How COVID-19 has affected staffing models in intensive care: a qualitative study examining alternative staffing models (SEISMIC)

Abstract

Aims: to understand how COVID-19 affected nurse staffing in ICUs in England, and to identify factors that influenced, and were influenced by, pandemic staffing models.

Design: Exploratory Qualitative study

Methods: Semi-structured, online interviews conducted July-September 2020 with regional critical care leaders including policy leads (n=4) and directors/lead nurses (n=10) across critical care networks in England.

Findings: The six themes emerging from the framework analysis illustrate how the pre-pandemic ICU culture influenced ICU staffing models during the pandemic. Changes in staffing impacted on the workforce and the care delivered, whilst it was necessary to learn from, and adjust to, a rapidly changing situation. Variation across and between networks necessitated variation in responses. The overwhelming outcome was that the pandemic has challenged the central tenets of ICU nurse staffing.

Conclusions: Pandemic nurse staffing models resulted in changes to ICU skill-mix and staffing numbers. Factors such as the impact of nurse staffing on care practices and on the workforce need to be taken into account when developing and testing future nurse staffing models for ICU. The extent to which ICUs will return to former staffing models is not yet known but there seems to be an appetite for change.

Impact:

- In common with many countries, nurse staffing in English ICUs was adapted to address surge requirements during the COVID19 pandemic.
- Findings highlight the challenge COVID-19 presented to pre-pandemic ICU nurse staffing guidelines, the impact on patient and staff wellbeing and the potential legacy for future staffing models.
- Study findings have implications for ICU nurse managers, researchers and policy makers: nurse staffing models need to be adaptable to the local context of care and future research should investigate the impact of different models on patients, staff and health service outcomes.

Key Words:

Nurses, intensive care, COVID-19, nursing workforce, qualitative

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Abstract   179 words

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INTRODUCTION

Nurse staffing in the intensive care unit (ICU) has not been subject to the same scrutiny as nurse staffing on other hospital wards (Griffiths et al., 2019; 2020). Wynne et al. (2021) point out the considerable diversity in staffing models across developed nations, despite practice standards being fundamentally similar, and most mandated nurse:patient ratios depending on patient acuity and other contextual factors (The Ohio State University, 2020). In England, ICU nurse:patient ratios are principally guided by the Guidelines for the Provision of Intensive Care Services (GPICS) (2nd edition) (FICM, 2019) and historical British Association of Critical Care Nurses position statements (Bray et al., 2010). Nurse staffing tools, which are mechanisms for determining and capturing staffing requirements and based on attempts to match staffing to average demand or time requirements (Griffiths et al 2020), are not routinely applied due to the lack of evidence and sensitivity in ICU (Greaves et al 2018). One-to-one ICU nurse:patient ratios remain the norm for level 3 patients (the sickest critically ill patients), with 1:2 for level 2 patients, those requiring critical care support for single non-respiratory organ failure (NHSE, 2019). In a study examining hospital capacity before and during the COVID-19 pandemic, ICU nursing capacity was identified as the most restrictive resource in terms of increasing critical care capacity to meet the demands of the pandemics and surge in critical care requirements. Without redeployment of general nurses to the ICU, bed capacity was limited to an extra 642 patients in England (McCabe et al., 2020). In this paper, we explore the changes to ICU nurse staffing models, for ICU patients in England, during the COVID-19 pandemic, based on qualitative interview data (see glossary at Table 1).

INSERT TABLE 1

Background

Nurse staffing commands particular focus given its high costs and impact on a range of clinical, nurse and patient outcomes; previous international studies have shown clear associations between fewer ICU nurses and detrimental outcomes such as patient mortality (Rae et al 2021). In a more detailed examination, West et al. (2014) found that the number of nurses was associated with greatest impact on patients at high risk of death (OR 0.98, [0.96, 0.99]), with more nurses associated with lower risk of death, whereas the same effect was not seen with medical staffing. Prior to the COVID-19 pandemic, ICU nurse staffing levels were already problematic with a national vacancy rate of 9% across the UK, and rates in cities such as London at nearly 20% (CC3N, 2020a).

