Can you see what I see? Examining the Impact of Smart Glasses on Communication Dynamics in Distributed Emergency Medical Teams

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Effective communication is critical for emergency medical teams, especially when distributed providers must collaborate under high-stakes conditions to deliver timely, life-saving care. Traditional communication tools such as radios and phones, while commonly used, are limited to audio-only exchanges—often resulting in misunderstandings, communication breakdowns, and delays in treatment. This study explores the use of smart glasses as an alternative communication tool in prehospital emergency care and examines how their use influences communication dynamics between prehospital providers (e.g., paramedics) and remote emergency physicians, compared to traditional methods (radio and phone). Through simulation-based testing, we found that smart glasses reduced communication breakdowns and facilitated more in-depth, context-rich discussions about patient care. Both EMS providers and physicians viewed the smart glass technology as a promising solution for enabling multimodal communication (e.g., visual, auditory, gestures, text). However, we also identified several challenges associated with its use in near-realistic simulation environments, including the need for overhearing capabilities, issues with visual alignment and motion-induced discomfort, extended interaction times, and concerns around autonomy and privacy. We conclude with a discussion of the design and practical implications of these findings.

CCS Concepts: • **Human-centered computing** → **Collaborative and social computing devices**.

Additional Key Words and Phrases: Smart Glass, Emergency Care, Prehospital Communication, Teamwork

ACM Reference Format:
Zhan Zhang, Enze Bai, Yincao Xu, Kathleen Adelgais, and Mustafa Ozkaynak. 2025. Can you see what I see? Examining the Impact of Smart Glasses on Communication Dynamics in Distributed Emergency Medical Teams. *Proc. ACM Hum.-Comput. Interact.* 9, 7, Article CSCW384 (November 2025), 34 pages. https://doi.org/10.1145/3757565

1 Introduction

Effective communication and care coordination are essential for safe, efficient, and patient-centered care [20, 52]. Failures in doing so are often seen as a major root cause of adverse events, such as delays in patient care and deviations from care procedure [80]. These adverse events are particularly concerning in emergency medical settings, where they can lead to severe consequences, including

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ACM 2573-0142/2025/11-ARTCSCW384
https://doi.org/10.1145/3757565

increased morbidity and mortality [41]. In these high-stakes environments, care providers must make rapid decisions under time pressure and with limited resources to treat life-threatening conditions, all while managing elevated cognitive workloads and stress [74]. The challenge is further exacerbated when communication and care coordination must occur across distributed, multidisciplinary teams, such as between prehospital emergency medical services (EMS) teams and remote emergency care providers—a process known as *prehospital communication* [67, 72, 96].

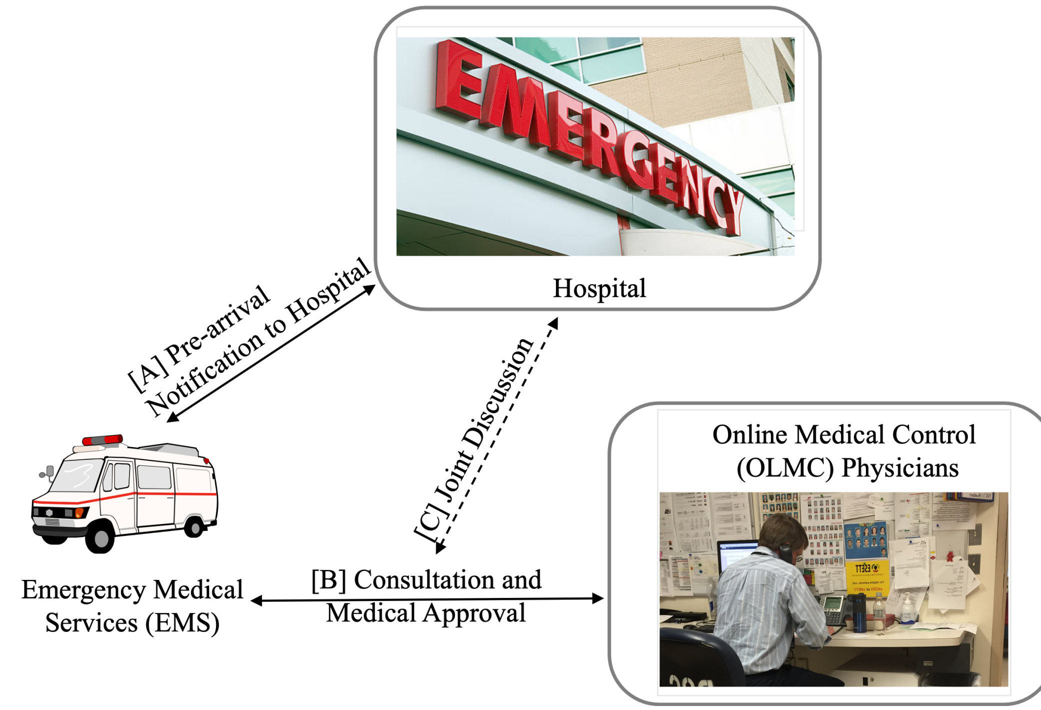

Fig. 1. A typical prehospital communication process in the United States: (A) Emergency medical services (EMS) providers contact the emergency department (ED) at the receiving hospital to provide a pre-arrival notification. (B) EMS providers contact an online medical control (OLMC) physician for medical guidance and decision support. (C) A hospital may be added to the call to discuss the appropriate patient destination jointly with EMS providers and OLMC physicians.

In the United States, there are currently more than 23,000 EMS agencies providing emergency care to over 40 million patients annually [62]. The management of critically ill or injured patients (e.g., trauma, stroke, heart attack) requires effective communication and care coordination across distributed emergency care teams [72, 81]. For example, EMS providers must give a pre-arrival notification to the emergency department (ED) at the receiving hospital, enabling the receiving ED teams to better prepare for the patient's arrival (e.g., summoning necessary experts, preparing needed equipment, and ordering lab tests, etc.) (Figure 1A). Additionally, per prehospital care protocol, EMS providers sometimes need to consult with a more experienced emergency care physician, known as an online medical control (OLMC) physician in the U.S. emergency care system, regarding diagnoses, treatments, and appropriate patient destinations (Figure 1B). When discussing patient destinations, the hospital may be added to the call to make a joint decision (e.g., determining whether the hospital has the required expertise or facilities to treat a critical patient)

(Figure 1C). Despite its critical role, the prehospital communication process remains ineffective and challenging [67, 70, 96]. One of the main reasons is the limited support offered by current communication mechanisms—EMS providers use either radio or phone to contact a remote OLMC physician or a hospital, relying solely on verbal descriptions to explain the situation they are facing. On the other side, OLMC physicians or the receiving ED team at the hospital often struggle to fully understand the patient's condition. These limitations in current communication mechanisms inevitably lead to confusion and miscommunication [67, 97], and even trust issues (e.g., OLMC physicians or ED teams may not trust EMS providers' judgment and interpretation of the patient's status and symptoms) [96], which can adversely affect patient outcomes.

To improve the communication process during prehospital care, several technology solutions have been proposed and tested over the past two decades [93], including ambulance-based telemedicine systems (e.g., [6, 10, 88]) and mobile applications for data sharing between the field and the receiving hospital [79]. However, these systems have had a very low adoption rate, partly due to specific limitations (e.g., portability and over-reliance on manual input) and their misalignment with prehospital workflows [69]. For instance, due to the size and weight of the telemedicine unit in ambulances, it is cumbersome or even impossible to use the device outside the ambulance, where a significant portion of patient care takes place [10]. EMS providers also need to keep their eyes and hands on the patient, which limits their ability to interact with handheld computing devices that require manual control [95]. Finally, the physical handling of these systems increases the likelihood of cross-contamination and patient infections [66]. Therefore, it is evident that more workflow-compliant technologies are needed to support prehospital communication and collaboration [76].

Smart glasses—a type of lightweight head-worn device (HWD) with a see-through screen and a video camera that can project first-person, point-of-view data to a remote viewer—have a high potential to serve as an unobtrusive technological conduit between distributed emergency care teams [76, 90]. These devices can be operated hands-free (e.g., through voice control), minimizing their intrusiveness in high-pressure, hands-busy clinical environments [48, 55, 91]. More importantly, smart glasses are often powered by augmented reality (AR) technologies that offer interactive capabilities—such as overlaying text, images, and annotations onto the wearer's view—to guide the execution of clinical tasks. Given these advantages, smart glasses have been explored to facilitate communication and collaboration between distributed emergency care providers (e.g., [9, 11, 16, 25]). While these studies highlight the technical feasibility, perceived usefulness, and clinical benefits of using smart glasses in prehospital care, their effects on communication dynamics and team collaboration remain underexplored [15, 43]. Recent studies have called attention to this gap, emphasizing the importance of examining the collaborative implications of smart glasses in high-stakes, fast-paced environments [1, 68, 78]. Building upon this prior work, our study aims to bridge this gap by investigating how smart glasses influence communication behaviors among emergency care providers compared to traditional communication tools (e.g., radio or phone). Specifically, we examine how smart glass technology may alter interaction patterns, information exchange, and collaborative dynamics between distributed medical teams. To that end, we aim to answer the following research questions (RQs):

- ***RQ 1: Does using smart glasses reduce communication breakdown?*** Conventional communication technologies (e.g., radio) that rely solely on verbal communication to share patient information between distributed emergency care teams have been identified as a root cause of communication breakdowns [67, 96]. When communication breakdowns occur, both sides must make extra efforts to understand each other, causing delays in the care process and leading to frustration. We are interested in examining whether smart glasses can help mitigate communication breakdowns.

- ***RQ 2: Does using smart glasses alter the communication dynamics among distributed emergency care providers?*** As smart glasses support the communication of multiple cues (e.g., visual, audio, gestures, gaze, text), we hypothesize that this multimodal communication mechanism may alter communication dynamics—such as the duration of interactions and the types of information exchanged. Therefore, we aim to assess whether using smart glasses impacts the communication behaviors of distributed emergency care providers. Additionally, as smart glasses may also affect intra-team interactions and collaboration [29], we are also interested in exploring how the use of smart glasses affects EMS teamwork—specifically, whether and how EMS providers who are not wearing the smart glasses engage with both their teammates and OLMC physicians while using different communication modalities.
- ***RQ 3: Is the visual attention between EMS providers and remote physicians aligned during video-based communication?*** A high level of visual alignment between distributed care providers during telemedicine could ensure efficient communication, as their attention is synchronized on the same objects (e.g., the patient, equipment, vital signs monitor, etc.). Misalignment between the smart glasses wearer's line of sight (e.g., the direction of gaze) and what the smart glasses camera captures (e.g., the camera's range and angle) has frequently been identified as a significant barrier to the effective use of smart glasses in remote care coordination [21]. This issue is often attributed to the limited field of view of smart glasses and can be exacerbated by sudden head movements, causing motion blur and even discomfort for remote collaborators [8]. As this issue could negatively impact communication, we aim to assess the visual alignment between EMS providers and remote emergency care physicians during their conversation via smart glasses.
- ***RQ 4: What are the experiences of care providers in using smart glasses for prehospital communication?*** Successful user adoption of any health information technology—no matter how promising—depends heavily on users' experiences with and satisfaction toward the technology [89]. Although smart glasses are not a new concept in the technology sector or academic research, their adoption in healthcare settings remains limited. To better understand the potential barriers and socio-technical issues for implementing smart glasses in prehospital care, we assessed the experiences of all stakeholders, including EMS team members (both wearers and non-wearers of smart glasses) and remote physicians.

