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SYSTEMATIC REVIEW

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Improving clinical handover between intensive care unit and general ward professionals at intensive care unit discharge

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Take-home message: Liaison nurses and handover forms have a positive effect on the quality of clinical handover between ICU and ward healthcare professionals at patient discharge. Researchers and clinicians considering to conduct an evaluation of an improved handover process should use robust designs to strengthen the evidence on this topic.

Electronic supplementary material
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Abstract *Purpose:* To systematically review and evaluate the effectiveness of interventions in order to improve the safety and efficiency of patient handover between intensive care unit (ICU) and general ward healthcare professionals at ICU discharge. *Methods:* PubMed, CINAHL, PsycINFO, EMBASE, Web of Science, and the Cochrane Library were searched for intervention studies with the aim to improve clinical handover between ICU and general ward healthcare professionals that had been published up to and including June 2013. The methods for article inclusion and data analysis were pre-specified and aligned with recommendations outlined in the PRISMA guideline. Two reviewers independently extracted data (study purpose, setting, population, method of sampling, sample size, intervention characteristics, outcome, and implementation activities) and assessed the quality of the included studies. *Results:* From the 6,591 citations initially extracted from the six databases, we included 11 studies in this review. Of these, six (55 %) reported statistically significant effects. Effective interventions included liaison nurses to improve communication and coordination of care and forms to facilitate timely, complete and accurate handover information. Effective interventions resulted in improved continuity of care (e.g., reduced discharge delay) and in reduced adverse events. Inconsistent effects were observed for use of care, namely, reduction of length of stay versus increase of readmissions to higher care. No statistically significant effects were found in the reduction of mortality. The overall methodological quality of the 11 studies reviewed was relatively low, with an average score of 4.5 out of 11 points. *Conclusions:* This review shows that liaison nurses and handover forms are promising interventions to improve the quality of patient handover between the ICU and general ward. More robust evidence is needed on the effectiveness of interventions aiming to improve ICU handover and supportive implementation strategies.

Keywords Clinical handover · Transitional care · Intensive care · Patient safety · Quality of care · Systematic review

Introduction

Efficient use of intensive care units (ICUs) has become a top priority of hospitals worldwide as a result of the increased pressure on hospital budgets [1, 2]. An optimal patient flow is critical to ensure a high quality of care, given that ICUs are often subject to forward pressure from various internal sources, such as emergency departments

or operating theaters [3, 4]. Early discharge from the ICU to the general ward is one strategy that can be used to relieve this pressure, but the successful implementation of this strategy requires close cooperation between a variety of healthcare professionals across different clinical settings [4–7].

A patient's discharge from one specialty to another is a high-risk event in the care process and one where poor clinical handover between healthcare professionals leads to preventable errors and adverse events [8, 9]. Patients discharged from the ICU are particularly vulnerable to poor handovers due to the complex physiology of their health condition and the significant decrease in monitoring which occurs upon the transfer of these patients to a general ward [10]. These factors are particularly relevant for patients subjected to early discharge policies [7, 11].

Despite the availability of professional guidelines for ICU discharge [12–14], the quality of clinical handover practices varies between ICUs [15]. Several studies have identified deficits in the communication, coordination of care and information exchange between ICU and ward healthcare professionals [16–20]. These factors increase the risk of suboptimal ICU discharge and may result in severe adverse events, ICU readmissions, and increased mortality [6, 21, 22]. In a study conducted in the USA in 2003, Nishi and colleagues reported that 37.3 % of the ICU readmissions within 48 h were potentially preventable [16, 23]. Based on available data, it is estimated that a reduction of the readmission rate by 1 %, incorporating an overall mean ICU stay of 6.6 days, could save the U.S. government $1.4 billion per year [1, 23–25].

There are several strategies to improve clinical handovers between ambulance crew and emergency department [26, 27], between shifts [28, 29], and between the hospital and community setting [20, 30], as well as postoperative handovers [31]. However, a comprehensive evaluation of the effectiveness of interventions with the aim to improve inter-specialty handovers from the ICU to a general hospital ward is lacking. Niven and colleagues recently reviewed the effect of transition programs for patients discharged from an ICU which focused on post-ICU discharge interventions and excluded studies with a neonatal or pediatric population [9]. Better insight into effective interventions could guide healthcare professionals and policy-makers in the development and implementation of polices aimed at reducing patient mortality rates and costly readmissions [32–34].

The purpose of the study reported here was to systematically review interventions with the aim to improve the quality of patient handover between ICU and general ward healthcare professionals at ICU discharge and to evaluate the overall effects of these interventions.

Methods

The criteria for article inclusion and data analysis were pre-specified [35], and the protocol followed is given in Electronic Supplementary Material (ESM) 1. We followed the recommendations outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement [36].

