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Original Research Article

Pilot evaluation of smart glasses for communication workflow and task performance in prehospital care

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ABSTRACT

Introduction: Communication between emergency medical services (EMS) clinicians and online medical control (OLMC) physicians is essential for effective prehospital decision-making but is currently limited by verbal-only tools (e.g., phone or radio).

Objective: This pilot study aimed to evaluate the impact of smart glasses on EMS–OLMC communication, workflow, and clinical task performance.

Methods: We conducted a pilot randomized crossover trial with 16 simulated EMS sessions across two agencies in the United States. EMS clinicians managed two scenarios using either smart glasses or standard communication (radio/phone) to consult with OLMC physicians. Task completeness and physician prompts were independently assessed by paired paramedic and physician reviewers using a standardized checklist, and both simulation and teleconsultation durations were analyzed to evaluate workflow impact.

Results: Smart glasses affected both workflow and clinical performance. Workflow analysis showed significantly longer simulation and teleconsultation durations when smart glasses were used compared with phone sessions ($p < 0.05$). Clinically, smart glasses yielded higher completion rates for physician-prompted critical tasks (96.0%) compared with radio/.48%, $p < 0.05$) and were associated with more physician prompts overall (2.1 vs. 1.6 per session).

Conclusion: Smart glasses have the potential to enhance EMS–OLMC communication and improve completion of physician-guided critical tasks, though these benefits come with longer interactions. These findings highlight important workflow considerations for integrating smart glasses into EMS practice.

1. Introduction

Effective communication between emergency medical services (EMS) clinicians and remote emergency care physicians is crucial for ensuring timely and accurate patient care, particularly for critically ill or injured patients, such as those experiencing trauma or stroke [1–3]. EMS clinicians must relay critical patient information to the receiving hospital and when necessary, consult with an online medical control (OLMC) physician to discuss treatment plans and obtain authorization for specific interventions. Traditionally, this communication has relied on radio or phone calls which enable verbal-only communication [4]. However, these approaches present certain limitations [2,5]. One of the primary challenges of verbal-only communication is the difficulty EMS clinicians face in clearly conveying a patient's condition, such as physical and mental states or specific signs of distress [2,5]. Similarly, remote physicians often struggle to fully understand these nuanced and

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contextual symptoms, which can lead to miscommunication and delays in decision-making [1,6].

Over the past two decades, various technologies have been proposed to enhance prehospital communication, including ambulance-based telemedicine systems [7–10]. However, adoption has remained low due to workflow misalignment [11]. For example, these systems can be bulky and impractical for use outside an ambulance, where much of patient care occurs [10]. Additionally, EMS clinicians must focus on hands-on care, limiting their ability to use handheld devices, while also minimizing cross-contamination risks [12]. These challenges highlight the need for hands-free, workflow-aligned solutions to support real-time prehospital communication.

Smart glasses, a head-mounted wearable device with a built-in camera and display, offer a promising alternative for enhancing prehospital communication by enabling real-time, first-person video streaming between EMS clinicians and remote physicians [13,14]. This technology supports hands-free operation and can incorporate voice control and augmented reality features (e.g., overlaying textual or visual information within the wearer's field of view), aligning well with typical EMS workflows [15]. While some studies have explored the usability and technical feasibility of smart glasses in prehospital settings [16–18], research on their clinical and workflow impact remains limited [19–22].

To address this gap, we evaluated the impact of smart glasses on EMS workflow and task performance through 16 simulated pediatric emergency scenarios. In each simulation, EMS providers managed two clinical cases while consulting with OLMC physicians using either smart glasses or standard radio/phone communication. The objective of this study was to test the hypothesis that smart-glasses-based teleconsultation would increase physician prompting and improve completion of critical treatment tasks compared with radio/phone communication, while minimally disrupting EMS workflow.

