Review paper

Safety culture in intensive care internationally and in Australia: A narrative review of the literature

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ARTICLE INFORMATION

ABSTRACT

Objective: Assessment of safety culture in health care is of particular relevance in the complex intensive care setting, where the effects of human error can have catastrophic consequences. The aim of this review was to examine the literature on safety culture in intensive care units (ICUs) and specifically, to explore the state of knowledge regarding safety culture in the context of Australian ICUs.
Methods: A search was conducted of key databases for studies published in English between January 2008 and December 2017 using terms 'safety culture', 'safety climate', 'safety attitude', 'intensive care', 'ICU' and 'critical care'. Studies were included if they presented original research, utilised the teamwork and safety climate factors of a quantitative survey tool to assess safety culture, the sample population included participants working in an adult intensive care, and the findings were reported in the context of intensive care.
Results: Of the 36 studies identified, two were conducted in Australia. The studies demonstrate a rapid expansion in safety culture assessment globally. Three levels of safety culture application in intensive care were identified, including safety culture assessment, effect of an intervention on safety culture, and evaluation of the association between safety culture and structural, process and outcomes measures. The use of targeted safety culture domains is emerging. Common findings included variation in perceptions of safety culture between ICUs, unit and hospital management, and professional groups.
Conclusion: Though the assessment of safety culture in ICUs has been an area of prolific research internationally over the past ten years, the Australian context is limited and could be advanced through further research, including the effect on safety culture of interventions, and to establish the association between safety culture and patient safety outcomes. Longitudinal studies to demonstrate sustained intervention effects on safety culture should be considered.

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1. Introduction

By nature, culture is deeply ingrained, and the beliefs and values that shape attitudes and behaviours are seldom clear to members of the organisation, let alone an external observer.[1,2] The term 'safety culture' (SC) is defined as 'the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and

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proficiency of, an organisation's health and safety management'.[3] Positive elements of SC in health care have been shown to be associated with decreased patient length of stay,[4] improved hand hygiene compliance,[5] patient satisfaction,[6] and a decrease in central line–associated bloodstream infections.[7] Research on the association between SC and other patient safety and organisational outcomes is ongoing[8] and has been identified as a priority area of research.[9,10]

The term 'safety climate' is sometimes used to refer to the observable and readily assessable elements of SC such as behaviours, espoused values, and attitudes.[11,12] This description of safety climate appears intimately related to the first and second levels of Schein's[2] three-layered model of organisational culture, justifying the frequent interchange of the terms 'climate' and 'culture' throughout the literature.[1] If only one term was to be used, it would be more correct to singularly use the term 'safety culture', of which safety climate is a component.[11] Therefore, the term safety culture is used throughout this article.

There has been much debate in the literature about the feasibility of SC assessment, with proponents for qualitative methods advocating that the underlying basic assumptions of SC can only be understood through an in-depth ethnographic study.[13,14] While yielding rich results, these methods are impractical for widespread use because of the time investment required, pragmatic restrictions of the sample size, and limited generalisability of results. Furthermore, SC is understood to be unique to individual clinical units, requiring local and repeated assessment to monitor change.[15,16] Qualitative studies of SC in health care remain in the minority in the literature, with cross-sectional quantitative surveys of SC being the most frequently used method of assessment.[11,17] The use of surveys for assessing perceptions of SC has been well validated, and a number of surveys have been empirically tested for psychometric validity and reliability.[15] The rapidity and ease of SC survey use makes measurement at a clinical unit level feasible, facilitates comparison with benchmarking data or from repeated surveys to evaluate change, and allows correlation of elements of SC with other safety outcomes.[12]

Much of the initial SC research in the healthcare domain was conducted in intensive care units (ICUs).[18,19] Intensive care is a highly complex organisational unit with significant variability in patient admission diagnoses and a narrow margin for error, making it a uniquely high-risk healthcare environment.[20–22] Critical care nurses are a large proportion of the intensive care multidisciplinary workforce, and thus, SC would be
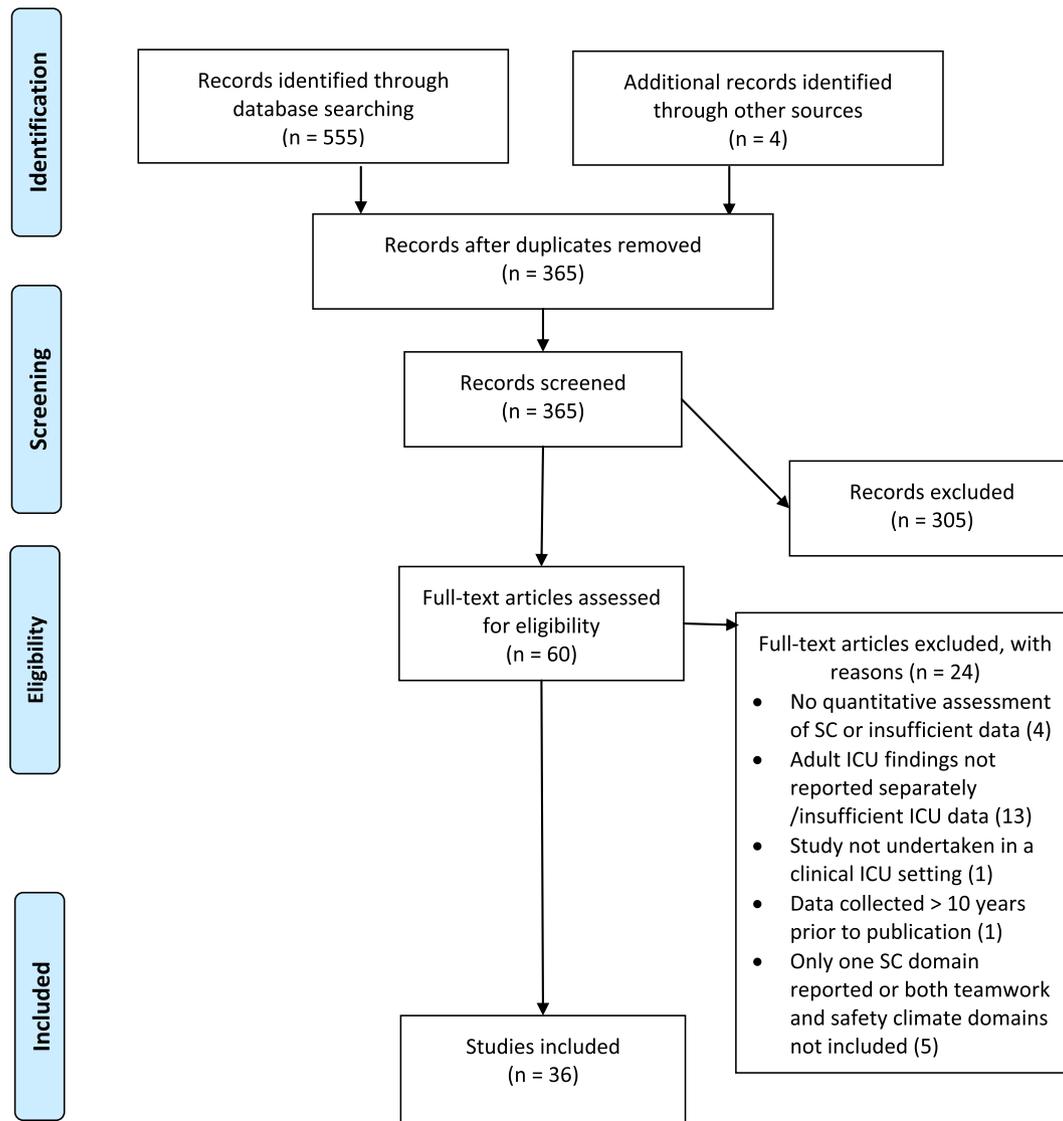

Fig. 1. Literature searches, screening, and selection of articles for inclusion. SC, safety culture; ICU, intensive care unit.

considered a pivotal part of their role. Despite this and extensive international studies, research into SC in ICUs in Australia is limited.

