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To cite this article: Gudrun Reay, Jill M. Norris, Lorelli Nowell, K. Alix Hayden, Katherine Yokom, Eddy S. Lang, Gerald C. Lazarenko & Joanna Abraham (2019): Transition in care from EMS providers to emergency department nurses: a systematic review, Prehospital Emergency Care, DOI: 10.1080/10903127.2019.1632999

To link to this article: https://doi.org/10.1080/10903127.2019.1632999

Accepted author version posted online: 18 Jun 2019.

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Transition in care from EMS providers to emergency department nurses: a systematic review

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Funding details: This work was supported by Alberta Health Services under the Emergency Strategic Clinical Network Systematic Review Grant competition.
Disclosure of interest: The authors report no conflict of interest.

Author’s contributions: GR, JMN conceived the study. GR, JMN, KAH, JA, KY, GCL, ESL designed the review and acquired funding. KAH, JMN created the search strategy. GR, JMN, JA, LN screened studies for inclusion. GR, LN extracted study data and assessed methodological quality. GR, LN, JMN synthesized the data. GR, JMN drafted the manuscript. All authors read, edited, and approved the final manuscript.
ABSTRACT

Background: Transitions in care between emergency medical services (EMS) providers and emergency department (ED) nurses are critical to patient care and safety. However, interactions between EMS providers and ED nurses can be problematic with communication gaps and have not been extensively studied. The aim of this review was to examine (1) factors that influence transitions in care from EMS providers to ED nurses, and (2) the effectiveness of interventional strategies to improve these transitions.

Methods: We conducted a mixed-methods systematic review that included searches of electronic databases (DARE, MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, CINAHL, Joanna Briggs Institute EBP), grey literature databases, organization websites, querying experts in emergency medicine, and the reference lists cited in included studies. All English-language studies of any design were eligible for inclusion. Two reviewers independently screened titles/abstracts and full-texts for inclusion and methodological quality, as well as extracted data from included studies. We used narrative and thematic synthesis to integrate and explore relationships within the data.

Results: In total, 8348 studies were screened and 130 selected for full text review. The final synthesis included 20 studies. Across 15 studies of moderate-to-high methodological quality, six factors influenced transitions: different professional lenses, operational constraints, professional relationships, information shared between the professions, components of the transition process, and patient presentation and involvement. Three interventions were identified in 6 methodologically weak studies: (1) transition guideline (DeMIST, IMIST-AMBO) with training, (2) mobile web-based technology (EMS smartphone and geographic information system location data), and (3) a new clinical role (ED ambulance off-load nurse dedicated to triaging and
assessing EMS patients). There were mixed findings for the effectiveness of transition guidelines and the new clinical role. Mobile technology was seen positively by both EMS providers and ED nurses as helpful for better describing the pre-hospital context and for planning flow in the ED.

**Conclusion:** While multimedia applications may potentially improve the handoff process, future intervention studies need to be rigorously designed. We recommend interdisciplinary training of EMS and ED staff in the use of flexible structured protocols, especially given review findings that interdisciplinary communication and relationships can be challenging.

**Keywords:** Systematic review, handover, transition in care, emergency department triage, emergency medical services
INTRODUCTION

Transitions in care, also known as handovers, within the emergency department (ED) are complex processes that function to communicate information and transfer the responsibility for patient care between healthcare professionals (1). When these transitions are compromised, vital information can be lost or altered, thereby exposing the transition and the patient to a high-risk event and safety issue (2). Suboptimal transitions can result in delayed or missed investigations, overlooking early deterioration, or transfer of cognitive bias (3-5). In the ED context, transitions primarily occur within the same profession at shift change, or from ED staff to the admitting physician and nurses on the in-patient unit. In these transitions, the practice environment is similar as the staff have access to the same information in the patient chart and transitions are a horizontal event within the same professional group.

Transitions in care between EMS providers and ED providers are vulnerable junctures for loss of information, which can lead to incorrect decisions about patient acuity, inappropriate prioritization for physician assessment, delayed time to treatment, or improper allocation of ED resources to the treatment area where the patient is triaged to in the ED (6-8). Patient safety, ED workflow, and the efficient, appropriate, and timely use of ED resources are thus dependent on accurate transfer of pertinent patient information during EMS-ED transitions. Multiple reviews have focused on transitions between members of the same profession (3, 9-12) and transitions from the pre-hospital setting via emergency medical service (EMS) providers to ED providers (13-15), including EMS-to-trauma team transitions (where whole team is present and care is initiated immediately) as well as EMS-to-physician transitions (potentially influenced by a power differential). One of the most common transitions in the ED is between EMS and ED
nurses at triage or at the bedside. However, there is a paucity of evidence about what factors influence transitions in care between EMS and ED nurses nor interventions proposed to improve these transitions in care.