2. Methods

2.1. Study overview and interventions

In our prior work, the research team iteratively designed and developed an integrated telemedicine system consisted of two main components: 1) a smart glass application for EMS clinicians to consult with OLMC physicians or notify receiving hospitals (Fig. 1, Left), and 2) a web-based interface for physicians to access patient information and communicate via real-time video (Fig. 1, Right). The smart glasses enable quick call initiation in three steps and allow EMS clinicians to share patient data (e.g., vitals, medications, interventions). On the physician side, the interface supports live video viewing, note-taking, and sending brief instructions directly to the EMS clinician's display. The system was developed through a user-centered, participatory design process with EMS clinicians and physicians; additional details are reported elsewhere [23,24].

The study used Vuzix M400 smart glasses (Vuzix Corporation, Rochester, NY, USA) (Fig. 2, Left), which feature a near-eye display and a forward-facing camera for streaming the wearer's point of view (Fig. 2, Right). For the purposes of this study, the device was connected to a cellular network for real-time video communication, while OLMC physicians accessed the feed via a web-based interface on a laptop.

2.2. Study design

We conducted a pilot study comparing smart glasses (intervention) with standard communication tools (phone and radio; control) using a randomized crossover design. The study included 16 simulation sessions across two U.S. EMS agencies (eight per site): a fire-based agency in a rural mountainous region and a hospital-based agency in an urban east coast setting. This sample size balanced data sufficiency with feasibility, given the scheduling and operational constraints of EMS clinicians and OLMC physicians. The study was approved by the Pace University Institutional Review Board (IRB #1708685).

Simulations took place in either a mobile lab replicating the rear compartment of an ambulance (rural site) or a hospital-based simulation lab (urban site). In each session, EMS teams completed two back-to-back pediatric emergency scenarios: a five-year-old with asthma exacerbation and a five-year-old with anaphylaxis. These scenarios were selected for their comparable complexity and relevance to EMS practice. Before each simulation, EMS clinicians were trained on the smart glass application and OLMC physicians on the web-based interface until they could use the system independently. Researchers first explained all features, then allowed participants to practice without time constraints.

During simulations, EMS clinicians used their standard equipment and medications. For each scenario, they contacted an OLMC physician via radio/phone (control) or the smart glass application (intervention) to discuss patient status and obtain treatment approval. At the rural site, teams used mobile phones (their usual method), while at the urban site, teams used radios. Due to limited availability, three physicians participated at the rural site (each in at least two simulations), whereas each urban simulation involved a different physician. To mitigate learning effects, the research team randomized the order in which each team completed the clinical scenarios (asthma or anaphylaxis first) and the communication methods (smart glasses or radio/phone first) (Supplemental File Table 1).

Fig. 1. Left: The smart glass application used by EMS clinicians to initiate OLMC call and share patient information. Right: The web-based interface used by OLMC physicians.

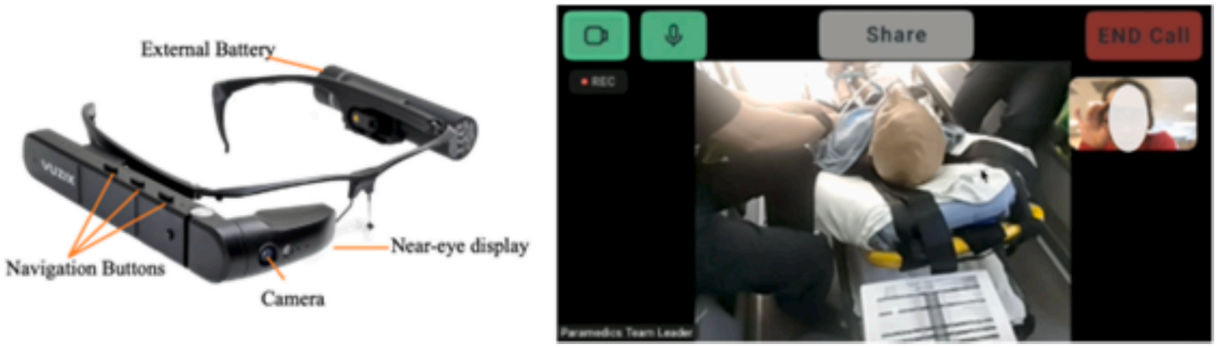

Fig. 2. Left: The Vuzix M400 smart glass device used by EMS clinicians in the study. Right: An example of the first-person video perspective captured by the smart glass during a simulation.

