Clinical handover of the critically ill postoperative patient: An integrative review

Abstract

Objectives

The clinical handover of critically ill postoperative patients from the operating theatre to the intensive care unit is a dynamic and complex process that can lead to communication and technical errors. The objectives of this integrative review were to illustrate how the use of structured handover processes between the operating theatre and intensive care unit impacts information transfer, handover duration, post-handover technical error and high risk events.

Review method used

Integrative review methodology was used to allow for the inclusion of broad research designs, summarising current knowledge from existing research and identify gaps in the literature.

Data Sources

A systematic search of electronic databases including the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane library, Embase, ProQuest central and PubMed were performed. Original research articles, in either adults or paediatrics, specific to handover between an operating theatre and intensive care unit were included.

Review methods

Data extracted from studies included country of origin, sample size, number of hospital sites, study design, study aim, measures, key findings and limitations. The quality of the integrative review articles was assessed against the '*Standard Quality Assessment Criteria for Evaluating Primary Research Papers*'.

Results

Ten articles meeting the inclusion criteria were included in the final analysis. Information transfer, post-handover technical errors and high risk events were positively influenced by the use of structured clinical handover tools. Handover duration did not change when using structured handover protocols.

Conclusions

The body of literature on clinical handover between operating theatre and the intensive care unit is in its early stages of development. Future research using rigorous study designs, broader populations and varied surgical procedures are needed to further evaluate the effect of clinical handover protocols.

Keywords

Critical Care; Handoff; Handover; Intensive Care; Operating Room; Operating Theatre; Perioperative

Introduction

Patient harm from potentially avoidable medical error continues to occur frequently in health care settings world-wide.[1-3] Both the Institute of Medicine and the Joint Commission on Accreditation of Health Care Organizations have reported that communication failure is the most common cause of preventable medical error.[2] Communication error in clinical practice reportedly contributes up to 70% of preventable medical error resulting in death, serious physical or psychological injury to patients.[2, 3] Several studies have reported higher observed rates of preventable error occur in operating theatres (OT) and intensive care units (ICUs), when compared to other health care areas.[4-6] Similarly, the Joint Commission reported that approximately half of communication failures were related to the clinical handover period.[2] In 2007, communication during patient handover was listed as one of the World Health Organization "High Five" patient safety initiatives.[7] The Joint Commission and the Australian Commission on Safety and Quality in Health Care have also identified clinical handover as an important area of focus for patient safety.[2, 3]

Background

The clinical handover of critically ill postoperative patients from OT to the ICU involves a dynamic and complex set of processes which can influence the recovery and outcomes of vulnerable patients.[8, 9] Clinical handover is broadly defined as the transfer of the patient, information, equipment, professional responsibility and accountability from one professional person or group to another, and may also include strategies that promote education and teamwork.[3, 8] Table 1 defines other terms and definitions used in this review. Information handover involves many different people at a single point of time, each of whom has a specific perspective and focus for patient care, potentially increasing the risk of ineffective communication.[8] For example, admitting a patient to the ICU from OT involves transferring

the patient and any related equipment. If patient and equipment transfer is undertaken at the same time as information handover, then the effectiveness of communication may be compromised, shifting team focus to the disconnection, transfer and reconnection of equipment rather than on the information being relayed.[10]

Ineffective communication during clinical handover can have immediate and long term consequences for the delivery of safe patient care.[2, 3, 11] In the short term, an ineffective handover may result in information loss and technical error, delays in medical diagnosis, wrong treatment and higher incidence of life threatening adverse events.[9, 11, 12] Potential longer term effects of ineffective handover have been reported to include increased patient complaints, hospital length of stay, and health care costs.[9, 11, 13]

The importance of clinical handover from OT to ICU is emphasised in Segal et al's [14] 2012 review of handover from OT to the post anaesthesia care unit (PACU) or ICU. The majority (n=20/31, 65%) of studies included in this review were specific to PACU, with fewer studies being focusing on handover from OT to ICU. The applicability of research conducted in the context of post-anaesthetic recovery to ICU practice is questionable given the higher level of patient acuity and surgical complexity of patients transferred from the OT to the ICU. Consequently, the handover process between OT and ICU is likely to be more complex because patients are sicker, require more monitoring and equipment, may be on life support, and have more interdisciplinary team members involved in care. Potentially, this higher level of complexity requires sophisticated processes of communication and consequently there is an increased likelihood of technical error during the handover process from OT to ICU. Since this review was published in 2012 there have been a further five articles published specific to handover between OT and ICU.[11, 15-18] To our knowledge this integrative literature review is the first in the area of handover from the OT to the ICU that has used robust systematic

assessment criteria (Standard Quality Assessment Criteria for Evaluating Primary Research Papers).