COVID-19 has thrown the pre-existing nurse-staffing crisis in ICU into sharp focus. The surge in ICU bed requirements in first wave (the dates of which were: March 23rd 2020- 30th May 2020, [Office for

National Statistics, 2021]) of the pandemic saw a rapid, up to three-fold expansion of ICU bed capacity in some areas. Hospitals throughout the world have had to expand their ICU bed provision utilising military style models, with nurses and other health care staff deployed from throughout the hospital to meet the demand (Cadge et al. 2020). ICU nurses have had to quickly adapt to working in different ways, with nurse:patient ratios below those normally experienced. Research and discussion papers from the United States (Akgün et al., 2021; Cadge et al., 2020; LoGiudice and Bartos 2021, Robinson and Stinson 2021) and elsewhere around the world (for example, Arabi et al., 2021, reporting from 6 European countries, Asia, Australasia, North and South America and Canada; Moradi et al.,2021, reporting from Iran) suggest that whilst these changes have negatively impacted nurses' well-being (Greenberg et al. 2021, Montgomery et al., 2020; Rattray et al., 2021; Sampaioa et al. 2021; Wozniak et al. 2021), they also offer opportunities to consider how best to engage our limited nursing resource.

Like other developed nations, NHS England (NHSE), supported by the ICU community, rapidly generated surge staffing criteria to mitigate and address the large shortfall in nurse staffing required to care for the increased number of critically ill patients during the pandemic, with new models coming into force in April 2020 in response to a worsening crisis (NHSE, 2020a; CC3N, 2020b). Similarly, ICU pandemic staffing models and recommendations were published in Australia (Marshall et al., 2020) and the US (The Ohio state University, 2020). However, like the NHSE guidance, these recommendations were based on expert opinion due to the lack of research evidence. Authors from across the world (for example, Cross et al., 2021) have described their approaches to managing the staffing crisis, but there is currently little published data regarding the impact of these different models.

The staffing model employed in England in the first wave was subsequently revised in December 2020, in the wake of outcry over the unsustainable ICU staffing model used in the first wave (NHSE, 2020b). The waves indicated the sustained increase in transmission and infection (Office for National Statistics, 2021). Subsequent concerns that ICU staffing models used during the pandemic in ICU may be applied as a 'new norm' in non-pandemic scenarios, led to new position statements from the alliance of all ICU nursing organisations in the UK being issued early in the second wave (determined to be beginning of September 2020 to 30th April 2021, [Office for National Statistics, 2021]) (UK Critical Care Nursing Alliance, 2020, 2021). However, there remains an absence of established evidence on what safe nurse staffing in critical care comprises.

Assumptions based on historic nurse:patient ratios continue to be challenged, not least as these are based on organ failure, rather than patient acuity and dependency (Endacott, 2012). Attempts to

measure nursing workload and nursing activity using tools such as the Therapeutic Intervention Scoring System and Nursing Activities Score have been well described in Brazil and other parts of the world. However, no tool has been shown to be superior to the professional judgement of an experienced nurse manager in assessing ICU nurse staffing requirements (Greaves et al., 2018). A narrative synthesis of international literature by Wynne et al. (2021) supports the need to develop workforce measures that more accurately reflect nursing work.

In England, critical care Operational Delivery Networks (ODNs, currently n=17), in place since 2013 across the NHS (NHS Commissioning Board, 2012), support the coordination of ICU patient pathways between healthcare providers to ensure access to specialist support at a regional level. These networks also drive forward innovation beyond individual ICUs, and benchmark care and services to ensure consistency, improving outcomes and operational productivity and efficiency at regional level. This helps to facilitate optimal services, patient care and bed management. Specialist commissioners work closely with the ODNs to set minimum standards of care and service delivery (NHSE, 2019), including examining staffing. Despite the influence of these groups on local staffing models and provision, there is negligible evidence on the impact networks have on critical care staffing decisions at a local or national level.

