

# Using the Systems Engineering Initiative for Patient Safety (SEIPS) model to describe critical care nursing during the SARS-CoV-2 pandemic (2020)

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## 1 | INTRODUCTION

As of April 2020, globally, there were over 1.3 million confirmed Covid-19 cases and 55 000 cases in the United Kingdom (WHO).<sup>1</sup> The Covid-19 pandemic is the greatest challenge faced by the National Health Service (NHS) to date. Recent data from the United Kingdom-based Intensive Care and National Audit Research centre (ICNARC) database<sup>2</sup> suggests patient mortality rates are almost double those of common viral pneumonia seen in intensive care unit (ICU) patients (50.1% vs 22.4%). In ventilated patients, ICU mortality is even higher (67%),<sup>2</sup> but interpretation should be cautious until further outcomes of this population become known. Severity of respiratory failure and high contagion index of SARS-Cov-2 has caused unprecedented patient numbers needing a high-dependency unit (HDU) or ICU.<sup>3</sup> In response, NHS ICUs have nationally increased bed capacity,<sup>4</sup> utilized staffing models not seen before,<sup>5</sup> and changed medical strategies.

Previous pandemic preparedness models have highlighted “four Ss” that include: space (beds), staff (clinicians and operations), stuff (physical equipment), and system (co-ordination).<sup>6</sup> The Systems Engineering Initiative for Patient Safety (SEIPS) human factors model potentially offers a more comprehensive framework by focusing on health care structures, relationships, and processes.<sup>7</sup> It consists of five key domains: person, task, tools and technology, environment, and organization. The SEIPS model<sup>7</sup> may facilitate a pragmatic approach in provisioning for pandemic preparedness, incorporating additional elements of task, tools, and technology. The systematic framework of this model provides the opportunity and means to examine the Covid-19 pandemic while utilizing real-time experiences from the frontline.

The aims of this Critical Commentary are to: (a) systematically describe the evolution of critical care nursing for patients with Covid-

19 and (b) propose that the SEIPS human factors model may facilitate organizational evaluation and surge preparedness during a pandemic.

## 2 | PERSON: PATIENTS AND ADVANCED STAFF ROLES

Despite SARS-CoV-2 infections being likened to adult respiratory distress syndrome (ARDS),<sup>8</sup> recent data suggest that the aetiology of illness may differ. SARS-CoV-2 has two phenotypes, L and H Covid-19,<sup>9</sup> characterized by Low elastance and high lung compliance or High elastance and low compliance. Covid-19 patients (self-ventilating or on non-invasive and invasive respiratory support) are physiologically unpredictable when being positioned. Careful consideration should be given to the positional interventions' risks and benefits with negative events, including hypoxaemia and hypotension.<sup>3</sup> The literature and anecdotal evidence suggest that mobilization, positioning, and proning should be driven by the multidisciplinary team (MDT) because of this significant exertional or positional hypoxia.<sup>3</sup>

Similarly, there is anecdotal evidence that, because of the varying phenotypes of Covid-19, including lung compliance and elasticity, ventilation strategies in this group are complex. Pandemic workforce provision may require that ICU nurses and physiotherapists lead ventilation strategies in some patients when medical supervision is limited. This may be challenging in ICU areas without existing advanced critical care nurse practitioners or advanced physiotherapy roles. Education and support to develop these skills should be proactively driven, evolving the ICU workforce with a resultant wider spectrum of expertise during future pandemics. The pace of this evolution requires investment in terms of remuneration, support, and MDT integration. Further research into the impact of these roles is required, with

functional patient outcomes and the retention of critical care staff as key outcomes.

### 3 | TASK: CARE WORKLOAD AND ADAPTED NURSE ROLES

Pandemic critical care nursing proposes an ethical debate. The favoured outcome is most likely the use of a utilitarian/deontological perspective, the reality observed in clinical practice being the provision of as much care as possible for the highest number of people while limiting total staff exposure time. The previous H1N1 pandemic highlighted difficulties for staff because of changing hospital strategies and care standards.<sup>10</sup> To mitigate this, a care Standardized Operating Procedure (SOP) should be developed, balancing nurse safety with adequate patient care.<sup>6,11</sup> Reducing Per Patient Workload (PPW) through SOPs is key to safely reducing staff-to-patient ratios and minimizing errors or omissions. Reducing the frequency of certain tasks that can include arterial blood gas sampling (if EtCO<sub>2</sub> and SpO<sub>2</sub> are continuously monitored), mouthcare, eyecare, suctioning, and patient positioning (if there are no concerns regarding skin integrity) can also reduce overall PPW. It may be possible that medications (routinely prepared at the patient's bedside) can be prepared by hospital pharmacy staff or other suitably trained staff, if this is not already a standard hospital process. The effects of this are a reduction in nurses' cognitive load<sup>5</sup> and an increase in ICU nurse resources for direct patient care. Another PPW reduction strategy is the use of proning teams, which consist of non-ICU staff or allied health professionals if hospital resources are available. Covid-19 research from China and early-hit European epicentres does not detail the actual and perceived workload of ICU staff despite being widely acknowledged as a major concern.<sup>1</sup> Adapted nursing roles (integrated into Care SOPs), with ICU-trained staff co-ordinating the care of other non-ICU staff, are required when care demands exceed ICU resources. Organizations should consider strategies to reduce PPW, adhere to care SOPs, and initiate adapted roles early in the pandemic while there is the support and infrastructure to do so. Attempting to change practice mid-surge may lead to greater error rates given high patient numbers, acuity, and staff anxiety.