To answer these research questions, we conducted simulations in two regions (a rural mountain region and an urban area on the east coast of the U.S.) where EMS providers used smart glasses and their current communication mechanisms (e.g., phone or radio) in simulated scenarios to communicate with an OLMC physician for decision support. Although our smart glass application was developed to support the full spectrum of prehospital communication—including EMS providers contacting an OLMC physician for medical guidance (Figure 1B), notifying the receiving hospital about patient arrival (Figure 1A), or conducting a multi-party discussion (Figure 1C)—this study specifically focused on communication between EMS providers and OLMC physicians. This focus was chosen because such interactions typically involve more extensive discussion and decision-making than hospital notifications, offering richer context and more meaningful communication instances for evaluating the technology. A variety of data (e.g., recordings of communication, eye-tracking, interviews, and survey responses) were collected and analyzed to provide a holistic view of the impact of using smart glasses on the dynamics of prehospital communication and team collaboration. This study demonstrates that smart glasses can significantly mitigate communication breakdowns and enhance communication between EMS providers and OLMC physicians by enabling first-person video streaming and multimedia information sharing (e.g., vital signs and treatments). However, challenges such as visual alignment issues, longer interaction durations, privacy and autonomy concerns, and impacts on team dynamics highlight the need to address these socio-technical barriers for the successful adoption of smart glasses in emergency medical settings.

Our study makes three key contributions to the CSCW field: 1) Empirical insights into how smart glasses influence communication dynamics among distributed emergency medical teams; 2) Socio-technical challenges associated with using smart glasses for facilitating remote communication in high-stakes medical environments; and 3) Design implications for enhancing the effectiveness of smart glasses in time-critical care.

2 Related Work

2.1 Computer-Mediated Communication in Medical Settings

Effective communication between care providers is critical for care delivery [20, 52]. This information exchange can take place both synchronously, such as through face-to-face care delivery, and asynchronously, through methods like emails, patient chart notes, or pagers. The importance of studying and improving communication among care providers in medical settings has been widely recognized by prior literature [22, 51, 84]. For example, seminal HCI and CSCW studies have looked into how the use of communication and information technologies facilitate or hinder communication between care providers with the ultimate goal of understanding how we can optimize the use of these technologies to support effective communication in dynamic medical settings (e.g., [4, 5, 32, 63, 85]).

Of particular relevance are studies focused on communication and care coordination in time-critical medical settings, and the use of technology to enhance synchronous communication among fast-paced medical team members, who may be collaborating remotely or are mobile and not physically co-present in the same location (e.g., trauma team members from different departments and units within a hospital) [19, 23, 40]. For example, one study examined communication patterns and disruptions within and between emergency care providers and found that the most significant communication gaps occurred between EMS providers and those in the ED who would ultimately care for the patient during their ED stay [23]. Another study [40] examined communication among distributed care providers (e.g., remote neurologists and paramedics) during telemedicine-enabled stroke care consults and highlighted the importance of using both verbal and nonverbal communication channels to ensure effective patient coverage during teleconsultation.

In this body of literature, telemedicine technology was the most commonly used tool to support synchronous communication among distributed emergency medical teams [10, 24, 40, 88]. Studies have tested the technical feasibility and clinical effectiveness of using ambulance-based telemedicine systems to establish real-time, audio-video communication between EMS providers and remote experts for medical guidance. It has been well documented that care providers found the video-based communication channel useful for patient diagnosis, and such systems have achieved a high level of satisfaction and acceptance among emergency care providers [6, 24, 88]. However, limitations and user concerns regarding ambulance-based telemedicine systems were also reported. A critical limitation of this technology is that the devices were hard to use, inconvenient to carry, and often became a hindrance to the user [93]. For example, one study [10] reported that the size and weight of the telemedicine unit made it cumbersome or even impossible to use outside the ambulance, where a significant portion of patient care takes place. Additionally, the devices (e.g., cameras and computers installed inside the ambulance) relied on manual operation (e.g., adjusting the camera angle to capture a designated area), which could interfere with patient care activities that often occupy the providers' hands [28].

Given the limitations of ambulance-based telemedicine systems, there is a growing need for more portable telemedicine technologies that can accommodate the hands-busy and mobile nature of EMS work. Hands-free, wearable technologies that support video streaming and multimedia communication have gained momentum and have been increasingly explored by CSCW and HCI researchers in recent years, as reviewed in the next section.

2.2 Wearable, Hands-Free Communication Technology in Time-Critical Medical Settings

A substantial body of CSCW research has explored how video streaming and visual sharing technologies support collaborative work across distributed teams, particularly in time- and safety-critical domains [7, 49]. Prior studies have shown that live video streaming from body-worn cameras enhances situational awareness in high-stakes environments [50], such as firefighting [42, 59], 9-1-1 calling [58], and emergency response [7, 37]. For example, Jones et al. [37] examined how wearable body cameras in search and rescue operations streamed live video to command centers, enhancing commanders' situational awareness and confidence in decision-making, while also reducing the need for frequent radio communication.

However, visual communication alone is often insufficient—particularly in critical medical settings where remote experts must actively guide on-site practitioners through complex procedures. Body-worn cameras (e.g., GoPro) may provide visual access to the scene, but they lack interactive capabilities necessary to support deeper collaborative engagement. In contrast, HWDs have gained attention as promising tools because they not only enable live video streaming but can also augment the wearer's view with contextual overlays such as text, images, and annotations to guide the execution of clinical tasks.

HWDs have been studied extensively in healthcare, as summarized by Schlosser et al. [77]. A key advantage of these devices is their hands-free functionality, which allows clinicians to access and share information while keeping both hands available for patient care. HWDs exist in various forms. One category includes mixed-reality (MR) devices, such as the Microsoft HoloLens, which allow users to interact with both physical and virtual objects. These MR systems have been used for both training and real-time collaboration. For example, one study [27] developed an MR system for immersive surgical telementoring, allowing a more experienced remote surgeon to guide a local surgeon through critical procedures using features like pointing, drawing, and annotation on video clips.

Despite their functionality, MR devices tend to be bulky and less practical in fast-paced, mobile clinical environments. In these settings, lightweight and simpler HWDs are often more appropriate and better received by care providers [30, 44]. Smart glasses, a type of lightweight HWD, have been found to be more suitable for mobile and dynamic emergency care settings such as EMS [18, 76, 90, 94]. In the following section, we review their use in supporting communication and coordination among distributed emergency medical teams.

2.3 Smart Glasses in Supporting Communication among Distributed Emergency Medical Teams

Smart glasses, a lightweight HWD option worn like a traditional pair of glasses with see-through screens, are often powered by augmented reality (AR) to overlay text, images, or annotations onto the wearer's field of view. Since their introduction almost a decade ago, smart glasses have been studied in various medical settings and have been shown to enhance collaboration among healthcare providers in different locations [18, 55, 68, 90]. For instance, a local surgeon might use smart glasses to receive real-time guidance from a remote specialist [8], or a nursing student can benefit from expert support during cardiopulmonary resuscitation [64].

Studies that examine the feasibility, effectiveness, and affordances of smart glasses in prehospital care settings are particularly relevant to our research (e.g., [9, 11, 16, 25, 78]). Using smart glasses, EMS providers can transmit live visual information from the field to remote emergency physicians in a hands-free manner. These studies highlighted that smart glasses could boost remote consultants' confidence in their judgment and achieve diagnostic accuracy comparable to that of in-person patient examinations [9, 61], and improve the proficiency and performance of patient care activities and tasks in the field [16, 25], all by enabling remote consultants to see the patient through the EMS providers' first-person view. In the meantime, EMS providers can keep both hands and eyes on the patient without the need to manually operate the device, minimizing interference with the EMS workflow. As a result, EMS providers reported positive user perceptions, high technology acceptance, and satisfaction with the use of smart glasses [9, 16, 25].

Although prior research has established the technical feasibility, usability, and clinical advantages of smart glasses in prehospital care, their impact on communication dynamics and team collaboration remains underexplored. Recent reviews have called attention to this gap, urging more research on the collaborative implications of smart glasses in high-stakes, fast-paced environments [15, 43]. A few studies in emergency response contexts have begun addressing these questions [1, 68, 78]. For instance, Reuter et al. [68] showed how smart glasses augmented with visualizations like "fog of war" could support coordination among search and rescue dog handlers, though the study focused more on spatial awareness than verbal communication. Similarly, Alharthi et al. [1] found that displaying team members' status through HWDs influenced how and when support was offered during search and rescue missions. More recently, Schlosser et al. [78] compared smart glasses and phone communication in a controlled EMS simulation. Although they did not observe significant differences in task completion time or error rates, they noted that smart glasses reduced the need for remote mentors to request situational updates and increased their ability to provide feedback and guidance.

While our study builds on this body of work, it differs in several key ways. First, we move beyond measuring performance metrics and basic communication frequency to examine more nuanced aspects of communication behavior, including communication breakdowns, visual attention alignment, interaction duration, and the specific types of content being discussed. Second, we evaluate the impact of smart glasses on both intra-team (e.g., between EMS providers) and inter-team (e.g., between EMS providers and remote physicians) collaboration and communication—an area, to the best of our knowledge, not previously examined in this context. Third, as pointed out by literature [17, 29, 75], many studies on medical AR technologies focus narrowly on task performance and overlook users' lived experiences—including perceived benefits, autonomy, privacy, and social implications. To address this gap, our study explicitly investigates the experiences of all key stakeholders: EMS providers wearing the smart glasses, their partners in the field, and the remote OLMC physicians.

