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Practice Points

Severe COVID-19 and healthcare-associated infections on the ICU: time to remember the basics?

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Coronavirus disease 2019 (COVID-19) has posed a significant health care challenge globally, with intensive care unit (ICU) provision being of particular consequence [1]. In the UK, where ICU beds are already lower per head of population than in much of the rest of Europe [2], there has been a requirement to expand the ICU bed capacity rapidly in response. St George's Hospital is a 1000-bedded tertiary care hospital in South West London. From an initial ICU capacity of 60 beds spread over three purpose-built units, ICU beds expanded at peak surge in April 2020 to 83 COVID-19 beds and 13 non-COVID-19 beds (96 in total), involving additional space on two medical wards, a day unit and surgical theatres. Key differences to ICU provision during this time are summarized in Table 1, and encompass changes in the environment, staffing and personal protective equipment (PPE), which combined to present a substantial infection control challenge. Patients had long average ICU stays over this period, with multiple central venous catheters (CVCs), and a high proportion of patients requiring additional access for renal replacement therapy. All of these factors

contributed to an increased risk of infection from cross-contamination of organisms between patients and within an individual patient.

Over a 16-day period in April 2020, 20 Gram-negative bloodstream infections (BSIs) were identified in patients across all of the COVID ICUs. Line-days were not recorded; however, this equated to 17.95 Gram-negative BSIs per 1000 bed-days on the COVID ICUs over this 16-day period. This contrasted with 1.04 Gram-negative BSIs per 1000 bed-days over the same 16-day period in the preceding year (2019). Eleven of these BSIs were wild-type *Klebsiella pneumoniae* species, with three demonstrating identical typing patterns. Eighteen of 20 patients had ICU stays in excess of 7 days at the time of bacteraemia, and half had been transferred from other hospitals. The source of bacteraemia was considered to be the CVC in all cases, either due to the same organism growing from a line tip or due to the lack of another clear focus. This indicates a higher-than-expected number of BSIs with a variety of organisms, suggesting that infection was largely caused by organisms from patients' endogenous flora. Given that three of the *Klebsiella* spp. were indistinguishable, this suggests some transmission between patients, although these patients were all treated on different ICUs.

On identification of the first four *K. pneumoniae* BSIs, an outbreak meeting was convened. All issues in Table 1 were discussed and addressed systematically. With ICU bed requirements beginning to decrease, a decision was made to relocate one of the new ICUs to a larger repurposed ward, and to condense the smaller new ICUs on to the existing ICUs as soon as possible. Staffing ratios were discussed, addressing both increasing nurse to patient ratios and decreasing unnecessary footfall. PPE practices were simplified and standardized with a requirement to don and doff gloves at the bedside rather than on entry to each bay, double gloving was stopped, and aseptic non-touch technique during line care was re-emphasized – all with the aim of re-establishing basic

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Table 1

Environmental, staffing and personal protective equipment (PPE) changes in intensive care units (ICUs), with infection control implications and details of actions taken

	UK standard ICU	COVID-19 surge ICU at St George's	Infection control implications	Action taken
Environmental				
Bed space	25.5 m ² [3]	Minimum 7 m ²	Lack of space for staff and equipment. PPE supplies not at each bed space. Inadequate environmental cleaning	Move to ward with larger bays and corridors. Alcohol hand gel available at each bed space
Handwashing facilities	One at each space [3]	One per bay of five or six patients	Insufficient availability to perform hand hygiene as often as required	
Staffing				
ICU-trained nurse to patient ratio	1:1 [4]	1:4 to 1:6 plus variable number of non-ICU-trained staff	Limited time to change gloves or perform hand hygiene	Increase in ICU nurse to patient ratio. Re-emphasis of importance of line hygiene and care bundles. Ensuring proning teams
Proning, vascular access and tracheostomy insertion	Proning and line insertion by resident ICU team	Dedicated proning, vascular access and tracheostomy teams moving between units	Sessional gown use with plastic 'over aprons' changed between patients. Large numbers of staff moving around units	changing aprons and using chlorine-based wipes to wipe gowns between patients. Enhanced infection control training for staff (see below)
Infection input	Microbiology input daily [4]	Microbiology input daily – primary focus on infection management	Limited capacity for daily review of infection control	
PPE				
Gowns	Plastic aprons for close contact (bare below the elbow). Single-use gowns if source isolating or performing procedure [5]	Sessional long-sleeved gowns, with plastic 'over aprons' for each patient	Same gown used to see all patients in session. Difficulty achieving adequate hand hygiene as not bare below the elbow	Training regarding PPE use, hand hygiene and aseptic non-touch technique. Consistent messaging regarding PPE use and areas to don and doff.
Gloves	Contact with sterile sites/mucous membranes/broken skin, procedures, any activities risking contact with body fluids [5]	Gloves when entering bay. Widespread use of double gloving and decontamination of gloves with alcohol gel	Potential use of same gloves between patients and within a single patient's care when should have been changed – falling short of WHO Five Moments [6]. Gelling of gloves between patients – providing inadequate hand hygiene [5,6]	Stopping practice of double gloving. Re-institution of Hand Hygiene and Saving Lives audits

WHO, World Health Organization.

infection control standards. Following these interventions, absolute numbers of Gram-negative BSIs have decreased (to 5.74 per 1000 patients on the COVID-19 ICUs at the time of writing), noting that this is also on a background of a slowing of COVID-19 ICU admissions.

Evidence from the literature suggests that concomitant bacterial infection during early COVID-19 is unusual [7]. However, we highlight our experience of later nosocomial infection in the sickest patients requiring ICU care. This is likely to be multi-factorial, including challenges inherent in the rapid upscaling of ICU capacity within existing infrastructure,

reduced staff to patient ratios, and increased length of stay and complexity of patients. The correct use of PPE in the new pandemic setting has been a particular challenge. The understandable focus on protecting healthcare providers from COVID-19 has often obscured the importance of the other role of PPE – as part of a basic infection control package to prevent hospital-acquired infection. Of note, Yap *et al.* reached a very similar conclusion in a paper documenting increased rates of meticillin-resistant *Staphylococcus aureus* transmission during the 2009 severe acute respiratory syndrome pandemic [8]. Infection prevention and control skills need to be seen as core

training requirements for all healthcare workers, with the flexibility to adapt this learning in the face of an emergency pandemic response with new PPE requirements. To neglect infection control going forward in the pandemic risks increasing the morbidity and mortality of the sickest COVID-19 patients.

Conflict of interest statement

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Ethical approval

This study was carried out in line with the Declaration of Helsinki. Ethical approval was not required according to the Health Research Authority tool, and the study was registered with the local hospital clinical audit group (Reference AUDI000634).

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