Informing the standardising of care for prolonged stay patients in the ICU: A scoping review of quality improvement tools

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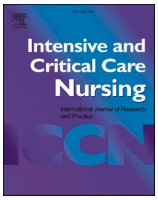

Review Article

Informing the standardising of care for prolonged stay patients in the intensive care unit: A scoping review of quality improvement tools

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ABSTRACT

Objectives: To inform design of quality improvement tools specific to patients with prolonged intensive care unit stay, we determined characteristics (format/content), development, implementation and outcomes of published multi-component quality improvement tools used in the intenisve care unit irrespective of length of stay.
Research Methodology: Scoping review searching electronic databases, trial registries and grey literature (January 2000 to January 2022).
Results: We screened 58,378 citations, identifying 96 studies. All tools were designed for use commencing at intensive care unit admission except three tools implemented at 3, 5 or 14 days. We identified 32 studies of locally developed checklists, 28 goal setting/structured communication templates, 23 care bundles and 9 studies of mixed format tools. Most (43 %) tools were designed for use during rounds, fewer tools were designed for use throughout the ICU day (27 %) or stay (9 %). Most studies (55 %) reported process objectives i.e., improving communication, care standardisation, or rounding efficiency. Most common clinical processes quality improvement tools were used to standardise were sedation (62, 65 %), ventilation and weaning (55, 57 %) and analgesia management (58, 60 %). 44 studies reported the effect of the tool on patient outcomes. Of these, only two identified a negative effect; increased length of stay and increased days with pain and delirium.
Conclusion: Although we identified numerous quality improvement tools for use in the intensive care unit, few were designed to specifically address actionable processes of care relevant to the unique needs of prolonged stay patients. Tools that address these needs are urgently required.
Systematic review registration: The review protocol is registered on the Open Science Framework, https://osf.io/ , DOI 10.17605/OSF.IO/Z8MRE

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Implications for clinical practice

- Numerous quality improvement tools have been developed that are designed to structure and standardise care; however, we only identified two designed for use for patients experiencing a prolonged intensive care unit length of stay confirming the need for tools in this patient population
- Sedation, ventilation and weaning, and analgesia management were common content areas in the tools we identified. Areas that may be more important to long stay patients such as psychological wellbeing strategies that enable patients to communicate were less common
- As well as improving care processes, actions arising from the implementation of quality improvement tools can improve patient outcomes.

Introduction

Quality improvement (QI) tools such as checklists, tools to structure rounds and care bundles or protocols are designed to structure and standardise care in the complex intensive care unit (ICU) environment. These tools may decrease errors of omission, standardise delivery of prophylactic treatments, and prevent healthcare-acquired infections, thereby improving patient outcomes and decreasing length of stay (Centofanti et al., 2014; Gonzalo et al., 2014; Jacobowski et al., 2010). However, these tools generally target the acute phase of ICU care and are not designed to address the needs of prolonged ICU stay patients, i.e., they may omit aspects of care important to recovery such as mobilisation, weaning, patient communication and patient-led goal setting (Rose et al., 2019). Prolonged ICU stay patients encompass those described elsewhere as persistent and chronic critical illness and refer to patients experiencing a length of stay greater than seven days (Iwashyna et al., 2015; Kahn et al., 2015).

Increased survival from critical illness coupled with an aging and comorbid population are contributing to longer ICU stays as less physically resilient patients take longer to recover (Martin et al., 2005). Prolonged ICU stays are more likely to result in physical (Fan et al., 2014), psychological (Wade et al., 2012), and cognitive morbidity (Pandharipande et al., 2013; Wilcox et al., 2013). A prolonged ICU stay also impacts family members, who experience greater psychological and financial difficulties (Petrinec et al., 2015; Wintermann et al., 2016) during their loved one's uncertain recovery trajectory. Patients experiencing a prolonged ICU stay require a change in goals and type of care delivered. Goals focus on transition to rehabilitation and recovery (or palliation and end of life) (Rose et al., 2014). This requires involvement of additional healthcare professions such as physiotherapists, social workers, occupational therapists, psychologists, and speech and language therapists. Further, prolonged ICU stay patients are less sedated and able to actively participate in their care. Therefore, their involvement in care decision-making along with their family members should be facilitated.

Why is it important to do this review?

Our previous systematic review exploring actionable processes of care and performance measures for persistent and chronic critical illness (Rose et al., 2019) did not identify QI tools specific to ICU patients with a prolonged stay. Given the distinct care needs, the rising prevalence of these patients, and the cost to the healthcare system (Hill et al., 2017), there is an urgent need to develop patient, family and clinician informed QI tools to meet these patients' needs. Understanding the content, design, impact, and implementation facilitators of existing ICU QI tools will provide guidance for a tool specifically designed to meet the needs of long stay ICU patients.

Our primary objective was to determine the characteristics (tool format e.g., paper vs electronic, design e.g., checklist, goal care bundle, and content) of multi-component tools designed to standardise and/or improve care delivery for adult ICU patients. Our secondary objectives were to describe (1) how tools were developed; (2) how tools were implemented in practice; (3) what outcomes (and measures) were reported; and (4) the effect of QI tools on these outcomes.

Methods

We used a scoping review approach as described by Arksey and O'Malley (Arksey and O'Malley, 2005) and adapted by Tricco et al. (Tricco et al., 2018). We report our scoping review in accordance with the guidance provided in the Preferred Reporting Items for Systematic Reviews and meta-Analyses PRISMA extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018). Further details of the eligibility criteria, search strategy, screening methods, and data charting processes can be found in our published protocol (Allum et al., 2020).

Inclusion criteria and search strategy

We included primary research studies describing QI tools designed to coordinate multiple aspects of care conducted in ICUs, high dependency units, or weaning centres. We excluded checklists for procedures such as central line insertion; care bundles with single objectives of care e.g. to prevent ventilator associated pneumonia; and single objective protocols i.e. delirium prevention. We included all study designs but excluded editorials, commentaries and animal studies. Our search strategy was designed in consultation with health information specialists, and was executed in five electronic databases from January 1st 2000 to January 1st 2022, to reflect current ICU care. We searched for trials using the World Health Organisation International Clinical Trials Registry Platform (https://apps.who.int/trialsearch/), systematic reviews via the Cochrane Library, and grey literature using Opengrey (https://www.opengrey.eu/), NHS evidence (https://www.evidence.nhs.uk/), Google Scholar and Prospero. We examined reference lists of included studies for additional relevant studies.

