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Design of InterFACE: A Tool to Improve Collaborative Work and Decision Making During Resuscitation

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Abstract. Successful resuscitation requires good teamwork, communication and quick decision-making. The complexity of the situation makes the communication often erratic. As a consequence, improper decisions can be taken and errors can occur, endangering patients. In order to support the resuscitation team in their work, we developed an innovative product named Interconnected and Focused Mobile Applications on Patients Care Environment (InterFACE), enhancing team situational awareness, and improving the team communication process. To develop our solution, we relied on a user-centred design process involving caregivers from both adult and paediatric emergency departments. The process started with interviews and observations, followed by an iterative development approach validated at each step by end-users. The resulting intervention is composed of a tablet app interacting with a large screen, visible to each member of the resuscitation team, presenting real time information about the resuscitation. Resuscitations are very complex and challenging situations involving many actors. Designing a support tool for such situations requires a strong involvement of end users to understand how people work together and what information they share.

Keywords. Patient Centred Care, mHealth, Emergency Medical Services

1. Introduction

In emergency departments (ED), the initial management of critically ill or injured patients aims to achieve three main objectives: stabilizing the patient, determining the extent of her/his illness or injuries and initiating a first plan of care for hospitalization [1]. These activities are carried out by a multidisciplinary team of caregivers and should be performed in accordance with guidelines and protocols [2,3]. However, resuscitation is a complex and stressful situation where caregivers must take quick and correct decisions to increase the chance of survival. The multiple actors and surrounding agitation often make it difficult to communicate in a clear and efficient way. As a

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consequence the effectiveness of a resuscitation team's communication could be hindered, instructions can be missed and the overall team situational awareness could be degraded [4,5].

Several interventions have attempted to improve collaborative work during resuscitation, but they concern mostly training and teambuilding through simulations [6,7], or mainly concern documentation system and do not attempt to really improve the shared situation awareness [8,9]. In order to support the resuscitation team in their work, we aimed at developing an innovative solution named Interconnected and Focused Mobile Applications on Patients Care Environment (InterFACE), enhancing team situational awareness, facilitating decision-making, and improving the team communication process.

The concept is born following two previous projects aiming at facilitating work during pediatric resuscitations. The first one is a tablet app that supports nurses in the preparation of drugs during pediatric resuscitation [10]. The second one consists in using augmented reality glass to display resuscitation guidelines to resuscitation leaders' to improve guidelines adherence [11,12]. During the evaluation of the second intervention, we observed that displaying information only to the team leader do not favor communication nor shared decision-making. Therefore, we came up to the conclusion that displaying all information on a central screen to the entire resuscitation team members will foster a common understanding of the situation. The proposed system is composed of two components, a large screen installed in the shock room (Team-screen) displaying information to the whole team and a controller app (Guiding-pad) installed on a tablet allowing to interact with the screen.

In this article we present the development of the InterFACE system and the first results of the implementation process.

2. Methods

We collected initial requirements with semi-directed interviews of emergency specialists as well as field observations. Once the basic requirements obtained, we designed mock-ups used a starting point for an iterative prototyping development approach validated and refined at each step by end-users during several standardized individual interviews. As soon as the prototype did not evolved significantly between two evaluation rounds, we started its implementation and performed additional rounds of iterative validation by end-users. This second round of evaluations consisted in using both the Guiding-pad and the Team-screen in an interactive way during simulation-based resuscitation scenario with ED nurses and physicians. The execution of the task was recorded on video camera and interactions were recorded through eye-tracking glasses. At the end of the scenario, both caregivers were interviewed using semi-structured interviews to identify strengths and weakness of the solution.

3. Results

3.1. Requirement

Requirements collection started with ED emergency physicians and nurses' focus group. The concept was presented to 2 paediatric and 2 adult emergency senior physicians as

well as 2 emergency nurses to identify which resuscitation guidelines and protocols could be supported by the tool, encompassing the most common situations experienced by these caregivers. Field observations were performed by two psychologists who attended to several resuscitations in paediatric and adult ED in order to identify the different stakeholders, their roles and the nature of the information shared. Finally, 2 nurses and 2 emergency physicians in paediatric and 2 nurses and 1 physician in adult setting were interviewed separately using semi-structured interview guide to determine which useful information has to be shared during resuscitation. Discussion about most common situation in ED made us target specific guidelines. For both the adult and paediatric settings, we targeted the American Heart Association (AHA) resuscitation advanced life support guidelines. Moreover, for adults, we extended the scope to ABCD evaluation as well on protocols for polytraumatism, heart failure and septic shock. In both paediatric and adult, trauma situation team comprise at least 5 people, one team leader physician, several nurses, a care assistant and a nurse in charge of the transcription procedure. In case of severe situations the team can be expanded with medical specialists and additional nurses. Nurses and physicians expressed the desire to obtain a better situation-awareness, to know better the specific roles devoted to each resuscitation team member, drugs to be injected and time to injection, and feedbacks.