2. Aim and objectives

The aim of this narrative review was to describe and summarise the literature on SC in adult ICUs. Objectives were to

1. examine the use of quantitative SC survey tools and
2. explore the current state of knowledge regarding SC in the context of Australian adult ICUs.

3. Methods

3.1. Design

A narrative overview method was chosen to provide a summary of the SC literature according to the review objectives.

3.2. Search strategy

A search was conducted using MEDLINE, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Excerpta Medica (Embase) databases using the search terms 'safety culture,' 'safety climate,' or 'safety attitude' and 'intensive care,' 'ICU,' or 'critical care' (Fig. 1). The search was limited to articles published in English within the previous 10 years (January 2008 to December 2017) to ensure relevancy of results in a rapidly changing healthcare environment.

3.3. Inclusion and exclusion criteria

Studies were included if they used an experimental, quasi-experimental, or cross-sectional descriptive design and a quantitative survey tool to assess SC or climate. The SC tool used must have included the domains of teamwork and safety climate. The sample population must have included participants working in an adult intensive care or critical care unit and the findings reported in the context of adult intensive care.

Publications were excluded if they did not report original research or reported only qualitative methods of SC assessment. Studies that recruited participants from paediatric or neonatal critical care areas only were excluded because previous work has reported significant cultural differences in adult, paediatric, and neonatal ICUs, thus creating a heterogeneous group.[23]

3.4. Procedure

Three authors (E.D., J.-L.C., F.C.) undertook selection of abstracts against the inclusion and exclusion criteria. Studies relevant to the criteria were retrieved in full. Full-text publications were also evaluated against the inclusion and exclusion criteria independently by the three authors (E.D., J.-L.C., F.C.). Disagreements were resolved through discussion. Consensus was reached, and no independent reviewer was required to arbitrate. The included studies were reviewed for data regarding the setting, sample population, response rates, survey tool, reported reliability, and main findings. In this narrative literature review, synthesis of the important elements and conclusions of each subgroup occurred to provide an integrated synopsis of the topic.[24]

4. Results

Thirty-six original studies meeting the search criteria were identified (Tables 1—3). Most studies (n = 15) identified the primary aim as the assessment of SC (Table 1).[25—39] Ten studies assessed an intervention using an SC assessment tool (Table 2),[40—49] and 11 studies investigated the relationship between SC and outcome measures and/or components of organisational analysis (Table 3).[4,50—59]

4.1. Study settings and participants

Thirty-four studies included in this review were located internationally, and two were Australian studies.[30,31] Of the international studies, 10 were set in Europe,[26,29,36,40,42,45,47,53,57,58] 10 in the United States of America (USA),[4,41,44,46,48,50,51,55,56,59] six in South America,[34,35,38,39,49,54] four in the Middle East,[25,27,28,32] two in Asia,[37,43] and two publications reported on Canadian studies.[33,43]

Participants and study settings were heterogeneous across the 35 studies. In 12 studies, the focus was on nursing staff alone.[26,27,29,32,34,37,39,47,50,51,54,58] Five of these studies were restricted to registered nurses.[29,47,50,51,58] The remaining 23 studies incorporated various grades of nursing staff, which depended on the country where the ICU was located and the local staffing structure. Six studies involved only nursing and medical staff.[25,31,36,41,45,57] Participants in 17 studies were multidisciplinary team combinations of nursing and medical staff, allied health professionals, and ancillary staff as either clinical staff only or both clinical and nonclinical staff.[4,28,30,33,35,38,40,42,43,46,48,49,52,53,55,56] Two studies did not report the specific composition of the participants surveyed.[44,59] Settings included single ICU or multiple ICUs within a single centre or across collaborative organisations.

4.2. Survey tools

Of the 36 studies reviewed, the most commonly used survey was the Safety Attitudes Questionnaire (SAQ)[12] which was exclusively used in 16 studies. The Hospital Survey on Patient Safety Culture (HSOPSC/Hospital Survey on Patient Safety (HSOPS)/ HSPSC)[60] was the second most commonly used tool used exclusively in 13 studies. Three studies used the SAQ in combination with another SC assessment tool; one study used both the SAQ and HSOPSC,[38] one study used the SAQ and Safety Climate Survey (SCS),[56] and one study used a previously validated variant of the SAQ and SCS.[40] Four studies used tools or surveys developed for the purpose of the study.[33,39,41,57] Validation and reliability testing were incorporated into most studies, particularly when translated tools were used.

The SAQ divides staff perceptions into six factors (also reported as dimensions, domains, or subscales): teamwork climate, safety climate, job satisfaction, stress recognition, perceptions of management (unit and hospital), and working conditions. Psychometric testing found comparable internal validity in only 36 of the initial 64 survey items, resulting in a shorter version, the 'SAQ-Short Form'. The 'SAQ-ICU' is a short-form version that has undergone minor modifications, reflecting the clinical area; however, item content remains the same.[12] Additional open-ended questions tailored to the purpose of the study are usually added.

The HSOPSC consists of 42 items grouped into 12 composite measures (also reported as dimensions or domains): teamwork within units, supervisor/manager expectations and actions promoting patient safety, organisational learning, continuous improvement, management support for patient safety, overall perceptions of patient safety, feedback and communication about error, communication openness, frequency of events reported,

Table 1
Studies where the primary aim was assessment of safety culture.

