ICNARC report on COVID-19 in critical care:

England, Wales and Northern Ireland

16 October 2020

This report presents analyses of data on patients critically ill with confirmed COVID-19 reported to ICNARC up to 4pm on 15 October 2020 from critical care units participating in the Case Mix Programme (the national clinical audit covering all NHS adult, general intensive care and combined intensive care/high dependency units in England, Wales and Northern Ireland, plus some additional specialist and non-NHS critical care units).

Due to the increasing number of recent admissions, data are reported separately for patients critically ill with confirmed COVID-19 at or after the start of critical care:

- admitted from 1 September 2020 to date; and
- admitted up to 31 August 2020.

Please note that adult critical care units in Scotland, paediatric intensive care units and neonatal intensive care units do not participate in the Case Mix Programme.

Reporting process

Critical care units participating in the Case Mix Programme are asked to:

- log a case with ICNARC by submitting a record, with minimal data, as soon as they have an admission with confirmed COVID-19;
- resubmit data, including first 24-hour physiology, as soon as possible after the end of the first 24 hours in critical care;
- resubmit data for the whole critical care stay, including critical care outcome and organ support, when the patient leaves critical care; and
- submit final data when the patient leaves acute hospital.

ICNARC have logged data for 1352 admissions of 1233 patients critically ill with confirmed COVID-19, either at or after the start of critical care admitted from 1 September 2020 to date in England, Wales and Northern Ireland. Of these, data covering the first 24 hours of critical care have been submitted to ICNARC for 1078 patients (Figure 1). Of the 1233 total patients, 643 have outcomes reported and 590 patients were last reported as still receiving critical care. These patients are compared with a cohort of 10,900 patients with confirmed COVID-19 admitted up to 31 August 2020.
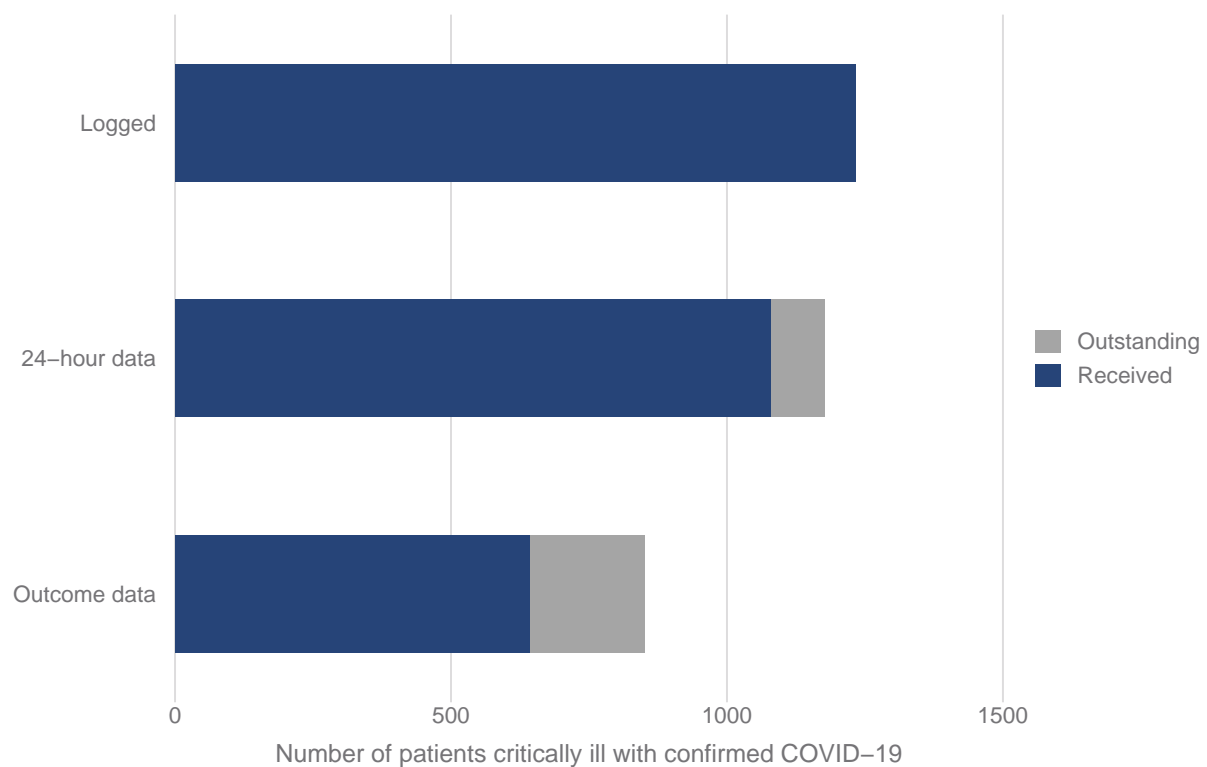
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Figure 1. Numbers of critically ill patients with confirmed COVID-19 admitted from 1 September 2020 with data included in this report and outstanding *

* Please note that 24-hour data are considered outstanding when a case was logged at least 48 hours previously and outcome data are considered outstanding when 24-hour data have been received and at least 10 days have elapsed since the start of critical care.

Of the 1233 patients critically ill with confirmed COVID-19 admitted from 1 September 2020 to date, the largest numbers were admitted in the North West, North East And Yorkshire, and Midlands regions (Figure 2).
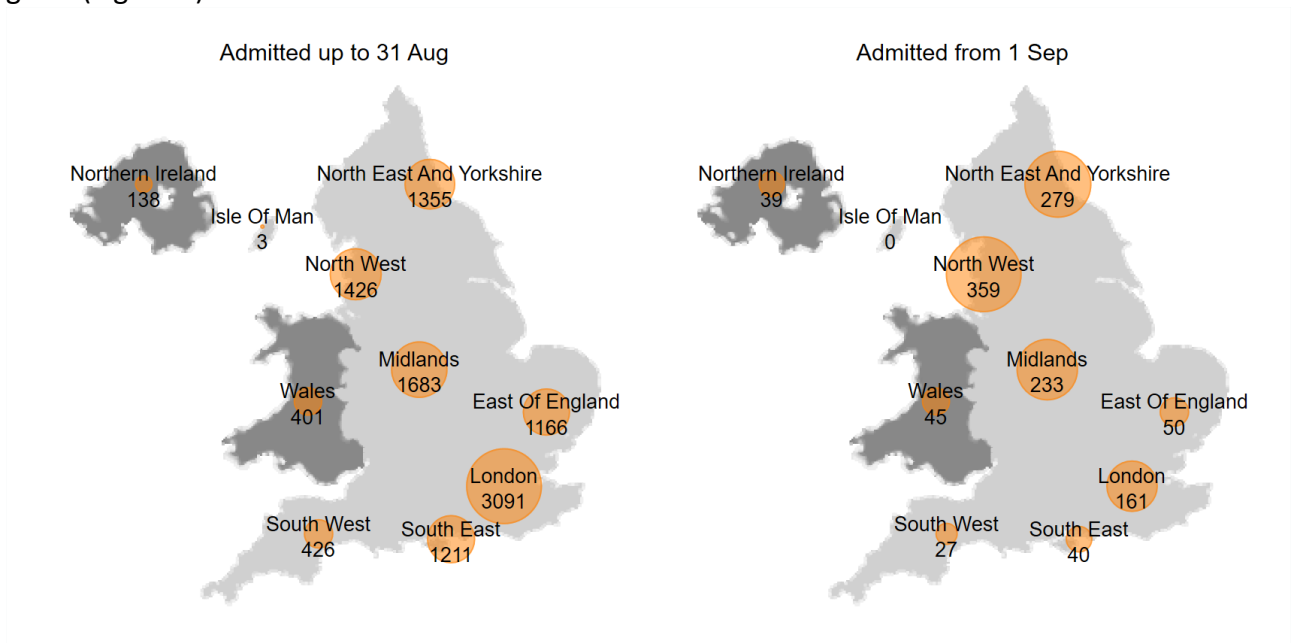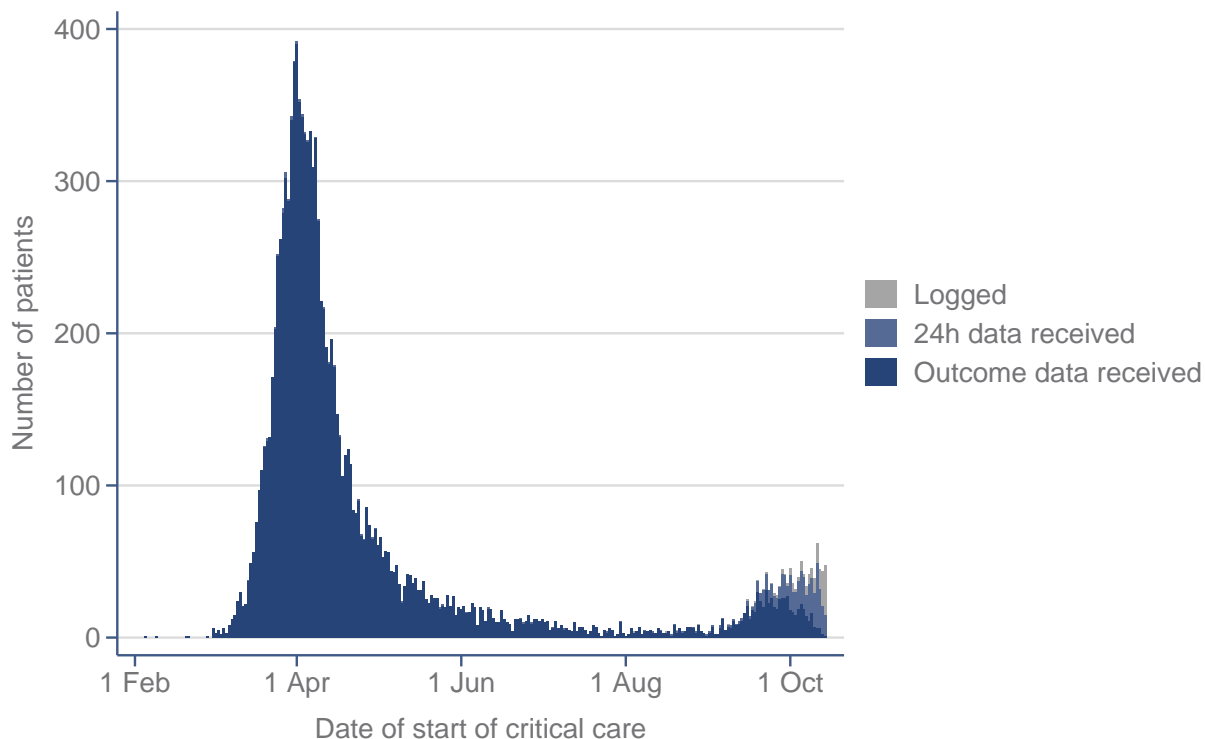

