Measuring Shared Situational Awareness at a Swedish trauma centre

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This paper describes a situation in trauma care, which we feel deserves more attention from HCI research. A series of studies was conducted to measure the level of situational awareness within 14 teams (145 participants) working on trauma exercises at a Swedish trauma centre. Data was collected through questionnaires filled in by all participants, and responses have been analyzed together with transcriptions of the video recordings made at each exercise. Our findings show a Fleiss' kappa of 0.495 over the entire dataset, a strong indicator of opportunities for improvement. We present in detail how the study was conducted, and discuss opportunities for moving forward.

Interactive systems in healthcare, Designing for collaboration, Socio-technical systems

1. INTRODUCTION

Figure 1: *The emergency room at Karolinska University Hospital, Huddinge.*

Consider Figure 1. It shows a typical situation in trauma care, with medical personnel scurrying around, working to stabilise the patient and save his or her life. The image is from a trauma exercise at Karolinska in Huddinge ("Huddinge"), Sweden, one of the two departments we work with at Karolinska University Hospital. The other department is Karolinska in Solna ("Solna"). The latter is designated as the most advanced trauma centre in Sweden, handling more cases than other hospitals, and especially difficult ones. The research being undertaken stems from a political motivation in Sweden to improve trauma care at locations lacking Solna's experience (e.g. rural hospitals or soldiers on foreign peacekeeping missions) through telemedicine. The experienced team at Solna is planned to be made available to other institutions through a video link (Tachakra, Jaye, Bak, Hayes and Sivakumar, 2000), and the Trauma Leader (i.e. the main authority in the room with the patient) can communicate with this team to receive support.

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A question that emerged in the early phase of our work was one of situational awareness. If the supporting expert team at Solna does not have a good grasp of the situation, including how personnel on the scene understand the situation, they may not be able to provide good support. In fact, it may even be dangerous.

The focus of our research group is not only on remote support for trauma centres, but also on the situational awareness shared within the team working on the patient (which is the topic of this paper). The two may be connected, as the goal would be to arrive at a socio-technical system that enables the remote supporter to be part of the on-site team. If the level of situational awareness of the remote supporter would ever match that of the on-site personnel, one could claim that the quality of care would at least not have a detrimental effect, and the expertise of the remote supporter would likely mean the quality of care would increase.

This paper discusses our findings on shared situational awareness in the trauma room at Huddinge (i.e. not including the remote expert). Our motivation for generating this data is to give us a baseline to compare against in future projects when we introduce new technology or changes in their processes, but we also believe the data to be interesting on its own. Our goal is not only to arrive at a socio-technical system where the remote supporter has the situational awareness to provide quality care to the patient (a requirement that is deemed very important), but at a system that also improves the situational awareness of the team on site with the patient.

The rest of the paper is organised as follows: First we briefly discuss concepts in situational awareness, introducing terms that we will be using later on and giving some general background on the subject. Following that, we will explain the methods we have employed in collecting data and analysis. We then go on to present our results. Lastly, we end the paper with a discussion.

2. BACKGROUND

This study can be seen in context with work done in collaborative sense making and information seeking (Paul and Reddy, 2010,R), where studies were done at a hospital's emergency departments. Whereas their studies were ethnographic, focusing on observations and interviews, this study centers on the use of a questionnaire to measure shared situational awareness, and the level of consensus within each team (Gutwin and Greenberg, 2002). Also, within medicine and IT there have been an ongoing focus to improve collaboration and situational awareness between multidisciplinary teams (Reddy, Paul, Abraham, McNeese, DeFlitch and, Yen, 2009,M), something our work attempts to contribute to.

Medical systems are an interesting and complex area for interaction designers (Randell, Wilson and Fitzpatrick, 2010). It naturally shares many traits with other environments where different disciplines collaborate to some kind of common goal (Reddy, Dourish and Pratt, 2001,M). Work in health care, however, does have some unique aspects, which complicates the design process (Jansson, Mörtberg and Mirijamdotter, 2008,F). Design choices have a much clearer connection to people's health and in its most extreme situation have a real effect on life and death for patients. Different kinds of communication is used for the flow of information in health care and the problems in this area have been looked on from many different perspectives (Leonard, 2004,H). Correct flow of information and understanding of the structure is even more important when designing for time-critical situations (Landgren, 2006,B) such as trauma treatments in healthcare (Sarcevic, Palen and Burd, 2011).

