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Research paper

The design and evaluation of a pre-procedure checklist specific to the cardiac catheterisation laboratory

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ABSTRACT

Background: With the increasing complexity of procedures being performed in the cardiac catheterisation laboratory, the multidisciplinary team has the challenge of providing safe care to patients who present with a multitude of healthcare needs. Although the use of a surgical safety checklist has become standard practice in operating theatres worldwide, the use of a pre-procedure checklist has not been routinely adopted into interventional cardiology.

Objective: The aim of this study was to design and evaluate a pre-procedure checklist specific to the cardiac catheterisation laboratory.

Method: A descriptive, exploratory design was used to develop a specifically designed pre-procedure checklist for use in the cardiac catheterisation laboratory in a private hospital in Melbourne, Australia. The pre-procedure checklist was developed by exploring the multidisciplinary team's opinion regarding the organisation's previous surgical pre-procedure checklist through a pre-implementation survey and focus groups. Following an expert review, and implementation of the proposed pre-procedure checklist, a post-implementation survey was completed.

Results: Thirty-five (70%) cardiac catheterisation laboratory healthcare professionals completed the pre-implementation survey, with 31 (62%) completing the post-implementation survey. Ninety-one per cent of participants agreed that important clinical information required for interventional procedures was not documented on the previous surgical checklist. A specific checklist was developed from the results of the survey and six focus groups (N = 25) and implemented in the cardiac catheterisation laboratory. In the post-implementation survey, participants identified that the cardiac catheterisation laboratory specific pre-procedure checklist included all relevant clinical information and improved documentation of patient information.

Conclusion: The development of a specific cardiac catheterisation laboratory pre-procedure checklist has led to an improved transfer of pertinent clinical information required prior to procedures being performed in the unit. The outcome of this study has implications for other cardiac catheterisation laboratories with the potential to standardise practice within interventional cardiology practice and improve patient safety outcomes.

1. Introduction

Coronary heart disease is the leading cause of death in Australia, accounting for 11% of all deaths in 2018.[1] It is also the leading specific cause of disease burden in Australia, calculated at 6.9% of the nation's total disease burden.[1] There were 161 800

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hospitalisations for coronary heart disease in Australia in 2015, with 60% of these admissions related to myocardial infarction and angina presentations.[2] The binational SNAPSHOT study found that across Australia and New Zealand, more than 70% of patients with myocardial infarction were managed with angiography, and more than 40% of patients were treated with percutaneous coronary intervention.[3]

A cardiac catheterisation laboratory (CCL) is the procedural area where coronary angiography and cardiac interventions are performed. CCLs across Australia and New Zealand have reported a significant increase in patient acuity and procedural complexity over the last 10 years,[4] which is attributed to an increasingly older patient population that present to the hospital with extensive comorbidities, such as type 2 diabetes and renal impairment.[5] These patients are at higher risk of complications during and after the procedure if risk factors are not identified and assessed prior to the procedure.

Patient safety is a global concern shared across the healthcare industry. Among hospitalised patients worldwide, 3–16% suffer injury as a result of a medical intervention, and approximately half of these injuries are preventable.[6,7] According to the Australian Commission on Safety and Quality in Health Care, the cost associated with hospital-acquired adverse events in the Australian public healthcare system was estimated to be $4.1 billion in the 2017–2018 financial year.[8] Similar to most procedural areas and operating theatres, patients in the CCL are at risk of adverse events,[9,10] for example, incorrect patient and procedure matching often results from poor teamwork and communication.[11] Therefore, processes for identifying patients for the correct cardiac intervention or procedure are essential to ensure that the right patient receives the right care. The World Health Organization's Safe Surgery Saves Lives program[12] involved the development of a checklist that aimed to standardise surgical practice and increase surgical safety. This program was developed to increase procedural safety by promoting effective teamwork and communication.