Figure 2. Geographical distribution of patients critically ill with confirmed COVID-19

The numbers of new patients, cumulative numbers of patients and numbers of patients in critical care by date are shown in Figures 3-8. Please note that these figures are affected by a variable lag time for submission of data.
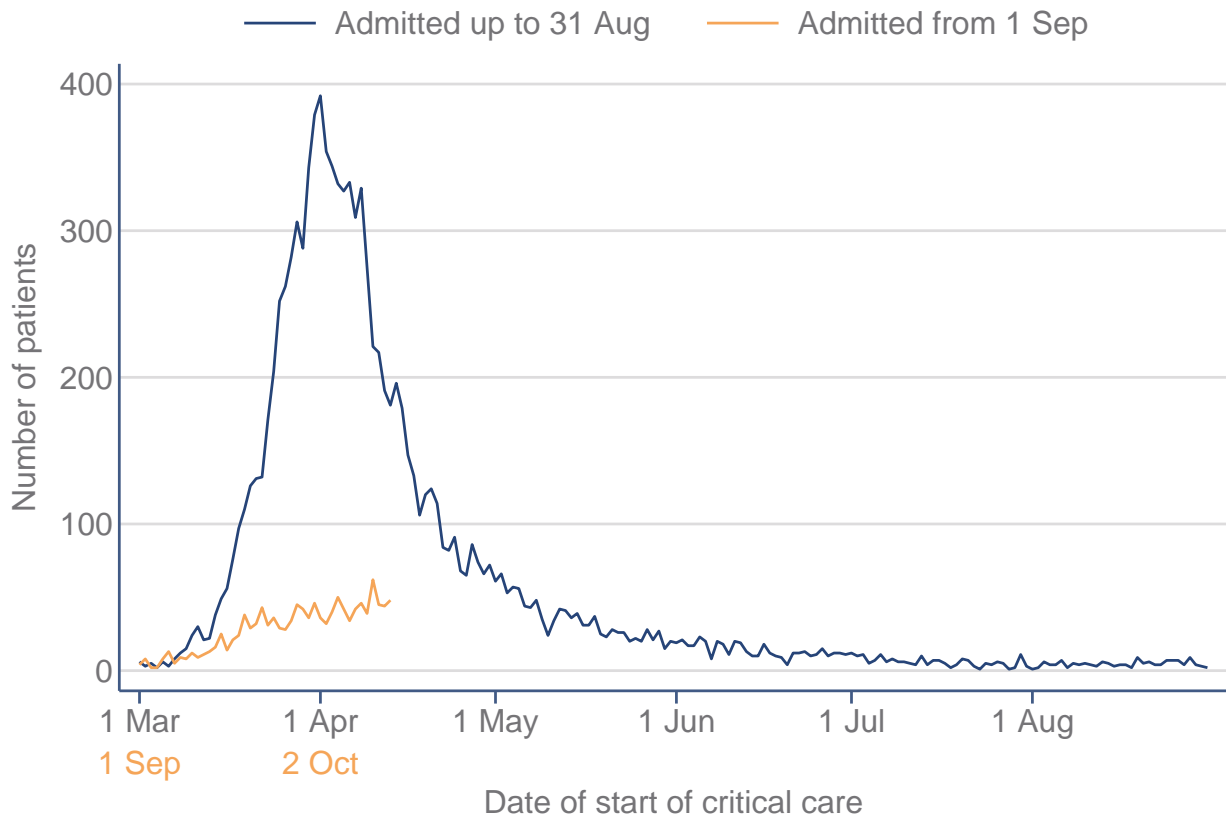

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Figure 3. Number of new patients critically ill with confirmed COVID-19 by date of start of critical care over the entire epidemic
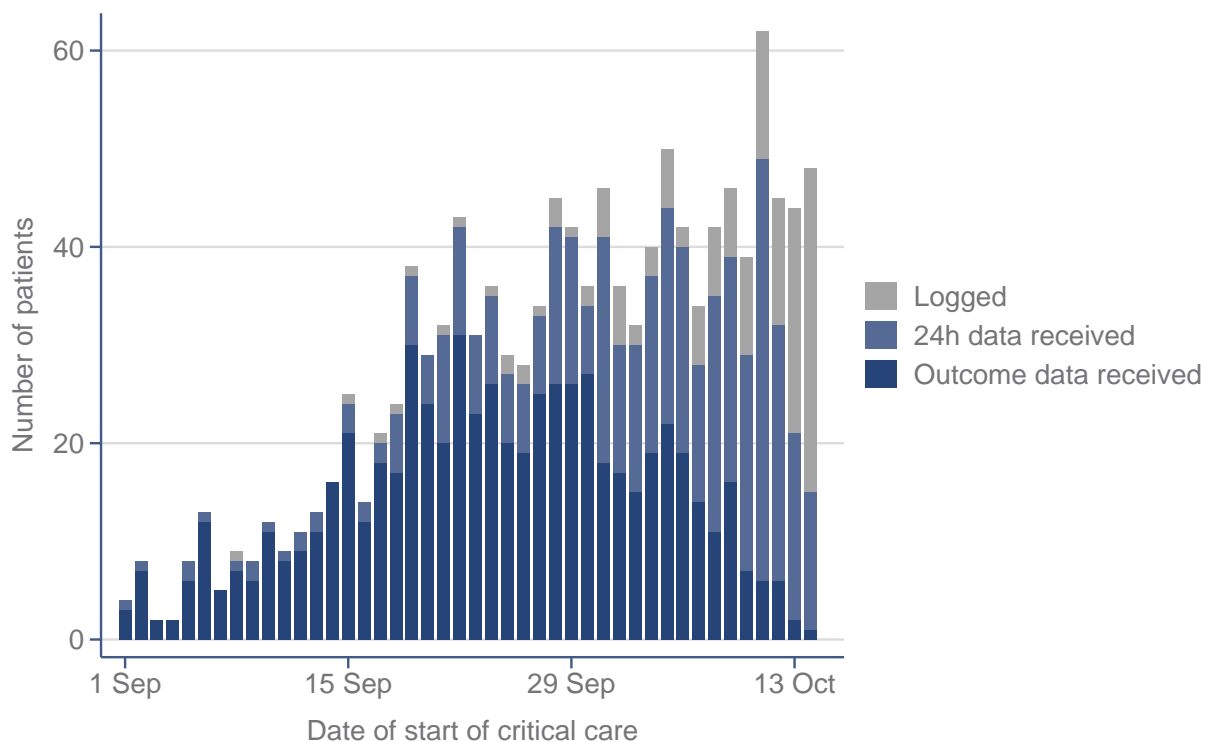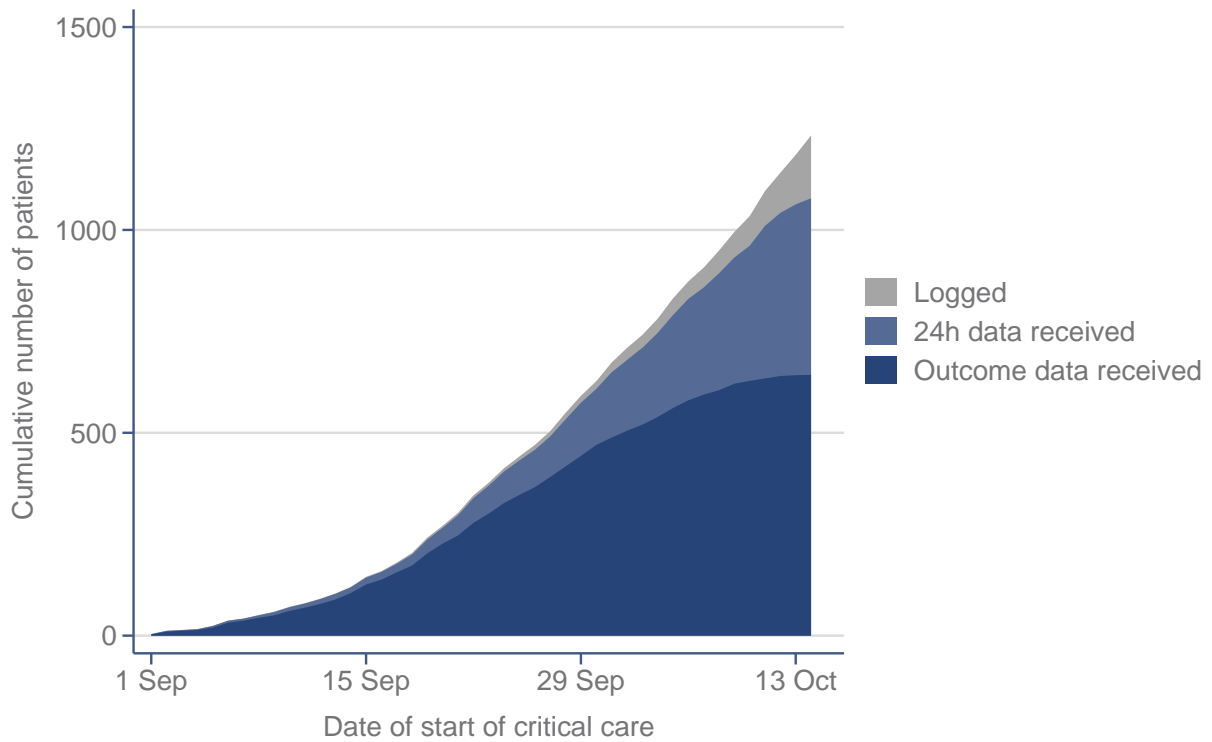