Situational Awareness is a concept that can be relevant on many levels. Each individual has a level of situational awareness related to his or her task, and together a team of individuals has a level of Team Situational Awareness ("Team SA") related to the task they are working to achieve. In addition, in order to achieve Team SA, the team needs to communicate certain information, which yields Shared Situational Awareness ("Shared SA"). We'll discuss each of theses concepts in turn.

Situational Awareness (without the "Team" or "Shared" prefix) refers to the individual's ability to detect, comprehend and understand a situation. Many definitions have been given, among them the popular "the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" by Endsley (Endsley, 1995a). Other, simpler ones include "knowing what is going on so you can figure out what to do" (Adam, 1993) and "what you need to know not to be surprised" (Jeannot, Kelly and Thompson, 2003).

Endsley's definition of Team SA is simpler than for the individual (but based on it): "the degree to which every team member possesses the Situational Awareness required for his or her responsibilities" (Endsley, 1995a). In order for all team members to have this situational awareness, the members of the team usually needs to communicate. This leads us to Shared SA.

For all individuals in a team to have the required situational awareness, each individual must be given the information they need, before they need it. This means that not only must members communicate the information they have, but they must understand which information others need, when, and who needs it. If everyone was to communicate everything, all the time, this would lead to a lot of noise, and probably also to information overload, as everyone would have to process all information and discard whatever they do not need. With this in mind, let us now return to Team SA.

We can divide aspects needed for Shared SA into the following categories:

- Team SA Requirements – the team members' understanding of which information needs to be shared with whom, and the status of others on the team
- Team SA Devices – the ways team members can communicate the needed information, such as verbally or shared displays
- Team SA Mechanisms – mechanisms for members to be able to interpret information in the same way (e.g. shared mental models) and to predict each other's actions
- Team SA Processes – the processes in place to facilitate sharing of the required information (e.g. norms or procedures)

3. METHOD

3.1. The Setting

The trauma unit is part of the gastro-surgical department at Karolinska University Hospital that has approximately 120 surgeons. The hospital has approximately 15,000 employees and 1600 patient beds spread out at two different campuses, Solna and Huddinge, approximately 26 kilometres apart in the city. The trauma unit is a centre for trauma cases within the Stockholm county council. In Huddinge, the emergency unit occasionally may have to manage cases that are categorised as trauma. The emergency unit is divided into surgery, medicine, orthopedy, and head.

In order to investigate how the participants in trauma care perceive a situation relative to each other we chose to focus initially on trauma exercises at Huddinge, which are held about once every three months. A trauma exercise is a simulated real case, and from the moment it is announced that a patient is incoming, the exercise is treated like a real case. As is also normal in a real case, team members are given approximately two minutes warning to set up and introduce themselves to each other before the patient is rolled into the room by ambulance personnel.

A trauma resuscitation can be divided into four phases; preparation, diagnosis and stabilisation, treatment, and discussion/analysis. The preparation phase begins when the alarm arrives indicating type and level of trauma. The trauma team gathers in the trauma room, present what roles they have, and the participants may put on a name tag (Sarcevic, Palen and Burd, 2011).

The case is then presented by the Trauma Leader, a surgeon acting as the main authority in the care of the patient. The team prepares for the patient to arrive with the ambulance. When the patient arrives, phase two is initiated by the ambulance personnel reporting from the accident scene and on the status of the patient. The focus in this phase is on diagnosing and first treatment to stabilise the patient for further examinations and treatment. The stabilisation is made by constant re-evaluation using a prioritised list with the mnemonic A B C D E (the list was developed by the American College of Surgeons and is named Advanced Trauma Life Support, or ATLS).

A Airways. Are the airways free?

B Breathing. Can the patient breathe? If not, the artificial respiration will be started.

C Circulation. Is the patient bleeding internally or externally?

D Disabilities. Is the patient conscious and coherent? The Glascow coma scale is used.

E Exposure/Environment. This point has the lowest priority and includes whether the patient is cold, etc.