Checklists are used in health care as a communication tool, providing healthcare professionals with the opportunity to discuss potential concerns and anticipated intraoperative requirements prior to commencing the procedure.[13,14]

Although the use of a surgical safety checklist has become standard practice in operating theatres worldwide, the use of a pre-procedure checklist has not been routinely adopted in interventional cardiology.[15] With increasing complexity of procedures being completed in the CCL, the multidisciplinary team has the challenge of providing safe patient care to a high volume of patients with a multitude of healthcare needs. According to contemporary literature, it has been widely accepted that checklists help to reduce adverse events in health care.[16,17] A checklist also standardises the process of capturing relevant patient information to ensure that all necessary details are collected prior to commencing the procedure. Well-designed checklists provide the framework to ensure adherence to procedural requirements and can reduce errors in routine and emergency situations.[18] However, there is little evidence to support pre-procedure checklists in the CCL specialty area, with many past studies based on modified time-out safety checklists, focusing mostly on preventing wrong side and wrong site interventions.[15,19,20]

Past research has highlighted challenges while completing checklists, with a lack of robust research of implementation strategies in the surgical checklist literature. How a checklist is designed and implemented requires a strategic approach, with significant input and leadership from the multidisciplinary team required.[21] It is suggested that involvement of the multidisciplinary team in tailoring the checklist content and allowing reflection and evaluation after implementation will enable greater participation and encourage perceived ownership of the checklist once it has been implemented.[21,22]

Review of the literature in relation to CCL specific pre-procedure checklists suggests that there is a gap in evidence in relation to the CCL as a unique area of clinical practice. Past work has not considered the specific needs of the CCL, and there has not been a focus on seeking the perspectives of various disciplines from CCLs in developing and testing a checklist specific to this setting.

Before this study, it had been stated anecdotally by the CCL staff that the previous checklist did not capture all of the data required for the check-in process of the patient when admitted to the CCL. Nurses regularly documented clinically relevant patient information on the page borders of the previous checklist to inform the 'time-out' safety checks conducted prior to the procedure. The process relied on nurses' specialty knowledge to ensure all clinically relevant information was documented and included during the handover of the patient to the CCL.

1.1. Aims of the study

The aims of the study were (i) to design a pre-procedure checklist specific to the CCL and (ii) to evaluate healthcare professionals' perception of the importance of the CCL-specific pre-procedure checklist (hereafter referred to as a pre-procedure checklist) prior to and after implementation in the CCL, to improve the usability of the document and improve communication of information between teams when patients are transferred to the CCL.

The key research question was as follows: Does the CCL-specific pre-procedure checklist contain relevant clinical information as identified by members of the multidisciplinary team?

2. Method

2.1. Study design

This study comprised a descriptive, exploratory design. The SQUIRE 2.0 guidelines were used as a framework for reporting this quality improvement study.[23]

2.2. Setting

The study was undertaken in a CCL in a 124-inpatient-bed private hospital in metropolitan Melbourne, Australia, in September 2017. The research site manages more than 3300 cases annually, with a variety of interventional cardiology procedures performed under sedation and local anaesthetic. These cases include cardiac angiograms, right heart catheterisation, and percutaneous coronary interventions. Structural cardiac interventions, such as patent foramen ovale and atrial septal defect closures, balloon aortic valvuloplasty, and transaortic valve insertion, are also performed. Procedures in the electrophysiology CCL include electrophysiology studies, ablations, external cardioversions, and pacemaker and internal cardiac defibrillator insertion.

2.3. Development of the pre-procedure checklist

A pre-implementation survey was used to explore the CCL multidisciplinary team's opinions regarding the organisation's previous surgical pre-procedure checklist, and the team's expertise was sought to guide the development of a pre-procedure checklist. CCL staff members from all disciplines, including cardiologists (electrophysiologists and interventional cardiologists), anaesthetists, nursing staff, technicians, radiographers, and cardiac technicians, were invited to participate in a pre-implementation survey and focus group through posters on notice boards in the CCL

department and discussions at the monthly team meetings. Only healthcare professionals who had worked in the CCL for more than 1 month were eligible to participate. A purposive sampling method was used to select participants with the relevant experience to inform the development of the pre-procedure checklist.[20]

All CCL staff members were provided with a copy of the pre-implementation survey and Participant Information and Consent Form via internal mail, with completed surveys returned to a designated secure box within the CCL department to protect confidentiality. The survey included demographic information and statements using a 10-point rating scale (1 being the least important and 10 being the most important), with seven of the questions pertaining to the layout and design of the previous checklist. Open-ended questions were also included to explore the participants' views about the previous checklist. The questions included in the survey were designed to be broad as the results from the pre-implementation survey were used to inform the focus group questions. The same survey was used after implementation of the pre-procedure checklist. Although patient outcomes were not directly measured, staff members were asked their opinions regarding the pre-procedure checklist in relation to patient safety and preventing errors.