Author, year	Aim	Setting, participants, and response rate	Survey tool, dates, and reliability (Cronbach's α)	Main findings
Abdi et al., 2015[25]	Explore nurses' and physicians' attitudes and perceptions relevant to safety culture in an Iranian ICU and elicit strategies to promote safety culture	- Iran - 1 hospital -Single 8-bed ICU (medical-anaesthetic led) - Medical and nursing staff - 42/46 surveys returned (91% response rate)	- SAQ-ICU plus 20 semi-structured interviews with purposefully chosen participants - Survey was translated into Farsi. - Administered from the late 2011 to early 2012 - Test−retest reliability (ICC 0.73 in all domains—95% CI) - Internal consistency (α = 0.80−0.89)	- 'Working conditions,' 'perception of management,' and 'stress recognition' domains scored highest. 'Safety climate,' 'teamwork climate,' and 'job satisfaction' scored lowest. - Interviews highlighted underreporting, failure to learn from errors, lack of speaking up, low job satisfaction among nurses, and ineffective nurse−physician communication
Águas et al., 2017[26]	Translate, adapt, and validate the SAQ-ICU for the Portuguese population	- Portugal - 3 hospitals - 6 ICUs (polyvalent, cardiology, and cardiothoracic surgery units) - All ICU nursing staff (total number not provided) - 120 surveys returned	- SAQ-ICU Portuguese version - Administration dates not recorded - SAQ-ICU total score reliability α = 0.873 (dimension range α = 0.62−0.85)	- Overall, nurses have a positive perception of safety climate in most dimensions but recognise that some areas need improvement - 'Safety climate' scored highest (mean score 67.5) and 'Perceptions of management' scored lowest (mean score 33.4) - The Portuguese version of the SAQ-ICU is a valid and reliable tool for the Portuguese population
Alayed et al., 2014[27]	Assess nurses' perspectives of safety culture in Saudi Arabian ICUs	- Saudi Arabia - 6 hospitals - 6 ICUs >10 beds (mixed medical and surgical) - Nursing staff with 6-month ICU experience, English speaking - 237/340 surveys returned (69.7% response rate)	- SAQ-ICU - Administered from September to November 2012 - Reliability: overall α = 0.82	- 'Job satisfaction' scored highest and 'perceptions of management' scored lowest. Scores comparable with use of SAQ in other clinical areas in Saudi Arabia
Al Malki et al., 2017[28]	Examine attitudes to patient safety in two ICUs from the perspective of healthcare professionals in Saudi Arabia	- Saudi Arabia - 2 hospitals - 2 ICUs - Healthcare professionals with ≥3 months of ICU experience (nurses, physicians, and respiratory therapists) - 144/249 surveys eligible (60% response rate)	- SAQ-ICU - Administered between November and December 2015 - Reliability in this study α = 0.78	- All respondents had a negative attitude towards patient safety in the six safety domains - Highest mean sore was 'job satisfaction' (70.3) and lowest was 'perception of management' (47.1) - Nurse leaders rated 'perception of management' higher than bedside nurses - Participants in one ICU scored lower in all domains - Findings are similar to those of another study in Saudi Arabia using the SAQ-ICU
Ballangrud et al., 2012[29]	Assess nurses' perspectives of safety culture in Norwegian ICUs and propose predictors for safety perception and incident reporting	- Norway - 6 hospitals - 10 ICUs; 4 medical, 4 general, and 2 mixed care units - RNs - 220/302 surveys returned (72% response rate)	- HSPSC (Norwegian translated and validated version) - Administered from December 2008 to February 2009 - Domain reliability ranged from α = 0.49 to α = 0.83	- Variation between unit types and between hospitals - Positive perceptions of safety overall (average 55%) but low rates of incident reporting - At a unit level, significant positive effect on overall safety perceptions contributed by 'manager's expectations', 'feedback/communication about error,' and 'teamwork within hospital units' - Also at a unit level, significant positive effect on incident reporting contributed by 'manager's expectations' and 'feedback/communication about error'.
Braithwaite et al., 2009[30]	Assess safety culture across a state health system and determine effects of profession, organisation, age, and model of care.	- Australia: South Australian public health system - 46 organisations - The number of ICUs not reported - 448 staff from ICUs (total 14858 surveys returned)	- SAQ 60-item version, short form only used for domain calculations plus one verbatim question - Administered in 2009, although actual dates not reported - Reliability not reported	- Variation with service type, region, and demographics - Variation between professions, medical staff - Clinical ICU scores were ranked in the bottom four of 20 clinical areas in all domains except stress recognition

Table 1 (continued)

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Author, year	Aim	Setting, participants, and response rate	Survey tool, dates, and reliability (Cronbach's α)	Main findings
		- All staff involved in direct or indirect patient care in all South Australian public health services - 16 619 surveys returned (52% response rate), only 14 054 were useable due to computer issues		- Similar scores to international benchmarking data[12]
Chaboyer et al., 2013[31]	Establish a baseline for safety culture assessment in Australian ICUs	- Australia - 10 hospitals - 10 ICUs - Nursing and medical staff who had worked > 1 month in the current ICU, plus working > two shifts or 15 h per week - 672 surveys returned (50.6% response rate)	- SAQ-ICU plus two verbatim questions - Administered from April to July 2009 - Domain reliability ranged from α = 0.65 to α = 0.81	- Overall highest mean sores were for 'teamwork climate' and lowest for 'perceptions of hospital management' - Medical staff had more positive perceptions of 'job satisfaction,' 'teamwork climate,' 'safety climate,' and 'working conditions' - Bedside nurses had more positive 'perceptions of hospital management' and 'working conditions' - Nine of 10 sites scored 'perceptions of hospital management' most poorly - Variation between sites in all domains except 'stress recognition'
Farzi et al., 2017[32]	Survey patient safety culture from the perspective of nurses in ICU	- Iran - 9 hospitals - The number of ICUs not reported - Nurses with ≥3 months of ICU experience - 367 nurses returned surveys (the number distributed not reported)	-Farsi version of HSOPSC plus demographic information - Administered between June and July 2016 - Reliability not reported	- Highest scores were for 'teamwork within units' (97.3%) followed by 'organisational learning-continuous improvement' (84%). Lowest scores were for 'handoffs and transitions' (21.1%) and 'nonpunitive response to errors' (24.7%) - Mean positive response for the 12 dimensions of safety culture was 57.7%, indicating a medium level of safety culture - Results similar to those of other studies except for 'nonpunitive response to errors' which was reported as 'high' in the study by Ballangrud et al.[29]
Kho et al., 2009[33]	Assess safety culture in a single ICU and seek suggestions for safety culture improvement	- Canada, Ontario - 1 hospital - 1 ICU - All clinical and nonclinical staff - 136/146 surveys returned (93.2% response rate) with the highest response rate from nurses 65/75 (86.7%)	- SCS (22 items) plus one verbatim question - Administration dates not reported - Reliability of the modified SCS in this study, α = 0.86	- Generally positive scores - No independent predictors of safety culture found
Mello and Barbosa, 2013[34]	Provide recommendations regarding patient safety	- Brazil - The number of hospitals not reported - 2 ICUs - Nurses, nursing technicians, and nursing assistants with a minimum of 6-month experience in the study ICUs -91/97 surveys returned (93.8% response rate)	- Portuguese HSOPSC and an additional qualitative open-ended question requesting three recommendations to improve patient safety in participant's unit - Administered between April and June 2011 - Reliability not reported	- Highest scores in 'teamwork within hospital units' (62%) and 'supervisor/manager expectations and actions promoting safety' (51%) - Lowest scores in 'hospital management support for patient safety' (13%) and 'teamwork across hospital units' (27%) - Fewer recommendations were associated with the higher scored dimensions compared with the lower scored dimensions
Minuzzi et al., 2016[35]	Assess the dimensions of patient safety culture from the perspective of ICU health team professionals	- Brazil - 1 hospital - 1 ICU - All ICU health team professionals (including nurses, physicians, and ancillary staff members) in direct patient contact with at least 6-month experience in the unit - 59/67 eligible participants returned surveys (88% response rate)	- Brazilian version of HSOPSC (Portuguese) - Administered from November 2013 to January 2014 - Reliability not reported, but authors note that their version of the HSOPSC was translated and validated for Brazil	- The healthcare team assessed the degree of patient safety as acceptable; however, 50% rating was not achieved in any of the dimensions for the healthcare team collectively. All dimensions were considered as potential areas for improvement - 'Supervisors' expectations/actions' scored highest for the health team (48.8%) and

