Paramedic to trauma team verbal handover optimization — a complex interaction

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Background: Handover to the trauma team is crucial to trauma care. The emergency medical services (EMS) report must be concise, contain key details, and be time-limited. Effective handover is difficult, often occurring between unfamiliar teams, in chaotic environments, and without standardization. We aimed to evaluate handover formats in comparison to ad-lib communication during trauma handover.

Methods: We conducted a single-blind randomized simulation trial evaluating 2 structured handover formats. Paramedics randomly assigned to ad-lib, ISOBAR (identify, situation, observations, background, agreed plan, and readback) or IMIST (identification, mechanism/medical complaint, injuries/ information about complaint, signs, treatments) handover formats underwent scenarios in an ambulance, then transfer to the trauma team. Assessment of handovers was completed by the trauma team and by experts using audiovisual recordings.

Results: Twenty-seven simulations were conducted, 9 for each handover format. Participant ratings of the usefulness of the IMIST and ISOBAR formats were 9/10 and 7.5/10, respectively (p = 0.097). Quality of the handover was deemed higher by team members when a statement of objective vital signs and a logical format was used. Handovers delivered with confidence, directed and summarized by a trauma team leader, before physical patient transfer, and without interruption were identified as having the highest quality. The type of format was not a significant contributor to handover; however, we identified a matrix of factors affecting the quality of trauma handover.

Conclusion: Our study shows agreement by prehospital and hospital personnel that a standardized handover tool is preferred. A brief confirmation of physiologic stability, including vital signs, limiting distractions, and team summarization improves handover effectiveness.

Contexte : Le mode de transfert en traumatologie est crucial pour cette discipline. Le rapport du service des urgences doit être concis et rapide, tout en incluant les paramètres clés. Il est parfois difficile de procéder à un transfert efficace car les équipes se connaissent peu, et le contexte est souvent chaotique et dépourvu de structure uniformisée. Nous avons voulu comparer aux échanges impromptus des modes de transfert structurés en traumatologie.

Méthodes : Nous avons réalisé un essai de simulation randomisé à simple insu pour évaluer 2 modes de transfert structurés. Assignés aléatoirement soit à des échanges impromptus, soit aux modes ISOBAR (identité, situation, observations, background, accord sur un plan et révision) ou IMIST (identité, mécanisme/symptômes, information sur les blessures, signes et traitements), les ambulanciers paramédicaux ont pris en charge des scénarios dans une ambulance, puis leur transfert vers l'équipe de traumatologie. L'évaluation des transferts a été effectuée par l'équipe de traumatologie et par des experts à partir d'enregistrements audiovisuels.

Résultats : Vingt-sept simulations ont ainsi été réalisées, 9 pour chacun des modes de transfert. Les participants ont respectivement classé comme suit l'utilité des modes IMIST et ISOBAR : 9/10 et 7,5/10 (p = 0,097). Les membres de l'équipe ont jugé que la qualité du transfert était meilleure lorsqu'un mode formel était utilisé, incluant les signes vitaux objectifs et un format structuré. Les meilleurs transferts sont ceux qui ont été fait avec aplomb, guidés et résumés par une personne responsable de l'équipe de traumatologie, avant le transfert physique des malades et sans interruption. Le mode en soi n'a pas été un important facteur contributif pour le transfert; toutefois, nous avons identifié une trame de facteurs qui affectent la qualité du transfert en traumatologie.

Conclusion : Selon notre étude, le personnel hospitalier et préhospitalier s'entend pour dire qu'un outil de transfert standardisé est à privilégier. Une brève confirmation de la stabilité physiologique incluant les signes vitaux, le fait de limiter les distractions et présenter un résumé pour l'équipe contribuent à améliorer l'efficacité du transfert.

Resuscitation of trauma patients is challenging as it involves coordinated care by multiple providers, with urgent interventions taking place in parallel.[1–3] Without effective communication, the quality of the resuscitation and outcome of the patient can be severely affected. Unlike other emergency medical services (EMS) care transfers, in which patient handovers seek to convey complete patient details, trauma handovers must be concise and communicate key details for initial resuscitation and decisions.[4–7] Effective handover ensures the receiving team has relevant information and does not delay care or critical interventions.