The aim is to quickly get the patient under the correct treatment, phase three. We have focused our research study mainly on the second phase. The discussion/analysis phase starts after the patient has been rolled out, when parts of the team gathers in a room outside the trauma room.

When a person with traumatic injuries is rolled into a trauma centre, the team receiving the patient is highly structured. The structure of the team may vary a bit depending on available resources, the circumstances of the accident and the nature of the patient (e.g. a case involving a child will often result in a larger number of people showing up, including more specialised personnel such as paediatricians). All our exercises have involved adults. At Huddinge, a team handling an adult patient consists of a Trauma Leader, one trauma surgeon, an anaesthesiologist and a team of supporting nurses. In addition to the core team, supporting personnel providing CT scans and ultrasound are on hand, as well as a radiologist to interpret the scans, and an orthopaedic surgeon. Figure 1 shows the general layout of the personnel, with the anaesthesiologist at the head of the patient (leftmost person), trauma surgeon by the patient's right side (leftmost person with her back towards the viewer), trauma leader by the patient's feet (standing with her arms crossed, facing the patient, between the two nurses with their back towards the viewer).

The team in a trauma resuscitation may also differ depending on the hospital (or even site as in our case) and what routines that have been set up. At Huddinge, for example, they use a documenter that keeps track of what happens to the patient regarding what drugs are given, changes of the vital signs etc. The Solna site does not have this role.

3.2. The Study

Our study was initiated in the autumn of 2011 and is still ongoing. Over the course of four exercises including in total 14 cases and 145 participants, we have used two different types of patients. For ten cases a human was used and for four cases an advanced computerised doll was used (see Table 1). The doll is controlled by a human operator, which also acts as the patient's voice, and has abilities that a human actor does not, such as varying the pupil dilation separately for each eye, and measuring the amount of fluids and types of medicine that is injected. The operator's workstation is shown in Figure 2. In the cases where a human was used as the patient, no real injections were given, instead the needles were taped to the patient's arm, but not penetrating the skin. For the doll, injections were given, as the doll has designated entry points for needles, with the fluid being collected in a bucket beneath the bed (real medicine or blood was not given, instead bags of coloured water were used). Despite all of the doll's features, the medical personnel at Huddinge responsible for trauma exercises consider a human to give about the same training value.

All teams were deemed to be at the same competence level. Remote support by expert trauma personnel was used in seven of the cases (see Table 2). Data was also collected from the remote expert, but this data has not been included in the study (evaluating Shared SA with the remote expert will be the subject of another paper). Remote

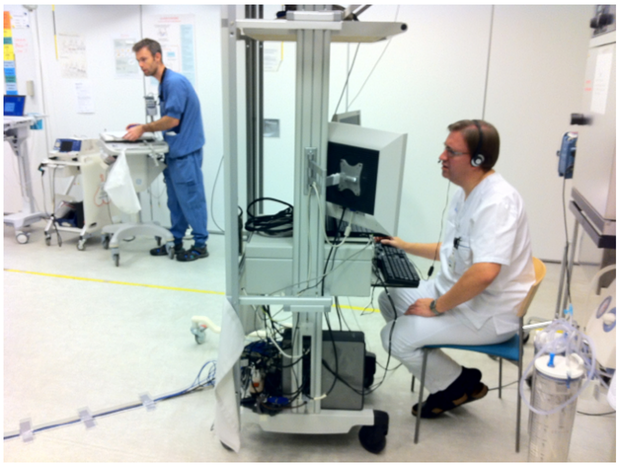

Figure 2: *Doll operator.*

support was only included in half the cases in order to juxtapose the performance of the team with and without remote support. When a trauma exercise was held, it usually included two scenarios (i.e. patients) and two or three teams of medical personnel. Typically team A would start with scenario 1, with remote support, and then move onto scenario 2, without remote support. Team B would start with scenario 2, with remote support, and move on to scenario 1, without remote support. This means that most scenarios were handled both with and without remote support, and no team handled the same scenario twice. There was no overlap in personnel between teams, so each scenario was new to everyone involved. In the cases involving remote support, the camera angle and zoom could be controlled. Figure 3 show this scenario. The link included voice and two-way video. The on-site trauma leader was designated the main contact point with the remote expert, although in practice the trauma surgeon often also entered the discussion.