METHODS

We conducted a systematic review of (1) factors that impact transitions in care from EMS providers to ED nurses, and to (2) identify effective interventional strategies. The protocol is registered in PROSPERO (CRD42017068844) and was published a priori (16); thus, the methods are briefly reported here with further detail for any modifications to the protocol. This report adheres to Preferred Reporting Items for Systematic Reviews and Meta-Analysis (17).

Eligibility Criteria

We included English-language primary studies that focused on transitions in care from EMS providers to ED triage nurses or ED bedside nurses, including (1) experiences and perceptions of transitions in care; (2) factors that influence transitions in care; (3) quality of information exchanged between EMS providers and ED nurses; or (4) any outcome (patient, provider, team, system) as a result of interventions to improve transitions in care. Studies that reported solely on transitions in care with ED trauma team, physicians, allied health professionals, referring healthcare professionals, unit clerks, police, or peace officers were excluded. Studies with EMS providers (paramedics, emergency medical technicians, registered nurses, licensed practical nurses, nurse practitioners), or ED nurses (registered nurses, licensed practical nurses, nurse practitioners) involved in transitions in care were included. Given that our review included qualitative studies whereby participant perspectives generated from multiple healthcare
providers—for example, “ED staff” were reported in aggregated themes related to EMS-ED transitions, and data could not be teased apart for the types of providers—we updated our inclusion criteria from the protocol to include studies with other healthcare providers if EMS providers or ED nurses were explicitly described in participant sample. Studies were not excluded on the basis of publication type or methodological quality.

**Data Sources and Search Strategy**

We searched the following OVID databases from database inception to July 2017 for English-language publications: Medline MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily, Cochrane Central Register of Controlled Trials, DARE (Database of Abstracts of Reviews of Effects), Cochrane Central Register of Controlled Trials, Embase, and Joanna Briggs Institute EBP. We also searched CINAHL Plus with FullText on the Ebsco platform. Grey literature searches included electronic databases (Proquest Dissertation and Theses Global database, Web of Science Conference Proceedings Citation Index, OAIster, OpenGrey, Canadian Electronic Library), relevant organizational websites (National Emergency Nurses Association, Paramedic Association of Canada, National Association of EMS Physicians, Emergency Nurses Association), journal hand searches (Canadian Journal of Emergency Medicine), and the reference lists and cited by included studies. Our final set of included studies was shared with EMS and nursing experts in emergency medicine to ensure inclusion of all known studies. All records were exported to EndNote v8 reference manager.

**Study Selection**

Prior to screening, we conducted a calibration exercise with reviewers that included independent
screening of 100 records using a standardized tool in Excel. Once inter-rater agreement reached 90%, all titles/abstracts were independently screened by pairs of two reviewers. Disagreements were resolved by a third reviewer. Full-texts of potential studies were then acquired and screening was conducted in the same manner as titles/abstracts screening.

Quality Assessment

Studies were independently assessed for quality by two reviewers using the Effective Public Health Practice Project Quality Assessment Tool (18) for quantitative studies and the Joanna Briggs Institute Critical Appraisal Checklist for Qualitative Research (19). We used both appraisal tools to assess mixed-method studies. Disagreements were resolved through discussion and passed to a third reviewer, if consensus could not be reached.

Data Extraction and Synthesis

The heterogeneity of studies prevented the statistical pooling of findings for meta-analysis and subgroup analysis; therefore, we conducted a narrative synthesis (including tabulation of study characteristics using Excel) and thematic synthesis (20, 21). Two reviewers independently extracted data using NVivo v11 (22) based on an a priori framework. Qualitative study findings were further inductively coded in three stages of thematic synthesis (23) to translate and integrate findings. We coded both first-order (verbatim participant accounts) and second-order interpretations (original research author observations). Initial codes were then compared between studies and grouped to generate initial descriptive themes. Analytical themes were created by considering how the descriptive themes related between the studies. Discrepancies were resolved through discussion with a third reviewer.
Sensitivity considerations

We conducted sensitivity analyses (24, 25) post hoc whereby the final synthesis with all studies was compared to syntheses without two types of studies: (1) low quality studies, and (2) mixed-provider studies, which typically integrated physician data with EMS practitioner or ED nurse data. The exclusion of these studies would have resulted in fewer robust themes and a less comprehensive picture for the final synthesis; therefore, we retained them in the final synthesis.

