

Critical care outreach during the COVID-19 pandemic: An observational study

Brigitta Fazzini   | Simon Nourse | Ann McGinley

Adult Critical Care Unit, Royal London Hospital, Barts Health NHS Trust, London, UK

Correspondence

Brigitta Fazzini, Adult Critical Care Unit, Royal London Hospital, Barts Health NHS Trust, Whitechapel Road, E1 1FR, London, UK.
Email: brigitta.fazzini@nhs.net

Funding information

This research received no grant or funding from agencies, the public, commercial or not-for-profit sector.

Abstract

Background: Since the beginning of the coronavirus disease 2019 (COVID-19) outbreak, the Critical Care Outreach Team (CCOT) remained operational to provide critical care support to acutely ill and deteriorating patients on the wards. We aimed to evaluate the demand and efficacy of the critical care outreach service during the COVID-19 pandemic.

Method: We prospectively evaluated all patients referred to critical care outreach enrolled during a twelve-month period. We reported the cumulative number of activities and interventions and baseline characteristics, acuity level and patients' clinical outcome. The rate of ICU admissions, activity plan, patients' acuity and mortality are compared to historical data pre-pandemic.

Results: Amongst 4849 patients referred, 3913 had a clinical review and of those 895 were COVID-19 positive. Non-invasive ventilation was mostly delivered to COVID-19 patients (COVID-19 +VE: 853/895, 95% vs. COVID-19 -VE: 119/3018, 4%) alongside awake prone positioning (COVID-19 +VE: 232/895, 26% vs. COVID-19 -VE: 0/3018, 0%). Compared to pre-pandemic, the cumulative number of patients assessed increased (observed: 3913 vs. historical: 3615; $p = 0.204$), patients meeting Level 2 acuity were higher (observed: 51% vs. historical: 21%; $p = 0.003$), but ICU admission rate did not increase significantly (observed: 12% vs. historical: 9%; $p = 0.065$), and greater mortality rate (observed: 14% vs. historical: 8%; $p = 0.046$) was observed.

Conclusion: Critical care outreach bridges the gap between the intensive care unit and general wards and supports the concept of 'critical care without walls' acting as a valuable resource in optimizing and triaging acutely unwell patients and potentially averting critical care admissions.

Relevance to Clinical Practice: The COVID-19 pandemic has generated an unprecedented surge of deteriorating and critically ill patients which has caused severe and sustained pressures on intensive care units (ICUs) and general wards. Acutely ill patients can deteriorate quickly, and early recognition is vital to commence critical intervention on the wards or transfer timely to ICU.

The Critical Care Outreach Team can help staff and optimize acutely ill and deteriorating patients by providing timely critical care interventions at the patient bedside.

KEYWORDS

COVID-19, critical care outreach, critical care without walls, deteriorating patients, non-invasive respiratory support

1 | INTRODUCTION

Critical Care Outreach Teams (CCOT) were formed in 2000 following the recommendation from the Department of Health aiming to improve recognition of deteriorating patients and support critical care step downs on the wards.¹ As a result, according to a workforce survey that was done by the critical care network, national nurse leads approximately 80%–85% of hospitals throughout the United Kingdom (UK) have developed a CCOT² to meet the local needs of the institutions and the populations served.

The coronavirus disease 2019 (COVID-19) outbreak has generated an unprecedented surge of deteriorating and critically ill patients with severe and sustained pressures on intensive care units (ICUs) and staff. In the United Kingdom, the National Health Service (NHS) authorities alongside the Intensive Care Society (ICS) established national guidelines for an emergency coordinated response.³ Hospitals receiving COVID-19 patients increased ward and intensive care unit (ICU) capacities dividing these based on the infectious status to contain the internal spread of infection. Organizational strategies included major redeployment of staff from other areas into critical care, as well as dilution of staff to patient ratios.⁴

Our local NHS institution is a multidisciplinary 760-bed academic hospital and one of London's major trauma centres. As a result of the coronavirus pandemic, internal ICU capacity was expanded from 44 beds to 150 beds, and 4 medical wards were reconfigured into respiratory support units managing patients on single organ failure requiring non-invasive ventilation. CCOT remained operational working alongside the ICU team by providing clinical expertise and support to non-ICU physicians and nurses but specifically providing non-invasive ventilation (usually mainly provided in ICU) to patients on the hospital wards. The team was also involved in multidisciplinary rounds in particular for patients with tracheostomy to ensure high standards of care and safety. Furthermore, CCOT helped with multidisciplinary decision-making processes including need for ICU admissions or setting ceiling of treatments and providing end-of-life care.