In sum, through quantitative analysis of communication behaviors, video analysis of team dynamics, and qualitative analysis of user experiences from all stakeholders, our work fills an important research gap in the CSCW literature by examining how smart glasses reshape communication practices, collaboration dynamics, and user experience in distributed emergency medical teams.

2.4 Visual Alignment during Camera Work

While video streaming offers distributed teams a powerful means of sharing contextual information, ensuring that relevant visual content—particularly the object of interest—is effectively captured remains a persistent challenge. Inefficient "camera work" [36, 37] can reduce situational awareness and shared understanding, potentially leading to miscommunication and loss of nuanced visual cues. These challenges become even more evident with mobile cameras, where a moving viewpoint complicates stable framing [39].

Smart glasses present similar limitations. Prior studies have highlighted frequent misalignments between the wearer's line of sight (e.g., gaze direction) and what the smart glasses' camera actually captures (e.g., camera range and angle) [21, 90]. This misalignment is often due to the limited field of view of smart glasses and can be worsened by sudden or frequent head movements, causing motion blur and even discomfort for remote collaborators [8]. Given the potential negative impact on communication, we aim to assess the degree of visual alignment between EMS providers and remote OLMC physicians during smart glass-enabled interactions and explore key factors that may hinder the development of shared visual focus and situational understanding.

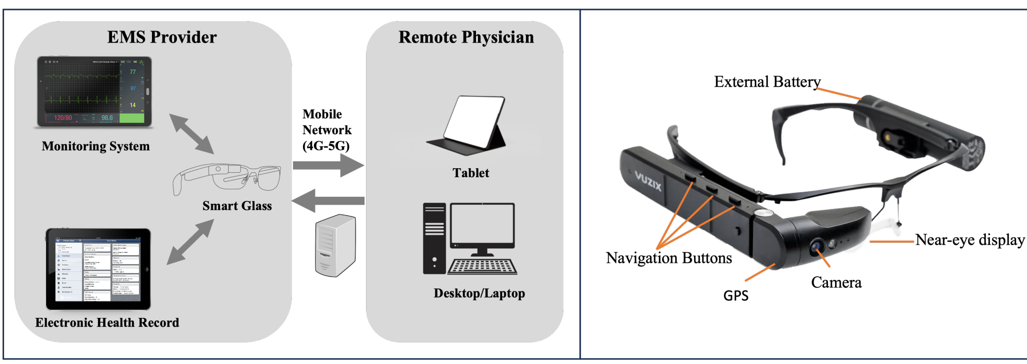

Fig. 2. Left: The system architecture of the integrated telemedicine system. Right: The smart glasses device (Vuzix M400) used in the project.

3 Methodology

3.1 Study Background

This study is part of a larger research effort to develop effective technology interventions to improve communication and care coordination between EMS providers and remote care teams (including OLMC physicians). As part of the research, we iteratively designed and developed an integrated telemedicine system, which consists of a smart glass application for EMS providers to contact an OLMC physician for medical guidance or the receiving hospital for patient arrival notification [92], and a web-based application for remote care teams (e.g., OLMC physicians) to receive information and connect with EMS providers for video-based communication [3] (Figure 2-Left). The smart glass application was designed to be device-agnostic; however, in this study, we deployed it on the Vuzix M400 device (Figure 2-Right). The web-based application can be accessed by remote physicians via a laptop, tablet, or desktop computer.

To connect with an OLMC physician using the smart glass application, the EMS provider needs to perform two steps: selecting the option to contact OLMC on the home screen and indicating the reason for the call (e.g., due to limited availability of OLMC physicians, more critical calls, such as trauma or heart attack, will be prioritized and answered first by OLMC physicians) (Figure 3-Left). The interaction with the device can be accomplished through three methods: clickable buttons on the device (Figure 2-Right), voice commands, and hand gestures. Once the call is established, the EMS provider can stream a first-person view to the remote OLMC physician. Additionally, the smart glass application can integrate with the electronic health record (EHR) system and the vital sign monitor to share key medical information—such as vital signs and administered medications—with

Fig. 3. Left: The interface of the smart glasses application used by EMS providers to contact an OLMC physician for medical guidance or the receiving hospital for patient arrival notification. Right: The web-based application interface for remote care teams (e.g., OLMC physicians) to connect with EMS providers for video-based communication and receive information.

Table 1. Summary of the features of the integrated system

System Feature	Brief Explanation
- Live Video Streaming	- Smart glasses stream a first-person view of the patient and environment to the remote physician.
- EHR and Vital Signs Integration	- Smart glasses connect to the EHR and vital sign monitor to transmit patient data.
- Touchless Operation	- The system supports hands-free control using voice commands and hand gestures.
- Note-Taking Functionality	- Remote physicians can take notes directly within the web-based application.
- Text-Based Guidance Display	- Remote physicians can send text instructions, which are displayed as augmented content in the smart glass wearer's field of view.

remote physicians (Figure 2-Left). On the receiving end, physicians can view both the video stream and the shared data through the web-based application (Figure 3-Right). They can also take notes and send written guidance (e.g., medication dosages) to EMS providers in situations where verbal communication is compromised, such as in noisy environments. This text-based guidance appears as augmented content within the glass wearer's field of view. The main features of our system are summarized in Table 1.

The system design process was iterative and grounded in participatory design, involving two phases of requirement gathering, rapid prototyping, and usability evaluation. The system design process for both applications has been reported elsewhere [3, 92]. In this paper, we report on our summative evaluation, during which we conducted simulations to assess how the integrated telemedicine system affects communication between EMS providers and OLMC physicians. The study design and simulation procedures are described below.

3.2 Study Design

In total, we conducted 16 simulations at two EMS agencies in the United States: a fire-based agency in a rural area of the mountain region, and a hospital-based agency in an urban area on the east coast. We selected these two sites with varying characteristics (e.g., rural versus urban, fire-based versus hospital-based, mountain region versus east coast) to enhance the generalizability of the findings. We conducted eight simulations at each EMS agency. In the mountain region agency, the simulations were conducted in a mobile simulation lab that resembles the back of an ambulance (Figure 4-Left), while at the east coast agency, the simulations were conducted in a simulation lab within the affiliated hospital (Figure 4-Right). In total, 35 unique EMS providers and 11 physicians participated in the simulations. We chose to test the system in simulated environments rather than real-world settings because the smart glass system is not yet fully integrated into routine EMS practice. Simulation offers a safe, controlled setting to systematically evaluate emerging technologies without disrupting actual clinical workflows or compromising patient safety. Given the high stakes of prehospital care, it is both necessary and ethical to first assess the feasibility, usability, and potential impact of such systems in a simulated context. Moreover, simulations allow for direct, in-person observation of team interactions and communication dynamics, enabling researchers to capture nuanced behaviors and breakdowns that may go unnoticed in the field. The early insights identified in this study are essential for refining the technology and ensuring readiness before progressing to field-based evaluations in real emergency scenarios.

Fig. 4. Left: An illustration of the mobile simulation lab used in the mountain region simulations. Right: An illustration of the simulations conducted in the simulation lab in the east coast region.

During each simulation, EMS providers were asked to perform two different medical scenarios back to back: a five-year-old pediatric patient with anaphylaxis (scenario #1) and a five-year-old pediatric patient with asthma (scenario #2). We chose these two medical scenarios to minimize their impact on task performance because they had an equivalent level of complexity, and most EMS providers were expected to have the necessary knowledge to handle such cases. In each scenario, the EMS provider was instructed to contact OLMC via either radio/phone (control group) or the smart glasses application (treatment group) to discuss the patient's status and obtain medical approval for certain treatments and medications. For the control group, the EMS teams in the mountain region agency used a mobile phone for communication, as that is their commonly used method for contacting the OLMC physician, while the EMS teams in the east coast agency used a radio as their communication method. Due to limited availability, three physicians participated in the simulations in the mountain region, with each physician participating in at least two simulations. In contrast, each simulation conducted in the east coast region had a unique physician.

We randomized the order of scenarios and the communication technology used for each team to ensure that the number of teams using smart glasses or radio/phone for each medical scenario was balanced. Table 2 provides details on the participating teams and the devices they used in each medical scenario. However, team 8 was unable to complete the simulation because the temperature inside the mobile simulation lab exceeded 105 degrees (Fahrenheit), causing discomfort due to the extreme heat. Therefore, we excluded the data from team 8 from this study.

Table 2. An overview of simulation study design details, including the EMS team ID, their geographic region, the physician assigned to each team, and the technology used in each scenario

EMS Team#	Region	Paired Physician	Scenario#1	Scenario#2
Team #1	Mountain region	Physician #1	Phone	Smart glass
Team #2	Mountain region	Physician #2	Phone	Smart glass
Team #3	Mountain region	Physician #2	Phone	Smart glass
Team #4	Mountain region	Physician #3	Phone	Smart glass
Team #5	Mountain region	Physician #2	Smart glass	Phone
Team #6	Mountain region	Physician #3	Smart glass	Phone
Team #7	Mountain region	Physician #1	Smart glass	Phone
Team #8	Mountain region	Physician #1	Smart glass	Phone
Team #9	East coast	Physician #4	Radio	Smart glass
Team #10	East coast	Physician #5	Radio	Smart glass
Team #11	East coast	Physician #6	Radio	Smart glass
Team #12	East coast	Physician #7	Radio	Smart glass
Team #13	East coast	Physician #8	Smart glass	Radio
Team #14	East coast	Physician #9	Smart glass	Radio
Team #15	East coast	Physician #10	Smart glass	Radio
Team #16	East coast	Physician #11	Smart glass	Radio

3.3 Simulation Procedure

Before each simulation session, the research team trained EMS providers to use the smart glass application and the OLMC physician to use the web-based application until they felt comfortable and confident using the system independently. Specifically, the researchers first explained all the system features, then invited participants to try out the system they would be using. There was no time limit for the training; participants were encouraged to take as much time as they needed to become familiar with the system.

During the simulation, EMS providers used the equipment and medications normally available to them to complete the two scenarios. They were also instructed to contact the OLMC physician for decision support and medical approval. After each simulation, both EMS providers and OLMC physicians first completed a survey with Likert-scale questions to assess the system's usability and their perceived usefulness of the integrated telemedicine system for communication. This was followed by a semi-structured interview to discuss any problems participants felt the system introduced, the hindrances it created, the support it provided, and its acceptability and potential for adoption.

We also used eye-tracking devices from Pupil Labs to track EMS providers' and OLMC physicians' visual attention while they were using their respective applications. We used the Neon model to track EMS providers' eye movement, as it can be mounted on wearable glasses, and the Pupil Core model for tracking OLMC physicians' visual attention, as this model is more suitable for desktop/laptop applications. The eye-tracking data helped us answer RQ3, which concerns the visual attention alignment of both EMS providers and OLMC physicians during communication via smart glasses.

