Usability Evaluation of a Mobile Medical Information System for Military Physicians

Shengnan Han*, Franck Tétard†, Ville Harkke*, Mikael Collan**
* Department of Information Technologies & IAMSR, Åbo Akademi University, Finland
** Department of Telecommunication and E-business, Turku University of Applied Science; & IAMSR, Åbo Akademi University, Finland
email: {firstname.lastname@abo.fi}

Abstract
A mobile medical information system, developed primarily for the purposes of civilian medicine, is expanded to be used in military medicine. A usability study with 7 military physicians at the Finnish Defense Forces was conducted in field conditions in December 2005. Their evaluation of the characteristics and the features of the system, and properties and the features of the mobile device-Nokia 9210 Communicator were investigated. The results show that both the mobile system and the device have some degree of readiness for military medicine. Further usability improvements of the system and the device are discussed.

1. Introduction

Mobile information systems have found their way in the field of medicine, especially, in the field of civilian medicine. The benefits of mobile technology have been researched and demonstrated [1, 2]. Military medicine refers to the science and art of medicine as used for the benefit of the military. It differs from civilian medicine in two perspectives. It must firstly meet the aspects of civilian health professions and, secondly, meet the aspects of military readiness. Due to the increasing availability and lowering costs of mobile devices and availability of suitable health information technology, it is not surprising that, in the recent years, also mobile technologies have started to penetrate military medicine. In order for military medicine to keep up with the building of more mobile and agile defense forces, using mobile technologies to support military medicine is becoming an increasing trend. Smaller national defense forces (e.g. Finland) have generally lacked the resources to design and develop a mobile health care system only for military purposes. In order to reduce the cost, it is better to expand the systems that are available in civilian medicine and on the market to be adapted in military medicine. However, it is very crucial for us to clarify if such systems have the potential to meet the aspects of military readiness.

When considering mobile devices, we can observe that two types of devices are available to deliver mobile health care solutions on the market: (i) single-purpose devices and (ii) multi-purpose devices. Single-purpose devices are designed and developed for the sole purpose of health care systems, and tailored to fit the needs of the users, and the demands of the environment in which these devices are operated (e.g. monitoring devices or single-condition electronic guides). Multi-purpose devices are designed and developed to attract a wider customer base; they include many features and do not necessarily meet the demands of extreme environments such as military field operations, but yet provide a suitable platform for operating applications usable in military medicine (e.g. iPAQ for BMIS-T).1

A mobile medical information system, developed primarily for the purposes of civilian medicine, was tested with 31 military physicians from the Finnish Defense Forces. The system (medical databases) was the same as the one available for civilian physicians in Finland, and the evaluated device was a commercially available device-Nokia Communicator (i.e. multi-purpose), not tailored for the needs of military medicine. Here, we report the preliminary results of a usability evaluation with 7 military physicians, and draw conclusions on the potential expansion of improving and using the system for military purposes.

The implications of this paper are twofold: (i) for device manufacturers, it presents evidence about the possible expansion of a multi-purpose device to the specific needs of a professional group (in this case, military physicians), and (ii) for the organization publishing the medical databases, it provides suggestions for improvement in order to meet the needs of military medicine.

The paper is structured as follows: in the second part of the paper, literature background of the study is described. Thirdly, the mobile medical information
system is introduced, and fourthly the research design is presented. Results are reported in the fifth section, and discussion, implications and concluding remarks are drawn at the end of the paper.

2. Literature background

2.1 Human-Computer interaction & usability

Human-Computer Interaction (HCI) as a discipline is concerned with the design, evaluation and implementation of interactive computing systems for human use, and with the study of the major phenomena surrounding them [3]. There are four main topics that are mostly focused in the research, i.e. the uses and context of computers, human characteristics, computer system and interface architectures, and the development process. Usability studies from an HCI perspective reveal the interactions between man and machine, identify the usability problems as well as figure out recommendations for improvement of system under investigation [4].

Usability of a system as defined by Shackel [5] is “the capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfill the specified range of tasks, within the specified range of environmental scenarios”, or in short “the capability to be used by humans easily and effectively.” The ISO standard 9126 has defined the usability as “the capability of the software product to enable specified users to achieve specified goals with effectiveness, productivity, safety and satisfaction within specified contexts of use.” [6] Recent years have seen a lot of studies carried out on issues of mobile HCI as more and more mobile systems are adopted both by business and consumers. Most of researchers follow the mainstream of traditional HCI definitions and methods to conduct their studies on mobile HCI [7].