Screening, data charting, critical appraisal, and data synthesis

One author (LA) performed the initial screen to remove duplications and obvious exclusions; two authors (LA, CA) conducted further screening independently for both title and abstract, and subsequent full texts. Disagreements were resolved through discussion and referral to a third author (LR). Using a bespoke data extraction developed by the authorship team, two authors (LA, CA) independently charted data on study characteristics, tool characteristics, development and implementation; primary or main (when a primary outcome was challenging to discern) outcomes, measures and reported effects of the QI tools. Two authors (LA, CA) independently applied the mixed methods assessment tool (MMAT) (Hong et al., 2018) to assess study quality. MMAT is a robust tool for describing quality of studies using various study designs. Studies with a score of < 50 % are at "high risk of bias", 50 % at "moderate risk of bias", and > 50 % at "low risk of bias". We summarised study and tool characteristics using descriptive statistics. We present a narrative synthesis to describe our findings as recommended by Levac et al (Levac et al., 2010).

Results

We screened 58,378 citations and identified 96 studies meeting

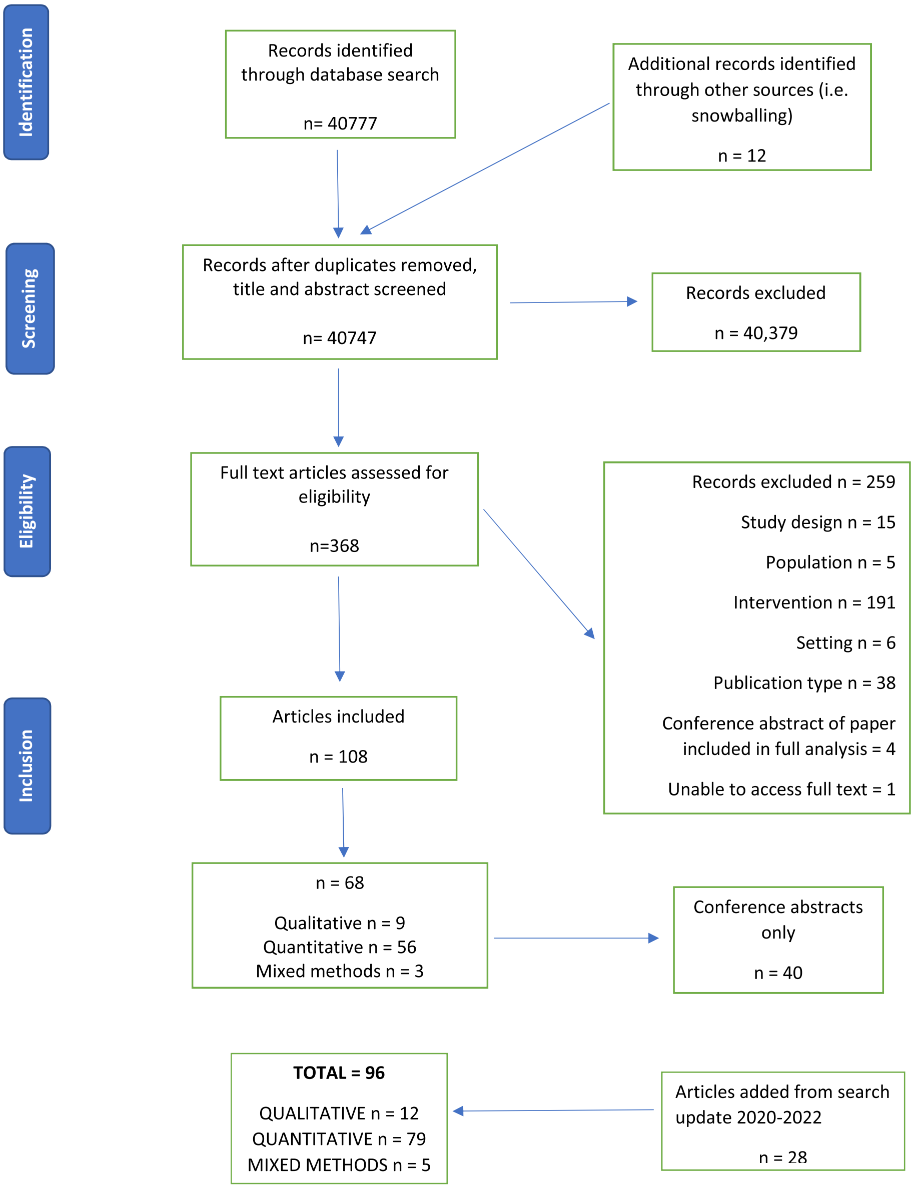

Fig. 1. PRISMA flow diagram.

inclusion criteria (See PRISMA Fig. 1). Most (n = 71, 73 %) studies were conducted in North America, were based in single ICUs (n = 60, 61 %), and employed quantitative methods (n = 78, 81 %) (Table 1). With the exception of three tools that were designed for patients with a length of stay of 14 days (Loeslie et al., 2017), over five days (Nelson et al., 2006) and over three days (Matone et al., 2021), all tools were designed to use from ICU admission. These three tools comprised a structured communication template for family meetings (Loeslie et al., 2017), a palliative care bundle focusing on identification of patient preferences and decision making surrogates, communication, social and spiritual support, and pain assessment and management, (Nelson et al., 2006) and a guide to transition patients to palliative care (Matone et al., 2021).

Quality assessment

Our application of the MMAT tool to appraise study quality of the 96 studies identified 56 (58 %) studies were of high quality, 32 (33) of medium quality, and 8 (9 %) studies of low quality (See Appendix 1).

Tool format and type

Of the 96 studies, 6 (6 %) described tool development or validity testing, three of these with implementation described in a later included study (Conroy et al., 2013a; Conroy et al., 2013b; Spooner et al., 2018a; Spooner et al., 2018b). One publication (Kamdar et al., 2014) was a second paper from an included study. Paper versions were the most common tool format described, (n = 28, 29 %) but more papers did not describe the tool format.

In the remaining 89 implementation studies, we identified

- 32 locally developed/tailored checklists (items rated as yes/no/not applicable) described as being evidence based or in some cases directly related to existing checklists such as FASTHUGS (Feeding, Analgesia, Sedation, Thromboprophylaxis, Head of bed elevation, Ulcer prophylaxis, Glucose control, Spontaneous breathing trial) Two additional studies (J. Dubose et al., 2010; Teixeira et al., 2013) conducted by the same group evaluated further implementation and outcomes of their locally developed Quality Rounds Checklist.

Table 1
Characteristics of included studies.