In the tables we have opted to designate each exercise with roman numerals, each case by a letter prefixed with the exercise designator and team by a letter prefixed with the exercise designator.

A trauma exercise is conducted in the same way a real trauma case would be handled. The alarm is simulated by the exercise leader presenting what has happened, with the same level of coarse detail that would have been communicated to the trauma leader and the trauma team in a real case. When the transporters from the ambulance bring in the patient they communicate to the group the type of trauma, the status of the vital parameters, if the patient has been given any drugs, and other things that can be of relevance. The trauma leader is in charge. In the cases where tele-consultation was used, it had not previously been defined if the trauma leader or the remote expert were in charge. The trauma

Exercise	Type of patient	Visualisation of vital signs	Head cam	Comment
I	Simulator doll	Yes, on a screen by the anaesthesiology monitor	No	A biomedical technician interacted with the doll to give feedback to the trauma team.
II	Actor	Only presented orally.	No	
III	Actor	One big screen at the far foot end of the patient.	Yes	
IV	Actor	One big screen at the far foot end of the patient and one iPad on the anaesthesiology monitor.	No	Short of staff, case 5 and 6 were only observed, no remote support.

Table 1: *An overview of the four trauma exercises*

Case	Team	Scenario	Remote support	Comment
I:1	I:A	High-speed car crash	No	
I:2	I:A	Fall from > 5 meters	Yes	
I:3	I:B	High-speed car crash	Yes	
I:4	I:B	Fall from > 5 meters	No	
II:1	II:A	Fall from > 5 meters	No	
II:2	II:A	Pedestrian hit by a car	Yes	
II:3	II:B	Fall from > 5 meters	Yes	
II:4	II:B	Pedestrian hit by a car	No	
III:1	III:A	Fall from > 5 meters	No	Only observed, no data collected
III:2	III:A	Abdominal gunshot wound	Yes	Head cam on the trauma leader
III:3	III:B	Fall from > 5 meters	Yes	Head cam on the trauma leader, did not work
III:4	III:B	Abdominal gunshot wound	No	Only observed, no data collected
III:5	III:C	Abdominal gunshot wound	Yes	Head cam on the trauma surgeon
III:6	III:C	Fall from > 5 meters	No	Only observed, no data collected
IV:1	IV:A	Pedestrian hit by a car	No	
IV:2	IV:A	Fall from > 5 meters	No	Trauma surgeon from case III:1 is trauma leader, a new trauma surgeon participates
IV:3	IV:B	Pedestrian hit by a car	No	Only observed, no data collected
IV:4	IV:B	Fall from > 5 meters	No	
IV:5	IV:C	Pedestrian hit by a car	No	Only observed, no data collected
IV:6	IV:C	Fall from > 5 meters	No	Only observed, no data collected

Table 2: *List of the cases in each of the trauma exercises*

scenario is controlled by an exercise leader who informs everybody in the room what is happening with the patient. For example, if the trauma surgeon is listening to the patient's lungs the exercise leader would say out loud "for the lungs you hear unclean respiration, not identical on both sides". In the last exercises vital signs were visualised on a screen that everybody in the trauma room as well as the remote support could see. The parameters were updated by the exercise leader using a web browser on a smartphone. In the first exercises the leader verbally informed the group on the status of these parameters. In real trauma cases vital signs are displayed on the anaesthesiology equipment.

Using trauma exercises to study situational awareness when using remote support may not reflect an optimal situation where tele-consultation would be used. This paper does not discuss the situational awareness of the remote supporter versus that of the remainder of the group, nor whether a remote supporter influences the situational awareness of the group compared to a group with no support. Instead, this paper focuses on the shared situational awareness of the team on-site with the patient. As mentioned, data collected from the remote expert is not included in the dataset, so any lack of situational awareness at the remote location does not affect our results.

Figure 3: *Remote support.*

3.3. Questionnaires and observations

The study consisted of a series of questionnaires that was handed out directly after the end of a completed trauma case, with no communication allowed before all questionnaires were handed in. Questionnaires were handed out in 14 of the cases in the four exercises. Video was also taken of all cases but two, to support our analysis and understanding (necessary for our future work, which will introduce technology into the setting).