Quality of evidence

To assess confidence in the qualitative evidence in the syntheses, we used the CERQual framework (26). We did not use the GRADE framework (27) as originally proposed in the protocol, given the heterogeneous nature of the intervention studies and reported outcomes.

RESULTS

Study Flow and Characteristics

From 8,358 records, we screened 6,154 titles/abstracts for eligibility and retained 130 full-text articles for subsequent screening. Overall, 20 articles from 19 studies were included in the final synthesis (see Figure 1). Articles were published between 2003 and 2017, with 80% \((n = 16)\) published after 2011. Ninety percent of the articles \((n = 18)\) were from Europe, Australia, or North America. None of the studies used a controlled design (see Table 1).

Assessment of Methodological Quality

The qualitative studies were generally moderate-to-high quality (see Supplementary Table 1). All studies had congruent objectives and data collection methods, and nearly all exhibited congruent
analysis, interpretation of results, conclusions, participation representation, and consideration of ethics. Most did not describe a philosophical grounding, locating theory or culture, or researcher reflexivity. One study was of low quality (28). Quantitative studies were generally of low quality (see Supplementary Table 2); only 3 studies had one strong rating (selection bias, data collection, withdrawals) and nearly all had at least three weak ratings (representing half of items). Studies were particularly weak for potential biases in design and the inclusion of confounders in analysis.

**Factors that Influence Transitions in Care**

A total of 15 studies reported factors that influenced transitions, including 12 qualitative studies and 3 survey-based studies (see Table 2). From the thematic synthesis, we identified six factors that caused variability in the conduct and processes of EMS-ED care transitions: professional lenses (n = 10), operational constraints (n = 10), professional relationships (n = 6), information shared between the professions (n = 10), components of the transition process (n = 10), and patient presentation and involvement (n = 13). Each of these qualitative findings were rated as having moderate confidence in the evidence (see Supplementary Tables 3 and 4 for the CERQual Summary of Qualitative Findings and Evidence Profile).

1. **Different professional lenses**

EMS providers and ED nurses have different professional lenses that converge during transitions, which can result in tension and trade-offs. They had different opinions about how and what information should be transferred; this was further complicated by the different educational backgrounds of the two groups (8, 29) and lack of formal training in standardized transitions (8, 29).
Paramedics generally felt they were perceived as holding lower professional status than ED nurses and expressed that ED nurses did not always understand their professional scope of practice (31, 32). However, both professional groups identified that being open to each other’s knowledge and cooperation across organizations could mitigate the potential for missed information (8, 33).

EMS providers and ED nurses practice in different contexts yielding different professional experiences and even a different professional language. EMS providers expressed difficulty in translating features from the pre-hospital context to ED nurses and nurses related how differences in professional language contributed to difficulties in creating a shared cognitive picture (30). However, being an experienced practitioner facilitated transitions as this enabled EMS providers to relay pertinent information and the experienced receiving to nurse to quickly form a comprehensive picture of the patient’s medical and social needs (34, 35).

EMS providers used their professional judgement to engage in trade-offs, which were in fact adaptive processes to balance the need for ambulances in the community (global) versus maintaining safety for the patient (individual) currently under their care (33, 36). One example is handing over to another ambulance crew so they could return to the community or, if they were concerned that critical information might be lost, purposefully seeking out the bedside nurse even after having given report to triage (33, 36). Handing over care to another crew was perceived as less than ideal and contributing to information loss through a process similar to the broken telephone game (30), meaning there were unintentional changes to, or omissions in, information each time handover occurred. Tension existed between the expectations of ED
nurses for help with patient transfer and receiving a complete report, versus the need for EMS providers to quickly return to the community (29, 34).

