
Research and Applications

Different roles with different goals: Designing to support shared situational awareness between patients and clinicians in the hospital

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ABSTRACT

Objective: Team situational awareness helps to ensure high-quality care and prevent errors in the complex hospital environment. Although extensive work has examined factors that contribute to breakdowns in situational awareness among clinicians, patients' and caregivers' roles have been neglected. To address this gap, we studied team-based situational awareness from the perspective of patients and their caregivers.

Materials and Methods: We utilized a mixed-methods approach, including card sorting and semi-structured interviews with hospitalized patients and their caregivers at a pediatric hospital and an adult hospital. We analyzed the results utilizing the situational awareness (SA) theoretical framework, which identifies 3 distinct stages: (1) perception of a signal, (2) comprehension of what the signal means, and (3) projection of what will happen as a result of the signal.

Results: A total of 28 patients and 19 caregivers across the 2 sites participated in the study. Our analysis uncovered how team SA helps patients and caregivers ensure that their values are heard, their autonomy is supported, and their clinical outcomes are the best possible. In addition, our participants described both barriers—such as challenges with communication—and enablers to facilitating shared SA in the hospital.

Discussion: Patients and caregivers possess critical knowledge, expertise, and values required to ensure successful and accurate team SA. Therefore, hospitals need to incorporate tools that facilitate patients and caregivers as key team members for effective SA.

Conclusions: Elevating patients and caregivers from passive recipients to equal contributors and members of the healthcare team will improve SA and ensure the best possible outcomes.

Key words: situational awareness, patient participation, design, patient care team

INTRODUCTION

Hospitals are inherently complex and high-risk environments, where clinicians work collaboratively in teams to deliver clinical therapies to individuals with an acute illness. In such environments, teams

need high levels of shared situational awareness to ensure patients receive high-quality and error-free care. Borrowing from the military and aviation domains, situational awareness (SA) has emerged as a theoretical foundation for understanding how clinical teams com-

municate to achieve goals in complex and stressful circumstances. SA requires individuals recognize what is going on around them, and what those details mean now and for the future. Shared SA ensures that individuals in a team have the same understandings and projections.¹ Unfortunately, many errors in the hospital result from differences in SA across the clinical team.²⁻⁵

SA has been studied and measured in a variety of health settings, including with anesthetists,⁶ primary care providers,⁷ and doctors and nurses in intensive care units.^{8,9} In addition, SA is fundamental to successful patient-physician communication practices, recognizing that good communication requires bidirectional information exchange.^{10,11} In addition, poor communication, resulting from breakdowns in SA, leads to misunderstandings that result in medical errors.¹²⁻¹⁴ To improve SA, healthcare organizations have implemented many strategies, such as huddle systems for staff and administrators,¹⁵ SA-focused content in teamwork training modules,¹⁶ and simulation-based learning experiences.^{17,18} Although these strategies have yielded positive outcomes—such as increased clinicians' collaboration, cohesion, accountability, and incremental patient safety improvements—few SA strategies consider the role that patients and caregivers play in their hospital care. Less is known about how patients and caregivers perceive SA, and what benefits or challenges they face in achieving shared SA with their care team. Given that patients and caregivers have the most to gain from shared SA and are often the first to detect and intervene in medical errors when they arise,^{19,20} understanding their perspectives is a critical step toward maximizing the potential of SA to improve their care and safety.

Situational awareness: Theoretical foundations

SA is broken down into 3 distinct levels and defined as “the perception of elements in the environment within a volume of time and space (Level 1), the comprehension of their meaning (Level 2), and the projection of their status in the near future (Level 3).”²¹ SA functions as the primary condition for an individual to make well informed and appropriate decisions.²¹

When people work together in teams, each person has a specific role and series of tasks to achieve a common goal. The team's success requires that various team members across all roles work interdependently.¹ Team SA is “the degree to which every team member possesses the SA required for his or her responsibilities.”²² The team might fail if one member of the team holds a specific piece of information but another team member who needs those details to perform their role does not. However, having the same SA across all team roles can result in information overload and interfere with team functioning. Thus, team SA is “dependent not on a complete sharing of information between team members, but only on a shared understanding of that subset of information that is necessary for each of their goals.”¹

Team SA requires that elements at all 3 levels of SA be shared across the team, a critical task to ensure proper team functioning. At times, this shared SA requires that one team member considers the status of another team member, and how that status impacts their own tasks and goals. Team SA requires that team members share their comprehensions and projections of the shared situation with the rest of the team. Unfortunately, teams often do not recognize what information must be shared across the team members, or individuals falsely assume that others will arrive at the same conclusions and projections that they have based on the same Level 1 data.²³

Objective

In this article, we explore team-based situational awareness from the perspective of patients and their caregivers, study how it impacts their hospital experience, and identify implications for the design of health information technologies.