The content of EMS handovers is not standardized, and although many formats exist, their effectiveness and compliance with using them is not clear.[10–12] A formatted approach allows both the EMS crews and the trauma team to communicate information efficiently and effectively.[4,8,9] Unstructured patient handovers can result in medical errors, whereas a structured approach can improve communication and reduce critical information loss.[7,9,13,14]

This study aims to evaluate trauma handover using 2 structured formats compared with the unstructured (ad-lib) approach currently used in the province. We aimed to identify improvements in content, quality and consistency in the delivery of handover through the use of a formalized handover tool and refine the process of EMS trauma handover.

Methods

We obtained ethics approval from the University of Alberta Health Research Ethics Board — Health Panel, study reference number Pro00078561, before any data collection or recruitment occurred. Our study was a randomized simulation trial evaluating structured handover formats compared with the current unstructured approach in use. We aimed to identify improvements through the use of a formalized handover tool by using a scoring matrix, objective measures and thematic analysis of multiple blinded experienced experts' comments on the study handovers.

This mixed-methods study recruited EMS providers from a high-volume provincial trauma system to take part in 3 scenarios, with providers assigned via random number generator to a standard stream (control), or a training module using 1 of 2 trauma handover formats. The 2 handover formats evaluated were the IMIST handover (identify, mechanism of injury, injury summary, signs and symptoms and, treatments)[10,14–17] and the ISOBAR handover (identify, situation/status, observations, background, assessment/actions, and acceptance of responsibility).[3–5,16,18] The intervention groups received a reference card of the assigned format and watched a short video primer demonstrating the key elements required in a verbal handover.[13,19,20] The intervention groups were assessed against a control group as well as an internal control comparison to the first scenario for all groups.

Experimental protocol

Three teams of paramedics were assigned to each stream (standard v. training module) for a total of 27 trauma simulations and handovers. The providers underwent standardized scenario iterations in an EMS mobile simulation ambulance, where they received a report of the scene findings followed by 10–15 minutes of assessment and ongoing simulated transport care before arrival at the simulation trauma centre. On arrival at the trauma centre, the paramedic team moved the mannequin from the ambulance into the hospital facility trauma bay with the trauma team awaiting, as would occur in a standard trauma team activation. The trauma team consisted of a trauma team leader, a surgical resident and trauma nurses. The paramedic team then provided a verbal handover to the trauma team (Figure 1).