2. Operational constraints

Transitions are conducted in a bounded system with operational constraints, including the hospital’s physical environment and capacity, provider workload, and EMS time targets. The physical layout of the ED resulted in transitions taking place in high-traffic noisy areas, which made it difficult for nursing staff to concentrate on the information that was communicated (29). Moreover, using hallways as holding areas could compromise patient safety (31) and privacy, which was important for the patient to feel secure (29, 34, 36, 37). The limited capacity of the ED could delay transition, resulting in multiple transitions or the potential for inexperienced staff receiving report (31, 33, 35). EMS providers identified how the high workload for nurses in the ED, who had to attend multiple competing demands, compromised transfer of information (30, 31, 33, 34, 37, 38). Furthermore, busy EDs could result in fatigue and burnout when EMS providers were required to wait for extended periods before transferring care and subsequently experienced missed breaks and shifts extending beyond 12 hours (8). ED staff expressed concern that organizational pressure on EMS to meet time targets resulted in substandard transitions with the potential to compromise patient safety (33). One study reported a perceived advantage of having one nurse receive handover for all ambulance patients, as this meant that knowledge of incoming patients resided with one person who could anticipate ED needs (33).

3. Relationships

EMS provider-ED nurse relationships and communication directly influenced the quality of both
the current transition and those in the future. The information shared and the perceived reliability of this information was dependent on the level of trust and the relationship between individual EMS providers and ED nurses. These relationships were developed over time and were dependent on past experiences (8). Good relationships resulted in EMS providers feeling that nurses trusted their assessments and believed them (8); however, this was not always the case. In some cases, the difference in reported acuity on scene and the patient's improved condition upon ED arrival as a result of EMS stabilization led to nursing disbelief. This questioning of assessment skills led to poor transitions in care and longer wait times at triage. (31, 35, 37).

Communication between EMS and ED nurses was problematic with ED nurses not paying attention, being indifferent, or multi-tasking (30-32, 36, 37). ED nurses identified the need to listen attentively, however the need to multi-task prevented them from doing so (30, 34).

Collaboration between organizations and fostering personal familiarity with colleagues was viewed as one avenue for improving transition practices (33, 36). Verbal handover in particular was considered helpful in building relationships (36). Professional conversations and positive transitions occurred when EMS providers and ED nurses initiated handover by greeting each other (34). Conversely, workplace culture with unprofessional or disrespectful behavior such as not greeting EMS providers, inattentive listening manifested as engaging in patient management during report, and speaking in a local vernacular not understood by everybody was a barrier to effective handover (35, 39).

4. Information

Both the form and content of information flow between EMS and the ED influenced transitions.
Information from pre-arrival notifications via radio or phone were used for planning use of staff, anticipating patient needs, and viewed as helpful in maintaining departmental flow (33-35). Once EMS arrived at the ED, however, there was tension between EMS providers wanting to supply rich information and nurses requiring information that helped them determine acuity and resources needed to treat the patient (36). EMS providers expressed difficulties relaying information that adequately portrayed a comprehensive picture of the patient’s pre-hospital status, particularly for patients who initially were critical, but had improved with treatment (30, 35). They felt it was necessary to share all information they perceived as clinically relevant. ED staff, on the other hand, expressed difficulties translating the information into a shared cognitive picture (30, 33). The most common information relayed by EMS providers was place of retrieval and condition on arrival, chief complaint, age, signs and symptoms including vital signs, treatments initiated, medical history, and medications (8, 40). If the patient’s status had changed during transfer, they provided more detailed information (31). They viewed themselves as patient advocates and sometimes added information to negotiate care for their patients (31, 34).

Key pieces of information required by ED nurses included patient name, age, chief complaint, time of onset of symptoms, problems requiring immediate intervention, treatments initiated, significant medical history, medications, and allergies (28, 37). Nurses were more likely to consider social history useful for low acuity patients (40). Common areas where further clarification was required were social history, exact mechanism of injury or circumstances of event, past medical history, presenting problem, vital signs, patient pickup environment, and allergies (37, 40). Including patients and families in the handover ensured that they were available to clarify questions (34, 35).
In several studies, nurses and EMS providers agreed that handovers lacked structure and that a structure would be helpful (8, 28, 30-32); however, in studies that included observations of handovers, a structured process was apparent (8, 34, 39). Some providers were concerned that structured handovers may be too rigid and that pertinent information might be missed or overlooked (31, 36, 41); on the other hand, others felt that the lack of structured handovers contributed to loss or unintentional distortion of information (30, 32, 36).

5. Components of transition process

Verbal report was preferred and the most common form of handover as the exchange provided opportunity to clarify information not available in the written record (8, 36, 40). The actual handover (report) itself from EMS providers to ED nurses was brief and often occurred under stressful conditions with interruptions (31, 34, 41); however, frequently there was a prolonged transition period with multiple handovers starting when the patient first arrived in ED and ending when the EMS providers were able to completely transfer responsibility of care to ED personnel (8, 30, 32, 38, 40). Final transfer of care was considered to have occurred when the patient was moved to the ED stretcher (34). During the transition period, it was unclear who was ultimately responsible for patient care (8, 36).