Each simulation lasted about one hour and was both video- and audio-recorded. The communication process between EMS providers and OLMC physicians was also recorded (communications that occurred via radio/phone were only audio-recorded, while those that occurred via smart glasses were both video- and audio-recorded). The study received approval from Pace University's Institutional Review Board (IRB). All participants signed consent forms before the simulations and received compensation (a $100 gift card).

3.4 Data Analysis

The recorded communication between EMS providers and OLMC physicians was transcribed verbatim using Excel sheets to provide a linear list of the conversations and performed tasks. Each transcript includes timestamps, conversations, the speaker (who was speaking), and the subject (who the speaker was talking to). For smart glass-based communication, we also documented actions, gestures (e.g., pointing), or tools used. One researcher (R2) transcribed all the recordings, while two other researchers (R1 and R3) performed quality control to ensure the transcription was accurate.

3.4.1 Analysis of Communication Breakdowns. To answer RQ1 (whether the use of smart glasses could help mitigate communication breakdowns), we analyzed and compared the types and frequency of communication breakdowns that occurred in smart glass conditions versus radio conditions. We did not include the cases where a phone was used because the phone also relied on a 5G network, similar to the smart glasses. Our analysis was grounded in established literature on communication and coordination breakdowns in high-stakes clinical settings (e.g., [65, 73, 86]) to identify instances of failed mutual understanding or disrupted information flow. Operationally, we reviewed all the transcripts and listened to all the recordings to identify events where conversations were inaudible, questions or information had to be repeated, or misunderstandings were evident. We also measured the recovery time associated with each breakdown—for example, how long it took to re-establish a connection, repeat a question, or clarify a miscommunication—and computed the average recovery time for both smart glass and radio conditions.

3.4.2 Analysis of Communication Dynamics. To answer RQ2 (whether the use of smart glass affects communication dynamics), we analyzed several aspects of the communication between EMS providers and OLMC physicians. For example, we first examined differences in interaction durations across smart glass, radio, and phone conditions. To do this, we measured the start and end times of each conversation to calculate its duration. We then performed the Mann-Whiney U test to assess whether there were significant differences across the different technology conditions. In addition, we measured the variability of interaction durations within each condition. A median-based Levene's test was subsequently conducted to determine whether there were significant differences in variance across the conditions.

We were also interested in understanding the differences related to the frequency of different communication purposes (e.g., asking a question or stating a decision), and the types of information being communicated, discussed, or asked across the smart glass, radio, and phone conditions. To do so, R2 and R3 first reviewed a small set of communication transcripts (1 radio case, 1 phone case, and 2 smart glasses cases) to develop a coding scheme to capture different purposes of communication and types of communicated information. The initial list of codes was discussed among all the researchers. After the coding scheme was finalized, we created a codebook defining each code to standardize the coding process (Appendix Table). The codes related to the purpose of communication included requesting information, reporting information, stating intention, stating a decision, acknowledging information, discussing the care plan, etc. The codes related to the type of communicated information were categorized into two levels. The higher-level categories included patient condition, equipment, physical examination, treatment, demographic, mechanism of injury, etc. Each high-level category had its own low-level categories; for example, patient conditions included low-level categories such as airway status, breathing, symptoms, consciousness, etc.

After completing the qualitative analysis of communication content, we conducted statistical analyses to assess whether there were significant differences across technology conditions. We chose non-parametric statistical methods because the sample size was not large enough to assume a normal distribution. More specifically, we first normalized the data to enable comparison within the same unit of time, as longer communications typically involve more information sharing and simply comparing the total frequency of communicated information within the total normalized simulation time across different technology conditions would not yield meaningful insights. By normalizing the data, we could assess which technology facilitated more information sharing and discussion within the same time frame. Following data normalization, we performed a Wilcoxon Signed-Rank test to compare the communication content and instances (e.g., types and frequency of communicated information) between smart glass conditions and those using phones or radios. Notably, we were comparing smart glasses to the other two traditional communication tools and not focusing on the comparison between phone and radio, which resulted in a two-group testing process for all aforementioned tests.

In addition to analyzing EMS provider–OLMC physician communication, we also examined how EMS teammates who did not wear smart glasses participated in the discussion, compared to the phone and radio conditions. Specifically, we investigated whether they engaged in the conversation during the call and how their level of participation differed across conditions. For the sessions in which teammates contributed to the discussion, we reviewed the transcripts and video recordings to identify behavioral differences in communication dynamics.

3.4.3 Analysis of Visual Attention. To answer RQ3 (the visual alignment between distributed care providers during smart glass-based communications), we followed prior work on joint attention in distributed collaboration [26, 31] to examine whether EMS providers and OLMC physicians were visually aligned during their interaction. In particular, we analyzed eye-tracking data from both parties to assess the extent to which their visual attention—defined as the focus of gaze—converged on the same areas or objects, indicating coordinated attention during critical moments of care.

Specifically, we began by uploading raw eye-tracking data from the Pupil Labs eye-trackers—which integrates input from two eye-facing cameras and a forward-facing camera—into Pupil Cloud, the platform's cloud-based data processing software. This tool reconstructs the first-person view with gaze overlays. Gaze points were visualized as circles, with smaller diameters indicating higher confidence in gaze estimation. This step helped identify the object a participant was visually focusing on at any given moment.

Next, two researchers conducted a manual, frame-by-frame analysis of the synchronized eye-tracking videos to identify the objects each participant focused on and the duration of that focus (referred to as dwell time [35]). These data were systematically recorded in Microsoft Excel. To assess meaningful visual attention, we focused specifically on instances where dwell time exceeded three seconds. We adopted this threshold based on prior literature, which distinguishes between glances—taking a quick glance (<= 3 seconds) and scrutiny—fixating attention over a longer time (> 3 seconds) [45, 82]. Our rationale for emphasizing longer dwell times is grounded in research showing that cognitive processing and information integration typically occur during longer visual fixation, not during fleeting glances [71].

Once we completed the analysis of where the care providers directed their attention, we examined visual attention alignment by comparing whether EMS providers and OLMC physicians were focusing on the same object at overlapping times. For each smart glass session, we calculated the total duration of aligned visual attention and plotted the dwell times of both parties on a synchronized timeline (see Figure 7 for an example). For sessions with low alignment, we further reviewed the recordings to identify contributing factors, such as task complexity and head movement.

3.4.4 Analysis of User Experience. To address RQ4 (care providers' experiences of using smart glasses in prehospital communication), we transcribed the interviews of both EMS providers (smart glass wearers and their teammates) and OLMC physicians, and used an open coding technique to analyze the interview transcripts [83]. The data analysis process involved several steps. First, two researchers (R2 and R3) reviewed all transcripts to familiarize themselves with the data and gain a general understanding of the content. Then, they independently coded a small subset of transcripts (two from EMS providers and two from OLMC physicians) using NVivo software. The analysis focused on identifying EMS providers' user experiences and perceptions of smart glasses, how the smart glass technology affected communication within EMS team (e.g., between smart glass wearers and their teammates) and with remote physicians compared to phones or radios, any problems participants felt the system introduced, and socio-technical issues relevant to the successful implementation of such systems. The initial codes were subsequently discussed among the research team to determine which codes to retain, merge, or discard, resulting in the development of a codebook that defined each code. Once the codebook was finalized, the same two researchers used it to analyze the remaining transcripts. A third researcher (R1) reviewed all analyses to ensure data integrity and validity. Any new codes that emerged during this process were added to the codebook. Disagreements were discussed and resolved among all researchers. Lastly, the finalized codes were grouped to identify overarching themes. In the remainder of the paper, interview quotes are labeled with "EMS P#" and "OLMC P#" to represent EMS provider participants and OLMC physician participants, respectively.

We also analyzed survey responses, paying particular attention to questions related to the user experiences and perceptions of using smart glasses in prehospital communication, such as "whether video-based communication is useful" and "whether the application enhanced their ability to communicate efficiently with their counterparts".

4 Results

4.1 RQ 1: The Impact of Smart Glasses on Reducing Communication Breakdowns

We found that communication breakdowns occurred only five times in all 15 smart glasses scenarios (one team was not able to complete the simulation as described in the method section). The average length of time to recover the communication (e.g., re-establishing the connection or clarifying miscommunicated information) was 3.53 seconds. The main issue was that video streaming was cut off for a second or so due to an unstable network.

In comparison, radios were initially used in 8 simulations in the east coast region, but in four of them, the participants decided to switch to a phone call because the radio signal was poor. We also found that communication breakdowns occurred more than 30 times in these 4 radio scenarios. The average length of time for both EMS and OLMC providers to recover from communication breakdowns was 38.83 seconds. Regarding the types of communication breakdowns, participants

Table 3. A case of communication breakdown due to an unstable radio signal.

Speaker	Subject	Dialogue
EMS	OLMC	Good afternoon. We're here with a five-year-old, bee sting, complaining about difficulty breathing as of right now, the patient is sitting at 89% heart rate. 116, 80 over 35 with bilateral wheezes, just looking for a consult. We wanted to start giving this patient some common treatments, maybe some epinephrine and steroids.
OLMC	EMS	Sorry. Can you repeat? All I heard was difficulty breathing. Forgive me. Can you start with the age again?
EMS	OLMC	So we're here with a five-year-old, difficulty breathing, secondary to a bee sting. The patient has hives, wheezing, sitting at 86% on a non-rebreather, 120 for the heart rate, 80 over 35, looking to give the child an epinephrine treatment. Maybe some steroids as well.
OLMC	EMS	Just to confirm, I heard a seven-year-old with wheezing and hives, setting 86, and a non-rebreather.
OLMC	EMS	Did you give epinephrine already?
EMS	OLMC	Negative at this time. We have not given epinephrine. [OLMC repeatedly asked whether epinephrine was given.]
OLMC	EMS	Hey, Medic, apologies, we're just getting caught up here on the connection. Is there a different channel that we can move to?

experienced a complete loss of connection for almost a minute. We also observed that OLMC physicians could misunderstand information or engage in multiple rounds of back-and-forth communication to clarify the same piece of information due to unstable signals or voice distortion over the wireless channel. Because of these issues, OLMC physicians sometimes misunderstood, as illustrated in Table 3, where the doctor didn't get the patient's age correct and only received a small portion of the information reported by the EMS provider. Additionally, both EMS providers and OLMC physicians became frustrated with the radio signal.