Data sources and searches

Using specific search terms (for details, see ESM Table 1), we searched for full-text intervention studies in the following databases: PubMed (including MEDLINE), CINAHL, PsycINFO, EMBASE, Web of Science, and the Cochrane Library. There were no restrictions based on publication date or language, but the presence of an English abstract was considered to be important. The authors' personal files, references from included studies, and bibliographies of previously published related reviews were also searched to identify additional relevant studies (snowballing) [9, 10, 37].

Study selection

Two researchers (NS and GH) independently screened the titles and abstracts of all studies identified by the search strategy for their eligibility. A study had to meet all of the following inclusion criteria to be included in the review:

1. Inclusion of patients or healthcare professionals involved in the handover from the ICU to a step-down unit or ward.
2. Inclusion of an intervention explicitly describing one or more components that aimed to improve the handover of care between healthcare professionals from the ICU and those of a step-down unit or general ward.
3. Study design was experimental or quasi-experimental, such as a (cluster) randomized controlled trial, cohort study, or a non-controlled before–after study.
4. There was at least one process or outcome measure addressing the quality or safety of the discharge.

Studies not available in full-text format were excluded. When the title and abstract did not clearly indicate whether the inclusion criteria were met, a full-text copy was retained and reviewed.

The full text of the potentially relevant studies were retrieved and reviewed by two researchers (NS, GH). The inclusion criteria were applied a second time, and a final set of studies was identified for data extraction. Disagreement on inclusion was resolved by discussion; when

no consensus could be reached, a third researcher (MZ) made the final decision.

Data extraction

Data from each study meeting the inclusion criteria were independently extracted by two researchers (NS, GH) using a pre-designed form modified from a checklist developed by Grimshaw and colleagues [38]. The extracted data described the objectives, underlying theory-based concepts, setting, study population, intervention characteristics, implementation activities, process evaluation, and outcome measures. Outcomes were divided into four pre-specified groups by the two researchers separately as: (1) use of care (e.g., ICU readmissions), (2) continuity of care (e.g., information accuracy), (3) adverse events, and (4) mortality. Any disagreement between the two researchers was resolved by discussion.

Quality assessment

The methodological quality was assessed by two researchers (NS, GH) independently. To ensure standardized scoring, we used a standardized form adapted from the Cochrane Effective Practice and Organization of Care (EPOC) Group's Risk of Bias Criteria [39]. Methodological quality was assessed on 11 criteria, including (1) whether studies used random and concealed allocation, (2) whether the studies documented similar baseline characteristics and outcomes between the intervention and control group, (3) whether the studies described a strategy for handling missing data, (4) the likelihood of contamination between study groups, and (5) whether the criteria were free from selective outcome reporting. The decision on whether the criteria were fulfilled was resolved by discussion, or a final decision was made by the third researcher (MZ). Studies were given 1 point for each fulfilled criterion, with a maximum of 11 points. If information was inadequate or missing, the criterion was labeled 'unknown' and no point was given.

Data synthesis and analysis

The study outcomes, such as sample size, intervention characteristics, outcome measures, statistical significance, and direction of the effects observed, were assessed by two researchers (NS, GH) and organized in a tabular form.

The interventions were classified by two researchers (NS and GH) based on the definition of continuity of care by Hellesø and colleagues [17]. This classification consists of three elements: (1) the quality of information that is exchanged between healthcare professionals in terms of completeness, accuracy, and clarity; (2) the coordination of care between healthcare professionals in terms of the quality of assessment, planning, and organization of follow-up services and needs; (3) the communication between healthcare professionals in terms of personal and direct contact, accessibility, and timeliness [17, 20].

Results

Search results

Our initial search identified 6,591 records (Fig. 1), of which 5,268 remained following the exclusion of duplicates. Subsequent screening by title and abstract excluded 5,231 records. The remaining 37 full-text studies were retrieved and reviewed, of which 29 were excluded. Three articles were identified through snowballing. The final set of articles included in the review of consisted of 11 published studies that had undergone full-text extraction [40–50].

Characteristics of included studies

A summary of the characteristics of the 11 studies included in this review is presented in Table 1. The study population included neonatal, pediatric, and adult patients and their healthcare professionals. Patients were treated in neonatal, pediatric, general, medical, and/or surgical ICUs situated in various types of hospitals (tertiary, regional, metropolitan, teaching, university/academic, community-teaching, tertiary-referral). Ten studies were single-center studies, and one was conducted across multiple ($n = 3$) hospitals [47]. The sample size per study ranged from 46 to 4,951 participants for the intervention group and from 53 to 1,872 participants for the control group.

The studies reported various outcomes (Table 2), although most studies reported an outcome related to use of care [40, 42–45, 47, 49, 50], mortality [40, 44, 45, 47, 49, 50], and continuity of care [41, 48–50]. One study reported adverse events as an outcome measure [46]. Statistical significant improvements were observed in two categories: continuity of care (reduced discharge delay, increased perceived accuracy of information, reduced time to finalize discharge letter) [41, 48, 49], and preventable adverse events [46]. Inconsistent effects were observed for various aspects of the use of care, namely, reduction of step-down unit length of stay (LOS), increase of transfers to higher care and increase of surgical procedures required [44, 45].