In England, the first wave of the COVID-19 pandemic surge in critically ill patients peaked in April 2020, with the cessation of many elective services, including non-essential surgery and outpatient appointments, to provide staffing to meet the exceptional demand for, and expansion of, ICU services. This first wave was over by the end of June 2020, with resumption of usual NHS activity in June 2020 (NHSE, 2020c). Second wave peaks exceeded those of the first wave in terms of infection rates (Cabinet Office, 2020) and approached the peak ICU bed use (ICNARC, 2020; Thomas, 2020). Not all health services ceased non-essential services in the second wave, meaning that ICUs could not draw on additional staff from operating departments, outpatients or surgical wards as they had in wave 1.

The number of ICU beds has historically been lower across the whole of the UK compared to much of Europe (UK Government 2014); an immediate expansion to bring ICU bed numbers in line with Europe is underway (Cabinet Office, 2020). These conditions have led to the need for an urgent review of ICU nurse staffing.

The dearth of evidence about nationally recommended staffing models, during and outside of pandemic situations, warrants deeper exploration of the factors influencing ICU nurse staffing decisions locally, nationally and internationally. Whilst a limited number of studies have attempted

to calculate the recommended number of staff required in specific disease situations, for example, Mascha et al. (2020), there has been little focus specifically on nurses' perspectives.

As new waves continue to emerge across the world, and health care workers become more exhausted, it is vital that critical care nurses' experiences and voices are heard and used to inform future planning (Cadge et al. 2020, Wynne et al. 2021). There is a clear need to examine the effect of the COVID-19 pandemic on nurse staffing models, on both staff and patient outcomes, as well as to understand potential future implications for ICU nurse staffing, leading to the research question: what impact has COVID-19 had on ICU nurse staffing models?

THE STUDY

Aims

The aims of this study were to understand how COVID-19 affected nurse staffing, from the perspectives of regional critical care leaders and policy makers, and to identify factors that influenced, and were influenced by, pandemic ICU staffing models.

Design A qualitative in-depth exploration of factors influencing ICU nurse staffing models from the perspectives of regional critical care leaders, including policy makers and critical care regional network leads, using semi-structured online interviews conducted between July-September 2020. Framework analysis and cross-case analysis were used to identify themes in the data (see analysis section). Study design and conduct are reported in line with COREQ guidelines.

Participants

Purposive sampling was used to identify potential interview participants. Fourteen participants were interviewed; ten were Critical Care ODN Directors and/or Lead Nurses, the remaining four were involved in setting policy directions for nursing workforce. Table 2 indicates respondents, granular detail would risk identifying participants, therefore, only broad participant information is included. The ten Network Directors and Nurse leads were responsible for ODNs across England covering between 8 and 21 ICUs, with a total of 145 ICUs in NHS Trusts.

INSERT TABLE 2

As devolved nations, Northern Ireland, Scotland and Wales have different nurse staffing criteria and funding mechanisms and were therefore excluded. The geographical range of networks included represented the whole of England; this enabled us to sample across a breadth of staffing models, regional & ICU sizes, vacancy rates, staff turnover and sickness/absence.. Nursing leads or network

directors were interviewed, to reflect the range of management roles within networks. The sample size was informed by saturation through the concept of *information power* (Malterud et al., 2015), the premise being that the larger the information power of the sample, the smaller the sample required. In other words, the sample (who was chosen for interview) and sample size was determined by the richness, depth and breadth of data yielded.

Inclusion criteria included policy makers, network directors and lead nurses working in their role and in the ICU field for at least one year. Policy makers, or network directors/lead nurses, who had no input into decisions about ICU staffing were excluded.

Data Collection

The online interviews were solely conducted by RE, a highly experienced researcher with an extensive background in intensive care, which enhanced qualitative credibility and dependability (Denzin and Lincoln, 2011) and information saturation (Malterud et al., 2015).

The interviews explored the COVID-19 pandemic situation and how staffing models used across the different networks were applied during the pandemic, as staffing models were not considered to be a fixed entity. The interview topic guide was developed with the external collaborators (UK Critical Care Nursing Alliance). Given some of these interviews took place prior to the second wave, and all but one participant had indicated a desire to continue supporting the study, we additionally contacted participants via email in February 2021 and asked if there were any changes to their answers with the advent of the second wave. The inclusion of data from this second time point enhanced credibility of findings in a rapidly changing situation (Denzin & Lincoln, 2011).

