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Original Article

Establishing a paediatric critical care core quality measure set using a multistakeholder, consensus-driven process

Jessica A. Schults, RN, PhD [a, b, c, d, ac, *], Karina R. Charles, RN, MNurs PICU [a, b, c, d], Johnny Millar, MBChB, PhD, MRCP, FRACP, FCICM [e, f], Claire M. Rickard, RN, PhD [a, b, g, ac], Vineet Chopra, MD, MSc [h], Anna Lake, RN, GradCertClinNurs [c, i], Kristen Gibbons, PhD [c], Debbie Long, RN, PhD [c, d, j], Sarfaraz Rahiman, MD, FCICM [d, ab], Katrina Hutching, RN, MHlthLd [k], Jacinta Winderlich, BNutDietet, MClinRes [l, m, w], Naomi E. Spotswood, BMedSc, MBBS, MIPH, FRACP [n, o, p], Amy Johansen, RN, MANP Research [q, r], Paul Secombe, BA, DipAud, BMBS (Hons), MClinSc, FCICM [s, t, u], Georgina A. Pizimolas, BPhty [d], Quyen Tu, BPharm [d, v, ac], Michaela Waak, MBBS, MD [c, d], Meredith Allen, MBBS, FRACP, FCICM, PhD, MSafSc [w, x], Brendan McMullan, BMed (Hons), PhD [y, z], Lisa Hall, BTech BiomedSci (Hons), PhD [a, aa], on behalf of the Australian and New Zealand Intensive Care Society Paediatric Study Group

[a] *Herston Infectious Diseases Institute, Metro North Hospital and Health Service, Queensland, Australia;* [b] *School of Nursing, Midwifery and Social Work, University of Queensland, St Lucia, Queensland, Australia;* [c] *The Children's Intensive Care Research Program, Child Health Research Centre, Faculty of Medicine, The University of Queensland, Brisbane, Australia;* [d] *Paediatric Intensive Care Unit, Queensland Children's Hospital, Queensland, Australia;* [e] *Intensive Care Unit, Royal Children's Hospital, Melbourne, Victoria, Australia;* [f] *Murdoch Children's Research Institute, Melbourne, Victoria, Australia;* [g] *School of Nursing and Midwifery, Griffith University, Queensland, Australia;* [h] *Department of Medicine, University of Colorado School of Medicine, Aurora, United States;* [i] *School-based Youth Health Nursing Service, Child and Youth Community Health Service, Children's Health Queensland, Australia;* [j] *School of Nursing, Centre for Healthcare Transformation, Queensland University of Technology, Brisbane, Queensland, Australia;* [k] *Paediatric Intensive Care Unit, Starship Child Health, Auckland, New Zealand;* [l] *Nutrition and Dietetics, Monash Children's Hospital, Melbourne, Australia;* [m] *Australian and New Zealand Intensive Care Research Centre, School of Public Health and Preventative Medicine, Monash University, Melbourne, Australia;* [n] *Department of Paediatrics, Royal Hobart Hospital, Hobart, Tasmania, Australia;* [o] *Maternal, Child and Adolescent Health Program, Burnet Institute, Melbourne Victoria, Australia;* [p] *Department of Medicine, University of Melbourne, Melbourne, Victoria, Australia;* [q] *Paediatric Intensive Care Unit, The Royal Children's Hospital Melbourne, Victoria, Australia;* [r] *Paediatric Intensive Care Research Group, Murdoch Children's Research Institute, Melbourne, Victoria, Australia;* [s] *Intensive Care Unit, Alice Springs Hospital, Alice Springs (Mparntwe), Northern Territory, Australia;* [t] *School of Medicine, Flinders University, Bedford Park, South Australia, Australia;* [u] *School of Public Health and Preventive Medicine, Monash University, Melbourne, Victoria, Australia;* [v] *Pharmacy, Queensland Children's Hospital, South Brisbane Queensland, Australia;* [w] *Paediatric Intensive Care Unit, Monash Children's Hospital, Melbourne, Victoria, Australia;* [x] *Department of Paediatrics, Monash University, Melbourne, Victoria, Australia;* [y] *Discipline of Paediatrics and Child Health, School of Clinical Medicine, University of New South Wales, Sydney, Australia;* [z] *Sydney Children's Hospital, Randwick, Sydney, Australia;* [aa] *School of Public Health, University of Queensland, Queensland, Australia;* [ab] *Faculty of Medicine, University of Queensland, Brisbane, Australia;* [ac] *The University of Queensland Centre for Clinical Research, Queensland, Australia*

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ABSTRACT

Introduction: Monitoring healthcare quality is challenging in paediatric critical care due to measure variability, data collection burden, and uncertainty regarding consumer and clinician priorities.
Objective: We sought to establish a core quality measure set that (i) is meaningful to consumers and clinicians and (ii) promotes alignment of measure use and collection across paediatric critical care.
Design: We conducted a multi-stakeholder Delphi study with embedded consumer prioritisation survey. The Delphi involved two surveys, followed by a consensus meeting. Triangulation methods were used to integrate survey findings prior tobefore the consensus meeting. In the consensus panel, broad agreement was reached on a core measure set, and recommendations were made for future measurement directions in paediatric critical care.