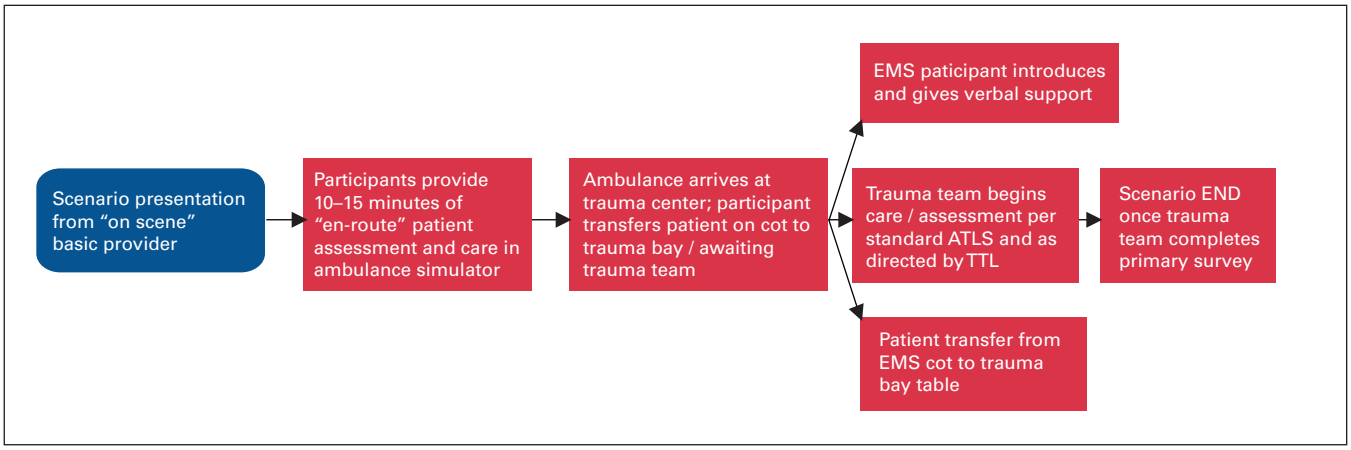

Fig. 1. Scenario progression from scene to hospital trauma bay handoff. ATLS = Advanced Trauma Life Support; EMS = emergency medical services; TTL = trauma team leader.

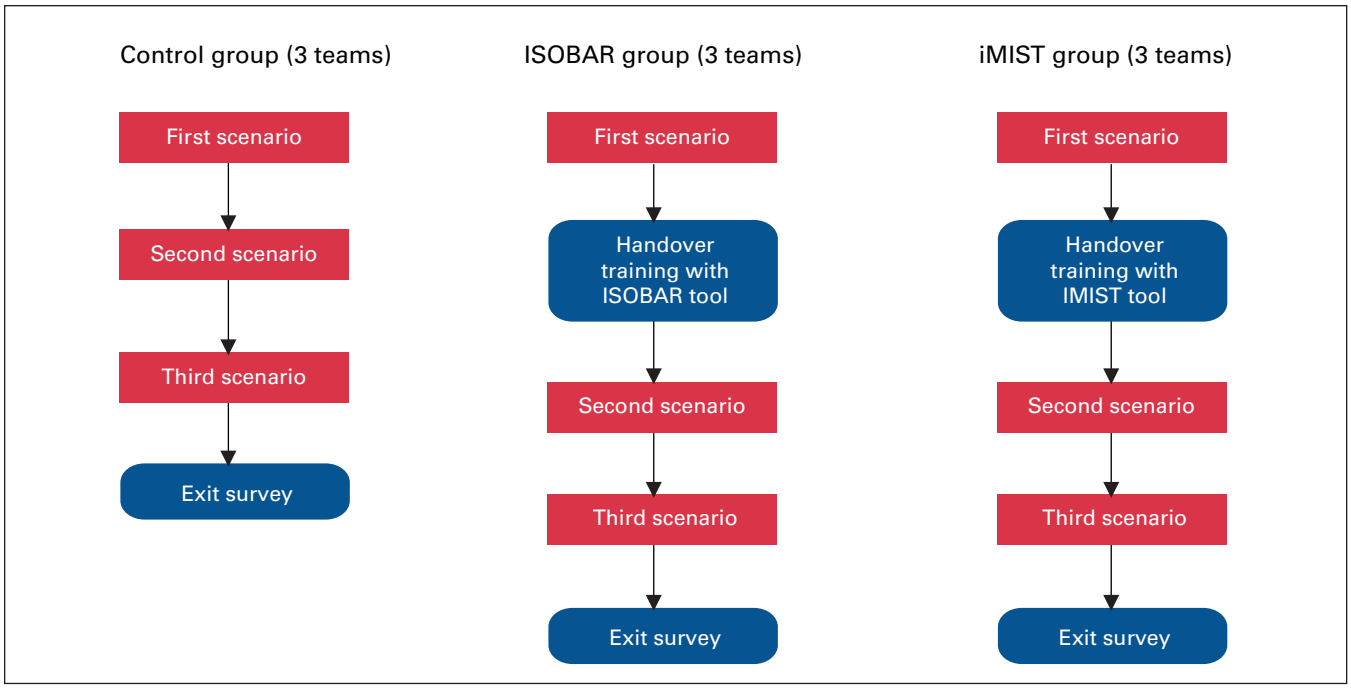

Fig. 2. Trauma simulation flow by study group and progression, for control and intervention groups.