Ethical considerations

Verbal informed consent was sought prior to each interview. Online interviews, including the consent process, were audio-recorded and transcribed verbatim. Research ethics approval was provided by West of Scotland Research Ethics Committee 5 (and the HRA (IRAS ID 259475).

Data analysis

Analysis was conducted by RE and NP independently for confirmability, aligning with the requirements for findings to be corroborated by another researcher (Lincoln and Guba, 1985). A framework analysis approach (Pope, 2000; Ritchie & Spencer, 1994) was adopted to rapidly generate findings appropriate for implementation into policy. Framework analysis is highly suited to applied

policy research given the focus on specific questions, predesigned sample and limited time frame (Srivastava and Thompson, 2009), in this case ICU staffing during the first two surges of the COVID-19 pandemic. The framework was refined by RE and NP during data collection, and during analysis. Framework analysis comprises five stages: familiarisation, defining a thematic framework, indexing, charting and mapping/ interpretation (Pope *et al.*, 2000). Interview data were analysed individually with line-by-line coding using the framework and then cross-case analysis applied to draw out comparisons (convergent and divergent themes) (Miles and Huberman, 1994).

Rigour

Study design and conduct were underpinned by Lincoln and Guba's (1985) 'trustworthiness' principles (credibility, transferability, dependability and confirmability of findings). The interviewer, RE, had regular meetings with the wider team during data collection and analysis. Early analysis was reviewed by the whole research team and analytical memos were shared. To ensure a strong connection between the analysis and clinical perspectives, emerging themes were discussed with a clinical stakeholder group.

FINDINGS

Framework analysis resulted in six themes, with a temporal dimension as depicted at Figure 1. Examples of data excerpts for the themes are presented at Table 3. Quotations are annotated with participant number and type.

INSERT FIGURE 1 HERE

INSERT TABLE 3 HERE

Enhanced pre-pandemic strengths and challenges

This theme set the scene in terms of the ways in which individual ICUs functioned before the pandemic, summarised by this participant as: "*the units* [ICUs] *we were worried about before COVID, we were even more worried about during COVID…*" (P7/ODN). The existing ICU culture, particularly in terms of staff support and approach to care, was perceived to have an impact on ICU and redeployed staff; where it was positive, it was: "*the only thing that got them through COVID*" (P2/ODN). This was echoed across the ODN Director/Lead Nurse interviews, illustrating their helicopter view, and broad oversight of how ICUs differed in their network. The strength of existing collaboration across the network was also evidenced in the speed with which new ICU transfer services (to facilitate rapid patient transfers between ICUs that had exceeded capacity) were established (P5/ODN), and the willingness of ICUs to provide mutual aid (P4/ODN) to smooth

demand (P10/ODN). In the second wave, mutual aid was evident across all of the networks represented, to manage bed demand and the lack of nurses available from other specialties.

Existing relationships between individual ICUs and the rest of the hospital were key. For example, existing staff rotation patterns between wards and ICU (P1/STP) were considered, including ODN leads' awareness of the bigger picture "*ensuring we don't deplete the rest of the Trust* [of staffing] *at the same time*" (P5/ODN).   Redeployed staff preconceptions about working in ICU were also highlighted:

> "*some of the redeployed staff – ah – were quite clear that they had been told to come to ICU and it was the last place in the – on earth that they wanted to be. They never wanted to work in ICU and particularly not during a surge.*[. . .] *But a considerable number of people were, if not overjoyed to be there, really willing to work hard and do the best job that they can*." (P11/ODN)

The existing workforce situation, particularly vacancies and the ability to meet the national standards, was a dominant issue (P3/ODN, P7/ODN). Although the lack of evidence for using registered nurses or ICU trained registered nurses was acknowledged (P11/ODN, P6/NHSE&I), it was clear that any deviation from usual nurse:patient ratios was greeted with '*angst*' (P1/STP) or fear: "*They were panicking about it*" (P3/ODN), an issue which was not always addressed in a timely manner by the respective organisations:

> "*They were frightened by it* [the pandemic staffing model] *at first when they saw it, and the staffing ratios. They were panicking about it. But I think perhaps the emphasis should have been more around that the additional workforce will be well-prepared to help you* (P3/ODN)."

