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An Interactive Interface for Displaying Recommendations on Emergency Phone Triage in Pediatrics

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Abstract. Emergency phone triage aims at identifying quickly patients with critical emergencies. Patient triage is not an easy task, especially in situations involving children, mostly due to the lack of training and the lack of clinical guidelines for children. To overcome these issues, we aim at designing and assessing an interactive interface for displaying recommendations on emergency phone triage in pediatrics. Four medical students formalized local guidelines written by the SAMU of Paris, into a decision tree and designed an interface according to usability principles. The navigation within the interface was designed to allow the identification of critical emergencies at the beginning of the decision process, and thus ensuring a quick response in case of critical emergencies. The interface was assessed by 10 medical doctors: they appreciated the ergonomics (e.g., intuitive colors), and found easy to navigate through the interface. Nine of them would like to use this interface during phone call triage. In the future, this interface will be improved and implemented in emergency call centers.

Keywords. Clinical Decision Support System, Pediatric, Emergency, Triage, Usability, Digital Health.

1. Introduction

Emergency phone triage aims at identifying quickly patients with critical emergencies *versus* the others. They involve health professionals who assess patients remotely and

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guide them to the appropriate levels of care: prehospital care, emergency department, GP at home or medical advice [1].

Patient triage is not an easy task, especially in situations involving children [2]. Indeed, in these situations, health professionals have to face several issues [2]: (i) the difficulty to assess child remotely based on parents' speaking, (ii) the management of parents' anxiety, (iii) the lack of training and clinical practice guidelines in pediatrics.

To tackle these issues, a group of medical doctors from the SAMU of Paris (one of the biggest emergency call centers in France), develop recommendations for phone call triage of pediatric patients. They collaborated and validated together textual recommendations corresponding to a large number of medical situations that are frequently met in emergency pediatrics (e.g., acute dyspnea; head trauma, fever). However, these recommendations are entirely textual, complex and not easy to use in clinical practice, resulting in a risk of poor adoption by health professionals involved in phone triage [3]. Furthermore, they are not easy to share and not transportable. In the faculty of medicine, medical students involved in a digital health program, proposed to implement these recommendations into an interactive and intuitive interface.

Here, we aim at describing both the design and evaluation of this interface that display the recommendations for phone call triage of pediatric patients.

2. Methods

2.1 Interface design

Four medical students analyzed the textual recommendations written by the medical doctors of SAMU of Paris. For each medical situation, they manually extracted all the terms related to the decision making, made them unambiguous and categorized them into decision or action variables. Then, they organized them into a decision tree. The order of the decision variables into the decision tree, was decided to allow the identification of critical emergencies at the beginning of the decision process (e.g., "loss of consciousness" in head injury situation). This ensures a quick response in case of critical emergencies.

Design techniques were used to facilitate the navigation into the interface [4]: use of intuitive colors following the principle of traffic lights (e.g., red buttons for questions about severity symptoms, orange for additional questions, and green for the display of recommendations); use of information bubbles for helping health professionals to ask the correct questions to patients; display of questions in the form of tick boxes only when needed; organization of the interface into a structured way.

The interface was implemented using RStudio version 1.3.1093 and Shiny package. The design of the application was created with shinythemes, shinyjs, shinyBS, shinydashboard and shinyWidgets packages.

2.2 Interface evaluation

The interface was assessed online by 10 medical doctors with experience in emergency phone call triage or in the design of clinical decision support system. Some of them have been involved in the initial writing of the textual recommendations.

They tested the interface individually, without supervision, with two clinical cases (fever and head injury), and then filled an online form. The form collected anonymous sociodemographic data (e.g., level of experience in emergency phone call triage), and 6

questions related to the ergonomics and the utility of the interface compared to the textual recommendations. Each question was assessed through a 5-points Likert-Scale. Additional open-ended questions were also integrated for free comments.

3. Results

3.1 Interface

The interface is divided into two main areas (Figure 1). The first one contains information required for all clinical situations (age, reason of call). This area is displayed in the form of a column colored in black to attract the eye of the user.

The second area contains information related to the decision tree. This area is displayed in bigger and colored in white to allow better navigation into the decision tree. Four sub-areas can be distinguished:

- the blue area recaps the essential information in a concise way.
- the red area displays the first questions to ask to quickly assess the seriousness of the situation. These questions are adapted to the reason of call that has been selected in the first black area, and details can be provided on demand through information bubbles.
- the orange area displays additional questions, adapted to the reason of call. Questions are displayed progressively according to user responses.
- the green area displays the recommendation of the system. Five types of recommended actions can be displayed: “send an emergency ambulance”, “send the fire-fighters”, “send a GP at home”, “go to emergency by your own”, or “advice” (e.g., reassuring parents).