* Corresponding author at: University of Queensland, Centre for Clinical Research, Building 71/918 RBWH Herston, Brisbane, Queensland, 4029, Australia. Tel.: +61 (0)7 37355224.
E-mail address: j.schults@uq.edu.au (J.A. Schults).

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Setting and participants: Australian and New Zealand paediatric critical care survivors (aged >18 years) and families were invited to rank measure priorities in an online survey distributed via social media and consumer groups. A concurrent Delphi study was undertaken with paediatric critical care clinicians, policy makers, and a consumer representative.
Interventions: None.
Main outcome measures: Priorities for quality measures.
Results: Respondents to the consumer survey (n = 117) identified (i) nurse-patient ratios; (ii) visible patient goals; and (iii) long-term follow-up as their quality measure priorities. In the Delphi process, clinicians (Round 1 n = 191; Round 2 n = 117 [61% retention]; Round 3 n = 14) and a consumer representative reached broad agreement on a 51-item (61% of 83 initial measures) core measure set. Clinician priorities were (i) nurse-patient ratio; (ii) staff turnover; and (iii) long term-follow up. Measure feasibility was rated low due to a perceived lack of standardised case definitions or data collection burden. Five recommendations were generated.
Conclusion(s): We defined a 51-item core measurement set for paediatric critical care, aligned with clinician and consumer priorities. Next steps are implementation and methodological evaluation in quality programs, and where appropriate, retirement of redundant measures.

1. Introduction

For more than two decades, paediatric critical care providers have undertaken quality measurement to generate performance information and drive practice improvements. Paediatric critical care is a complex system to measure healthcare quality.[1,2] Staff and resource shortages,[3,4] limitations in adverse event monitoring systems,[5,6] combined with the proliferation of quality measures collected,[7,8] make measurement challenging. Critically ill children have increased risk of healthcare-associated harm[9] due to the invasive nature of medical treatment and patient factors such as pre-existing organ failure.[10–12] While some progress has been made, lack of alignment across paediatric critical care quality programs has contributed to challenges for clinicians and facilities when it comes to prioritising quality measures that are meaningful to patients, families, and clinicians.[13]

Core quality measure sets have been proposed as a solution to address inconsistency and data aggregation issues across healthcare. Designed to be meaningful to consumers, patients, and clinicians, core measure sets aid in the promotion of measures that are evidence-based practice and generate valuable information for quality improvement. Core sets help reduce measure proliferation and decrease collection burden. In Australia and New Zealand (ANZ), the use of core measure sets remains in its infancy. Internationally, work has been undertaken to develop paediatric critical care measurement sets;[6,13–16] however, efforts to date have failed to include consumer and multidisciplinary clinician involvement.[15,17] As such, we sought to establish a core quality measure set using a multistakeholder consensus process. Recognising implementation of core measure sets is challenging; we also sought to generate recommendations for future directions.

2. Methods

We conducted a two-stage, multistakeholder consensus-driven process. Stage 1 was a consumer prioritisation survey; stage 2 was a multistakeholder Delphi study comprising 3 rounds. A study schema is outlined in Fig. 1. We intentionally did not seek input on measure specification. Project scope was restricted to ANZ to maximise potential impact on local public policy. We defined quality-measure types as outcome, structure, or process measures (Supplementary material 1):[18–20] we anticipated other composite, cost, and efficiency measures being proposed by participants throughout the study.

A community and consumer investigator (AL) was involved in all aspects of the project with remuneration provided per local policy. Ethical approval was obtained from the Children's Health Queensland Hospital and Health Service Human Research Ethics Committee (HREC/22/QCHQ/85549). The study was endorsed by the Australia and New Zealand Intensive Care Society Paediatric Study Group (PSG2022-05), a binational paediatric intensive care collaborative. The study is reported in line with Guidance for Reporting Involvement of Patients and Public (GRIPP2)[21] and was further informed by published consensus reports[22] and developing guidelines (ACCORD; equator network).[23]

2.1. Stage 1: consumer survey

A cross-sectional survey was conducted between July 2022 and February 2023 to determine consumer quality-measure priorities. Administered in English, opt-in, snowball sampling was used to recruit paediatric critical care survivors aged >18 years (at the time of survey completion) or parents/caregivers of children who experienced a paediatric critical care admission in ANZ. The sampling strategy was supported by family advisory groups of participating hospitals and investigator networks (e.g., hospital foundations). Survey recruitment occurred via electronic platforms (Facebook advertisements, email) and posters placed in participating paediatric intensive care units ($n = 5$).

2.1.1. Survey instrument

The survey questionnaire (Supplementary material 2) comprised four sections and was based on (i) existing quality measures identified through a scoping review (n = 57)[13] and (ii) the Australian Commission for Safety and Quality in Healthcare advice for measuring patient safety culture.[24] At the time of recruitment, participants were asked to complete a general informed consent process. Participants were then asked to self-report key demographic characteristics and rank priorities for quality measurement in paediatric critical care.