2.3.1. Focus groups

The purpose of conducting focus groups was to allow participants to discuss their views about the previous checklist that was in use in the CCL at the time of the study and to encourage them to develop ideas about the design of a CCL specific pre-procedure checklist. Inviting members from the various disciplines to participate ensured that essential patient information would be included in the checklist. A timetable was placed on the notice board in the CCL department where participants allocated themselves to attend one focus group. Discussions were guided by questions developed from the pre-implementation survey results.

During each focus group, the previous checklist in use in the CCL at the time was enlarged to an A3-size hard copy and used as a prompt to guide feedback from participants and to allow them to write on the document to illustrate their comments. Focus group sessions were audio recorded, with recordings stored on a password-protected shared drive. Notes were taken during the focus groups by the mediator, which acted as prompts when re-listening to the recordings. The audio-recorded focus groups were transcribed verbatim by an external professional transcriber, with participant names changed to protect their confidentiality.

2.4. Design of the CCL specific pre-procedure checklist

A draft of the pre-procedure checklist was developed, using the results from the pre-implementation survey and focus groups. Checklist design requires consideration of content, format, trial, and feedback, followed by formal testing and evaluation.[18,24] Therefore, prior to implementation, an expert review of the pre-procedure checklist was undertaken. Each of the healthcare professionals involved in the expert review was chosen either by seniority within the department, or by years of experience, or they were supervisors with research expertise. These experts were deliberately targeted to provide face and content validity, and to assess the usability and layout of the CCL pre-procedure checklist by completing a short survey. This approach ensured the relevance of the clinical content, to improve the documentation of pertinent patient information, and to enhance the patient check-in process prior to the procedure, had been captured on the checklist.

The research team also sought ratification from the organisation's forms committee, which was a hospital-convened group that was responsible for reviewing all documents used within the organisation.

2.5. Implementation and evaluation of the pre-procedure checklist

Educational sessions were provided prior to implementing the checklist, to ensure all CCL healthcare professionals and ward staff involved in the handover of the patient understood how to use the CCL specific pre-procedure checklist.

The pre-procedure checklist was implemented into practice in February 2018, replacing the previous document for a period of 1 month, prior to being evaluated. CCL staff members from all disciplines were invited to participate in a post-implementation survey that explored their views about the pre-procedure checklist, including the design and content. Completed post-implementation surveys were returned anonymously in envelopes provided and posted in a secure box within the CCL department.

Demographics data were collected from the participants, including their discipline, years of experience in the CCL, and qualifications, to illustrate the breadth of end-user feedback during both the pre-implementation and post-implementation of the pre-procedure checklist.

2.6. Ethics

Ethics approval was received from the research site Human Research Ethics Committee (HREC Project: 2016.377) and the university Human Research Ethics Committee (LNR/17/MH/158). Governance approval was provided by the private hospital with support from all levels of management, including the hospital's Director of Nursing, Manager General and senior clinicians. All data were anonymised, thus helping to maintain confidentiality and privacy of the participants. Written consent was obtained from each participant.

2.7. Data analysis

Responses from the pre-implementation and post-implementation surveys were captured in a Microsoft Excel (version 2016) spreadsheet and analysed using SPSS (version 26). Descriptive statistics were used to summarise the quantitative data and describe the sample groups. As the data were not normally distributed, a non-parametric test was required to test for significant differences between the pre-implementation and post-implementation data. Pre-implementation and post-implementation data could not be linked as surveys were anonymous because no identifying data were collected. Therefore, the pre-implementation and post-implementation samples were treated as independent, and a Mann–Whitney U test was used to test for significant differences.

Inductive content analysis was undertaken to identify patterns and themes of the qualitative responses from the pre-implementation and post-implementation surveys. These were coded and reported as key themes,[25] with findings from the pre-implementation survey used to develop questions for the focus groups.

Thematic analysis was undertaken on focus group data to link ideas and concepts related to the research aims.[25] A thematic map was produced to conceptualise the data patterns and relationships between them by one researcher, which was verified for accuracy by a second researcher. Developed themes were reviewed by all members of the research team, and any discrepancies were resolved. The A3-sized copies of the CCL pre-procedure checklist used by the participants to illustrate their ideas were compared to identify patterns or themes.