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Figure 4. Number of new patients critically ill with confirmed COVID-19 admitted from 1 September 2020 by date of start of critical care

Figure 5. Comparison of the number of new patients critically ill with confirmed COVID-19 by date of start of critical care from 1 March 2020 to 31 August 2020 versus 1 September 2020 to date

Figure 6. Cumulative number of patients critically ill with confirmed COVID-19 admitted from 1 September 2020 by date of start of critical care
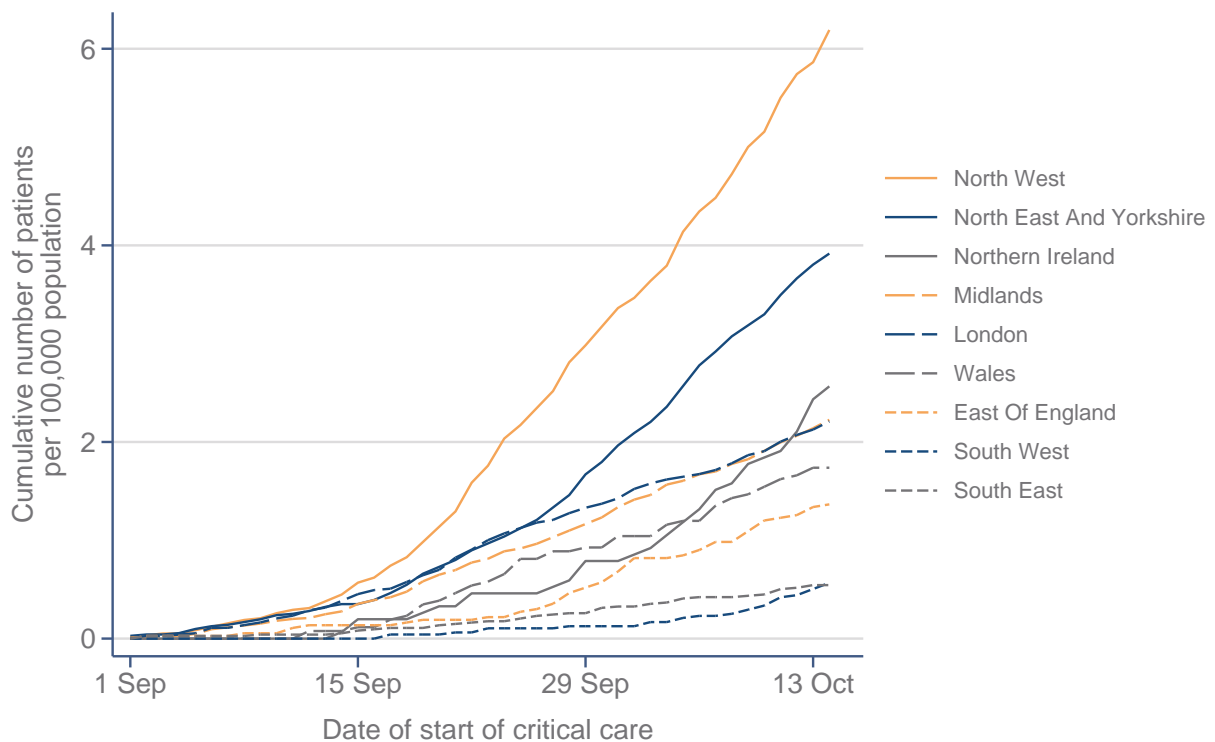

Figure 7. Cumulative number of patients critically ill with confirmed COVID-19 admitted from 1 September 2020 per 100,000 adult population by region
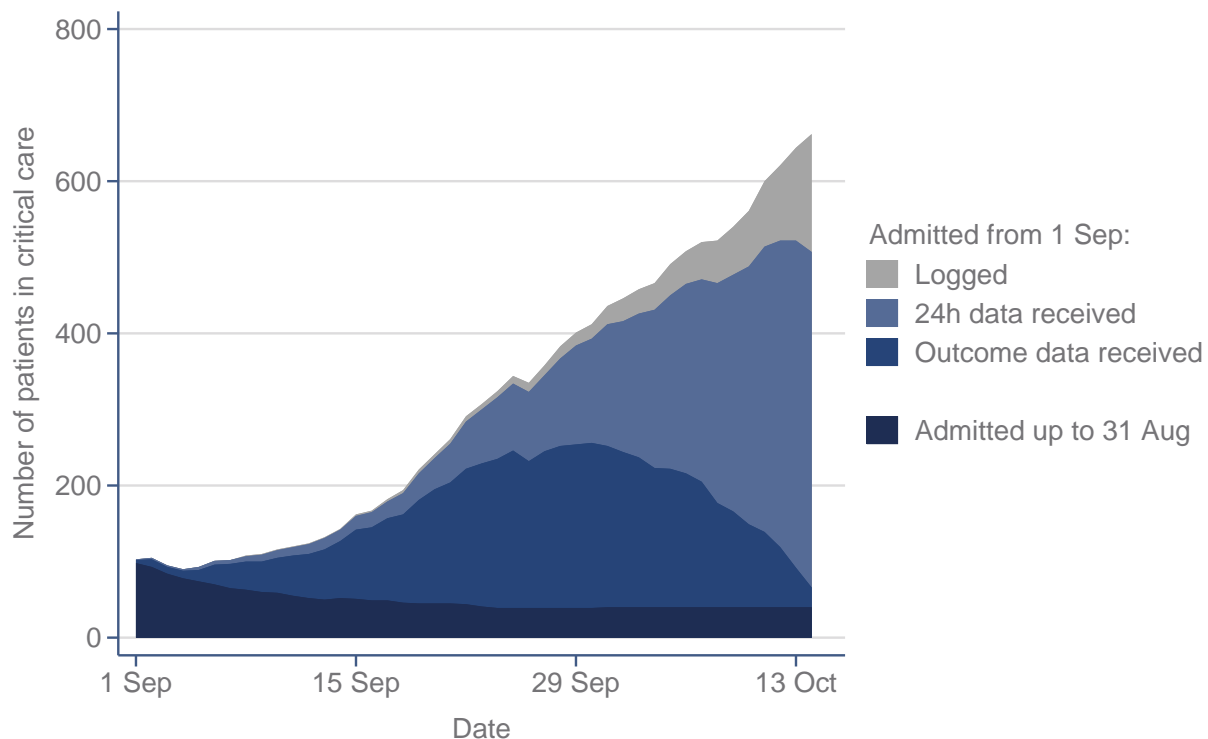
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Figure 8. Total number of patients critically ill with confirmed COVID-19 from 1 September 2020 by date *

* Please note patients whose outcome data have not been received are assumed to remain in critical care as of 15 October 2020.