2.3. Participants

We recruited 35 EMS clinicians and 11 emergency medicine physicians to participate in the simulations. Among the EMS clinicians, 25 were paramedics and 10 were emergency medical technicians (EMTs) with each simulation having at least one paramedic. EMS participants had a wide range of experience, from 2 months to 33 years, and 21 of them (61.76%) had over 10 years of experience. The EMS agency in the rural area had 3–5 clinicians in a team, while the agency in the urban area only had 2 clinicians. This team composition mimics their typical team structure in real practice. Physicians have a year of experience ranging from 1 to 10 years. The study has been approved by Pace University IRB.

2.4. Outcome measures

We used the following four major measures to measure the impact of smart glasses on EMS workflow and task performance: (1) the interaction time between EMS clinicians and remote physicians, (2) the simulation length, (3) the rate of task completion, and (4) the frequency of task prompts initiated by OLMC physicians.

2.5. Data collection

We recorded all simulation sessions using both audio and video recorders, capturing interactions and conversations on both the EMS clinician and physician sides. All data were transferred to a HIPAA-compliant server for further analysis.

2.6. Data analysis

To understand the impact of smart glasses on workflow, we examined the duration of EMS–OLMC communication as well as the overall simulation time across different communication technologies. To do this, we measured the start and end times of each conversation and simulation to calculate their duration. We then performed the Mann-Whiney U test to assess whether there were significant differences across the sessions applied with different technology.

To examine the impact of smart glasses on care performance, we assessed the number of clinical tasks successfully completed under each communication condition. To do so, we recruited four clinical domain experts—two experienced paramedics and two emergency physicians—to evaluate clinical performance across all simulation sessions. These experts were independent of the study team and did not participate in any of the simulations. Each session was independently reviewed by one paramedic and one physician. This dual-review process ensured balanced perspectives and domain-specific expertise in both EMS practice and medical decision-making. Experts used a standardized checklist (Supplemental File Table 2) with expected assessment and intervention actions. The checklist was adapted from a previously validated tool [25,26], with further modifications to evaluate 18 paired critical action steps that would be similar between the two clinical scenarios (asthma and anaphylaxis) and aligned with Advanced Life Support EMS clinician scope of practice as well as local EMS agency protocol. Each item included for the analysis was scored as "Completed Action", "Incomplete Action", or "Could Not Observe". Expert reviewers also indicated for each task whether it was "prompted by OLMC". These experts received written and verbal instructions detailing how to score the scenarios. We used two primary metrics in our analysis: 1) OLMC prompt–whether the remote OLMC physician prompted the EMS team to perform a specific action step–an indicator in telemedicine and supervision research to quantify the extent of remote clinical intervention [27,28]. 2) Task completeness–whether the EMS team completed the specified clinical task during the simulation. Task completion has been widely used as a performance metric in EMS simulation and quality-of-care studies because it reflects adherence to guidelines and execution of time-critical actions [25,29]. These metrics were chosen to assess both the extent of telemedicine intervention and the clinical execution of time-critical actions by EMS clinicians.

We conducted descriptive statistical analyses to quantify the number of OLMC prompts and task completion rates for each critical action step across different communication conditions (e.g., smart glasses vs. radio/phone). We performed inferential statistical analyses to examine the effects of smart glasses compared to traditional communication tools on task completeness and OLMC prompt frequency. Specifically, we used chi-square tests to compare 1) Task completeness rates – calculated as the number of completed action steps divided by the total number of prompted and unprompted action steps. 2) OLMC prompt frequency – calculated as the number of prompts issued by physicians per session. We set the significance threshold at $p < 0.05$. The analysis was performed at both the aggregate level (overall task completion and prompts across all sessions) and at the individual level (each critical action step), allowing us to identify whether smart glasses had varying impacts depending on the specific clinical task.