During the first and second wave of the COVID-19 pandemic, each hospital had a different approach in managing staffing and resources, and in many centres, CCOT were entirely redeployed to ICUs. Currently, there is no evidence outlining the benefit of providing critical care outreach during a pandemic scenario. The study aims to evaluate the demand and interventions of the critical care outreach during the COVID-19 pandemic. This investigates if there is a clinical need to maintain CCOT supporting to the wards during the pandemic.

What is it known about the topic?

- Patients affected by coronavirus disease 2019 may require non-invasive respiratory support.

What this paper adds?

- Critical Care Outreach can triage and optimize acutely ill and deteriorating patients needing time- critical care interventions.
- Critical Care Outreach is a valuable resource in providing teaching and advice around prompt initiation and management of non-invasive respiratory support and awake prone positioning.

2 | METHODS

2.1 | Study design and setting

We conducted a single-centre prospective observational study in a major tertiary academic hospital in London, United Kingdom. The study included all consecutive patients (irrespective of COVID-19 status) referred from the wards and physically reviewed by CCOT during a twelve-months period of the COVID-19 pandemic from the 1st March 2020 to 28th February 2021. Patients who did not have a face-to-face review were not included. Patients who were reviewed remotely via computer system were not included as only phone advice was provided. Historical data pre-pandemic from January 2018 to February 2020 were used as comparison. The study is reported according to STROBE guidelines.⁵

2.2 | Data collection

Data were collected prospectively into an internal standardized database. Demographic characteristics (age and gender), National Early Warning Score (NEWS-2), SpO₂/FiO₂ (S/F) ratio, acuity level, the number of physical examinations and type of interventions undertaken were collected. Clinical outcomes such as rate of ICU admission and mortality were recorded and compared to historical data from 2018 to 2020.

Quality indicators to monitor the service delivered included the number of 1) referrals, 2) cardiac arrest, 3) intubation on the wards and 4) admission to the intensive care unit.⁶

2.3 | Outcomes

The primary outcome was to assess the rate of admission to the ICU and secondary outcomes were activities, patients' level 2 acuity on the ward, mortality rate defined as hospital discharge status.

2.4 | Definitions

The critical care outreach team is a well-established service since 2001, and two practitioners are available seven days a week for 24 h a day. The CCOT includes a critical care nurse consultant, a physiotherapist and eleven specialist intensive care nurses with advanced clinical skills and non-medical prescribing.

NEWS-2 is a nationally recognized early warning score, which aims to identify acutely ill and deteriorating patients. It is a scoring system in which a score is allocated to the physiological vital signs routinely recorded at the patient bedside.⁷ The aggregate score can range from 0 to 23 depending on the clinical state of the patient. A score equal or more than 5 is a key threshold indicating patients has a medium risk for deterioration requiring urgent response by the parent team and the critical care outreach team.^{7,8}

Patient acuity is a classification system that allows prediction of patients' requirement in terms of hospital care, and it is used to guide admission to critical care. The National Institute for Health and Care Excellence (NICE) and the Intensive Care Society (ICS) classify the acuity level system as follow: level 1 is a patient in stable condition but dependent on nursing care, level 2 patients who are unstable needing advanced monitoring for single organ failure and support excludes invasive ventilation and level 3 are patients needing advanced respiratory support and therapeutic organ support.^{9,10}

2.5 | Patient care and non-invasive ventilation

Ward staff including nurses, doctors and physiotherapists had a common and standardized decision-making driving referral system to the critical care outreach team. Patients were referred to CCOT following internal protocol detailing the criteria for escalation of deteriorating and critically unwell patients (i.e., NEWS-2 > 5 points or oxygen level > 50%).^{8,11} All COVID-19 patients needing non-invasive ventilation were managed according to NHS guidelines and the local respiratory failure management algorithm and were considered for prone position when appropriate¹¹ (See Data S1).

The escalation plan was shared with the ward's senior consultants or registrars, the critical care outreach team and the ICU consultant in charge.

2.6 | Data analysis

The CCOT collected the data prospectively into a standardized local internal database. Data were automatically transferred into XLSTAT program (Microsoft Excel statistics) and statistical analysis was performed into RStudio a professional software for data science.