Aims

This paper reports the findings of an integrative review which provides a synthesis and critique of existing research relating to OT to ICU clinical handover. A description of the state of the science in this important patient safety area is described. Specifically, we illustrate how the use of structured handover processes between the OT and ICU impacts information transfer, handover duration, post-handover technical error and high risk events.

Methods

Integrative review methodology was used to allow for the inclusion of both experimental and non-experimental research designs[19] broadly summarising the current state of the science from existing research and to identifying gaps in the literature.[19] This review process provides broad understanding of healthcare problems whilst identifying areas for future research focus, contributing to nursing science, with the potential to influence policy and nursing care.[19, 20]

Literature search strategies

A systematic search of electronic databases including the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane library, Embase, ProQuest central and PubMed was performed. We included articles that reported original research, regardless of research design, not limited to a date range, that were specific to handover between an OT and ICU, in either the adult or paediatric context, using search terms in Table 2. Additional literature was identified through hand searching reference lists of included papers and the systematic review of Segal et al.[14] Figure 1 describes the process of article identification, screening, eligibility and inclusion.

Data Extraction

Data extraction was independently completed by one author. During data extraction, the review authors met regularly to discuss emerging queries, which were resolved through consensus. Data were extracted from primary sources and categorised according to setting and sample, study design, study aim, measures used, key findings, and study limitations. Primary sources were re-reviewed to check concepts and findings at the original source. In this review definitions were informed by the Australian Commission on Safety and Quality in Health Care or how ever defined by the study authors (Table 1).

Quality Assessment

To facilitate the inclusion of broad designs, a quality assessment tool specifically developed for this purpose was selected.[21] The quality of the integrative review articles was assessed against the '*Standard Quality Assessment Criteria for Evaluating Primary Research Papers*'.[21] The checklist for assessing the quality of quantitative studies has previously been tested for inter-rater reliability with a level of agreement of 73% to 100%. The checklist comprised 14 questions scored from 2 (yes), 1 (partial), 0 (no), or not applicable (n/a).[21]

Results

Search of the five databases identified a total of 100 articles. Article titles and abstracts were screened for relevance to the criteria. Reference sections of articles meeting the inclusion criteria were then hand searched and one additional article was located. After removal of duplicates, screening against the inclusion criteria and hand searching, a total of 10/101 (9.9%) articles were included in the integrative review (Figure 1).

All studies reviewed used prospective data collection at single hospital sites (Table 3). Most studies used pre-post interventional designs (n=8; 80%), and all but one study occurred in a paediatric cardiac ICU (n=9; 90%). Sample sizes ranged from 29 to 1,507 clinical handovers,

with the majority of studies (n=8; 80%) using sample sizes of less than 79. Of the 10 reviewed studies eight measured information transfer (n=8, 80%), five measured handover duration (n=5, 50%), three measured technical error (n=3, 30%) and two measured high risk events (n=2, 20%) (Table 4).

Information Transfer

The use of a structured clinical handover tool was found to improve information transfer, handover accuracy and item frequency when compared to pre-intervention verbal handovers. All seven interventional studies measuring information transfer reported reduced information omissions in the post intervention sample (Table 3).[12, 15-18, 22, 23] Itemised information transferred during handover was reported to have increased by approximately 25% in two interventional studies.[15, 16] Results indicated that the amount of critical information transferred improved after the implementation of a structured handover protocol.[16, 18, 22, 23]