To aid comprehension, quality measures and safety culture questions were reviewed and refined with consumers (AL, BR [acknowledgement]). Beforedistribution, the survey was piloted with five parents and presented to two consumer groups (New

South Wales [John Hunter] consumer group and Queensland Family Advisory Council). Standardised mortality rate, paediatric critical care length of stay, and duration of mechanical ventilation were intentionally removed from the list of considered measures, with consumers considering these fundamental to collect for public safety reporting.[1] Face validity of the instrument was demonstrated with a median rating of 4.5/5 (interquartile range: 3–5) for clarity and relevance across the five parent assessors. All questions scored >4 for clarity and feasibility using a 5-point level of agreement (1, not; 2, somewhat; 3, neutral, 4, quite; 5, highly) on content validity assessment.[25,26] Revisions to flow and item wording were proposed and accepted. In this paper, we report consumer measure prioritisation only, perception of health care quality will be reported separately by consumer investigators.

2.2. Stage 2: expert Delphi

We conducted a Delphi study with ANZ experts in paediatric critical care between July 2022 and April 2023. The Delphi comprised 2 electronic survey rounds and a consensus meeting. Data triangulation methods were used to integrate consumer survey and Round 1 and 2 clinician survey results before the Delphi consensus meeting. Data triangulation was a critical step in developing a comprehensive understanding of clinician and consumer priorities going into the Delphi consensus meeting. Consensus was defined as agreement by more than 70% of the participants in scale statements or recommendations.[27–29]

2.2.1. Survey rounds

A convenience sample of clinicians actively involved in the care of critically ill children was invited to participate via email advertisements to Australia and New Zealand Intensive Care Society Paediatric Study Group members. We supplemented this approach with posters in paediatric critical care units and social media advertisement. We aimed to capture a diverse sample of critical care clinicians and viewpoints across health disciplines (i.e., medicine, nursing, allied health), clinical speciality (i.e., infectious disease, neonatology), and geography (ANZ).

Experts completed two survey rounds. Survey distribution occurred via an electronic Research Electronic Data Capture link (hosted by The University of Queensland)[30,31] with the associated quick response code. We included an email identifier to facilitate Round 2 distribution and prevent multiple survey submissions.

The Round 1 survey instrument was based on currently collected measures, identified in a literature review, and through expert consultation.[13] The survey comprised three sections: participant characteristics, rating of measure importance, and free-text questions to propose additional measures. Based on recommendations for quality-measure evaluation,[18] importance was defined as the extent to which the specific measure focus is important to making significant gains in healthcare quality. Panellists rated measures' (n = 83) importance using a 3-point Likert scale, where 1 = 'not important', 2 = 'important but not critical', and 3 = 'important'. As suggested by Grading of Recommendations Assessment, Development, and Evaluation, only measures perceived as 'important' were kept and used to formulate clinical recommendations.[32] Pilot testing of the survey (n = 13 clinicians) led to adaptations of the initial 9-point Likert scale[22] to a 5-point, then 3-point scale.[16] The adaptation, based on feedback (i.e., survey fatigue, completion challenges related to time), reflects our attempt to maximise completion and response rates.

In Round 2, experts reviewed measures that had achieved consensus (for importance) and ranked their top 10 measure priorities. Clinicians then rated measure feasibility (case ascertainment) on a 3-point Likert scale, where 1 = 'feasible', and 3 = represented 'not feasible'.[22] Feasibility was defined as the ease with which the measure could be accurately collected without undue burden.[18,33] Where a measure was perceived as 'not feasible', participants were asked to select a predefined reason: (i) unable to collect the event data; (ii) resource intensive to collect; and (iii) lack of standardised case definition and measurement information. Finally, measures that did not achieve consensus threshold for importance were re-presented to participants for confirmation of exclusion (y/n).

2.3. Data triangulation

To consolidate input from clinicians and consumers, we used data triangulation at the close of the consumer survey and Round 2 of the clinician survey. A convergence coding scheme[34] was used to interpret and integrate key findings across the consumer and clinician surveys. 'Agreement' indicated that the key finding was identified in a stage of the study, 'partial agreement' meant that the finding was partially covered, and 'disagreement' indicated a contradictory finding. A thematic matrix was generated outlining key findings. Agreement assessment was undertaken by two investigators (JS, KC), and if necessary, disagreements were settled by a third reviewer (LH). Triangulation provided a framework for securing a deeper understanding of each informant group's perspective on priorities and future directions for quality measurement in paediatric critical care. Triangulation enabled the generation of key statements that were crafted into draft '*future direction*' recommendations for panel consideration (Supplementary material 3). In line with guidance for stakeholder engagement in the quality measure lifecycle,[18] the use of stakeholder input to prioritise areas for future directions is an important step in addressing gaps and improving.