There was also frustration expressed around lack of recognition that the defining factor for bed number expansion was not availability of ventilators but availability of staff (P4/ODN).

Impact on workforce

An over-riding theme across the interviews was the perceived impact on staff wellbeing with phrases such as '*causing huge psychological harm to staff*' (P8/ODN) and '*harrowing*' (P9/ODN). In wave 2 this was exacerbated in some Trusts by pressures, from hospital bank and external nursing agencies, for nurses to take on additional shifts to cover shortfalls (P5/ODN). The long-term effects were also

reported in terms of retirement, described by one network lead nurse as *'an exodus of near-retirement staff'* (P9/ODN).

The impact was also talked about in terms of overall numbers of staff, despite one network identifying that some ICUs were '*overrun with staff come the end of the first wave'* (P11/ODN) and had to turn redeployed volunteers away. The picture was quite different in the second wave as most usual hospital services continued for longer and support staff were not always available for redeployment. Additional staff from non-NHS sources, such as military, were not able to access patient records, so assumed different roles from other support staff (P5/ODN). One network director also reported that the term 'ICU nurse' was used more broadly in wave 2, to include agency nurses with an ICU background, who may have had no local or recent ICU experience (P12/ODN). The changed skill-mix at the bedside was a major concern, particularly the need for junior ICU nurses to lead teams of redeployed staff who often were more experienced/senior or came from a different speciality such as dental nursing. Participants also reported the distress experienced by junior staff when they had to talk with families about end of life care via an iPad (P9/ODN). The previous experience of redeployed staff was a major factor in reported overall workload for the ICU (P10/ODN), for instance prior ICU skills, although, regardless of their experience, the redeployed staff '*really going above and beyond was what enabled that* [pandemic staffing model] *model to work'* (P11/ODN). The impact of COVID on the wider hospital workforce was acknowledged, in particular the burden of ICU admission decision-making for respiratory teams (e.g. P4/ODN, P8/ODN), dissonance between the perspectives of ICU (nurse and medical) managers and hospital managers in terms of staffing expectations, and the need to conceptualise the ICU team much more broadly than traditional notions of what an ICU team encompassed (P3/ODN, P12/ODN). Despite all these concerns, there was also an air of optimism from some participants, with COVID unlocking a *'mindset of possibilities'* and different ways of working across the team or the network (P5/ODN, P1/STP).

Impact on care

An over-riding impact raised across the interviews was adverse events such as pressure injuries, nosocomial infections and medication errors, resulting from lower skill-mix with non-ICU staff having *'no concept of what's urgent and what's not urgent'* (P4/ODN). This was also reflected in the prolonged use of prone positioning, identified as a '*huge confounding factor* [for adverse events]*'* (P6/NHSEI) and the shift from '*proactive to reactive care'* (P12/ODN). There was an acknowledgement that adverse events often were not documented because there was *'no time for Datix* [adverse event recording system]*'* (P9/ODN) meaning that *'we won't know the full impact'*

P6/NHSEI. There was a reluctance to share these experiences at network meetings because of the concern that *'they'll think our ICU's rubbish'* (P12/ODN), hence the scope for learning is limited. Concern about dropping standards was also expressed: *'If we allow standards to drop now, how will we ever get them back*?' (P8/ODN) with a fear that working with lower numbers of ICU nurses was *'kind of normalised – a bit'* (P10/ODN).

A second major concern about impact on care related to families because nurses were *'working the opposite of the way we're used to working, from patient and relative perspective'* (P1/STP). There was concern that the family were not part of the experience as they might be usually – *'the sights, sounds, smells of ICU'*(P1/STP) – which may result in family not understanding '*why* [their] *husband or wife is so frail or angry or depressed or psychotic and why they've got these nightmares or altered memories'* (P1/STP).