Each paramedic team undertook 3 standardized trauma scenarios in random order. Scenarios were of similar acuity, with comparable injuries, intervention and clinical trajectory. The EMS providers randomized to intervention streams received a training module on handover content and communication along with instruction regarding either ISOBAR or IMIST handover tools after completing the initial control scenario (Figure 2). The sample size was one of convenience based on available EMS teams on the simulation days and simulation resource constraints.

Data collection consisted of video and capture in the simulated trauma bay of the prearrival, arrival, handover, and initial assessment phases of care in each scenario. The physician and nursing staff completed Likert rating scales (scored 1–10) of the handover as well as qualitative comments and observations regarding the handover interactions.

Post hoc evaluation of the recorded handovers was undertaken by 7 independent evaluators with expertise in crisis resource management (2 trauma surgeons, 2 emergency medicine trauma team leaders, 2 EMS educators, and 1 intensive care unit fellow). Each reviewer received a randomized order of videos to review using 2 tools. First was an assessment of handover content and completeness, and second an overall subjective impression in the form of a 10-point Likert scale. Comments regarding each handover were collected from each reviewer. The EMS participants were invited to complete a postparticipation survey regarding handover tools in trauma handover.

Qualitative analysis

The comments collected were reviewed and underwent a thematic analysis process. These were analyzed using NVivo qualitative analysis software (QSI International).

Statistical analysis

Descriptive analysis was completed using means (standard deviations), medians (interquartile ranges [IQRs]) and frequencies, as appropriate. Comparisons between and within groups were completed using 1-way analysis of variance, Kruskal–Wallis and paired Student *t* tests as appropriate. We used STATA 13.0 software (StataCorp.) for the analyses. We considered results to be significant at a p value less than 0.05.

Results

A total of 13 EMS providers participated: 9 (69%) advanced care paramedics (ACP) and 4 (31%) primary care paramedics (PCP). Median (IQR) years of experience was 14.5 (10–18) years, with the ACP providers being significantly more experienced (16 [14–19] yr v. 3 [2–6.5] yr). A total of 27 simulations were conducted with 9 simulations in each randomized group (control, ISOBAR and IMIST) (Table 1). Each group had 1 PCP, with the remainder of participants in each group being ACPs. Average years experience for the control, ISOBAR and IMIST providers in each group were 8, 16.5 and 12 years, respectively.

Video analysis was conducted on 26 of 27 scenarios owing to a video capture failure on 1 control scenario (the first scenario of a control group sequence). Most (70%) providers described using handover tools in the past, and all participants felt a handover tool was useful and valuable. Participant feedback responses included statements such as "I found the organization of the IMIST tool to be largely intuitive and natural to use" and "It would be ideal to have a standard that worked for both professions." Participant ratings (mean ± standard deviation [SD]) of the usefulness of using IMIST compared with ISOBAR on a scale of 1–10 (not useful to very useful) were 9 ± 1.5 v. 7.5 ± 3, $p = 0.097$, and likelihood to use those handover tools in the future was rated 9 ± 2.75 v. 8 ± 2.5, $p = 0.12$. Handovers had an overall mean duration of 71 s ± 24 s, with mean control, ISOBAR and IMIST times of 75 s ± 25 s, 66 s ± 26 s and 65 s ± 20 s ($p = 0.65$). Correlation of duration to quality score for the handover was calculated using Pearson correlation and showed no correlation between subjective quality ratings and duration of handover ($r_{26} = –0.22$, $p = 0.287$).

Table 1. EMS provider level and experience, and total handoff duration by study group

Factor	Value
Total providers, *n*	13
Primary care paramedic, *n* (%)	4 (31)
Advanced care paramedic, *n* (%)	9 (69)
Years of experience, median (IQR), yr	14.5 (10–18)
Primary care paramedic	3 (2–6.5)
Advanced care paramedic	16 (14–19)
Handoff elapsed times, mean ± SD, s	
Total	71 ± 24
Control group	75 ± 25
ISOBAR group	66 ± 26
IMIST group	65 ± 20
p value	0.65

EMS = emergency medical services; IQR = interquartile range; SD = standard deviation.