2.4. Consensus panel

We convened an expert panel of public policy and discipline experts to refine measures and recommendations. The panel was a multiprofessional binational group (ANZ), including two cochairs (JS, LH) and a consumer investigator (AL). Panellists are listed in Supplementary material 4. The panel included paediatric critical care specialists, physiotherapists, pharmacists, nurses, and experts in rural and remote intensive care, infectious disease, and quality and safety measurement. Panellists were chosen based on their experience and activity (including clinical practice relevancy) in the field, in the last 10 years. Panellists were all active clinicians except for the (i) paediatric critical care researcher; (ii) consumer, and (iii) national safety agency representative.

The formal consensus exercise was conducted over two committee meetings. Conflicts of interest were declared before the panel meeting. Written, informed consent was obtained from panel participants. Panellists were asked to consider measure priorities, importance, and feasibility ratings and draft recommendations for future directions. Panellists voted on these topics using a 3-point scale (1 = in support; 2 = not in support; or 3 = abstain). Participants were able to abstain from voting if they felt they had insufficient knowledge in a domain. This vote was excluded from agreement calculation. Following the consensus meetings, a summary document was prepared, reviewed, and endorsed by panel members.

2.5. Data analysis

Descriptive statistics was used to summarise respondents' characteristics and demographic details. Medians (interquartile range) were used to express the central tendency and dispersion of

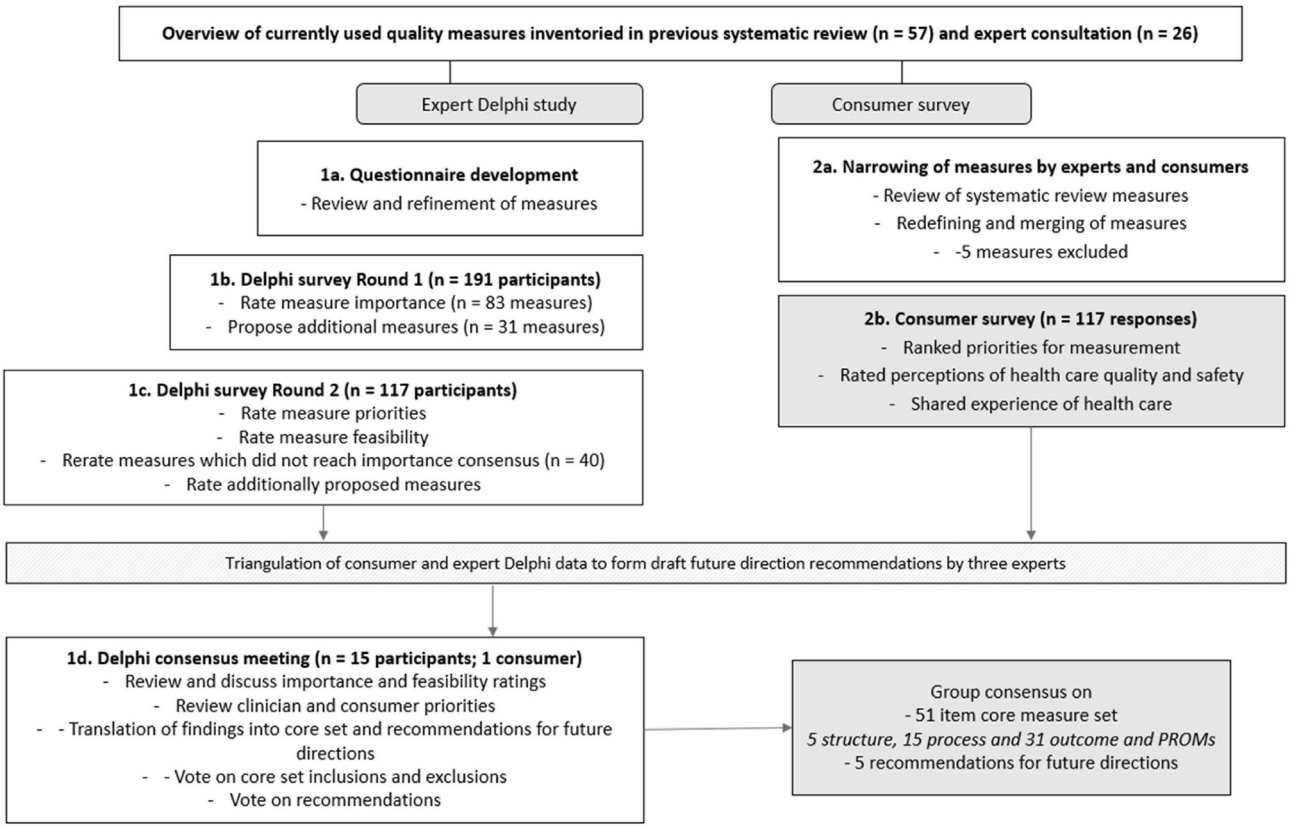

Fig. 1. Study schema, core quality measurement set for paediatric critical care. PROMs = patient-reported outcome measures.

responses for the Likert-scale questions, noting the restricted 3-point scale. Qualitative data (from open ended questions) were analysed using inductive content analysis.[35] Initially, two researchers (KC, JS) read qualitative comments and independently generated coding categories. Line-by-line coding was used (facilitating an audit trail) to enhance dependability.[36] Categories were generated using the constant comparative method and the systematic comparison of text assigned to each category.[37] Categories were reviewed and defined with continued reference to codes and raw data to enhance authenticity.[38] A number of strategies were used to enhance data quality and increase rigour, including data immersion and triangulation of emerging findings between researchers.[39]

3. Results

A study schema is outlined in Fig. 1.