Methodological quality

The overall methodological quality of the studies was relatively low, with an average score of 4.5 points out of

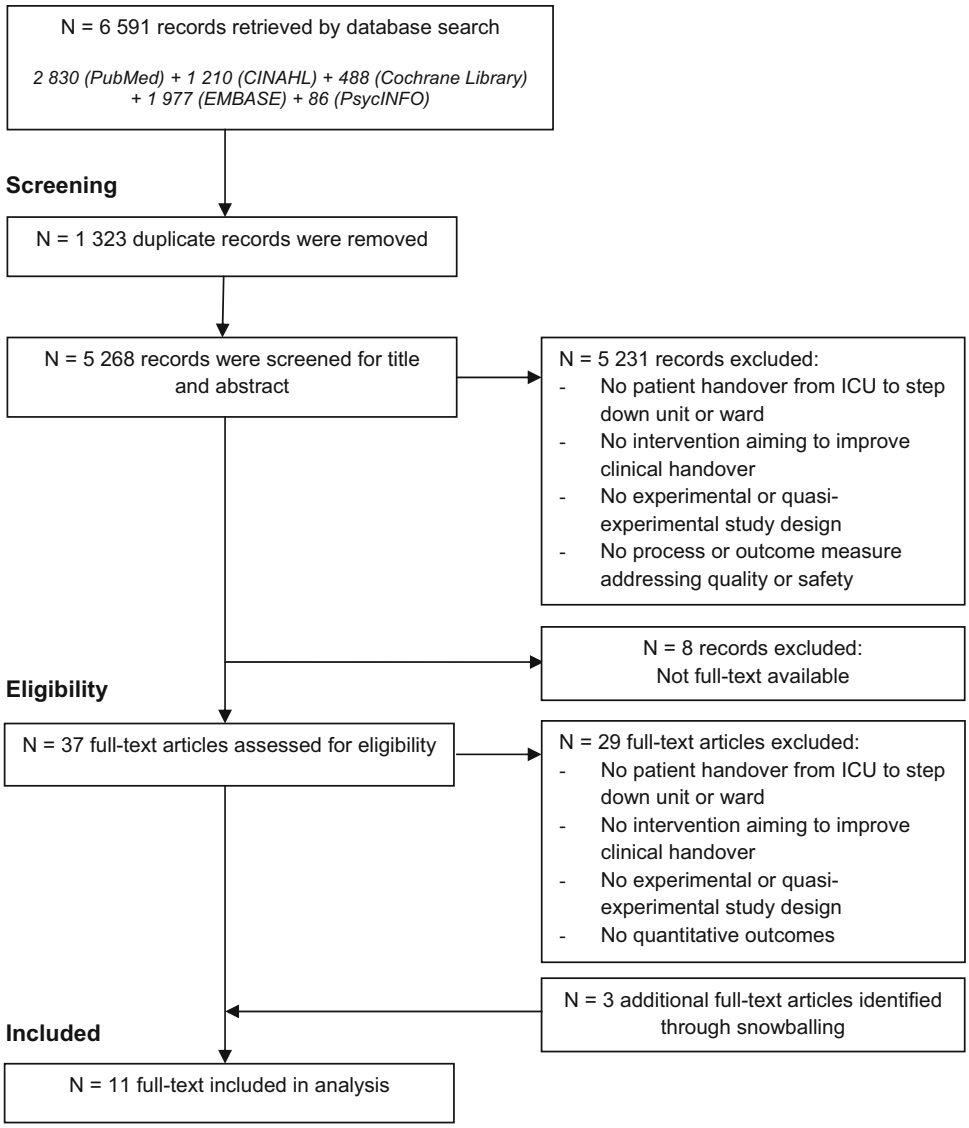

Fig. 1 Summary of evidence search and selection

11 possible (ESM Table 2). In none of the studies was the allocation sequence randomly assigned and the allocation concealed. Six studies did not report similar baseline characteristics [40, 42, 43, 48–50], eight studies did not perform a sample size calculation [40–42, 44, 45, 48–50], and nine studies had no plan for handling missing data [40, 42–46, 48–50].

Classification and effects of interventions

Table 3 provides an overview of the five types of interventions we identified in the 11 studies, namely, handover forms ($n = 3$ studies), a redesigned discharge process ($n = 1$), medication reconciliation ($n = 1$), liaison nurses ($n = 4$), and outreach services ($n = 2$).