To account for variation across expert reviewers, Krippendorff's Alpha was used to assess inter-rater reliability. We evaluated nature and direction of discordant scores for each task between expert reviewers using McNemar's test. When discrepancies occurred between the two primary reviewers, a third physician independently reviewed the task to resolve the disagreement.

3. Results

3.1. Workflow impact

As Table 1 illustrates, the duration of simulations and teleconsultations across different communication technologies varies. Smart glass sessions had the longest mean simulation time (9.33 min), followed

Table 1
Duration of simulations and teleconsultations across different communication technologies.

	Smart Glass Sessions			Radio Sessions			Phone Sessions		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
Simulation Length	9.33 min	14 min	6 min	9.05 min	12 min	6.78 min	6.13 min	12 min	2 min
Teleconsultation Length	5.25 min	8 min	3 min	5.93 min	8.48 min	4mins	2.05 min	3 min	1 min

by radio, with phone-based sessions being the shortest. Radio sessions had the longest mean teleconsultation time (5.93 min), followed by smart glasses (5.25 min) and phone sessions (2.05 min). We found significant differences in simulation duration between smart glass sessions (median = 8.1 min) and phone sessions (median = 5.5 min) ($p = 0.04$). We also observed significant differences in teleconsultation duration between smart glass sessions (median = 5.0 min) and radio sessions (median = 5.63 min), and between smart glass sessions and phone sessions (median = 2.15 min) ($p < 0.001$).

Upon further examination of how EMS clinicians and physicians interacted through reviewing the simulation recordings, we noticed that, interestingly, OLMC physicians often stayed on the call longer in smart glass sessions to continue observing until the discussed/approved treatments were completed and the patient's condition improved. In contrast, while using phone or radio, once medical approval was obtained from physician for certain interventions, the call was usually hanged up.

3.2. Clinical impact

Inter-rater reliability as measured by Krippendorff's Alpha indicated high reliability for task completeness ratings ($\alpha = 0.85$) and moderate-to-high reliability for OLMC prompt ratings ($\alpha = 0.70$). For both task completeness and OLMC prompting, no consistent directionality was observed in the discordant ratings between physician and paramedic reviewers ($p = 0.056$).

Table 2
Comparison of physician prompts and task completeness between smart glasses and radio/phone communication across all critical action steps.

