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The aim of this Critical Commentary is to discuss the optimal organisational model and UK nurse education through the experience of a non-located (with adult services) specialist paediatric intensive care unit (PICU), which admitted critically ill adults with COVID-19 during the first and second waves of the pandemic.

In March 2020, the World Health Organization (WHO) declared COVID-19 a global pandemic with more than 150 countries affected with unprecedented pressure on intensive care beds within the adult population [1,2,3]. From China's and other countries' experience, the burden of COVID-19 infection within the paediatric hospital setting was anticipated to be far less than for adults [4,5]. In March 2020, the UK government required all elective surgery to be suspended, although urgent surgery would still need to be provided to neonates and children with congenital heart disease.

Aiding overwhelmed adult critical care services

Our PICU is a standalone specialist children's hospital in the North West of England, providing tertiary services to the wider North West region, a population of approximately 7.5 million. Prior to the pandemic we had 21 PICU and 15 High Dependency Unit (HDU) commissioned beds, admitting children up to the age of 17 years, and were a designated and funded Extracorporeal membrane oxygenation (ECMO) centre. When the adult critical care network in the region became overwhelmed in April 2020, our hospital offered support to both adult and paediatric colleagues. All other hospitals in the region were also working in extraordinary ways, with other tertiary centres decreasing their paediatric beds, as many were co-located within an adult hospital (with an adult ICU), in preparation for a surge in demand of critically ill adults. At this time our hospital expanded its overall critical care bed capacity to 46 PICU and 26 HDU beds. We offered 19 adult ICU beds, with a total of 65 (46 paediatric & 19 adults) level 3 and 4 ECMO beds.

Organisational models of care in a pandemic

This pandemic resulted in a rapid requirement for a more seamless system of critical care beds, and this made us question whether the organisational model of standalone specialist hospitals is better than that of larger co-located children's hospitals. Nationally, some centres ran a hybrid model, with PICU staff managing both adult and paediatric patients [6]. The decision to admit adults into our standalone children's hospital and critical care unit was complex and included a comprehensive engagement with local Operational Delivery Network (ODN) and strategic planning. Admitting adults to a children's hospital is not easy from an organisational perspective. Early on we agreed specific criteria, such as age under 70 years, body mass less than 120kg and few multiple co-morbidities; however, these criteria had to be rapidly relaxed due to their restrictive nature. Support and advice from an adult ICU was given virtually, with use of shared resources from our regional adult ICU lead centre, with once weekly on-site visit from an adult intensivist, but largely the management of these adults was by paediatric intensivists, nurses and allied health professionals, unlike other co-located PICUs that admitted adult patients where there was more on-site, in person advice and support. Although there are well established paediatric, adult and neonatal regional networks within the UK that all work effectively, for services like transportation, education and manager

forums, they remain predominantly separate and segregated. The COVID-19 pandemic has highlighted this segregation of critical care beds and has shown that these ODN need to work more collaboratively to provide critical care across the lifespan. Using a collaborative network approach would strengthen the mutual aid response nationally and mirror some other international approaches, such as that used in Australasia, [7] with more joined up critical care networks. This would also provide improved opportunities for integrated learning, collective working on a regional and national level, virtual meetings, networking groups and conferences to promote this [8,9].