Patient characteristics

Characteristics of patients critically ill with confirmed COVID-19 admitted from 1 September 2020 to date are summarised in Tables 1-3 and compared with patients admitted up to 31 August 2020.

Table 1. Patient characteristics: demographics

Demographics	Patients with confirmed COVID-19	
	Admitted from 1 Sep (N=1233)	Admitted up to 31 Aug (N=10,900)
Age at admission (years) [N=1233]		
Mean (SD)	59.7 (14.4)	58.8 (12.7)
Median (IQR)	62 (51, 70)	60 (51, 68)
Sex, n (%) [N=1231]		
Female	376 (30.5)	3263 (30.0)
Male	855 (69.5)	7631 (70.0)
Ethnicity, n (%) [N=1139]		
White	787 (69.1)	6921 (66.0)
Mixed	8 (0.7)	191 (1.8)
Asian	227 (19.9)	1671 (15.9)
Black	62 (5.4)	1003 (9.6)
Other	55 (4.8)	694 (6.6)
Index of Multiple Deprivation (IMD) quintile *, n (%) [N=1203]		
1 (least deprived)	133 (11.1)	1542 (14.4)
2	141 (11.7)	1731 (16.1)
3	174 (14.5)	2074 (19.3)
4	299 (24.9)	2603 (24.2)
5 (most deprived)	456 (37.9)	2795 (26.0)
Body mass index *, n (%) [N=1056]		
$<$18.5	4 (0.4)	79 (0.8)
18.5-$<$25	205 (19.4)	2640 (25.5)
25-$<$30	339 (32.1)	3557 (34.3)
30-$<$40	383 (36.3)	3253 (31.4)
$\geq$40	125 (11.8)	827 (8.0)

* Please see Definitions on page 21.

Table 2. Patient characteristics: medical history

| Medical history	Patients with confirmed COVID-19	
	Admitted from 1 Sep (N=1233)	Admitted up to 31 Aug (N=10,900)
Dependency prior to admission to acute hospital, n (%) [N=1079]		
Able to live without assistance in daily activities	961 (89.1)	9647 (89.4)
Some assistance with daily activities	116 (10.8)	1109 (10.3)
Total assistance with all daily activities	2 (0.2)	40 (0.4)
Very severe comorbidities *, n (%) [N=1107]		
Cardiovascular	10 (0.9)	71 (0.7)
Respiratory	18 (1.6)	126 (1.2)
Renal	16 (1.4)	187 (1.7)
Liver	5 (0.5)	50 (0.5)
Metastatic disease	7 (0.6)	59 (0.5)
Haematological malignancy	20 (1.8)	212 (2.0)
Immunocompromise	47 (4.2)	386 (3.6)
CPR within previous 24h, n (%) [N=1133]		
In the community	8 (0.7)	51 (0.5)
In hospital	7 (0.6)	76 (0.7)
Prior hospital length of stay [N=1213]		
Mean (SD)	2.0 (4.0)	2.5 (6.2)
Median (IQR)	1 (0, 3)	1 (0, 3)
Currently or recently pregnant, n (% of females aged 16-49) [N=110]		
Currently pregnant	13 (11.8)	29 (3.7)
Recently pregnant (within 6 weeks)	6 (5.5)	41 (5.2)
Not known to be pregnant	91 (82.7)	717 (91.1)

* Please see Definitions on page 21.

Table 3. Patient characteristics: indicators of acute severity

Indicators of acute severity	Patients with confirmed COVID-19 and 24h data received	
	Admitted from 1 Sep (N=1078)	Admitted up to 31 Aug (N=10,900)
Mechanically ventilated within first 24h *, n (%) [N=998]	265 (26.6)	6247 (58.1)
APACHE II Score [N=1049]		
Mean (SD)	14.2 (5.5)	15.1 (5.3)
Median (IQR)	14 (11, 17)	15 (11, 18)
PaO$_2$/FiO$_2$ ratio † (kPa), median (IQR) [N=973]	13.8 (10.0, 18.8)	15.8 (11.3, 22.0)
PaO$_2$/FiO$_2$ ratio †, n (%) [N=973]		
$<$ 13.3 kPa ($<$ 100 mmHg)	457 (47.0)	3783 (36.9)
13.3-26.6 kPa (100-200 mmHg)	405 (41.6)	4905 (47.8)
$\geq$ 26.7 kPa ($\geq$ 200 mmHg)	111 (11.4)	1563 (15.2)

* Please see Definitions on page 21. Indicators of acute severity are based on data from the first 24 hours of critical care. † Derived from the arterial blood gas with the lowest PaO$_2$ during the first 24 hours of critical care.
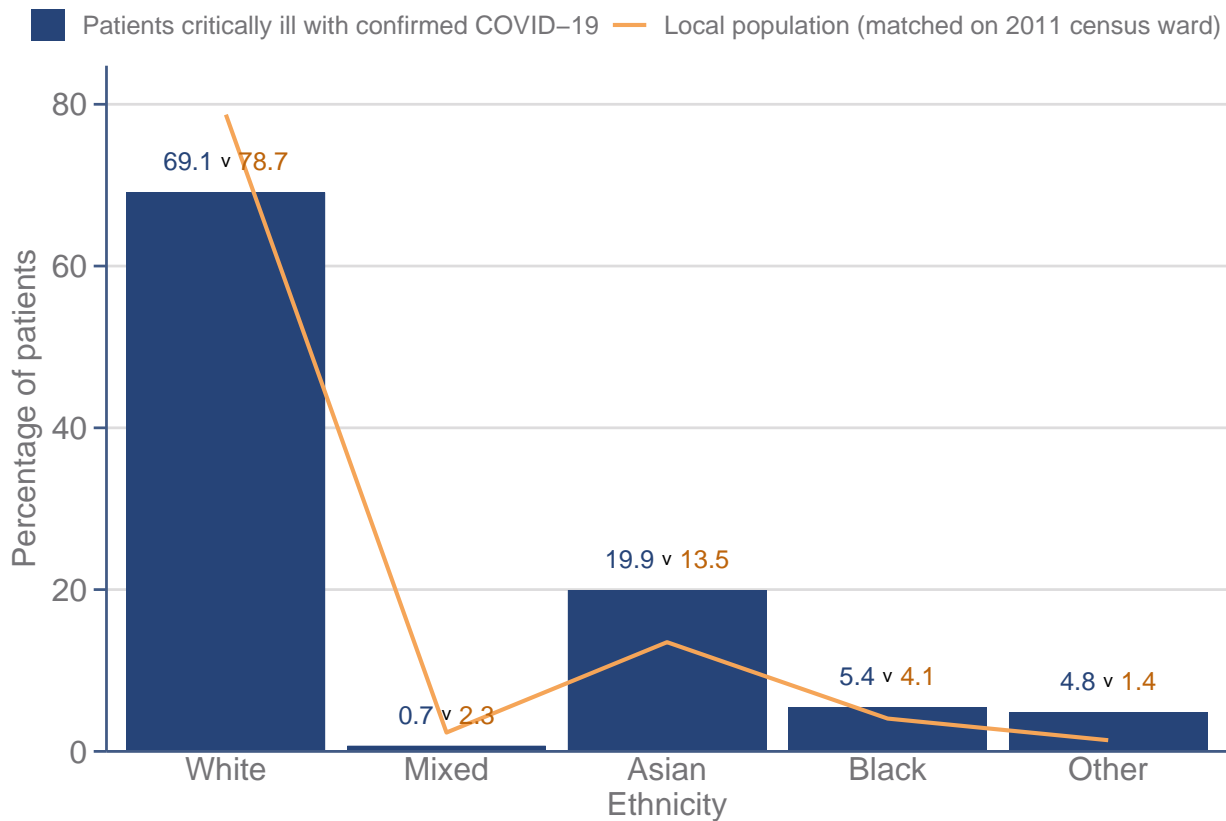
The distribution of age and sex is presented in Figure 9.
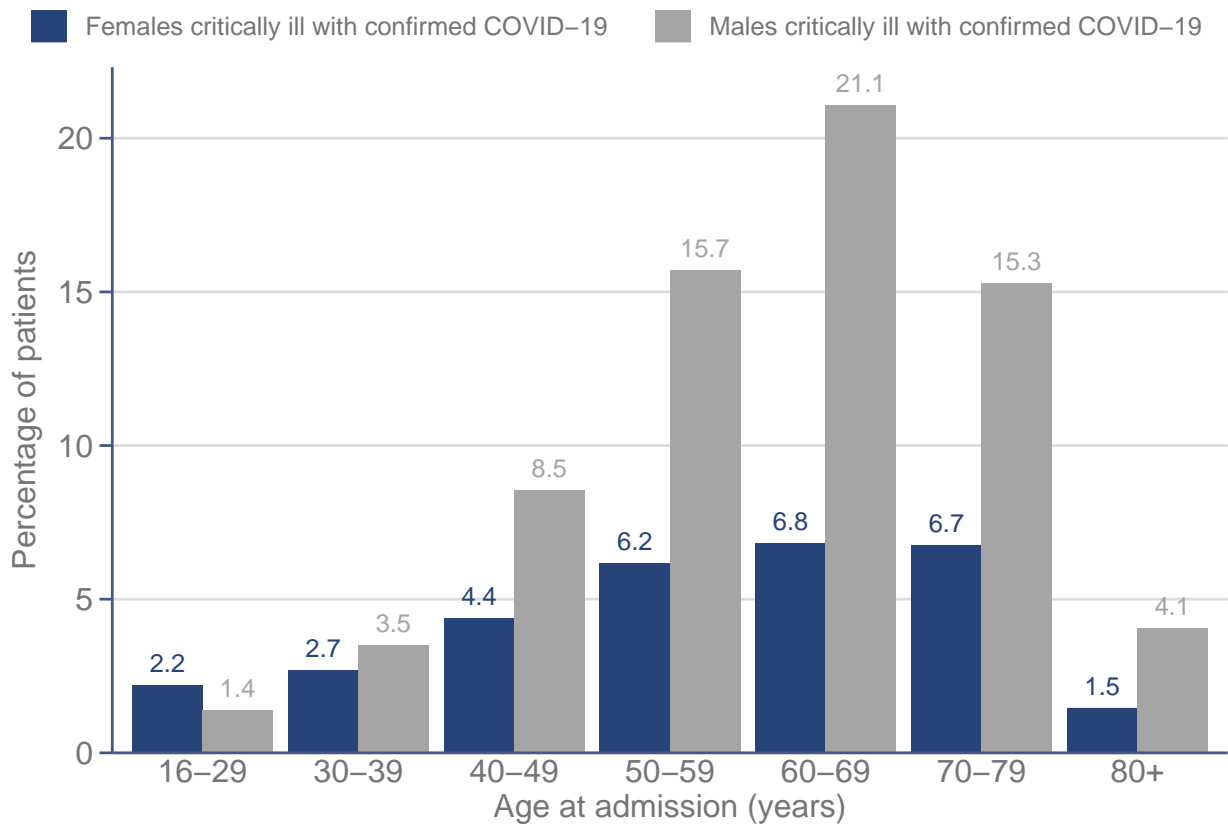
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Figure 9. Age and sex distribution of patients critically ill with confirmed COVID-19 admitted from 1 September 2020