According to Dix et al. [8], approaches to usability evaluation regarding the implementation of a system involve various techniques, such as experimental evaluation, observational techniques, and query techniques (interviews or questionnaires). Among these, interviewing users about their experience with an interactive system provides a direct and structured way of gathering information, particularly eliciting information about user preferences, impressions and attitudes. The interviews should be prepared in advance to ensure the effectiveness.

In any usability evaluation, there are always debates regarding how many users are enough for an evaluation. Virzi [9] suggests that five users will uncover approximately 80% of usability problems. This result is further confirmed by [10, 11].

2.2 Mobile devices for mobile e-health services

Ever since the introduction of the Apple Newton (The original MessagePad was launched at Macworld Boston in August 1993 [12]) there have been medical applications for mobile computers. In fact, there is such a variety of applications that one would expect practically every physician to use some of them. Even if this may not actually be the case, the usage of mobile tools is spreading rapidly [13].

There are several multi-purpose mobile devices or terminals available on the market: The pen-based Personal Digital Assistants (PDAs) either with a Palm™ or Windows CE™ operating systems, smart phones which integrate the functionalities of a PDA and a mobile phone, and Blackberry devices that differ from PDAs in that these are always connected to a wireless network [14].

The mobile terminals have some characteristics that reduce their usefulness in professional settings. Firstly, the screens of mobile terminals are (inevitably) smaller than the desktop, or laptop versions, thus limiting the types of information that are practical to view. Secondly, the input systems are either miniaturized keyboards or pen-based handwriting systems, neither of which is suitable for inputting large amounts of free text. The pen-based touch screen devices have proven to be ideal for structured data input such as selecting items from lists [15] held in one hand and used by the other. Another aspect is the battery life. Most PDA type devices have a typical battery life of 2.5 to 4 hours of continuous use [16]. This will not necessarily be enough for a full workday. Another aspect is the communication with other networks. The handheld terminals obtain data either by downloading over wireless networks, or by connecting the devices periodically to sync stations and downloading larger amounts of data at once [17].

When studying actual usage of handheld computers (Palm OS, Handspring visor de luxe) in the Geneva University hospital in 2001, Tschopp et al. [18] found that usage of the devices declined after the initial discovery phase and evened out at a level of 2.14 usage sessions per day. This would suggest that the mobile system does have a degree of usefulness since the usage never neared zero, and that compared with usage levels of other reference tools there is a strong case for further development of mobile systems.
2.3 Physicians’ information needs and use of supportive technologies to access information

The medical practice is very information-intensive by nature. The modern (electronic) ways of handling this information are, compared to other businesses, underused in the medical sector [19]. The main user of different types of medicine-related information is a physician. The physicians’ information needs can be classified as follows [20, 21]:

- Information on particular patients;
- Data on health and illness within local population;
- Medical knowledge (information about diseases, therapies, interpretation of lab tests etc.), which is potentially applicable to decisions about multiple patients and public health policies, unlike patient data [22];
- Information on local health care system;
- Information on local social influences and expectations;
- Information on scientific, political, legal, social, management and ethical changes that will affect medical practices.

With the development of technology, especially computer and Internet technology, physicians can access medical information easily and efficiently.

Through the use of mobile technology, more freedom is offered to both, healthcare providers and patients [23]. Mobile e-health services offer a solution for coping with healthcare challenges in the 21st century [23, 24].

Existing mobile e-health services available on the market range from simple medical dictionaries to sophisticated patient data systems, capable of handling digital images and laboratory test results. A set of applications is being financed by the pharmaceutical companies and focuses naturally on creating and handling drug prescriptions. Most of the systems are still standalone applications running in the mobile devices themselves, updating their data only when connected to a computer network.

3. A mobile medical information system

The mobile medical information system, used in this research, is designed by Duodecim Publishing Ltd (Finland). It is a set of medical information and knowledge databases. It contains the doctor’s handbook, the EBMG (available in both English and Finnish) with Cochrane abstracts, a pharmacology database—Pharmaca Fennica, with a wireless update service for a complete medicine price list, the international diagnosis code guide (ICD-10) in Finnish, a laboratory guide by the Helsinki University Hospital, an emergency (acute) care guide issued by the Meilahti Hospital, a medical dictionary of over 57,000 terms, and a comprehensive database over health-care related addresses and contact information (pharmacies, hospitals, health centers). The content of the system is generated by an XML (eXtensible Markup Language) database. The system functions in most mobile devices operated by different systems, e.g., Symbian, Palm OS, and Windows CE. The device most commonly uses as a platform in Finland is Nokia Communicators.

