
Project On Mobile Communication Application - PEDSTalk

The objective of this proposal is to address the issue of lack of communication tools in the pediatric critical care setting via a mobile communication application, named PEDSTalk. It is intended to improve communication between patients, healthcare providers, family members, overall patient satisfaction and health care outcomes. This proposal will examine project objectives, software requirements, design process, solution analysis via i*Social modeling technique and its impact on the stakeholders.

Keywords— communication, critically ill children, intensive care unit, mobile application, health outcomes, social modeling

Purpose, Scope And Objectives

Admission and care in the pediatric intensive care unit (PICU) is often a frightening, distressful and painful experience for both children and their families. Mechanical ventilation is one of the most common performed intervention, affecting up to 64% of pediatric patients. Less sedation, resulting in more conscious, intubated and mechanically ventilated children is also gaining increased prevalence in the current PICU settings. Endotracheal intubation and other invasive medical equipment result in patient's limited verbal and non-verbal communication abilities which can significantly impact the quality of care, safety and patient satisfaction. The aim of this project is to develop a communication tool in the form of a mobile application prototype with a goal of improving patient-health care provider communication, patient-family communication, patient satisfaction and overall quality of care in the PICU. The application's objective is to act as a user friendly platform to convey essential patient needs and wants.

Motivation

The motivation for this project stems from the lack of effective, innovative and child friendly communication tools in the critical care area. From personal clinical experience, I can speak directly of the discomfort, high anxiety levels and decreased patient satisfaction that comes from lack of tools. The most common communication methods currently used include gestures, mouthing of words and answering yes/no questions. These have frequently proven to be unreliable, inadequate and tiring for the patients, healthcare providers and family members. The age demographics of a pediatric intensive care unit is very diverse, ranging from newborns up to and including 17 year olds; hence the communication needs of each age group are also substantially different.

Effective patient – provider communication is key with regards to the quality and safety of care. Mechanically ventilated and non-verbal patients, frequently have an altered cognitive level, limited fine and gross motor skills, which significantly impact their capacity to communicate. With the current practice of using less sedation and keeping patients intubated and awake, the call for effective communication tools is even more pertinent. Children that are awake and mechanically ventilated have unique needs that if unmet can lead to significant patient discomfort, dissatisfaction and even adverse patient outcomes.

Background And Literature Review

Communication is a key aspect in meeting healthcare outcomes. Critically ill patients are particularly deprived of the ability to communicate due to mechanical ventilation, significant disease process, sedation and other complex factors. Inability to communicate has been rated as one of the most distressful and anxiety provoking factors for patients. Nurses, as primary bedside care providers also face challenges in communicating with intubated patients, understanding their needs and providing good quality care. Currently there is limited research related to communication standards and tools for non-verbal, critically ill patients, especially the pediatric population. The most common research pertains to the review of communication methods such as the use of gesturing, lip reading and nodding. The inefficiency of this approach was addressed earlier in the motivation section. This section will review the most commonly used communication tools and a few high tech communication devices. They will be briefly described and analyzed for their applicability to the stakeholder's needs involved in this project. Communication boards, most commonly take the form of preprinted images with words. Basic needs are illustrated, such as pain scale, and the patient can point to the need that pertains to him/her. This communication tool could be effective in patients with good visual acuity and alert mental status.

On the contrary, communication boards can either contain too much or not enough information, limiting its use and applicability. Augmentative and alternative communication (AAC) devices have mostly been studied and used in the chronic population. The needs of the critically ill patients compared to chronic patients are significantly different and require tailoring. Some of the electronic devices that have been researched in the critical care setting include voice output communication aids (VOCAs), ICU-Talk and LiveVoice computerized tools. These interventions have proven to be effective in improving communication and patient satisfaction. Their limitations include poor device positioning and patient boundaries which consist of cognitive, physical and visual abilities. VidaTalk™ is a high technological intervention which has the closest resemblance to the "to be" developed communication tool. It provides the user with pre-programmed messages and the opportunity to customized messages through drawing and typing. The above mentioned devices, including VidaTalk™, have been studied in the adult ICU setting with limited to no tools tailored specific for the pediatric population. These findings call for a high need of easy to use, mobile communication application for children in the critical care setting.

Requirements Specifications

The PEDSTalk mobile application is intended to be used as a platform to facilitate communication in the critical care setting. The stakeholders for this application are pediatric critical care patients, family members and healthcare providers. It is mainly intended for children age three to seventeen years old. The goal is to provide an effective tool and improve communication with awake but intubated, nonverbal children. It aims to facilitate both patient to healthcare provider and patient to family communication. Since most patient's in the critical care setting have altered mental, cognitive and physical abilities, the application should be child friendly, easy to use and simple in design. Functional and non-functional requirements will be described below.