The distribution of ethnicity, matched on 2011 census ward for location of patients critically ill with COVID-19, is presented in Figure 10.

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Figure 10. Ethnicity distribution of patients critically ill with confirmed COVID-19 admitted from 1 September 2020 compared with the local population (linked to 2011 census ward)

The distribution of Index of Multiple Deprivation (IMD) is presented in Figure 11.
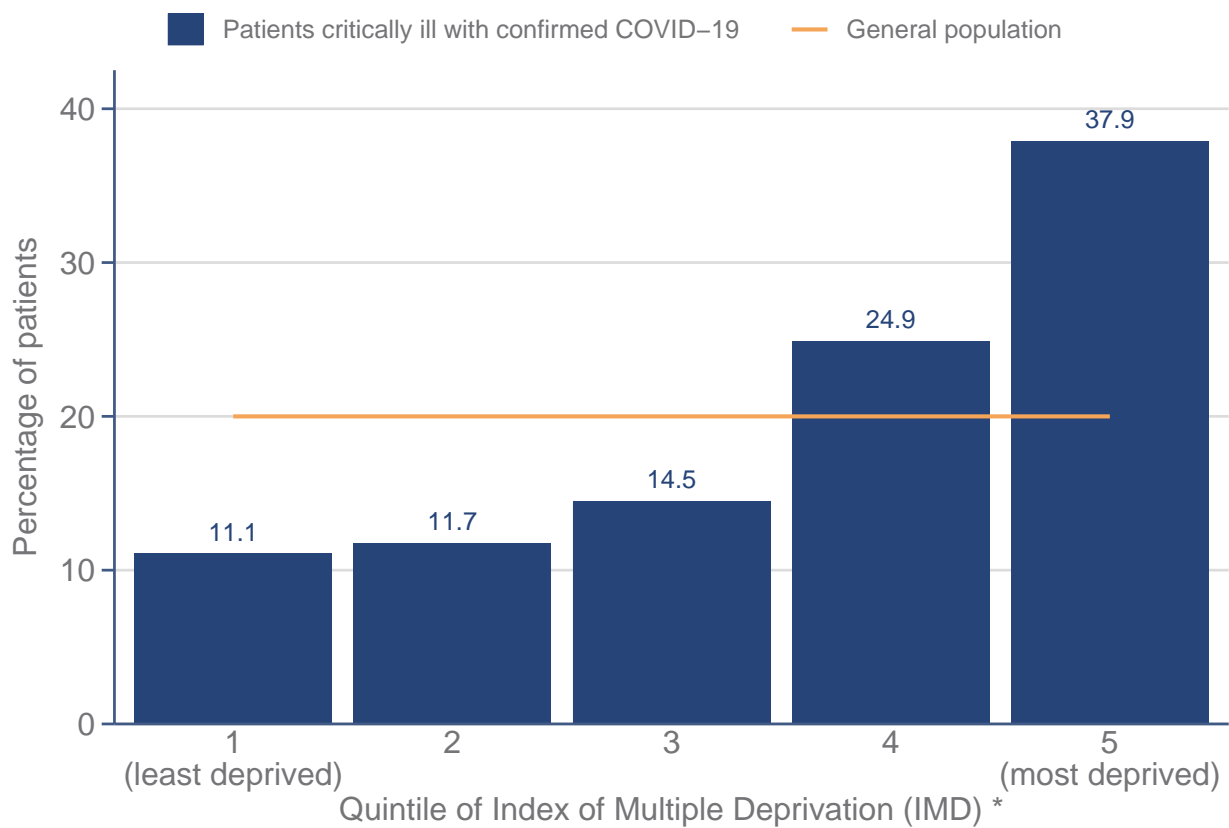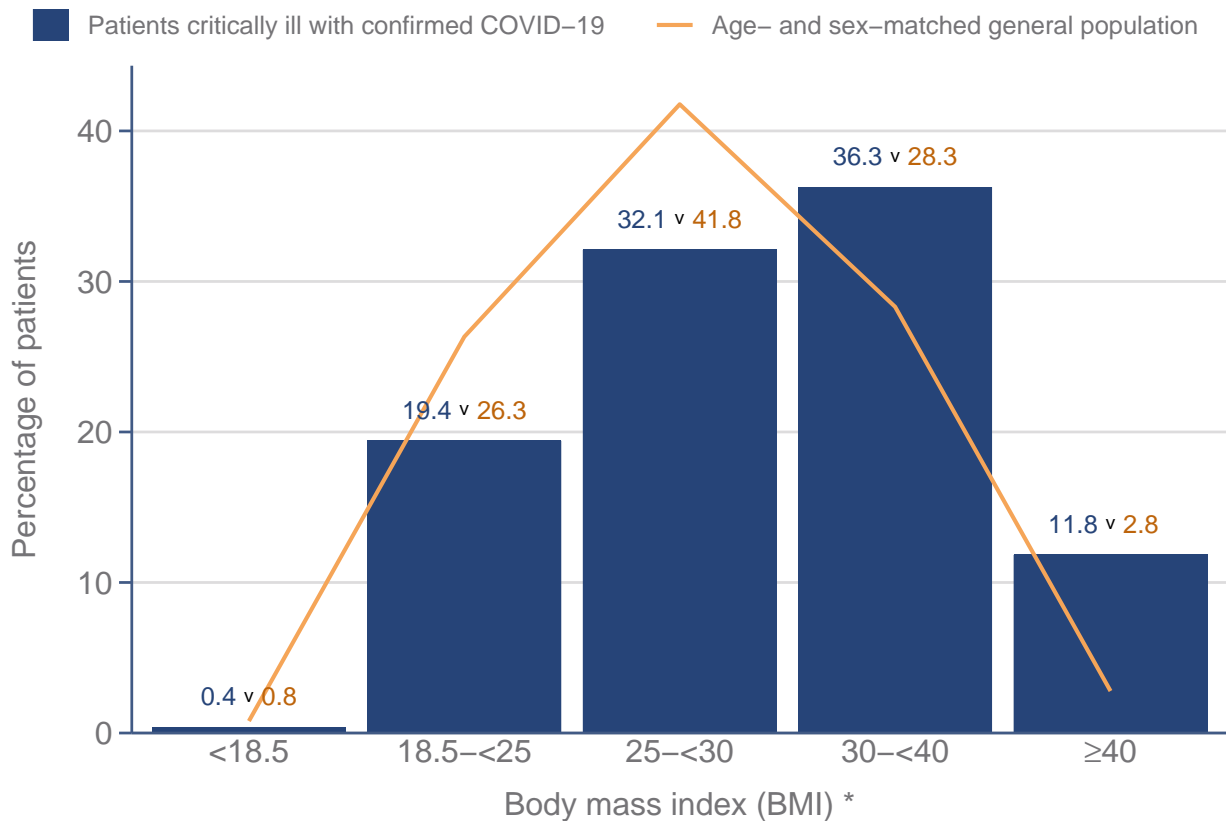

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Figure 11. Index of Multiple Deprivation (IMD) * distribution of patients critically ill with confirmed COVID-19 admitted from 1 September 2020 compared with the general population

* Please see Definitions on page 21.

