needed at the peak. As a step towards filling this gap, 52 635 limited-featured devices exist.[5] Although these could be deployed for treatment of moderate cases, they might not be an appropriate substitute for ventilators in the care of severely ill patients.[5]

These estimates should represent a lower bound for additional ventilator requirements. To avoid triage for use of ventilators,[6] units would have to be perfectly distributed both geographically and temporally, which in turn relies on centralised coordination among states and more precise forecasting than is currently possible given the constraints on testing for severe acute respiratory syndrome coronavirus 2. Worryingly, areas such as New York city are experiencing the first surge of cases in the absence of national coordination, while facing competition with other regions simultaneously trying to secure these critically important resources.[7] Also concerning is that the USA is already several weeks into its epidemic. With invasive ventilator needs exceeding availability at week 14 of our simulations, there are substantially fewer weeks to procure the requisite supply.

We urge three complementary avenues of action to reduce the imbalance between supply and demand for ventilators. First, vigilant social distancing has potential to flatten the curve,[1] which will both delay and suppress the outbreak peak. In addition to reducing the peak demand for ventilators, the delay would provide a window of opportunity to ramp up ventilator production. Second, it is plausible that the USA will experience several asynchronous local peaks rather than one apex. A nationalised allocation system that transfers ventilators based on state-level epidemiological projections would most efficiently capitalise on existing units. Third, the USA simply needs more ventilators. In that respect, the Defense Production Act has been invoked, compelling some automobile manufacturers to shift production to ventilators.[8] This Act also permits the Administration to coordinate distribution among states, thereby addressing our second recommendation. The Administration has refused to engage in coordination, suggesting that it is not yet needed. However, given the time required to refit manufacturers and begin producing ventilators, waiting until the national shortage is upon us would be disastrous. By contrast, these three steps will save lives and avoid the devastating rationing that would unfold in the absence of action.

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Use of polymyxins in Chinese hospitals

We acknowledge the Comment from Federico Perez and Robert A Bonomo[1] regarding our Article[2] on the decline of colistin resistance and *mcr-1* abundance in *Escherichia coli* from animal and human origins following the ban of colistin as an animal growth promoter in China. We appreciate their suggestion that the insufficient data on clinical polymyxin use is a limitation of our study.

From the introduction of polymyxin in the 1980s, its use in China was restricted to food-producing animals. However, in January, 2017, the China Food and Drug Administration (CFDA) approved polymyxin B as a therapy in humans,[3] and injectable polymyxin B (lyophilised powder, 500 000 units per dose) became available for clinical use in October, 2017. In May, 2018, the CFDA also approved colistin (polymyxin E) for exclusive use in humans,[3] and injectable colistin (lyophilised powder, 500 000 units per dose) became available for clinical use in December, 2018.

We collected hospital consumption data for polymyxins, including polymyxin B (2018–19) and colistin (2019), from 26 Chinese provinces using the CHINET surveillance system, and compared the data with samples that were positive for colistin-resistant *E coli* from the corresponding provinces in 2018–19.[2]

In total, 354 442 polymyxin doses were administered between 2018 and 2019. More than 10 000 doses were given to patients who were hospitalised in ten provinces. Nine of the ten provinces (except Beijing) were among the top ten wealthiest areas in China (by gross domestic income in 2019, appendix p 1). Hospitals in Zhejiang, Jiangsu, Beijing, Shanghai, and Guangdong consumed over half (196 018 [55·3%] of 354 442 doses) of all polymyxin used for the treatment of serious multidrug-resistant infections, mainly caused by carbapenem-resistant Gram-negative bacilli. Notably, hospitals from five of these provinces are major referral centres and have some of the best resources in China. Based on consumption data, we conclude that Chinese clinicians should consider polymyxin as a last resort antibiotic, and that clinical polymyxin use should be heavily restricted.

To understand the relationship between polymyxin use and infections caused by colistin-resistant *E coli* in Chinese hospitals, we did a correlation analysis. Spearman's correlation coefficient showed no significant correlation between polymyxin use and colistin-resistant *E coli* (Spearman's ρ=0·18, p=0·389). We propose three possible reasons for the absence of correlation. First, a large number of inpatients receiving polymyxin were treated in intensive care units and had little or no similarities of ward to inpatients who were positive for colistin-resistant *E coli* from other hospital units, including the intensive care unit.[3] Second, some inpatients who were positive for colistin-resistant *E coli* were administered antibiotics that were not polymyxin, including tigecycline and carbapenem plus fosfomycin combination therapies. Third, unlike animals, in which large quantities of colistin were used and associated with colistin resistance, the short term and smaller amounts of polymyxin used in Chinese hospitals had little direct pressure on the emergence of colistin-resistant *E coli*.

Nevertheless, our data will be useful baseline data for future studies. With the increase in carbapenem-resistant pathogens causing clinical infections,[4,5] polymyxin use in Chinese hospitals is also expected to increase; therefore, continuous surveillance of both polymyxin use and colistin-resistant *E coli* infections is warranted.

For the **CHINET surveillance** system see http://www.chinets.com

See **Online** for appendix

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See **Articles** page 1161

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