N = 96 studies		n (%)
Country	North America	71 (73)
	Australia	9 (9)
	Europe	9 (9)
	Other [a]	7 (8)
Clinical setting		
	1 ICU	60 (61)
	>3 ICUs	20 (21)
	2–3 ICUs	15 (16)
	Weaning centre	1 (1)
Speciality		
	Mixed	58 (60)
	Medical only	16 (16)
	Surgical only	6 (5)
	Trauma	3 (3)
	Neuro	2 (2)
	Cardiothoracic	1 (1)
	Not reported	10 (11)
Participants		
	Patients	36 (37)
	Clinicians (mixed)	30 (32)
	Patients and interprofessional team	16 (16)
	Patients, family and interprofessional team	4 (5)
	Family and interprofessional team	5 (5)
	Patients and family	2 (2)
	Family	3 (3)
Study design		
	Quantitative: observational	42 (42)
	Quantitative: quasi-experimental and experimental	36 (39)
	Mixed methods	13 (13)
	Qualitative	4 (5)
	Secondary analysis	1 (1)

[a] Other = 1 study each from Israel and Taiwan, 2 studies each from Brazil and South Korea.

- 28 locally developed/tailored goal setting or structured communication templates (more open format providing ability to add free text responses with items as prompts).
- 23 studies of care bundles, of which
  - o 18 evaluated the ABCDE(F) bundle (Assess, prevent and manage pain, Both spontaneous awakening trials and spontaneous breathing trials, Choice of analgesia and sedation, Delirium assessment, prevention and management, Early mobility and exercise, Family engagement and empowerment) (Balas et al., 2013; Balas et al., 2022; Bardwell et al., 2020; Barnes-Daly et al., 2017; Barr et al., 2020; Boehm et al., 2020; Chen et al., 2021a; Collinsworth et al., 2021; Collinsworth et al., 2020; Costa et al., 2018; DeMellow et al., 2020; Hsieh et al., 2019; Lee et al., 2020; Loberg et al., 2022; Negro et al., 2022; Otusanya et al., 2021; Pun et al., 2019; Sosnowski et al., 2018).
  - o Two evaluated a locally developed delirium prevention bundle (Bannon et al., 2018; Smith and Grami, 2016).
  - o One evaluated a bundle to improve family communication (Black et al., 2013).
  - o One evaluated a palliative care bundle (Nelson et al., 2006).
  - o One evaluated a bundle based on the Rethinking Critical Care programme (Liu et al., 2016).
- A further nine studies of mixed format QI (Abraham et al., 2012; Abraham et al., 2014; Abraham et al., 2016; Brown et al., 2020; Chapman et al., 2021; Dalal et al., 2016; Dykes et al., 2017; Karalapillai et al., 2013; Cavalcanti et al., 2016), three of which evaluated the Handoff Intervention Tool (HAND-IT) (Abraham et al., 2012; Abraham et al., 2014; Abraham et al., 2016).

Tool purpose and objectives

Most (n = 39, 43 %) of the 89 implementation studies reported on tools designed for use during ICU rounds. Fewer studies reported on tools designed for use during:

- The ICU day (n = 24, 27 %) (Balas et al., 2022; Bardwell et al., 2020; Barr et al., 2020; Boehm et al., 2020; Collinsworth et al., 2021; Collinsworth et al., 2020; DeMellow et al., 2020; Heim et al., 2019; Hsieh et al., 2019; Jablonski et al., 2017; Kamdar et al., 2013; Lee et al., 2020; Liu et al., 2016; Loberg et al., 2022; Ma et al., 2021; Negro et al., 2022; Otusanya et al., 2021; Pun et al., 2019; Smith and Grami, 2016; Sosnowski et al., 2018; Sutton et al., 2021; Tonna et al., 2021; Wessman et al., 2017; Zucco and Damirji, 2018).
- The ICU stay (n = 8, 9 %) (Dalal et al., 2016; Dykes et al., 2017; Kodali et al., 2015; Loeslie et al., 2017; Nelson et al., 2006; Noome et al., 2017; Suen et al., 2021; Tonna et al., 2021).
- Physician or nurse handover (n = 10, 10 %) (Abraham et al., 2012; Abraham et al., 2014; Abraham et al., 2016; Al Ashry et al., 2016; Dippel et al., 2022; Hoskote et al., 2017; Martini and Resek, 2021; Spooner et al., 2018b; Usher et al., 2018; Verholen et al., 2021).
- Variety of purposes for example during and after family meetings (n = 9, 10 %) (Ali et al., 2017; Au et al., 2021; Bannon et al., 2018; Bjurling-Sjoberg et al., 2018; Black et al., 2013; Chua et al., 2010; Costa et al., 2018; Matone et al., 2021; Sona et al., 2020).
- A further seven (8 %) studies did not specifically state the tool purpose.

Most QI tool implementation studies (n = 49, 55 %) reported process objectives such as improving communication, standardisation of care, or rounding efficiency as opposed to study objectives specific to improving patient outcomes such as reducing delirium, length of stay or healthcare acquired infections.

Tool content

Implementation studies used QI tools to standardise the following most common clinical processes:

- Sedation management (n = 62, 65 %).
- Ventilation and weaning (n = 55, 57 %).
- Analgesia administration (n = 58, 60 %).

Few implementation studies used tools that included items related to:

- Patient psychological support (n = 8, 8 %) (Ali et al., 2017; Bjurling-Sjoberg et al., 2018; Black et al., 2013; Centofanti et al., 2014; Kodali et al., 2015; Matone et al., 2021; Nelson et al., 2006; Noome et al., 2017).
- Family psychological support (n = 8, 8 %) (Black et al., 2013; Centofanti et al., 2014; Chen et al., 2021b; Kang et al., 2020; Kodali et al., 2015; Nelson et al., 2006; Noome et al., 2017; Suen et al., 2021).

Almost half (n = 39, 40 %) of the implementation studies used a tool that included items focusing on communication and collaboration with family members regarding decision-making. However, only eight (8 %) (Black et al., 2013; Cao et al., 2018; Carlos et al., 2015; Dalal et al., 2016; De Bie et al., 2017; Dykes et al., 2017; Kodali et al., 2015; Sona et al., 2020) included prompts to include patients in decisions about their care (Table 2).

Tool development and implementation

Tools were described by the study authors as evidence-based (n = 43, 45 %) and/or based on interprofessional expert consensus (n = 33, 34 %), and/or modified from a previously validated tool (n = 38, 40 %). Only four (4 %) studies reported on tools were developed with patients or family members involved in their design (Au et al., 2021; Bannon

Table 2
Tool content.