The content and subjective overall impressions, as scored by our 7 independent video evaluators, showed large variation. Handover content was largely similar between groups. Patient introduction was consistently offered, while a stability statement, arrival vital signs, and descriptions of injuries and interventions were more varied between experimental groups (Table 2). There was large interrater variation in the overall impression of handovers (Table 3).

Qualitative analysis began with a word frequency search of the comments from all video evaluators, trauma team comments post-handover and the comments from EMS participants' exit surveys. The word frequency map informed initial codes, or themes, to codify all comments. Two evaluators reviewed the comments for agreement on codes. Five parent codes with multiple sub-codes were identified in comments as factors influencing the quality and content of the handovers. The 5 parent codes identified were EMS provider factors, trauma team factors, team dynamic factors, patient factors, and format of delivery factors (Figure 3).

The EMS provider factors focused on the perceived confidence of the report delivery. Reviewer comments included "Confidently delivered handover with pertinent information provided," "The EMS practitioner had a complete lack of confidence for the duration…," and

Table 2. Video evaluator scoring results for handoff content checklist

Content	Control group	ISOBAR handoff	IMIST handoff	Total	*p* value
n (%)	98 (53.8)	42 (23.1)	42 (23.1)	182 (100.0)	–
Introduction (0,1,2*), median (IQR)					
Stability statement	1 (1–1)	1 (0.5–1)	1 (0–2)	1 (0–1)	0.23
Demographic intro	2 (1.25–2)	2 (2–2)	2 (1–2)	2 (1–2)	0.65
Time of injury stated	1 (0–1)	1 (0–1)	1 (0–1)	1 (0–1)	0.75
Clinical assessment (0,1,2*), median (IQR)					
Critical injuries noted	2 (2–2)	2 (2–2)	2 (2–2)	2 (2–2)	0.51
Minor injuries omitted	2 (0–2)	1 (0–2)	2 (0–2)	2 (0–2)	0.54
ABC status noted	2 (1–2)	2 (1–2)	2 (1–2)	2 (1–2)	0.82
Initial vitals stated	1 (1–2)	1 (1–2)	1 (1–2)	1 (1–2)	0.95
Arrival vitals stated	2 (1–2)	1 (1–2)	2 (1–2)	2 (1–2)	0.02
Critical events noted	2 (2–2)	2 (2–2)	2 (2–2)	2 (2–2)	0.66
Interventions (0,1,2*), median (IQR)					
C-spine noted	2 (1–2)	2 (0–2)	2 (1–2)	2 (1–2)	0.28
All major interventions noted	2 (2–2)	2 (2–2)	2 (2–2)	2 (2–2)	0.93
Vascular access identified	2 (1–2)	2 (1–2)	2 (0.5–2)	2 (1–2)	0.73
Fluid totals	2 (0–2)	1 (1–2)	2 (1–2)	2 (1–2)	0.22
Opiate totals	2 (2–2)	2 (2–2)	2 (0–2)	2 (1–2)	0.78

ABC = airway, breathing, circulation; IQR = interquartile range.
*0 = No; 1 = Incomplete; 2 = Complete.