> "All of those principles that we hold dear. Well, the door's closed.[. . .] So, they're dealing
> with something – a black hole almost – that must be very difficult to make sense of."
> (P1/STP)

Alongside this there was an acknowledgement that families' expectations were different - *'… you did the best you possibly could and we're grateful.'* (P6/NHSEI) and that the impact of transfer to another hospital was minimised for the family: '*from a relatives point of view they just had to ring a different hospital* (P5/ODN). Other positive impacts on care were described in terms of innovative practices, for example for rehabilitation (P3/ODN), workforce agility across professional boundaries, such as teams of surgeons to prone patients (P10/ODN) and using a mobile endotracheal intubation team approach to make best use of the existing skills of redeployed staff (P4/ODN).

Learning as we go

The dominant sub-themes related to rapid learning from changes to ICU nurse:patient ratios under the emergency nurse staffing model and *'changes in the way work is delivered'* (P6/NHSEI), for example the teams approach highlighted in previous themes. It was also clear that the impact of personal protective equipment (PPE) was not initially appreciated. There were also divergent views between managers and clinicians about bed modelling (P1/STP). There was clear learning about the skills of the redeployed staff who joined the ICU team, the need to sustain education and relationships with redeployed staff and the focus on provision for staff wellbeing. The central role of the networks was emphasised in this theme enabling ICUs to learn from each other, with examples of specific therapies such as new modes of delivering non-invasive ventilation, and how teams were

working in different ICUs. The visibility of, and rapid evidence dissemination from NHS leaders was emphasised, the limits of evidence available was widely acknowledged.

'One size doesn't fit all'

The name given to this theme was repeated across interviews; it was clear that COVID highlighted the variations between networks, identified in terms of ICU beds/100,000 population, and between ICUs, in terms of demand (P10/ODN, P7/ODN). There was emphasis both from within London and outside that *'the London model* [a specific approach to adjusting nurse:patient ratios] *doesn't work everywhere'* (P5/ODN, P13/Commissioner), with emphasis placed on the impact of regional geography (P13/Commissioner). Problems with applying centrally-determined models in ICUs of different layouts and estates configurations was also emphasised, in particular lack of '*line of sight*' (P7/ODN) for supervision of staff. This led participants to comment that the '*bottom line'* for ICU capacity might be different for ICUs of the same bed number (P10/ODN). In the second wave, this was affected by the capability of health services to provide non-invasive respiratory support outside of critical care; in smaller hospitals these patients would likely need to occupy an ICU bed (P4/ODN). The size of individual ICUs also impacted the scope to expand the workforce (P8/ODN, P12/ODN) and whether there was a dedicated therapy workforce (P13/Commissioner). Ongoing education support for redeployed staff, to keep them up to date for future COVID surges, was also variable (P9/ODN, P10/ODN); however, one network director did report investment in redeployed staff who didn't return to ICU in Wave 2 (P12/ODN).

Challenging central tenets of staffing

This theme echoes some of the content of other themes (for example Theme 1 'existing workforce difficulties' and theme 2 'mindset of possibilities') but with a clear emphasis on what this means for ICU nurse staffing in future. The need to have *'someone'* in each ICU bed space, to provide vigilance, reassurance and communication, was clearly articulated but questions were raised about the unique skills of an ICU nurse and the potential for nurses and other healthcare professionals from other specialties, such as operating department practitioners, redeployed surgeons, non-ICU qualified nurses and upskilled support workers, to be part of the nursing workforce during the pandemic. There were legacy questions in relation to this as well; how could these staff be retained as part of a flexible workforce to manage with future surges in critical care demand? There was a clear sense that some ICUs were unlikely to revert to the pre-pandemic ICU nurse staffing model with 1:1 nurse:patient ratios for level 3 patients and 1:2 for level 2 patients. Staffing models such as team nursing (a team of nurses and support staff, which might include non-nursing staff, caring for a