N = 96	n (%)
Sedation management	62 (65)
Ventilator management (including weaning and SBT)	55 (57)
Nutrition	39 (41)
Analgesia	58 (60)
DVT prophylaxis	33 (34)
Sepsis management	40 (42)
Family communication and collaboration	39 (40)
Systems-based assessment	20 (21)
Delirium screening/management	49 (51)
Mobilisation/rehabilitation	41 (43)
Blood glucose management	23 (24)
Review of laboratory/radiology results	27 (28)
Interprofessional referrals and communication	21 (22)
Urinary catheter management	23 (24)
Goals for care/day	39 (40)
DNR/AD/SDM discussions	21 (21)
Pressure area care	22 (22)
Medication review	23 (24)
Discharge planning	12 (13)
Bowel care	12 (13)
Restraint	11 (11)
Oral Care	11 (11)
Planning of tests and procedures	10 (10)
Prompts to talk to/involve patient	8 (8)
Psychological care of patient	8 (8)
Family support	8 (8)
Environmental management	6 (6)
End of life care	6 (6)
Other[a]	18 (19)
Not reported	2 (2)

SBT: spontaneous breathing trial; DVT: deep venous thromboprophylaxis; DNR: do not resuscitate; AD: advanced directive; SDM: substitute decision maker.

[a] Including falls/safety screen; checking of allergies; inclusion in research studies, wound care, eye protection, swallow review.

Table 3
Tool development and implementation.

N = 96	n (%)
Tool development	
Evidence based	43 (45)
Interprofessional expert consensus	33 (34)
Modification or use of a previously validated tool	38 (40)
Single profession expert consensus	10 (10)
Patient and family involvement	4 (4)
Not described	11 (11)
Tool feasibility/validity testing	
Not reported/done	53 (55)
Feasibility/pilot testing of tool	9 (9)
Staff feedback on tool	4 (4)
Family, patient, and staff feedback on tool	1 (1)
Not applicable – previously validated tool used	36 (38)
Tool implementation strategies	
In-person didactic and bedside teaching	58 (60)
Written or online educational material	37 (39)
Audit and feedback	26 (27)
Tool champions	27 (28)
Reminders and prompts	23 (24)
Bedside support (troubleshooting, coaching and facilitating)	14 (15)
Prompter (person joining rounds to remind staff to complete tool items)	14 (15)
Not described	22 (23)
Interprofessional implementation leaders/teams	11 (11)
Identifying/targeting local barriers	6 (6)
IT decision support	1 (6)
No implementation measures used	6 (6)
Other[a]	8 (8)
Tool already implemented	2 (2)
Tool not implemented	6 (6)

[a] Other includes: use of an implementation specialist; involvement of former ICU patients/families; printing tool on blue paper to create visual awareness; mandating too compliance; educational credits; reimbursement; and support from ICU leadership digital community, site visits and a multidisciplinary conference.

Note: proportions do not always sum to 100% as multiple methods were used for the same tool in terms of tool development and implementation strategies.

et al., 2018; Dalal et al., 2016; Lip et al., 2021). Only nine (11 %) studies reported tools to have undergone formal feasibility testing (Abraham et al., 2012; Abraham et al., 2014; Abraham et al., 2016; Barcellos and Chatkin, 2020; Chen et al., 2021b; Liu et al., 2016; Nelson et al., 2006; Pronovost et al., 2003; Spooner et al., 2018b) (Table 3).

Studies reported various strategies for tool implementation but most frequently education, including in-person group didactic or bedside teaching (n = 58, 60 %), and written or online educational materials (n = 37, 39 %). Tool champions (n = 27, 28 %) and audit and feedback (n = 26, 27 %) were also commonly used strategies. Identifying and targeting local barriers to tool implementation was reported for only six (6 %) studies (Conroy et al., 2015; Jablonski et al., 2017; Kamdar et al., 2014; Lee et al., 2020; Noome et al., 2017; Pun et al., 2019) (Table 3).

Primary or main outcomes and measures

Process outcomes were most commonly reported as primary or main study outcomes (Table 4).

These included:

- Compliance with tool recommendations (n = 19, 21 %) (Balas et al., 2022; Bardwell et al., 2020; Black et al., 2013; Byrnes et al., 2009; Carlos et al., 2015; Chapman et al., 2021; Collinsworth et al., 2021; Conroy et al., 2015; Costa et al., 2018; De Bie et al., 2017; DeMellow et al., 2020; DuBose et al., 2008; Dubose et al., 2010; Loberg et al., 2022; Ma et al., 2021; Nama et al., 2016; Noome et al., 2017; Teixeira et al., 2013; Weiss et al., 2011).
- Team understanding of goals of care (n = 9, 10 %), (Ainsworth et al., 2013; Hoskote et al., 2017; Karalapillai et al., 2013; Matone et al., 2021; Narasimhan et al., 2006; Perry et al., 2016; Pronovost et al., 2003; Qian et al., 2020; Shaughnessy and Jackson, 2015).
- Tool usage metrics (n = 12, 13 %) (Brown et al., 2020; Centofanti et al., 2014; C. Chen et al., 2021b; De Bie et al., 2021; Gunter et al., 2019; Kamdar et al., 2014; Martini and Resek, 2021; Newkirk et al., 2012; Spooner et al., 2018b; Suen et al., 2021; Thongprayoon et al., 2016; Verholen et al., 2021).

The most commonly reported patient primary outcomes were:

- Mortality (n = 14, 16 %) (Barcellos and Chatkin, 2020; Barnes-Daly et al., 2017; Chen et al., 2021a; Collinsworth et al., 2020; De Bie et al., 2021; Lemkin et al., 2020; Liu et al., 2016; Loberg et al., 2022; Nahouraii et al., 2019; Pun et al., 2019; Reiff et al., 2015; Verholen et al., 2021; Wilson et al., 2009; Cavalcanti et al., 2016),
- Health care acquired infection (n = 9, 10 %) (Chua et al., 2010; A. J. De Bie et al., 2021; JJ. DuBose et al., 2008; J. Dubose et al., 2010; Duclos et al., 2018; Lemkin et al., 2020; Reiff et al., 2015; Siegele, 2009; Teixeira et al., 2013),
- Mechanical ventilation duration (n = 12, 13 %) (Barcellos and Chatkin, 2020; Bardwell et al., 2020; C. M. Chen et al., 2021a; A. J. De Bie et al., 2021; Heim et al., 2019; Hsieh et al., 2019; Loberg et al., 2022; Nahouraii et al., 2019; Pun et al., 2019; Sutton et al., 2021; Weiss et al., 2011; Wilson et al., 2009),
- Delirium occurrence and duration (n = 8, 9 % n = 10, 11 %) (Barnes-Daly et al., 2017; Boehm et al., 2020; Jablonski et al., 2017; Kamdar et al., 2013; Lee et al., 2020; Ma et al., 2021; Pun et al., 2019; Smith and Grami, 2016; Sutton et al., 2021; Tonna et al., 2021).