Completed Critical Action Steps	Unprompted[b]		Prompted[a]		Total[c]	
	Smart Glass	Radio/Phone	Smart Glass	Radio/Phone	Smart Glass	Radio/Phone
Assess airway	9 (81.8%)	12 (92.3%)	N/A	N/A	9 (81.8%)	12 (92.3%)
Auscultate chest-	11 (100%)	13 (100%)	N/A	N/A	11 (100%)	13 (100%)
Supplemental oxygen	8 (75%)	8 (61.5%)	N/A	N/A	8 (67.7%)	8 (61.5%)
Asthma history	8 (75%)	10 (76.9%)	N/A	N/A	8 (67.7%)	10 (76.9%)
Allergic reaction history	9 (81.8%)	11 (76.9%)	1 (100%)	N/A	10 (83.3%)	10 (76.9%)
Verbalizes asthma	5 (62.5%)	8 (80%)	2 (100%)	1 (100%)	7 (70%)	9 (81.8%)
Check pulse, attach cardiac monitor	12 (100%)	13 (100%)	N/A	N/A	12 (100%)	13 (100%)
Blood pressure	10 (83.3%)	12 (92.3%)	N/A	N/A	10 (83.3%)	12 (92.3%)
Interprets blood pressure	6 (50%)	5 (38.4%)	N/A	N/A	6 (50%)	5 (38.5%)
Estimate weight-based dose	9 (75%)	4 (30.7%)	N/A	N/A	9 (75%)	4 (30.8%)
First-line treatment	4 (50%)	5 (71.4%)	4 (100%)	5 (83.3%)	8 (67.7%)	10 (76.9%)
First reassessment	10 (83.3%)	10 (76.9%)	N/A	N/A	10 (83.3%)	10 (76.9%)
Ancillary treatment	5 (71.4%)	8 (80%)	4 (80%)	2 (67.7%)	9 (75%)	10 (76.9%)
IV access	5 (83.3%)	6 (67.7%)	3 (100%)	2 (100%)	8 (88.9%)	8 (72.7%)
IV bolus	2 (28.5%)	6 (67.7%)	1 (100%)	2 (100%)	3 (37.5%)	8 (72.7%)
Additional ancillary treatment	3 (60%)	7 (87.5%)	5 (100%)	3 (100%)	8 (80%)	10 (90.9%)
Magnesium sulfate	2 (33.3%)	3 (33.3%)	3 (100%)	2 (100%)	5 (55.6%)	5 (45.5%)
Contact OLMC	11 (100%)	11 (100%)	1 (100%)	2 (100%)	12 (100%)	13 (100%)
Total	129/175 (73.7%)	151/203 (74.4%)	24/25 (96%)	19/21 (90.4%)	153/200 (76.5%)	170/224 (75.9%)
Average	10.8	11.6	2.1	1.5	12.8	13.1

N/A = not applicable given no physician prompt for critical action task.

[a] Total Prompted Tasks: Number of tasks that were prompted by a physician. Completed Tasks (Prompted): Number of prompted tasks that were completed by EMS clinicians.

[b] Total Unprompted Tasks: Number of tasks that were not prompted by a physician. Completed Tasks (Unprompted): Number of unprompted tasks that were completed by EMS clinicians.

[c] Total Completed Tasks: Total number of completed tasks (both prompted and unprompted).

The number and type of physician prompts and task completeness outcomes are shown in Table 2. Regardless of the communication technology used, physician prompts significantly improved task completeness ($p < 0.05$ for both smart glasses and phone/radio conditions). In the radio/phone condition, task completeness was 90.48% when prompted (19/21 tasks) compared to 74.39% when unprompted (151/203 tasks). With smart glasses, task completeness increased from 73.71% when unprompted (129/175 tasks) to 96.00% when prompted (24/25 tasks).

The average number of physician prompts per session was 2.1 when using smart glasses, compared to 1.6 with radio or phone communication; however, this difference was not statistically significant (Table 2). Remote physicians more frequently prompted EMS clinicians to take action on treatment-related critical tasks, such as establishing IV access and ancillary treatment.

Regarding task completeness, the average number of completed steps was similar across the communication methods, averaging around 13 per session (Table 2). However, for those tasks prompted by physicians, smart glasses led to a significantly higher task completeness rate (96.00%) compared to radio/phone (90.48%) ($p < 0.05$).

4. Discussion

In recent years, smart glasses have emerged as a promising tool for enhancing communication and care coordination among geographically distributed medical teams [14]. This potential has led researchers to investigate their use in prehospital emergency care, particularly in facilitating communication between EMS clinicians and remote physicians. Several studies have focused on the role of smart glasses in patient triage during mass casualty incidents [16–18], producing mixed findings. For instance, one study reported minimal impact on triage quality, noting that EMS clinicians rarely used smart glasses to engage with remote physicians, even when the technology was available [18]. Conversely, another investigation found that the use of smart glasses significantly improved the overall accuracy and quality of field triage decisions [16]. These contradictory outcomes highlight a critical need for further research to examine the clinical effectiveness of smart glasses in prehospital settings. By addressing this gap, we can better understand whether smart glasses can enhance emergency care delivery.