Handover Duration

The use of structured handover protocols did not significantly change the duration of the clinical handover, when compared to unstructured verbal handovers.[12, 16, 17, 22, 23] Changes in handover duration reported ranged between a decrease of 2 minutes to an increase of 2.8 minutes across five studies, when compared to non-structured handovers.[12, 16, 17, 22, 23] All five studies measuring handover duration had small sample sizes ranging from 31 to 79.[12, 16, 17, 22, 23]

Technical Error and High Risk Events

The use of structured handover protocols was found to reduce post-handover technical errors, complications and high risk events.[12, 15, 22] Technical errors were significantly reduced in two out of the three studies, with decreases of up to 76%.[12, 22] The third study also reported reduced technical errors however the results did not reach statistical significance.[15] There was a correlation between poor technical handovers and higher information omissions

during clinical handover reported, indicating a possible confounding effect with handover error.[22] Significant decreases in the incidence of high risk events including cardiopulmonary resuscitation, mediastinal re-exploration and metabolic acidosis were reported in one study,[15] yet decreases in high risk events did not reach significance as reported in another.[23]

Structured Handover Development

There were several concepts that were common to the development of structured handover protocols. Information to be included in handover was decided by key stake holders (n=8, 80%), from previous research (n=4, 40%),[11, 16, 24, 25] aviation and Formula 1 pit stop models (n=1, 10%),[22] or by identifying areas prone to high consequence error (n=1, 10%).[12] All protocols used contextually developed checklists to structure and standardise clinical handovers (n=10, 100%), often categorising information into demographics, patient history, anaesthesia information, surgical information and postoperative information (n=6, 60%).[12, 15-17, 23, 24]

Discussion

The evidence reported in our integrative review suggests that information transfer, post-handover technical errors and high risk events may be positively influenced by the use of structured clinical handover tools, however results are not consistent. Factors such as sample size, outcomes measured, context, patient complexity and clinical handover delivery formats have implications on the results reported in the included studies.

Statistical and Clinical Significance

Studies examining the impact of structured handover protocols often did not detect statistically significant differences in their results. Sample sizes were less than 80 in 80% of studies, possibly rendering them underpowered for analysis, thus unable to demonstrate any effect.[26] In contrast, results from other studies with larger sample sizes (n=1078 and n=106)

reported statistically significant reductions of high risk events with structured handovers between OT and ICU.[15, 27] Despite results not reaching statistical significance, many smaller studies examining the impact of structured handover protocols from OT to ICU still showed improvements in outcomes such as technical errors and high risk events.[15]

The clinical significance of the results from OT to ICU structured handover studies may be limited because many studies did not measure the impact of interventions on patient outcomes. Often 'softer' process or health professional outcomes were measured such as how many team members were present or provider satisfaction with handover. Evidence-based practice is evolving, shifting focus to clinically important outcomes which have direct impact on the patient such as morbidity and mortality.[28, 29] Demonstrating a benefit in clinical outcomes (e.g., mortality/morbidity) requires large sample sizes. Importantly, handover protocols are implemented for patient safety, with the intent of achieving effective and efficient communication at the time when the responsibility for clinical care is transferred. Demonstration of an improvement in the handover process, increased efficiency and provider satisfaction may be appropriate in the clinical setting. Implementing handover protocols as a means of quality improvement recognises the need to address issues around interdisciplinary communication.

Context

During this review we identified that clinical handover development was a context specific process within all studies. Recent publications on clinical handover have proposed that handover tools could be standardised and implemented on a wide scale across health care settings.[3, 7] While structured handover tools may improve the consistency of clinical handovers, due to their contextual nature it is doubtful that a standardised handover tool could be successfully implemented across different contexts.[3] Previous studies which have

shown rigid standardisation approaches with checklists can perform poorly when implemented without flexibility in health care settings.[9, 30] Current National guidelines suggest flexible approaches to structured handover tool development, allowing them to be custom made for the context which they are performed.[3] Similarly, information content included in handovers has been shown to benefit from key stakeholder development specific to the context, empowering staff members, improving compliance, and ensuring important information is transferred.[8, 9, 30-32] Interestingly, all studies that successfully implemented structured handover processes were from specific contexts such as single hospital sites which were highly specialised such as paediatric cardiac ICUs. It remains unknown if the structured handover processes that were useful within specialised paediatric cardiac ICU context would achieve similar outcomes within different environments such as general adult ICUs.