3. Results

3.1. Pre-implementation and post implementation survey results

A total of 50 pre-implementation and post-implementation surveys were emailed, with a response rate of 70% (N = 35) and 62% (N = 31), respectively. The CCL pre-procedure checklist was implemented in the CCL on January 12, 2018, for a 1-month period to document clinical information on all patients transferred into the CCL, replacing the previous checklist. The CCL pre-procedure checklist was used on all patients (N = 260) who were transferred to the CCL during the implementation period.

The majority of participants who completed the pre-implementation and post-implementation surveys were aged between 31 and 40 years or between 51 and 60 years. Most respondents were scrub or circulating nurses, with representation from anaesthetists, interventional cardiologists, electrophysiologists, radiographers, and cardiac technologists. One neuro-interventionalist participated in the pre-implementation survey (Table 1).

In the post-implementation survey, 100% of the respondents scored the new pre-procedure checklist for patient safety and preventing errors, compared with 77.2% of respondents for the previous checklist. Ninety-seven per cent of respondents believed the new checklist improved communication between the CCL team members, which was similar when rating the effectiveness of the clinical handover of the patients' medical and surgical history on admission to the CCL. In all, responses for the new pre-procedure checklist scored higher than the responses for the previous checklist. The Likert scale results were all statistically significant for the post-implementation scores when compared with the pre-implementation scores, as analysed using the Mann–Whitney U test (Table 2).

The participants responded to the open-ended questions regarding the previous pre-procedure checklist and the pre-

Table 1
Demographic characteristics of the participants from the pre-implementation survey, post-implementation survey, and focus groups.

Characteristics	Pre-implementation survey (%), N = 35	Post-implementation survey (%), N = 31	Focus group (%), N = 25
Gender			
Female	18 (51.4)	19 (61.3)	15 (60)
Age groups, years			
20–25	2 (5.7)	3 (9.7)	
26–30	5 (14.3)	4 (12.9)	
31–40	12 (34.3)	10 (32.3)	
41–50	9 (14.3)	3 (9.7)	
51–60	11 (31.4)	10 (32.3)	
60+		1 (3.2)	
Qualifications			
Diploma	2 (5.7)	3 (9.7)	
Bachelor's degree	16 (45.7)	13 (41.9)	
Graduate certificate	6 (17.1)	6 (19.4)	
Graduate diploma	5 (14.3)	6 (19.4)	
Master's degree	3 (8.6)	1 (3.2)	
Other[a]	3 (8.6)	2 (6.5)	
Number of years of experience in a cardiac catheterisation laboratory (CCL)			
>1 year	1 (2.9)	1 (3.2)	
1–5 years	11 (31.4)	10 (32.3)	
6–10 years	11 (31.4)	8 (25.8)	
11–15 years	4 (11.4)	5 (16.1)	
16–20 years	5 (14.3)	4 (12.9)	
20+ years	3 (8.6)	3 (9.7)	
Number of years worked in the study site			
<1 year	6 (17.1)	3 (9.7)	
1–5 years	15 (42.9)	14 (45.2)	
6–10 years	5 (14.3)	7 (22.6)	
11–15 years	5 (14.3)	2 (6.5)	
16–20 years	3 (8.6)	4 (12.9)	
>20 years	1 (2.9)	1 (3.2)	
Current employment in the CCL			
Anaesthetist	4 (11.4)	2 (6.5)	1 (4)
Anaesthetic nurse	2 (5.7)	3 (9.7)	1 (4)
Cardiac technologist	4 (11.4)	5 (16.1)	4 (16)
Electrophysiologist	4 (11.4)		2 (8)
Interventional cardiologist	2 (5.7)	3 (9.7)	1 (4)
Radiographer	4 (11.4)	5 (16.1)	4 (16)
Scrub/circulation nurse	14 (40.0)	13 (41.9)	12 (48)
Other[b]	1 (2.9)		

[a] Included one neurointerventionalist (n = 1).
[b] Included Doctor of Philosophy (n = 2) and physician specialist training (n = 1).

Table 2
Pre-intervention (N = 35) and post-intervention (N = 31) survey checklist questions.