Our study was situated in pediatric emergency care. Gaps in the prehospital care of children are well documented including inequities in the treatment of pain, anaphylaxis, and asthma, as well as high rates of medication errors [30–34], making these scenarios an ideal context to test for effectiveness in optimizing communication with a remote physician. We found that smart glasses offer some advantage over verbal-only communication methods in supporting EMS clinicians during prehospital care, particularly in the context of physician-guided critical task completion. More specifically, we found that the frequency of physician prompts was notably higher in the smart glass condition (2.1 per session) than in the radio/phone condition (1.6 per session). This increased engagement may be attributed to the richer visual information available through the smart glass feed, which allows physicians to better identify when intervention or clarification is needed. Although the overall number of tasks completed per session was similar across both smart glass and traditional communication conditions, smart glasses significantly improved the completion rate for physician-prompted critical actions. This difference may suggest that the enhanced situational awareness enabled by smart glasses—via real-time video—helps physicians provide more effective, context-specific guidance. Additionally, EMS clinicians may be driven to complete tasks knowing that their actions are being directly observed by a remote physician.

These results underscore the potential of smart glasses to improve care performance and completeness of critical treatment tasks. However, it may come with trade-offs—most notably, OLMC physicians often stayed on the call longer when smart glasses were used. Two likely explanations for this observation: (1) in the absence of established teleconsultation procedures, physicians may be uncertain about the appropriate point at which to conclude the interaction, and (2) a novelty effect associated with early use of emerging technologies may lead both EMS clinicians and physicians to stay engaged longer than necessary. Nevertheless, longer communications should be avoided because they may lead to workflow disruptions. For instance, EMS clinicians may not have sufficient time to engage in extended conversations, and OLMC physicians' availability in real-world settings may be limited, potentially delaying their ability to respond to other EMS calls. These results underscore the importance of developing clearer guidance and training for the use of video-based telecommunication tools in time-sensitive situations. In particular, protocols that specify when a teleconsultation should conclude—such as ending the interaction once treatment authorization is provided rather than waiting until the procedure is fully completed—could help streamline workflow.

Future work should also examine how to best integrate this technology into EMS workflows across diverse settings and explore its impact on patient outcomes in real-world emergencies. It is also important to assess whether the use of smart glasses introduces additional cognitive or operational burdens for EMS clinicians. The need to manage new technologies during high-stress scenarios could inadvertently contribute to workflow inefficiencies or provider burnout. Understanding these aspects will be essential for designing smart glass systems that support—not hinder—EMS work practices.

5. Limitations

This study has several limitations that should be considered when interpreting the findings. First, the research was conducted in a simulated environment, which, while controlled and standardized, may not fully capture some of the complexity and unpredictability of real-world emergency scenarios. Second, the sample size was relatively small, with only 16 paired simulation sessions, which may affect the generalizability of the results. Future research should validate these results in real EMS settings with more diverse scenarios.

6. Conclusion

This pilot study demonstrates that smart glasses can enhance EMS–physician communication, evidenced by more frequent physician prompts and higher completion rates for physician-prompted critical tasks compared with traditional radio or phone communication. However, these benefits were accompanied by longer communication times, a trade-off that warrants further investigation. Overall, our findings highlight important considerations and future directions for integrating and adopting smart glasses within EMS workflows.

Ethical approval

The study has been approved by Pace University IRB (IRB #1708685).

Generative AI Declaration Statement

The authors did not use a generative artificial intelligence (AI) tool or service to assist with preparation of this work. The author(s) take full responsibility for the content of this publication.

CRediT authorship contribution statement

Zhan Zhang: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Enze Bai:** Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation. **Yincao Xu:**

Writing – original draft, Methodology, Formal analysis, Data curation. **Mustafa Ozkaynak:** Writing – review & editing, Writing – original draft, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Jared Kutzin:** Writing – review & editing, Investigation. **Mark Hanna:** Writing – review & editing, Formal analysis. **Nikiah Nudell:** Writing – review & editing, Formal analysis. **Cody Ruble:** Writing – review & editing, Formal analysis. **Meghann Zapcic-Desrochers:** Writing – review & editing, Formal analysis. **Kathleen Adelgais:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization.