The questionnaire has been developed by a physician (anaesthesiologist) at Karolinska as part of a research project to create a tool for evaluating the effectiveness of remote support in trauma exercises. It attempts to arrive at a set of questions that all participants in the emergency room should be able to answer, regardless of the type of scenario they have handled. The quality of the questionnaire is evaluated using Content Validity Index (Polit, Beck and Owen, 2007) using a group of medical experts and trauma personnel. Refining the questionnaire is ongoing work, but as used in this study it consisted of 64 multiple-choice questions, with options being either "Yes", "No"or "Unknown".

In two cases (5 and 6) in exercise III, the exercise leader had to take the role of trauma leader because they were short staffed. As this person knew the scenario we have not added the data collected to the dataset, and instead only observed the case. We also observed one trauma exercise conducted before those in which we performed our studies. A summary of all the studies and observations during trauma exercises is given in Table 3. All the cases at the four trauma exercises except two have been video recorded.

We have also conducted field studies at the emergency unit in both sites, one observation at Huddinge and three observations at Solna, one of them during the night shift. Field notes were taken during the observations.

A potential criticism is that we do not make use of the Situation Awareness Global Assessment Technique ("SAGAT") (Endsley, 1995b) to measure the situational awareness. With SAGAT we could use the same questionnaire, but it would be necessary to stop the exercise at random times in the middle of the trauma case and administer the questionnaire. This would indeed give more detailed results, but we have unfortunately not been able to do this yet due to other constraints at the hospital.

3.4. Analysis

To arrive at a measurement for the level of shared situational awareness within each group, we have made use of Fleiss' kappa (Fleiss, 1971), which measures the level of agreement between raters above what would be expected if they made their ratings completely random.

As part of calculating Fleiss' kappa one has to calculate the extent to which raters agree on each question (i.e. the number of rater-rater pairs that are in agreement, relative to the number of possible rater-rater pairs), for a given patient case. Perfect agreement for a question gives a score of 1.0.

κ	*Interpretation*
< 0	Poor agreement
0.01 – 0.20	Slight agreement
0.21 – 0.40	Fair agreement
0.41 – 0.60	Moderate agreement
0.61 – 0.80	Substantial agreement
0.81 – 1.00	Almost perfect agreement

Table 3: *Suggested interpretation table for kappa*

A possible criticism here could be that the consensus of the entire team is not important, only between the most important roles (e.g. trauma leader, trauma surgeon and anaesthesiologist). However, the medical view, and official policy, of the hospital we work with is that the communication needs to be adequate to involve the entire team, not only doctors, as each member may have valuable observations and experiences to draw from.

3.5. Qualitative analysis

Eight of the 22 video recordings from the trauma exercises have been transcribed and tagged based on what happened. The other video recordings have been watched and sections of interest, i.e. fitting the tags, have been transcribed. Field notes from the observation studies have been transcribed and tagged based on what happened.

4. RESULTS

4.1. Kappa scores

In Figure 4 we can see the kappa results (y-axis) for the 14 cases (x-axis), for different groupings of roles in the team. Although it is true that the goal of the hospital is that everyone has the same level of situational awareness, we find the data interesting in order to understand which parts of the group manage to keep a high level of shared SA, and which do not.

The series with legend ”All” is the value with everyone is included (except the remote supporter, which is not included in any result), ”Trio” is a designator for the combination of trauma leader, trauma surgeon and anaesthesiologist (this is considered the three most important roles in the team). ”Non-trio” is everyone else besides the trauma leader, trauma surgeon and anaesthesiologist. ”MDs” is all medical doctors in the team, and ”Non-MDs” are all non-doctors, such as nurses.

We can see from this chart that except for two cases (III:2 and IV:4), the trio of trauma leader, trauma surgeon and anaesthesiologist scores consistently higher than the rest (Non-trio), an indication that there is more consensus, and thus more Shared SA, in this group. It is important to note, however, that the trio-group is much smaller (3 people) than the non-trio (usually around 8), so it is more prone to chance. Thus, this finding should be backed up by other measures of Shared SA (such as subjective measures, self-assessment, interviews etc).

The lowest agreement (not kappa) for any question in the dataset was 0.238. To highlight a few examples, a team scored 0.267 on a question about whether flail chest (a life critical condition) was suspected, and another team scored 0.333 for a question regarding suspected head injury. 29% of agreement-levels were perfect agreements, meaning that everyone on the team chose the same answer to a question.