Multiple handovers from EMS to a sequence of different staff members were common (8, 37, 38, 40), most commonly because the staff member who was supposed to eventually manage the patient was not present at the initial handover (37). Sequential handovers were perceived as contributing to information loss or reduced fidelity of information (30, 32). ED staff felt that at
times repetition was necessary to clarify details (37). EMS providers expressed that direct handover to physicians, especially of critical details, resulted in a more comprehensive transfer of information (31).

6. Patients

Transitions were influenced by patients’ presentation and needs, with varying levels of patient involvement and resulting trust. Patient presentation determined the type of information shared (8). Patients with clear needs were considered easy to handover, whereas patients with ambiguous or complex needs presented more difficulty (34, 35). A hierarchy existed with trauma patients at the top and so-called ‘frequent-fliers’ at the bottom (31). Handovers were more robust for trauma patients and patients with clear needs, for example, breathing difficulties, whereas patients with ill-defined needs or perceived as using the ambulance unnecessarily for transport were sometimes met with disinterested and resultant poor transfer of information (31, 34, 35).

Verbal report with involvement from the patient and significant others enhanced handovers and provided the opportunity for patients to augment information (34). However, this was not always the case and, in some instance, patients were deliberately excluded, or their needs ignored (35, 39). Patient trust was enhanced if patients felt that there was continuity of care at handover and reassurance from the ED staff; breakdown in communication resulted in the patient’s trust being lost. (34, 35, 38)

Transitions in Care Interventions

Of the six intervention studies, four used a pre-post design and two used post-only design; all
were methodologically weak (see Table 3 for included intervention studies and outcomes); therefore, there is low confidence in the evidence. Studies included one of three intervention types. First, two studies introduced a transition in care guideline (DeMIST(41), IMIST-AMBO(42)) with training; however, only EMS providers were provided training (with 53% completion) in one study (41). Overall, there were mixed findings for guideline use and adherence, communication between EMS providers and ED nurses, and the effectiveness of the transition. Second, three studies examined mobile web-based technology including an EMS smartphone for sending multimedia files (43, 44) and geographic information system (GIS) location data (45) to the ED. Multimedia and location data helped the ED plan ahead and created a better picture of the pre-hospital context. In one study (45), location data helped to significantly reduce wait times that were greater than 10 minutes, but did not change unprepared ED activations or median wait time. The third intervention was the introduction of a new clinical role, an ED ambulance off load nurse who was dedicated to triaging and assessing EMS patients. Patients were either offloaded if there was ED treatment space available, or the nurse provided prescribed treatments for Category 3-5 patients (Australian Triage Scale) while the patients remained on the ambulance stretcher (46). Using administrative data (21,454 patients), this role significantly improved the time for patients to be seen by 2 minutes and reduced the number of patients who left the ED without being seen. There were no changes to length of stay and the hospital discontinued the role after the retrospective pre-post study had completed.

**DISCUSSION**

In this systematic review of transitions in care from EMS providers to ED nurses, multiple factors influenced transitions, including different professional lenses, system issues, professional
relationships, information shared between the professions, components of the transition process, and patient presentation. Transition in care was found to occur over a spectrum of time from pre-alert to final handover when the patient had been transferred to an ED stretcher and ED staff had assumed full responsibility for care. We did not find robust evidence for interventions that improved transitions in care: none of the intervention studies included a control group and all studies were of weak quality with inconsistent outcomes. Transfer of digital images, audio recordings that allow for asynchronous communication, and GIS early notification showed some promise; however, these studies were methodologically weak.

The handoff process at triage is a transition in care between two inherently different contexts. Each provider, while participating in the transitions in care of an individual patient, also represents his or her system and is influenced by, and acutely aware of, system expectations. EMS providers aim to safely transfer patients to ED staff while still being available to respond to 911 calls in the community. The responsibilities of the ED triage nurse are to not only ensure the safe transfer of the EMS patient, but also for the care of existing ED patients and ED operations, such as throughput efficiency. Balancing systems expectations while exchanging essential patient information during the transfer of care is challenging.

