

Mobile Phone Pulse Oximetry: A Usability Study of iPleth

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Background & Objectives

- Acute respiratory infections, such as Pneumonia, account for 2 million child deaths a year, 98% of which are in developing countries¹
- Hypoxia (low blood O₂ levels) is the major fatal complication of Pneumonia¹
- Pulse Oximetry can detect Hypoxia quickly and non-invasively, and is more accurate than clinical signs – such as cyanosis – which can be difficult to detect¹
- Developing nations have recently seen large increases in mobile phone use, enabling the penetration of this technology to many areas where Pulse Oximetry is not available^{2,3}
- Our objective is to investigate how experts in the medical field with differing technological proficiency would react to the iPleth with no prior training or instruction, and show that this device could be used by anyone, regardless of their familiarity with mobile phone technology.



Figure 1: iPleth in action

Methods

- After REB approval and informed consent, N=20 users were gathered from several different medical professional backgrounds
- Demographic information, iPhone/iPod touch experience, and Pulse Oximeter experience were gathered
- Users were asked to identify their use of mobile phones by choosing a label from the Mobile Phone Usability Questionnaire (MPUQ)⁴ metric
- Users were given a 23 item Task List to complete on the iPleth with no prior instruction
- The Number of Tries (#) for each task, Completion of Task (Y/N), Assistance with Task (Y/N), and Comments were recorded by the investigators
- Four de-briefing questions were posed after the Task List to gauge a user's impression of the interface
- A 55-item questionnaire based on the MPUQ was administered
- Questionnaire was analyzed for Frequency of Response, 5 (Strongly Agree) being the best score, and 1 (Strongly Disagree) being the worst
- Negative questions, where Strongly Disagree would be the best answer were given a score of 5 for data analysis (likewise, Strongly Agree was assigned a value of 1)

Results



Figure 2: Problem areas identified on the iPleth interface

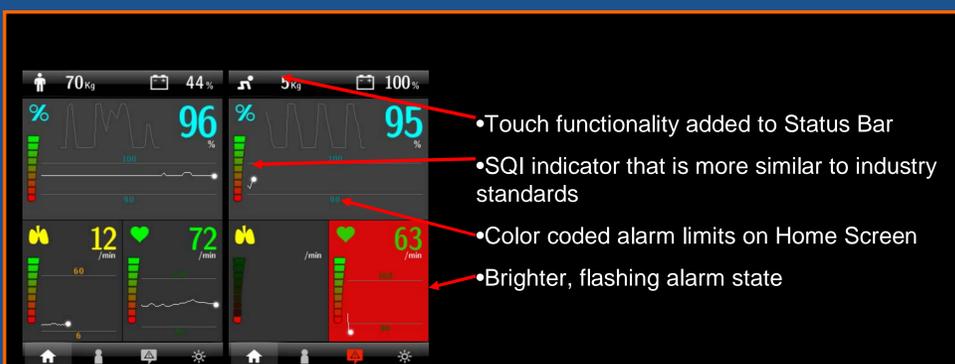


Figure 3: Improvements made after usability test

	Error Rates of Users	
	No iPhone Experience	iPhone Experience
Number of Users	9	11
Mean number of Tasks with >1 try	3.0 ± 0.5	3.36 ± 1.80
T-Test Value	0.535	
Total number of tries (min: 23)	29.0 ± 1.87	30.09 ± 5.03
T-Test Value	0.517	
Tasks not completed	10	4
Assistance Requested	8	2

Figure 4: Error frequency and analysis

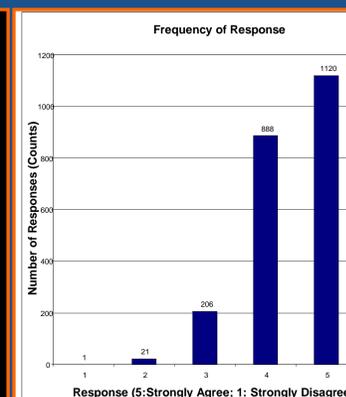


Figure 5: Frequency of response to MPUQ

Results

- The user population was diverse in both professional experience and technological knowledge.
- Of the 20 users, 10 were Medical Doctors, 5 were Registered Nurses, 2 were Anesthesia Assistants, 2 were Residents, and 1 was a medical student.
- The majority of users (55%) identified themselves as Minimalists on the MPUQ metric for mobile phone use, from the 4 categories:
1. Display Maven 2. Mobile Elite 3. Minimalist 4. Voice/Text Fanatic
- Distribution of answers for MPUQ questionnaire demonstrates strong indication of user satisfaction (Fig. 5).
- No difference was found between those users with iPhone experience and those without (Fig. 4).

Discussion

- There was a difference in how many users requested assistance and in the amount of incomplete tasks (Fig. 4).
- This is most likely due to familiarity with aspects of the device which are not unique to the iPleth, such as Scrolling on the Settings menu (Fig. 2), which is seen in other iPhone/iPod applications.
- The amount of tries is more telling than comparing incomplete tasks or assistance; we observed great difference in users' willingness to persevere and solve the problem on their own.
- From the error data (Fig. 4), it can be inferred that the iPleth is simple and usable enough to account for differences in technological proficiency.
- Several issues were reported by our users and are highlighted in Fig. 2, and include:
 - Ambiguity of Signal Quality Index (SQI)
 - Ambiguity of alarm state
 - Ambiguity of Trend Line icon
 - No "touch" functionality of Status Bar
- Design rectifying the above issues has been created (Fig.3)

Conclusions and Future Directions

- The first version of the iPleth tested very well with a wide demographic of users.
- Improvements on the first version of the design (Fig. 3) have already been implemented from the results of this study, and include more obvious alarm state on the Home Screen; improved SQI; and touch screen capabilities added to Status Bar on Home Screen (Fig.3).
- The iPleth based on the iPod will be taken to Uganda in the Fall to conduct the same usability study to determine user reaction to the device in a developing nation.

References
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