				- 'support from hospital management' (12.5%) the lowest score - 'Communication openness' scored highest for nurses (51.5%) and 'support from hospital management' scored lowest (6.06%) - No significant differences were identified among the proportions of the different professional categories in both positive and negative assessments
Raftopoulos and Pavlakis, 2013[36]	Explore factors affecting safety culture in ICUs in Cyprus	- Cyprus - 5 hospitals - The number of ICUs not reported - Nursing and medical staff, currently working in public ICUs (medical staff excluded because of the poor response rate) - 142/172 surveys returned were from nurses (response rate 83%), of these 10 were incomplete, leaving 132 analysed.	- SAQ-ICU (translated to Greek) plus additional four questions - Data collection from February to June 2011 - SAQ domain reliability ranged from $\alpha = 0.62$ to $\alpha = 0.73$	- Medical staff excluded from the final analysis because of the poor response rate - Domain scores varied significantly with experience, age, and job permanency - 'Job satisfaction' scored highest and 'stress recognition' lowest, although significant variation was found between ICUs - Results were not indicative of a positive safety climate when compared with the international benchmark as the only domain to reach a positive safety score was 'job satisfaction' in one ICU - Greek version of the SAQ-Short Form has acceptable reliability
Ramya, 2017[37]	Explore the perception of nurses about the safety culture in the ICU of a private hospital	- India - 1 hospital - 5 ICUs - Nurses with a minimum of 3-month experience with either a diploma or (baccalaureate) degree - 82 surveys returned	- SAQ-ICU plus additional local items (modified with permission) - Administered during November 2016 - Reliability $\alpha = 0.68$ to 0.85	- Highest mean score was in 'teamwork climate,' while lowest mean score was in 'stress recognition' - Total years of experience was significantly associated with 'stress recognition'
Santiago and Turrini, 2015[38]	Assess health professionals' perception about patient safety climate and culture in different ICUs and the relationship between HSOPSC and SAQ scores	- Brazil - 1 hospital - 3 ICUs with total 36 beds (adult-18, neonatal-12, and paediatric-6) -197 healthcare and administrative professionals working in the units for more than 6 months - 88 complete surveys included in the analysis (20/108 surveys returned were incomplete [44.6% response rate])	- Brazilian Portuguese version of SAQ-Short Form - Brazilian Portuguese version of HSOPSC - Administered from March to April, 2014 - Reliability for SAQ $\alpha = 0.85$ - Reliability for HSOPSC $\alpha = 0.90$	- Despite statistically significant correlations between the SAQ and HSOPSC, the highest correlations were of moderate strength with the 'safety climate' domain of the SAQ highest between the total scores - SAQ: highest adult ICU mean score was for 'job satisfaction' 77.7 (overall 81.2) and lowest was for 'perception of management—hospital administration' 54.7 (overall 55.2). These domains scored highest and lowest for all three ICUs - HSOPSC: highest adult ICU score was in 'supervisor/manager expectations and actions promoting safety' 74.8% (overall 75.4%) and the lowest of 25% 'nonpunitive response to error' (overall 29.6%) dimensions - The adult ICU achieved the lowest scores for most of the SAQ and HSOPSC
Schwonke et al., 2016[39]	Describe the safety culture perception of intensive care nurses in their hospital	- Brazil - 7 hospitals - 7 ICUs - Nursing staff (nurses, nursing technicians, and nursing assistants) - 173/216 surveys returned (80% response rate)	- Rio Grande 2012 (adapted from Stanford Patient Safety Centre of Enquiry [four dimensions]) - Reliability total scale score $\alpha = 0.83$	- Mean scores were lower in the dimensions related to managerial and organisational issues compared with those relating to individual attitudes and peers

α, Cronbach's alpha; ICC, interclass correlation coefficient; ICU, intensive care unit; HSOPSC, Hospital Survey on Patient Safety Culture; HSPSC, Hospital Survey Patient Safety Culture; SAQ, Safety Attitudes Questionnaire; SAQ-ICU, Safety Attitudes Questionnaire for intensive care units; RN, registered nurse; SCS, Safety Climate Survey.

Table 2
Studies using a safety culture survey to assess an intervention.

Author, year	Aim	Setting, participants, and response rate	Survey tool, dates, and reliability (Cronbach's α)	Intervention plus additional measures (if applicable)	Main findings
Bodi et al., 2017[40]	Assess the impact of a real-time random safety audit on structure, process, and outcome indicators	- Spain - Two hospitals - Two ICUs - 71 professionals: medical, nursing, and ancillary staff - Three survey periods; first period 67/71 surveys returned (94.4% response rate), second period 46/71 surveys returned (66.6% response rate), and third period 48/71 surveys returned (70.4% response rate)	- Previously validated questionnaire based on the SCS and SAQ-ICU - Reliability not reported - Study conducted from January to December 2013 - Survey administered 1 month before study commencement, month 6 of the study, and 1 month after the end of the study	- Safety rounds conducted 3 days per week assessing 37 safety measures - Safety tool analysed against structure (safety culture and healthcare protocols), process (improvement related to application of the tool), and outcomes (mortality, average length of stay, rate of central line—associated bloodstream infection [CLABSI] and ventilator-associated pneumonia [VAP])	- The use of the safety tool was associated with a progressive and significant increase in the 'safety climate' dimension of the safety culture tool throughout the study period
Chu-Weininger et al., 2010[41]	Assess safety culture and teamwork in three ICUs before and after introduction of a tele-ICU program	- USA—Gulf Coast - Three hospitals - Three ICUs—two general and one trauma - Medical staff admitting at least one patient per week and all nursing staff -Baseline 84/118 surveys returned (71% response rate) - Postimplementation, 71/118 surveys returned (60% response rate)	- Teamwork climate and safety climate domains of SAQ, additional eight teamwork and six safety climate items, plus 12 items - Baseline assessment from June to July 2005, postimplementation assessment 'in the first 4 months' after implementation - Reliability ranged from α = 0.8 to α = 0.9	- Introduction of a tele-ICU program -'Workflow quality-of-care scale' was an additional organisational analysis tool	- Significant improvement in teamwork climate and safety climate scores after the introduction of the tele-ICU program
Kemper et al., 2016[42]	Compare the impact on safety culture after crew resource management (CRM) training in ICU to matched control ICUs without training	- Netherlands - Six paired ICUs: intervention (n = 3) and control (n = 3) - ICU multidisciplinary team members (medical, nursing, and managers) - 193 staff trained - Response rate at the baseline 76% (360/474) and at 10-month follow-up 72% (341/474)	Translated and validated Dutch version of the HSOPSC (α range 0.54 −0.71)	- Classroom-based CRM training over two consecutive days in groups of 15 participants - Additional tools were the 'End-of-course Critique and Evaluation Questionnaire' (devised for the study) and Error Culture Questionnaire	- Two dimensions in the intervention group were rated more positively after CRM training: 'supervisor/manager expectations' and 'actions promoting patient safety' rated more positively - No statistically significant overall effect of CRM on culture; however, 'adequate staffing' was rated significantly higher in the intervention group after the training
Ling et al., 2016[43]	Assess the impact of a patient safety course on patient safety culture	- China (Hong Kong) - Two hospitals - Two ICUs (one intervention and one control) - Convenience sample of medical, nursing staff, and patient care assistants - 95/127 surveys returned (74.8% response rate); 78 RNs, 11 patient care assistants, and six physicians	- Hong Kong Chinese version of HSOPSC - April 2011−March 2012 - Precourse survey conducted immediately before the first session delivery of the course; postcourse survey administered within 3 months of completion of the series of courses - Reliability not reported	- Patient safety courses consisted of interactive sessions addressing precirculated e-learning material concerning a serious medication error	- Intervention ICU showed significant improvement in the domains of 'teamwork within hospital units' and 'hospital management support for patient safety' compared with control ICU - Both groups showed decreased frequency of reporting - Overall, intervention ICU showed greater improvement in positive responses in five domains from the baseline than control ICU
Meddings et al., 2017[44]	Examine the association between hospital units' (ICU and non-ICU areas) results for the HSOPSC and	- USA	- HSOPS	- Participating hospital units (ICUs and non-ICUs) implemented interventions to reduce catheter-	- Study was a secondary analysis of a subset of healthcare worker survey and patient outcome data