In three of the 11 studies, handover forms as a tool for improving the information transferred between ICU and ward were evaluated [46, 48, 49]. All three studies found a statistically significant improvement in the reduction of adverse events [46] or in continuity of care [48, 49]. Williams and colleagues investigated the efficacy of a multidisciplinary form completed predominantly by nurses in combination with a discharge checklist completed by the medical staff. They found that the proportion of preventable adverse events was significantly reduced from 65 to 42 % ($p < 0.001$) [46]. Palma and colleagues implemented the use of a printed sign-out document and sign-out data entry form and reported that the staff perceived these new discharge tools to be significantly more accurate in terms of improving the transfer of information than those used previously ($p = 0.0025$) [48]. Medlock

Table 1 Characteristics of the 11 studies included in the review

Study/year (references)	Setting	(Participants, *n*)		Intervention vs. control	Results			
		Intervention	Control		Outcome	Intervention	Control	*p* value
Garcea et al. [39]	Patients discharged from a ITU or HDU in a general hospital (UK)	833	547	Outreach service vs. usual care	ICU readmission rate (%)	9.5	9.0	NR
					Readmissions critical care mortality, % (CI)	22.8 (−2.4 to –30.3)	36.7	NR
					Readmissions in-hospital mortality, % (CI)	32.6 (−1.4 to 33.5)	49.6	NR
					Readmissions 30-day mortality, % (CI)	32.6 (2.8–37.6)	53.1	NR
					Total critical care mortality (%)	9.3	14.3	NR
					Total in-hospital mortality (%)	4.8	9.8	NR
Chaboyer et al. [40]	Patients discharged from a 13 bed ICU in tertiary referral hospital (Australia)	85	101	Liaison nurse vs. usual care	Discharge delay of >2 h (%)	22.4	49.0	<0.001
					Discharge delay of >4 h (%)	14.1	29.0	<0.001
					Discharge delay of >2 h, OR (95 % CI)	1.0	3.3 (1.7–6.2)	<0.001
					Discharge delay of >4 h, OR (95 % CI)	1.0	2.5 (1.2–5.2)	<0.05
Caffin et al. [41]	Patients discharged from a pediatric ICU in an tertiary hospital (Australia)	1,388	1,487	Liaison nurse vs. usual care	Unplanned readmission rate, % (95 % CI)	4.8 (3.8–6.1)	5.4 (4.3–6.7)	0.5
Zeigler et al. [42]	Patients admitted to the surgical or medical ICU and receiving SUP in a 766-bed community-teaching hospital (USA)	61	53	Medication reconciliation vs. usual care	Incidence of prolonged SUP upon ICU discharge (%)	79	85	0.39
					Incidence of prolonged SUP upon surgical ICU discharge (%)	87	88	1.00
					Incidence of prolonged SUP upon medical ICU discharge	71	81	0.351

Table 1 continued

Study/year (references)	Setting	(Participants, *n*)		Intervention vs. control	Results			
		Intervention	Control		Outcome	Intervention	Control	*p* value
Eliott et al. [43]	Patients admitted to a 12-bed general medical-surgical ICU in a 348-bed metropolitan university teaching hospital (Australia)	943	835	Liaison nurse vs. usual care	Admission: ICU, median LOS, days (range)	2.1 (0–68)	2.2 (0–86)	0.07
					Admission: ICU, mean step-down LOS, days (SD)[a]	37 (15.5)	71 (14.2)	<0.001
					Admission: median hospital LOS, day (range)	11.5 (0.4–68)	12.0 (0.2–230)	0.16
					Admission: ICU mortality (%)	14	15	0.69
					Admission: hospital mortality (%)	22	23	0.78
					Readmissions: median ICU LOS, days (range)	3.0 (0.3–41)	4.0 (0.3–86)	0.89
					Readmissions: mean step-down LOS, days (SD)	NR	NR	NR
					Readmissions: median hospital LOS, days (range)	35 (6–174)	39 (8–139)	0.59
					Readmissions: ICU mortality (%)	16	18	0.79
					Readmissions: hospital mortality (%)	26	35	0.30
Endacott et al. [44]	Patients discharged from ICU in a 220-bed regional hospital (Australia)	187	201	Liaison nurse vs. usual care	Rate of transfer to higher care (%)	23.0	13.9	0.0114
					Crude odds of transfer to higher care (95 % CI)	1.88 (1.14–3.09)	1.00	0.014
					Adjusted odds of transfer to higher care (95 % CI)	1.82 (1.07–3.09)	1.00	0.028
					Rate of surgical procedure required, %	26.2	15.9	0.022
					Crude odds of surgical procedure required (95 % CI)	1.85 (1.09–3.12)	1.00	0.022
					Adjusted odds of surgical procedure required (95 % CI)	2.11 (1.24–3.58)	1.00	0.006
					Rate of unexpected death, %	3.2	3.5	0.881
					Crude odds of unexpected death (95% CI)	0.92 (0.30–2.79)	1.00	0.881