Table 1 Overview of main requirement identified and their associated solutions

Requirement	Solution
Multiple Guideline support	Use of BPML
Continuous Data source integration	HL7 ORU-R0 messages
Shared vision of the situation	Large screen on the wall
Manual input	App controller
Guidelines visualisation	Display of associated guidelines
Guidelines deviations	Actions on demand

3.2. Mock-up and Prototyping

Based on the requirements identified at the previous stage, initial static mock-ups for the Team-screen and the Guiding-pad were proposed. The Guiding-pad contains five zones, each with a specific purpose. One zone is dedicated to display the resuscitation guideline under execution. Each step of the guideline is expended in a second zone where details of the action(s) to perform are displayed. The third zone shows actions under progress for which a new action may be required. All interactions already performed are listed in a historic zone. The fifth zone is dedicated for the addition of actions not expected in the protocol. The Team-screen contains an additional zone providing vital signs information from the monitoring scope (heart rate, pulse oximetry, etc.).

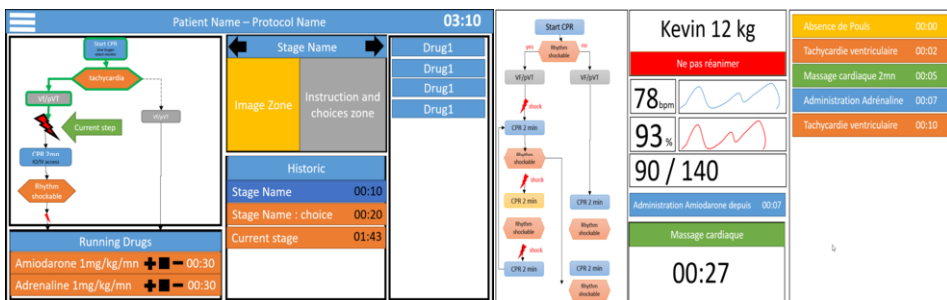


Figure 1. First mockups built for the Guiding-pad and Team-screen on requirement identification

These mock-ups were used as a starting point to a more dynamic prototyping realized using the Axure software. At each iteration step, it was presented to 2 members of the resuscitation team in order to collect their feedback and advices to improve it.

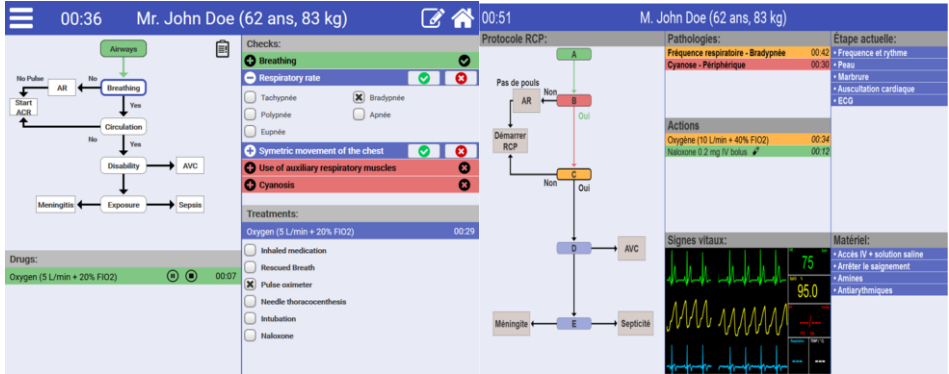


Figure 2. clickable prototypes

Feedback of end-users concerned mostly the relevance of the medical information provided and thus made us update the specific information related to each protocol stage. We also checked the good understanding of the chosen color code, different interaction strategies, and correct interactions between modules. In total 4 rounds of prototype evaluation were done on until it reached a sufficient maturity and effectiveness.

3.3. System architecture and implementation

As soon as the prototypes stopped to evolve significantly between two evaluation iterations, the development team started to implement the tool. The system backend is composed of several components communicating using a message driven orchestrator dispatching messages to registered components. This architecture has the advantage to ensure the complete independence of each module and thus allowing not only modularity but also evolution of the product over time. Thereafter, the server was connected to the Capsule™ system allowing to collect scope data stream in real time through HL7 (v2.3) communications with ORU-R01 message and OBX segment.