### 4 | TOOLS AND TECHNOLOGY: HOSPITAL INFORMATION TECHNOLOGY SYSTEMS

Hospital Information Technology (IT) needs to be strengthened and tailored to facilitate patient care<sup>11</sup> during a pandemic. This can be challenging given the geographical diversity of critically ill patients throughout a hospital. Clinical areas, not traditionally ICU, need to be linked by the same computer system in order to contribute to the fluidity of staff redeployment, and problems arise when multiple systems remain clinically used. Using the same IT system enables efficient pandemic data collection feeding into concurrent research, which is integral to pandemic management. Usability of health care IT is never

more important than during a pandemic, and using labour-intensive processes that staff tolerated prior to the pandemic becomes more problematic. Documentation should be streamlined and all non-essential (during a pandemic) processes removed. Streamlining can be challenging but should be approached from an MDT perspective, related to pandemic care SOPs, and focus on maximizing staff and patient safety. If effective and used correctly, ICU IT systems can dramatically reduce nursing cognitive burden, facilitate pandemic care, and improve team communication and research opportunities.

### 5 | ENVIRONMENT: ICU CLINICAL AREA

The NHS has largely been unable to create COVID-only hospitals as was the case in China. As a result, the NHS has accepted that visiting of patients in hospital is to be prohibited except for extenuating circumstances, including palliation or child admissions. This differs from some ICU models of uninhibited access to ICU patients (open visiting), which was suggested because of the positive psychological effects that families provide to patients.<sup>12</sup> Pandemic ICU relative provision is challenging and involves striking a balance between the needs of the patient, relatives, and society by reducing transmission risks. Bereaved families in critical care experience greater levels of post-traumatic stress disorder (PTSD) than the "normal" population, and it is not unreasonable that this will be more profound during and following the pandemic.<sup>13</sup> Utilizing technical solutions, such as teleconferencing, is feasible and should be recommended. Communication systems should be delivered to patients (facilitated by local charitable funds) who have no means themselves, which can provide a much-needed link to families. New nursing roles, such as a family liaison, should be utilized as a point of ICU contact for relatives. It is arguable that it should not have been a pandemic that triggers these solutions but that this should be delivered as part of standard ICU care.

### 6 | ORGANIZATION: LEADERSHIP

It is proposed that health care worker well-being, safety, and minimizing moral distress is paramount,<sup>14</sup> never more so in a major incident or pandemic. In a pandemic such as COVID-19, this must start with adequate personal protective equipment (PPE), for which there are two key considerations: acquisition and training. Rapid acquisition of medical supplies and PPE is a primary target for any public health emergency.<sup>6,15</sup> Exploring avenues of reusable PPE is paramount as perishables are unlikely to keep up with demand, as exemplified in both China<sup>15</sup> and during the H1N1 epidemic.<sup>10</sup> Locally, the provision of reusable FFP3 grade respirators anecdotally may give clinical staff a greater sense of security than a disposable PPE kit. This is partly because of staff having ownership over equipment, not being reliant on supply chains to feel psychologically safe at work, and being able to care for their equipment (cleaning) to standards that they feel minimize risk. For training, literature suggests that local areas should appoint PPE champions<sup>6</sup> who propagate "donning and doffing"

knowledge and processes, reducing possible staff confusion and suspicion previously described.<sup>10</sup> The formalization of the doffing process has been seen to strengthen team dynamics. The trust that staff have for one another and the observability of the importance of staff safety by having a “doffing buddy” cannot be underestimated.

## 7 | CONCLUSION

The COVID-19 pandemic continues to test the resolve of the NHS, staff, and critical care. ICU departments have changed work patterns, clinical environments, and medical approaches in a matter of weeks. This commentary combines knowledge from several local experts, which include patient safety, hospital IT, research, and critical care education, resulting in a critical commentary detailing frontline pandemic ICU nursing. It outlines the possible application of a human factors model to developing pandemic evaluation and planning. COVID-19 research currently focuses on drugs trials or patient outcomes, although other research may be emerging. It is clear from this work that, currently, there are significant COVID-19 literature gaps including nursing workload, hospital IT preparedness, workforce roles expansion, and planning for future critical care delivery that warrant further investigation.

### CONFLICT OF INTEREST

The authors declare no conflicts of interest.

### AUTHOR CONTRIBUTIONS

All authors contributed to the manuscript and provided critical care expertise based on their disciplines of interest. All authors read and agreed with the final manuscript. C. L. is the Clinical Governance lead and specializes in patient safety and human factors. A. E. is the clinical lead for critical care IT. T. V. is Senior Clinical Lecturer and Critical Care Education Lead. S. R. is a Senior Sister, Clinical Governance Co-ordinator, and Renal Lead Nurse for the Adult Intensive Care Units. J. E. is a critical care researcher with an interest in human factors.

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