Table 1 continued

Study/year (references)	Setting	(Participants, *n*)		Intervention vs. control	Results			
		Intervention	Control		Outcome	Intervention	Control	*p* value
Williams et al. [45]	Discharges from 22-bed general tertiary-referral unit in a metropolitan teaching hospital (Australia)	295	NR	Discharge plan vs. usual care	AE fluid management (%)	7	47	NR
					AE respiratory problems (%)	16	24	NR
					Probably preventable AEs (%)	16	53	<0.001
					Definitely preventable AEs (%)	26	12	<0.001
Williams et al. [46]	Patients discharged from ICUs in 3 tertiary-referral hospitals (Australia)	1,435	1,566	Outreach service vs. usual care	Median ICU LOS (days)	1.8	1.9	0.57
					Median LOS admission ICU until hospital discharge (days)	10.1	9.8	0.86
					Hospital mortality (%)	5.4	5.5	0.86
					Readmissions (%)	5.4	5.6	0.83
Palma et al. [47]	All healthcare professionals working in a 74-bed neonatal ICU in a 304-bed academic hospital (US)	46	54	Neonatal-specific electronic handoff tool vs. Microsoft Access-based handoff tool	Perceived accuracy of sign-out document: very accurate (%)	37	13	0.0025[c]
					Perceived accuracy of sign-out document: somewhat accurate (%)	54	64	
					Perceived accuracy of sign-out document: somewhat inaccurate (%)	9	22	
					Perceived accuracy of sign-out document: very inaccurate (%)	0	0	
Medlock et al. [48]	Patients treated in a 30-bed mixed medical-surgical closed format ICU in an academic hospital (the Netherlands)	4,951	1,872	Policy change and electronic decision support and reminders for writing ICU discharge letters vs. usual care	ICU LOS (days)	1.9	1.9	0.36
					Mortality (NR)	17.81	17.47	0.74
					Initial discharge letter formally completed at time of discharge (%)%	96.6	11.4	NR
					Initial discharge letter for deceased patients completed at time of discharge (%)	99.7	71.6	NR
					Time to finalize initial discharge letter, median no. days (IQR)	4 (2–9)	23 (9–41)	<0.0001

Table 1 continued

Study/year (references)	Setting	(Participants, *n*)		Intervention vs. control	Results			
		Intervention	Control		Outcome	Intervention	Control	*p* value
Chaboyer et al. [49]	Patients discharged from a 12-bed general ICU in a 580-bed metropolitan hospital (Australia)	786	1,001	Redesigned discharge process vs. four-step discharge process	Average delay time, h	1.0	4.6	NR
					Patient mortality in wards after ICU discharge (%)	3.21[b]	3.21[b]	NR
					Readmission rate of $\leq$ 72 h (%)	2.01[b]	2.01[b]	NR

p values less than 0.05 are significant

ICU intensive care unit, *ITU* intensive therapy unit, *HDU* high dependency unit, *LOS* length of stay, *SUP* stress ulcer prophylaxis, *NR* not reported, *AE* adverse events; *CI* confidence interval, *OR* odds ratio, *IQR* interquartile range, *SD* standard deviation

[a] ICU step-down days are defined as time spent in the ICU with a nurse-to-patient ratio of 1:2

[b] Numbers based on figure in Chaboyer et al. [49]

[c] overall *p* value

and colleagues investigated the implementation of an electronic discharge letter with a template to support content decisions. The median time to finalize the discharge letter was significantly reduced from 23 [interquartile range (IQR) 9–41) to 4 days (IQR 2–9; $p < 0.0001$) [49].

Four studies examined the effects having an ICU liaison nurse in place to coordinate care and communication between ICU and general ward healthcare professionals [41, 42, 44, 45]. Three of these studies found that a liaison nurse had a statistically significant effect on use of care [44, 45] or continuity of care [41]. Chaboyer and colleagues evaluated the effects of liaison nurses who were involved in assessing patients for ICU discharge, coordinating transfer to other wards, and communicating with ward staff [41]. In their study, the liaison nurse assessed ward staff skill-mix and resources, prepared both the ICU and ward for transfer, assessed bed status, and provided clinical support and resources to ward nurses. The authors found that the proportion of patients with a discharge delay of >2 h decreased significantly from 49 to 22 % [odds ratio (OR) 3.3, 95 % confidence interval (CI) 1.7–6.2, $p < 0.001$] and that the proportion with a discharge delay of >4 h decreased significantly from 29 to 14 % (OR 2.5, 95 % CI 1.2–5.2, $p < 0.05$) [41]. Elliott and colleagues implemented the use of liaison nurses who supported the management of discharged patients with complex care needs. The service involved communicating with ward staff and providing support and bedside education. These authors reported a significant reduction in mean step-down unit LOS from 71 to 37 days [44]. Endacott and colleagues investigated the role of a liaison nurse who visited patients at least daily for the first 3 days after ICU discharge [45]. In their study, the liaison nurse clinically assessed each patient, reviewed the charts, and provided support and informal education to ward staff. The proportion of patients discharged from the ICU who needed transfer to higher care was significantly increased from 14 to 23 % (adjusted OR 1.82, 95 % CI 1.07–3.09, $p = 0.014$), and the proportion of patients requiring a surgical procedure significantly increased from 16 to 26 % (adjusted OR 1.85, 95 % CI 1.09–3.12, $p = 0.022$) [45].

Two studies evaluated outreach services, in which activities were used which focused mainly on the follow-up of discharged ICU patients and supporting ward staff. Both studies found that the intervention did not have a statistically significant effect [40, 47].

