Ambulance Protocols: A Mobile Solution

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Abstract. The paper illustrates a pilot study involving nurses and paramedic staff to evaluate a mobile platform for rendering and distributing emergengy care protocols. Its specific features were developed to simplify the consultation and reduce the factors that negatively affect the adherence to standards. The study was planned to last one month and two questionnaires are administered to the participants: one at the starting phase, pre-intervention, and one at the end, post-intervention. Here we report the results and considerations coming from the first administration.

Keywords. Emergency Outpatient Unit, Medical Informatics, Guideline Adherence, Patient Outcome Assessment, Questionnaire Design.

1. Introduction

In their every-day life human people are inherently error-prone. That feature exacerbates when they are faced with a large amount of information or with a stressful condition as it customarily happens in a medical work context [1]. This induces a variance in clinical decisions when managing similar cases, leading to inappropriate treatments that may have serious consequences on the patients' health and increase the overall costs borne by the health care institutions [2]. Medical advisory boards were formed to identify suitable courses of actions to be adopted as standards in the most common situations. At first this led to the formulation of Clinical Practice Guidelines (CPGs) as an attempt to combine knowledge described in the literature with clinical experience. CPGs depict the human resources required each time, their roles, and the actions to be accomplished according to the best practices [3]. Unfortunately, CPGs turned out to be often unsuitable for the daily practice because of their bulk size, which makes them difficult to skim quickly, and the expertise required to properly interpret and apply them. That's why, in some medical areas, the current trend is to turn CPGs into medical checklists or protocols having a much smaller size and providing only the operational information required to manage very specific tasks [4]. This simplification, on the other hand, increases their number making them difficult to manage. Thus, even though standards are available, adhering to them still represents a critical point since they are applied in a suboptimal way. Ebben et. al [5] accomplished semi-structured interviews with nurses and found that the main reasons for this lie in individual, organizational and protocol characteristics. Another important factor preventing the exploitation of standards strictly correlates with the level of support (including

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electronic support) provided for protocol development and dissemination also in the light of the high number of procedures available [6].

This paper describes the preliminary evaluation of a mobile platform developed for nurses and paramedic staff working on the ambulances of an emergency department located in the autonomous region of Aosta (Italy). It aims at a rapid and efficient consultation of Emergency Protocols (EPs). After being provided with the platform, operators will be asked to assess the differences in their daily activities. Those will be evaluated through the administration of two questionnaires, a first one at the start (preintervention) and another one at the end of the study (post-intervention). Preliminary results regarding the first administration in a pilot study are reported below.

2. Methods

We designed a platform supporting EPs deployment and rendering on mobile devices from two different perspectives: the protocols to be rendered on that platform, and the influencing factors preventing their adoption. Going through the paper documents representing the protocols, we realized that all of them could be represented through regular flowcharts, whose different routings are determined by the users' answers to a number of "decision points". Thus, they are similar to questionnaires and this suggested the adoption of G-quest, a mobile application initially designed for administering questionnaires to home patients [7]. G-quest has been subsequently adapted to the context of EPs distribution and rendering by adding new features addressing the following main issues influencing the adoption of standards:

- Physical availability of the standard source for consultation when needed: EPs provided in paper format are quite easily lost or even forgotten outside the ambulance. Moreover, even though the whole package is on-board, the documents could be scattered inside the vehicle, preventing the rapid consultation of a protocol;
- Incapability of consultation due to physical barriers: nurses and paramedic staff work under stressful conditions and their actions have to be accomplished quickly and on time. Those factors hinder the ability of doing simple calculations, such as those required to derive drug dosages based on the patient's weight. Moreover, when the staff people are busy with their hands in manipulating a patient, the consultation of a EP becomes even more difficult;
- Difficulty of consultation due to formal, logic or operational barriers: paper EPs do not undergo formal or logic validations, and errors or omissions are often discovered in them. In addition, the paramedic staff does not always take part in the process of formalizing the protocols and this lack of contribution may affect the contents provided, that sometimes are unrelated from the real practice;
- Limitations in updating and disseminating newer versions: each time EPs contents change accounting for new information or updates, the centre has to face the task of printing the new versions and promptly distributing those to all the staff members;
- Impossibility of collecting feedback about EPs usage: due to clinical and legal reasons, the paramedic staff may need to prove that they adhered to the standards demonstrating that the applicable protocol was properly consulted.

A study was planned to exploit G-quest for rendering the EPs currently adopted by the emergency department of Aosta, that is a mountain region located in the northern part of Italy. Because of the location and conformation of that region, many of its villages are very difficult to reach especially in winter. Thus emergency or first aid care is often accomplished on a local basis by nurses, paramedic staff or even volunteers who did not undergo an extensive training and do not directly possess the skills to manage every possible situation they may face. The availability of a platform supporting them with the application of standard practices is therefore very helpful.