Rating scale 1 = least important 10 = most important		1 %	2 %	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %	Mann–Whitney U test[a]
Q1	Pre-intervention	0	0	2.9	0	11.4	2.9	5.7	14.3	20.0	42.9	U = 705.000, p < .005
Importance of the pre-procedure checklist in patient safety and preventing errors	Post-intervention	0	0	0	0	0	0	0	6.5	22.6	71.0	
Q2	Pre-intervention	0	2.9	14.3	5.7	14.3	11.4	25.7	14.3	8.6	2.9	U = 930.000, p < .001
Effectiveness of the pre-procedure checklist in improving commination between CCL team members	Post-intervention	3.2	0	0	0	0	0	0	19.4	32.3	45.2	
Q3	Pre-intervention	0	11.4	8.6	17.1	14.3	11.4	20.0	8.6	5.7	2.9	U = 940.000, p < .001
Effectiveness of the pre-procedure checklists in the clinical handover of patients' histories on admission to the CCL	Post-intervention	0	0	0	0	0	3.2	0	38.7	25.8	32.3	
Q4	Pre-intervention	8.6	5.7	5.7	11.4	8.6	8.6	20.0	25.7	2.9	2.9	U = 788.500, p < .001
Score for layout of the pre-procedure checklist	Post-intervention	0	3.2	0	3.2	0	6.5	19.4	25.8	29.0	12.9	
Q5	Pre-intervention	0	0	2.9	17.1	22.9	20.0	20.0	11.4	5.7	0	U = 980.500, p < .001
Score for content of the pre-procedure checklist	Post-intervention	0	0	0	0	0	3.2	3.2	12.9	41.9	38.7	
Q6	Pre-intervention	5.7	2.9	11.4	8.6	8.6	17.1	22.9	14.3	8.6	0	U = 869.000, p < .001
Score for flow of information of the pre-procedure checklist	Post-intervention	0	3.2	0	3.2	0	0	12.9	25.8	32.3	22.6	
Q7	Pre-intervention	11.4	2.9	8.6	11.4	8.6	5.7	11.4	28.6	11.4	0	U = 821.500, p < .001
Score for ease of use of the pre-procedure checklist	Post-intervention	0	0	0	6.5	0	0	6.1	25.8	35.5	16.1	
Q8	Pre-intervention	8.6	5.7	0	5.7	20.0	14.3	20.0	20.0	5.7	0	U = 975.500, p <0.001
Score for usefulness of the pre-procedure checklist	Post-intervention	0	0	0	0	3.2	0	0	3.2	32.3	61.3	
Q9	Pre-intervention	5.7	11.4	2.9	17.1	25.7	8.6	8.6	11.4	5.7	2.9	U = 992.500, p < .001
Score for relevance to the CCL of the pre-procedure checklist	Post-intervention	0	0	0	0	0	0	3.2	0	25.8	71.0	
Q10	Pre-intervention	11.4	17.1	17.1	20.0	11.4	8.6	0	11.4	2.9	0	U = 990.500, p <.001
Score for space for clinical information of the pre-procedure checklist	Post-intervention	0	0	0	0	3.2	3.2	6.5	22.6	48.4	16.1	

CCL, cardiac catheterisation laboratory.
[a] U = Mann–Whitney U test to test for differences between pre-implementation and post-implementation survey results.

procedure checklist. Responses were categorised into three main themes.

3.1.1. *A pre-procedure checklist improves patient outcomes*

In the pre-implementation survey, the participants acknowledged the potential for a CCL specific pre-procedure checklist to reduce complications within the unit. Issues were raised about the previous checklist not including important information when patients are admitted to the CCL. Problems could be highlighted during the patient handover, which would have allowed the necessary preventive action to be taken prior to the procedure, reducing the risk of adverse outcomes for patients. In the post-implementation survey, the participants reported that the pre-procedure checklist was well designed with clear, concise, and logical sequencing of information. The checklist also included all pertinent clinical information, and all relevant alerts were included.

3.1.2. *Pre-procedure checklists are vital for accurate patient handover*

The participants stated that the previous checklist relied on individual healthcare professionals' experience and initiative to ensure salient clinical information was documented prior to each patient's CCL procedure. They observed that there were 'key elements missing', and it was reported that nurses were required to document clinically relevant information on the page borders of the previous pre-procedure checklist to ensure it was available when conducting a time-out safety check prior to the procedure. The participants felt that this situation could lead to an increased risk to patients if their condition deteriorated.