MATERIALS AND METHODS

We utilized a mixed-methods approach to understand both the role that patients and caregivers play in shared SA as well as the barriers they face. The study was conducted at 2 different hospitals in Seattle, Washington: an adult tertiary care hospital (Virginia Mason Hospital) and an academic children's hospital (Seattle Children's Hospital). Both hospitals serve as tertiary referral centers and admit between 15 000 and 16 000 patients annually, covering a wide geographic region. The authors' and hospitals' institutional review boards approved this work.

Study procedures

We recruited participants between February and May 2015. In our pediatric cohort, participants needed to be at least 7 years of age and have parental consent as well as their own assent to participate. Caregivers included family members and friends who actively observed and participated in the patient's care. We utilized a purposeful sampling framework focusing on age, gender, ethnicity, medical or surgical service, and disease complexity, oversampling underrepresented demographic groups. We excluded patients in the intensive care unit at both sites and on the pediatric oncology service, as well as non-English-speaking patients. We used the Q methodology²⁴ to structure our data collection, conducting 2 separate semi-structured interviews with patients and their caregivers. Quantitative results from the Q-sort have been published previously,²⁵ and here we focus solely on the qualitative interviews. These interviews asked patients and their caregivers about their current hospital stay as well as their experience receiving and communicating care information with providers, exploring their attitudes toward active engagement in their care, and managing information the hospital.²⁶ The first interview took place during a participant's hospital stay, with the second approximately a week after discharge. Participants received \$100 for completing all components of the study.

Analysis

Members of the research team analyzed the transcribed interviews using an iterative deductive and inductive coding process. Given our focus on shared SA within teams, including patient and caregivers' perception of team-based SA, the research team first identified quotes that were related to teamwork within the hospital, and from this subset, we looked for quotes related to situational awareness. Next, utilizing the SA framework, 4 members of the research team worked together to review each quote and assign 1 of the 3 SA levels (perception, comprehension, or projection) codes to each quote. Given our focus on shared SA, codes were assigned based on the level of shared SA for the entire team, not an individual's SA. After assigning the quotes a specific SA level, we reviewed the quotes one last time using an open coding approach to identify additional themes that emerged from the data.

RESULTS

Purposeful sampling across our 2 hospitals allowed us to recruit a range of hospital care experiences and participants. A total of 47 people participated in our study: 28 patients and 19 caregivers across the 2 sites. Our recruitment methods focused on maximizing participant diversity including age, gender, ethnicity, primary medical service, and disease complexity (Table 1).

From our open coding phase, we identified 3 overarching themes, consistent across both sites: (1) reasons that patients and their caregivers want shared SA, (2) barriers to shared SA, and (3) facilitators of shared SA. We present our findings for each of these high-level themes. Within each theme, we connect back to the 3 stages of SA: perception, understanding, and projection. Illustrative quotes are in theme specific tables in which we identify participants with a code: the first letter indicates the site as adult (A) or pediatric (Y), the second letter designates patient (P) or caregiver (C), and the number is a unique identification provided by the research team.

Reasons that patients and caregivers want shared SA with healthcare teams

Our results show that patients and their caregivers seek to create shared SA with their healthcare team when in the hospital (Table 2). Our participants expressed a strong desire to play an active role in their care, instead of just being passive recipients. They wanted **autonomy** to make their own decisions, as they have to live with the results of those decisions (AP01, AP10, YC06). Because they possessed unique knowledge about the patient's health outside the hospital, they saw themselves as having valuable insight that should be part of any decisions made about the patient's care. This insider information encompassed both the patient's health and the patient's values. Like others have found in outpatient settings,²⁷ our participants felt the need to communicate both kinds of information to the care team, to build team SA, support patient autonomy, and achieve **improved health outcomes** that were also more consistent with the patient's goals and values.

Participants described how team SA in the hospital could help them better self-manage their illness, even after they left the hospital. For instance, YP06, who was newly diagnosed with type 1 diabetes, wanted to be aware of every relevant factor that could impact her condition, to self-manage after discharge. Similarly, her mother (YC06) felt that sharing clinicians' understanding of her daughter's health situation, and especially of the reasons for their medical recommendations, would help her manage her daughter's health at home.