3.1. Consumer survey

One hundred seventeen consumers (parents/carers/survivors) completed the consumer survey. Most consumers were based in Queensland (n = 99; 87%) and had experienced a critical care admission for a child aged 5 years or less (n = 86; 74%). Respondent characteristics are outlined in Table 1.

Table 2 displays consumer-prioritised measures with supporting quotations. The number of nurses on shift to care for children (n = 57; 49%) was the top priority, followed by visible patient goals at the bedspace (n = 51; 44%) and long-term follow-up/development of new disability (n = 44; 38%).

3.2. Delphi process

3.2.1. Survey rounds

A total of 191 multidisciplinary experts from ANZ completed survey Round 1: 117 completed survey Round 2 (61% retention rate). Approximately one-third of respondents were medical officers; allied health respondents comprised 6%–8% of the sample across respective rounds (Table 2; Fig. 1). In Round 1, 43 of the initial 83 measures (52%) reached consensus for importance; four structural, 14 process, and 25 outcome measures (Supplementary material 5). Forty measures (48%; Supplementary material 5) did not achieve consensus threshold and were taken forward for consideration as redundant measures in Round 2 and the consensus panel. Clinicians proposed 31 additional measures in Round 1: nine (29%) related to workforce, culture, and wellbeing and 11 (35%) related to parent/family experience; these measures were also taken forward.

In Round 2, experts rated 13 of 43 measures (30%) 'feasible' to collect, despite most measures being currently collected (Supplementary material 5). Measures of emerging priority, such as long-term follow-up, were perceived as currently infeasible. Lack of standardised case definition was the main reason cited for an infeasibility rating. Clinicians' measurement priorities were nurse-patient ratio (n = 57; 49%), staff turnover (n = 51; 44%), and long-term follow-up (n = 39; 33%; Table 2). No additional measure proposed in Round 1 reached consensus for inclusion in Round 2 voting. These measures were taken forward to the consensus meeting to confirm exclusion (Supplementary material 6).

3.2.2. Consensus panel

From two consensus meetings (March, April 2023), 15 panellists reached broad agreement on a 51-item core quality measure set (Table 3).

Table 1
Survey respondent characteristics.

Participant characteristics	Round 1 N = 191 n (%)	Round 2 N = 117 n (%)	Consumer N = 117 N (%)
Gender			
Male	27 (14)	21 (18)	11 (9)
Female	163 (85)	92 (79)	106 (91)
Prefer not to say	1 (1)	4 (3)	–
Age			
<19 years	–	–	2 (2)
20–29 years	42 (22)	15 (13)	15 (13)
30–39 years	57 (30)	35 (30)	46 (39)
40–49 years	54 (28)	36 (31)	37 (32)
50–59 years	29 (15)	22 (19)	15 (13)
>60 years	9 (5)	9 (8)	2 (2)
Country of practice			
Australia	160 (84)	104 (89)	113 (96)
Australian Capital Territory	–	–	3 (3)
New South Wales	50 (31)	25 (24)	8 (7)
Victoria	30 (19)	23 (22)	3 (3)
Queensland	48 (30)	32 (31)	99 (87)
Western Australia	28 (17)	20 (19)	–
Tasmania	2 (1)	2 (2)	–
Northern Territory	2 (1)	1 (1)	–
South Australia	–	1 (1)	–
New Zealand	29 (15)	12 (10)	2 (2)
Other	2 (1)	1 (1)	2 (2)[b]
Discipline			
Doctor	41 (21)	33 (28)	
Nurse	138 (72)	75 (64)	
Allied Health	12 (6)	9 (8)	
Patient population			
Paediatric	110 (57)	71 (61)	
Mixed	81 (42)	46 (39)	
Years of experience (PICU)			
<5 years	61 (32)	26 (22)	
5–10 years	46 (24)	30 (26)	
11–20 years	45 (23)	29 (25)	
>20 years	36 (19)	29 (25)	
Other	3 (1)	3 (2)	
Admission type[a]			
Planned			30 (26)
Unplanned			92 (79)
Child's age at PICU admission			
Neonate (e.g. <37 weeks; born premature)			3 (3)
0–12 months			48 (41)
1–5 years			35 (30)
6–10 years			20 (17)
>11 years			11 (9)

Abbreviation: PICU = paediatric intensive care unit.
[a] Some respondent had multiple admissions.
[b] United Kingdom, United States of America.