Previous studies have implemented protocols from aviation and formula one racing into clinical handover practices.[2, 22] However, the fundamental difference in health care is teams are inconsistent and providers are likely to change frequently when compared to regular teams in other settings.[33, 34] Studies that have successfully implemented these concepts have applied them into highly specialised health care settings where there may also be greater team consistency and continuity of care. Previous results have related frequently changing teams with higher communication error, indicating that results may differ if implemented into a less consistent environment.[9, 13]

There is a relationship between patient complexity with clinical handover information omissions and interruptions. Patients with greater surgical complexity and medical compromise were found to have less information transferred during handover, increasing the

risk of communication error and potentially adverse events. One study demonstrated a positive relationship between patients surgical risk and information omissions.[22] Similarly, a recent study revealed that more interruptions occur during handover of long term complex ICU patients when compared to shorter stay ICU patients.[10] Excessive interruptions during handover of more complex long term ICU patients may reduce information retention, decision making, increasing error and adverse events in these most vulnerable patients.[10, 35] This indicates that handover on sicker patients may actually be less comprehensive and systematically structured, leading to increased error and poorer outcomes.

Delivery Format

We identified a variety of methods used to deliver clinical handovers across studies. Verbal handover accuracy and recall improved when combined with contextually developed checklists of structured handovers in all reviewed studies. These results are consistent previous studies which found the combined use of verbal handovers with checklists had more information transferred, less important data loss, and the greatest information recalled during simulated handovers.[36, 37] Handovers using verbal handover delivery alone had the least information transfer and recall, followed closely with the combination of verbal and note taking handovers.[36, 37] Research suggests that people may retain information in different ways.[38] Some participants may process information more successfully in written, visual or auditory delivery formats.[38] It is possible that handovers which incorporate a mixture of verbal and written delivery may provide the best approach as they will appeal to a broader range of learning styles in participants.

The use of context specific checklists was related to the successful implementation of structured handover protocols. The results of reviewed studies are consistent with other research results that showed checklists increased consistency, information transfer,

accuracy, and confidence in unfamiliar environments, allowed evaluation of health care processes, improved care, reduced mortality and morbidity.[39] Similarly, recent studies suggest that check lists were more successfully implemented if direct care providers had developed and implemented the checklist with the belief that it would solve the clinical problem.[39, 40] However, other findings indicate that there are some negative impacts associated with using checklists. Checklists have been found to be laborious needing considerable resources to develop and can take staff away from immediate patient care.[40, 41] Others have suggested that the use of checklists may impede health care by encouraging a 'doing' tick and flick approach that may reduce practitioners 'thinking' about the items used.[40] The use of electronic checklists has been reported as a popular and successful delivery technique although it was not evaluated in any of the studies included in this review. In our review, the successful implementation of structured handover protocols was more likely with the use of contextually developed checklists.

Future Research

Whilst the body of literature on structured clinical handover between OT and ICU is in its early stages of development, it has laid an important foundation for future research. The evidence described in this review suggests that future research using rigorous study designs broader populations and varied surgery presentations are needed to further evaluate the effect of clinical handover protocols. Future research also needs to explore the impact of using other innovative delivery formats, such as electronic checklists with verbal handovers, which may increase the quality and consistency of information transfer further.

Limitations

We acknowledge that this review and the studies included herein have limitations. First, limitations of the body of literature were that study designs, sample size and measurement

were problematic. Rigorous study designs, broader populations with varied illness and surgery presentations across multiple sites are needed to evaluate the effect of clinical handover protocols.

We have applied a rigorous approach to conducting an integrative review. Nevertheless it is possible we may have overlooked some studies or reviews. Due to resource constraints only one author completed the data extraction and quality assessment of articles and therefore no reliability measures were completed. There is also the possibility of selection bias as our review was limited to studies reported in English. Therefore we may have missed important studies published in other languages.