group of patients) and buddying (one nurse + one support person for two level 3 patients) were reported to be '*less stressful because the ICU nurse knows she has one person with her all the time*' (P5/ODN). There were also different perspectives on the appetite for change, *"don't think there's a general desire to – to move away from, kind of, the current model."* (P11/ODN) and clear calls for an evidence-based model: '*we need to stick to GPICS2 until science tells us otherwise*' (P9/17). The opportunity to learn from workforce changes and different approaches to team work introduced for COVID was emphasised (P3/ODN, P5/ODN) alongside the importance of considering staff needs when redesigning staffing models (P12/ODN). This was emphasised more strongly in Wave 2, with the need for an ICU career structure to prevent attrition and provide appropriate reward for staffing (P2/ODN).

DISCUSSION

This study has drawn on data from ten participants in senior roles in English critical care networks, covering over 145 ICUs, to understand how the pandemic affected existing ICU nurse staffing models. This was supplemented by interviews with regional and national policy makers. There are key implications centring on defining and understanding the impact on capacity to expand and rapidly provide ICU services in response to a surge situation, like a pandemic, on staff and on patient outcomes.

The COVID-19 pandemic has shone a light on existing strengths and weakness for ICU nurse staffing, namely the culture of the ICU; where the climate of ICU was positive pre-pandemic this facilitated positive working, particularly for redeployed staff. The ICU culture has several layers, at a nurse level, unit and organisational level, as the data emphasises. Scholtz et al, (2016), in describing ICU nurse culture in ethnographic work in South Africa, alluded to the need of ICU nurses to rapidly adjust, with sometimes negative personal consequences, and the ability to create almost sibling-like teamwork to foster a strong culture in ICU. Based on work developed and tested across Europe and in the United States, Guidet and Glez-Roma (2011) identified how the shared values, beliefs and assumptions underlying a unit have a significant impact on how it functions. Moreover, nurses may choose to work in ICU for a range of reasons, including teamwork, autonomy and in-depth patient-focus, which was threatened in the pandemic, and, in turn, is likely to have an effect on issues of retention and recruitment. A recent UK survey highlighted the high human cost to the ICU workforce during the pandemic, in part due to the staffing, alongside high mortality (Greenberg et al., 2021). As we have seen in this study and in data from other international qualitative studies (Cadge et al.,

2020; Moradi et al., 2021), not all redeployed staff embraced the ICU culture. More broadly, COVID-19 presented a challenge to pervading cultures in ICU, forcing people to confront and move away from traditional models of working and staffing, disrupting ICU culture, this was at a pace not in anyone's control. Our study supports that of other international literature highlighting the importance of good staff relationships during such crises (Cadge et al., 2020) and of effective organisational support (Moradi et al., 2021).

The resulting impact on workforce and on care has been profound, with many unknown consequences, such as a negative impact on patient safety through (largely unreported) adverse events. While mortality from COVID-19 in ICUs is well described across countries (Quah & Phua 2020), morbidity in relation to the pandemic staffing models is not clear. In the first wave, usual practices for reporting were lifted temporarily, meaning that many incidents were not reported (Denning et al., 2020), despite the higher severity of illness and intervention requirements of COVID-19 patients (ICNARC 2020). Providing high-quality support for redeployed staff may be associated with improved safety perception in future pandemics (Denning et al., 2020). In this study, participants described clinical incidents and measures taken across the network to ensure these were swiftly addressed across the region, to prevent occurrences elsewhere. The need for proactive and responsive working extended beyond individual incidents and staff agility was demonstrated by models in which staff moved across organisations, and indeed regions, to deal with local surges in demand. An author team from 14 countries (Arabi et al., 2021) describe how ICUs will never be the same, echoing participants' opinions in this study. They suggest ICUs must be prepared to accommodate surges of patients and ICU staffing models should allow for fluctuations in demand.

This study has delineated some of the mechanistic ways in which regions have responded to these demands, such as redeployment programmes and buddying for redeployed staff. The study has emphasised the wide-ranging factors to be considered when re-designing staffing models, from the local solutions to region-wide and national responses to staffing. Evidence for staffing models is weak (Butler et al., 2019), with none for ICU, therefore our respondents and nurse leaders in other countries chose to address staffing in a pragmatic way, supported by national guidance (NHSE, 2020a, Marshall et al., 2020; The Ohio State University, 2020).