Some participants illustrated that it was not just important for patients and caregivers to understand clinician reasoning—it was also important for clinicians to know that patients and caregivers shared that understanding. For example, YC01's understanding about her daughter's condition and ability to demonstrate shared SA with the clinicians managing her daughter's recent heart transplant allowed them to leave the hospital much sooner than what was typical for other patients. Not only does this example highlight the potential cost savings as a result of shared SA with patients by reducing length of stay, but also it suggests a way to reduce hospital readmissions, which in itself is a significant burden on the healthcare system.

Another important reason to include hospitalized patients and their caregivers when facilitating shared SA is to reduce and ultimately prevent errors. Patients and their caregivers have critical pieces of information needed for ensuring appropriate and safe care.

Table 1. Participant characteristics

Patients	
Sex	
Male	13
Female	14
Not specified	1
Age, y	
Pediatric	12 (7-17)
Adult	53 (18-76)
Caregivers	
Sex	
Male	2
Female	15
Not specified	2
Age	
18-29 y	1
30-39 y	7
40-49 y	6
50-59 y	3
Not specified	2
Race/ethnicity	
Hispanic/Latino	6
American Indian/Alaska Native	2
Asian	5
Native Hawaiian/Pacific Islander	1
Black/African American	7
White/Caucasian	30

Values are n or median (interquartile range).

In addition to describing their past medical history and previous responses to therapy (which includes identifying adverse reactions such as drug allergies), they also provide key details on treatment preferences, and establishing their goals of care. When any of these items are missing, it can lead to significant challenges in achieving shared SA for any member of the medical team, and ultimately results in some type of error (YP12).

While patients and their clinical care team often share the same overarching **goals**—such as achieving a cure, reducing pain, improving functional status, or improving quality of life—sometimes the subtleties and specifics of these goals differ. Patients and caregivers described building team SA through conversations with their clinicians, in which all members of the team expressed their goals and concerns (YC01). These conversations led to conflict identification, increased the team's comprehension of the current situation, and yielded outcomes that met everyone's goals. When these conversations do not occur and shared SA is not achieved, significant errors can result.

In addition to facilitating collaborative goal setting, shared SA has the potential to help individuals **manage expectations** in the hospital. When patients and their caregivers have expectations about outcomes, treatment responses, or even treatment plans that differ from those of the clinical care team, breakdowns in shared SA can occur (YC08). Unfortunately, these differences (ie, projection failures) often result in the patients interpreting the outcome as an "undesirable event," such as an unexpected prolonged hospital stay as a result of needing intravenous antibiotics.

Our results also provide many examples in which patients and their caregivers recognize that their expertise in their own health should drive therapeutic decisions. When this expertise is not heard or ignored, it leads to breakdowns in team-based SA and results in

Table 2. Reasons to support team situational awareness

Topic	Participant	Quote
Patient autonomy	AP01	I don't want secrets. If you know something that has to happen or if you know something's happening, if you don't tell me, I have a real problem with that. This is my healthcare, not yours that you're talking about. This is me being affected, not you being affected, so let me know.
	YC06	I'm not here just to sign the paperwork. This is her life, our life, so I need to know what's going on.
	AP10	Yeah. It's good to know that they know what you want out of this outcome, what's important to you. I understand what they're trying to get done, but they need to know what I need and what's important to me. Did we need all these procedures, did I need all these? They need to know what's important to the patient and understand the patient, what makes the patient tick.
Improve outcomes	YP06	I would like to know how serious my illness just because—what was happening, and why I had diabetes, more specifics about it, so basically seeking it out like how dangerous low blood sugar is, and how much it actually affect me. I think without that knowledge, I probably wouldn't do as well at home. It would have taken a fairly long time for me to get stable. I think it's good to know how serious it is because—I really need to make sure I'm good at this
	YC06	Because for future decision making, if I understand why they're making a recommendation for something, it will help me make more decisions on my own going forward instead of having to call every two seconds—like what does [clinician] think?
	YC01	From the time she was an infant, in order to get her home we had to learn how to care [for] her. So in order to even get her home, we had to know, we had to be active, we had to take a part. Otherwise [clinicians] wouldn't feel confident in us, and part of how she got home—she had her transplant on [date] and we came home on [date] which is 17 days later. Which is very uncommon, but it was because her dad and I and my parents had taken an active role in taking care of her, wanting to know what meds she's on, why she's on them, when she's got to take them, how to take them, and being that active participant. Otherwise she wouldn't have come home.
	YP12	Like say I wanted to start swimming exactly when I got out of the hospital and the doctors and nurses said that it would be bad for my health. [I don't want to do anything] that they disagree with.
Manage expectations	YC08	Her IV for her antibiotics. I thought they were trying to figure out what kind of oral antibiotics to give her so that she can take them at home and then I found out today that that's not even a possibility, it's going to be that she's going to have continue taking her antibiotics by IV. So that was the only change in plan that I wasn't aware of until the GI doctors came in this morning. I was like—oh, you should have let me know, but at least I know now, not like the day we're getting ready to go. Like oh, by the way, you're not taking that pill, we're just going to keep giving you the IV.
Create common goals	AP02	And then I do know from experience it takes a team to—when you're treating a person or trying to help a person, it takes a team to do that, because I might not have all the answers or all the services that they need. I might have to like resource out for that. But here they have a team that has all that under one roof. And you see that. I don't know, it makes you feel more comfortable, I guess. More safe.
	YC01	Every once in a while, she gets infusions of what they call IVIG. . .and they had decided that they wanted to do an infusion last night. Which in and of itself it's not that big, but they wanted to do it in conjunction with diuretics. . .So they wanted to start it at 9 and give her diuretics at midnight, and her dad and I are like that's not okay for her to be up all night. She'll be up all night going to the bathroom, that's not fair to her. She needs to be able to get some rest. So can we change the plan? The doctor came in, we talked to him, and he listened to us, and they did it this morning in conjunction with diuretics like they wanted. It's just they waited because we spoke up.