Twenty studies (22 %) reported clinical processes of care outcomes such as pain or sedation levels and sleep promotion.

In total, 14/89 (16 %) studies reported either a patient or a family-

Table 4
Primary or main study outcomes.

N = 89 implementation studies	n (%)
Patient outcomes	*44 (49)*
Mortality	14 (16)
Healthcare acquired infection (e.g, VAP, CLABSI, UTI rates)	9 (10)
Mechanical ventilation duration (days)	12 (13)
Delirium occurrence and duration	10 (11)
ICU/hospital length of stay	12 (13)
Adverse events (falls, decubitus ulcers, pulmonary embolus)	3 (3)
ICU/hospital discharge, readmission, discharge disposition	4 (4)
Clinical process of care outcomes	*20 (22)*
Pain and sedation levels	7 (8)
Duration of central venous catheter/Foley placement (days)	2 (2)
Sleep promotion/quality	2 (2)
Physical rehabilitation consultations	1 (1)
Early mobility interventions	6 (7)
Restraint use	1 (1)
Empirical antibiotic duration (days)	3 (3)
Family outcomes	*9 (10)*
Family satisfaction with communication	5 (6)
Family meeting rates	3 (3)
Process outcomes	*49 (55)*
Compliance with tool recommendations (prophylactic measures and clinical management strategies)	19 (21)
Team alignment/understanding of goals/plan of care	9 (10)
Tool usage metrics (e.g., completion rates; number of items discussed; workload)	12 (13)
Information/communication disconnect (missing/incorrect information)	5 (6)
Rounding/handoff time	8 (9)
Barriers and facilitators to tool use	8 (9)
Clinician attitudes to the tool	9 (10)
Interprofessional collaboration	4 (4)
Perception of communication	5 (6)
Patient and family input into daily and overall goals	4 (4)
Trial feasibility	4 (4)

VAP: ventilator associated pneumonia; CLABSI: central line-associated bloodstream infection; UTI: urinary tract infection.

reported outcome measure (P(F)-ROM) (Cao et al., 2018; C. Chen et al., 2021b; Conroy et al., 2015; Dykes et al., 2017; Kamdar et al., 2013; Kang et al., 2020; Kodali et al., 2015; Loeslie et al., 2017; Noome et al., 2017; Sona et al., 2020; Sosnowski et al., 2018; A. Suen et al., 2020; Sutton et al., 2021; Tonna et al., 2021).

Eight (10 %) studies reported seven different Patient-reported outcome measures (P-ROMs) (Cao et al., 2018; Conroy et al., 2015; Dykes et al., 2017; Kamdar et al., 2013; Loeslie et al., 2017; Sosnowski et al., 2018; Sutton et al., 2021; Tonna et al., 2021). Of these:

- 3/9 (3 %) measured satisfaction with care (Cao et al., 2018; Dykes et al., 2017; Loeslie et al., 2017).
- 2/9 (2 %) satisfaction with communication (Cao et al., 2018; Loeslie et al., 2017).
- 2/9 (2 %) measured pain scores (Conroy et al., 2015; Sutton et al., 2021).
- Two (2 %) measured perceived sleep quality (Kamdar et al., 2013; Tonna et al., 2021).
- Other P-ROMS included health-related quality of life (Sosnowski et al., 2018), patient concordance with plan (Dykes et al., 2017) and independence in function and living (Sosnowski et al., 2018).

Nine (10 %) studies reported on five different Family-reported outcome measures (F-ROMs).

- Family satisfaction with care was reported by 5/10 (5 %) (Cao et al., 2018; Dykes et al., 2017; Kodali et al., 2015; Noome et al., 2017; Sona et al., 2020).
- 8/10 (9 %) measured family satisfaction with communication (Cao et al., 2018; C. Chen et al., 2021b; Kodali et al., 2015; Loeslie et al., 2017; Noome et al., 2017; Sona et al., 2020; Suen et al., 2021).
- 2 (2 %) measured family satisfaction with involvement in care (Noome et al., 2017; Sona et al., 2020).
- 2 (2 %) reported markers of psychological distress such as anxiety and depression (Chen et al., 2021b; Kang et al., 2020).

Impact of tools on patient or process of care outcomes

Of the 36 studies reporting patient or clinical process of care outcomes, only two identified a negative effect i.e., increased ICU length of stay (LOS) (Al Ashry et al., 2016) and increased ICU days with severe pain and delirium (Sutton et al., 2021). Five studies demonstrated no effect, one study (Cavalcanti et al., 2016) found no effect on mortality; the second found no effect on delirium but there was an increase in early mobility interventions and duration (Lee et al., 2020), one showed no difference in family HADS/decisional conflict and quality of care ratings (C. Chen et al., 2021b), one showed no improvement in proportion of patient days with guideline compliance to pain assessment (Ma et al., 2021) and one with no difference in ICU mortality, length of stay and readmission rates (Verholen et al., 2021) All other studies demonstrated a positive effect on study outcomes measured (Table 5).

Discussion

In this scoping review including 96 studies involving QI tools (seven development/validation studies and 89 implementation studies), we found almost all were designed to be administered from ICU admission. Only three studies specifically focused on patients experiencing a longer ICU stay. QI tools were most commonly used to guide ward rounds, used a variety of formats both paper and electronic and included checklists, or structured templates, as well as bundled interventions. Tool implementation strategies focused primarily on more traditional methods such as education, champions and audit and feedback. Few studies specifically identified and addressed existing barriers to tool implementation, and fewer involved patients in their design or directed clinicians to involve patients in decisions relating to care. QI tools more commonly focused on improving communication or efficiencies/standardisation of care without reporting the effect on patient outcomes. Of the studies that reported patient or process of care outcomes, almost all demonstrated a positive impact on the outcomes measured. Few studies measured patient-reported outcomes and even fewer studies measured family-reported outcomes.