	catheter-associated infection rates (CLABSI and catheter-associated urinary tract infection [CAUTI])	- Adult acute-care ICUs and non-ICUs that were part of the CLABSI and CAUTI collaboratives - Composition of staff participants not reported - CLABSI, 598 units (304 ICUs)/436 hospitals; CAUTI, 675 units (164 ICUs)/463 hospitals - 24% survey response rate for CLABSI collaborative - 43% response rate for CAUTI collaborative (response rates calculated as the number of clinical units with HSOPS data divided by the total number of active units)	- Administered at the baseline and again 1 year later (dates not reported) - The infection rate of catheter-associated infections per 1000 catheter days was collected from CLABSI collaborative 2008–2011 and from CAUTI collaborative cohorts 1–4 from 2011 to 2013 - Reliability not reported	associated infections using safety principles from the comprehensive unit-based safety program (CUSP)	- No significant associations were found between CLABSI or CAUTI rates and HSOPS measures at the baseline or over time. Regardless, CLABSI and CAUTI collaboratives were successful in reducing infection rates. - The authors acknowledge the low response rates as a limitation.
Meurling et al., 2013[45]	Assess association between simulation-based team training, self-efficacy, staff turnover, and perceptions of collaboration/communication, teamwork, and safety.	- Sweden - Two ICUs; one intervention and one control - Medical and nursing staff - 114/151 surveys returned at baseline and after intervention (75% response rate)	- SAQ (64 items, Swedish translation) - Data collection from 2006 to 2010 and intervention from 2007 to 2009 - SAQ domain reliability ranged from $\alpha = 0.43$ to $\alpha = 0.75$ (lower than English version)	- Training for each participant consisted of a 4-h interactive seminar concerning safe teamwork in times of stress followed by 1 day of simulation-based team training - Additional analysis included a 4-item self-efficacy questionnaire	- Staff turnover decreased in intervention ICU and increased in control ICU. No significant difference in sick leave - Medical staff scored safety culture higher than nurses before intervention and did not improve. - Nurses' and nurse assistants' safety culture scores increased with intervention - All participants reported improvement in self-efficacy with intervention
Saladino et al., 2013[46]	Evaluate effect of a CUSP on safety culture in a single ICU	- USA—North Carolina - One critical care unit - 81 clinical staff working in current ICU >2 months - Preintervention 60 surveys returned (74% response rate) - Postintervention 55 surveys returned (69% response rate)	- SAQ-Short Form (36 items) plus three open-ended questions - Administered preintervention: July 2011 and postintervention: February 2012 - Overall reliability $\alpha = 0.82$, not given by domain	- CUSP steps included education for staff on the 'science of safety,' identification of safety concerns, implementation of executive walk rounds, implementation of improvements, and documentation and sharing of results	- No statistically significant change in domain scores with intervention - Nonsignificant decrease in all domains excepting 'stress recognition'
Vifladt et al., 2016a[47]	Compare changes in RNs' perception of the patient safety culture in restructured ICUs compared with nonrestructured ICUs during a 4-year period[a]	- Norway - 6 hospitals - Before restructure[29] - After restructure: six hospitals with five mixed, one general, and one medical unit. - RNs - 50% (145/289) RN response rate with 34% (49/145) participating in both before and after surveys.	- HSOPSC minus the two single-item outcomes - Norwegian translated and validated version used - Administered from December 2012 to February 2013 - Reliability not reported	- Intensive care unit restructuring[29]	- Restructuring of the ICUs showed an unfavourable impact on safety culture dimensions within the unit level, particularly for less manager feedback and actions promoting safety, weaker teamwork within hospital units, and increased staffing workload.
Vigorito et al., 2011[48]	Evaluate impact of SAQ action plan (SAQAP) and effect of VAP and CLABSI	- USA—Rhode Island - 11 hospitals - 23 adult ICUs - All clinical staff with >50% time commitment to current ICU for >4 weeks before survey administration - At the baseline, 841/1024 surveys returned (82% response rate) - After intervention, 918/1080 surveys returned (85% response rate)	- SAQ (64 items) - Baseline survey administered in autumn 2007 and postintervention survey administered in autumn 2008 - Reliability not reported	- The SAQAPs were targeted unit-specific interventions - Outcome measures were VAP and CLABSI	- 9/23 ICUs (39%) completed SAQAPs, and all these units demonstrated higher rates of improvement from 2007 to 2008 in all SAQ domains except 'working conditions,' although not statistically significant - Improvement in SAQ domain scores and decrease in infection rates in intervention ICUs did not reach statistical significance

Table 2 (continued)

Author, year	Aim	Setting, participants, and response rate	Survey tool, dates, and reliability (Cronbach's α)	Intervention plus additional measures (if applicable)	Main findings
Writing group for CHECKLIST-ICU investigators and BRICNet, 2016[49]	Determine whether a multifaceted quality improvement intervention reduces the mortality of critically ill adults (safety culture assessment is part of the secondary analysis)	- Brazil - The number of hospitals not reported - Multidisciplinary team (described as 'staff members') - 131 ICUs enrolled in observational phase 1 - 6656 staff members answered SAQ - 118 adult ICUs randomised in phase II - 3151 staff members in intervention ICUs answered SAQ (total administered not reported) - 3224 staff members in routine care ICUs answered SAQ	- Validated Brazilian–Portuguese SAQ - Phase I conducted between August 2013 and March 2014 (baseline) - Phase II conducted between April and November 2014 - Reliability not reported	- ICUs randomised to a quality improvement intervention (daily checklist and goal setting during multidisciplinary rounds with follow-up clinician prompting for 11 care processes) or to routine care - Primary outcome measure was 60-day in-hospital mortality - Exploratory secondary outcomes included safety climate, adherence to care processes, and clinical events	- End of phase II showed a significant improvement in the perception of 'teamwork' and perception of patient 'safety climate' in the intervention group compared with the control group - No significant difference noted after intervention in the other four SAQ domains

α, Cronbach's alpha; ICC, interclass correlation coefficient; ICU, intensive care unit; HSOPSC, Hospital Survey on Patient Safety Culture; HSPSC, Hospital Survey Patient Safety Culture; SAQ, Safety Attitudes Questionnaire; SAQ-ICU, Safety Attitudes Questionnaire for intensive care units; SCS, Safety Climate Survey; RN, registered nurse.

a Comparison to previously reported survey (Ballangrud et al., 2012[29] Table 1).

teamwork across units, staffing handoffs and transitions, and nonpunitive response to errors.[59] The HSOPSC includes two additional questions (outcome measures) regarding the participant's overall perception of the patient safety grade in their work area or unit and the number of events they reported in the previous 12 months. The HSOPSC contains seven domains at the unit level and a further three domains at the hospital level.[59]

Items in both surveys are graded on a five-point Likert scale (1 = 'strongly disagree' to 5 = 'strongly agree') converted to a 0–100 point scale.[12,60] SAQ results are reported as a mean value, with scores > 75 identifying a positive safety climate, and more recently, in terms of the percentage of respondents with positive climate scores.[4] HSOPSC results are reported as a percentage with positive responses graded into high (>75%), medium (50–75%), and low (<50%) levels of SC.[32] Demographic, or background, information is usually requested with each survey, and additional questions may be included depending on the aim of the investigation.

4.3. Studies where the primary aim was assessment of SC

Patient SC was assessed within a single ICU in three studies,[25,33,35] across more than one ICU in 12 studies,[26–32,34,36–39] in a single hospital in three studies,[35,37,38] or within a group of hospitals in nine studies[26–32,36,39] (Table 1).

Studies using the SAQ that surveyed only nursing staff, or where data for nursing staff were reported separately, recorded the highest mean scores in the domains of 'teamwork climate,'[37] 'job satisfaction,'[27,36] and 'safety climate.'[26] Lowest scores were for 'perceptions of hospital management'[26,27] and 'stress recognition.'[36,37] Investigations of safety climate involving medical and nursing staff recorded highest means in 'working conditions'[25] and 'teamwork climate.'[31] The lowest mean scores were for 'safety climate' and 'perceptions of management.'[31] Multidisciplinary teams scored highest in 'job satisfaction,'[28,38] whereas the lowest scores were for 'perceptions of management' in the same two studies.[30] Braithwaite et al.[30] conducted an extensive multidisciplinary study in the public health system of South Australia incorporating 20 clinical areas. ICU scores were ranked in the bottom four clinical areas in all domains except 'stress recognition.'