 The study has emphasised the critical importance of not aiming for the one size fits all approach, particularly because ICU are widely heterogenous in terms of skill mix, staffing numbers, hospital estates and patient populations admitted to ICU. It was clear that, before the pandemic, there was much more variation in the way in which ICUs manage nurse staffing in England than the national guidance (FICM, 2019) might suggest.

The theme of *learning as we go* has delineated the range of practices and measures put in place to try to meet the demand, and how learning from successful and unsuccessful practices was shared. A number of new nurse staffing approaches have emerged during the pandemic, including the buddying and team approaches identified by our participants and an on-call model (Jin et al., In press). Data from this study presents a challenge to the traditional tenets of ICU nurse staffing in England, moving from 1:1 for level 3 and 1:2 for level 2 patients, as per professional guidance (FICM, 2019) to completely different models across the country. Despite a call to return to pre-pandemic staffing models from the highest levels in the NHS (Chief Nursing Officer, 2021), it is unlikely this will be achievable where there was a pre-pandemic shortfall of ICU nurses nationally (CC3N, 2020a), and in the context of a national programme for rapid ICU bed expansion to be sustained post-pandemic (NHSE, 2021). Regions and ICUs are likely to look for different solutions, which need to be underpinned by research evidence.

Most importantly, there is a human cost to all of this. Staff wellbeing has emerged as a key concern, both in our findings and more generally across media and professional body reporting of COVID impacts. A recent survey of 709 ICU health care professionals across nine hospitals, including 344 (49%) nurses, found that 168 (49%) met the criteria for probable post-traumatic stress disorder (PTSD) and a similar number had moderate depression (167/49%) (Greenberg et al., 2021). These data were collected in June and July 2020, a similar timeframe to our data collection, and reflect the concerns of our participants. Data from other UK (Rattray et al., 2021) and international studies (for example Sampaio et al., 2021) further support these findings, which collectively have important implications for future nurse recruitment and retention.

A systematic review of 13 qualitative studies reporting data on nurses' experiences during a pandemic emphasises the need for Governments, policy makers and nurse leaders to work together to design workforce models that prevent loss of the nursing workforce (Fernandez-Castro 2020). Whilst descriptive accounts of workforce models employed around the world, and the experiences of nurses during the COVID pandemic, are beginning to appear (for example, LoGiudice and Bartos, 2021; Robinson and Stinson, 2021), there remains little evaluative data to guide future decision making. Robust research, testing the impact of nurse staffing models, informed by our data and that of others (for example, Akgün et al., 2020; Cadge et al., 2021) is urgently required. There is a need to better understand the impact of a more agile, flexible nursing workforce not only on patient outcomes but also on outcomes such as nurses' perceptions of their professional identity, their role as a member of a team and how these impact on their intentions to stay within different contexts. Whilst Wynne et al. (2021) argue that critical care nursing practice in developed nations is

fundamentally similar, further research exploring the impact of context and culture, on how well staffing models work at a local, national, and international level is clearly warranted.

Limitations

Data collection was deliberately focused on those responsible for overseeing staffing model changes at a regional level; hence the findings are slightly removed from the impact felt by clinical staff delivering care.

Data collection took place primarily between July and September 2020 with follow up in February 2021. At this point, it was not clear to what extent ICUs may return to pre-existing models especially if there were no further surges in COVID19 activity.

CONCLUSION

The COVID-19 pandemic necessitated rapid changes to existing workforce models and ratios, with the notions of what critical care nursing is being challenged as a result of a large volume of non-critical care nursing staff being redeployed into critical care. Critical care regional leaders in this study have highlighted the need for a collective response and solution to ensure critical care services can meet exceptional demands, such as in a pandemic, including through deployment of staff to areas and units in greatest need. The factors identified as influencing nurse staffing models, such as impact on care practices and the workforce in ICU, need to be built into the development and testing of future staffing models and there needs to be more robust research to underpin these models.

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