Conclusion

In conclusion, information transfer, post-handover technical errors and high risk events were positively influenced by the use of structured clinical handover tools, however results are not consistent. Handover duration did not change using structured handover protocols despite more information being delivered Future research exploring innovative combination delivery formats, broader populations, varied surgery presentations and contexts are needed to strengthen evidence supporting the use of structured handover protocols.

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Table 1. Definitions used in the review.		
Term	Definition	Source
Clinical Handover	The transfer of the patient, information, equipment, professional responsibility and accountability from one professional person or group to another.	[3, 8]
Verbal Handover	The delivery of information by a team member without following a pre-existing structure or protocol; includes handovers made before standardisation of structured handover processes.	[12]
Structured Handover	Contextual standardisation of technical and information handover by required team members in a structured format; may include the use of checklists; in a face to face format.	[3]
Information Handover	Has previously been defined as the transfer of important information that is crucial for the continuation of patient care	[19]
Information Handover Error	The omission of important information that is crucial for the continuation of patient care.	[19]
Technical Handover	Has previously been defined as the transfer of equipment or technology, and includes ventilation, monitoring, pumps, equipment, drains, and lines	[19]
Technical Handover Error	Any transfer of equipment or technology that has been performed incorrectly or with unusual difficulty.	[19]
Handover Duration	The time interval from the moment the patient enters the ICU to the moment the OT team leave the bedside.	[19]
Team Members Present	Any health care professional present for the handover and such as surgical, medical, anaesthetic, nursing and other health care staff, having varied levels of experience and qualifications	[17]
A High Risk Event	Any unplanned change in a patient's condition that may have serious impact on their recovery. High risk events include accidental extubation, high carbon dioxide, pneumothorax, cardiac arrest, return to theatre, arrhythmias, loss of arterial or central lines, loss of drains, pH < 7.25 or >7.55, seizure or death	[3, 15]

Table 2. Literature Search Terms	
Data Base	Search Terms
CINHAL [K, ST, T, AT] PROQUEST [K, A, FT] PubMed [K, ST, T]	Handover OR Handoff AND Operating Theatre OR Operating Room or Perioperative AND Intensive Care OR Critical Care
Cochrane Library [M, TA] EMBASE [M, TA]	"Handover" OR "Handoff" AND "Operating Room" AND "Intensive Care" OR "Critical Care"

A-abstract only, AT-all text; FT-full text; K-key word; M-medical subject heading (MeSH); ST-smart text searching, T-title; TA-title and abstract.

Table 3. Postoperative handover articles included in the review							
Lead Author, (Year), Location	Setting, Sample	Design	Aim	Measures	Key Findings	Limitations	Quality Score
Agarwal, (2012), US	• Single hospital site OT-Paediatric cardiac ICU • 700 verbal (July 2007-June 2009) and 378 structured handovers (July 2009-	• Prospective observational clinical study (verbal and structured handover groups)	• Determine if use of a structured handover tool from OT to paediatric cardiac ICU following cardiac surgery is associated with a reduction in the loss of information transfer and improvement in the quality of communication exchange.	• Information transfer of patient information, preoperative, anaesthesia, surgical, postoperative details, and laboratory values • Complications in the first 24 hours • Extubation in the first 24 hours	• Complications in first 24 hours in ICU reduced from 100% to 12% ($p<0.001$). • Successful extubation in first 24 hours increased from 43.2% to 50% ($p=0.04$). • Structured handover improved information transfer, reduced postoperative complications, and improved 24 hour patient outcomes.	• Single site in highly specialised area reduces generalisability • Change in groups may be from improved staff efficiency and maturation of their working process • Hawthorne effect	19/28 (68%)
Catchpole, (2007), UK	• Single hospital site OT to paediatric cardiac ICU • 50 patient handovers (23 pre, 27 post)	• Pilot study, prospective pre post intervention study	• Improve the quality and safety of handover of patients from surgery to ICU using the analogy of the formula 1 pit stop and expertise from aviation.	• Technical errors • Handover information • Overall handover duration • Team performance	• Mean technical errors reduced from 5.42 (95% CI±1.24) to 3.15 (95% CI ±0.71). • Mean handover omissions reduced from 2.09 (95% CI ±1.14) to 1.07 (95% CI ±0.55). • Mean handover duration reduced from 10.8 min (95% CI ±1.6) to 9.4 min (95% CI ±1.29) not significant	• Pilot/ feasibility study but 'tests for effect'- not a feasibility criteria • Sample size appears small for the analysis. • Single site & specialised area reduces generalisability	16/28 (57%)