After the implementation of the CCL specific pre-procedure checklist, participants indicated that handover between the ward and CCL nursing staff improved, which they attributed to the new pre-procedure checklist. The participants believed that the new checklist provided ward nurses with a systematic framework of relevant clinical information required for procedures performed in the CCL and that the use of the pre-procedure checklist ensured that this information was communicated during the handover. Any abnormal results or anomalous patient histories that could affect the patient outcome were addressed prior to the procedure, thereby potentially reducing adverse events and improving patient safety through accurate patient information during the handover.

The tick boxes printed on the pre-procedure checklist prompted documentation of signs, symptoms, and previous investigations and cardiac risk factors, which were positive aspects of the pre-procedure checklist. The participants perceived that the pre-procedure checklist was more specific for procedures performed in the CCL than the previous checklist.

3.1.3. *The pre-procedure checklist is considered a communication tool*

The pre-procedure checklist was regarded as a communication tool when used during the handover of a patient from the ward to the CCL. It also informed the 'time-out' safety check prior to commencing the procedure. After implementation of the pre-procedure checklist, the participants felt that communication among the ward staff and CCL multidisciplinary team members had improved.

Healthcare professionals in the CCL and nurses on the ward provided a better 'picture' of each patient's condition and history. Some participants suggested that the pre-procedure checklist reduced time inefficiencies and that it helped them to visualise all of the clinical information required prior to the procedure on a

single checklist. The participants also felt that they could respond to deteriorating patients faster.

3.1.3.1. Focus group results. Six focus groups of between two and six participants were conducted in the boardroom at the hospital study site. The focus group sessions ranged from 20 to 40 min in length, with 25 CCL healthcare professionals participating. Demographic data are presented in Table 1.

Three keys themes were identified from the focus group findings.

3.2. Accountability in documenting patient care

The participants all agreed that the pre-procedure checklist should include pertinent information required for all procedures performed in the CCL, for example, marking of the procedure site and availability of diagnostic images. Additional sections were suggested, such as a separate column for ward and CCL staff to document the handover of the patient from each area. As stated by one participant, *"this adds to the accountability of the person that is documenting it"* (radiographer 3).

3.3. Information order during patient handover

The participants had mixed opinions regarding the order in which the information should be presented. It was suggested that the pre-procedure checklist should follow the order in which information was presented during the handover of a patient to the CCL. Another suggestion was to categorise items in order of importance. The participants also felt that documenting blood results, and including instructions about notifying cardiologists of any anomalies, would prompt ward staff to act on abnormal blood results. Additional clinical information deemed necessary to incorporate onto the CCL checklist included location and gauge of the intravenous cannula and documenting the brand of the pacemaker or internal cardiac defibrillator that the patient had *in situ*. This was argued to be important because reprogramming of devices during procedures in the CCL was often required.

A key theme that arose from the focus group finding was that a CCL specific pre-procedure checklist would improve the transfer of a patient to the unit. It was stated by a number of participants that "*checklists act as a prompt for the ward staff to ensure patients are prepared appropriately*" (CCL nurse 3, CCL nurse 8, CCL nurse 10) and that all necessary clinical information is documented. Some participants voiced concerns about the quantity of information being included on the pre-procedure checklist, suggesting that having too much information would make it "*cumbersome and redundant*" (electrophysiologist 1, CCL nursing staff 9, CCL nursing staff 5, radiographer 3), resulting in staff members not completing sections of the checklist.

4. Discussion

This research involved the development of a CCL specific pre-procedure checklist with the aim of improving the usability of the document and improving communication of clinical information when patients are transferred to the CCL. The intention was to establish a breadth of end-user feedback about the pre-procedure checklist and to ensure participation from each CCL discipline in the study. By involving the multidisciplinary team during the development and evaluation of the pre-procedure checklist, successful implementation into practice was ensured.

Adverse events occur most frequently when patients are transferred between departments within the hospital.[26] A pre-procedure checklist that includes pertinent clinical information[20] informs staff of relevant clinical information during the handover of the patient to the receiving unit.[26] The results from this study indicated that there was a need for a CCL specific pre-procedure checklist. implementation, the respondents indicated that the previous checklist did not incorporate all relevant clinical information required for procedures performed in the CCL, with greater agreement found post-implementation. Checklists standardise performance by reducing the reliance on memory and therefore errors of omission.[20,27–29] This is particularly applicable to the CCL as procedures are becoming more complex, with a high turnover of cases, thus making the design of the pre-procedure checklist an important aspect of patient safety.