Forty-three measures that had reached agreement and an additional eight measures which a convincing majority of the panel considered relevant (>70%). The final set included five structure-, 15 process-, and 31 outcome- and patient-reported outcome measures. Clinician- and consumer-measure priorities are represented across set inclusions. Narrative around long-term outcome (LTO) measures (e.g., quality of life of survivors and family members, receiving information around LTOs) and screening for new disability (e.g., intensive-care-acquired weakness) led to the broad inclusion of both measures by panellists, without further specification. All additionally proposed measures were subject to discussion; however, agreement for inclusion was not reached on any measure. Mental wellbeing (of clinicians), burnout, and unit culture were discussed in panel; however, none were selected for the final set. Panellists' noted measures such as cost-effectiveness, low-value care, and socioeconomic and environmental impact were not proposed. Panel discussion did not lead to any measure inclusion in the final set. Panellists discussed generally low-feasibility ratings across measures and agreed that feasibility should not comprise an exclusion category but noted future specification, testing, and implementation evaluation as important.

Five draft recommendations for future directions, based on stakeholder prioritised areas, were reviewed and voted on by panel members. Recommendations were revised in panel and were recirculated following the panel meeting to confirm consensus and acceptability of statements. Resulting recommendations are outlined in Table 4.

4. Discussion

Using a multistakeholder consensus process, we defined a 51-item core measure set for paediatric critical care. Despite low-feasibility ratings, the core set largely aligns with the currently collected Australian and New Zealand Paediatric Intensive Care Registry minimum dataset (104 variables [2022])[13,40] and international modules (e.g., Paediatric Intensive Care Audit Network healthcare-associated infections expansion set[41]). The reduced core set offers a pragmatic approach to both institutional surveillance and multijurisdictional benchmarking. It is likely to have broad applicability with respect to institution and geography due to our wide sampling strategy. High-impact concepts, identified as important and meaningful to stakeholders, included long-term follow-up and new disability screening (nonspecified). These measures require further work to define case ascertainment procedures and agreed measurement scales. Recommendations generated, while seemingly obvious to those entrenched in quality measurement, are vital, given the lack of evidence and public-policy-informing quality measurement in paediatric critical care. Such guideposts are invaluable to direct future large-scale efforts.

To date, reports of quality-measure selection in this field consist primarily of studies conducted outside of ANZ, with limited stakeholder sampling (e.g., physician sampling only). These reports[14,16,42] propose a variety of data elements (range 20–72) for standardised measurement, with no identification of consumer and community priorities. Our study builds on this prior work but introduces several novel findings. Firstly, a key finding of our work was the alignment of clinician and consumer priorities. Nurse-patient ratio was the number-one priority across both cohorts, while long-term follow-up was ranked among the top three for both groups. Consumers highlighted the need to measure the 'value of care as experienced by the patient and family', across the child's care continuum, with experts recommending further specification work being needed in this space. Multinational Delphi studies[43,44] have developed recommendations for LTO measurement in paediatric critical care survivors. Recommended screening includes measures related to the global domains of cognitive, emotional, physical, and overall health; and specific outcomes including child-health-related quality of life, pain, survival, and communication. Implementation of standardised LTO assessment would require early consideration of data usability, feasibility (including cost), and risk-adjustment strategies.[6] Multimodal data collection (e.g., survey links via text automation, phone, and in-person follow-up) are likely needed, both to facilitate data capture and maximise response rates. The creation of online community platforms such as a paediatric critical care living lab may facilitate innovation in paediatric critical care long-term follow-up program development and evaluation. In ANZ, work is being undertaken to address these priorities with a Patient-Reported Outcome and Experience Measures pilot project underway. Ultimately, intensive care unit registries are likely instrumental in facilitating such measurement, with automation by a centralised service providing a method for efficient resource use.[45] Further work is needed to explore

Table 2
Emerging top ten priorities for clinicians ($n = 117$) and consumers ($n = 117$).

Rank	Clinician		Consumers		Consumer free-text response
	Measure	N (%)	Measure	N (%)	
1	Nurse-patient ratio	68 (58)	The number of nurses on shift to care for the children Parent node: nurse-patient ratio	57 (49)	'The executive really need to focus on improving the hospital PICU to get enough staff for the amount of beds on PICU' [P49]. 'THERE NEEDS TO BE MORE NURSES the amount of times where our child needed to be in the PICU, but due to not having enough nurses, they were risking our child's life up in the ward' [P066].
2	Staff turnover	44 (38)	Visible patient goals	51 (44)	'The visible goals sheet was hung in our room, but we didn't contribute to this; sometimes things were just too busy, and if something didn't go as planned with xx treatment, we didn't always know what this meant in the longer term for getting better and leaving the ICU' [P90].
3	Long-term follow-up measures	39 (33)	Long-term follow-up and screening for new disabilities	44 (38)	"I wonder how the follow-up from the ICU could be improved; once you've left, no one checks on you" P89. "The follow-up care of post stress from long [admission] in babies and educating staff how to treat those children in the future …" P117. "No facility to provide mental health for long-term conscious patience and their families, so they witness unimaginable deaths and grief during their stay" P78.
4	Adverse event reporting system	28 (24)	Medication complications	44 (38)	"Having better medication procedures to reduce the risk of the wrong medications being given" P66.
5	Hand hygiene compliance	27 (23)	Infection in the blood associated with hospital care (e.g., central line infection, surgical infection, ventilator pneumonia) Parent node: hospital-associated bloodstream infection	41 (35)	"I was very worried about a surgical infection following the operation and could not find any information on how often this happens to children in our hospital. Luckily, we did not experience this, but it was my number-one worry" P51.
5	Protocols for medication/drug administration by nurses	27 (23)	The critical care unit having enough equipment and supplies	34 (29)	"Delaying necessary surgeries because there are no beds … is not acceptable" P95. "when you have children with disabilities, better utilities in the ICU … would be of benefit" P112.
6	CVC-associated bloodstream infection (CLABSI)	24 (21)	Accidental removal/malposition of an invasive medical device (e.g., intravenous catheter)	33 (28)	"Line of sight broken that led to near fatality for my and other vent-dependent children in unit over the 10 months we stayed in the PICU" P78.
7	Documented treatment strategy/ goals	22 (19)	Sleep disturbance	31 (26)	
8	Unplanned readmission	21 (18)	Separation of children with infectious disease from children without the infectious disease	30 (26)	"2-to-1 nursing care when children are immuno sensitive is not acceptable" P48. "All adjoining room doors need to be permanently locked or welded shut to prevent cross infection" P49.
9	Standardised mortality rate	20 (17)	Unplanned intensive care admission	29 (25)	
10	Ventilator-associated pneumonia bundle compliance	18 (15)	The number of children who develop a pressure injury	28 (24)	"My son developed a lung infection following a motor vehicle accident; we didn't know if he would pull through" P80. ' … when there were complications with the breathing tube and lung infection, we didn't fully understand why/how this happened. If this was normal' P85.