The Nokia 9210 Communicator, the device we studied in the paper, is an advanced mobile phone. It is not only a handheld computer, or a Personal Digital Assistant; but rather a mobile solution combining a mobile phone and high connectivity features (for example, access to Internet, communication by email, SMS, and fax). The phone includes a high-resolution color display (4096-color screen), enabling to use diverse applications, such as Web applications, word processor, spreadsheet, mobile e-mail, and multimedia. The phone also includes features such as calendar, notes, and contacts. The Nokia 9210 Communicator enables access to locally stored or remote databases. The phone operates on the Symbian platform, and uses the EGSM 900/1800 operating frequencies.

The mobile medical system is delivered on a 128 MB (now 256 MB) memory card, and is self-installing, containing the search engine, user interface programs, and core databases. In the near future, the system will be able to update itself partly, or completely, through the wireless networks. In the autumn of 2003, the price list, part of the Pharmaca Fennica was updated itself through the GSM (Global System for Mobile Communications) data link provided by the device. The databases have been updated to include a drug interaction database. It is important to point out that even if the most commonly used platform is an advanced mobile telephone, the system does not require connection capabilities to be fully operational: the system is stand-alone.

Figure 1: The mobile medical information system
4 Research design

4.1 Background

On September 6, 2005, with support from Pfizer Finland Ltd. and Duodecim Publishing Ltd, thirty one (military) physicians (including some medical students), undergoing their military service in the Finnish Defense Forces, were given a Nokia Communicator 9210 equipped with a mobile medical information system for a period of 8 months test. On December 10, 2005, after the military physicians had used the mobile medical system for a time of approximately three months, we conducted a field study: the researchers visited a training camp to interview the military physicians and to observe them in their daily routines and in their operating environment. We had the opportunity to visit two different attachments of military physicians during a military exercise, one at the battalion level medical station and one on the front line. Seven actual users were interviewed: others were unavailable, as they were either dispatched to other battalions or unavailable for an interview at that time. The age of our interviewees ranged from 20- to 30-years old. Six physicians were male; one of the interviewee was female.

4.2 Data Collection

Usability evaluation of the mobile medical information system was carried out by following the rules of thumb we presented in section 2.1. Interviews, one of the query techniques, and 7 users were selected to perform the usability evaluation during the field study: the interviews included questions regarding (i) the characteristics and the features of the medical database, and (ii) the properties and the features of the device.

(i) The characteristics and the features of the medical database:
  - Navigation issues in the database.
  - Are the most important functions easily available?
  - Is there a need for additional functions?
  - The use of colors in the interface.
  - Easiness in finding information – Failed searches.
  - Missing information.
  - Quality of the information: accuracy, completeness, up-to-date.
  - Suitability of the system in crisis situations.

(ii) The properties and the features of the device:
  - Screen properties: lighting, size, readability of the information (text size, font), and use in different weather and daylight conditions.
  - Keyboard properties: size, layout (easiness to input text, use with gloves), and use in different weather and daylight conditions.
  - Phone cover: robustness and durability.
  - Phone storage and portability: how is the phone handled? Is the phone easy to carry with? Where and how is it kept?
  - Battery life.

Interviewees were asked to report problems they had with the system in different field situations, and also to propose improvements they would like to see in the device/system for their use in the field. The interviews were video-taped as a means to capture contextual information, and to let the interviewees show how they use the system in various situations.

4.3 Data Analysis

The data collected during the interviews was transcribed, and the physicians’ opinions about the features of the system (the databases) and the device were categorized according to a set of questions determined before the interviews. In section 5, extracts of the data are reported in the form of quotes; these quotes have been translated from Finnish to English by the authors.
5 Results

5.1 Characteristics and features of the medical database

Navigation in the mobile database
The mobile medical information system is composed of different content-specific databases. Search for information is performed by keyword search. Users were asked to comment on the navigation within and between databases, and to mention problems or shortcomings they had noticed during their use of the system. All users reported that basic search and navigation within a specific database did not pose any particular problem: a search is usually complete with a keyword search and a couple of clicks through the database. The “back” button is often mentioned as the way to navigate back to the main menu. Users did not experience being “lost” in the database during the use; one reason is that physicians seem to build their own “mental model” of the database over time, making it easier to locate information. A few users mentioned that they would like in a few databases (Pharmacca, doctors’ handbook) to see some headers as shortcuts to the information they need: “... actually for example in the Pharmacca database, there could be the headers here in the beginning. So one could jump directly.”