Table 3. Video evaluator scoring results for handoff content checklist

Overall impression and content evaluation	Control group	ISOBAR handoff	IMIST handoff	Total	*p* value
n (%)	98 (53.8)	42 (23.1)	42 (23.1)	182 (100.0)	–
Overall impression score1–10, median (IQR)	7 (5.75–8)	7 (4–8)	7 (5–8)	7 (5–8)	0.29
Content evaluation1–5, median (IQR)					
Establishes attention to begin handoff	4 (3.75–4)	4 (3.5–4)	4 (3–5)	4 (3–5)	0.16
Mechanism of injury is described concisely	4 (4–4)	4 (3–4.5)	4 (3.5–5)	4 (3–5)	0.12
Clearly established clinical trajectory during transport	3 (3–4)	4 (2–4)	4 (2.5–5)	3 (2.5–4)	0.53
Head to toe format of injury summary is provided concisely	4 (3–4)	4 (2–4)	4 (3–4)	4 (3–4)	0.67
Interventions followed a logical order (ABCDE)	4 (3–4)	4 (2–4)	4 (3–4)	4 (2–4)	0.98
Handoff follows a clear format	4 (3–4)	4 (2–4)	4 (2.5–4)	4 (2–4)	0.70
Handoff is delivered in a clear and confident manner	4 (3–4)	4 (3–4.5)	4 (3–5)	4 (3–4)	0.56

IQR = interquartile range.