Table 3. Postoperative handover articles included in the review continued.							
Lead Author, (Year), Location	Setting, Sample	Design	Aim	Measures	Key Findings	Limitations	Quality Score
Chen, (2011), US	• Single hospital site OT-Cardiac surgery paediatric ICU • 29 handovers events from Jan 2008-Aug 2008	• Observational cross-sectional study	• To understand how users adapt handover process over time by evaluating the present process	• Presence of interdisciplinary team members during handover • Item frequency during the handover • Number of distractions occurring during handover	• Individuals present = 97% • Content items averaged 53% • Bed side nurse announced sterile cock-pit and initiated handover communication 21% of the time. • Total of 2.3 environmental distractions per minute of communication. • Question time at the end 67% of the time.	• Small underpowered convenience sample • Sample possibly doesn't meet assumptions for analysis • Hawthorne effect • Single site and specialised area reduces generalisability	16/28 (57%)
Craig, (2011), UK	• Single tertiary hospital site paediatric ICU providing both general and cardiac. • Total 43 handovers (handovers 21 pre, 22 post).	• Prospective pre and post interventional study.	• To investigate the effect of the implementation of a structured handover in the intensive care unit.	• Pre-handover readiness. • Information handover readiness. • Staff attentiveness • Organisation of the handover. • Flow of information.	• Improved handover attentiveness, organisation, information flow, and fewer interruptions. • Improved staff perceptions (readiness for the patient, & ability to focus on the handover). • Improved communication between OT and ICU staff. • No increase in handover duration	• Sample size seems small to test for effect, similar sample size to a pilot study. • Hawthorne effect • Single site in a specialised area reduces generalisability.	14/28 (50%)

Table 3. Postoperative handover articles included in the review continued.							
Lead Author, (Year), Location	Setting, Sample	Design	Aim	Measures	Key Findings	Limitations	**Quality Score**
Joy, (2011), US	• Single hospital site paediatric cardiac ICU. • 79 patient handovers (41 pre, 38 post).	• Prospective pre-post interventional study.	• Determine whether the implementation of a standardised handover protocol could reduce the number of errors occurring during patient transitions from the OT to ICU.	• Technical errors. • Information omissions • Proportion of realised errors out of total errors. • Handover duration.	• Critical verbal handoff omissions were reduced from 6.33 to 2.38 ($p<0.001$). • Mean technical errors per handover was significantly reduced from 6.24 to 1.52 ($p<0.001$). • No increase of handover duration.	• Single site in highly specialised area reduces generalisability. • Small sample size with reduced power & no power calculation. • Hawthorne effect.	17/28 (61%)
Karakaya, (2013), Belgium	• Single hospital site OT-Paediatric cardiothoracic ICU. • 48 paediatric cardiac surgery. Power calculation α 0.05 & βerror of 0.8 =sample 40.	• Prospective pre/post interventional clinical study.	• Test the hypothesis- the implementation of a standardised checklist used during verbal patient handover could improve postoperative data transfer after congenital heart surgery.	• Data transferred on itemised checklist. • Interruptions and irrelevant data. • Confusing pieces of information. • Handover duration. • 1 hour post-handover interview on handover evaluation.	• Overall data transfer increased from 48% to 73% ($p<0.001$). • Increased nursing staff assessment scoring from 81% to 88% ($p=0.004$) • Reduced duration of handover from 6 min to 4 min ($p=0.04$)	• Sample size seems small, the design is to 'test for effect' yet it has used a pilot sample size. • Single site in highly specialised area reduces generalisability. • Hawthorne effect.	18/28 (64%)