4.2 RQ 2: The Impacts of Smart Glasses on the Dynamics of Prehospital Communication and Teamwork

4.2.1 Impacts on EMS-OLMC Communication. To assess whether using smart glasses impacts the communication dynamics between EMS providers and OLMC physicians and how they differ from phone or radio communication mechanisms, we examined several factors, including communication length, types of communication instances, and the types of information or content discussed between EMS providers and OLMC physicians.

As illustrated in Figure 5-Left, the average interaction durations for radio (4 cases; providers chose to switch to phone in the other four cases), phone (11 cases), and smart glasses (15 cases) was 356 seconds or 5.94 minutes (max: 510 seconds, min: 240 seconds, STD: 114 seconds), 116 seconds or 1.93 minutes (max: 179 seconds, min: 52 seconds, STD: 45 seconds), and 285 seconds or 4.76 minutes (max: 529 seconds, min: 83 seconds, STD: 124 seconds), respectively. A significant difference was found between smart glass and phone interaction durations ($p < 0.05$), though no significant difference was observed between smart glass and radio ($p = 0.36$). Notably, radio resulted in the longest interactions, while phone yielded the shortest.

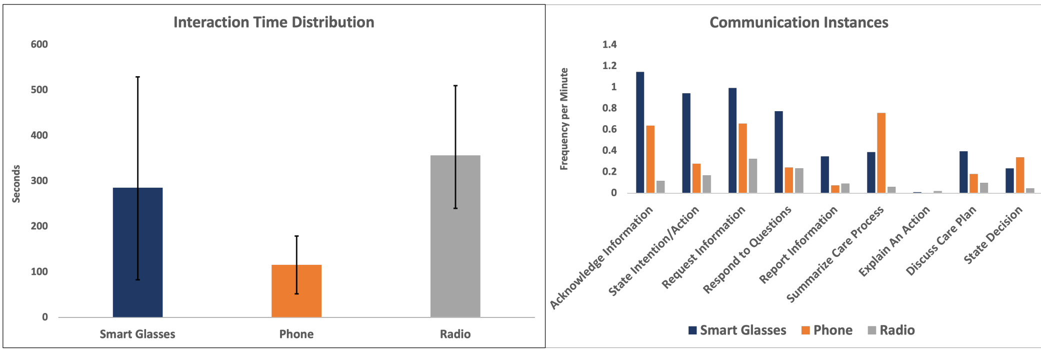

Fig. 5. Left: Average interaction duration (in seconds) using smart glasses (dark blue), phone (orange), and radio (gray). Smart glasses and radio have similar interaction times, while phone communications are significantly shorter. Right: Types of communication instances and their normalized frequencies (per minute) across different technology conditions. Compared to phone and radio, smart glasses supported a broader range and higher frequency of communication types, particularly those supporting collaborative sensemaking (e.g., acknowledging information, requesting/responding to information).

Table 4. A case of phone-based teleconsultation.

Speaker	Subject	Dialogue
EMS	OLMC	Hi, doctor. We are with a 5-year-old male, sounds like he is having asthma. We've given him Benadryl. His vitals are pretty steady. 110 of 65, and his cardiac is around 150. And we do have him on a non-breather currently.
OLMC	EMS	What's his breathing like?
EMS	OLMC	He is speaking in full sentences. He does have a cough and some wheezes.
OLMC	EMS	Just go ahead and repeat the epi dose over times three.
EMS	OLMC	Okay. Will do absolutely. Sounds great.
OLMC	EMS	All right. Thank you! Call me back if you need anything else.

Levene's test for equality of variance (based on medians) revealed that smart glass sessions exhibited significantly greater variance in duration (15,461.4) compared to phone (2,053.8) ($p < 0.05$), but not compared to radio (13,052.3). This suggests that although some providers were able to complete teleconsultations using smart glasses in a duration comparable to phone-based communications, overall, the duration of smart glass interactions varied more widely, in contrast to the more consistent durations observed with phone or radio use.

The higher variability and longer average duration for smart glass use prompted us to investigate further. We found that phone consultations typically ended shortly after the physician delivered a decision, as shown in Table 4. In contrast, OLMC physicians often remained connected longer during smart glass consultations—even after giving medical approval—to observe treatment execution and monitor patient response. For example, as illustrated in Table 5, the physician remained online during treatment administration, even without additional discussion—highlighting the extended, and sometimes passive presence of OLMC physicians in smart glass-based communication.

Table 5. An excerpt of communication between EMS providers and OLMC physicians using smart glasses.

Speaker	Subject	Dialogue
Team leader	OLMC	We'd like to give epi [epinephrine]. Calling for permission.
OLMC	Team leader	Sure. What dose would you like to use?
Team leader	Co-worker	What dose would you give him like?
Co-worker	Team leader	Ask doctor for the dose.
Team leader	OLMC	40 pounds, so about 20 kg, doctor. We'd like to give dexamethasone.
OLMC	Team leader	10 of dex.
Team leader	Co-worker	Doctor says 10 of dex.
OLMC	Team leader	0.15 of epinephrine.
Team leader	OLMC	Okay, doctor.
Team leader	Co-worker	And you are gonna give epi point 15, doctor said.
Co-worker		.15 epi, 10 of dex, albuterol neb.
Team leader	OLMC	Albuterol nebulizer, doctor. Okay to proceed?
OLMC	Team leader	Sure, yeah, we can do it. We can do albuterol nebs.
Team leader	Co-worker	We can do albuterol.
Team leader	OLMC	Should we give the treatment and call telemetry back, or do you want to stay on the line while we give the treatment?
OLMC	Team leader	I can stay on the line.
	[About 1 minute later]	
Co-worker	Team leader	Is the doctor still online?

Regarding the differences in communication instances across the three technology conditions, as illustrated in Figure 5-Right, we found significant differences between the smart glass and radio conditions ($p < 0.05$), while no significant difference was observed between the smart glass and phone conditions ($p = 0.10$). Radio conditions clearly had the fewest instances of communication, even though the average duration of radio communications was the longest. Another interesting observation is that smart glass-based communication typically included more instances of stating intention, responding to questions, reporting information, acknowledging information, and discussing care plans. In contrast, phone-based communications involved more frequent summarizing of the care process and stating of decisions compared to smart glasses. A couple of interesting observations to note: First, EMS providers stated their intentions far more frequently in smart glass conditions compared to phone or radio use. We found that EMS providers often combined verbal and non-verbal cues (e.g., pointing to the patient or medical equipment) to indicate what they were planning to work on. Second, smart glasses facilitated more discussions on the care plan and shared decision-making; in contrast, in phone conditions, OLMC physicians more frequently made and stated decisions with limited and less frequent discussion with EMS providers.

Further examination of the types of information communicated revealed that nearly all high-level information categories were discussed more frequently in smart glass-based communication than in radio or phone conditions (Figure 6-Left). In the low-level category, several patient condition-related information, such as breathing, symptoms, and consciousness, was discussed less frequently in smart glass conditions compared to phone or radio conditions; in contrast, medication information was communicated far more frequently in smart glass scenarios than in phone or radio scenarios (Figure 6-Right).

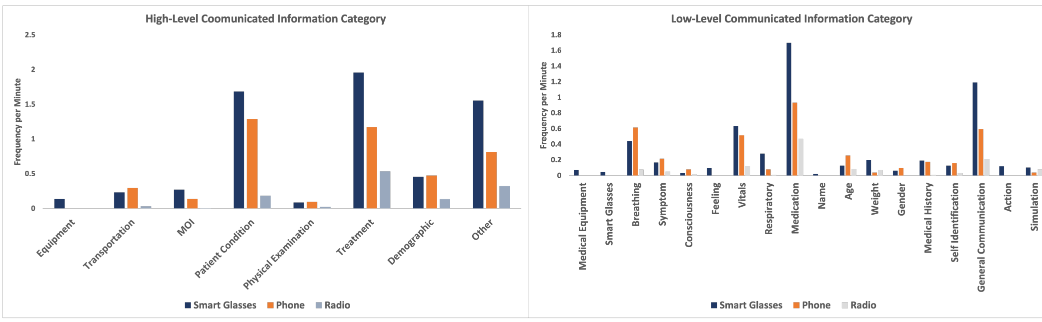

Fig. 6. Left: Frequency (per minute) of high-level information categories (e.g., patient condition, treatment, demographics) shared during EMS-physician interactions using smart glasses (dark blue), phone (orange), and radio (gray). Smart glasses generally supported more frequent communication on patient condition and treatment. Right: Frequency (per minute) of low-level, specific clinical information (e.g., breathing, vitals, medication). Smart glass use was associated with more frequent discussion of vitals and medications, while phone and radio showed relatively higher frequencies in some categories like breathing and consciousness.

4.2.2 Impacts on EMS Co-workers (Non-wearers of Smart Glasses). We also examined whether the smart glass wearer's teammates participated in the prehospital communication process and, if so, how they engaged in the discussion. In the 15 smart glass sessions, we observed teammate participation in 5 sessions. In comparison, teammate participation occurred in only two radio sessions and was absent entirely in phone sessions. In most radio cases, teammates could overhear the OLMC physician's questions and respond directly, as the radio broadcast was audible to everyone on the team. However, in smart glass sessions, the audio was only accessible to the wearer, meaning that teammates had to rely on the team leader (i.e., the smart glass wearer) to relay the physician's questions and responses.

The communication excerpt in Table 5 illustrates the unique dynamics of team interaction when using smart glasses for teleconsultation. More specifically, in this scenario, the team leader initiates the call by requesting permission to administer epinephrine. When the OLMC physician responds with a follow-up question about dosage, the team leader turns to their co-worker for input, who then suggests asking the physician for the exact dosage. Throughout the exchange, the team leader continues to serve as the intermediary—receiving dosage instructions from the OLMC physician (e.g., "10 of dex," "0.15 of epi") and relaying them to the teammate, who then verbally confirms the medication plan. This back-and-forth information exchange underscores a key implication of smart glass use: while it enables remote video consultation, it also creates a communication bottleneck where only the wearer has direct access to physician instructions. As a result, additional intra-team coordination is required to ensure shared understanding and task coordination. The final lines of the exchange—where the co-worker asks whether the physician is still online—further emphasize this point, as non-wearers lack a direct view of the smart glasses and must rely on the wearer to determine whether the physician is still present.

4.3 RQ 3: Visual Attention Alignment between EMS Providers and OLMC Physicians during Teleconsultation

As described in the methodology section, we used eye-tracking devices to capture and analyze the visual attention of EMS providers and OLMC physicians during teleconsultations. Our analysis identified several key objects that both parties commonly focused on, including the patient, vital signs monitor, medical equipment, other EMS team members, and occasionally, the patient's family members.