High disagreement highlights confusion within the team, something we want to avoid. If a score is low, it is a strong indication that the team has not communicated well enough (Mentis, Reddy and Rosson, 2010).

Fleiss’ kappa for the whole dataset (i.e. all cases combined) was 0.495. Considering that the score could be approaching 1.0, this is a clear indication that there is room for improvement. Even using the suggested interpretation table (Landis and Koch, 1977), shown in Table 3, the score ranks at a mere ”Moderate agreement” – something we would claim to be a low score considering that this is medical personnel working together to save lives.

4.2. Observations from the exercises

In one of the cases (III:2) it is clear that the trauma leader either does not notice what two other persons are saying, or he has forgotten. One of the nurses says that she has set another peripheral venous catheter on the patient. The exercise leader repeats this out loud. A while after that, when they have turned the patient to check the wound on the back, the remote trauma support says that they should do the massive transfusion protocol. The trauma leader says that they will run the protocol but that they only have one peripheral venous catheter. The nurse responds that they have two, both by saying so and by holding up two fingers in the air.

In the same exercise and case, right after the above described incident the anaesthesiologist asks about the plan. An earlier dialogue between the trauma leader and the remote trauma support has not been noticed or heard by the anaesthesiologist. Already six minutes after the patient has arrived, the remote trauma support says that they have an obvious circulation-problem and that the patients

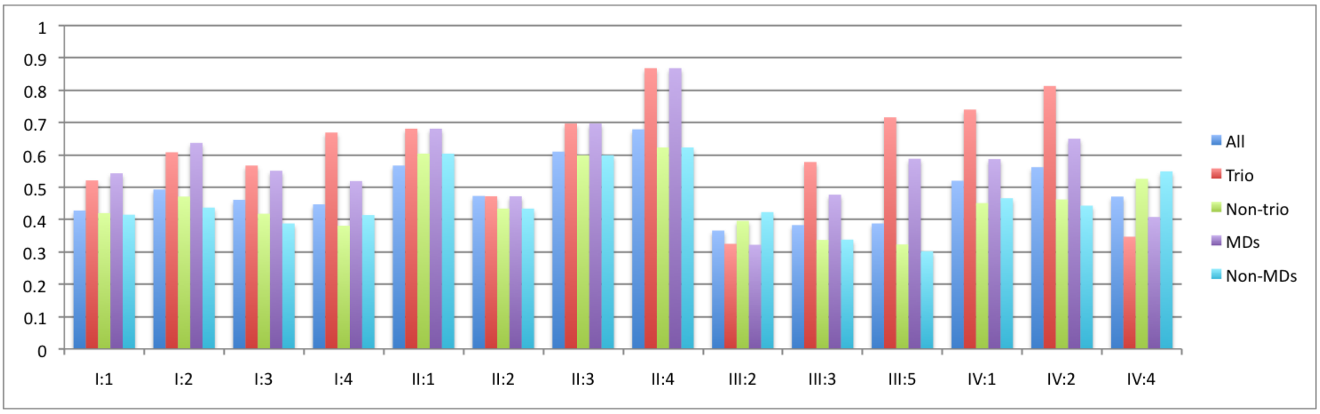

Figure 4: *Kappa scores for 14 trauma cases.*

need surgery as quick as possible, and that they need to pack the patient and that the entrances need to be set. The trauma leader repeats this to the team: ”We must simply try to set one more entrance to make the patient stable ... or ... prepare for surgery. We will block turn before, to see if we need to open in another place, ok.”. They turn the patient and look at the wound on the back. The remote trauma support repeats that the patient should be packed and go to surgery.

In case IV:5 (only observed) it was quite obvious that it is important to make re-evaluations of the patient’s status continuously in order for everybody to know what has happened and what will happen. In case IV:5 the exercise leader acted as a trauma leader together with the trauma surgeon, and it was the exercise leader who, in the role of a trauma leader, suggested that they should do a final re-evaluation before rolling out the patient to the CT-scan and OR in order to treat a diagnosed orthopaedic injury: ”Let’s re-evaluate once more before we leave so that we are sure that everything feels ok”. Hence, the re-evaluations are considered important enough to be motivated a delay of transporting the patient for further treatment.