The distribution of body mass index (BMI), compared with an age- and sex-matched population (from the Health Survey for England 2018), is presented in Figure 12.

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Figure 12. Body mass index (BMI) * distribution of patients critically ill with confirmed COVID-19 admitted from 1 September 2020 compared with the age- and sexmatched general population (Health Survey for England 2018)

* Please see Definitions on page 21.

Critical care outcomes have been received for 643 (of 1233) patients. Of these, 174 have died and 469 have been discharged from critical care (Figures 13 and 14). The remaining 590 were last reported to still be receiving critical care.
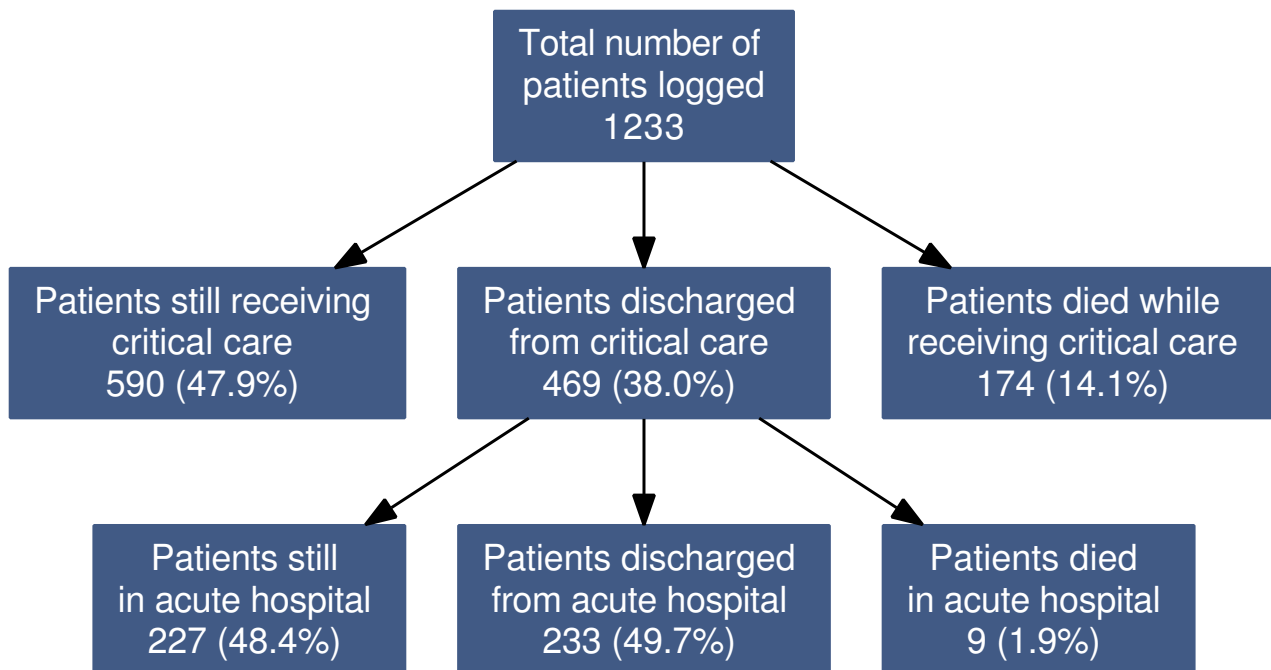
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                        ┌─────────────────────┐
                        │   Total number of   │
                        │   patients logged   │
                        │        1233         │
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Patients still receiving critical care 590 (47.9%)	Patients discharged from critical care 469 (38.0%)	Patients died while receiving critical care 174 (14.1%)

Patients still in acute hospital 227 (48.4%)	Patients discharged from acute hospital 233 (49.7%)	Patients died in acute hospital 9 (1.9%)

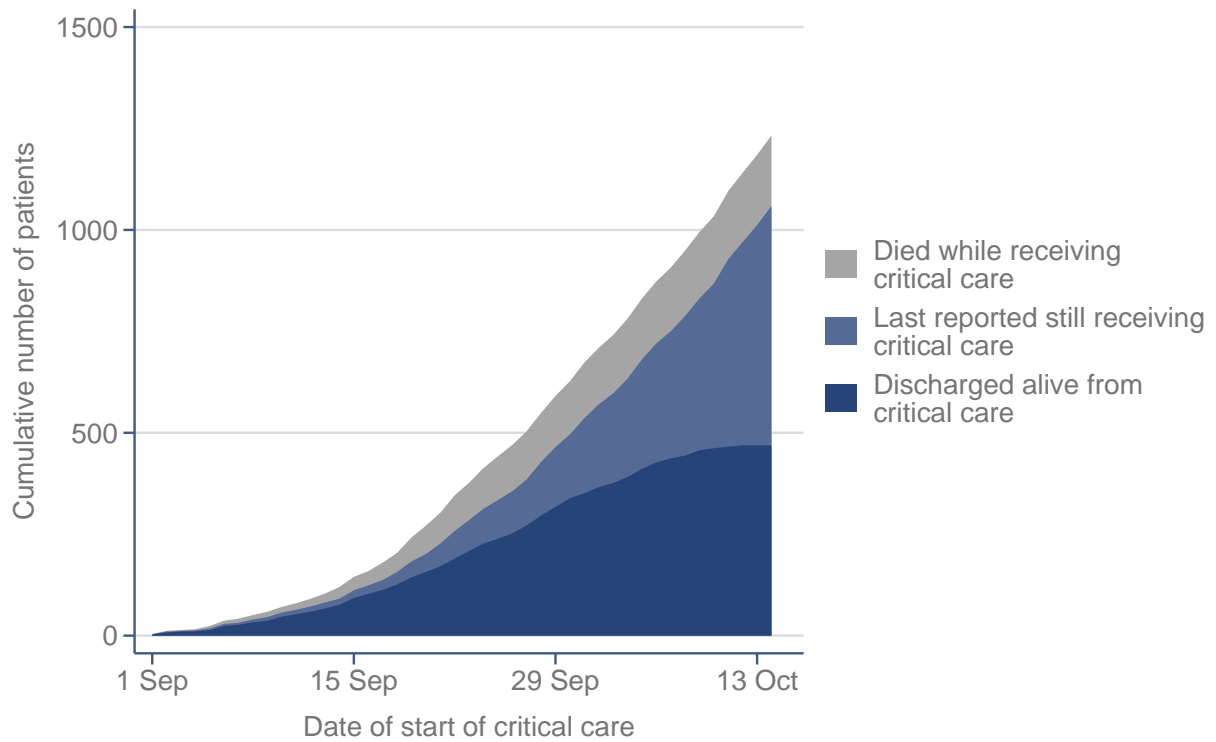**Figure 13. Critical care and acute hospital outcomes for patients admitted from 1 September 2020**

Figure 14. Cumulative outcomes for patients admitted from 1 September 2020 by date of start of critical care *

* Please note that patients whose outcome data have not been received are assumed to remain in critical care as of 15 October 2020.

Critical care outcome, duration of critical care and organ support for patients critically ill with confirmed COVID-19 admitted from 1 September 2020 to date for whom outcomes have been received are summarised in Table 4 and compared with patients admitted up to 31 August 2020.

Table 4. Critical care outcome, duration of critical care and organ support

	Patients with confirmed COVID-19 and outcome received	
Critical care outcome	Admitted from 1 Sep (N=643)	Admitted up to 31 Aug (N=10,837)
Outcome at end of critical care, n (%) [N=1233]		
Discharged	469 (38.0)	6554 (60.1)
Died	174 (14.1)	4283 (39.3)
Still receiving critical care	590 (47.9)	63 (0.6)
Duration of critical care		
Duration of critical care (days) †, median (IQR) [N=641]		
Survivors	5 (3, 8)	12 (5, 28)
Non-survivors	8 (3, 15)	9 (5, 16)
Organ support (Critical Care Minimum Dataset) *		
Receipt of organ support, at any point, n (%) [N=629]		
Advanced respiratory support	180 (28.6)	7808 (72.1)
Basic respiratory support	529 (84.1)	7393 (68.2)
Advanced cardiovascular support	85 (13.5)	3326 (30.7)
Basic cardiovascular support	579 (92.1)	10090 (93.1)
Renal support	49 (7.8)	2899 (26.8)
Liver support	4 (0.6)	113 (1.0)
Neurological support	17 (2.7)	982 (9.1)
Duration of organ support (calendar days), median (IQR) [N=629]		
Advanced respiratory support	8 (4, 13)	14 (7, 24)
Total (advanced + basic) respiratory support	6 (3, 9)	11 (5, 22)
Advanced cardiovascular support	2 (1, 4)	3 (2, 6)
Total (advanced + basic) cardiovascular support	6 (4, 10)	11 (5, 22)
Renal support	4 (2, 8)	8 (3, 15)

Please note that the results for patients admitted from 1 September 2020 are biased towards patients with shorter lengths of stay in critical care prior to discharge or death, i.e. those who died or recovered quickly. * Please see Definitions on page 21. † Duration of critical care is the total over all critical care admissions for the the same patient and excludes any time spent outside critical care areas (e.g. prior to any readmissions).