Users reported that browsing back and forth between several databases felt awkward and slow in the beginning; they eventually got used to it. A persistent problem seems to be that, when browsing from one database to another, the system would reset the database to the main screen and delete earlier searches. The capacity to retrieve or log earlier searches could be a useful addition to a new version of the database: “sometimes I might forget some information... or not remember where it was... I could have browsed to another page and switched off the database by accident... it could be handy to browse back to visited pages or retrieve visited pages from a log file...”.

Use of colors in the database
The use of colors was not heavily criticized by the respondents. The only detail which was mentioned regarded the scrolling pointer, and how it somehow hindered reading of information by using color-inverted mode with selected text elements.

Availability of the most important functions – Suggestions for new functions
At first, few physicians could comment on new functions that they would see as necessary in their work. The only improvement to the database expressed by the physicians themselves was the addition of a search by active substance. Most physicians said that that type of search would be very useful in their work.

The interviewers suggested the possibility to bookmark links to information that is often needed. The reactions of the respondents were mixed: some of them saw that most of their searches are of the “one time” type and not necessarily repetitive; others saw that the possibility to retrieve the last 5-10 searches would be an improvement. The possibility to bookmark specific bits of information was usually welcome.

Easiness in finding information – Failed searches
Respondents unanimously reported that they find the information they need, except in the case of some specific tables and pictures which can not be displayed, most often because of layout problems or simply because the information is not in the database.

The interviewees mentioned that they found the system faster to use than traditional medicine books, but less convenient that a similar database on the Internet: “in my opinion, the speed is one advantage ... searching from a book takes a lot of time... this is easy to carry with you, whereas books are not always there where you need them...”. Users mentioned that they usually find the information because they know in advance where that particular information is located.

When asked if the speed of the system is satisfactory in different situations, users reported that they found information relatively fast. However in some situations, like urgent care situations, the speed of the system is not satisfactory. As one user puts it: “it depends on the situation; not in acute situations in this sense it is vain to look for revival instructions ... it would be too slow, but when receiving patients. – Question: what would be the time needed for you to start searching from the database? Answer: it depends, but at least one minute ... the information does not come that fast...”

Missing information
Tables and pictures were reported as the most important shortcomings of the database in respect with content (they were not transferred to the mobile system). In some cases, that missing information can be essential for some medical activities. The “acute care” guide was blamed for its poor content; proposed additions were revival instructions, including the basic scheme for revival and drug prescriptions.
Quality of the information: accuracy, completeness, up-to-date

All respondents said that the information was accurate, complete and up-to-date, and that it matched their expectations also in field work. One user reported that information quality was at the same level as the information found in medicine books.

Another user reported that information is condensed enough, but lower levels of detail information can be found if necessary.

One important aspect for users of the system is that successful use depends on whether the physician has a clue of where to find information in the database or not. Here, medical training becomes important: physicians’ own training, knowledge and expertise are the primary sources of information in most situations; the mobile medical system remains a secondary source of information.

Suitability of the system in crisis situations

Most respondents did not see how the system could be suitable in crisis situations; rather they mentioned that it would remarkably suit patient reception. The device can of course be developed further and customized to meet the physical demands of challenging field conditions. If an addition could be made to the content of the database, it should include information about crisis situations, such as first-aid and shock treatment information; the information should be organized in such a way that it could be retrieved within a couple of clicks.

5.2 Properties and features of the device

Screen properties

Physicians were asked to comment on the screen of the device, for example its size, the readability of the information presented, its use in various weather and light conditions.