A. Functional Requirements

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1. Picture based vocabulary and aged based communication folders: toddler, preschool, school aged and adolescent. As mentioned above, PICU provides care for newborns and patients up to seventeen years old. The needs and communication abilities of children are very different depending on each age group category. As such, the PEDSTalk application will have illustration based communication folders for each age group which have proven to be effective with intubated patients. The choice for a picture based vocabulary stems from the goal of creating an easy to use application which requires minimal effort from patients.
 2. Pre-programmed messages and option for typing. For older children, there will be the option of pre-programmed messages that are specific to the PICU context, e. g. :“I need a suction”. In addition, patients with normal cognitive and physical abilities will have the option of typing their personalized messages.
 3. Save previous used images as “Often used”. The needs of an intubated, awake child are frequent and repetitive. This functional requirement will allow the patient to access previously used images/text easily, which will increase efficiency and decrease use of patient resources.

B. Non-Functional Requirements

1. Supported by Android Platform. The end goal for the PEDSTalk mobile application is to be accessible from both Android and iOS platforms. For the purpose of this project, the mobile prototype will be built to be accessible on Android.
2. Performance: 2 seconds or less response time. Reasonable efficiency is important due to limited patient resources and attention span.
3. Accessibility: The application should be accessible to patients with diverse capabilities.
 - a. Clear font option and possibility to display the text in larger fonts
 - b. Voice support (both male and female) for images, words and sentences. Voice support is a significant feature of the PEDSTalk application. Since mechanical intubation deprives patients of one of the most basic human functions, to speak; PEDSTalk will be an empowering tool and will give children a voice.
4. The mobile application should be easy to download from play store, not requiring a lot of user data input.

Solution Specifications

An important feature of this project is to create a mobile communication tool that will satisfy both functional and non-functional requirements of all the stakeholders involved. To meet these requirements the user interface must be easy to use, simple in design, efficient and accessible. In order to fully understand how these requirements could be satisfied, a usage scenario of a fully functional prototype is described below. All actors described in this scenario are hypothetical. A 15 year old, awake, intubated and mechanically ventilated patient, named John, is in the critical care setting requiring to be suctioned. He has the PEDSTalk mobile application tool installed on his android. He has never used this application before however he is familiar with using mobile technology and other mobile application tools. With one touch he opens the application which brings him to the main menu. Meanwhile John calls for the nurse to his room. The application opened easily and efficiently. From there he could choose from 3 options:

picture based vocabulary, pre-programmed messages from the adolescent folder, and/or typing his own message. John chose to type his own message, where he expressed the need to be suctioned. The text to type was easily readable and required little energy on his end. John showed the message to the nurse, which facilitated prompt care. The nurse acknowledged John's efficient use of the application and asked if she could help him with any other tasks. John clicked on a picture that read NO. This encounter illustrated several solution specifications and how these requirements would be addressed.

Project Planning

Agile development methodology will be best suited to accomplish the objectives of this project. This method is appropriate for a team of 5 members that work collaboratively and have the stakeholder's needs as high priority. The rigorous iterative process permits for relatively seamless adjustment in the working software if the needs of the stakeholders change. The limitation of time and resources in relation to this project further highlights the need for agile methodology to help streamline, accelerate and accommodate change during the software development process. The work breakdown structure (WBS) highlights the ongoing development, evaluation and improvement process that the prototypes will undergo. Careful planning of the architectural design, requirements specifications and resource allocation will occur at the start of the project. Further, two prototypes will be developed each cycling through design, evaluation, and enhancement based on vigorous analysis. The final prototype will be adapted and enhanced based on the ongoing iterative process. The project milestones, deliverable dates, estimated time and human resources are included in the Gantt chart. The Gantt chart was developed and downloaded via TeamGantt.

Assumptions And Constraints

For the purpose of this project, several assumptions and constraints need to be specified. The application is intended for patients and family members with working phones, powered by Android. The users must read and write in English. Moderate to normal visual, motor and cognitive function required. Connection to the LTE or Wifi required for system updates and background operational functions.

Project Feasibility

A. Technical Feasibility

The objective of this project is to have a working prototype by the end of November 2018th. In order to facilitate this goal, all team members must adhere to the Gantt chart timeline and be committed to meeting deadlines. A team of 5 members is adequate to meet the milestones of each stage described in the WBS. The size of the project is also tailored to meet the deadlines with the resources currently available. All team members should familiarize themselves with coding and the technical aspects of software development during the architecture and planning stage of the WBS.