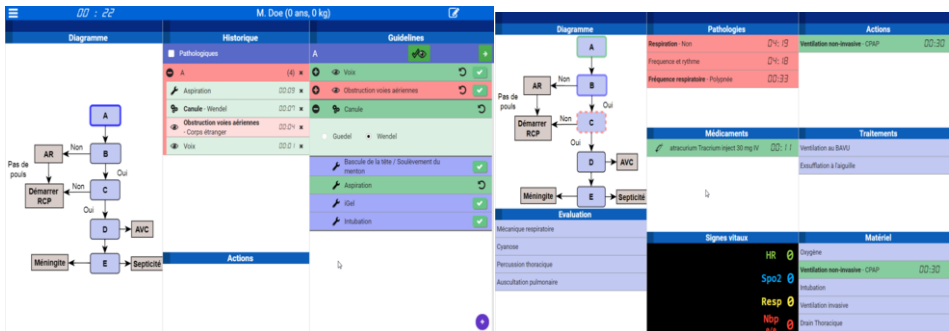


Figure 3. Translation of the prototype on the actual tool

Concerning the user interface, after implementing all functionalities described in the prototype, the tool was presented to several ED nurses and physicians for additional

rounds of evaluation. This second evaluation, consisting in the execution of a medical scenario leading users through an ABCDE evaluation, was performed by 3 physician-nurse duets. This helped us to control the efficiency of the solution in a more realistic setting, to evaluate the interaction paradigm, and the relevance of the information provided. Based on these supplementary evaluation rounds, we made appropriate changes accordingly.

4. Conclusion

The development of a tool to support teamwork during emergency care situations is very challenging. The complexity of these situations, the numerous actors involved in the resuscitation process, as well as the stressful environment induce lot of constraints that need a strong end users involvement to be captured and correctly tackled in a supportive tool. By fostering the adoption of standardized care practice, the increased transparency of decision-making and facilitating communication between resuscitation team, the system has a clear potential to improve communication and collaboration during resuscitations, with a potential impact on patients' survival. This outcome should however be validated through formal evaluation in simulated setting before being used in real situations.

References

- [1] T. Thim, N.H.V. Krarup, E.L. Grove, C.V. Rohde, B. Lofgren, Initial assessment and treatment with the Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach, *Int J Gen Med* **5** (2012), 117–121.
- [2] E. Fernandez Castela, S.G. Russo, M. Riethmüller, M. Boos, Effects of team coordination during cardiopulmonary resuscitation: A systematic review of the literature, *J Crit Care* **28** (4) (2013), 504–521.
- [3] R.H.A. Ebben, L.C.M. Vloet, M.H.J. Verhofstad, S. Meijer, J.A.J. Mintjes-de Groot, T. van Achterberg, Adherence to guidelines and protocols in the prehospital and emergency care setting: a systematic review, *Scand J Trauma Resusc Emerg Med* **21** (2013), 9.
- [4] E. a. G. Bergs, F.L.P. a Rutten, T. Tadros, P. Krijnen, I.B. Schipper, Communication during trauma resuscitation: do we know what is happening?, *Injury* **36** (8) (2005), 905–911.
- [5] J.C. Morey, R. Simon, G.D. Jay, R.L. Wears, M. Salisbury, K. a Dukes et al., Error reduction and performance improvement in the emergency department through formal teamwork training: Evaluation results of the medteams project, *Health Serv Res* **37** (2002), 1553–1581.
- [6] Z. Khademian, F. Sharif, S.Z. Tabei, S. Bolandparvaz, A. Abbaszadeh, H.R. Abbasi, Teamwork improvement in emergency trauma departments, *Iran J Nurs Midwifery Res* **18** (4) (2013), 333–339.
- [7] H.K. Westli, B.H. Johnsen, J. Eid, Teamwork skills, shared mental models & performance in simulated trauma teams, *Prof Saf* **59** (6) (2014), 49–50.
- [8] D. Golay, *Computerized data entry and display in trauma resuscitation*, 2016.
- [9] K. Yadav, J.M. Chamberlain, V.R. Lewis, N. Abts, S. Chawla, A. Hernandez et al, Designing Real-time Decision Support for Trauma Resuscitations, *Acad Emerg Med* **22** (9) (2015), 1076–1084.
- [10] J.N. Siebert, F. Ehrler, C. Lovis, C. Combescure, K. Haddad, A. Gervaix et al, A Mobile Device App to Reduce Medication Errors and Time to Drug Delivery During Pediatric Cardiopulmonary Resuscitation: Study Protocol of a Multicenter Randomized Controlled Crossover Trial, *JMIR Res Protoc* **6** (8) (2017), e167.
- [11] F. Ehrler, J. Siebert, K. Haddad, A. Sahin, P. Schrurs, R. Diener et al, Adapting Guidelines for Google Glass: the Case of Pediatric CPR, *Stud Health Technol Inform* **224** (2016), 141–145.
- [12] J.N. Siebert, F. Ehrler, A. Gervaix, K. Haddad, L. Lacroix, P. Schrurs et al, Adherence to AHA Guidelines When Adapted for Augmented Reality Glasses for Assisted Pediatric Cardiopulmonary Resuscitation: A Randomized Controlled Trial, *J Med Internet Res* **19** (5) (2017), e183.