Staff members were asked about the pre-procedure checklist in relation to patient safety and preventing errors. The respondents felt that the checklist was vital for an accurate patient handover, with greater agreement found when asked to rate the pre-procedure checklist in relation to improving the handover of patients' clinical histories on transfer to the CCL. The participants also stated that they had a greater understanding of patients' condition, including the indications for the procedure after implementation of the pre-procedure checklist. They considered the use of the pre-procedure checklist essential, with communication identified as one of the most important factors. Results from previous studies have found that checklists contribute to improved communication and increased situational awareness amongst multidisciplinary teams.[30–33,36,37] Studies completed in interventional medicine also support the notion that a safety checklist promotes staff involvement and reduces human error.[15,27,36,37] Although patient outcomes were not measured in this study, a reduction in mortality (1.5–0.8%) and inpatient complications (11–7%) was reported in a systematic review after the introduction of a surgical safety checklist in the operating theatre.[38] With the limited implementation of a pre-procedure checklist in the CCL, generalising the finding from studies conducted in the operating room could be considered as it is a comparable clinical environment, with similar risks that influence patient safety.[21]

Some studies reported that elements of checklists are often omitted in practice, regardless of their perceived importance or relevance,[14,34,35] with the potential to disrupt teamwork and result in communication failure and poor patient outcomes.[15,30] The multidisciplinary team who participated in this study said that several sections in the previous checklist were irrelevant to the unit, which were left blank when transferring a patient to the CCL. Nurses were also required to document relevant patient information along the border of the document so that salient information was captured. Evaluating the relevance of the checklist to the CCL in this study showed an increase in agreement about the design and content of the pre-procedure checklist, which has the potential to improve documentation. Braham et al.[15] explored the relevance of the content of a checklist and found an improvement in the completion of the checklist after implementation owing to the improved relevance of the checklist. Their finding would suggest that the implementation of a pre-procedure checklist that is specific to the CCL would reduce the reliance on memory and therefore reduce errors of omission.[20,27–29] This reduction of reliance on memory is likely to improve communication among those in the CCL team, thereby promoting safe patient care.

4.1. Strengths and limitations

In this study, the designed pre-procedure document was evaluated for its content features and its usability in the CCL where the study was conducted. However, multisite studies should be carried out to test its usability and validity in other CCLs and procedural

areas, in particular, in public hospital settings, as results from this study relate to a private metropolitan hospital.

The major challenges when implementing a pre-procedure checklist in health care include implementation and compliance.[15,21] Among those in the multidisciplinary team in the CCL, there needs to be investment in the process by all members. A pre-procedure checklist is most useful when healthcare professionals believe in its practical worth, as well as in the potential to improve patient outcomes. The long-term challenge is to maintain compliance with regard to completion of the CCL specific checklist after the study has ended. The underlying safety process involves ongoing training and engagement of healthcare professionals. Therefore, for the CCL checklist to be used effectively, it is necessary to have a strategy for team communication to provide a safe procedural environment. Although compliance was not investigated in the study, future recommendations for audits at 3 months, 6 months, and 1 year after implementation, as part of the organisation's quality control, to assess the completeness of the new CCL pre-procedure checklist and guard against complacency have been made.

4.2. Implications for practice

The CCL pre-procedure checklist has become part of the documentation required for all patients undergoing a CCL procedure at the research study site, replacing the organisation's previous surgical pre-procedure checklist. Plans are currently underway to incorporate this checklist into the electronic medical record that will be accessible to other CCLs within the organisation to standardise documentation.

5. Conclusion

The development of a specific CCL pre-procedure checklist has led to an improved translation of pertinent clinical information required prior to procedures performed in the CCL. This quality improvement study has shown that with appropriate implementation, a safety checklist has the potential to promote a culture of effective team-based communication, which may result in improved patient safety in the CCL.

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Conflict of interest

None.

CRediT authorship contribution statement

Patricia Nicholson: Conceptualisation; Methodology; Investigation; Writing - Review & Editing; Supervision; Project administration; **Lisa Kuhn**: Conceptualisation; Methodology; Investigation; Writing - Review & Editing; Supervision; **Elizabeth Manias**: Conceptualisation; Methodology; Investigation; Writing - Review & Editing; Supervision; **Marie Sloman:** Conceptualisation; Methodology; Investigation; Writing - Original Draft; Writing - Review & Editing; Project administration.

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Appendix A. Supplementary data

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