This scoping review confirmed the lack of QI tools designed specifically for the needs of patients experiencing a prolonged ICU stay. The three studies that did have a focus on longer stay patients developed tools focusing on family communication and palliative care needs (Loeslie et al., 2017; Matone et al., 2021; Nelson et al., 2006). Although there may be substantial overlap with the needs of patients with short or average lengths of stay (e.g., ongoing need for deep vein thrombosis (DVT) prophylaxis; delirium prevention), longer stay patients may experience different needs that could be addressed by QI tools. Our systematic review (Rose et al., 2019) highlighting actionable processes of care of relevance to long stay ICU patients identified processes that address patient psychological wellbeing as well as strategies that enable patient ability to communicate as commonly studied aspects of care. Conversely our scoping review found only eight tools (Ali et al., 2017; Bjurling-Sjoberg et al., 2018; Black et al., 2013; Centofanti et al., 2014; Kodali et al., 2015; Matone et al., 2021; Nelson et al., 2006; Noome et al., 2017) addressed patient psychological needs, and none prompted the use of communication aids or adjuncts. Furthermore, in recent work conducted by our group that included end-user interviews with

Table 5
Main results of studies reporting patient and process of care outcomes.

Primary Author	Main outcomes	Tool	Study Findings	MMAT
Al Ashry et al., 2016	Length of stay	Checklist	↑ ICU LOS (1.20 days, 95 % CI 1.01–1.43, P < 0.05)	High
Ali et al., 2017	Physical rehabilitation consultations	Checklist	↑OT/PT consults (17.3 % checklist vs 7.6 % no checklist, p < 0.01)	High
Barcellos and Chatkin, 2020	Length of stay and ventilation duration	Checklist	↓ ICU LoS 8 (4–17) to 5 (3–11) and ↓ IMV days 5 (1–12) to 2 (<1–7) both significant (p ≤ 0.001).	Medium
Bardwell et al., 2020	Ventilation duration and sedation duration	Bundles	↓ Mean (SD) ventilator days 3.92 (0.54–13.76) vs 1.94 (0.13–10.9) = − 49.5 % p = 0.02. ↓ Mean (SD) sedation days 3.68 (0.43–13.73) vs 1.75 (0–6.01) = − 47.6 % p = 0.12 1/34 patients required reintubation within 24 h. 0/33 patients were readmitted within 30 days of hospital discharge or reintubated within 30 days of extubation.	Medium
Barnes-Daly et al., 2017	Survival; delirium and coma-free days	ABCDEF bundle	↑ hospital survival with 10 % increase in *total* compliance (OR 1.07, 95 % CI 1.04–1.11, P < 0.001); and 10 % increase in *partial* compliance, (OR 1.15, 95 % CI 1.09–1.22, P < 0.001); ↑days delirium/ coma free (IRR 1.02, 95 % CI 1.01–1.04, P = 0.004 *total* & IRR 1.15, 95 % CI 1.09–1.22, p < 0.001 *partial*)	High
Cavalcanti et al., 2016	Mortality	Multi-faceted QI	No difference in hospital mortality (1096 deaths (32.9 %) vs 1196 deaths (34.8 %); OR 1.02, 95 % CI 0.82–1.26; P = 0.88)	High
Chen et al., 2021a	MV duration, ICU and hospital length of stay, medical costs, and intra-hospital mortality	Bundle	↓ mean ICU LOS (8.0 vs 12.0 days), costs (22100 vs 31,700 New Taiwan Dollars) and intra-hospital mortality (8.3 vs 36.6 %)No change to MV duration (170.2 vs 188.1 h) and hospital stays (21.1 vs 23.3 days).	Medium
Chen et al., 2021b	Depression, anxiety, decisional conflict and quality of communication	Communication framework	After adjustment for differences in confounding covariates, there was no significant difference in HADS, DCS, and QOC	High
Collinsworth et al., 2020	Hospital mortality, Final discharge destination, Hospital length of stay, Direct costs of hospital care with bundle adherence	Bundle	ABCDE bundle adherence ≥ 60 % ↓ mortality (48 % vs 22 %) and a ↓ $4,949 increase in direct inpatient costs. Incremental cost-effectiveness ratio (ICER) was calculated as $15,077 per life saved and $1,057 per life-year saved. High bundle adherence was associated with a 0.12 increase in quality-adjusted life-years, a $4,949 increase in 1-year care costs, and an incremental cost-effectiveness ratio of $42,120 per quality-adjusted life-year.	High
Chua et al., 2010	Hospital acquired infection	Checklist	↓CLABSI rates 4.08/1000 central catheter days vs 0.00 (P = 0.0008); ↓UTI rates 2.85/1000 catheter days vs 2.10, 26 % decrease (P = 0.0056); ↓VAP rates 9.27/1000 ventilator days vs 1.6/1000 ventilator days, 82 % decrease (P = 0.003)	High
DuBose et al., 2008	Hospital acquired infection	Checklist	VAP incidence (16.3 vs 11.3 per 1,000 ventilator days) ↓central line-related infections (8.9 vs 5.8 per 1,000 device days)	High
Dubose et al., 2010	Hospital acquired infection	Checklist	↓VAP incidence (12.4 to 8.7 per 1,000 ventilator days)	High
Duclos et al., 2018	Hospital acquired infection	Checklist	↓VAP rates (21 % vs 11 %, P < 0.001)	High
Dykes et al., 2017	Adverse events	Mixed structure	↓ adverse events (29 %, 59/1,000 (95 % CI, 52–67) to 42/1,000 patient days (95 % CI, 36–48P < 0.001)	High
Heim et al., 2019	Ventilation duration	Structured template	↓ ventilation days (4.0 (4.8) vs 3.4 (4.0) days, P = 0 0.0021)	High
Hsieh et al., 2019	Ventilation duration; Length of stay	ABCDE bundle	↓ ventilation duration (–22.3 %, 95 % CI, –22.5 % - –22.0 %, P < 0.001); ↓ ICU LOS (–10.3 %, 95 % CI –15.6 % - –4.7 %, P = 0.028), and ↓ hospital LOS (–7.8 %, 95 % CI –8.7 % - –6.9 %, P = 0.006)	High
Jablonski et al., 2017	Pain and sedation levels; Delirium occurrence	Structured template	↑ mean % of total scores at goal RASS (38 %-50 %, P < 0.02). No difference in mean % total scores at goal BPS/NPS (86 %-83 %, P = 0 0.16). Mean % positive CAM-ICU scores unchanged	Medium
Kamdar et al., 2013	Sleep promotion/quality Delirium occurrence and duration	Checklist	No difference in overall Richards-Campbell Sleep Questionnaire sleep quality score; Improved mean noise ratings (65.9 (26.6) vs 60.5 (26.3), p = 0.001), ↓ delirium/ coma incidence (OR 0.46, 95 % CI 0.23–0.89, P = 0.02); ↑ daily delirium/coma-free status (OR 1.64, 95 % CI 1.04–2.58, P = 0.03)	High
Lee et al., 2020	Delirium occurrence and duration; Early mobility	ABCDE bundle	No difference in delirium 67 %-75.5 % or delirium duration 5.9–6.1 days. ↑early mobility interventions (11 %-54.3 %, P < 0.001) with ↑mean duration (0.8 (3.6) days, P = 0.003)	High
Lemkin et al., 2020	ICU mortality, ICU Length of stay, ICU-acquired infections, daily cost	Smart checklist	Pts with smart list used during ≥ 60 % of their ICU stay (N = 432 patients, 3.6 %) were significantly more likely to have a shorter ICU LOS (HR = 1.20, 95 % CI:1.0 to 1.4, p = 0.015) with an average decrease of $1218 (95 % CI: -$1830 to -$607, P b 0.001) in the amount charged per day. The intervention cohort had fewer average ventilator days (3.05 vent days, SD = 2.55) compared to propensity score matched controls (3.99, SD = 4.68, p = 0.015), but no changes in mortality (16.7 % vs 16.0 %, p = 0.78. There was a trend towards fewer cases of ventilator-associated pneumonia among cases (N = 3, 0.7 % vs N = 10, 2.3 %, p = 0.051).	High
Liu et al., 2016	Mortality	ICU care bundle	↓ overall mortality (12.3 % to 10.9 %, P < 0.01)	Medium