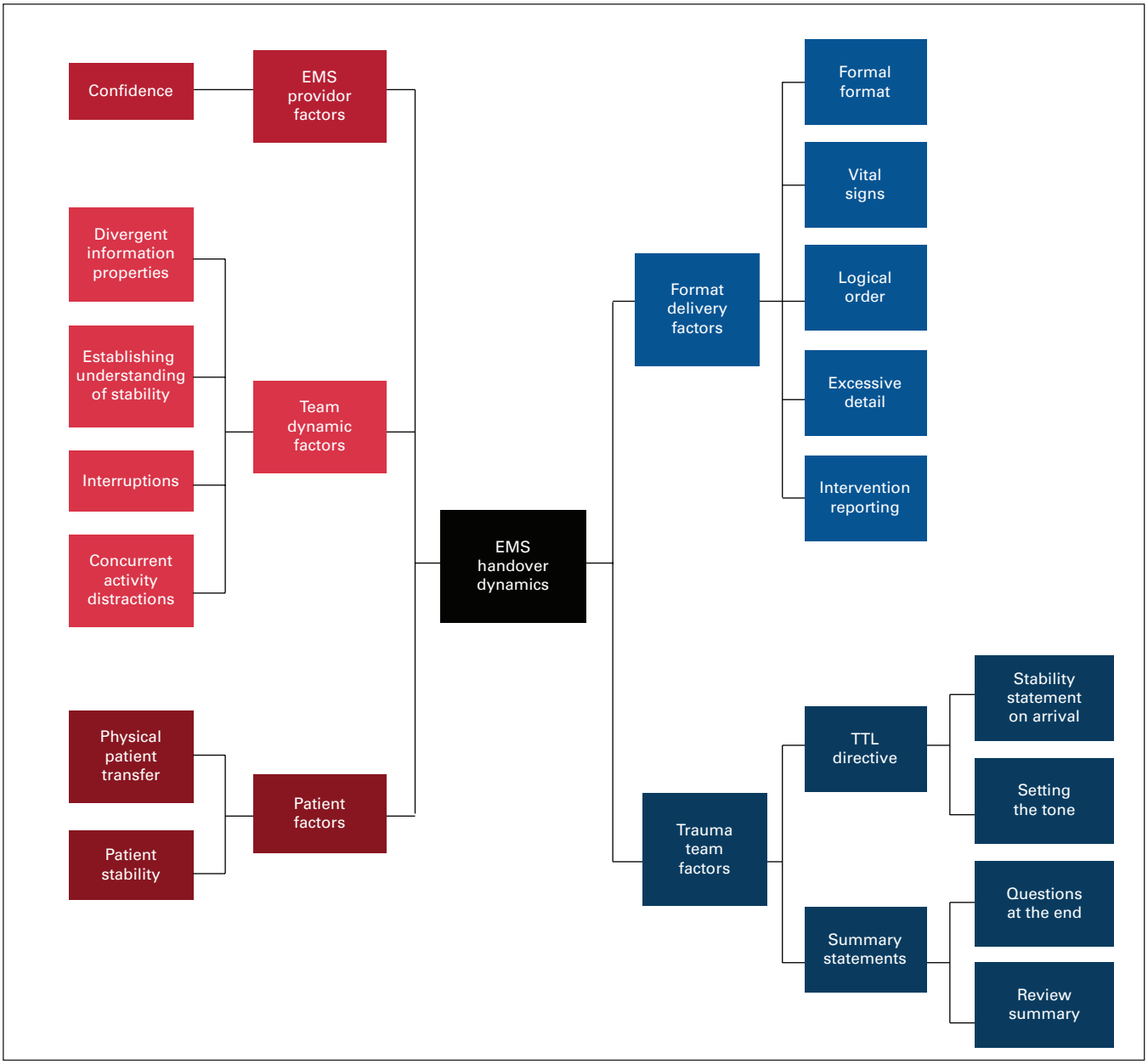

Fig. 3. Thematic analysis codes (themes) and sub-codes from comments by emergency medical services (EMS) providers, trauma team members and expert reviewers within the study. TTL = trauma team leader.

"Confident and good rhythm, speed in handover, clear language."

Trauma team factors included trauma team leader direction and use of summary statements. Handovers were considered to have higher quality when the trauma team leader summarized, when they enforced no interruptions during the paramedic report, and when they made an initial "zero survey" or quick patient impression and communicated deliberately to the team that there was time to pause to hear the report.

Team dynamics factors were divergent information priorities, understanding of stability, interruptions, and concurrent activities. Regarding divergent information priorities, the information EMS providers thought important to include differed from team and team leader expectations. The EMS providers tended to give summary statements regarding stability and trends in vital signs, whereas the trauma team leader and surgeon sought objective values to inform their decision making. Regarding understanding of stability, EMS crews noted stability with reference to change over time in vital signs, whereas the trauma team and evaluators noted inaccuracies in these statements. Interruptions included direct interruptions of the EMS report for questions, clarifications or to divert attention to another task or intervention. The concurrent activities code captured comments regarding the impact of care activities occurring during the EMS handover. Nursing activity as well as resident/physician primary surveys were noted to negatively affect the perceived quality of the EMS handover.

Patient factors included physiologic stability and timing of the patient transfer to the hospital bed. Physical transfer was closely linked in comments to the concurrent activity team dynamics factor. Patient transfer to a resuscitation bed before the handover was noted as a theme, with more concurrent activity occurring and negatively affecting communication. Reviewer comments in this theme category included statements such as "Moving patient while giving handover disrupted report, also RN speaking during report (talking to patient) — not all team members [paid] attention to the report."

The format of delivery factors noted to positively influence the quality of a handover included the use of a formal and known format, a statement of objective vital signs and brief mention of interventions. Format factors noted to have a negative impact included excessive detail and use of narrative timeline as a report format.

Both intervention groups (ISOBAR and IMIST) were noted to have fewer interruptions during handover than the control group (ISOBAR 2.47% v. IMIST 4.81% v. control 7.27%). The EMS provider confidence comments during handover were increased in the ISOBAR and IMIST groups compared with the control group (ISOBAR 7.41% v. IMIST 5.77% v. control 2.73%). Patient transfer was noted to interrupt handover in the control group but not in the intervention groups (control 1.82% v. 0% for ISOBAR and IMIST).

Discussion

Our analysis showed that trauma team handover is complex and that the quality of the handover is influenced by many factors that can in turn affect the quality of trauma patient care. A formalized handover did not change the subjective scoring nor the content of the handovers analyzed. However, through qualitative analysis of the feedback, we uncovered insights into the many factors that influence the quality of a trauma patient handover. A standardized format may not change the content of the report, but it does establish a standard and shared mental model between the delivering (EMS) and receiving (trauma) teams, as the expectations of both EMS and receiving trauma teams can diverge. Our analysis shows that a standard format results in fewer interruptions and increased perceived confidence in the delivery of the handover. Concurrent activity, such as active patient transfer and nursing tasks, distract from the handover report and result in lower-quality handovers.