Quantitative data were tested for normal distribution by using QQ plot and are presented as median with interquartile range (IQR) or mean (\pm standard deviation [SD] and 95% confidence interval [CI]) as appropriate. Categorical variables are given as number (n) or percentage (%). *p*-value <0.05 was considered significant.

2.7 | Ethical considerations

The study was registered internally with the clinical effectiveness unit, and it was approved by the local Science Committee.

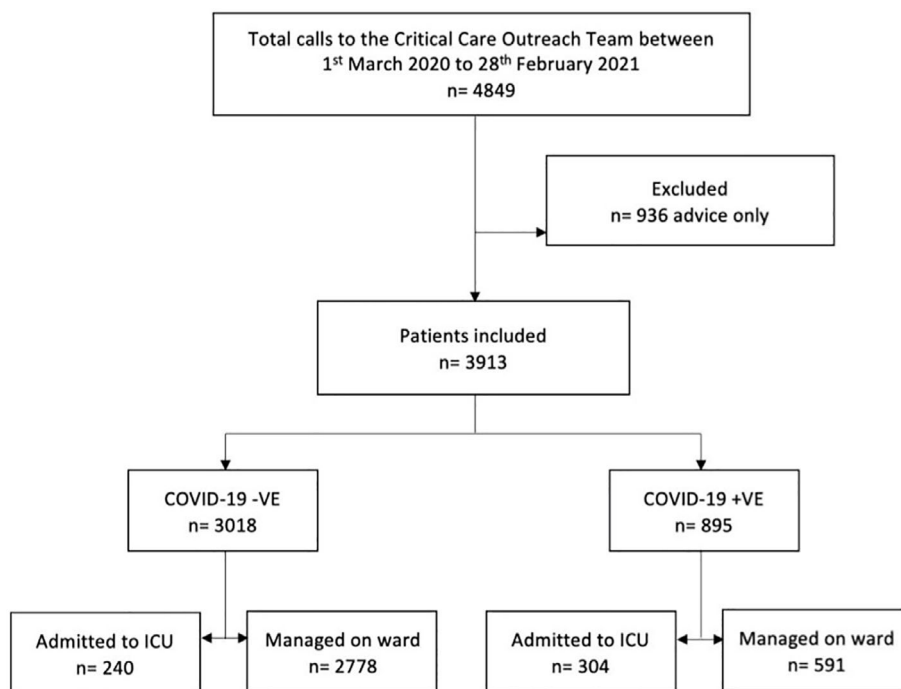


FIGURE 1 Study flow diagram. Abbreviations: COVID-19, coronavirus disease 2019; -VE, negative; +VE, positive

TABLE 1 Characteristics of patients reviewed by the critical care outreach team during the COVID-19 pandemic

Characteristics	Study population (n = 3913)	COVID-19 -VE (n = 3018)	COVID-19 +VE (n = 895)
Age, year	59 (18–80)	59 (18–80)	59 (19–75)
Gender (M/%)	2631/67%	1871/62%	760/86%
NEWS-2	7 (0–20)	7 (0–20)	7 (0–20)
-NEWS-2 ≤5	1259 (32%)	1026 (34%)	233 (26%)
-NEWS-2 >5	2654 (68%)	1992 (66%)	662 (74%)
S/F ratio	230 (35–476)	271 (35–476)	158 (35–476)
Acuity level	2 (IQR 1–3)	1 (IQR 1–3)	2 (IQR 1–3)
-Level 1	1818 (46%)	1720 (57%)	98 (11%)
-Level 2	1999 (51%)	1238 (41%)	761 (85%)
-Level 3	96 (3%)	60 (2%)	36 (4%)
Non-invasive ventilation			
-HFNO	766 (20%)	105 (3%)	661 (74%)
-CPAP	177 (5%)	3 (0%)	174 (19%)
-BiPAP	29 (1%)	11 (1%)	18 (2%)
Reason for review:			
-ICU stepdown	1291 (33%)	1328 (44%)	49 (5%)
-Referrals	2387 (61%)	1479 (49%)	811 (91%)
-Cardiac arrest	235 (6%)	211 (7%)	35 (4%)
Assessments	7374	5354	2020
-Assessment/ patient	1 (1–19)	1 (1–19)	2 (1–12)
-Time per assessment	00:55 (00:15–10:00)	00:40 (00:15–06:25)	01:10 (00:30–10:00)
Intubated on ward	109 (3%)	62 (2%)	47 (5%)
Outcome			
-Patient improved	881 (23%)	701 (23%)	180 (20%)
-Continue CCOT review	2280 (58%)	1916 (61%)	364 (41%)
-Transfer to ICU	544 (14%)	240 (8%)	304 (34%)
-Inter-hospital transfer	13 (0%)	11 (0%)	2 (0%)
-DNAR	195 (5%)	150 (5%)	45 (5%)
Length of CCOT follow-up (days)	1 (1–6)	1 (1–6)	1 (1–4)
Length of hospital stay (days)	18 (3–237)	19 (3–169)	36 (5–237)
Hospital discharge status			
-Survivors	2897 (74%)	2336 (78%)	561 (63%)
-Deaths	860 (22%)	586 (19%)	274 (31%)
-Awaiting hospital d/c	156 (4%)	96 (3%)	60 (7%)