(*continued on next page*)

Table 5 (*continued*)

Primary Author	Main outcomes	Tool	Study Findings	MMAT
Loberg et al., 2022	Hospital mortality, ICU LOS, Ventilator days, Hospital LOS, 30 day readmission rates, compliance with each element of bundle	ABCDEF bundle	↓ ICU LOS (5.61–5.11, P = 0.475) and a 0.56-day ↓ in ventilator time (5.71–5.15, P = 0.660), but this did not reach statistical significance. ↑ hospital LOS by 1.1 day, not significant (P = 0.414) ↑ observed versus expected mortality (1.71–0.94) and 30-day readmission rates (0.98–0.82) for patients.	Medium
Ma et al., 2021	Pain, sedation, agitation and delirium.	Structured template	The intervention did not improve the proportion of patient days with guideline compliance to the assessment of pain (23.4 % vs 22.4 %, p = 0.80), agitation (42.9 % vs 38.9 %, p = 0.28), nor delirium (35.2 % vs 29.6 %, p = 0.10). Of patient-days with PAD assessments, there was no significant difference in patient-days with significant pain, optimal sedation, oversedation, agitation, nor delirium	Medium
Nahouraii et al., 2019	Ventilator days; ICU LOS, hospital LOS and mortality	Rounding checklist	↓ ventilation days (surgical 0.74 vs 0.59 days, P = 0.03;) (trauma 2.2 days vs 1.6 days, P = 0.05); ↓ ICU LOS (surgical 0.67 vs 0.61, P = 0.01) (trauma no difference); ↓ hospital LOS (1.47 vs 1.22, P = 0.0005). (trauma no difference). No differences in mortality	High
Narasimhan et al., 2006	Length of stay	Structured template	↓ ICU LOS (4.3 vs 6.4 days, P = 0.02)	High
Otusanya et al., 2021	Total hospital cost for each stay. Total ICU cost and average daily ICU cost. Total hospital, total ICU and average daily number of ICU laboratory tests and diagnostic radiology used	ABCDE bundle	↓ reduced total hospital laboratory costs by 27.3 % (95 % confidence interval, CI [9.9 %, 41.3 %], P = 0.004). ↑ total hospital physical therapy costs 2,888.6 % (95 % CI [77.9 %, 50,113.2 %], P = 0.018). No significant changes in costs of total hospital medications, diagnostic radiology and respiratory therapy.	High
Pun et al., 2019	Hospital death, next-day ventilation, coma, delirium, physical restraint, ICU readmission, discharge disposition	ABCDEF bundle	↓ 7-day hospital death (aHR 0.32, 95 % CI 0.17–0.62); ↓ next-day ventilation (aOR 0.28, 95 % CI 0.22–0.36); ↓ coma (aOR 0.35, 95 % CI, 0.22–0.56); ↓ delirium (aOR 0.60, 95 % CI, 0.49–0.72); ↓ physical restraint (aOR 0.37, 95 % CI 0.30–0.46); ↓ ICU readmission (aOR 0.54, 95 % CI 0.37–0.79); ↓ discharge to facility not home (aOR 0.64, 95 % CI 0.51–0.80)	High
Reiff et al., 2015	Mortality; Hospital acquired infection; Adverse events (PE)	Standardised checklist	↓ pneumonia (OR 0.68, 95 % CI 0.51–0.89); death (OR 0.50, 95 % CI 0.31–0.79); and PE (OR 0.31, 95 % CI 0.13–0.73	High
Siegele, 2009	Hospital acquired infection; Length of stay; Adverse events (falls, decubitus ulcers)	Structured template	↓ mean LOS annually over three 2006–2008; ↓VAP rates, falls, decubitus ulcers and bloodstream infections to 0 (end of 2006)	Medium
Smith and Grami, 2016	Delirium occurrence	Delirium prevention bundle	↓ delirium (OR 0.22, 95 % CI 0.08–0.56, P = 0.01)	Low
Sutton et al., 2021	Ventilator days, analgesic and opioid use, pain, time to extubation, delirium, constipation	PADIS	↑ scheduled IV/oral acetaminophen (84 % vs 69 %; p = 0.05), less likely to receive a lidocaine patch (33 % vs 50 %; p = 0.05), no change in ketamine (4 % vs 3 %; p = 1.0), NSAIDs (7 % vs 3 %; p = 0.26), or gabapentin/pregabalin (16 % vs 9 %; p = 0.23), or daily average opioid (70 [42–99] [2017] vs 78 mg [49–109 mg]; p = 0.94.↑ ICU days with severe pain (p = 0.04). ↑ delirium(54 % vs 36 %; p = 0.05). No change in coma, constipation, and mechanical ventilation.	Medium
Teixeira et al., 2013	Hospital acquired infection	Checklist	↓ CLABSI incidence (0.85/1,000 vs 4.98/1,000 catheter days, P < 0.001); no difference in VAP (1.66/1,000 vs 8.74/1,000 ventilator days, P = 0.07)	Medium
Tonna et al., 2021	Delirium and RCSQ	Checklist	↓ days of delirium (15 +/- 27 % vS 20 +/- 31 %; P = 0.022), Overall RCSQ-perceived sleep quality ratings did not change, but the RCSQ noise subscore ↑ (9.5 % [95 % CI, 1.1 %-17.5 %; P = 0.02).	Medium
Verholen et al., 2021	ICU mortality, ICU Length of stay, ICU readmission, SOFA score, handover duration, physician satisfaction with checklist and % handovers checklists used	Structured template	No significant differences seen for ICU mortality/LoS/readmission and SOFA scores overall except for at 24hrs (difference 2.19p = 0.02)	Medium
Wilson et al., 2009	Mortality; Hospital acquired infection; Ventilation duration	Checklist	↓ mean ventilation (6.33 days to 4.88 days); ↓ severity adjusted mortality (0.5 % in 1 year); ↓ 0.33-day ↓ in ICU LOS.	Low
Weiss et al., 2011	Ventilation duration; Empirical antibiotic duration; CVC/Foley placement duration	Checklist	↑ median ventilator-free duration (22 [14–26] vs 16 [0–21.5] days, P = 0.028); ↓ empirical antibiotic days (2 [1–3] vs3 [2–7], P = 0.012) and CVC duration (3 [2–5] vs5 [2–8], P = 0.007). Foley catheter duration did not change	High