undesirable events. Ultimately, our data illustrate the value of fostering team SA among patients, caregivers, and clinicians. Including patients and caregivers in team SA supports all stakeholders resulting in increased patient autonomy, identifying more appropriate goals of care, and ultimately, better health outcomes.

Barriers to team-based situational awareness

Despite the importance of creating shared SA among patients, caregivers, and the clinical care team, many barriers prevent the establishment of team SA for hospitalized patients. Here, we identify various barriers organized by what stage of SA (perception, comprehension, and projection) the barrier occurred (Table 3).

Perception barriers

The first level of SA, perception—when individuals recognize the availability of information—is key to the creation of SA. However,

we identified many factors that inhibit individuals—whether patients, caregivers, or clinicians—from receiving the information they need for team perception. Verbal communication plays an important role in transmitting data among team members, especially in the hospital setting, and breakdowns in communication prevent the formation of team SA. Our participants identified many examples of **poor communication** with clinicians (YP11, AP13). These problems ranged from clinicians discounting the concerns of patients and their caregivers, to patients not listening to what their clinicians have to say.

In some cases, patients did not want to hear information from clinicians that conflicted with their own perception of their health status or goals, especially when they were afraid of what they might hear (YP12, AP11). This **fear** prevented some patients from fully perceiving what their clinicians said, especially when discussing a poor or scary prognosis. This problem was especially prevalent for pediatric participants who did not want to engage in these conversa-

Table 3. Barriers to team situational awareness

Topic	Participant	Quote
Perception barriers		
Poor communication	YP11	I went to the emergency room and they did some tests and then I told them some stuff and they kind of just ignored it. I was like, I give up, you're the doctors, I can't argue with you. And [they said] "you're fine, you can go home" and I was like "no, I'm not. I need to be put in," and here I am.
	AP13	Like when I first went in with the migraines, they gave me Fentanyl and I told them it wasn't working, and so the lady says, "Oh, we'll just give you more this time." And [they] gave me more. That wasn't what I said, I said it wasn't working, can we try something different? I was trying to make it very plain, I was not just there chasing pain meds. And that was like communication stopped there. They had an idea what I was about, and that was pretty much it. Like the last time I was in the ER over there, they basically told me not to come back because I was wasting their time.
Fear	YP12	I just feel like if stuff gets worse, I don't like to know about it. If it's really dangerous to me I tend to not want to know about it
	AP11	They didn't really give me a book, they just really told me everything, which I wish they wouldn't have. I feel like half the stuff they told me that was probably going to happen that I was so terrified about didn't happen, wasn't going to happen, probably.
Protect patients	YC11	I mean, it's just hard—he knows things because he reads and he researches. But I guess you don't want them to know the reality of the true—it's a grim reality in many ways, so you try to shield them from that and keep them as healthy as you can. So he doesn't feel like—it's just that, not that I don't want him to know, but as he gets older he's going to learn these things and be there to talk with him about it, but I don't want him to say "hey, I just got my lung transplant. What do you mean I don't need a lung transplant?" So as he gets older, he's understanding more about it and he can learn, but not just to bombard him when he's little.
Comprehension barriers		
Cognitive challenges	AP09	Yeah, I'm still on morphine, but it was stronger in the beginning, so I mean the doctors need to give it to you I guess as often as you can, I just think everybody needs to be cognizant of the fact that I probably will need that information again when I'm more clear-headed, when the patient's more clear-headed, because it's especially—like to me kind of palpable that I have asked the same questions a few times.
	YC01	Her temp usually runs in the 97 range and her temp got up to 99 and I told the evening nurse, "I think that's a fever." The nurse said "no, that's not a fever, we don't think a fever is until she gets to 100." Well, the next morning it had spiked up to 103 degrees and she ended up having an infection on her port. If the nurse had listened to me the night before, could we have potentially caught it earlier? I think we could have. But she didn't listen. So I think it's very important that they listen to me as well as I listen to them
Blind trust	AP02	He's a professional, it's not important I understand what he's saying because I understand he's saying it from facts and looking at my condition and stuff, so I don't need to know his reasoning and all that. I'm not a psychologist!
Projection barriers		
Unrealistic expectations	YC03	Last year it was actually her first time being admitted and I had no idea what to expect. Nobody had told us. In the 12 years that we've been dealing with cystic fibrosis, I honestly wasn't aware how long the CF clean-out was. So when she was admitted, I thought we were going to be here three nights maybe 2-3 nights, and when I came in and asked how long do we stay, and they told me two weeks, my heart just dropped.
	AP03	I'm supposed to go on dialysis a long time ago this year, and I refused to go, so then this happened.