Note: Values are presented as median with interquartile range (IQR) or number and absolute (%).

Abbreviations: BiPAP, bilevel positive airways pressure, CCOT, critical care outreach team, CPAP, continuous positive airways pressure, DNAR, do not attempt resuscitation; EOL, end of life; HFNO, high flow nasal oxygen; ICU, intensive care unit; M, male; min, minutes; NEWS-2, national early warning score 2; S/F ratio, SpO₂/FiO₂ ratio.

Ethical approval and patient consent were not deemed to be required.

936 patients (23%) reviewed remotely for advice only, 3913 (77%) who had a physical review were included in the study sample (See Figure 1).

3 | RESULTS

A total of 4849 patients were referred to the critical care outreach team from 1st March 2020 to 28th February 2021. After excluding

3.1 | Baseline characteristics

3018 (71%) were COVID-19 negative and 895 (29%) COVID-19 positive.

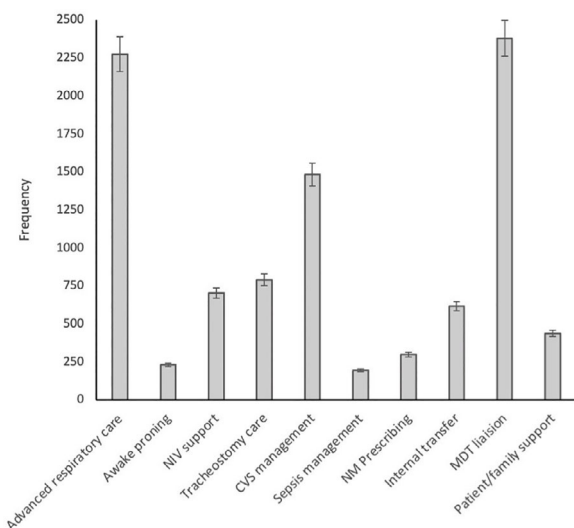


FIGURE 2 Intervention frequency distribution. Abbreviations: CVS, cardiovascular; MDT, multi-disciplinary; NIV, non-invasive ventilation, NM, non-medical

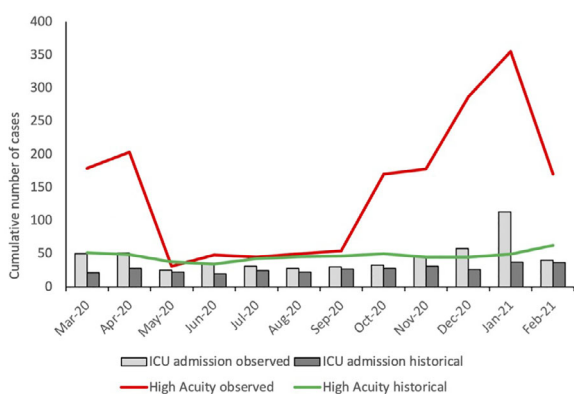


FIGURE 3 High acuity and ICU admission observed in 2020-2021 compared to historical data pre-pandemic from 2018 to 2020. Abbreviations: ICU, intensive care unit

Patients had a general median age of 59 (IQR: 18-80) years, which was similar across each cohort (COVID-19 -VE: 59 IQR:18-80 vs. COVID-19 +VE: 59 IQR: 19-75). Male were equal to 67%, and this proportion was greater amongst patients with COVID-19 (COVID-19 -VE: 62% vs. COVID-19 +VE: 86%). The baseline demographic characteristics are shown in Table 1.