ICU: intensive care unit; LOS: length of stay: CI: confidence interval; OT: occupational therapist; PT: physical therapist; OR: odds ratio; IRR: incidence rate ratio; CLABSI: central line associated blood stream infection; UTI: urinary tract infection; VAP: ventilator associated pneumonia; BPS: behavioural pain score; NPS: numeric pain scale; CAM-ICU: confusion assessment method-ICU; aHR: adjusted hazard ratio; aOR: adjusted odds ratio; PE: pulmonary embolus.

prolonged ICU stay survivors, family members and clinician and Delphi questionnaire, we sought to identify consensus on the most important actionable processes of care for inclusion in tools designed to improve care quality for prolonged ICU stay patients. Among the top three actionable processes to gain consensus as critical for inclusion in such tools were (1) need to establish and track rehabilitation/physiotherapy goals; and (2) need to assess and manage the patient's symptom profile (i.e. a range of symptoms including breathless, fatigue or thirst as well as pain) (L Rose and PERFORM investigators, 2020). Conversely, in this scoping review, although QI tool content in 41 studies included items related to mobilisation and rehabilitation few studies measured outcomes related to physical rehabilitation.

In our scoping review, most studies had a main objective of understanding the effect of the QI tool on patient or process of care type outcomes (as opposed process outcomes such as compliance with tool recommendations). Although inferences are limited by a lack of randomised controlled trials, in general QI tools appear to have a positive effect on patient outcomes. At present our understanding of the impact of care quality on the development of, or failure to recover from, persistent or chronic critical illness is limited. However, Viglianti and colleagues (Viglianti et al., 2020) recently demonstrated that Veteran Affair hospitals in the United States (US) with higher risk-and reliability adjusted 30-day mortality rates also had a greater proportion of patients who developed persistent critical illness. In an ethnographic study of eight Long Term Acute Care Hospitals, again in the US, designed to identify effective care practices for patients with prolonged mechanical ventilation, elements of care delivery and organisational processes were found to differentiate high versus low performing hospitals in terms of risk adjusted mortality (Rak et al., 2020).

We found only three studies in which patients had been involved in the design of the QI tool, only eight studies that included prompts to include patients in decisions about their care, and a similar number of studies that used patient reported outcome measures. The need to involve patients in QI tool design, decisions related to care, or in measurement of outcomes reflects a biomedical approach, arguably more relevant to the acute phase of illness when patients are frequently unconscious or sedated, that impedes the relational and symptom-management aspect of care so important for the long-stay patient (Minton et al., 2018).

Although we identified only nine studies (Cao et al., 2018; C. Chen et al., 2021b; Dykes et al., 2017; Kang et al., 2020; Kodali et al., 2015; Loeslie et al., 2017; Noome et al., 2017; Sona et al., 2020; A. O. Suen et al., 2021) measuring family member reported outcomes, 39 of the 96 identified tools included prompts to communicate with family members regarding decision-making. Although the role of substitute decision maker is not without its challenges (Schenker et al., 2012), patients generally want family members involved in care decisions, with one study reporting patients consider family member perspectives should have precedence over their own advance directives (Puchalski et al., 2000). Numerous studies identify communication issues and conflicts between family members and the ICU team (Studdert et al., 2003; A. Suen et al., 2020). Concerningly, clinician communication behaviours may have a considerable and negative impact on family wellbeing (Azoulay et al., 2018). Family communication was among the top three actionable processes of care we identified in our earlier systematic review (Rose et al., 2019) and therefore would be an important element to include in QI tools for patients experiencing a prolonged ICU stay.

Limitations

Strengths of our study include iterative search design in consultation with an experienced information specialist, searching of multiple databases and grey literature, independent citation screening by two authors, and Preferred Reporting Items for Systematic Reviews and meta-Analyses, Scoping Review (PRISMA-ScR) reporting structure. We considered a scoping review the most appropriate method to achieve our objectives of mapping tool components, implementation, and outcomes from studies using various designs. Limitations include the exclusion of studies published prior to 2000 and languages other than English. We acknowledge our exclusion of tools for care bundles with a single objective of care e.g. to prevent ventilator associated pneumonia and single objective protocols with a single-aim may discount some tools which address pertinent actionable processes of care for prolonged stay patients.

Conclusion

At present, although we identified numerous QI tools for use in ICU settings, few were designed to specifically address actionable processes of care relevant to the unique needs of prolonged ICU stay patients. Common implementation strategies included traditional methods such as education, champions and audit and feedback, with few studies addressing site specific barriers and facilitators. Given that prolonged ICU stay patients comprise only a small proportion of ICU patients overall, future studies of QI tools for prolonged stay patients may need to consider site specific implementation barriers. Encouragingly, nearly all studies demonstrated a positive impact on patient outcomes, emphasising the importance of QI tools. Lack of patient involvement in QI tool design or content specific to patients awake and able to experience and direct their care may further make existing QI tools less applicable for prolonged ICU stay patients. Development of such tools should be a research priority with subsequent implementation into clinical practice.

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CRediT authorship contribution statement

Laura Allum: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft. **Chloe Apps:** Data curation, Formal analysis, Investigation, Writing – review & editing. **Natalie Pattison:** Writing – review & editing, Supervision. **Bronwen Connolly:** Writing – review & editing, Supervision. **Louise Rose:** Conceptualization, Formal analysis, Methodology, Supervision, Validation, Writing – review & editing.

Declaration of Competing Interest

The authors 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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