tions. Parents of pediatric patients also felt a need to **protect** their children from information and conversations that could scare their child. However, parents recognized the need to balance protection with the need to ensure the children had the information to properly engage in their care both now and in the future, as they transition to adults (YC11). These conflicts reveal a tension at pediatric hospitals between the need to include pediatric patients so they understand what is happening, but also to consider their emotional and developmental needs to ensure that information is provided in a way that does not cause fear and harm.

Fear also acted as a barrier to receiving information for our adult participants. Specifically, they identified conversations regarding planned treatments and procedures with their physicians that generated much angst and worry. Although the consent process is meant to provide shared SA so that the patient can make an informed decision about undergoing the procedure, this process worried patients

about potential complications that had a very low likelihood of occurring. Shared SA needs to strike a balance with providing enough information to ensure perception, without causing too much fear.

Comprehension barriers

In addition to perception challenges, our participants identified barriers to understanding information due to the physical and cognitive barriers that developed as a result of their medical condition. Many studies have described the inability for patients and caregivers to retain and process information while in the hospital.^{28–31} Our participants provided many examples in which these **cognitive challenges** prevented them from processing the verbal information that the clinical care team provided to achieve SA (AP09). Interestingly, this problem also creates a second barrier to shared SA, as the clinicians do not know how much of the details they have provided have actu-

ally been received and processed by patients and caregivers. Therefore, providers may falsely assume that the information they have provided to patients and caregivers has been received and understood, when in fact patients and caregivers had **different interpretations** from clinicians of what they perceived about their health and care. In addition, failures in clinician comprehension resulted when unique patient characteristics manifested in ways that were different from established clinical norms (YC01).

Finally, we identified **blind trust**³² as a barrier to shared SA. Some patients trusted their clinicians without asking questions and, rather than wanting additional information, deferred to their interpretation of the situation to their clinicians (AP02). By deferring to their clinicians, patients and caregivers did not develop the SA needed to take an active role in their health in the hospital and after discharge. Despite receiving the right information, not understanding what the information means in the patient-specific context (ie, failed comprehension) prevented team SA in the hospital.

Projection barriers

While breakdowns in perception and comprehension can lead to projection failures, we also identified examples of individuals appropriately perceiving and comprehending care information, but then projecting the wrong outcome. Commonly, we saw this expressed as **unrealistic expectations** regarding treatment response, prognosis, or outcomes (YC03, AP03). While some failures of projection led to misunderstandings without resulting in significant clinical impacts, other participants described examples that resulted in clinical harm, such as AP03 not initiating dialysis in a timely manner. Unfortunately, a patient's inaccurate projection affects their ability to engage effectively in self-management. Self-management implies that an individual takes responsibility for their health and engages in beneficial activities.³³ However, when they lack SA due to projection failures, patients can experience challenges in making decisions for their best interest, which can exacerbate their clinical condition.

In summary, our results identify a variety of barriers that prevent the formation of shared SA at all levels of the SA model.

Facilitators of shared situational awareness

We also identified practices that facilitated team-based SA (Table 4). Patients and caregivers have **expertise**, values, and goals that must be communicated to help drive clinical decision making. While clinicians may have a preference on how to move forward when faced with multiple therapeutic options, incorporating patient expertise facilitates team SA leading to decisions that respect the values and preferences for all stakeholders (YC05).