Chaboyer and colleagues implemented a redesigned ICU discharge process, including a handover form to facilitate face-to-face or phone communication between ICU and ward healthcare professionals, a notification from the ward to their ICU counterparts of a specific time they were able to receive the patient, and a daily update to the ward staff summarizing all likely patient discharges

Table 2 Outcome measures and statistical significance of effects reported in the 11 studies included in the review

Study/year (references)	Intervention	Outcome types			
		Use of care[a]	Continuity of care[b]	Mortality[c]	Adverse events[d]
Garcea et al. [39]	Outreach service	✔		✔	
Chaboyer et al. [40]	Liaison nurse		✔[e]		
Caffin et al. [41]	Liaison nurse	✔			
Zeigler et al. [42]	Medication reconciliation	✔			
Eliott et al. [43]	Liaison nurse	✔[e]		✔	
Endacott et al. [44]	Liaison nurse	✔[e]		✔	
Williams et al. [45]	Discharge plan				✔[e]
Williams et al. [46]	Outreach service	✔		✔	
Palma et al. [47]	Neonatal-specific electronic handoff tool		✔[e]		
Medlock et al. [48]	ICU discharge letter policy change and electronic decision support	✔	✔[e]	✔	
Chaboyer et al. [49]	Redesigned discharge process	✔	✔	✔	
Total		9	4	7	1

[a] Use of care as outcome includes (unplanned) readmissions; readmissions within 72 h; ICU LOS; step-down LOS; general ward LOS; second ICU LOS; hospital LOS; LOS from admission to ICU to hospital discharge; transfer to higher level care; surgical procedure required; incidence of prolonged stress ulcer prophylaxis

[b] Continuity of care as outcome includes discharge delay (>2 h; >4 h); average delay time; initial discharge letter formally completed at time of discharge; initial discharge letter for deceased patient completed at time of discharge; time to finalize initial discharge letter; perceived accuracy of sign-out document (very accurate; somewhat accurate; somewhat inaccurate; very inaccurate). Definitions adopted here are from Hellesø and colleagues [17] and are all outcomes that relate to the quality of information, communication, and coordination of care) [20]

[c] Mortality as outcome includes patient mortality in wards after ICU discharge; ICU mortality; critical care mortality; (in-) hospital mortality; 30-day mortality; unexpected death

[d] Incidence of adverse events (AE) as outcome includes AE fluid management; AE respiratory problems; probably preventable AEs; definitely preventable AEs—i.e., unintended occurrences in handover of care potentially causing harm to the patient [20]

[e] Outcome with statistically significant effect

('ICU discharge alert sheet') to better plan patient transfers and coordinate appropriate follow-up [50]. However, these authors reported that their changes to the ICU discharge process did have any statistically significant effects [50].

Zeigler and colleagues examined the use of medication reconciliation [43]. Upon ICU discharge, medication profiles were printed and reviewed by the primary physician and either discontinued or resumed. No statistically significant effects were found on the study outcome, namely, prolonged use of stress ulcer prophylaxis (SUP) [43].

Implementation activities

All of the 11 studies included in the review incorporated specific activities to facilitate the process of implementation of the intervention (Table 3). In terms of the implementation of handover forms, activities assessed to be effective were informal instructional sessions, the automatic filling of the handover form with data from the electronic medical record, development of software by the ICU staff, electronic reminders, a top–down directive, and involvement of healthcare professionals in the decision-making process [46, 48, 49]. Regarding the implementation of liaison nurses, activities assessed to be effective were a clear task description (based on the literature, formats of other hospitals, and experiences of patients, their families, and ICU and ward nurses), correct qualifications (experienced ICU or critical care nurse), provision of training to standardize the tasks carried out by liaison nurses, and encouraging ward staff to consult a liaison nurse if in doubt [41, 44, 45].

Discussion

In this review we have reported the effects of interventions focusing on improving clinical handovers between ICU and ward healthcare professionals at the time of patient discharge from the ICU. After an extensive search process of six databases and subsequent selection of relevant reports, we ultimately only included 11 studies in our review, which indicates that very few studies on this specific topic have been performed. A statistically significant effect on quality of handover was observed in six of these studies (55 %). Effective interventions included: (1) implementation of liaison nurses to improve the communication and coordination of care between ICU and ward healthcare professionals and (2) handover forms to facilitate the timely handover of complete and accurate clinical information from ICU to ward healthcare professionals. Interventions were effective in improving the continuity of care and reducing preventable adverse

Table 3 Overview of interventions reported in the 11 studies included in the review

