Briefing prepared by the Analytical Collaboration for COVID-19 – 5 May 2020

Are some countries better at caring for their ICU patients than others?

Why look at ICU deaths?

Recent headlines have suggested that around 50% of COVID-19 patients admitted to NHS ICUs are dying. What should we conclude from this figure? Is this unavoidable mortality?

Those patients who are most seriously ill with COVID-19 are often admitted to ICUs – and ensuring these units had enough free beds, and ventilators, was a key concern early in the pandemic. Understanding whether there is significant variation in ICU mortality rates between different countries could help us to understand effective clinical care and staffing, and to identify where ICUs were overwhelmed (as in Lombardy) and what effect this had.

Understanding, and comparing countries performance here though, is challenging. Different countries' populations will have different demographics, the population infected will vary (e.g. perhaps in Italy many more old people were infected), and criteria for admitting to ICUs will vary – both potentially due to rationing, but also due to different clinical decision making.

Is ICU mortality really 50%?

Yes. If we exclude those patients who are still in the ICU, 51% of NHS ICU patients have died. This compares to 62% in one small site in Wuhan, 61% in Lombardy, and 78% in one major provider in New York City. An early (still in press) study from France suggests ICU mortality of between 30-40%.

However, it is too soon to conclude whether (a) these differences in mortality between countries are significant/ real or (b) if they are the result of differences in the quality of care or definitions or (c) whether the duration/stage of the epidemic is a factor (e.g. in the earlier stages, whether 'less sick' patients get access to IC).

Table 1: Summary of studies and reports on ICU deaths

Location	No. patients included	No. deceased	No. discharged	No. remaining in ICU	% deceased of those who have left ICU
Washington State[i]	21 (one site)	14 (67%)	2 (9.5%)	5 (24%)	88%
Wuhan, China[ii]	52 (one site)	32 (61.5%)	20 (38.5%)	-	62%
Lombardy, Italy[iii]	1,591 (regional data)	405 (26%)	256 (16%)	920 (58%)	61%
Spain[iv]	6,349 (national data)	1,587 (19%)	-	-	-
NHS, all UK[v]	6,720 (national data)	2,067 (31%)	2,011 (30%)	2,642 (39%)	51%
New York City[vi]	1,281 (one provider)	291 (23%)	82 (6%)	908 (71%)	78%

What can we conclude from this variation?

There are two main reasons ICU mortality rates will vary between countries. Firstly, differences in the risk profile of who is admitted to the ICU (are they younger? Less sick?). Secondly, because of variations in the quality of care – of treatment, of staffing ratios, or of the availability of key equipment such as ventilators. By looking at the demographics of individuals admitted to ICUs in different countries we can begin to unpick this variation.

Who is being admitted to ICUs?

We know that COVID-19 mortality is strongly affected by age and comorbidities. If a country admits a greater proportion of young patients, with few comorbidities to their ICU, their ICU mortality will be lower. There are two reasons for this variation:

1. The demographics of who is infected in a given population vary – one country may have an older population, or the infection may primarily have spread amongst older people (for example, in care homes). A greater proportion of those with severe illness with therefore be elderly, and ICU mortality will be higher.
2. Countries may differ in who they admit to ICUs. This could be because (as in Lombardy) overwhelmed ICUs were forced to ration care (and therefore those most likely to die would not be admitted – reducing ICU mortality). It could also be an intentional clinical decision where those with low chances of survival are not admitted – for example because of 'Do Not Resuscitate' (DNR) orders.

The U.K.'s ICU mortality rate could, therefore, be explained by us admitting, on average, younger, healthier patients to our ICUs. We know that U.K. patients are, on average, a few years younger than those in Spain, Italy, and NYC. Understanding the prevalence of comorbidities in populations would also be helpful here – but we don't yet have comparable data for most countries.

We know – anecdotally – that ICUs in Lombardy & Wuhan were overwhelmed, but that, for the most part, those in the UK, New York City, and Spain were not. Future research could look into how admissions procedures vary by country.

Table 2: ICU Mortality: Demographic breakdowns

Location	No. patients included	% deceased	Mean age	White	Male	>1 comorbidity	CVD	Diabetic
Washington State	21	88%	70	*not included*	-	86%	-	33%
Wuhan, China	52	62%	60	*N/A*	67%	-	10%	10%
Lombardy, Italy	1,591	61%	63	*not included*	82%	-	21%	17%
Spain	6,349	-	64	*not included*	70%	81%	44%	25%
NHS, all UK[1]	6,720	51%	59	66	72%	-	-	-
New York City[2]	1,281	78%	63	39.8	60%	88%	57%[3]	34%

Does the quality of care vary?

If the quality of care is better in some ICUs, we might expect mortality to be lower. For example, as the epidemic progresses we might have better evidence on what treatments and care are effective; different proportions of patients might be in clinical trials; staffing ratios may vary; access to key equipment such as ventilators may be rationed, or the quality of some ventilators may be lower.

[1] NHS data only includes those with 'very severe comorbidities'
[2] NYC data includes all those hospitalised, not just those in ICUs - can expect data to skew younger and healthier.
[3] Hypertension only.

Understanding this, though, would require analysis to both control for different disease burdens & age demographics, and qualitative research to describe and understand any variations in practice.

Can we conclude that the NHS's ICUs are performing better?

The short answer to this is, no, not yet. Without a complete understanding of the demographics and morbidity of patients admitted to ICUs in different countries, we cannot unpick what variation might simply be due to the case mix – and what's the result of variations in the quality of care. Even the limited comparisons we can make are only with countries that are not very comparable to the U.K. Lombardy & Wuhan saw their ICUs overwhelmed at the start of the pandemic. Washington State was primarily an outbreak in a care home, and New York City had a very severe outbreak, and has issues with access to care that the U.K. does not have. It also has much higher levels of comorbidity.

As more data emerges from the pandemic, researchers interested in this question should prioritise two things. Firstly, looking at variation within countries (particularly within the NHS) – to see whether factors such as level of staffing, or number of COVID-19 patients, are related to ICU mortality rate. Secondly, as more comparable countries such as France and Spain produce more complete data – unpick and understand, ideally using multivariate analysis, whether true variation between different countries exists.

[i] Arentz et al (2020) Characteristics and Outcomes of 21 Critically Ill Patients With COVID-19 in Washington State, JAMA https://jamanetwork.com/journals/jama/fullarticle/2763485

[ii] Yang et al (2020) Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study, the Lancet Respiratory Medicine https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(20)30079-5/fulltext

[iii] Graselli et al (2020) Baseline Characteristics and Outcomes of 1591 Patients Infected With SARS-CoV-2 Admitted to ICUs of the Lombardy Region, Italy, JAMA https://jamanetwork.com/journals/jama/fullarticle/2764365

[iv] RENVE (2020) Informe sobre la situacion de COVID-19 en Espana: informe COVID-19 no 26 27 de abril de 2020. https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Paginas/InformesCOVID-19.aspx

[v] ICNARC (2020) ICNARC report on COVID-19 in critical care 10 April 2020 https://www.icnarc.org/Our-Audit/Audits/Cmp/Reports

[vi] Richardson et al (2020) Presenting characteristics, comorbidities, and outcomes among 5,700 patients hospitalized with COVID-19 in the New York City Area https://jamanetwork.com/journals/jama/fullarticle/2765184