Each participant has a specific role, but there is flexibility in who does what. For example, if the trauma leader needs to perform a specific activity because she is the one with those skills, another person may take over the trauma leader role. This did not happen in any of the cases we collected data from, but it happened in a single case when we were only observing.

After a trauma exercise the participants gather and go through the case. In the first exercise we observed they had this discussion and the first question asked was what kind of accident the patient had been involved in. Everybody in the team gets to respond to the question. Two of the participants said that it was a motorbike accident while the others said it was a belted driver in a car. The two people who were wrong, may not have had central roles in the resuscitation, but still, all persons participating in a trauma resuscitation must have the same picture of what has happened and is happening.

In informal interviews, trauma surgeons and others have stated a heartfelt need for introducing displays and connectivity throughout the chain of care, from the ambulance to the operating theatre. At Huddinge they had a test system some years ago where ambulance personnel took a picture of the place of the accident with a mobile phone. This was something they still want implemented, alongside streams of vital signs from an ambulance or a helicopter, as it may provide an important context. Similarly, personnel in the operating theatre say they could benefit from being able to follow the events in the trauma room (or even earlier information from the transit phase, as the progression of the patient’s state is important). On the other hand, one of the trauma experts in Solna says that he only believes the vital signs would be important to send from the ambulance or helicopter. Images of the accident would not be of any help for the trauma resuscitation.

5. DISCUSSION

Throughout this study we have worked closely with personnel at the hospitals. We have met little resistance towards the idea of introducing technology into this setting. In fact, most seem to see this as inevitable, and positive. The resistance we have faced has been from nurses worrying that their trauma exercises would be too experimental and not match the current setting with less technology. There has been no resistance from someone believing technology would hinder them in their work. Instead, we believe the current political ambition of supporting trauma care through telemedicine provides an opportunity for the HCI community to gain entry to personnel, facilities and resources, in order to help shape tomorrow's systems for saving lives.

Our aim with the study has been to investigate the shared situational awareness among the participants in the trauma room during resuscitation. In ordinary trauma exercises questionnaires with 64 multiple-choice questions have been handed out at the end of each case. The results from our study show a rather low shared situational awareness among the participants. When analysing recordings from the exercises we identified a correspondence in the results from teams with high situational awareness as being more organised and clear during the resuscitation. Similarly, in teams with low situational awareness we could identify misunderstandings or information spoken not being registered by persons with central roles. For example, if the trauma leader, with the most central role during the resuscitation, does not register what is said, important issues may not be communicated. There is a lot of noise in the trauma room that can explain why the trauma leader missed important information.

Apart from two cases we can see a correspondence in high and low levels of shared situational awareness among the medical doctors and the group of nurses. This is not surprising, but emphasises the importance of a structured and organised trauma leader. If the trauma leader fails to communicate important information to the team, the less experienced will be the group of participants that may not have a clear picture of what happens. The medical doctors appear to have a better understanding of the case even if the trauma leader fails to communicate important information. The trauma leader should, if necessary, continuously re-evaluate the status of the patient according to the ATLS protocol. This is practiced during the exercises.

REFERENCES

Adam, E.C. (1993). Fighter cockpits of the future. Proceedings of 12th IEEE/AIAA Digital Avionics Systems Conference (DASC), 318323.

Bardram, J.E., Hansen, T.R., Soegaard, M.: AwareMedia: a shared interactive display supporting social, temporal, and spatial awareness in surgery. Computer supported cooperative work. pp. 109118. ACM (2006).

Bolstad, C. A. & Endsley, M. R. (2000). Shared displays and team performance. Proc. of Human Performance, Situation Awareness and Automation Conference.

Endsley, M.R. (1995). Toward a theory of situation awareness in dynamic systems. Human Factors 37(1), 3264.

Endsley, M.R. (1995). Measurement of situation awareness in dynamic systems. Human Factors, 37(1), 6584.

Endsley, M. R., Bolte, B., & Jones, D. G. (2003). Designing for situation awareness: An approach to human-centered design. London: Taylor & Francis.