Patients and caregivers highly value their interactions with their clinicians to gather key information about their current health and clinical status. While patients gather this information when directly interacting with the clinicians, they also benefit from **observing** communication events that take place between the clinical care team members. For example, several participants learned additional important and often unknown details when observing a nurse hand-off or during rounds (AP10). Allowing patients and caregivers to observe these events increased transparency into the process, offering additional opportunities to hear from other team members, interact with the information, and build shared SA. **Repetition** of critical information provides additional value, such as hearing different perspectives from clinicians with various backgrounds and specialties (YC05).

Good communication, incorporating **empathetic** listening, facilitated goal sharing, especially when all members of the team were involved and treated as equals (YC14, AP03). It allows patients to feel comfortable with asking additional questions, clarifying items they do not understand, and sharing their values and goals with the clinical care team. Relatively simple practices such as taking the time to listen helped to create team SA within the hospital.

Activities that facilitated communication, trust, and empathy among team members were key for improving SA. Including patients and caregivers as team members is important to build shared SA.

DISCUSSION

Situational awareness provides a strong theoretical foundation to argue for increased patient and caregiver participation as team members in the hospital. Patient and caregiver expertise and values provide key details to enhance clinical decision making while the clinical team's knowledge supports patients' own self-management after hospitalization. Missing or inaccurate SA can lead to negative or undesirable outcomes, in the form of either a small misunderstanding or life-threatening patient harm. Therefore, stakeholders need to address barriers that prevent team SA and consider how to best leverage health information technology to facilitate team SA among patients, caregivers, and clinicians. In the following sections we explore how to best design health information technology to support team SA leveraging 3 guiding design principles (DP):

1. Ensure that all clinical team members, including patients and caregivers, have access to all data and all data sources, to support and facilitate shared perception.
2. Provide appropriate context when presenting data to facilitate shared comprehension.
3. Provide opportunities for open and honest communication to uncover comprehension and projection differences across the team.

Designing to support shared perception

To increase perception in the hospital setting, supporting our first design principle, stakeholders need access to all information sources. A significant amount of clinical information is stored within the electronic health record (EHR) and other clinician-facing tools, but this information is not consistently transmitted or documented for patients and caregiver use. Therefore, we must facilitate access to data stored in electronic systems as well as support the transmission and recording of data maintained by individuals to all team members. In the following sections, we share recommendations that we hope will increase perception first for patients and caregivers and then for clinicians.

Supporting patient and caregiver perception

Currently, EHRs serve as the repository for a majority of clinical information on hospitalized patients. Traditionally, access to the EHR has been limited to clinicians only, though more recently there has been a trend to provide access to the hospital EHR through patient portals designed for patients to use when in the hospital.^{34,35} Most commonly, these tools provide limited access to the medical record, focusing on results and less so on clinical notes written by clinicians, despite evidence that most patients want full access. Recently, Grossman et al³⁶ demonstrated that providing clinical notes to patients and caregivers while in the hospital is both feasible and beneficial. However, simply opening access to the EHR, a system originally designed for clinicians, to patients and caregivers without a

Table 4. Team situational awareness facilitators

Topic	Participant	Quote
Patient expertise	YC05	For example, like we let the doc know that [patient's] having a difficult time eating and drinking and whatnot, he's feeling a little grumpy with the medicines. . . And then they can change it to make him more comfortable. For example they had a feeding tube in him to do the flush-out process and they said we got an option to keep the feeding tube in and then feed him the nutrient supplements that way or have him eat on his own, and [Patient] really wanted to be able to eat on his own and get that tube removed because he would be more comfortable, less in pain, a number of different reasons. They were like yeah, let's do the right thing for him, that he feels comfortable with.
Observation	AP10	They sit here and they tell each other what's been going on during the day, what kind of medications I'm on, what the doctors have said, what's in some of the charts, what's in some of the X-rays, what the plan is for the rest of the night. They do it every day, so some of the stuff that I might not have listened to and know, I get more information listening to them, because they've talked to the doctors or the doctors have talked to them and they may have to pass the information onto each shift
Repetition	YC05	I feel more like they just really want us to know what's going on, and even though they're repeating what the other one said, they repeat it with another little twist, like a little bit extra information from their side, their specialty. . . So even though they're talking about the same thing, they have different approaches and then different information from their side of the experience.
Empathy and comfort	YC14	They've been so great, and actually this is the only place where they talked to her like she's an actual person here, she's not just sidelined. And so it's really cool. She gets to have a lot of say and they totally listen to her. She has a say in what's going on. Like with the IV, she was super freaked about getting it flushed again because it hurt and they totally worked with her. So they were able to keep it open a different way.
	AP03	Sometimes you feel like—it could be a doctor visit in their office, I feel like they want to hurry, hurry, and then I totally avoid asking questions. But I feel comfortable with them, they really seem very concerned, then I don't feel rude and I want to ask more questions, like what does that mean? What is that pill's going to do to me? So when they use medical terms and I don't understand, I don't feel bad to ask them questions, if I don't understand it, they can explain what does that mean.