HSOPSC studies included three that investigated nurses' perceptions of patient safety which found the patient safety climate to be positive overall, although with a wide range of mean scores. 'Teamwork within hospital units' scored the highest percentage in these three studies.[29,32,34] Ballangrud et al.[29] and Farzi et al.[32] found opposite results for 'nonpunitive response to errors' which was second highest in the study by Ballangrud et al. and second lowest in the study by Farzi et al. Lowest scores were achieved in 'frequency of events reported,'[29] 'handoffs and transitions,'[32] and 'hospital management support for patient safety.'[34] A fourth multidisciplinary study by Minuzzi et al.[35] in a single ICU found that none of the domains achieved acceptable percentages of positive answers. However, nurses achieved the highest score for 'communication openness' (51.5%) and the lowest for 'support from hospital management' (6.06%). Highest reported positive percentages for the healthcare team were for 'supervisors' expectations/actions' (48%) and lowest for 'support from hospital management' (12.5%). The authors noted that there was potential for improvement in all areas.

Santiago and Turrini[38] used both the SAQ and HSOPSC and found moderate correlation between the scales but no equivalence. However, the AICU scored lowest in most domains of the SAQ and HSOPSC. Less widely used SC survey tools were identified in two studies.[33,39] Kho et al.[33] used a modified SCS and found that positive SC was found overall, but there were no independent predictors of SC identified. Schwonke et al.[39] used the Stanford

Table 3
Studies where safety culture assessment is a component of organisational structure, process, and outcome analysis.

Author, year	Aim	Setting, participants, and response rate	Safety culture tool, dates, and reliability (Cronbach's α)	Additional tools/measures	Main findings
Armellino et al., 2010[50]	Assess relationship between structural empowerment and safety culture	- USA—New York - Single adult ICU - RNs with > 8 weeks in current ICU - 102/257 surveys returned (40% response rate)	- HSPSC - Administration dates not reported - HSPSC domain reliability ranged from α = 0.63 to α = 0.84	- Conditions of workplace effectiveness questionnaire-II	- Structural empowerment and safety culture were positively correlated
Collier et al., 2016[51]	Explore the relationship between culture of safety and employee engagement in critical care units of a Midwestern healthcare system	- USA - 10 community hospitals and one quaternary care (tertiary) hospital - 26 ICUs with four or more beds - RNs - The number of surveys administered and response rate not reported	- HSOPSC - Reliability not reported - Administration dates not reported	- Gallup Q Survey was used to assess employee engagement	- Considerable variations across ICUs for HSOPSC; however, highest ratings were for 'teamwork in hospital units,' 'supervisor/manager expectations and actions promoting safety,' 'organisational learning/continuous improvement,' and 'hospital management support for patient safety' - Lowest ratings were in 'nonpunitive response to error,' staffing, 'hospital handoffs and transitions,' and 'teamwork across hospital units' - There was a significant positive relationship between the total employee engagement score and the total patient safety scores
Dodek et al., 2012[52]	Assess organisational and safety cultures in Canadian ICUs, correlate culture with the ICU bed number and the medical management model, and examine the relationship between organisational culture and safety culture	- Canada - 23 hospitals - 23 ICUs - Medical and nursing staff, respiratory therapists, pharmacists, dieticians, pastoral care staff, social workers, and unit coordinators - 1285/2374 surveys returned (54% response rate)	- HSOPSC - Administration dates not reported, although the study was conducted between 2006 and 2008 - Completed surveys collected over 4–6 weeks - Reliability not reported	- Organisation and management of intensive care units (short form) survey	- Weak positive correlation between positive perceptions of organisational culture and safety culture - Perceptions of hospital management scored lowest - The size of the ICU was negatively correlated with error reporting rates and teamwork scores and positively correlated with perceptions of care quality and recruitment/retention of staff. - Medical staff reported poorer perceptions of between-group communication accuracy and staffing adequacy lower than other professions - Medical staff reported perceptions of between-group communication openness, communication timeliness, and medical leadership higher than other professions
Garrouste-Orgeas et al., 2015[53]	Investigate whether burnout, depression, and safety culture affect the frequency of medical errors and adverse events in ICUs	- France - 31 ICUs—medical, mixed, or surgical - ICU physicians, nurses, nursing assistants, and physiotherapists	- SAQ-ICU - Administered from August 2009 to December 2011 - Reliability not reported	- Maslach Burnout Inventory (Fontaine French version) - Centre of Epidemiologic Studies Depression scale	- The median SAQ-ICU score was 60.7 for physicians and 57.5 for other staff - None of the ICUs had an effective SAQ-ICU score

Table 3 (*continued*)

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Author, year	Aim	Setting, participants, and response rate	Safety culture tool, dates, and reliability (Cronbach's α)	Additional tools/measures	Main findings
		- For SAQ-ICU, 1192/1534 (78%) of questionnaires were fully completed			- Scores were lowest for approval with management decisions - The safety culture score had only limited influence on medical errors - Depression symptoms were an independent risk factor for medical errors, and burnout was not associated with medical errors
Guirardello, 2017[54]	Assess nursing team's perception of clinical environment in critical care services and its relation with safety attitude, perceived quality of care, and burnout level	- Brazil - Three hospitals - Three ICUs (22 beds, 20 beds, and eight beds) - All nurses and nursing technicians who worked in their current area for 3 months or more - 114 surveys returned but the total number distributed was not reported	- Brazilian version of the SAQ-Short Form 2006 - Administered from December 2014 to February 2015 - Brazilian Portuguese SAQ reliability previously reported with total (41 items) α = 0.89, domain range α = 0.65−0.79	- Maslach Burnout Inventory - —NWI-R	- Only the job satisfaction domain was considered favourable (mean 76.19); however, stress recognition and teamwork climate domains scored highly (mean > 68 points) - Nurses scored higher in the stress recognition domain than nursing technicians, indicating that perceived stress interferes in perceived safety attitude - All SAQ domains except 'stress recognition' showed moderate correlation with NWI-R - A weak correlation was found between the length of experience in the unit and the safety climate, job satisfaction, perception of unit, and hospital management domains, i.e., less unit experience related to a worse perception of safety attitude
Huang et al., 2010[4]	Evaluate whether safety culture is associated with safety outcomes—hospital mortality and length of stay (LOS)	- USA - 30 ICUs - All ICU clinical and nonclinical staff with >1 month of experience in current ICU - 2103/4394 surveys returned (47.9% response rate, ranging between ICUs from 17.2% to 98.4%)	- SAQ-ICU version (60 items) - December 2003 to April 2004 - Administration dates not reported - Reliability not reported	- Data from the Project IMPACT Critical Care Medicine (PICCM) clinical database were used for patient hospital mortality and LOS	- Variation between ICUs, greatest in 'job satisfaction' and least in 'stress recognition' domains (significance not reported) - Variation between professional groups, nurses scoring most domains lower than medical staff (significance not reported) - Decrease in 'perceptions of hospital management' was associated with higher hospital mortality - Decrease in the safety climate score was associated with increase in hospital LOS - 'Perceptions of hospital management' was not significant when only ICUs with the response rate >50% were included in the analysis

