

Evaluating strategies to improve patient and staff outcomes in a distributed paediatric ICU: A simulation study at the Children's Hospital at Westmead

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Abstract: Rescheduled medical procedures negatively impact patients and healthcare staff by introducing care delays, inefficiencies, and frustration. While mitigating this risk is a challenge for any healthcare organization, it is uniquely challenging for paediatric intensive care units (PICUs). PICUs care for some of the most vulnerable patients in the healthcare system: in this context, rescheduled procedures can be extremely distressing for families, require patient transfer, force lower-acuity procedures to be rescheduled, and can be stressful for staff. Many PICUs manage this risk through careful, deliberate policy choices and resource allocation methods, including the use of specialized pods (i.e. clusters of ICU beds and nurses) to facilitate more efficient patient monitoring and management. The PICU at the Children's Hospital at Westmead (CHW) faces similar challenges: in anticipation of a move to a new facility wherein PICU pods will be geographically distributed, the CHW sought to explore management strategies using a discrete event model. The model generates patients from ANZPICs procedure data, schedules them for surgery, and admits them to the appropriate pod provided bed space and adequate nursing staff are available. Several strategies were tested to maximise the benefits of pods while mitigating their challenges, including (1) hiring cardiac pod nurses, (2) reallocating beds with and without adding nurses available to any pod, (3) opening a second cardiac surgery theatre two days per week, and (4) diverting eligible patients to Enhanced Recovery After Surgery (ERAS) beds. Results showed that distributed pods doubled the number of inadequately staffed cardiac shifts due to conflicting nursing requirements. The source of this conflict was the cardiac pod's need for highly-specialised nurses and the non-cardiac pods' disproportionate patient volume, which frequently preoccupied specialised nurses. The model determined that this conflict could be alleviated by hiring one or more ECMO-trained cardiac nurses for weekday day shifts: a single nurse was projected to reduce rescheduled cardiac surgeries by 30.8% without compromising non-cardiac care. Other strategies showed mixed results. Adding a second surgical theatre reduced rescheduled procedures by 11% under current elective cardiac demand but led to tradeoffs when elective demand increased. ERAS beds were underutilised and had minimal impact under current eligibility criteria, but expanding eligibility criteria was predicted to lead to better PICU outcomes. Funding more beds in the cardiac pod at the expense of non-cardiac pods improved cardiac outcomes but reduced overall bed occupancy and increased non-cardiac cancellations. These findings are consistent with the nuanced outcomes of prior research and reinforce the idea that when pods are involved the details are critical to success.

Keywords: Paediatric intensive care unit, staff optimisation, healthcare operations, cardiac surgical patients