3.2 | Patients' acuity and non-invasive ventilation

Patients scoring NEWS-2 greater than 5 comprised more than 60% for each group (COVID-19 -VE: 66% vs. COVID-19 +VE: 74%). The overall NEWS-2 was 7 (IQR 0-20), and this was similar in each cohort, but patients positive for COVID-19 had lower S/F ratio (COVID-19 -VE: 271 vs. COVID-19 +VE: 158). The COVID-19 cohort had greater acuity with the majority meeting criteria for level 2 admission (COVID-19 -VE: 41%, $n = 1238/3018$ vs. COVID-19 +VE: 85%,

$n = 761/895$) compared to those negative. Non-invasive ventilation including high flow oxygen (HFNO), continuous positive airways pressure (CPAP) and bilevel positive airways pressure (BiPAP) was mostly delivered to COVID-19 patients (COVID-19 -VE: 119/3018, 4% vs. COVID-19 +VE: 853/895, 95%). HFNO (COVID-19 -VE: 3% vs. COVID-19 +VE: 74%) and CPAP (COVID-19 -VE: 0% vs. COVID-19 +VE: 19%) were the main oxygen delivery devices in use, as shown in Table 1.

3.3 | Clinical review

The number of referrals were higher (91%; $n = 811$) in the COVID-19-positive group compared to negative patients (49%, $n = 1479$). The rate of cardiac arrests accounted for 6% ($n = 235/3913$) of the total, and this was similar in each group (COVID-19 -VE: 7% vs. COVID-19 +VE: 4%). 7374 assessments were undertaken for a median of 2 assessments per patient of 50 min each. COVID-19-positive patients had doubled the average number of assessments (COVID-19 -VE: 1 vs. COVID-19 +VE: 2) with longer time per assessment (COVID-19 -VE: 00:40 [00:15-06:15] vs. COVID-19 +VE: 01:10 [00:30-10:00]). After review, 58% of patients continued CCOT followed-up for a median of 1 day (IQR: 1-6).

3.4 | Outcomes

Overall, 3% of patients ($n = 109/3913$) were intubated on the ward, and this was similar in both groups (COVID-19 -VE: 2%, $n = 62/3018$ vs. COVID-19 +VE: 5%, $n = 47/895$).

The proportion of patients admitted to ICU was higher amongst those positive for COVID-19 (COVID-19 -VE: 11%; 240/3018 vs. COVID-19 +VE: 34%; 304/895). We did not report any transfer made for capacity reasons, instead we observed only few secondary inter-hospital transfers (COVID-19 -VE: 11 vs. COVID-19 +VE: 2) for clinical reasons as patients required specialist care and management which is not available in our institution. The overall length of hospital stay was 21 ± 19.5 days which was shorter in the COVID-negative group (COVID-19 -VE: 26 ± 28.1 vs. COVID-19 +VE: 22 ± 19.5). There was higher rate of hospital death in the COVID positive cohort (31%; $n = 274/895$) compared to those negative (19%; $n = 586/3018$). (See Table 1).

3.5 | Activities and interventions

81% ($n = 3169$) of patients reviewed received interventions initiated by CCOT alongside advice, and only 4% ($n = 156$) had no intervention required. The critical care outreach team delivered education (5%, $n = 269$) and supported transfer to the intensive care unit (10%, $n = 544$). A total of 3253 interventions were delivered across the time period. The frequency of interventions undertaken is shown in Figure 2.

Frequent interventions undertaken by CCOT were multi-disciplinary liaison ($n = 2381$) and advanced respiratory care ($n = 2276$), followed by tracheostomy care ($n = 792$) and non-invasive ventilation management ($n = 703$). Additional interventions included cardiovascular management (i.e., fluid bolus) ($n = 1482$) and intra-hospital (i.e., internal) transfers to other clinical areas, such as wards, theatres, imaging department, excluding ICU ($n = 617$). Patients and family support ($n = 439$), non-medical prescribing ($n = 300$) and awake prone position ($n = 232$) were also interventions undertaken with high frequency.

3.6 | Comparison with historical data

During the COVID-19 pandemic, we experienced two waves of patients' surge: the first from March to May 2020 and the second one from September 2020 to February 2021 (refer to Figure 3). Over this twelve-months period, the number of clinical reviews accounting for the CCOT workload increased compared to historical data (workload observed: 3913 versus workload historical 2018–2020: 3615; $p = 0.204$). CCOT managed a significantly higher number of patients meeting level 2 acuity (level 2 observed: 1770 versus level 2 historical: 558; $p = 0.003$), and this proportion was noted to be higher during the spring and winter outbreak of the coronavirus disease.