Fleiss, J. L. (1971) "Measuring nominal scale agreement among many raters." Psychological Bulletin, Vol. 76, No. 5 pp. 378382

Frykholm, O., Nilsson, M., Groth, K., Yngling, A.: Interaction design in a complex con-text. Proceedings of the 7th Nordic Conference on Human-Computer Interaction Making Sense Through Design - NordiCHI 12. p. 341. ACM Press, New York, New York, USA (2012).

Gutwin, C., & Greenberg, S. (2002). A descriptive framework of workspace awareness for real-time groupware. Computer Supported Cooperative Work (Vol. 11, pp. 411446). Springer. Retrieved from http://www.springerlink.com/index/h51l362v34870961.pdf

Hill, K.: The sound of silence - nurses non-verbal interaction within the ward round. Nursing in Critical Care. 8, 231239 (2003).

Hornbæk, K., Hertzum, M.: The notion of overview in information visualization. Interna-tional Journal of Human-Computer Studies. 69, 509525 (2011).

Jansson, M., Mörtberg, C., Mirijamdotter, A.: Participation in e-home healthcare @ North Calotte. Proceedings of the 5th Nordic conference on Human-computer interaction build-ing bridges - NordiCHI 08. p. 192. ACM Press, New York, New York, USA (2008).

Jeannot, E., Kelly, C. & Thompson, D. (2003). The development of situation awareness measures in ATM systems. Brussels: Eurocontrol.

Landgren, J.: Making action visible in time-critical work. Proceedings of the SIGCHI con-ference on Human Factors in computing systems CHI 06. 201 (2006).

Landis, J. R., and Koch, G. G. The measurement of observer agreement for categorical data. Biometrics 33, 1 (1977), 159174.

Leonard, M.: The human factor: the critical importance of effective teamwork and communication in providing safe care. Quality and Safety in Health Care. 13, i85i90 (2004).

McCurdy, N. J., Griswold, W. G., and Lenert, L. A. Realityflythrough: Enhancing situ-ational awareness for medical response to disasters using ubiquitous video. AMIA Annual Symposium proceedings AMIA Symposium AMIA Symposium 2005, 510514.

Mentis, H.M., Reddy, M., Rosson, M.B.: Invisible emotion. Proceedings of the 2010 ACM conference on Computer supported cooperative work - CSCW 10. p. 311. ACM Press, New York, New York, USA (2010).

Morrison, C., Fitzpatrick, G., Blackwell, A.: Multi-disciplinary collaboration during ward rounds: embodied aspects of electronic medical record usage. International journal of medical informatics. 80, e96111 (2011).

Paul, S.A., Reddy, M.C.: Understanding together. Proceedings of the 2010 ACM conference on Computer supported cooperative work - CSCW 10. p. 321. ACM Press, New York, New York, USA (2010).

Polit D.F., Beck C.T., Owen S.V.: Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Res Nurs Health. 2007 Aug;30(4):459-67. Review.

Randell, R., Wilson, S., Fitzpatrick, G.: Editorial Evaluating New Interactions in Health Care: Challenges and Approaches. International Journal of Human-Computer Interaction. 26, 407413 (2010).

Reddy, M.C., Spence, P.R.: Collaborative information seeking: A field study of a multidis-ciplinary patient care team. Information Processing & Management. 44, 242255 (2008).

Reddy, M.C.M., Dourish, P., Pratt, W.: Coordinating heterogeneous work: Information and representation in medical care. In: Prinz, W., Jarke, M., Rogers, Y., Schmidt, K., and Wulf, V. (eds.) EC-SCW 2001. pp. 239258. Springer (2001).

Reddy, M.C., Paul, S. A, Abraham, J., McNeese, M., DeFlitch, C., Yen, J.: Challenges to effective crisis management: using information and communication technologies to coordinate emergency medical services and emergency department teams. International journal of medical informatics. 78, 25969 (2009).

Sarcevic, A., Palen, L.A., Burd, R.S.: Coordinating time-critical work with role-tagging. Proceedings of the ACM 2011 conference on Computer supported cooperative work - CSCW 11. p. 465. ACM Press, New York, New York, USA (2011).

Tachakra, S., Jaye, P., Bak, J., Hayes, J., Sivakumar, a: Supervising trauma life support by telemedicine. Journal of telemedicine and telecare. 6 Suppl 1, S711 (2000).