Figure 1. Interface. Example of a 2-year-old boy with fever. Severity signs to check in first are displayed within the red area (e.g., respiratory failure). If severity signs are absent, then additional questions are asked on the orange area (e.g., previous history of journey abroad). Finally, the recommended action is displayed in the green area (e.g., go to the emergency department). Additional information is available on interactive bubbles.

3.2 Evaluation

The interface was assessed by 4 senior doctors and 6 junior doctors/residents in emergency. Regarding experience in phone call triage: 7 were beginners, 2 intermediates, and 1 was confirmed.

90% of them would like to use this kind of interface during phone call triage (Figure 2). All of them liked the interface design and found the colors intuitive. 80% of them found easy to navigate through the interface. The qualitative analysis of open questions highlighted that the interface was easy and quick to use. One doctor proposed to consider other parameters in the medical decision, such as the tone of voice for patient anxiety, especially in case of doubt. Another explained that it could be hard to use this interface during the phone call triage, because of the difficulty of patient interview in real life.

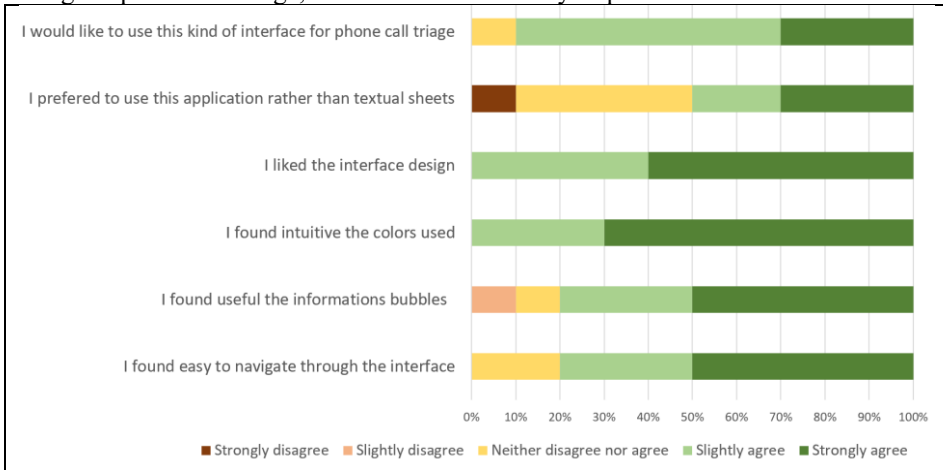


Figure 2. Interface evaluation.

4. Discussion

We designed an interface that displayed the recommendations for phone call triage of pediatric patients. Recommendations were issued from textual recommendations designed by medical experts from SAMU of Paris, one of the biggest emergency call centers in France. Recommendations were formalized into a decision tree by four medical students, and then implemented into an interface following usability principles and design techniques. Ten medical doctors assessed the interface: 90% of them would like to use it during phone call triage, and all of them liked interface design. The interface seems to be sufficiently easy and intuitive to use, without the need of training or tutorial.

Some limits need to be highlighted. First, the update of the interface can cause problem since the medical knowledge is constantly changing. To overcome this issue, we plan to develop an administrator interface allowing medical experts to automatically update the interface, without the need of a computer engineer. Another possibility would be to use Natural Language Processing techniques [5] to automatically build the decision trees from textual recommendations. Second, the interface considers only a few clinical situations met in phone call triage. In the future we aim at implementing all the most frequent clinical situations met in emergency call centers and validating the related

decision trees by medical doctors. Third, the interface was assessed by only 10 medical doctors with only two clinical cases, and the evaluation focused on ergonomics and the utility of the interface. However, this work is the first step of software lifecycle, and these preliminary results will help us to improve the current interface and then conduct a larger trial. In the future we plan to consider other parameters mentioned by the evaluators, such as more help details in case of doubt [6] or for managing patient anxiety. Other parameters will also be considered, such as those having showed their utility in decision support system efficacy (e.g., the provision of advice for both patients and doctors) [7].

Finally, this work was part of a new digital health program at Université de Paris. This innovative program aims at involving both medical students and doctors in the design of clinical decision support system (under the supervision of the medical informatic team). This work demonstrated the need to develop such digital health program in medical curriculum, and not only at master's degree level [8,9].

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