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Data availability

The data that support the findings of this study are available from the first author (ZZ) upon reasonable request.

Declaration of competing interest

The authors report there are no competing interests to declare.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijmedinf.2026.106571.

References

[1] Z. Zhang, A. Sarcevic, C. Bossen, Constructing common information spaces across distributed emergency medical teams, in: Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing, 2017, pp. 934–947.
[2] Z. Zhang, A. Sarcevic, K. Joy, et al., User needs and challenges in information sharing between pre-hospital and hospital emergency care providers, in: AMIA Annual Symposium Proceedings, 2022, p. 1254.
[3] A. Rowlands, An Evaluation of Pre-Hospital Communication Between Ambulances and an Accident and Emergency Department, SAGE Publications Sage UK, London, England, 2003.
[4] Z. Zhang, A. Sarcevic, R.S. Burd, Supporting information use and retention of pre-hospital information during trauma resuscitation: a qualitative study of pre-hospital communications and information needs, in: AMIA Annual Symposium Proceedings, 2013, p. 1579.
[5] M.C. Reddy, S.A. Paul, J. Abraham, et al., Challenges to effective crisis management: using information and communication technologies to coordinate emergency medical services and emergency department teams, Int. J. Med. Inf. 78 (2009) 259–269.
[6] R. O'Hara, M. Johnson, E. Hirst, et al., A qualitative study of decision-making and safety in ambulance service transitions, Health Serv. Deliv. Res. 2 (2014).
[7] Z. Zhang, J. Brazil, M. Ozkaynak, et al., Evaluative research of technologies for prehospital communication and coordination: a systematic review, J. Med. Syst. 44 (2020) 1–14.
[8] L. Yperzeele, R.-J. Van Hooff, A. De Smedt, et al., Feasibility of AmbulanCe-Based Telemedicine (FACT) study: safety, feasibility and reliability of third generation in-ambulance telemedicine, PLoS One 9 (2014) e110043.
[9] S. Bergrath, D. Rörtgen, R. Rossaint, et al., Technical and organisational feasibility of a multifunctional telemedicine system in an emergency medical service–an observational study, J. Telemed. Telecare 17 (2011) 371–377.
[10] S.J. Cho, I.H. Kwon, J. Jeong, Application of telemedicine system to prehospital medical control, Healthcare Inf. Res. 21 (2015) 196–200.
[11] H. Rogers, K.C. Madathil, S. Agnisarman, et al., A systematic review of the implementation challenges of telemedicine systems in ambulances, Telemed. e-Health 23 (2017) 707–717.
[12] O. Pilerot, H. Maurin Söderholm. A conceptual framework for investigating documentary practices in prehospital emergency care, 2019.
[13] P. Schlosser, B. Matthews, I. Salisbury, et al., Head-worn displays for emergency medical services staff: properties of prehospital work, use cases, and design considerations, in: Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems, 2021, pp. 1–14.
[14] Z. Zhang, E. Bai, K. Joy, et al., Smart glasses for supporting distributed care work: systematic review, JMIR Med. Inform. 11 (2023) e44161.
[15] L.-H. Lee, P. Hui, Interaction methods for smart glasses: a survey, IEEE Access 6 (2018) 28712–28732.
[16] A. Follmann, M. Ohligs, N. Hochhausen, et al., Technical support by smart glasses during a mass casualty incident: a randomized controlled simulation trial on technically assisted triage and telemedical app use in disaster medicine, J. Med. Internet Res. 21 (2019) e11939.