We also found notable differences in visual attention alignment across simulation teams. The highest visual alignment between an EMS-OLMC pair reached 78.3% (Figure 7-Left), while the lowest was 20.7% (Figure 7-Right). On average, visual attention alignment accounted for approximately 55.6% of the teleconsultation duration, with teams in the rural mountain region reaching 57.9% and those in the east coast urban area averaging 53.4%.

One key pattern we observed was that visual alignment tended to be lower when the EMS provider wearing the smart glasses was actively engaged in hands-on care. In contrast, higher alignment was achieved when the wearer remained hands-off and focused primarily on the consultation. For example, in the case shown in Figure 7-Left, although EMS and OLMC providers demonstrated strong visual alignment overall, misalignment occurred when the EMS provider looked downward to prepare medication on their lap—an area outside the field of view of the smart glass camera. This made it impossible for the OLMC physician to see the object of focus, resulting in a loss of shared visual context.

Additional factors contributing to misalignment included moments when OLMC physicians were distracted, looked away from the screen due to perceived task triviality, or were referring to clinical protocols. Another interesting observation was that EMS providers frequently glanced at the smart glass screen itself—likely to check for the presence or facial cues of the OLMC physician displayed in the interface (as illustrated in Figure 7-Right). While doing so, the EMS provider's visual attention was directed at the smart glass display, whereas the physician remained focused on the streamed video feed showing the forward-facing scene from the EMS provider, resulting in temporary misalignment.

4.4 RQ 4: User Experiences about Using Smart Glasses in Prehospital Communication

4.4.1 Perceived Usefulness of the Multi-Modal Communication Enabled by Smart Glasses. In follow-up interviews, both EMS providers and OLMC physicians described the first-person video streaming feature of smart glasses as highly beneficial for improving communication. EMS providers emphasized that allowing OLMC physicians to see what they were seeing in real-time reduced the need for extensive verbal reporting, which can be time-consuming and susceptible to miscommunication: *"I prefer smart glasses [over radio or phone] because I feel like it's a step up. The doctor can actually see what you're doing in real-time, rather than just relying on your report." [EMS P#23]* Additionally, video-based teleconsultation provided more accurate and contextualized information about the patient—information often difficult to articulate—thereby minimizing potential misunderstandings by remote experts: *"The doctor can see the patient's body language and tone of voice. That was really good." [EMS P#21]* OLMC physicians likewise emphasized the value of visual information, noting that it provided a more complete understanding of both the patient and the scene, which in turn enabled quicker, more accurate medical decisions: *"The video was much better. You get actual information through the video, whereas with phone calls, it's always so hard because you can't actually see what's there." [OLMC P#10]* Survey results supported these qualitative findings: EMS providers rated the video call feature's usefulness at 4.32 out of 5, while OLMC physicians gave it a 4.82 out of 5.

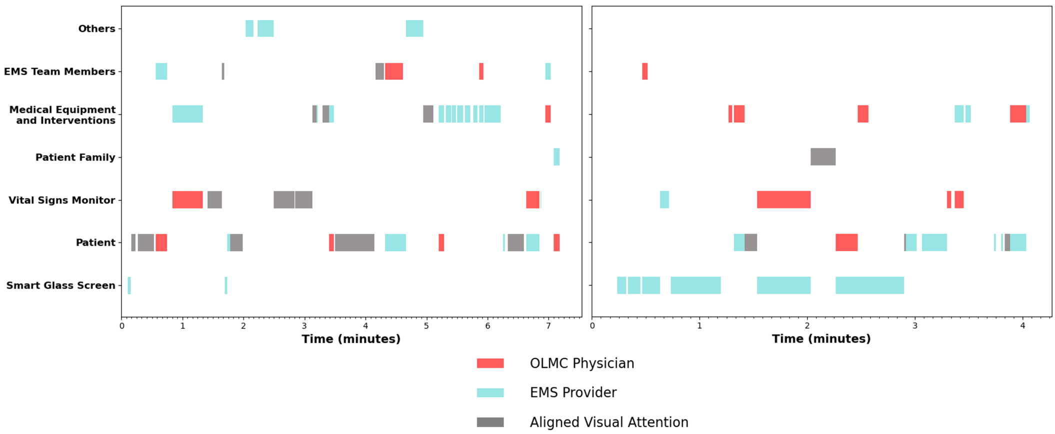

Fig. 7. Left: Example of a smart glass-based communication scenario with higher visual attention alignment between EMS providers and OLMC physicians. Right: Example of a smart glass-based communication scenario with lower visual attention alignment between EMS providers and OLMC physicians. (The color-coded legend identifies visual fixation events for the OLMC physician (in red), the EMS provider (in teal), and moments of aligned visual attention between them (in gray). Time is displayed on the x-axis.)

In addition to video streaming, our system enabled EMS providers to share essential medical information—such as vitals and treatments—in text format. Nearly all OLMC physicians underscored the benefits of having access to such textual information, including: (1) reducing misunderstandings that may arise from verbal communication; (2) alleviating the cognitive load of remembering multiple pieces of information; and (3) mitigating issues related to conveying information through the smart glass camera (e.g., when the wearer attempts to show the vital signs monitor with the remote physician, the vitals may not be readable due to head movement or distance from the monitor). One participant clearly articulated these benefits: *"I like both the visual of the patient and the text I could read to see direct information. Talking on the radio alone, I'm having to remember what it is they said—like remember the blood pressure, the age of the patient, and those other things. I really liked seeing the vital signs, because one thing I will say is that when he tried to show me the monitor, there was a glare from the window, and I couldn't see the monitor very well." [OLMC P#3]* Overall, this feature received an average usefulness rating of 4.55 out of 5 from physicians.

Another notable feature was the ability for OLMC physicians to send short text messages that appeared directly in the wearer's field of view. Both EMS providers and physicians agreed that this feature is useful for confirming the agreed-upon treatment plan (e.g., medication dosage) and reducing the risk of medical errors. As one EMS provider explained: *"I think that's good for confirmation because we have a lot of discrepancies. I mean, a lot of medications—if the decimal is off, they could say 100 milligrams and really mean 10. You know, they could just make a verbal mistake. But if we see it and we hear it, and they match, then we know, okay, this is the medication they want." [EMS#15]* Similarly, one OLMC physician noted: *"If they couldn't understand what I'm saying, and I wanted to spell something out, it would be helpful that they could see it in writing. Like if there are two medications that sound similar, or I want to make sure they're doing 50 instead of 15—like five-zero instead of one-five—it would be nice to be able to text them, for sure." [OLMC P#6]* Beyond confirmation, this feature is also useful for maintaining discretion when the physician does not want the patient or the patient's family to overhear sensitive parts of the conversation: *"If you need to text something to the paramedics that you don't want the parents to hear—like, 'the child looks like*

Table 6. Summary of the socio-technical considerations for adopting smart glass-based telemedicine systems. * indicates a concern shared by both EMS providers and OLMC physicians; § indicates an EMS provider–specific concern; # indicates an OLMC physician–specific concern.

Specific Consideration	**Brief Explanation**
Length of Communication*	- Both OLMC physicians and EMS providers noted that visual access to the patient via smart glasses led to longer-than-necessary calls, as physicians stayed online to monitor treatment progress.
Privacy*	- Concerns were raised about using the smart glass speaker for audio output, particularly when discussing sensitive patient information in the presence of patients or bystanders.
Internet Connectivity*	- While network issues were minimal during the study, both EMS providers and OLMC physicians questioned the reliability of smart glasses in real-world settings, especially in areas with weak signals.
Autonomy§	- EMS providers expressed concern that continuous visual monitoring by OLMC physicians could undermine their autonomy in making field-based decisions.
Shared Awareness and Overhearing§	- EMS providers emphasized the importance of teammates being able to overhear the conversation with OLMC physicians to ensure shared understanding and timely execution of tasks.
Visual Discomfort#	- OLMC physicians reported motion sickness or disorientation caused by excessive or rapid head movements from the smart glass wearer, leading to unstable video feeds.

he's going critical, prep for cardiac arrest,' or if it is a cardiac arrest and they've been doing CPR in the field, you could text something like '20 more minutes of CPR, then call it [death time].'" [OLMC P#10] This feature received an average usefulness rating of 4.29 out of 5 from physicians.

4.4.2 Socio-Technical Considerations for Adopting Smart Glass-Based Telemedicine Systems. While smart glasses were generally perceived as useful and promising, post-simulation interviews revealed several socio-technical considerations and potential barriers to adoption (summarized in Table 6). Some concerns were shared across both EMS providers and OLMC physicians, while others were unique to each group.

Shared Concerns (EMS Providers and OLMC Physicians): One of the most frequently mentioned issues was the length of smart glass-based teleconsultations. Both EMS providers and physicians noted that visual access sometimes prolonged the call, as physicians tended to stay online to monitor care delivery and patient response. As one OLMC physician noted: *"Sometimes physicians actually delay care because we want to do and see too much." [OLMC P#1]*. EMS providers echoed similar sentiments: *"It's [smart glass] a more fluid conversation, but I could have a much quicker conversation [on the phone]." [EMS P#29]*.