customized view does not support their unique information needs and is likely to result in usability issues for patients without facilitating shared SA.^{37,38} These issues risk information overload for patients and caregivers who are often unfamiliar with the medical terms and concepts used by clinicians, not to mention that portals currently omit key details wanted by patients and caregivers.^{26,39,40} Previous research has explored tools to address some of these concerns, focusing on design needs⁴¹ and supporting the educational and communication needs of patients and caregivers in the hospital.^{35,42} These studies provide insight into how to build shared SA, beyond just providing access to information, and support the unique needs required by patients and caregivers (DP2).

In addition to improving access to the medical record, our participants clearly identified value in observing clinician handoffs and discussions as another important source of information to build shared SA. Patients find value in bedside handoff practices between nurses, but they need to happen consistently to be the most effective.^{43–45} However, current best practice recommendations do not advocate for physician handoff events to occur in front of patients and caregivers.⁴⁶ Because physicians provide care to more patients in the hospital compared with their nursing colleagues, it has not been feasible to conduct bedside handoffs. Therefore, we need alternative methods to provide access to these information-rich sessions. For example, recording physician handoffs and making them available to patients could improve access to information and minimize the burden to clinicians' workflow. Alternatively, providing a live video feed of clinician handoff events would likely provide a similar benefit. Finally, requiring that handoff events take place in a standard fashion minimizes communication breakdowns between clinicians,⁴⁷ and would allow patients and caregivers to follow a predictable information exchange.

In our previously published work detailing the results of the Q-sort, we identified a series of patient and caregiver personas, orga-

nized by their information needs and priorities.²⁵ While all participants highly valued receiving information, there were differences in their preferences for gathering and receiving as well as using clinical information. Recognizing these differences, and tailoring information delivery accordingly, will help facilitate patient and caregiver perception. In addition, leveraging the situational awareness framework as done with this qualitative study may provide a mechanism to identify and differentiate individuals into these various personas, to better support their unique information and communication needs.

Supporting clinician perception

Observing handoff events not only increases perception opportunities for patients and caregivers, but also helps clinicians to form a more accurate picture of a patient's status. Much has been written about how patients listening to and participating in rounds and handoff events provide important context, correct mistakes, and even prevent errors.^{48,49,50} In addition, family rounds have been shown to improve SA for both clinicians⁴⁸ and patients.^{51,52} Similarly, including patients and caregivers during all handoff events, including those between physicians, would help to create a common picture across the team and provide insight into what others on the team know and understand about the current situation (DP3). Unfortunately, clinicians do not have a way to reliably and consistently assess what information patients retain after a conversation, often incorrectly assuming that patients completely heard and understood everything that was discussed. Utilizing safety tools such as report-backs and read-backs, in which the person receiving information reads back what he or she heard to ensure an accurate transmission has occurred,^{53,54} may help to increase clinicians' perception of the level of their patient's understanding of the current situation.

A key finding from our work demonstrated that breakdowns in communication prevented shared SA. One possible solution is allowing patients and caregivers to enter data directly into the EHR. Given that clinicians utilize the EHR frequently throughout the day, patient-entered data provide a method for communicating important details without significantly changing clinician workflow. Patients could potentially document goals, report on symptoms, ask questions, identify topics or results that they do not understand, and importantly, point out inconsistencies or errors (DP1 and DP3). Providing patients and caregivers full access to their EHR, including the ability to contribute information, such as the OurNotes project,⁵⁵ has the potential to significantly increase shared SA for all stakeholders but will require careful planning and additional research.⁵⁶

Previous work has recommended maximal customization and flexibility for systems designed for patient-provider collaboration.^{56,57} On the one hand, entering data in a standardized form into something like an EHR may be difficult for patients, who may not be experts in the system or have expertise in the medicine that they are trying to understand, and whose health is already compromised in the hospital. On the other hand, allowing patients and caregivers to enter data in nonstandardized forms can make their data more difficult for clinicians at the other end to use, a problem clinicians already encounter in approaching patient-generated data in outpatient environments,^{58,59} and may make it more difficult to achieve shared SA because clinicians may interpret nonstandardized data differently. Researchers and designers must explore how systems can resolve this tension, for instance, by helping guide patients and caregivers to the right tools or terminology to ensure the validity and intelligibility of the information that they enter.