For intervention strategies, EMS providers and nurses alike felt that multimedia images were useful. Digital images helped to convey injury or illness severity, particularly if the patient’s condition had improved during transfer (43, 44). Digital images could both augment verbal report and improve communication between providers. Asynchronous audio recordings allowed EMS to transmit information immediately without depending on the ED to answer (45) and ED
nurses to replay the recording and listen when convenient (43-45). However, the opportunity to clarify information between sender and receiver can be lost.

Standardized handover protocols from EMS to ED triage nurses were used in two intervention studies with conflicting findings (41, 42). Ebben and colleagues (41) found that questions and interruptions increased, whereas Iedema et al. (42) reported a decrease in questions and repetitions. It is difficult to draw any conclusions from this since the investigators used different handover protocols (DeMIST versus iMIST-AMBO), different educational strategies (e-learning program vs. rapid at-work training) and learners (EMS providers only vs. both EMS providers and nurses), and, mostly different outcome measures. Handoff standardization has been proposed as a safety mechanism to ensure essential information is exchanged effectively and efficiently. For instance, the Joint Commission has suggested handoff standardization as a national patient safety goal (NPSG 2E) to mitigate handoff failures and adverse sentinel events (47). A standardized EMS-ED handoff, such as IMIST-AMBO, can help create a common language between the interdisciplinary care providers (15) and may improve ambulance-to-ED handover communication (42). Similarly, structured communication tools can help with training care providers to follow a standardized format, thereby reducing the risk of communication failures (48). Standardization has been investigated and implemented within shift-based handoffs, with limited work on inter-professional, interdisciplinary handoffs such as EMS-ED handoffs.

While the purpose of standardized handovers is to ensure that essential information is included in each transition, rigid standardized protocols do not always reflect nuances in individual patient situations. Sujan et al. (36) suggested that variation in handover behaviors may be an essential
aspect of ensuring patient safety, as providers engage in dynamic trade-offs between work as prescribed and work as performed based on their own perception of risk to the patient. Using EMS-ED handoff structured tools may minimize opportunities to share out-of-hospital critical patient information (e.g., interpersonal threats at home) and undermine face-to-face interactions beneficial to patient care (31). Wood and colleagues (1) suggested that the intricacies of the handover process cannot necessarily be captured by protocols and to instead take a broader perspective of the handover process without reducing it to an issue of standardization. Our review emphasizes the need for more intervention studies examining the impact of flexible standardized handover tools for fostering communication between EMS providers and ED nurses, while maintaining accuracy, efficiency, and completeness of the shared information shared during this process.

Handovers are often thought to occur between a sender and a receiver, which excludes the patient. Considering other non-ED contexts, in a survey of Australian nurses from various settings, family presence during bedside handovers was perceived as positive and increased handover effectiveness (49). We found patients with ambiguous or ‘minor’ needs were at risk for poor handover (31, 34, 35). Similarly, findings from an integrative review of the caring sciences in the ambulance service indicated that patients with clear medical needs are perceived as easier to handover (50). Any development of handover interventions or staff training should ideally include considerations of patients with unclear needs and make patient and family involvement in the handoff process explicit.

It is our assessment that the one-size-fits all approach to handovers may not be optimal,
especially given concerns that pertinent information might be missed (31, 36, 41). In a previous literature review of handovers from EMS to ED staff (13), a key barrier to quality handovers was interprofessional communication. The authors argued that interdisciplinary training in communication and adoption of structured flexible frameworks are necessary components of safe and effective transitions. We suggest that to allow for variations in handover practices, protocols should include required information while allowing for incorporation of supplementary information. Furthermore, given that the objective is safe transition of the patient, how to include patients and significant others in the actual handover should be considered. As handover frequently occurs over a spectrum of time from pre-alert to final transfer of responsibility, attention should be directed towards the type of information that is vital at each stage. One solution to promote uptake of structured flexible protocols could be involving interdisciplinary end-users in the design of locally adapted protocols. Given that EMS providers and ED nurses have different professional lenses and at times characterized working relationships as suboptimal, interdisciplinary training in the use of protocols could help foster collegial working relationships and consistent use of protocols.

**Limitations**

While we conducted this review using rigorous and established methods, there are several limitations. First, relevant studies may have been missed despite our comprehensive search strategy. When we contacted experts, several non-English studies were identified that we could not include. Second, the methodological quality, especially for the intervention studies, were weak to moderate, so we were not able to answer the second review question and make inferences about potential intervention strategies to improve transitions. Third, we deviated from
our original protocol and chose to include 9 studies that included a variety of ED staff, including physicians. As identified in the participant characteristics of each articles, these studies explicitly included EMS providers and ED nurses, but also included other healthcare professionals. We were not able to parse out specific data by provider type as themes and data were aggregated, which could be problematic because physicians (for example) may have distinct views and experiences with transitions in care. However, we retained these articles because they contributed to a more nuanced and layered view of transitions in care than a synthesis without these studies.