[17] J. Broach, A. Hart, M. Griswold, et al., Usability and reliability of smart glasses for secondary triage during mass casualty incidents, in: Proceedings of the Annual Hawaii International Conference on System Sciences Annual Hawaii International Conference on System Sciences, 2018, p. 1416.
[18] M.X. Cicero, B. Walsh, Y. Solad, et al., Do you see what I see? Insights from using google glass for disaster telemedicine triage, Prehosp. Disaster Med. 30 (2015) 4–8.
[19] D. Drummond, C. Arnaud, R. Guedj, et al., Google Glass for residents dealing with pediatric cardiopulmonary arrest: a randomized, controlled, simulation-based study, Pediatr. Crit. Care Med. 18 (2017) 120–127.
[20] A. Kebapci, M. Ozkaynak, F. Bowler, et al., A pilot randomized controlled study to determine the effect of real-time videos with smart glass on the performance of the cardiopulmonary resuscitation, CIN Comput. Inform. Nurs. (2023), https://doi.org/10.1097/CIN.0000000000001211.
[21] K. Apiratwarakul, L.W. Cheung, K. Ienghong, Impact of smart glasses on patient care time in emergency medical services ambulance, Prehosp. Disaster Med. 38 (2023) 735–739.
[22] P.D. Schlosser, B. Matthews, P.M. Sanderson, et al., Effects of augmented reality-based remote mentoring on task performance and communication: a simulation study in the context of emergency medical services, Telemed. e-Health 30 (2024) 1470–1478.
[23] Z. Zhang, E. Bai, Y. Xu, et al., A smart glass telemedicine application for prehospital communication: user-centered design study, J. Med. Internet Res. 26 (2024) e53157.
[24] E. Bai, Z. Zhang, Y. Xu, et al., User-centered design of an Emergency Department telemedicine application for prehospital communication. American Medical Informatics Association Annual Symposium, 2024.
[25] R.L. Lammers, M.J. Byrwa, W.D. Fales, et al., Simulation-based assessment of paramedic pediatric resuscitation skills, Prehosp. Emerg. Care 13 (2009) 345–356.
[26] T.P. Boyle, J.N. Dugas, J. Liu, et al., Adaptation of a simulation model and checklist to assess pediatric emergency care performance by prehospital teams, Simul. Healthc. 18 (2023) 82–89.
[27] Y. Kim, C. Groombridge, L. Romero, et al., Decision support capabilities of telemedicine in emergency prehospital care: systematic review, J. Med. Internet Res. 22 (2020) e18959.
[28] J.R. Langabeer, M. Gonzalez, D. Alqusairi, et al., Telehealth-enabled emergency medical services program reduces ambulance transport to urban emergency departments, West. J. Emerg. Med. 17 (2016) 713.
[29] S. Thim, T.B. Henriksen, H. Laursen, et al., Simulation-based emergency team training in pediatrics: a systematic review, Pediatrics 149 (2022) e2021054305.
[30] H.A. Hewes, M. Dai, N.C. Mann, et al., Prehospital pain management: disparity by age and race, Prehosp. Emerg. Care 22 (2018) 189–197.
[31] J.D. Hoyle Jr, A.T. Davis, K.K. Putman, et al., Medication dosing errors in pediatric patients treated by emergency medical services, Prehosp. Emerg. Care 16 (2012) 59–66.
[32] S. Owusu-Ansah, R.P. Crowe, S. Ramgopal, Racial, ethnic, and socioeconomic disparities in prehospital encounters for children with asthma, Prehosp. Emerg. Care 27 (2023) 1107–1114.
[33] L.M. Cristiano, B. Hiestand, J.W. Caldwell, et al., Prehospital administration of epinephrine in pediatric anaphylaxis–a statewide perspective, Prehosp. Emerg. Care 22 (2018) 452–456.
[34] J.L. Trainor, Z.E. Pittsenbarger, D. Joshi, et al., Outcomes and factors associated with prehospital treatment of pediatric anaphylaxis, Pediatr. Emerg. Care 38 (2022) e69–e74.