Designing to support shared comprehension

The greatest opportunities to improve comprehension is to support patients and caregivers while processing and interpreting clinical information (DP2). As our results and those of others have identified,²⁸⁻³¹ physical and cognitive barriers prevent individuals from hearing, understanding, and processing information when in the hospital. Providing patient and caregiver access to the EHR may also increase comprehension, allowing them to get information at a time and place that is convenient, while supporting those with limited cognitive capacity, as they no longer have to keep key details in memory. However, providing this information without leading to information overload will require that additional explanations and visualizations be provided to support individuals with less clinical expertise.⁶⁰

In addition, physical and cognitive barriers impede effective communication. Tools that capture discussions (ie, audio recording devices) and allow later review have the potential to greatly increase comprehension. Additionally, automatically transcribing and annotating recordings with definitions of medical terms and concepts could dramatically increase the comprehension for all. This feature would allow patients and caregivers to provide direct feedback to the clinicians regarding their level of understanding or add additional context that would improve the clinicians' comprehension of the situation as well.

Designing to support shared projection

Supporting the earlier stages of SA helps to facilitate accurate projections, but as our results have identified, there may be opportunities to support this stage directly. Breakdowns in projection often

result from unrealistic expectations or when patient and caregiver goals differ from clinician goals.^{61,62} Therefore, new tools should focus on the transmission of goals and expectations between patients, caregivers, and clinicians. Again, allowing patients and caregivers full access to the EHR will provide insight into clinicians' goals and expectations. In addition, having patients and caregivers contribute directly into the EHR would allow them to add their own goals and expectations for clinicians to review. A new collaborative goal setting and expectation tool within the EHR has the potential to be a great shared display, helping to create accurate shared projections. To facilitate shared projection, the tool needs to highlight the goals and expectation for each individual, highlighting differences or conflicts, and then ultimately support a conversation for reconciliation (DP3).

Limitations and future work

Our findings reveal new opportunities to support shared SA among hospitalized patients, caregivers, and clinicians. However, we recognize some limitations to our study. Our sample represents individuals from only 2 different hospitals located in a single large metropolitan area in the United States and, therefore, might not represent findings from other geographic regions. In addition, our participants' views also may not reflect those from a larger and more diverse sample. Although our results did not suggest substantial differences between our pediatric and adult participants, our study was not powered to assess differences quantitatively and, therefore, additional work in this area is warranted. In addition, despite our diverse sampling approach we were unable to detect any differences between additional subpopulations such as hospital visit type (eg, planned vs emergent), given the relatively small sample size. Finally, selection bias may have influenced our results, as participants agreeing to participate might have been more engaged in their care compared with typical hospitalized patients.

Given the emphasis on shared SA with the clinical team, we have only provided insights from the patient and caregiver perspective; therefore, future work should include clinicians, exploring what barriers and enablers exist for their shared SA and why it is important. In addition, we recognize that additional factors, such as low health literacy and limited English proficiency, could impact SA, and would require additional studies to understand and explore.

CONCLUSION

In this study, we identified many reasons why patients and caregivers must be included as members of the team and supported by team SA. Patients, caregivers, and their clinicians all play important and unique roles, working together to ensure hospitalized patients achieve mutually desired outcomes. All stakeholders need shared situational awareness to work collaboratively as a team to gather data, interpret information, and project outcomes that will enable effective and error-free care. Team-based situational awareness requires that each team member have the information they need to accomplish the team's shared goals. Yet, our results point to many barriers that patients and caregivers face that impede their shared SA. By utilizing our suggested designs to facilitate shared SA among patients, caregivers, and clinicians, we have an opportunity to ensure that patients and caregivers function as full, contributing members of the clinical care team. When we guarantee that everyone's values, goals, and autonomy are heard, understood, and incorporated into the

decision-making process of the team, patients will experience fewer undesirable events and have better overall outcomes.

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AUTHOR CONTRIBUTIONS

AHP, SRM, and WP all participated in designing the study, conducting the research, analyzing the data, writing the manuscript, and approving the final version. SH, CA, and MK played a significant role in data analysis, writing the manuscript, and approving the final version. All authors agree to be accountable for the work and attest to its accuracy and integrity.

CONFLICT OF INTEREST STATEMENT

None declared.

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