Study/year (reference)	Intervention	Relevant actions	Key players	Classification			Implementation activities	Significant effects
				Information	Coordination	Communication		
Garcea et al. [39]	Outreach service	The outreach team consists of two senior grade nurses and a consultant nurse specialist, and a consultant intensivist acts as lead clinician; follow-up of discharges on at least a daily basis; acts as liaison between ward-based staff and critical care intensivists; ward staff are encouraged to refer any patients of concern directly to the outreach team for review	Outreach team, ward staff		✔	✔	Experienced nurses	No
Chaboyer et al. [40]	Liaison nurse	Assessment of patients for transfer to the ward, with major focus being the coordination of ICU patient transfer and liaison with ward staff; communicating with ward staff; assessing ward staff skill-mix and resources; assessing bed status; providing clinical support, resources and education to ward nurses	Liaison nurse, ICU staff, ward staff		✔	✔	Role development using literature review and focus groups interviews	Yes
Caffin et al. [41]	Liaison nurse	Follow-up of patients discharged from PICU within the last 48 h; advanced nurse consultancy and education; improve communication between PICU staff and staff on the wards	Liaison nurse, ICU staff, ward staff		✔	✔	Role development using existing guidelines; experienced and post-graduate nurse	No
Zeigler et al. [42]	Medication reconciliation	Medication profiles are printed and reviewed by the primary physician; existing medications are ordered to be either discontinued or resumed	Primary physician	✔			Educational sessions; web-based training module; presentations; one-on-one communication	No
Eliott et al. [43]	Liaison nurse	Communicating with ward staff and providing support and bedside education as required	Liaison nurse, ward staff			✔	Experienced nurses	Yes

Table 3 continued

Study/year (reference)	Intervention	Relevant actions	Key players	Classification			Implementation activities	Significant effects
				Information	Coordination	Communication		
Endacott et al. [44]	Liaison nurse	Post discharge visit to patient involving clinical assessment and chart review; support and informal education to staff	Liaison nurse, ward staff			✔	Experienced nurse with specialist critical care qualification; additional training for liaison nurse to standardize intervention	Yes
Williams et al. [45]	Discharge plan	The discharge plan is a multidisciplinary form used as a tool to facilitate the handover and provide information on ongoing care needs; nursing information includes a summary of the patient's stay in the ICU, social history, status, and care that the patient is receiving on discharge; checklist that includes whether the handover to the specialty team is documented, fluid or completed, and discharge summery written in the medical record	ICU staff, ward staff	✔			Intervention development by users; education for ICU and ward staff	Yes
Williams et al. [46]	Outreach service	Assessment before discharge from ICU; follow-up visits by critical care nursing specialists, who review and assess patients before and after ICU discharge; education and clinical support of general care staff; protocol for processes undertaken at bedside and actions taken in response	Outreach team, ward staff		✔	✔	Job description and selection criteria used in recruitment; 2-week orientation period for outreach nurses; newsletter, personal communication and education sessions to inform hospital staff about study	No

Table 3 continued

Study/year (reference)	Intervention	Relevant actions	Key players	Classification			Implementation activities	Significant effects
				Information	Coordination	Communication		
Palma et al. [47]	Neonatal-specific electronic handoff tool	Printed neonatal sign-out document; neonatal sign-out data entry form; sign-out document is organized by bed location and is populated automatically; patient description, a systems-based summary of active medical issues and ongoing care, a to-do list are entered as free text on sign-out entry form	ICU staff, ward staff	✔			Instructions of handoff tool were emailed to users; training for pediatric residents; informal instructional sessions were provided to staff	Yes
Medlock et al. [48]	ICU discharge letter Policy change and electronic decision support	A letter as a transfer note; a copy of the completed initial letter goes with the patient at the time of ICU discharge; assignment of responsibility is an automatic process; provision of decision support, through automatic copying of important content from the patient record to the letter	ICU medical staff	✔	✔	✔	New software was developed by users; consensus about the software was reached among clinicians by round table discussion; the software was tested and integrated in existing data management system	Yes
Chaboyer et al. [49]	Redesigned discharge process	Handover sheet was used to guide phone handover and face-to-face handover, and as documentation for ward staff to record information and provide a basis for future reference by ward staff; notification by ward staff of a specific time they could receive the patient; a daily 'ICU discharge alert sheet' summarizing all likely patient discharges	ICU staff, ward staff	✔	✔	✔	Appointing a well-known and respected nursing leader as a change agent; handover sheet developed by ward charge nurses; education by change agent for staff; poster, bedside summary as memory aids and to facilitate face-to-face handover; ongoing support for ICU and ward staff; nursing leaders from ICU and ward endorsed new process	No

PICU Pediatric intensive care unit, *LN* liaison nurse, *NNP* neonatal nurse practitioner

events. The effects found for the use of care were inconsistent; a decrease in step-down unit LOS was observed [44], as well as an increase in transfers to higher care and in the requirement for surgical procedures [45],

In accordance with our review, two recent studies report that liaison nurses can be a useful tool for bridging coordination gaps between healthcare settings [20, 30]. In the studies included in this review, factors facilitating the implementation of a liaison nurse were a clear task description, 'casting' the right person based on experience, and encouragement of ward staff to consult a liaison nurse [41, 44, 45]. The literature also highlights a number of factors considered to be important for proper functioning of a liaison nurse: (1) that the liaison nurse be able to personalize his/her role as an ICU liaison nurse; (2) that the liaison nurse be able to gain the respect of ICU and general ward colleagues; (3) that ward staff view the implementation of a liaison nurse as a collaborative and supportive effort—and not as an intrusion in their ward [5].