Abbreviations: CVC = central venous catheter; CLASBI = central line-associated bloodstream infection; PICU = paediatric intensive care unit; ICU = intensive care unit.

acceptable and practicable methods for large-scale standardised data collection.

4.1. Recommendations for future research and policy

Implementation of the core measurement set may be challenging. Establishment of a binational working group for paediatric critical care quality measurement may help drive the national agenda, inform local activities, and help overcome harmonisation and feasibility issues. Lack of standardised definitions was the main reason for measures rated as infeasible. The most common reasons for which measures were rated 'somewhat feasible', compared to 'feasible' were (i) lack of standardised definition and (ii) resource intensive case ascertainment. With advances in digital technology, the critical care community is in a prime position to develop semiautomated measures and risk-assessment systems.[46] Such tools would support the collection of standardised data for benchmarking while reducing collection burden. International studies have seen promising early results using electronic medical records to capture mobilisation metrics.[47] Further pilot studies are needed to determine acceptability, impact, and cost. For now, adoption of the core set may free up resources to support local quality-improvement work[48] in less resourced units.

Importantly, the set while developed for the ANZ context may be generalised to other settings as it includes measures collected globally in critical care.[13] It is challenging to estimate the value and impact of surveillance.[13,49] Quantifying the impact of standardised surveillance in paediatric critical care across clinical cost and end-user outcomes is likely to have important and wide-reaching public health benefit.

4.2. Strengths and limitations

This study represents a pragmatic effort to inform standardised quality measurement in paediatric critical care. A strength of this project is that it is grounded in literature and is informed by both consumer and clinician priorities. Full specification of measures was beyond the scope of this project and is a

Table 3
Core quality measurement set.

Outcome measures [a]Inc. patient-reported outcome measures	Round selected	Process (n = 15)	Round selected	Structure (n = 5)	Round selected
1. Mortality	1	1. Hand hygiene compliance	1	1. Nurse-patient ratio	1
2. Standardised mortality rate	1	2. Percentage pts wearing ID band	1	2. Transfer due to lack of resources	1
3. Length of invasive mechanical ventilation	1	3. Percentage pts documented allergies	1	3. Staff turn over	1
4. Cardiac arrest	1	4. Emergency trolley checks	1	4. Harassment/bullying claims	1
5. Intracranial monitoring in severe TBI	1	5. Adverse reporting system	1	5. Inability to admit	3
6. Unplanned ICU admission	1	6. CVC BSI insertion bundle compliance	1		
7. Blood stream infection	1	7. VAP bundle compliance	1		
8. Multiresistant organism	1	8. Documented treatment strategy/visible patient goals	1		
9. Extracorporeal cardiopulmonary resuscitation	1	9. Incidence of AEs related to sedation	1		
10. Surgical complications requiring unplanned return to OT	1	10. Protocols for drugs administration	1		
11. Unplanned readmission	1	11. Antimicrobial use and resistance	3		
12. CVC-associated bloodstream infection (CLABSI)	1	12. Use and completion of sedation scale	1		
13. Ventilator-associated pneumonia	1	13. Parent education for children on home ventilation	1		
14. Ventilator-associated events	1	14. Parent education for children on home PN	3		
15. Surgical site infection	1	15. Process for family feedback			
16. Infections or inflammatory complications associated with devices, implant, or grafts or prosthetics/ implantable	1				
17. Other high-impact infections, e.g., hospital-acquired sepsis	1				
18. Healthcare-associated SAB	1				
19. Adverse tracheal-intubation-associated events	1				
20. Accidental extubation	1				
21. Fall resulting in fracture/intracranial injury	1				
22. Respiratory complications, e.g., PARDS	1				
23. Venous thromboembolism	1				
24. Renal failure—hospital-acquired	1				
25. Medication complications	3				
26. Failed extubation	3				
27. Extravasation injury	3				
28. PICU length of stay	3				
29. Delirium	3				
30. Development of a new morbidity[a]	1				
31. Long-term follow-up measures					