CONCLUSION

In summary, we found that there is a paucity of robust intervention studies examining transition in care from EMS to ED nurses, that the use of multimedia applications show promise in transferring comprehensive information, and that inter-disciplinary training promotes the use of handover protocols. We recommend that flexible standardized protocols are developed with active involvement of end-users, that such protocols are designed to include the family or significant others and evaluated in rigorously designed intervention studies. Furthermore, given our findings that interdisciplinary communication and relationships can be problematic, we recommend that any implementation of handover protocols should be preceded by inter-disciplinary training and that robust multimedia applications for use during handover are developed and evaluated.
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Records identified through database searching (n = 8348)

Additional records identified through other sources (n = 10)

Duplicates (n = 2204)

Records excluded (n = 6024)

Full-text articles assessed for eligibility (n = 130)

Full-text articles excluded (n = 110)
  - Not EMS-ED nurse TIC (n = 52)
  - Not a study (n = 38)
  - No extractable information for EMS or ED nurse (n = 13)
  - Duplicate (n = 3)
  - Not English (n = 2)
  - Could not retrieve (n = 2)

Studies included in the synthesis (n = 20)

Figure 1. Flow diagram
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<tr>
<td>Qualitative</td>
<td>11</td>
<td>55</td>
</tr>
<tr>
<td>Mixed methods</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Observational</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Sample</td>
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<tr>
<td>ED nurse only</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>EMS practitioner only</td>
<td>2</td>
<td>10</td>
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<tr>
<td>Mixed providers</td>
<td>11</td>
<td>55</td>
</tr>
<tr>
<td>Mixed providers with physicians</td>
<td>9</td>
<td>45</td>
</tr>
</tbody>
</table>
Table 2. Studies that reported factors that influenced transfers in care

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Design</th>
<th>Data Collection (Participants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bost 2012</td>
<td>AUS</td>
<td>Focused ethnography</td>
<td>Observations, interviews (79 paramedics, 65 nurses, 19 physicians)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>38 TIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20 Interviews</td>
</tr>
<tr>
<td>Bruce 2005</td>
<td>SWE</td>
<td>Phenomenology</td>
<td>Interviews (6 ED nurses)</td>
</tr>
<tr>
<td>Cuk 2017</td>
<td>USA</td>
<td>Qualitative study</td>
<td>Interviews (6 EMTs)</td>
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<td></td>
<td></td>
<td></td>
<td>EMTs’ paper-based reports</td>
</tr>
<tr>
<td>deLange 2017</td>
<td>ZAF</td>
<td>Hermeneutic study</td>
<td>20 Observations (paramedics, ED nurses)</td>
</tr>
<tr>
<td>Dojmi 2014</td>
<td>ITA</td>
<td>Survey</td>
<td>Survey (23 ED nurses)</td>
</tr>
<tr>
<td>Ebben 2015</td>
<td>NLD</td>
<td>Qualitative study</td>
<td>Focus group (2 ED nurses, 2 ambulance nurses, 1 EMD-nurse, 2 ED physicians)</td>
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<tr>
<td>Jenkin 2007</td>
<td>GBR</td>
<td>Survey</td>
<td>Questionnaire (42 paramedics, 21 ED nurses, 17 physicians)</td>
</tr>
<tr>
<td>Kalyani 2017</td>
<td>IRN</td>
<td>Descriptive exploratory</td>
<td>Interviews (14 paramedics, 11 ED nurses)</td>
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<tr>
<td>Meisel 2015</td>
<td>USA</td>
<td>Qualitative study</td>
<td>7 Focus groups (35 EMT, 2 nurses, 11 physicians)</td>
</tr>
<tr>
<td>Owen 2009</td>
<td>AUS</td>
<td>Qualitative study</td>
<td>Interviews (19 paramedics, 15 nurses, 16 physicians)</td>
</tr>
<tr>
<td>Siemsen 2013</td>
<td>DNK</td>
<td>Qualitative study</td>
<td>Interviews (5 paramedics, 23 nurses, 13 physicians, 6 others)</td>
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<tr>
<td>Sujan 2015a</td>
<td>GBR</td>
<td>Qualitative study</td>
<td>Observations (270 TIC)</td>
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<tr>
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<td></td>
<td>39 Interviews (7 ambulance service, 15 ED staff including nurses and physicians)</td>
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<td>3 Focus groups (22 ED staff)</td>
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<tr>
<td>Sujan 2015b</td>
<td>GBR</td>
<td>Qualitative study</td>
<td>Observations (270 TIC)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>39 Interviews (7 ambulance service, 15 ED staff including nurses and physicians)</td>
</tr>
<tr>
<td>Suserud 2003</td>
<td>SWE</td>
<td>Phenomenology</td>
<td>Interviews (6 ambulance nurses)</td>
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<tr>
<td>Yong 2008</td>
<td>AUS</td>
<td>Sequential exploratory</td>
<td>Observations (621 TIC)</td>
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<td></td>
<td></td>
<td></td>
<td>Survey (51 respondents: 24 ED nurses, 11 profession NR)</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Intervention</td>
<td>Evaluation Design</td>
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<tr>
<td>Ebben 2015</td>
<td>NLD</td>
<td>Handover guideline (DeMIST) with e-learning program for EMS only (53% completed)</td>
<td>Prospective pre-post</td>
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<td>Iedema 2014</td>
<td>AUS</td>
<td>Handover guideline (IMIST-AMBO) with training</td>
<td>Prospective pre-post</td>
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<tr>
<td>Greaves 2017</td>
<td>AUS</td>
<td>New clinical role (ED Ambulance Offload Nurse)</td>
<td>Retrospective pre-post</td>
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<tr>
<td>Murad 2014</td>
<td>USA</td>
<td>Mobile web-based technology (with 5-P guideline)</td>
<td>Post only</td>
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</table>
ED: The web interface provided easy access and retrieval of multimedia information (digital audio, pictures, videos) in an easy to read and usable format for the ED.