Clarity around communication can help manage expectations of all involved. Objective vitals in lieu of terms such as "stable" ensure the patient condition is communicated and received without ambiguity. A culture within the trauma team to give EMS 60 seconds of silence to provide handover can reduce interruptions and improve the handover process, as well as enhance trauma team dynamics and respect for our prehospital colleagues. Our trauma nurses reported feeling empowered to do this if the trauma team leader performed a rapid "zero survey" confirming the patient was not in extremis based on a quick visual assessment and current vitals from EMS. The "zero survey," as we have termed here, is informally performed by most experienced providers regularly, and is akin to a "sick or not sick" initial visual assessment performed by an experienced clinician, in this case, the trauma team leader. Verbal interruptions by the receiving team also seemed to disrupt the handover flow and result in longer, disorganized handovers, favouring an approach using a designated question segment following an initial handover monologue by EMS.

The lack of formalized EMS handover may lead to disorganized handover reports that are lengthy and irrelevant. The duration of a handover is often noted as a factor affecting the quality of discussions with receiving trauma team members. This was consistently echoed by study participants, with frequent calls for more succinct handovers. While this strategy may result in missed information, this can be mitigated with an effective tool acceptable to both prehospital and hospital providers. Quantitatively, however, there was no correlation in quality ratings of handovers with duration of handover in our results.

No single format was superior; however, thematic codes supported the use of a common format familiar to both EMS and the trauma team. This helps to create a shared mental model, where roles and expectations are predicted ahead of time, and interruptions are limited. EMS is more likely to have the required information available, and the receiving team can follow the narrative and avoid interruptions by anticipating upcoming information. Key elements the surgical trauma team members need from EMS include vitals, major injuries noted, mechanism of injury (very brief) and key interventions performed.

Other considerations for EMS handovers include minimizing abbreviations, which was noted in comments within our study as being unfamiliar to some receiving team members. In addition, it is important for EMS teams to note that the initial verbal handover should contain only the critical information the trauma team requires for the initial resuscitation, and additional detail can and should be provided via a supplementary verbal report after the trauma team completes the primary survey and/or through written reports completed in a timely manner.

Limitations

Our study is limited in its design as a simulation study, which could introduce elements of artificiality. However, the setup and use of practising professionals from each role involved as well as the realistic setting gave these simulations high fidelity as it pertains to the team interaction and dynamic. Elements of Hawthorne effect and various "simisms" or artificialities may have introduced bias or factors affecting handover quality that were not measured or accounted for in the study design. An additional limitation stems from the training integration of the 2 handover tools employed. Using a newly acquired handover tool in a task undertaken in daily work conceivably may have been suboptimal. The large interrater variability was informative when examined in conjunction with qualitative results; however, the utility of this measure in forming conclusions is limited. An additional limitation to quantitative results was the small sample size owing to resource availability. In addition, while the ISOBAR and IMIST communication training used mixed teaching methods, learning styles among participants were not factored in our analysis.

Conclusion

The handover from EMS to the trauma team is a key transition of care in the trauma spectrum. Our simulation study has highlighted that this transition is highly nuanced, and expectations of handover content are not standard, even among trauma care providers from the same centre. Our study highlights agreement that a standard should exist and be understood clearly; qualitative analysis favours the use of the IMIST handover tool. To ensure a shared mental model and promote trust before proceeding with formal handover, we suggest a brief confirmation of physiologic stability by EMS before leading handover with precise vital signs. Creating a culture of respect by limiting distractions and intervention during the EMS handover report can improve the overall transfer of information, optimize trauma team dynamics and provide seamless transition of care.

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Contributors: S. Cowan, M. Kim, B. Mador, K. Verhoef and S. Widder designed the study. S. Cowan, E. Chang, C. Cameron, K. Verhoef and S. Widder acquired the data, which S. Cowan, P. Murphy, M. Kim, B. Mador, A. Kabaroff, E. North, K. Verhoef and S. Widder analyzed. S. Cowan, K. Verhoef and S. Widder wrote the article, which all authors reviewed. All authors approved the final version to be published.

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