28-day in-hospital outcome

A Kaplan-Meier plot of in-hospital survival to 28 days following admission to critical care for patients critically ill with confirmed COVID-19 admitted from 1 September 2020 to date is shown in Figure 15 and compared with patients admitted up to 31 August 2020.
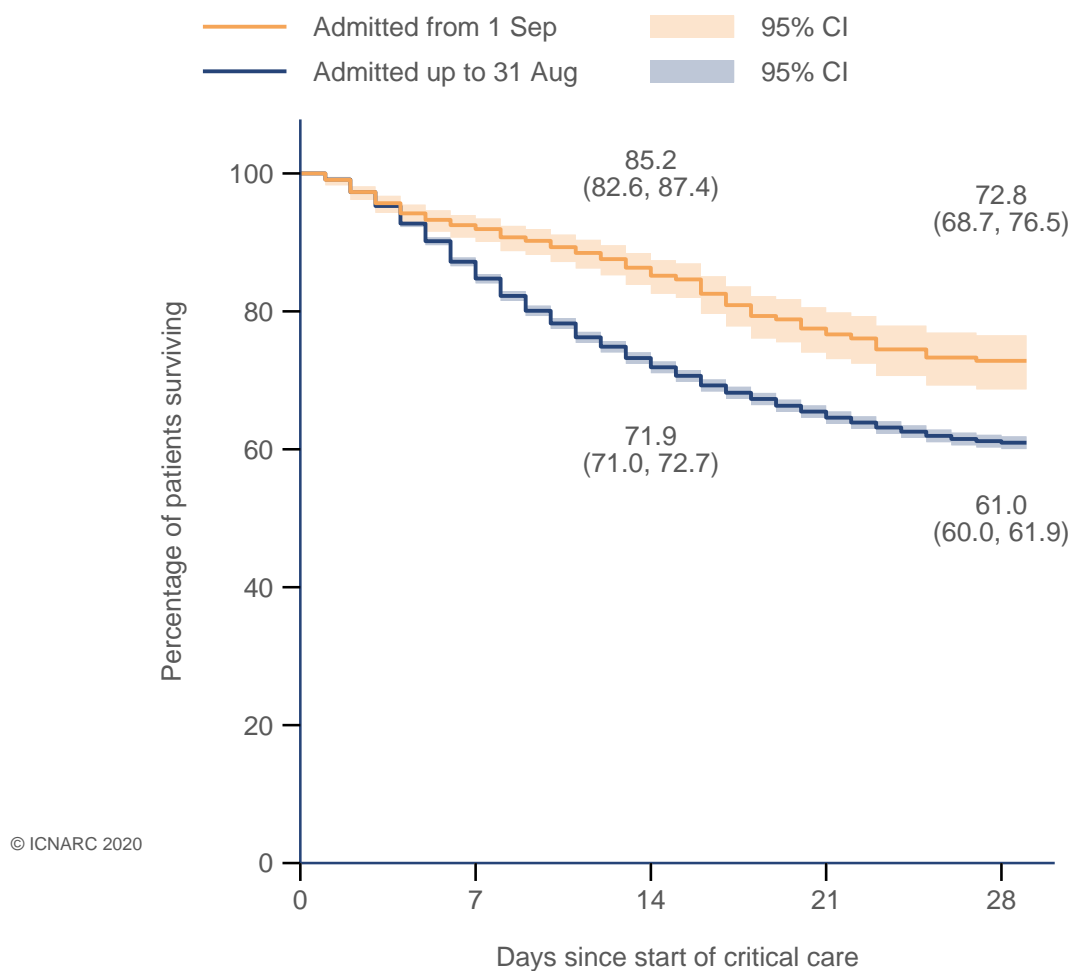
Admitted from 1 Sep					
At risk	1077	769	478	262	121
Died (in hospital)	0	82	130	169	180
Censored	0	226	469	646	776
Admitted up to 31 Aug					
At risk	10896	9228	7824	7028	6627
Died (in hospital)	0	1661	3061	3856	4251
Censored	0	7	11	12	18

Figure 15. In-hospital survival to 28 days following admission to critical care

Kaplan-Meier survival analysis. Patients last reported to be still receiving critical care censored on the most recent date of data submission by the treating unit. Patients discharged from acute hospital within 28 days assumed to survive to 28 days. Please note that these survival curves are not adjusted for differences in patient characteristics (see Tables 1-3).

28-day in-hospital mortality for patients critically ill with confirmed COVID-19 admitted from 1 September 2020 to date by patient characteristics (demographics and indicators of acute severity) is presented in Figures 16 and 17 and compared with patients admitted up to 31 August 2020.
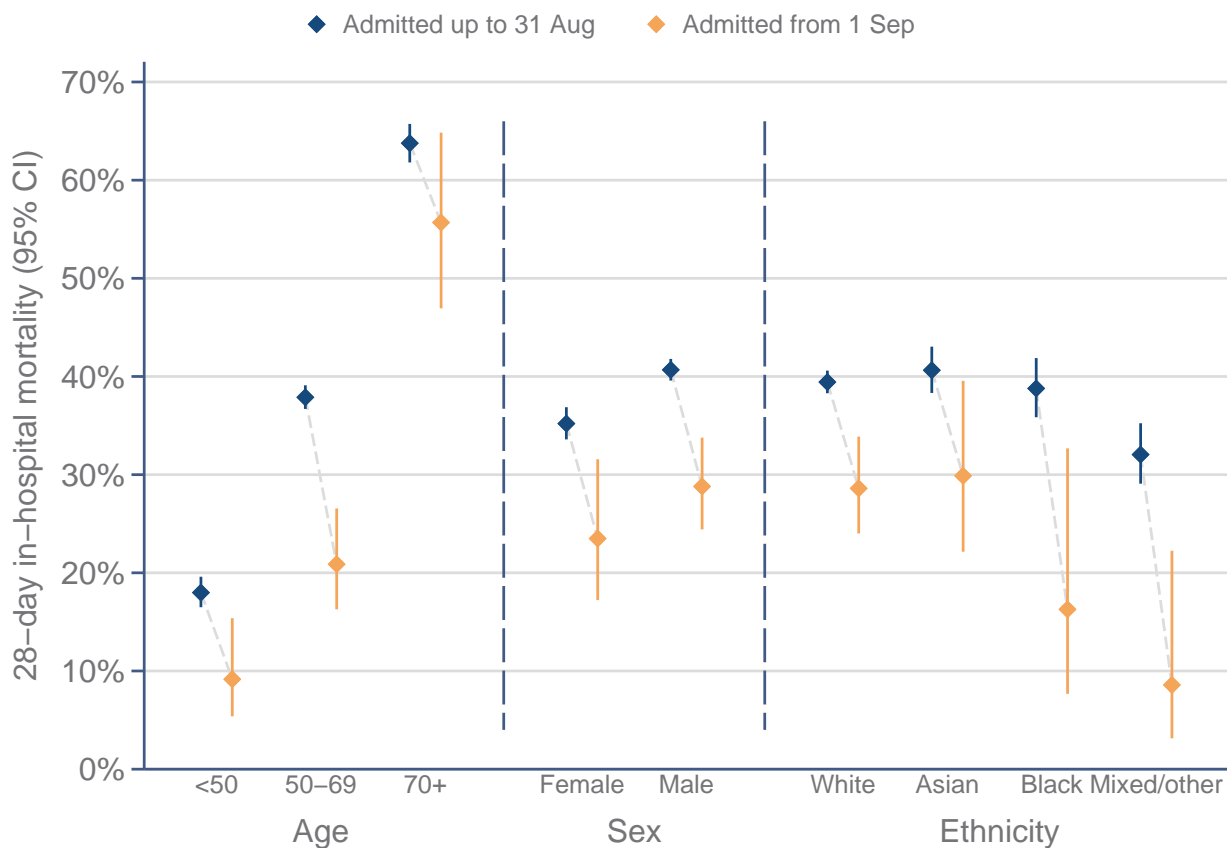
Figure 16. 28-day in-hospital mortality by patient characteristics (demographics)