We took advantage of a project that is planning to upgrade some of the emergency vehicles with the *TomTom Bridge* as a device for receiving emergency calls and tracking vehicle operations. This is basically an Android smartphone enclosed in a rugged casing meant to be used for business purposes. Besides hosting a special version of the TomTom software, being an Android device it is able to host any standard application developed for that operating system. On this basis we installed our platform on top of it and undertook the effort to develop, deploy and render the official EPs in use by the Aosta emergency department addressing areas such as: *pediatric or adult cardiac arrest, airways obstruction, ventilation and oxygenation management, pediatric or adult seizure, chest pain, generic pain.*

A pilot study was scheduled in the detached location of Morgex lasting for one month. Eight nurses and paramedics employed by the emergency department were involved, each having more than 8 years of experience. Before starting the study they were gathered for a training phase, during which the mobile platform was introduced, and the first questionnaire assessing the baseline situation was administered. This is composed of the following questions.

- Physical availability of the standard source for consultation when needed (a):
 - Do you always find the EPs package on the vehicle ? (1a)
 - Do you always find the needed EP in the package ? (2a)
 - Do you have to search for an EP a long time before finding it ? (3a)
 - Do you have to wait for an EP until another member of the staff finishes his consultation ? (4a)
- Incapability of consultation due to physical barriers (b):
 - Are you unable to consult an EP while being busy with your hands ? (1b)
 - Do you find calculating drug dosages difficult under stressful conditions ? (2b)
- Difficulty of consultation due to formal, logic or operational barriers (c):
 - \circ Is the information provided in the EPs clear ? (1c)
 - \circ Is the information provided in the EPs complete ? (2c)
 - \circ Is the information provided in the EPs easy to be applied in practice ? (3c)
 - Do you find searching for specific information inside an EP difficult ? (4c)
- Limitations in updating and disseminating newer versions (d):
 - Did you find any EP not up-to-date with recent scientific evidences ? (1d)
- Impossibility of collecting feedback about EPs usage (e):
 - How often do you consult EPs ? (1e)
 - If the EPs were in computer-interpretable format, would you like a full vocal interaction system for their consultation ? (2e)
 - Do you think it is important proving the consultation of an EP under certain conditions (e.g. for medical and legal problems)? (3e)
 - Have you ever had this need ? (4e)

- Do you usually consult an EP in order to:
 - Review the protocol ? (5e)
 - Find specific information ? (6e)

Thus, the questionnaire mainly aims at capturing the emergency personnel's needs and the issues related with the current use of the protocols.

3. Results

After administering the pre-intervention questionnaire, we collected and analyzed all the answers provided by the eight nurses and the paramedic staff involved in the pilot study. In Table 1 and Table 2 we report the percentages of the selected answers for each question. Almost all the study participants (87.5%) declared to consult the EPs to recall the specific procedures described, while 62.5% do so only when they need to acquire some specific information. All subjects said that sometimes they look for information in the EPs, but only a quarter of them attempt to always consult them.

Considering the influencing factors, what emerges is that working under stressful conditions, being busy with their hands, and the need to avoid wasting time, represent barriers towards consulting EPs for most of the ambulances members. In particular, 87.5% find hard to review an EP while keeping their hands on the patient and trying to intervene on him. More than half (62.5%) would like a full vocal interaction system so that EPs consultation could be supported in any case. Also the same percentage declares to have difficulties in doing mathematical calculations under stress. The opportunity of proving the adherence to an EP under particular conditions is considered an important issue by all of them (100%), even though none has ever had this necessity till now.

Questions concerning the physical availability of the EPs, the formalization quality of their contents and the difficulties arising when updating them received answers that show a general positive feeling. Less than half (37.5%) complained that sometimes EPs are not available on the vehicle or that sometimes it takes time before finding the one they are looking for. Only a quarter of them declared that they had to wait for an EP until another member finished his consultation. EPs provided to the staff seemed to be well formalized since only few of them complained about the clarity (25%), the completeness (12.5%) or the easiness of consultation (25%). Finally, 12.5% asserted that sometimes they did not find the most updated EPs versions on-board.

Question	Never	Sometimes	Often	Always
1a	0%	37.5%	0%	62.5%
2a	0%	25%	12.5%	62.5%
3a	62.5%	37.5%	0%	0%
4a	75%	25%	0%	0%
1b	12.5%	50%	37.5%	0%
2b	37.5%	50%	12.5%	0%
1c	0%	25%	12.5%	62.5%
2c	0%	12.5%	37.5%	50%
3c	0%	25%	37.5%	37.5%
4c	50%	50%	0%	0%
1d	75%	12.5%	12.5%	0%
1e	0%	50%	25%	25%

Table 1. Percentages of answers provided by the paramedic staff to questions with four available choices.

Question	No	Yes
2e	37.5%	62.5%
3e	0%	100%
4e	100%	0%
5e	12.5%	87.5%
6e	37.5%	62.5%

Table 2. Percentages of answers provided by the paramedic staff to questions with two available choices.

4. Discussion

The administration of the pre-intervention questionnaire to the participants of the pilot study, and the consequent analysis of their answers, lead to interesting results and considerations. Within this pilot study we found out that physical barriers and necessity of proving adherence to EPs really represent critical problems for the staff. On the other hand, we underline that EPs used in this study are regional ones and may considerably differ from country to country. In this specific case, they seem to be quite well formalized and quite often available on the ambulances. In summary the pilot study was satisfactory since it helped in pointing out the critical issues affecting the delivery of emergency care in the Aosta region. We are now waiting for the termination of the pilot study and the subsequent results coming through the administration of the second post-intervention questionnaire. Hopefully they will witness an improvement perceived by the participants in accessing EPs through the mobile platform provided.

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