The overall rate of ICU admission increased, but this was not statistically significant (ICU admission observed 12% vs. ICU admission historical: 9%; $p = 0.064$), and it was noted to be higher during the first and second wave of the pandemic. The mortality rate at hospital discharge was greater (mortality observed: 14% vs. mortality historical: 8%; $p = 0.046$), and this peaked in April 2020 and January 2021.

4 | DISCUSSION

Our data collection covers a twelve-months period giving a broad perspective of the increasing pressure for hospital wards and intensive care during the COVID-19 pandemic.

We reported an evident high workload and greater acuity level compared to normal times, considering 3913 patients were reviewed and the majority of those (51%; $n = 1999$) met criteria for level 2 admission. Interestingly, the increased rate of ICU admission was not statistically significant (ICU admission 2020–2021 12% vs. ICU admission 2018–2020: 9%; $p = 0.064$), perhaps highlighting that a proportion of high-risk deteriorating patients with single organ failure were managed on the ward.

The COVID-19 outbreak severely affected the United Kingdom over the past 12 months, with a cumulative number of hospital admission equal to more than 400 000 patients of which 35 240 needing critical care.¹² Our organization response plan was based on delivering the appropriate level of treatment and care from the emergency department to the intensive care unit, and for this reason, the critical care outreach team was maintained operational. Critical care outreach focussed on the concept of 'critical care without walls' ensuring each patient received the appropriate level of intensive care throughout the hospital. CCOT approach supported three main aims 1) to avert critical care admissions,

2) to enable critical care discharges and 3) to share acute care skills across other hospital wards or departments.⁶ Specifically, CCOT facilitated prompt initiation of awake proning alongside non-invasive ventilation, and this may be the reason why the majority of patients with single organ failure (i.e., level 2 acuity) were managed on the wards avoiding further deterioration and ICU admission.^{13,14}

COVID-19 has highlighted the limitations of our current hospital structures to be prepared in facing a surge of acutely ill patients requiring hospitalization and close monitoring. The literature provides scarce recommendations on balancing surge capacity and allocation of limited resources. Although increasing the number of ICU beds is an option, upgrading monitoring and critical care support to hospital wards may be part of the solution.¹⁵ Our local response followed national directive including pausing all elective workload, expanding services, optimizing existing resources and relocating of staff.^{16–18} We re-organized internal wards for delivery of non-invasive ventilation and cardiorespiratory support to acutely ill and deteriorating patients. By doing so, we were able to mitigate the surge and triage patients more effectively, so ICU was reserved for those requiring advanced organ support and invasive ventilation. The creation of these designated areas also called 'silent ICUs' has been recognized as a potential strategy for expanding critical care provision using medical ward setting and staff.^{4,19} These operational changes require flexibility and planning; and the support by critical care outreach is vital to tackle 'failure to rescue' and detect deteriorating patients timely. Evidence has highlighted how deteriorating patients with COVID-19 can rapidly worsen respiratory failure with clinical symptoms such as low saturation and high oxygen requirement with only minor abnormalities in other vital signs; therefore, NEWS-2 score would be relatively low (i.e., NEWS-2 < 5 cumulative points).²⁰ Positive COVID-19 patients had similar presentation (i.e., hypoxia and low NEWS-2) in our study.

During the pandemic, CCOT had a high workload of activities considering the number of patients reviewed and the assessments undertaken. We would like to highlight that this was not the sole workload undertaken during the pandemic. The study does not account for all the essential work alongside the clinical commitment such as teaching sessions, simulation training, tracheostomy ward-rounds, internal meetings and time spent supporting the surge planning. No real comparison data exist, but two smaller studies have described the positive impact of the CCOT role during a short period.^{21,22}

It is worth to acknowledge that there is a dramatic under provision of critical care throughout the United Kingdom, but especially staffing to support real estate within properly constituted critical care areas.²³ While many institutions were able to manage patients effectively outside of ICUs, critical care is more than just providing respiratory support and advice. It is the high-quality nursing care at appropriate ratios, the allied health professionals and the calm environment for patients and their families. None of us was able to provide usual standard of care in the contest of the pandemic, but maintaining the critical care outreach team operational allowed us to cope better with the demand.