Privacy was another shared concern. The use of a speaker as the default audio output raised issues around discussing sensitive patient information audibly, especially in the presence of the patient, as one EMS provider explained: *"We're talking to medical control. They don't want to be on speakerphone where the patient can also hear what they're saying, right? So they need to talk to us* *privately." [EMS P#28]* Physicians also raised similar concerns: *"I imagine people may have privacy concerns, because family members in the ambulance may not want to be videoed." [OLMC P#2]*

Connectivity also emerged as a practical concern. While no major disruptions occurred during the study, participants questioned whether reliable network access would be available in real-world scenarios, particularly in rural or signal-poor environments: *"Normally you're connected to the ambulance's Wi-Fi, but if you need to go a block and a half down because it turns out the patient's in the carriage house, there's no connectivity. Unless the glasses have built-in LTE or 5G—or unless you create a hotspot on your phone. But that's an extra step. I would worry about that a little bit more." [OLMC P#1] "During my testing experience, like I said, the only problem with that is internet access, because I would have to make sure we have internet access in order to be online with medical control." [EMS P#22]*

EMS-Specific Concerns: Autonomy emerged as a significant concern among EMS providers. Some providers expressed that they felt overly supervised by the remote OLMC physician during video calls, which they believed could interfere with their decision-making autonomy in patient care: *"We've always been a very doctor-hands-off system. And what this is doing is putting doctors back hands-on, like a 'mother, may I?' system." [EMS P#6]*

Another frequently discussed issue among EMS providers was whether one or multiple team members should wear smart glasses during teleconsultation. Most providers felt that a single wearer was sufficient but emphasized the importance of including the teammate in the communication loop—at least as a listener—to ensure shared understanding and coordinated action: *"We make decisions as a team. So if my teammates can hear what the doctor is saying, then we are all on the same page." [EMS P#24]* Non-wearers also echoed this sentiment, highlighting the importance of accountability and mutual confirmation: *"As a second provider, I don't know about necessity, but I would like to be included in that to make sure that there's accountability. You heard the same thing that I heard." [EMS P#32]* Being able to overhear the OLMC physician's instructions was also seen as critical for enabling the non-wearer to act immediately, without waiting for relayed directions: "If I hear it as soon as the orders are given, then I could give the medication right away." [EMS P#35] To address this need, several participants proposed equipping the teammate with a Bluetooth headset to listen in on the call: *"While I was talking to the doctor, my teammate doesn't need a pair of glasses, but he could have maybe a headset on, like a Bluetooth headset. He can hear what we are saying." [EMS P#35]*

OLMC Physician-Specific Concern: Some physicians experienced discomfort when smart glass wearers moved their heads excessively, leading to shaky or disorienting video feeds. This occasionally forced physicians to avert their gaze or disengage from the video stream. As two OLMC physicians noted: *"Little dizzying for me because the person was wearing the glasses, and when they're looking around, the view bounces around a little bit. So that was a little, you know, dizzying." [OLMC P#3] "I guess it was like a little disorienting, with the EMS provider looking back and forth from the patient to, like, his stretcher with his bags on it. Like, back and forth. So, maybe it makes me a little dizzy or, like, tired of the view which is constantly changing." [OLMC P#6]*

5 Discussion

5.1 Establishing Common Ground among all Care Providers

Common ground—shared knowledge, beliefs, and assumptions among collaborators—is essential for effective communication, especially in high-stakes, distributed teamwork [13, 14]. Clark and Brennan [12] define grounding as a collaborative process supported by communication cues such as gaze, gesture, and feedback. Our findings indicate that smart glasses support this process by providing a first-person video feed and enabling multimodal communication (e.g., visual, verbal, gestural), thereby reducing reliance on extensive verbal descriptions. For example, OLMC physicians could directly observe patient symptoms and status—such as breathing or level of consciousness—without needing both parties to extensively discuss them. As a result, our analysis revealed that discussions around such observable evidence occurred less frequently in smart glass conditions than in phone-based communications.

Additionally, smart glass-enabled communication enabled more interactive exchanges—such as real-time reporting, question-and-answer sequences, acknowledgments, and collaborative care planning. In contrast, radio and phone communications were typically more one-directional, with EMS providers summarizing information and OLMC physicians stating decisions. These findings underscore how smart glasses could help facilitate the joint construction of common ground.

Clark and Brennan further emphasize that grounding is shaped by the affordances and constraints of the communication medium. Media that reduce ambiguity more effectively support common ground and enable efficient collaboration [12, 56]. In our system, smart glass enables rich contextual information sharing through video streaming, while additional features—such as transmitting medical information via text and displaying physician guidance as augmented content—offer alternative channels for clarifying meaning. These multimodal capabilities help mitigate communication breakdowns, especially when video or audio is unclear. Although we did not quantify how each feature contributes individually to communication efficiency—due to the compounded nature of these features—our post-simulation interviews suggest that smart glasses provide substantial benefits beyond video streaming alone, contributing to better shared understanding and fewer miscommunications between EMS providers and OLMC physicians.

However, establishing common ground through smart glasses is not without challenges. In the following sections, we discuss key issues—including limited overhearing by teammates (Section 5.2), prolonged communication duration (Section 5.3), emerging supervisory dynamics that may affect EMS autonomy (Section 5.4), and visual attention misalignment (Section 5.5)—that may impact how common ground is constructed and maintained in practice while using smart glasses.

5.2 Enabling Overhearing for Effective Teamwork

While smart glasses facilitate direct communication between the wearer and the OLMC physician, a key limitation observed in our study is that other EMS team members are often excluded from this interaction. Because the audio output is restricted to the smart glass wearer, teammates must rely on verbal relays to stay updated—introducing delays and increasing the risk of miscommunication. This setup contrasts with traditional radio systems, where communication is typically audible to the entire team, allowing for seamless coordination and shared situational awareness through a process known as overhearing [33].

Overhearing plays a critical role in high-pressure, fast-paced environments like emergency medical care [96]. It enables team members to monitor the progress of tasks, anticipate next steps, and act immediately without requiring repeated instructions. The lack of this capability with current smart glass configurations can affect teamwork and disrupt the establishment of common ground across all care providers. These concerns echo findings from the use of smart glasses in other high-stakes clinical environments. For instance, Grundgeiger et al. [30] found that in the context of supervising multiple operating rooms via smart glasses, co-workers felt excluded from essential conversations due to a lack of overhearing, which disrupted team coordination and grounding—mirroring the challenges observed in our setting.

These findings highlight the need to support grounding not only between the remote physician and the smart glass wearer but also across the entire EMS team. Future system designs might address this by incorporating multi-channel audio outputs (e.g., earpieces for teammates) to ensure all care providers remain aligned in understanding the care plan and contribute effectively to collaborative decision-making.

5.3 Balancing Discussion Depth and Interaction Duration in Smart Glass-Based Teleconsultation

Smart glasses facilitated more extensive and in-depth discussions during teleconsultations. By enabling OLMC physicians to visually observe the preparation and administration of medications and other treatments, smart glasses allowed remote providers to offer real-time feedback on critical actions, such as syringe alignment or selection of a treatment site on the patient's body. This capability supported richer discussions around these clinical tasks. In contrast, when using traditional communication methods like radio or phone, OLMC physicians lacked visual access to these procedures and therefore had limited discussions on such topics.

However, this enhanced communication depth came with trade-offs. Although in some cases smart glass-based consultations could be completed within timeframes comparable to phone-based interactions, we observed that OLMC physicians often stayed on the call longer when smart glasses were used. A likely explanation is that the visual access enabled by smart glasses prompted physicians to continue observing until the approved treatments were completed and the patient's condition improved. This level of extended involvement could be beneficial—allowing for richer assessments and more informed decision-making.

On the other hand, it can extend interaction time. Longer interaction times may stem from inefficiencies such as communication lags, interface complexity, or uncertainty about when to conclude the consultation. This ambiguity suggests that extended calls do not necessarily indicate better care and may instead reflect confusion or workflow disruptions. For example, EMS providers may not have time for longer discussions, and OLMC physicians' availability could be impacted in real practice, causing delays in addressing other EMS calls. This concern was echoed by several OLMC physicians, who noted the risk of unnecessarily extended teleconsultations.

These findings highlight the need for clearer guidelines and training on the use of video-based telecommunication tools in time-critical care. In particular, establishing protocols that clarify when a call should end—such as after treatment approval rather than after treatment completion—could help optimize workflow efficiency. This aligns with prior literature suggesting that remote collaboration technologies for fast-paced teams should be designed to avoid burdening or distracting workers [36–38].

Furthermore, these findings raise important questions about the longevity of the observed behaviors. It is possible that the extended interaction durations were influenced by the novelty effect often associated with the early use of emerging technologies. To better understand the lasting impact of smart glasses on communication practices, future research should conduct longitudinal studies to examine how usage patterns evolve over time. Few studies have explored the real-world, long-term use of smart glasses. One notable exception is the work of Grundgeiger et al. [30], who followed anesthesiologists using HWDs over 8–10 days. Their findings revealed that prolonged use led to shifts in team dynamics and communication practices, prompting users to develop strategies for managing distractions and integrating the technology into their workflow. Building on this work, our future research aims to deploy smart glasses in real-world EMS environments over extended periods to assess whether the communication and collaboration patterns observed in our simulation-based study persist—or evolve—with routine use.

5.4 Mitigating Autonomy and Privacy Concerns

Our study identified two key concerns related to the use of smart glasses in prehospital communication—autonomy and privacy—both of which may influence the technology's adoption and effective use. EMS providers expressed feeling overly supervised during smart glass-based teleconsultations. The visual access afforded to OLMC physicians created a sense of direct oversight, raising concerns that remote physicians might take on a more "hands-on" role by remaining connected to observe the administration of treatments or monitor patient responses—potentially interfering with EMS providers' ability to act independently. However, as this was the first time both EMS providers and OLMC physicians used smart glasses—a fundamentally different communication modality (i.e., video-based)—it is likely that the longer interactions were influenced by the novelty of the technology and the lack of established usage guidelines. Moving forward, as users become more familiar with smart glass-based teleconsultation and clear protocols are developed, interaction times may decrease, and EMS providers' feelings of being monitored may subside.

Privacy concerns were also raised, particularly regarding the audio output settings on smart glasses. Since the default output relies on a speaker, some EMS providers highlighted the risks of discussing sensitive patient information openly—especially when patients or bystanders are within hearing range. While audio privacy is generally manageable when using phones, smart glasses lack this level of discretion without dedicated headphones. The absence of a private audio channel could compromise patient confidentiality—a key component of patient-provider trust—particularly in sensitive scenarios [57, 61]. This also helps explain why the feature allowing physicians to send text messages or guidance to be displayed in the wearer's field of view was considered valuable; it reduces the likelihood that family members or patients will overhear sensitive information. A simple solution would be to use headphones with smart glasses to preserve confidentiality during patient conversations, aligning with standard privacy practices and ensuring compliance with the Health Insurance Portability and Accountability Act (HIPAA) regulations in healthcare.

5.5 Improving Shared Visual Focus for Effective Smart Glass Teleconsultation

Since smart glasses enable a "see-what-I-see" experience by streaming a first-person point of view to remote experts, it is assumed that remote experts could follow the smart glass wearer's visual attention, enhancing the establishment of common ground by enabling distributed collaborators to focus on the same object of interest. Our findings revealed several insights worth discussing.

First, the average visual alignment rate across all teams was 55.6%, though interpreting this metric in practice requires nuance. High alignment suggests greater opportunities for establishing common ground, as shared gaze has been linked to improved coordination in distributed work. However, visual alignment alone does not guarantee mutual understanding or better clinical decision-making. For instance, providers may be looking at the same object but interpret it differently or prioritize it unequally. Thus, while visual alignment serves as a useful proxy for collaborative attention, future work should investigate how it correlates with shared understanding and decision quality through complementary methods such as conversational analysis or outcome-based evaluation.