Published studies also show that poor information transfer is a common patient safety issue in all types of handover settings [51–53]. Various reviews have reported the effectiveness of standardizing tools (e.g., standardized handoff tools, computerized handoff tools) to improve information transfer [30, 54, 55] and, possibly, quality of care as well. In accordance with these studies, we found that the use of an ICU discharge form is an effective intervention by which to standardize information transfer and communication between ICU and ward healthcare professionals. It is interesting that the aims of the studies on information transfer focused on improving written communication [e.g., improving the situation background assessment recommendation (SBAR) checklist or collaboration between ICU and ward healthcare staff with team training], even though culture, team climate and verbal communication have been identified as important factors for inadequate patient handover [56].

Assessment of the 11 studies included in our systematic review reveals that a timely transfer of the patient together with accurate and complete information on the patient being transferred from the ICU to the ward are the specific aspects of handover which most readily show a change following interventions. Continuity of care in terms of reduced discharge delay and improved accuracy of discharge information was improved in three out of four studies investigating this outcome measure. However, whether this resulted in any beneficial clinical outcome beyond a better recording of data is unclear. Mortality rates were not improved in any of the seven studies evaluating mortality as an outcome measure. Evidence showing a reduction in ICU readmission or ICU LOS was limited; only one study found evidence for a reduction in step-down unit LOS [44].

The limitations of our review relate to the nature of the interventions and the study designs used. Similar to other reviews on patient handover, most interventions consisted of a complex set of activities. Most studies contain specific activities that have not been studied outside the set of activities used in the intervention. These aspects hinder an appropriate and direct evaluation of the interventions [20, 57]. Second, the poor methodological quality of most of the included studies makes it difficult to draw firm conclusions on the effectiveness of individual interventions. Single-institution evaluations with an observational design, i.e., non-controlled before–after design, dominated the studies we identified. In general, observational studies overestimate the effect. Third, the studies were characterized by significant heterogeneity for both interventions and outcome, making it impossible to perform a meta-analysis. Heterogeneity has been acknowledged to be a common limitation in the clinical handover literature [9, 20, 54, 57]. Fourth, the classification of interventions into information, coordination, and communication categories was strictly based on the description of the intervention provided in the studies. Although interventions were independently classified by two researchers, the classification may be subject to bias due to minimal or unclear intervention descriptions. Fifth, we excluded non-published studies and non-full-text studies, which may have increased the risk of publication bias, i.e., the risk that this review overestimates or underestimates the true intervention effects. Moreover, we could not assess the risk of publication bias using a funnel plot due to the heterogeneity in outcome measures and the small number of studies found [39].

Despite handover being an important topic for the World Health Organization [58], and national government agencies, such as the Joint Commission, this systematic review highlights the absence of evidence on how to improve patient handovers between the ICU and general wards. Several reasons for the lack of effects have been described: use of an inappropriate intervention in relation to the underlying healthcare problem [43], measurement of inappropriate outcomes [50], and suboptimal research population, such as low mortality rate at baseline [47]. The lack of effects may also be influenced by limited actual exposure of healthcare professionals to the intervention and implementation activities [59]. These reasons reflect the difficulty of demonstrating the effectiveness of complex quality improvement interventions, as has been mentioned in several publications [60–62].

Our hope is that this systematic review will act as a stimulus to gather more evidence on the interventions described in the 11 studies included in the review, as well as interventions evaluated in other settings, such as a shared electronic information exchange system to improve handover between hospital and primary healthcare providers [63]. The implementation of interventions for which insufficient evidence is available carries the burden of potentially wasting valuable resources, which may increase the reluctance of clinicians to implement

other quality improvement initiatives [64]. We recommend that researchers and clinicians considering to conduct an evaluation of an improved handover process use robust designs to strengthen the quality of evidence on this topic. Randomized controlled trials are often impossible to conduct due to difficulties in blinding and concealment of allocation. Cluster randomized controlled trials pose difficulties in terms of sample size and obtaining a uniform control group. Other rigorous study designs, such as an interrupted time-series or a controlled before-and-after study, are good alternatives and are more feasible in practice [65]; however, they are associated with a greater risk of bias. Objective outcome or performance measures, such as readmission rate or mortality rate, are the ideal parameters for measuring effectiveness, but due to low incidence, it is hard to reach statistical significance. Process measures can be used to gain more insight in the processes leading to improvement in the outcome measures [61].

In conclusion, liaison nurses and handover forms are promising interventions to improve the quality of clinical handover between ICU and ward healthcare professionals at patient discharge. Due to the limited number of studies identified in this review and the weak methodological quality of the included studies, more robust evidence is needed.

Conflicts of interest None.

Ethical standard Ethical approval was not required under Dutch National Law.

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