Communication

EMS: improved consistency in reporting patient information.
EMS: Paramedics used audio, images, video, and text information alone or in combination, which improved communication between paramedics and ED staff.

ED: System audio recordings were listened to by nurses in the ED and used to brief other nurses and physicians. The audio helped improve information completeness and accuracy.

Text messaging, and videos were less useful to the ED with the exception of trauma cases.

Notification times for rural or remote motor vehicle accident

ED: Allowed for early notification and pre-registration, particularly for faster information retrieval of essential information at the hospital.

Raaber 2016  DNK  Mobile web-based technology (GIS data)  Prospective pre-post  Web application  Wait time (ED activation to patient arrival)  Unprepared ED activation

Web application  Wait time (ED activation to patient arrival)  Unprepared ED activation

Median 5 mins to 5 mins (p = .18); wait time > 10 mins, 11% to 4% (p = .01)

Survey
11 ED nurses  Timing  ED activation more precise

Helped in coordinating patient reception, workflow, nurse organization and preparation

Interviews
4 ED nurses  Patient reception or treatment quality  Helpful in planning which nurse would receive the patient and where, overall improving overview without regarding workload as having increased, improving patient treatment quality

Having the right ward and well-prepared staff provided better patient reception.

Possible to avoid situations where non-critically ill patients were received by an unprepared staff.

Work environment  Improved the work environment and decreasing nursing staff stress level. Reduced team members’ annoyance due to unnecessary wait times.

More information about patients was perceived as a
way to better organize and prepare
Hasty patient transfers to other wards or departments were avoided, resulting in improved working relationships

| Schooley 2013 USA | Mobile web-based technology | Post only | Web application 801 records | Use 3-month pilot: 437 images, 446 audio recordings, 25 videos, 126 text messages | Time required to send video file too extensive
| 5 Focus groups 22 Paramedics 17 ED nurses | Decision making Digital images were used to: evaluate motor vehicle crashes, estimate the severity of trauma, prompt for more extensive diagnostics and medical evaluation, monitor patient injury and/or health status progression. | Convenience The system allowed EMS to record audio at their own convenience and not have to wait for the ED to respond before talking. Nurses perceived audio files as convenient as they could listen to recordings when able to and allow physicians to listen to the context if they felt the information was important. |
| Communication Enabled asynchronous communications that fit well with EMS and ED workflow processes. Paramedics found data entry and multi-tasking on scene efficient |

Note: NR = not reported, NS = not significant, ED = emergency department, TIC = transitions in care, GIS = geographic information system