Measures may crosscut categories. Pts = patients; ID = identification; CVC = central venous catheter; VAP = ventilator-associated pneumonia; BSI = bloodstream infection; AE = adverse event; PN = parenteral nutrition; PARDS = paediatric acute respiratory distress syndrome; TBI = traumatic brain injury; PICU = paediatric intensive care unit; ICU = intensive care unit; OT = operation theatre.
[a] Screening for new disability.

Table 4
Recommendations for future directions for quality measurement in paediatric critical care.

Recommendation	Agreement rating[a]
1. We suggest quality measurement in paediatric critical care be standardised to facilitate benchmarking and support improvement activities	100% agreement
2. We suggest a specific set of hospital-acquired complications (including infections) be developed and prioritised for children, including critically ill children	100% agreement
3. We suggest paediatric critical care services routinely collect long-term follow-up data related to the development and identification of new morbidities to inform the initiation of early interventions	100% agreement; 1 abstention
4. We suggest paediatric critical care services collect patient and family (i) experience and (ii) outcome measures to support improvement efforts	100% agreement
5. We suggest a government-funded, large-scale collaborative improvement program to drive healthcare-quality measurement in paediatric critical care should be worked towards	100% agreement; 3 abstentions

Nb. Recommendations can be applied to support quality measurement of hospitalised children presenting with a critical illness, most of whom will be younger than 16 years.
[a] Reflect expert panel agreement rating.

necessary next step;[50] however, it is important to note that most measures are already collected nationally. Future work should focus on specification of measures of emerging importance (e.g., LTOs) and retirement of redundant measures where appropriate. This would include development of technical specifications, scales, and timing of measurement and associated data protocols.

Study limitations include generalisability challenges. This was an Australian and New Zealand prioritisation exercise; however, this was important as context should be considered if we want to prioritise measures that are impactful locally. Furthermore, the sample may not be reflective of all paediatric critical care units with underrepresentation of New Zealand participants. Finally,

the process measure 'Regular Morbidity and Mortality meetings' was neither offered nor identified throughout the study process. This may be due to the Morbidity and Mortality meetings being well embedded as a clinical meeting and potentially disconnected in time and place from other quality-surveillance measures.

5. Conclusion

This consensus statement provides a core set to standardise quality measurement in critically ill children in ANZ. We recommend intensive care registries make future revisions with the core set and stakeholder priorities in mind. The insights provided by this work will permit evidence-based adjustments to the current quality-surveillance guidelines, which may significantly further our epidemiological knowledge of health outcomes of critically ill children, subsequently providing clinicians and policy makers with a more rigorous platform from which to advocate quality and safety improvement initiatives.

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CRediT authorship contribution statement

Jessica A Schults: Funding acquisition, conceptualisation, methodology, validation, investigation, data curation, writing-original draft. **Karina Charles:** Funding acquisition, Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – original draft. **Johnny Millar:** Funding acquisition, Conceptualization, Methodology, Investigation, Writing – review & editing. **Claire Rickard:** Funding acquisition, Conceptualization, Methodology, Investigation, Writing – review & editing. **Vineet Chopra:** Data curation, Writing – original draft. **Anna Lake:** Funding acquisition, Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – review & editing. **Kristen Gibbons:** Funding acquisition, Conceptualization, Methodology, Writing – review & editing. **Debbie Long:** Funding acquisition, Conceptualization, Methodology, Investigation, Writing – review & editing. **Sarfaraz Rahiman:** Funding acquisition, Conceptualization, Methodology, Investigation, Writing – review & editing. **Katrina Hutching:** Funding acquisition, Conceptualization, Methodology, Investigation, Writing – review & editing. **Jacinta Winderlich:** Investigation, Writing – review & editing. **Naomi Spotswood:** Methodology, Validation, Investigation, Writing – review & editing. **Amy Johansen:** Funding acquisition, Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – review & editing. **Paul Secombe:** Investigation, Writing – review & editing. **Georgina Pizimolas:** Investigation, Writing – review & editing. **Quyen Tu:** Investigation, Writing –review & editing. **Michaela Waak:** Investigation, Writing – review & editing. **Meredith Allen:** Investigation, Writing – review & editing. **Brendan McMullan:** Investigation, Writing – review & editing. **Lisa Hall:** Funding acquisition, Conceptualization, Methodology, Investigation, Writing – review & editing.

Conflict of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jessica Schults reports financial support was provided by Australian and New Zealand Intensive Care Foundation. Claire Rickard reports a relationship with Australian and New Zealand Intensive Care Foundation that includes: board membership. Jessica Schults reports a relationship with Australian and New Zealand Intensive Care Foundation that includes: board membership. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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