Our study has several strengths. Firstly, we include a large dataset and offer a novel evaluation of the provision of Critical Care Outreach during twelve months of the pandemic. Second, we provide clinical description of outcome for patients COVID-19 positive and negative. Thirdly, we

provide previously unknown information regarding the role and involvement of critical care outreach during a pandemic scenario. Ultimately, the study offers a clear complete picture of the experience in managing acutely ill and deteriorating patients during a pandemic on the general wards and in a critical care outreach setting. The study findings should be viewed considering its methodological limitations. The prospective observational design relied on collecting data from the electronic health record; therefore, it may be susceptible to missing data or recording bias. An additional limitation is the use of historical data as a control group, as baseline differences between cohorts exist and may be cause of confounding bias. Finally, the study was performed in a single UK centre and during the specific and unique historic time of the COVID-19 pandemic, which may limit its generalisability to other institutions or context. However, this study may generate a compelling argument for implementing or retaining critical care outreach team in institutions that have none.

5 | CONCLUSION

In the context of a hospital and ICU surge, a significant reorganization took place within the institution, but the critical care outreach team remained operational in order to provide effective care under pandemic conditions. As a result, the CCOT were able to provide the appropriate level of care and treatments by delivering non-invasive ventilation to acutely unwell and deteriorating patients on the medical wards. This was associated with staff liaison and support, as well as patient optimisation and triage to the ICU or appropriate palliative care support. In the context of a pandemic, this allowed our institution to maintain the rate of ICU admission at a reasonable level. This study suggests that adequate critical care resources should be placed in the ICU as well as the wider hospital when planning an effective response and staff relocation and building a system that can safely care for acutely ill patients in future waves or new epidemics.

ACKNOWLEDGEMENTS

We would like to thank Prof. Rupert Pearse and Dr. PJ Zolfaghari for the extremely valuable editorial advice.

AUTHOR CONTRIBUTIONS

Brigitta Fazzini, Ann McGinley: Study design. Brigitta Fazzini, Simon Nourse: acquisition of data and data analysis. All authors contributed to data interpretation, revised and edited the draft for its intellectual content and approved the final version to be published. All authors agree to be accountable for all aspects of the work thereby ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

DATA AVAILABILITY STATEMENT

All data generated or analysed during this study are included in this published article and its supplementary information files.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was registered with the clinical effectiveness unit at Barts Health NHS Trust (project ID number: 11976), and it was approved by

the Barts Life Science committee. Ethical approval and patient consent were not deemed to be required as no sensible data were collected.

ORCID

Brigitta Fazzini  <https://orcid.org/0000-0003-3569-1203>

TWITTER

Brigitta Fazzini  @fazzini_b

REFERENCES

1. Department of Health (UK). Comprehensive Critical Care- A Review of Adult Critical Care Services. London DH. 2000. [cited March 12, 2021]. Available at: https://webarchive.nationalarchives.gov.uk/20121014090959/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4082872.pdf
2. Critical Care Network National Nurse Leads (CCN3N). National Critical Care Nursing and Outreach Workforce Survey Report. 2018. [cited 2021 Mar 12]. Available from: https://www.cc3n.org.uk/uploads/9/8/4/98425184/national_critical_care_nursing_and_outreach_workforce_survey_report_2018_final_1.pdf
3. National Institute for Health and Care Excellence (NICE). COVID-19 Rapid Guideline Critical Care in Adults. NICE. 2021. [cited 2021 Mar 12]. Available at: <https://www.nice.org.uk/guidance/ng159/resources/covid19-rapid-guideline-critical-care-in-adults-pdf-66141848681413>
4. Arabi YM, Azoulay E, Al-Dorzi HM, et al. How the COVID-19 pandemic will change the future of critical care. *Intensive Care Med.* 2021; 47(3):282-291.
5. Von Elm E, Altman DG, Egger M, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet.* 2007; 370:1453-1457.
6. National Outreach Forum (NOF). Quality and Operational Standards for the Provision of Critical Care Outreach Services. 2020. [cited 2021 Mar 12]. Available from: <https://www.norf.org.uk/resources/Documents/QOS%20CCOS%20NOF/NORF%20QOS%20Final%20December%202020.pdf>
7. Royal College of Physicians (RCP). National Early Warning Score (NEWS) 2. Standardising the assessment of acute-illness severity in the NHS. Executive summary. RCP. 2017. [cited March 12, 2021]. Available from: <https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2>
8. Barts Health NHS Trust, BARTS Health trust corporate policy observation and escalation policy - adult patients [excluding pregnant women], clinical Foreign Policy CLI/POL/198/2018-01. [cited 2021 November].
9. National Institute for Health and Care Excellence (NICE). Emergency and acute medical care in over 16s service delivery and organisation. NICE guideline [NG 94]. 2018. [cited March 12, 2021]. Available from: <https://www.nice.org.uk/guidance/ng94>
10. Intensive Care Society (ICS). Levels of Adult Critical Care, Consensus Statement. March 2021. [cited November 12, 2021] Available at: https://www.ics.ac.uk/Society/Guidance/PDFs/Levels_of_Care_25_3_21
11. Barts Health NHS Trust. Guidance for the role of non-invasive respiratory support in adult patients with coronavirus (confirmed or suspected) at the Royal London Hospital. Latest Version January 2021.
12. Intensive Care National Audit and Research Centre (ICNARC). ICNARC report on COVID-19 in critical care: England, Wales and Northern Ireland, March 12, 2021. [cited March 12, 2021]. Available from: <https://www.icnarc.org/Our-Audit/Audits/Cmp/Reports>
13. Fazzini B, Fowler AJ, Zolfaghari P. Effectiveness of prone position in spontaneously breathing patients with COVID-19: a prospective