Second, we found that EMS teams in rural areas had slightly higher visual alignment (57.9%) than those in urban areas (53.4%). One possible explanation lies in differences in team composition and task distribution. In rural regions (fire-based agency), EMS teams typically included at least three members, allowing the smart glass wearer—often the team leader—to assume a more observational and communicative role during teleconsultation, with fewer hands-on responsibilities. In contrast, urban teams generally operated with only one or two members, requiring the smart glass wearer to be more actively involved in physical tasks. This increased care activity involvement may have limited their ability to maintain consistent shared visual focus with the OLMC physician, resulting in lower alignment percentages.

Finally, we found that several EMS-OLMC pairs achieved a high level of visual attention alignment (close to 80% of the entire duration). However, we also observed lower visual alignment (as low as 20%), which can disrupt grounding by creating discrepancies between what the EMS provider sees and what the OLMC physician perceives. These breakdowns challenge Clark and Brennan's notion of joint attention [12], and may even lead to false grounding, where participants believe they are aligned in understanding when they are not. Upon further examination, we found that when the smart glasses wearer was performing hands-on care tasks, visual alignment between the wearer and the remote OLMC physician tended to be lower than in cases where the wearer was hands-off and focused on teleconsultation. Two possible explanations may account for this finding. First, when EMS providers were engaged in extensive patient care activities, they often moved their heads and shifted their attention rapidly. This sudden and frequent head movement caused motion blur or even motion sickness for remote experts, as described in the literature [87] and confirmed by our OLMC physicians during follow-up interviews. As such, OLMC physicians had to move their eyes away from the screen to avoid discomfort (e.g., dizzying). This finding suggests that the EMS provider who is hands-off may be the better candidate to wear the smart glasses, rather than the provider engaged in intensive patient care activities. Second, due to the limited field of view of smart glass cameras, the wearer's focal point is sometimes not captured by the smart glasses. For example, our study found instances where the EMS provider looked downward while preparing medication on their lap, placing the view outside the camera's range and making it impossible for the remote OLMC physician to see the provider's focus. This difference in line of sight between the smart glass wearer and remote experts can prevent the remote expert from seeing exactly what the wearer sees, potentially leading to confusion during communication [21, 57].

To address these challenges, several prior studies have proposed hardware enhancements. For example, a couple of studies [78, 87] experimented with attaching mirrors to smart glasses to expand the field of view, enabling remote experts to see both the forward-facing perspective and hand movements below the camera. Other work suggests implementing more advanced mounting methods to stabilize the smart glasses on the wearer's head, ensuring a better alignment between the wearer's visual field and the camera's capture range [94]. Looking ahead, integrating eye-tracking technology into smart glasses offers a promising direction. By detecting the wearer's gaze, the system could infer whether their visual attention is aligned with what the camera is capturing. If a mismatch is detected—for instance, when the user is looking downward but the camera isn't capturing the activity—the system could prompt either the EMS provider to adjust their head position or alert the remote physician to request a change in view. Although devices like HoloLens already support eye-tracking, most commercially available smart glasses do not currently include this capability. Future hardware development should explore integrating low-power eye-tracking solutions into smart glasses.

Finally, a promising design direction to address view misalignment in smart glass-based teleconsultation is to shift some of the responsibility for achieving shared visual focus from the smart glass wearer to the remote expert. Nicholas et al. [60] demonstrated that shared camera control in social contexts (Friendscope) enhanced in-the-moment experience sharing. Prior CSCW research in surgical telemedicine highlights the collaborative effort required to effectively co-construct knowledge and understanding of a surgical operation between local and remote surgeons. Mentis et al. [54] observed the limitations of relying solely on local surgeons to determine what and how to share during remote procedures. Building on this, Mentis et al. [53] introduced the concept of "remotely shaping the view," in which remote surgeons used telestration (e.g., drawing or annotating on a live video feed) and verbal instructions to guide or adjust the camera view during surgical telementoring. They demonstrated that giving remote experts tools to directly or indirectly influence the visual field improved collaborative understanding. Translating this idea to the EMS context, future smart glass systems could incorporate interactive features such as telestration and remote control of the camera (e.g., zooming in or out). These capabilities would reshape smart glass communication—not as a static "see-what-I-see" stream, but as a dynamic, co-constructed visual workspace shaped collaboratively by both local and remote participants. However, despite their promise, the acceptability and unintended consequences of granting remote physicians greater control over the visual field in smart glass-based teleconsultation should be carefully examined.

5.6 Enabling the Use of Smart Glasses in Different Network Conditions

In our study, we leveraged 5G technology to enhance the network connectivity of smart glasses; however, we still encountered a few instances of communication breakdown (e.g., brief video streaming interruptions), which were easily and quickly resolved. This is not surprising because the effective use of smart glasses, or any video-based telecommunication tools, depends on access to a high-bandwidth cellular network to ensure quality video and audio calls with remote teams [34, 37, 90]. However, similar to other first responders (e.g., firefighters, search and rescue teams, etc.), EMS providers often work in areas with limited signal coverage, such as subway stations, rural areas, or wilderness locations, impacting their ability to effectively use such tools. To address limited network access, several studies have explored alternative approaches. For example, store-and-forward video recordings is a common method used in telemedicine systems [93]. Prior work has also suggested that such systems should function in both "online" and "offline" modes, adjusting based on network availability—for instance, by periodically sending video recordings or sequential photos, or streaming at lower resolutions to save bandwidth [37, 47]. In line with these design recommendations, we suggest that the smart glasses system should be capable of adjusting video resolution or even automatically disabling video streaming when network conditions are poor.

With advancements in telecommunication technologies and improvements in network infrastructure, the network limitations affecting the use of smart glasses and other video-based telemedicine systems may soon be mitigated. For example, the availability of 5G technology has enabled efficient communication between distributed medical teams, resulting in high user satisfaction with smart glasses [46]. Additionally, ongoing initiatives to establish a dedicated broadband network for first responders [2] show promise in addressing connectivity challenges for advanced, multi-modal communication technologies (e.g., video, audio, image, text).

5.7 Study Limitations

This study has several limitations that should be considered when interpreting the findings. For example, our simulations took place in controlled environments, which may not fully capture the complexities and unpredictability of real-world prehospital scenarios. Although we aimed to replicate typical EMS conditions, factors such as environmental noise, unpredictable patient reactions, and varying network connectivity could impact the actual use of smart glasses in field settings. Furthermore, we did not examine long-term adoption or routine use, nor did we address implementation challenges such as potential impacts on workflow efficiency and cost considerations. Future research could address these limitations by conducting field studies in diverse environments and over extended periods to provide a more comprehensive understanding of smart glasses' effectiveness in prehospital communication. Finally, some OLMC physicians participated in multiple simulation sessions, potentially introducing familiarity or learning effects over time. Although this approach aligns with real-world OLMC practices—where a small number of physicians typically handle EMS consultations within a region—it may have affected the consistency of physician guidance. Future studies should consider involving a larger and more diverse pool of physicians to reduce this potential bias.

6 Conclusion

This study demonstrates that smart glasses have the potential to transform communication and collaboration in distributed emergency medical care by enabling real-time, first-person video streaming and multimodal information exchange. These capabilities promote deeper discussion, reduce ambiguity, and help establish shared understanding between EMS providers and OLMC physicians. However, their use also raises important challenges—including the need for overhearing capability, issues with visual alignment and motion-induced discomfort, extended interaction times, and concerns around autonomy and privacy. These findings highlight the broader need to design remote collaboration technologies that not only deliver rich contextual information but also align with the cognitive, social, and workflow demands of high-pressure environments. Smart glasses must evolve from simply offering a "see-what-I-see" view to enabling co-constructed, team-wide understanding. As wearable AR devices continue to gain traction, it is essential to move beyond proof-of-concept evaluations to examine long-term use, evolving norms, cross-team dynamics, and the socio-technical tensions that arise when integrating immersive technologies into critical care settings.

Acknowledgments

We extend our heartfelt gratitude to all the EMS providers who participated in our research. We would also like to express our sincere appreciation to Dr. Jared Kutzin at Mount Sinai Health System (New York City, New York), and Brittany Olvera at Colorado Springs Fire Department (Colorado Springs, Colorado) for their support in coordinating the studies and recruiting participants, and Carl Elston (Children's Hospital Colorado) and Nicolena Mitchell (EMS for Children Colorado State Partnership Program) for their help in conducting the simulations. This study was supported by the National Science Foundation [grant 1948292] and the Agency for Healthcare Research and Quality [grant 1R21HS028104-01A1].

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Received October 2024; revised April 2025; accepted August 2025

Table 7. Codes and Descriptions for Types or Purposes of Communication

Code	Description	Example
Acknowledge information	Confirm that an instruction was understood, or a piece of information was received.	Alright, got it, thanks.
State intention/action	Report what the provider is planning to do.	I am going to put an oxygen mask on him.
Request information	Ask for a piece of information or clarification.	What dosage should I give to the patient?
Respond to questions	Provide answers or clarification in response to a question.	He is currently conscious.
Report information	Proactively report information (e.g., patient condition) without being asked.	We found rashes on his back.
Summarize care process	EMS providers summarize the patient's status or care plan.	I've got a four-year-old with difficulty breathing, sounds like a history of asthma, unresponsive to treatment from his mom.
Explain an action	Explain the reasoning behind a decision or action.	The reason you want to go in the thigh is because there's a larger vascular bed.
Discuss care plan	Discuss the treatment plan or medication administration.	We should give this patient some steroids.
State decision	Physicians provide guidance or medical approval for treatments and medications.	He is five years old, so let's do 0.2 milligrams of epinephrine.

Table 8. Codes, Descriptions, Subcategories, and Examples for Types of Communicated Information

Code	**Description**	**Subcategories**	**Example**
Equipment	References to any tools, devices, or medical equipment.	a. Medical equipment, smart glasses	Can you hand me the medicine bag?
Transportation	Which hospital or medical facility the patient will be transported to.	—	You are going to children's hospital, right?
Mechanism of Injury (MOI)	What happened to the patient.	—	The child fell from the bed.
Patient Condition	Information about the patient's current condition.	a. Breathing, symptom, consciousness, feeling, vital signs	The child is conscious.
Physical Examination	The examination performed on the patient.	—	Alright, we'll re-listen to lung sounds.
Treatment	Actions, procedures, or medications related to treating the patient.	a. Respiratory/airway support, medication, other	We have started albuterol.
Demographic	Demographic information about the patient.	a. Name, age, weight, gender, medical history	Okay, I got a five-year-old.
Other	Non-medical related communication.	a. Introduction/greetings, simulation-related questions	Are we really gonna give the medication for the simulation?