B. Economic Feasibility

The development of a mobile application prototype, on the Android platform is a cost

effective solution to the current need for communication tools in the critical care setting. The minimal cost involved in the development of this application could substantially decrease the overall cost involved in managing adverse outcomes related to miscommunication and potential gaps in care. If the final application proves to be efficient in enhancing communication and these results could be well documented, this tool could qualify for funding and become implemented in the clinical setting.

C. Organizational Feasibility

The PEDSTalk application tool is intended to be primarily used in the hospital setting. Most hospitals hold excellent patient care and innovation as key objectives. By helping improve communication, patient satisfaction and health outcomes, this application will directly address these values. To test the efficacy of this tool, several stakeholders such as hospitals, healthcare providers, patients and family members must be willing to use the application and provide feedback.

i*Modeling And Project Analysis

The i*social modeling has been used to reflect the relationships and interactions between different stakeholders in the proposed solution. The four actors involved in the models include: patient, nurse, physician and family members. The main goal of effective communication has been illustrated in the existing system, as well as in the proposed solution. The piStar tool was used to develop and download the i*Models.

A. As-Is i* Model Solution Analysis

In the existing system illustrated via Strategic Dependency (SD) model, the patient is highly dependent on the nurse and family members to help address his/her healthcare need. Further, a more in-depth illustration of the rationale behind the dependency links between the patient and the nurse are modeled via Strategic Rationale (SR) model. One of the main goals, "Communicate Needs" is not met because "Use physical resources", "Use whiteboard", "Use mental resources", "Use nonverbal communication" hurt the main task of "Communicate". It requires significant amounts of energy from a critically ill patient that already has limited resources. Due to "Communicate Needs" being hurt "Address needs fast" and "Fast Recovery is also jeopardized. In the existing system, the nurse is also highly dependent on patient's "Clear Communication" abilities in order to "Address Needs Promptly" and to provide "Effective Care". In order to understand these needs, the nurse must rely on her own abilities to interpret nonverbal communication such as mouthing of words, nodding or trying to decipher hand written white board messages. This leaves a very large room for error which can negatively impact the nurse's abilities to provide good quality care and meet healthcare needs.

To follow, the physician heavily relies on the nurse to correctly identify and document patient needs so they could be addressed in the treatment plan. Nurses are very skilled healthcare professionals however there is no formal teaching to communicate with an intubated child or to correctly interpret nonverbal communication. Each nurse has a very diverse skill and comfort level when it comes to such encounters, therefore the "As-Is"

system calls for a more effective and standard communication tool.

B. To-Be I* Model Solution Analysis

The to-be SD model illustrates the dependencies between all actors mentioned above and the addition of a new actor, PEDSTalk app. It offers a formal tool for the patient to communicate and allows for less reliance on the nurse as the sole interpreter of patient's needs. The SR model also proves a more streamline communication process when using the mobile application. Patients use minimal resources to engage in effective communication which enables them to be easily understood and to clearly communicate healthcare needs. It helps reduce anxiety, frustration and energy spent on trying to communicate, compared to the as-is model. This further benefits the soft goals of "Address needs fast" and promotes "Fast Recovery". The nurse to patient communication is also significantly improved when using the proposed solution. It provides nurses with an easy to use tool to help identify, document and address patient needs promptly. When needs are clearly recognized, it promotes better patient advocacy and patient centered care. Family members, on the other hand, also can rely on this tool to communicate and understand needs and wants of their loved ones. Admission to the intensive care unit is a very frightening and overwhelming experience. Providing an effective communication pathway allows for some of these emotions to be better controlled and for the patient to be better supported.

C. Discussion

Healthcare is a very complex and multidimensional system. It encompasses multiple stakeholders with very diverse needs. A clinical problem/need is easily identifiable yet, frequently stakeholders cannot adequately describe their requirements and vision of the product. In these situations, i* modeling can act as an effective tool to help visually illustrate requirements and relationships between different actors. As in the above proposed solution, i* modeling aided in the qualitative evaluation of the as-is system and the to-be system. It captured the task reasoning structure and intentions of each actor and the connections between actors. One possible limitation of this modeling technique in relation to the proposed solution is the inability to perfectly model and control each actor's exact behaviors and response to a task/ situation. When analyzing different modeling techniques, i* modeling accentuates the social conception of the problem and "people" features while it falls short on illustrating the structural components of the system. An UML diagram on the other hand would have the system process and information flow at its core. A limitation of the UML diagram is that it provides a very technical and internal modeling approach which limits the understanding of actor's wants and needs.

Conclusion

The above project proposal clearly defines the scope, objectives, system requirements, project planning and analysis of a mobile communication tool intended for mechanically ventilated, nonverbal children in the intensive care unit. Background research demonstrates lack of child friendly communication tools and the importance of addressing this need with a digital solution.

i* modeling further illustrates user requirements, relationships and social understanding of the proposed solution.

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