- cohort study. *J Intensive Care Soc.* 2021;175114372199654. doi:10.1177/1751143721996542
14. Ricard JD, Roca O, Lemiale V, et al. Use of nasal high flow oxygen during acute respiratory failure. *Intensive Care Med.* 2020;46(12):2238-2247. doi:10.1007/s00134-020-06228-7
 15. McDonald L. Critical Care Outreach Teams and COVID-19. *Journal of intensive care and critical care nursing.* 2021. [cited March 12, 2021]. Available at: <https://www.alliedacademies.org/journal-intensive-critical-care-nursing/>
 16. Michard F, Saugel B, Vallet B. Rethinking the post-COVID-19 pandemic hospital: more ICU beds or smart monitoring on the wards? *Intensive Care Med.* 2020;46(9):1792-1793.
 17. National Health Service. Advice on acute sector workforce models during COVID-19. NHS England. [cited 2021 Mar 12]. Available at: https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/12/C0833_advice-on-acute-sector-workforce-models-during-COVID_with-apps_10dec.pdf
 18. Hempel S, Burke RV, Hochman M, et al. Resource allocation and pandemic response: an evidence synthesis to inform decision making. (Prepared by the Southern California Evidence-based Practice Center under Contract No. 290-2015-00010-I). AHRQ Publication No. 20 (21)-EHC027. Rockville, MD: Agency for Healthcare Research and Quality. doi:10.23970/COVIDRESOURCE
 19. Supady A, Curtis JR, Abrams D, et al. Allocating scarce intensive care resources during the COVID-19 pandemic: practical challenges to theoretical frameworks. *Lancet Respir Med.* 2021;9:430-434. doi:10.1016/S2213-2600(20)30580-4
 20. Machiwenyika JMT, Zhu Y, Villar SS, Mackay JH. Trajectories of vital signs in patients with Covid-19. *Resuscitation.* 2021;162:449-450. doi:10.1016/j.resuscitation.2021.01.047
 21. Vlachos S, Wong A, Metaxa V, et al. Hospital mortality and resource implications of hospitalisation with COVID-19 in London, UK: a prospective cohort study. *Crit Care Res Pract.* 2021;2021:1-13. doi:10.1155/2021/8832660
 22. Messina A, Pradella A, Alicino V, et al. Critical care outreach team for the critical care provision during the COVID-19 outbreak in Lombardy: ventilatory support in the ward and outcome reports. *Respir Care.* 2021;4(66):928-935.
 23. McCabe R, Schmit N, Christen P, et al. Adapting hospital capacity to meet changing demands during the COVID-19 pandemic. *BMC Med.* 2020;18(1):329. doi:10.1186/s12916-020-01781-w

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Fazzini B, Nourse S, McGinley A. Critical care outreach during the COVID-19 pandemic: An observational study. *Nurs Crit Care.* 2022;1-8. doi:10.1111/nicc.12772