Table 3. Postoperative handover articles included in the review continued.							
Lead Author, (Year), Location	Setting, Sample	Design	Aim	Measures	Key Findings	Limitations	Quality Score
Kaufman, (2013), US	• Single hospital OT-Neonatal, paediatric and adults cardiac ICU • Pre 621 (Jan 2009-May 2010), post 886 (June 2010-Dec 2011).	• Prospective pre-post interventional study.	• Assess benefits and improvements in care following the adoption of a handoff protocol. • As a parallel project an initiative to reduce unplanned extubations in the CICU was implemented.	• Number of surgical cases. • Percentage of neonatal surgeries. • Total ventilator days. • Surgical mortality rate. • Monthly unplanned extubation rates.	• Post intervention-significant reduction of unexplained extubation events from 0.62 to 0.24 per 100 ventilator days (p =0.03). • Significant reduction in median ventilator time per patient from 17 hours (IQR: 5.3-57.7) to 12.8 hours (IQR: 4.8-31.8) (p =0.02).	• Single site in highly specialised area reduces generalisability. • Hawthorne effect.	15/28 (54%)
Petrovic, (2012), US (Pilot study).	• Single hospital site OT-Adult cardiac surgery ICU • 60 patients (30 pre, 30 post (Dec 2008-June 2009).	• Pilot prospective pre-post interventional study.	• Evaluate the impact of a standardised handoff process on (1) patient care and (2) provider satisfaction.	• Duration of handover. • Team members present at the bed side. • Amount of information transferred. • Provider satisfaction with handover process. • Technical problems during handover.	• Team members at bed side increased from 0% to 68% (p<0.001). • Information sharing increased from 78% to 84% (p<0.01). • Improved satisfaction of ICU nurses (the most) and ICU practitioners. • Reduced technical error (forgot chart, missing patient ID).	• Single hospital site in highly specialised area reduces generalisability • Pilot/ feasibility study but tests for effect-not a feasibility criteria • Hawthorne effect	20/28 (71%)

Table 3. Postoperative handover articles included in the review continued.							
Lead Author, (Year), Location	Setting, Sample	Design	Aim	Measures	Key Findings	Limitations	Quality Score
Vergales, (2014), US	• Single hospital site OT-Paediatric cardiothoracic ICU. • 79 consecutive paediatric congenital heart surgery patients.	• Pilot study prospective, pre-test post-test.	• Develop & implement a primary face to face handover process from OT to ICU for paediatric congenital heart surgery patients.	• Frequency and accuracy of handover steps. • Provider's satisfaction with the handover process. • Providers perception that handover improved patient care. • Providers comfortable asking questions.	• 94% felt patient care was improved post intervention. • High compliance to new process across disciplines. (e.g. 100% compliance of ICU going to OT to collect the patient). • Perceived improved efficiency by staff. Complex patients can be handed over in same duration.	• Pilot/ feasibility study underpowered to test for effect • Single site in a highly specialised area reduces generalisability. • Hawthorne effect	17/28 (60%)
Zavalkoff, (2011), Canada	• Single hospital site tertiary care, paediatric intensive care unit • 31 handovers (15 pre, 16 post)	• Prospective pre-post interventional study (not blinded)	• Improve the quality of handover for complex patients after paediatric cardiac surgery through the use of a simple handover tool. • Determine the tools impact on handover duration & HRE in the initial postoperative period.	• Handover completeness (preoperative, intraoperative medical, intraoperative surgical, and current status) • Number of post-handover HRE • Handover duration	• Handover completeness increased significantly. • Significant improvement of medical & surgical intraoperative information sub scores. • No change handover duration. • Non-significant decrease HRE	• Small sample size & reduced power, no power calculation • Single site in highly specialised area reduces generalisability • Hawthorne effect	21/28 (75%)

A-August; CICU-cardiac intensive care unit; D-December; HRE-high risk events; ICI-intensive care unit; J-January; OT-operating theatre; Paeds-paediatric.

