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**Katerina Iliopoulou**  
Postdoctoral Research Fellow  
King's College London  
London, UK

katerina.iliopoulou@kcl.ac.uk

🐦 @Katerinalliopou



**Andreas Xyrichis**  
Senior Lecturer  
King's College London  
London, UK

andreas.xyrichis@kcl.ac.uk

🐦 @AndreasXyrichis

# Critical Care Telemedicine: A Management Fad or the Future of ICU Practice?

Critical care telemedicine is likely to be a key feature of the future ICU, but its success will hinge on the development of a sophisticated and robust implementation roadmap.

## Introduction

The future ICU will shape the future of the modern hospital, and the future of health-care in the wider sense. This responsibility cannot be taken lightly. In this paper, we draw from our experience in London and the international literature to discuss how critical care telemedicine is not only a likely feature of the future ICU, but an inescapable reality. We caution, however, that the success of critical care telemedicine, as of much of ICU innovation, will ultimately hinge on the development of a sophisticated and robust implementation roadmap.

## Background

As Vincent et al. (2017) eloquently described, the future of ICU is full of potential. Technological advances in health informatics in particular will shape the size, space, number of personnel and the type of treatments available in the future ICU. Telemedicine, alongside artificial intelligence and management of big data could lead to more personalised treatment for better patient outcomes (Seymour et al. 2017).

It is now widely accepted that the burden of critical illness is growing rapidly and it is likely to be greater than currently

appreciated. Critical care telemedicine has a special part to play in enabling access to scarce critical care expertise and reducing variability in treatment and care through clinical decision support enabled by the analysis of large data sets and use of predictive tools (Lovejoy et al. 2019). Technology and clinical informatics are evolving rapidly, and machine intelligence is here to stay; however, challenges with regard to how new technologies and devices are applied, overseen and monitored must be carefully considered (Vincent and Creteur 2017).

## Critical Care Telemedicine

Medical advances and demographic shifts have contributed to an older and more complex ICU population, placing pressure on critical care services worldwide. In combination with a limited supply of critical care expertise, this situation leaves many small and rural hospitals feeling stretched and unable to cope with demand (Xyrichis et al. 2017).

Telemedicine has long been thought of as one way with which to overcome the lack of critical care resources, while at the same time improve access to critical care expertise, contain variance in clinical outcomes and foster a safety culture within and across ICUs (Mackintosh et al. 2016). We use telemedicine to refer to "a system to facilitate the remote delivery of critical care services using interactive audio, video, and electronic links" (Kahn et al. 2011).

Applications of critical care telemedicine range from continuous e-surveillance by a remote team of experts to bedside support of patients with specific clinical conditions through interaction with bedside providers.

## Evidence of Effectiveness

Adoption of critical care telemedicine has been associated with lower ICU and hospital mortality, and with reduced length of stay (Wilcox et al. 2012; Lilly et al. 2013), although this is based on suggestive rather than definitive evidence. For example, in instances where telemedicine interventions allowed for an increase in timely involvement of intensivists, there was higher utilisation of ICU best practices and lower rates of complications (Lilly et al. 2011). However, methodological limitations of available research, in combination with challenges in evaluating its clinical and economic impact, limit our ability to support the efficacy of telemedicine with high confidence. This cautiousness notwithstanding, it is important to note that to date there has been no evidence of harm associated with the adoption of critical care telemedicine.

Mackintosh et al. (2016) looked at the effect of 24-hour critical care telemedicine with standard ICU care for acutely ill adults and children. They concluded that although there was some evidence for the impact of telemedicine on hospital mortality (reduction from 13.6%, [CI, 11.9–15.4%]) to

11.8% [CI, 10.9–12.8%]), further multi-site experimental studies are urgently needed to inform future investments. Moreover, a recent systematic review concluded that research studies in telemedicine should do more to clearly define the study population, the intervention elements, and the organisational context in which telemedicine is implemented; specifically, it is important to note the staffing models and healthcare infrastructure involved in the delivery of any telemedicine intervention (Flodgren et al. 2015).

### Utilisation and Implementation

Even though telemedicine is understood to be a potentially effective tool, and its adoption is increasing rapidly, reliable data on its real cost and its acceptability by ICU staff, patients and carers is limited. Qualitative data from Thom et al. (2017) revealed considerable variation on how bedside ICU staff utilise critical care telemedicine across moderate/basic and complex ICUs. Quantitative and qualitative data from Mullen-Fortino et al. (2019) showed that contact with the telemedicine hub was less likely to occur if ICU bedside nurses did not know the telemedicine physician personally. In that study, the majority of nurses (79%) acknowledged telemedicine's positive impact on patient outcomes; however, they identified regular and personal communication between themselves and the tele-ICU staff as essential if telemedicine is to reach its potential.

Variations in the implementation of critical care telemedicine interventions within different hospital settings point to a need to understand how different contexts and management practices can influence performance, since what works in one setting may not work in another (Kringos et al. 2015). Thus, understanding whether, or how much, context explains variation in performance would help telemedicine intervention designers make changes and improvements, and disseminate these across settings (Ovretveit 2011). Xyrichis

et al. (2017), in an attempt to understand contextual features affecting implementation of critical care telemedicine, have been undertaking a systematic implementation review to examine healthcare stakeholders' perceptions and experiences of factors affecting the implementation of critical care telemedicine. This work, due to be published early 2020, is designed to offer a greater understanding of issues affecting implementation of critical care telemedicine, which can enable the design and evaluation of approaches that are more likely to result in successful implementation.

### Family-Centred Care

Research examining the impact of critical care telemedicine on clinical and organisational outcomes is slowly growing; however, little is still known about the perceptions, experiences and awareness of ICU patients, family members and carers with regard telemedicine. ICU family members experience high levels of anxiety and distress during, and long after, a loved one's ICU stay (Bench et al. 2016; Xyrichis et al. 2019). High levels of support and communication with the ICU care team is therefore of the outmost importance. Yet, a survey amongst ICU patients' significant others identified that the majority (66%) were not aware that their loved one was admitted in a tele-ICU (Jahrsdoerfer and Goran 2013). Moreover, in that study, families reported diverse information needs about critical care telemedicine; however, a primary and common concern was the presence of a live camera within the unit. Future research examining the views, experiences and perceptions of families concerning critical care telemedicine is desperately needed.

### Conclusion

Critical care telemedicine is a potential solution to the scarcity of critical care expertise, while quality and safe care can also be promoted through off-site surveillance, early warning capabilities, clinical decision

support and alerts for non-adherence to best practices. To date, data on its efficacy have been promising yet limited, partly because few studies consider baseline organisational and management factors such as the complexity of the ICU setting, type of interventions, staffing models, end-ICU users' perceptions and organisational readiness.

The potential of critical care telemedicine is too great to ignore, and it is therefore increasingly likely for it to be a key feature of the future ICU. We argue that if critical care telemedicine is to be successfully integrated into standard ICU practice, then its adoption needs to move away from the current haphazard approach of local initiatives towards the development of a more systematic and evidence-based implementation roadmap. ■

### Key Points

- Medical advances and demographic shifts have contributed to an older and more complex ICU population, placing pressure on critical care services worldwide.
- Critical care telemedicine has a special part to play in enabling access to scarce critical care expertise and reducing unwanted variability in care.
- Although telemedicine is understood to be a potentially effective tool, and its adoption is increasing rapidly, high-quality data concerning effectiveness, cost and acceptability by ICU staff, patients and carers remain scarce.

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