Rapidly increasing the critical care workforce

Like other hospitals within the UK, an urgent two-day education course was developed to train non-critical care trained staff to work within a PICU at a basic level, led by PICU Advanced Nurse Practitioners and Consultants, with the challenge to train 200 staff in anticipation of the first surge of adult patients. This was provided while simultaneously having to manage a reduced workforce due to shielding, self-isolating, and running a PICU and providing urgent paediatric surgery. The minimum safe staffing level ratio was provided by NHS England [10] with clear guidance on the surge capacity for registered nurses without critical care experience and critical care nurses. This was identified as 1 critical care nurse with 6 trained registered nurses to provide 1 to 1 nursing care of critically ill patients during the COVID-19 crisis, a change from the UK standard of 1:1 critical care nurse: intubated patient [11,12]. We were forced to consider the potential impact of this diluted specialist workforce on patient safety, when using non-specialist critical care nurses. It is well documented that low registered nursing staffing ratios are associated with omissions of essential nursing care [13,14,15]. Like others, we enlisted other now redundant (in light of the pandemic) clinical teams to comprise new proning and intravenous line insertion teams [10,12]. More than 250 staff were redeployed from outside of PICU to support caring for this critically ill group of patients, and this was an alien environment for many staff. To compound this, because these were adult patients most staff were unfamiliar with the medications, dosages, pathology and complexity of these adult patients and non-PICU staff were unfamiliar with information technology systems used in PICU. Another important question that COVID-19 generated was whether a two-day intensive critical care skill training programme was enough to 'up-skill' non-critical care trained staff, staff with previous ICU experience or operating theatre skills in a pandemic situation. It takes around 12-24 months of degree level specialist nurse education (and associated clinical experience) to train a critical care nurse from novice to competent to manage level 3 patients [16]. It is well documented that higher levels of experience and education are associated with fewer patient deaths [17]. In addition to this training, we had to consider how to rapidly train a group of competent paediatric critical care nurses to manage adult patients.

The flexibility of the UK nursing workforce

The UK is currently the one of the only countries with field-specific branch undergraduate nurse education (adult, children's, mental health or learning disability nursing). This has resulted in children's nurses who have never nursed adults and vice versa. This pandemic has therefore raised questions around the flexibility and capability of this UK nursing workforce in situations like the COVID-19 pandemic. Additionally, many children's nursing students were unable to undertake their clinical placements and be facilitated in the clinical environment during the pandemic for several reasons. This required the use of alternative virtual learning

and simulation scenario teaching, all measures which may have adversely impacted on their clinical learning experience and the future workforce [18,19]. During the first wave of the pandemic, when our unit admitted adults, one of the biggest distress factors for the nurses was the stress of having to nurse adults and on top of this COVID-19 adults. At this time, our PICU nursing staff (88% of who were children's nurses) often voiced their thoughts around whether having had more generic nurse training (including care adult patients) would have been beneficial. Much of their stress and anxiety related to having to nurse adult patients with different morbidities, requiring different drugs and doses and to communicate with relatives of adult patients (who were not routinely allowed visiting into the PICU). The lack of family visitation felt wrong to these nurses who were used to having families present at the bedside. This issue remains a question for the UK Nursing and Midwifery Council (NMC) and nurse educationalists to consider for the future, whether such a highly specialist workforce at undergraduate level creates a flexible and capable workforce, in light of the fact that the UK is the only country to use this approach [20]. In practically all other countries, specialisation is at a post-graduate/post qualifying level [21].

The uniqueness of our experience of a standalone PICU that admitted adult COVID patients, lies not in dealing with COVID-19 in general, but in the largely paediatric workforce having to adapt and learn to manage critically ill adults in the context of an organisational model of a standalone specialist children's hospital.

Conclusions

During the first wave of the pandemic our PICU admitted 11 adults with COVID-19, of which 36% died and 64% survived to discharge, whereas in the second wave our unit admitted nine adults with COVID-19, 33% died and 67% survived. This picture reflects the national adult ICU statistics. This patient group was extremely sick not even reflecting a 'normal' pre-pandemic adult ICU population, with serious respiratory failure complicated by many comorbidities leading to multi-organ failure. Despite the challenges, there were many transferable skills between these different patient populations. History suggests a pandemic is likely to occur again in the future [22,23]. Therefore, we must learn from this experience and anticipate how best to 'future proof' both the workforce and the organisation. Consideration of more aligned 'across the lifespan' critical care networks are required within the UK. Concurrently, the NMC should reconsider the advantages and disadvantages of having separate children's and adult nursing programs at undergraduate level.

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