

The Role of Telemedicine in Pediatric Critical Care



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KEYWORDS

• Telemedicine • Telehealth • Tele-ICU • Remote monitoring • Pediatric critical care

KEY POINTS

- Telehealth technologies can address disparities in access to care, allowing critical care providers an immediate presence at the bedside of critically ill children in remote locations.
- Telehealth technologies can improve remote diagnostic, therapeutic, and transport decisions among children receiving care in nonpediatric referral centers.
- The use of telehealth technologies has been shown to positively affect the quality and cost-effectiveness of care in intensive care units.
- The use of telehealth technologies has the potential to improve the efficiency of pediatric critical care workflows and help address shortages in workforce.

In the past 2 decades, 2 major health system factors have been identified that maximize the chances of high care quality and minimizes risks of mistakes and complications in the intensive care unit (ICU). The first factor is the regionalization of specialty ICU services. ICU regionalization is a means of concentrating medical expertise and increasing patient volumes at designated referral and tertiary care hospitals. Higher patient volumes often result in increased care efficiency and improved patient outcomes. Well-known examples include the regionalization of trauma, specialty surgical procedures, adult critical care, as well as neonatal and pediatric intensive care.¹⁻⁷

The second factor shown to improve outcomes and quality of care in the ICU is to ensure that all patients are actively cared for by critical care physicians. In both adult and pediatric critical care medicine research, it has been shown that critically ill

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patients have a lower risk of death and shorter ICU and hospital lengths of stay, and receive higher care quality when critical care physicians are involved in their management.^{8–11} Researchers estimate that ICU mortality is reduced by 10% to 25% when critical care physicians direct patient care compared with ICUs where critical care physicians have little to no involvement in patient care.^{8,9,12}

Despite the clear motivation that all critically ill children receive treatment in a regionalized pediatric ICU and by pediatric critical care physicians, many are cared for in less ideal settings. This finding is explained in part by simple geography, pediatric population density, and economic factors, namely the infeasibility of all hospitals to maintain the equipment and personnel to treat specific pediatric conditions.¹³ The regionalization of pediatric ICUs, although increasing quality and efficiencies of care, also by its design creates disparities in access. Critically ill children from nonurban areas are frequently cared for, by necessity, in hospitals that lack the full spectrum of pediatric ICU services and/or pediatric critical care expertise.^{14–16} Magnifying the problem of geography is the continued shortage of critical care physicians, both adult and pediatric, which is expected to worsen in future years.^{17–19} The distribution of pediatric ICUs in the United States has been reported in the past decade.^{20,21} These reports identified growing numbers of pediatric ICUs and beds as well as increased rates of baseline and 24-hour-per-day staffing by pediatric critical care physicians. The number of beds per pediatric population is similar across each US census region (national average of 1 bed per 18,542 children), although disparities still exist state by state (ranging from >1 bed per 15,000 children to <1 bed per 75,000 children). In addition, although smaller units (1–6 beds) had higher physician and nursing staffing ratios, they had lesser capacities compared with larger units to provide advanced therapies such as renal replacement and inhaled nitric oxide. Combined, regionalization and physician shortages sometimes make it difficult to guarantee that all critically ill children are treated in a timely manner, by qualified physicians, and in an appropriate full-service pediatric ICU.

Telemedicine, the interactive delivery of health care over distance using advances in telecommunication technology (ie, videoconferencing equipment), is an evolving model for care delivery that increases access, improves outcomes, and reduces costs. By improving access, both geographically and temporally, telemedicine is a potentially transformative use of technology, allowing earlier involvement of specialists in acute, life-threatening situations, as well as for many other in-person health interactions that, although not urgent, are not happening efficiently, because they are impeded by the current delivery system.^{22,23} Grundy and colleagues²⁴ first reported on the use of telemedicine in intensive care in 1977. Access to medically underserved areas, both rural and urban, is improved by enabling critical care physicians' participation in the care of the most critically ill patients in remote locations^{25,26} with the potential for cost savings primarily from reducing unnecessary patient transports, although the ultimate economic impact of telemedicine needs further study.^{27,28}

By importing specialty expertise using telemedicine, emergency departments (EDs), inpatient wards, and nonspecialty ICUs are given the means to increase their capacity to provide higher quality of care to pediatric patients.²⁹ Critical care physicians can also increase their efficiency with these technologies so that their expertise can be disseminated to more patients at more than one ICU or hospital at a time. The use of telemedicine technologies can also reduce the need to transfer children who are less ill to referral centers, reserving the limited pediatric ICU beds for those most in need of a regionalized center.^{30,31} For these reasons, the use of telemedicine by hospitals and physicians providing critical care services will continue to increase and be individualized to best fit the needs of their patients.

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