Table 4. Variables measured across studies

Lead Author, Year	Agarwal (2012)	Catchpole (2007)	Chen (2011)	Craig (2011)	Joy (2011)	Karakaya (2013)	Kaufman (2013)	Petrovic (2012)	Vergales (2014)	Zavalkoff (2011)
Handover completeness/ item frequency	✓	✓	✓		✓	✓		✓	✓	✓
Handover duration		✓			✓	✓		✓		✓
Number of interruptions or distractions	✓		✓		✓	✓				
Technical problems/ errors		✓			✓			✓		
Post-handover high risk events	✓									✓
Team members present			✓					✓		
Provider satisfaction								✓	✓	

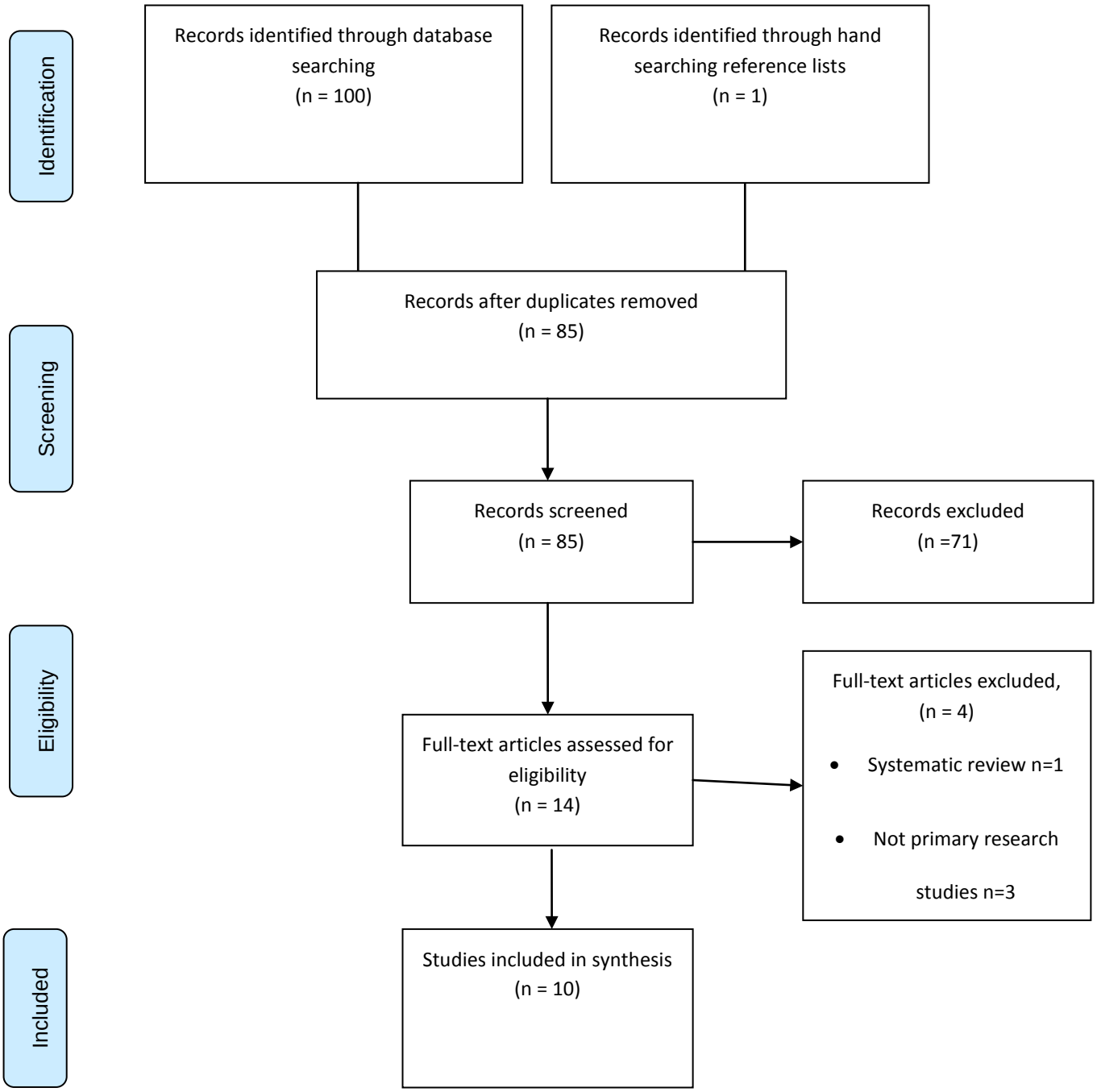

Figure 1. PRISMA Flow Diagram.