Estimates of 28-day in-hospital mortality based on Kaplan-Meier survival analysis. Patients last reported to be still receiving critical care censored on the most recent date of data submission by the treating unit. Patients discharged from acute hospital within 28 days assumed to survive to 28 days. Please note that these estimates are not adjusted for differences in other patient characteristics (see Tables 1-3).
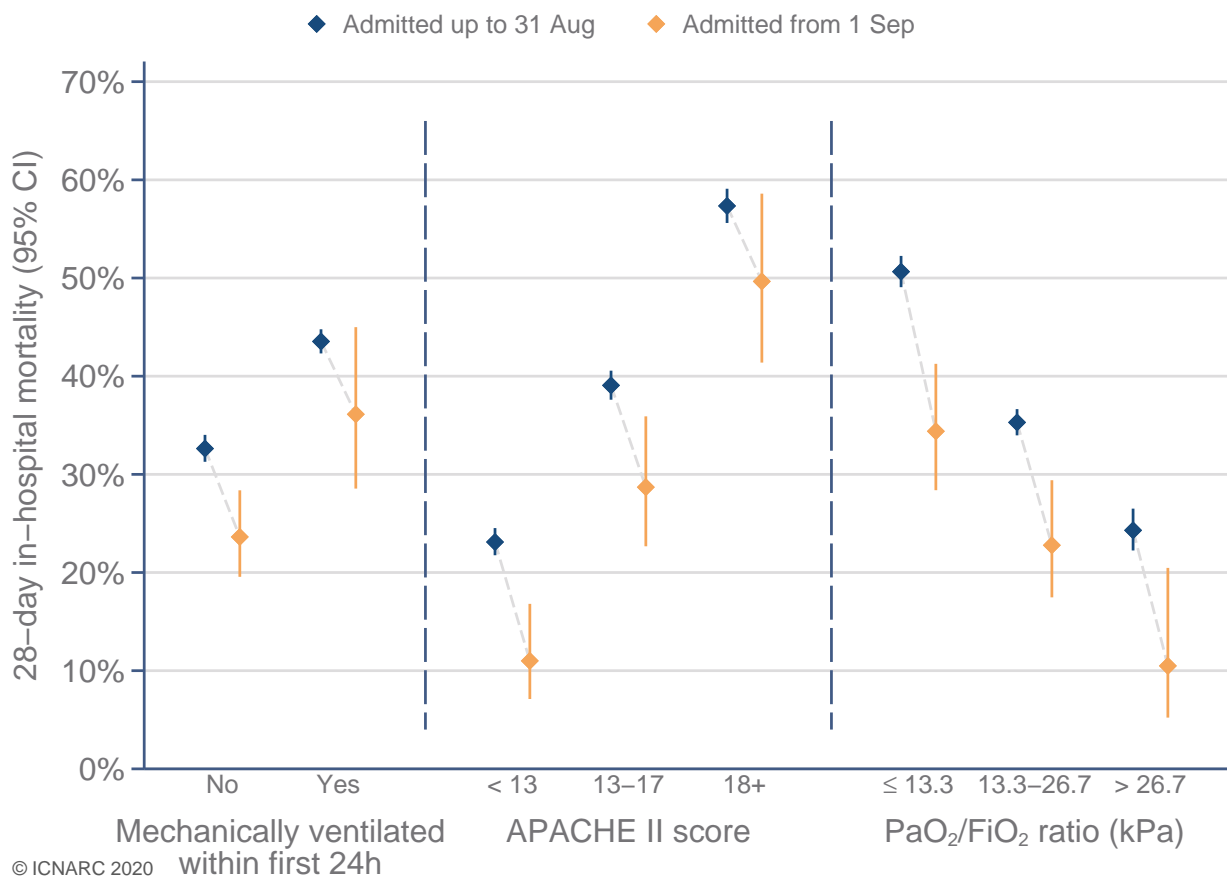
Figure 17. 28-day in-hospital mortality by patient characteristics (indicators of acute severity *)

Estimates of 28-day in-hospital mortality based on Kaplan-Meier survival analysis. Patients last reported to be still receiving critical care censored on the most recent date of data submission by the treating unit. Patients discharged from acute hospital within 28 days assumed to survive to 28 days. Please note that these estimates are not adjusted for differences in other patient characteristics (see Tables 1-3). * Please see Definitions on page 21. Indicators of acute severity are based on data from the first 24 hours of critical care.

Definitions

Ethnicity is recorded using the ethnic category codes from the 2001 census and grouped as:

- White: White – British; White – Irish; White – any other
- Mixed: Mixed – white and black Caribbean; Mixed – white and black African; Mixed – white and Asian; Mixed – any other
- Asian: Asian or Asian British – Indian; Asian or Asian British – Pakistani; Asian or Asian British – Bangladeshi; Asian or Asian British – any other
- Black: Black or black British – Caribbean; Black or black British – African; Black or black British – any other
- Other: Other ethnic group – Chinese; Any other ethnic group
- Not stated or not recorded

Index of Multiple Deprivation (IMD) is based on the patient's usual residential postcode (assigned at the level of Lower Layer Super Output Area) according to:

- English Index of Multiple Deprivation 2019 for postcodes in England
- Welsh Index of Multiple Deprivation 2019 for postcodes in Wales
- Northern Ireland Multiple Deprivation Measure 2017 for postcodes in Northern Ireland

Body mass index is calculated as the weight in kilograms divided by the height in metres squared. Weight and height values may have been measured or estimated.

Dependency prior to admission to acute hospital is assessed as the best description for the dependency of the patient in the two weeks prior to admission to acute hospital and prior to the onset of the acute illness, i.e. "usual" dependency. It is assessed according to the amount of personal assistance they receive with daily activities (bathing, dressing, going to the toilet, moving in/out of bed/chair, continence and eating).

Very severe comorbidities must have been evident within the six months prior to critical care and documented at or prior to critical care:

- Cardiovascular: symptoms at rest
- Respiratory: shortness of breath with light activity or home ventilation
- Renal: renal replacement therapy for end-stage renal disease
- Liver: biopsy-proven cirrhosis, portal hypertension or hepatic encephalopathy
- Metastatic disease: distant metastases
- Haematological malignancy: acute or chronic leukaemia, multiple myeloma or lymphoma
- Immunocompromise: chemotherapy, radiotherapy or daily high dose steroid treatment in previous six months, HIV/AIDS or congenital immune deficiency

Mechanical ventilation during the first 24 hours was identified by the recording of a ventilated respiratory rate, indicating that all or some of the breaths or a portion of the breaths (pressure support) were delivered by a mechanical device. This usually indicates invasive ventilation; BPAP (bilevel positive airway pressure) would meet this definition but CPAP (continuous positive airway pressure) does not.

Organ support is recorded as the number of calendar days (00:00-23:59) on which the support was received at any time, defined as:

- Advanced respiratory: invasive ventilation, BPAP via trans-laryngeal tube or tracheostomy, CPAP via trans-laryngeal tube, extracorporeal respiratory support
- Basic respiratory: >50% oxygen by face mask, close observation due to potential for acute deterioration, physiotherapy/suction to clear secretions at least two-hourly, recently extubated after a period of mechanical ventilation, mask/hood CPAP/BPAP, non-invasive ventilation, CPAP via a tracheostomy, intubated to protect airway
- Advanced cardiovascular: multiple IV/rhythm controlling drugs (at least one vasoactive), continuous observation of cardiac output, intra-aortic balloon pump, temporary cardiac pacemaker
- Basic cardiovascular: central venous catheter, arterial line, single IV vasoactive/ rhythm controlling drug
- Renal: acute renal replacement therapy, renal replacement therapy for chronic renal failure where other organ support is received
- Liver: management of coagulopathy and/or portal hypertension for acute on chronic hepatocellular failure or primary acute hepatocellular failure
- Neurological: central nervous system depression sufficient to prejudice airway, invasive neurological monitoring, continuous IV medication to control seizures, therapeutic hypothermia

Publications

The following publications, based on these data, are in press or preprint:

- Richards-Belle A, Orzechowska I, Doidge J, Thomas K, Harrison DA, Koelewyn A, Christian MD, Shankar-Hari M, Rowan KM, Gould DW. Critical care outcomes, for the first 200 patients with confirmed COVID-19, in England, Wales and Northern Ireland: a report from the ICNARC Case Mix Programme. *J Intensive Care Soc* 2020; doi:10.1177/1751143720961672
- Richards-Belle A, Orzechowska I, Gould DW, Thomas K, Doidge JC, Mouncey PR, Christian MD, Shankar-Hari M, Harrison DA, Rowan KM. COVID-19 in critical care: epidemiology of the first epidemic wave across England, Wales and Northern Ireland. *Intensive Care Med* 2020; doi:10.1007/s00134-020-06267-0
- Ferrando-Vivas P, Doidge J, Thomas K, Gould DW, Mouncey P, Shankar-Hari M, Young JD, Rowan KM, Harrison DA. Prognostic Factors for 30-day Mortality in Critically Ill Patients with Coronavirus Disease 2019: An Observational Cohort Study. *Crit Care Med*, in press.
- Doidge JC, Mouncey PR, Thomas K, Gould DW, Ferrando-Vivas P, Shankar-Hari M, Harrison DA, Rowan KM. Trends in intensive care for patients with COVID-19 in England, Wales and Northern Ireland. *Preprints* 2020; 2020080267; doi:10.20944/preprints202008.0267.v2

Acknowledgement