O'Brien, 2009[55]	Evaluate the relationship between patient safety climate, patient outcomes, staffing, and hospital performance measures	- USA—California and Texas - 10 hospitals: Nine in California and one in Texas - 14 ICUs - All full- or part-time staff who had worked in the unit for at least 1 month - 637 surveys in total returned from all ICUs	- SAQ - Administered over a 1-month period third quarter of calendar year 2006 - The Texas hospital completed an abbreviated SAQ using only 4 subscales - Domain reliability ranged from $\alpha = 0.654$ to 0.851	- Falls, hospital-acquired pressure ulcers (HAPU), and staffing data were evaluated	- Patient safety climate varied significantly across units and among hospitals - No relationship was found among patient safety climate, falls, and HAPU
Speroff et al., 2010[56]	Determine whether organisations vary in culture and assess the association between organisational culture and safety climate	- USA - 61 hospitals invited, 40 responded (66% response rate) - 110 ICUs invited, 64 responded (58% response rate) - Medical, nursing, ancillary, and allied health staff - 1406 useable surveys returned (43% response rate)	- SAQ-Short Form (30 items) - SCS (10 items) - Administered from December 2005 to February 2006 - SAQ domain reliability ranged from $\alpha = 0.73$ to $\alpha = 0.83$ - SCS reliability $\alpha = 0.86$	- Competing Values Measure of Organisational Culture Assessment Instrument (CVMOCAI)—24 items - Information and analysis (4 items) questionnaire on use of data for quality improvement	- SAQ showed good internal reliability, and CVMOCAI had variable reliability. - Hierarchical organisation had significantly lower safety climate scores than group-focused organisations - Medical staff scored group culture higher and hierarchical culture lower than nurses and returned higher safety climate scores than nurses - Significant variation was found between hospitals and ICU's
Steyrer et al., 2013[57]	To explore the relationship among safety culture, workload pressures, and medical errors.	- Europe (Austria and Switzerland) - 57 hospitals - 57 ICUs - Medical and nursing staff (patients included in outcome data collection) - 549 surveys returned from nurses (response rate 41.4%) - 185 surveys returned from doctors (35.2% response rate)	- Vienna Safety Climate Questionnaire (4 dimensions) - Administration dates not reported - Domain reliability ranged from $\alpha = 082$ to $\alpha = 0.91$	- Protective safety tools were noted, workload and capacity indicators were assessed, and medical errors were recorded by staff in each unit over a 48-h period	- Increased workload was associated with increased error rates - An increased safety climate score was associated with a decreased error rate - Safety tools (e.g., regular safety audits and training to improve patient safety and barcodes or electronic tools to avoid medication errors) did not affect error rate
Vifladt et al., 2016b[58]	Examine the associations between RNs' perception of the patient safety culture, burnout, and sense of coherence (primary) and compare results in restructured and nonrestructured ICUs (secondary)	- Norway - Six hospitals - Seven ICUs - RNs - 143/289 (49.5%) RN response rate	- HSOPSC minus the two single-item outcomes - Norwegian translated and validated version used - Reliability not reported - Administered from December 2012 to February 2013 after restructure of 6 hospital ICUs	- . Norwegian Bergen Burnout Indicator Questionnaire - Sense of Coherence Questionnaire (the intervention was ICU restructuring[29,47])	- A positive safety culture was significantly associated with low burnout and a strong sense of coherence - No significant differences detected in burnout and sense of coherence between restructured and nonrestructured ICUs
Weaver et al., 2014[59]	Investigate the relationship between ICU patient safety climate profiles and central line–associated bloodstream infection (CLABSI) rates	- USA - The number of hospitals not reported - 238 ICUs - Composition of staff participants not identified	- HSOPS - 4 cohorts of data collected between September 2009 and October 2010 - The baseline HSOPS data were collected during the first 30–60 days of each cohort's participation - Reliability not reported	- CLABSI rates	- ICUs with conflicting and nonpunitive safety climates had a greater CLABSI risk than those with a positive leadership climate

α, Cronbach's alpha; ICC, interclass correlation coefficient; ICU, intensive care unit; HSOPSC, Hospital Survey on Patient Safety Culture; HSPSC, Hospital Survey Patient Safety Culture; NWI-R, Nursing Work Index - Revised; SAQ, Safety Attitudes Questionnaire; SAQ-ICU, Safety Attitudes Questionnaire for intensive care units; SCS, Safety Climate Survey; RN, registered nurse.

University Patient Safety Centre of Inquiry (Stanford) culture survey adapted to a Brazilian context (Rio Grande 2012). Dimensions relating to managerial and organisational issues scored lower than those at the unit level relating to individual attitudes and peers.

4.4. Studies using an SC survey to assess an intervention

Ten studies used an existing SC assessment tool, or an adapted tool, to evaluate the effects of an intervention (see Table 2). These studies are vastly heterogeneous, and all used SC as a primary or secondary outcome measure for the testing of an intervention. Three studies[43,46,47] used an SC assessment tool in their pre-intervention and postintervention evaluations. In seven studies,[40–42,44,45,48,49] the intervention effect was analysed using SC assessment in combination with other outcome or organisational measurements. Most studies used multiple other outcome measures. Interventions ranged from health service restructuring to quality improvement and staff education initiatives. Small numbers of study settings, from one to seven ICUs, were predominantly involved in these studies because of the nature of the interventions. Interventions in smaller scale studies ranged from a unit-based safety program,[46] a patient safety course,[43] and resource management.[42] Larger-scale studies, with more than 100 participating ICUs, incorporated complex combinations of outcome measures including SC. Outcome measures ranged from a national collaborative for central line–associated bloodstream infection and catheter-associated urinary tract infection[44] to a national research network testing the efficacy of checklists, and goal setting interventions reduced patient mortality.[49]

4.5. Studies where SC assessment is a component of organisational structure, process, and outcome analysis

A diverse combination of SC surveys, structural, employee, and patient outcome measurement tools were used in the eleven studies included in Table 3. The presiding aim of these studies was to explore multifactorial organisational and outcome relationships with SC. Only one study was conducted in a single-centre ICU, while the remaining 10 studies involved three to 281 ICUs. Structural assessment tools used include the 'conditions of workplace effectiveness questionnaire-II,'[50] 'organisation and management of intensive care units' survey,[52] staffing data,[55] 'Nursing Work Index,'[54] 'Competing Values Measure of Organisational Culture Assessment Instrument,'[56] the use of protective safety tools, workload, and capacity indicators.[57] Patient or clinical outcome measures were analysed in five studies: patient hospital mortality and length of stay,[4] falls and hospital-acquired pressure injuries,[55] 'Information and analysis questionnaire,'[56] central line–associated bloodstream infection rates,[59] and the number of medical errors reported.[57] Employee factors were measured in six studies using the 'Gallup Q Survey' to assess employee engagement,[51] 'Maslach burnout inventory,'[53,54] 'Centre of epidemiologic studies depression scale,'[53] Norwegian Bergen burnout indicator,[58] and 'Sense of Coherence Questionnaire.'[58]

5. Discussion

The USA was at the forefront of early investigations into SC; however, international awareness of the influence of SC on ICUs has exploded in the last 10 years and is evidenced by notable increases in publications emanating from Europe, South America, the Middle East, Asia, and Australia. Significantly, the accessibility of international studies investigating SC has increased in recent years due to a larger number being translated into English. This provides a more representative status of the influence of SC globally. There were no

studies set in the USA included in the 10-year period for this review where the primary aim was assessment of SC. However, four studies set in the USA assessed the influence of an intervention on SC,[41,44,46,48] and six studies[4,50,51,55,56,59] investigated the relationship between SC and workforce characteristics, hospital performance measures, or patient outcomes, showing that work in the USA in this area has progressed beyond primary assessment of SC.

In 2011, Halligan and Zecevic[62] reported that none of the studies in their literature review reported on the effectiveness of interventions and that there is an urgent need for longitudinal research on improving SC. In this narrative overview, we found that pre- and post-intervention assessment of SC occurred in a number of ICU studies (Table 2). In addition to the two studies by Vifladt et al.,[47,58] another four studies examined pre- and post intervention effect on the same ICUs.[40,41,44,46] Five studies looked at the effect of an intervention on SC against control ICUs.[42,43,45,48,49] Nevertheless, evidence of this long-term perspective requiring repeated assessments is lacking in ICU studies thus far, but models for implementing SC improvement in health care incorporating this approach have been proposed.[62–64]

A further emerging aspect of SC assessment is targeted use of SC domains. Chu-Weininger et al.[41] developed a tool primarily using the safety climate and teamwork domains of the SAQ to assess the effectiveness of a tele-ICU program in three ICUs varying in size and type, arguing that these constructs correlate strongly with patient outcomes. An improvement was identified at the unit level, particularly among nurses, despite no increase in overall hospital-level safety climate scores.[41] Selective assessment of different SC domains is gaining legitimacy and value and is promoted by the SAQ developers,[65,66] though several single-domain investigations were excluded from this literature review for logistical reasons. Kho et al.[33] suggest that shorter questionnaires can be more effective because they reduce the burden on respondents and are more likely to achieve high response rates.

Variations between ICU types, for example, teaching and nonteaching,[25,65] private and public,[36] closed and open,[53] intensivist staffed and nonintensivist staffed,[52] serve to confound result comparisons and contribute to significant variations in findings. Halligan and Zecevic[62] suggest that survey assessment is more indicative of climate assessment rather than culture, and this may be one reason for the diversity. Furthermore, perceptions of safety climate often varied between the unit and hospital management level[31] and between sites.[31,36]

Where the primary aim of the research was SC assessment, nursing staff members were sampled in 47% (7/15) of studies as shown in Table 1; 10% of studies (1/10) as shown in Table 2; and 36% of studies (4/11) as shown in Table 3. Investigation of the same participant professional group can present shared similar perceptions. Results reported here for other studies investigating combinations of nursing and medical staff, or the multidisciplinary team, are not truly representative because the nuances regarding safety climate perceptions among professional groups often varied.[28,30,31] Variation in perceptions of SC between professions has been well established, particularly between medical and nursing staff.[4,25,52,56] Despite this and other hierarchical differences, Kho et al.[33] and Minuzzi et al.[35] reported no significant differences among the ICU health team in both positive and negative assessments. Studies involving the multidisciplinary team were set in either open or closed ICUs. Differences in SC findings may be associated with this variance, but the ICU structure is not always clear.

Variation in SC was evident between individual units and between subcultures of role and leadership in the studies reviewed. Huang et al.[67] found that lower unit survey scores were significantly associated with higher rates of active treatment and more elderly patients, and Dodek et al.[52] found that larger units and

those with lower staff turnover scored higher. The common finding of variation between units reinforces the importance of evaluation of SC at the unit level[67,46] and that caution should be taken when generalising findings of individual unit surveys.[4,31]

5.1. Benchmarking and choice of SC tool

The widespread availability of valid and reliable SC assessment tools has increased and may be contributing to the marked expansion in publications where the primary aim was assessment of SC. These tools provide generally large data sets useful for comparison; however, they are rated and scored differently, creating difficulties for comparison of data when different tools are used.[61,68] Jackson et al.[68] propose that the advantage of choosing between a succinct range of survey tools is that scores from one hospital can be compared with data reported in other studies, thus facilitating benchmarking. The Australian studies by Braithwaite et al.[30] and Chaboyer et al.[31] used the benchmarking potential of the SAQ in comparing the mean domain scores of the Australian ICUs with the ICU results for the UK, New Zealand, and USA, the latter reported in the study by Sexton et al.[12] However, the number of participating ICUs was not reported by Braithwaite et al.,[30] and comparison of SC survey findings with international benchmarking studies such as that of Sexton et al.[12] and Sorra et al. [6] should be made with caution as these data are now over a decade old.[30] Several studies in Table 1 benchmarked against the Sexton SAQ findings,[25,26,33,36] but more recent studies benchmarked primarily to contemporary studies.[37] In benchmarking the HSOPSC, there tended to be a wider variety of studies incorporated.[29,32] HSOPSC results can be submitted to a large database of studies for benchmarking purposes.[59]

Etchegaray and Thomas[61] suggest choice of survey tool between the reliable and validated SAQ, and HSOPSC depends on several factors. For example, the SAQ has advantages that include the ability to trend hospital data over time, benchmark and examine relationships with outcomes, and a shorter length. The HSOPSC might be preferable when looking to prioritise quality improvement activities as this survey focuses on the unit- and institutional-level results across a large number of domains.[61] Comparisons in areas for improvement and potential strategies can also be gauged against the findings of other studies. The use of specifically developed tools other than these in the studies in this review mainly relates to the period in which the research was conducted as earlier studies did not have access to the tools that are widely available in recent years. Also, choice of survey tool may depend on organisational or regulatory body preference, particularly in large collaboratives.[62]

5.2. SC in Australian ICUs

The literature on SC in Australian ICUs demonstrates an emerging exploration of SC. Australian studies included in this review have taken the first step in the improvement of SC by using survey assessment.[67] There is currently a deficit of publications investigating the effect of interventions on SC in Australian ICUs. Assessment of SC and its relationship to organisational structure, process, and outcome measures is also an area requiring further development in Australian ICU research. Awareness of the significance of SC in patient safety and research into strategies to improve SC has grown rapidly in the period of this review.[69] It is, therefore, concerning that results from published SC surveys in Australia indicate that the standard of SC in Australian ICUs is similar to or poorer than the published benchmarking studies, suggesting that recognition of the influence of SC on clinical practice has not advanced at a comparable rate. For example, no published work

was identified that examined the impact of interventions on the SC in Australian adult ICUs.

5.3. Recommendations for future research

The studies in this review primarily focus on the perspective of the ICU workforce; however, incorporating patients' perception of hospital care in comparison to ICU staff perceptions is gaining increasing attention in the literature and should be a consideration for future SC research. Attention should also be given to longitudinal studies investigating the sustainability of interventions to improve SC, and repeated SC assessments should be part of an overall improvement strategy. For short, sharp analyses, the effect of SC improvement programs on specific domains, such as teamwork and safety climate, may be beneficial to stimulate local unit development.

6. Limitations

This narrative review provided a summary of existing SC studies. Further work in the form of systematic review and meta-analysis of SC studies in adult ICUs is warranted. Although a comprehensive search of the literature was undertaken by the three reviewers, critical appraisal of the studies was not addressed. This is an acknowledged limitation of this review. Some studies in this review sought not only to investigate the ICU SC but also to identify priorities and strategies for SC improvement, usually elicited through open-ended questions or focus groups. It was beyond the scope of this review to incorporate this qualitative perspective, although it is acknowledged that such approaches offer a rich and actionable perspective.

7. Conclusion

This literature review identified 36 quantitative studies that assessed SC using a survey tool from the context of intensive or critical care, two of which were conducted in Australia. The assessment of perceptions of SC using survey tools is widely practiced and is of particular use at an organisational unit level. As the relevance and applicability of SC assessment becomes more widely recognised, there are increasingly sophisticated applications appearing in the literature. There is some evidence of improvement in SC survey scores with focused interventions, while the data linking SC surveys to other outcomes are increasing. Additionally, longitudinal studies would demonstrate whether improved SC following focused interventions was sustained and could explore factors contributing to sustainability. While little research has been conducted on the perceived safety climate of Australian ICUs, the studies included in this review are significant. Australian studies to date have only taken the first step in exploring the application of SC assessment to interventions and outcomes.

Author contribution

All authors have made a significant contribution to the article. Specifically, Elspeth Dunstan, Jane-Louise Cook, and Fiona Coyer contributed to the concept, design, analysis and interpretation of data, and drafting of manuscript.

All authors declare that they have reviewed and approved the final version of the manuscript for submission, agree to be

accountable for all aspects of the work, and acknowledge that all those entitled to authorship are listed as authors.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.aucc.2018.11.003.

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