All physicians expressed that the screen size was suitable to the types of situations they had to face. When asked if the screen could be larger, most users mentioned that it could be larger, but not at the expense of the overall size of the device; “I don’t really like a larger screen, this size of the device is quite maximal at this point” However, when asked if the device could be smaller, mixed opinions were expressed: to some users, screen size could not be smaller as it would automatically mean a smaller device (“I think that it (the screen) should not be smaller ... especially because it would mean a smaller keyboard, which would not be as handy”), whereas some users expressed that they would like to have a smaller, less bulky device, but they would not be ready to compromise on the size of the screen (“It could be a bit smaller, I mean that the new Communicator looks a bit more handy and is smaller”).

An interesting comment about the screen size touched upon the shape of the screen, especially the horizontally-oriented screen of the Communicator vs. the vertically-oriented screen of a PDA. According to one interviewee, a PDA screen would be more suitable to present the type of information included in the database; in the sense that less screen real estate would be used to line breaks between paragraphs and therefore decrease the amount of scrolling through the database: “the screen should be so that more information should fit in one screen instead of scrolling back and forth”.

Interviewees reported unanimously that readability and font size did not pose any problem. Screen readability in various weather and light conditions was not blamed; however it was mentioned several times that, when trying to type in text in the dark, the screen had to be bended in order to bring light onto the keyboard. This could be assumed to affect readability and make the use of the device somehow unpractical.

Keyboard properties

Physicians were asked to comment the device’s keyboard and its use in various weather and light conditions. The keyboard of the Nokia 9210 Communicator reminds a computer keyboard; the keyboard is rather large, with keys separated from each other, compared to the keyboard of the Nokia 9300 Communicator. Text input did not pose any major problem in most cases; input of special signs, which are not accessible directly through the keyboard, was not really possible (“text input is easy, well... actually I have had a few problems inserting special signs because I never quite remember how (to do it)...”).

Use of the keyboard with gloves, for example in cold weather conditions, was said to be nearly impossible, even with the large keyboard of the Nokia 9210 Communicator (“in winter with the gloves, it is not really possible to type ... the keyboard should not be made any smaller...").

The need for a backlit keyboard was expressed: using the keyboard in the dark is impossible unless the screen is bended towards the keyboard (“well, it works if one bends the screen towards the keyboard... but a backlit keyboard would be a good idea”).

Phone robustness and durability

When asked to comment the phone’s robustness and durability in field conditions, the physicians mentioned that the device seemed to be robust in stationary conditions, for example in a field hospital.
However, when on the move in “extreme” conditions (in cold and humid circumstances, or when crawling in the field), the device would break down easily unless protected by a phone case; in winter conditions, the battery of the device would certainly run out very fast (“actually here humidity comes into play, we have obviously humidity here on this camp, that’s why one of the phone broke down”). On the basis of the interviews, humidity seemed to be the factor that would influence the most the phone’s robustness and durability; one phone actually broke down when being exposed to humidity.

Size of the device, phone storage and portability

The physicians expressed their opinions about the size of the device, and they reported how they store the device in their daily operations. When starting their training, the physicians were given a leather case to keep the device; this leather case can be easily attached to a belt, or used simply to protect the phone when carried in a pocket.

In the section on screen properties, we mentioned that the interviewees thought that the size of the device was maximal, though they saw that there is potential to increase the screen size. A smaller device would be welcome, but not at the expense of the size of the screen size, or the keyboard. Still, the device under scrutiny can be considered to be bulky (although better than medical books), and it is not convenient to carry it along attached to a belt in a leather case; that leather case is in most cases insufficient against humidity. Physicians reported that they carried the device in the front pocket of their uniform jackets.

Battery life

Battery life is a major concern for field operations, especially when battery charging possibilities are not available. Physicians have used the device during several training camps; they reported the situations where battery life was a problem. A few of the interviewees mentioned that they did not encounter any problem with the phone battery, the battery lasted several days (about 5 days) during a training camp (“it lasts several days, if one does not phone a lot”). Others reported situations where battery was insufficient, for example:

- war-like situations, which last longer than a training camp, and where charging possibilities do not exist; in these situations, a spare battery was deemed to be necessary “the battery has lasted, but if we think about a war-like situation with older equipment, there is not necessarily any electricity nearby the first-aid point ...a spare battery is definitely needed, if the phone is used in a crisis situation”
- outdoor operations with cold weather conditions, where the battery runs out very fast “difficult to say... if it is cold then the battery will discharge quickly... charging possibility should be available”.

A recurrent problem in field operations is that the work pace can be very hectic, which means that the user can forget to charge the battery, or leave the phone running, therefore, consuming the battery.

6 Discussion

This paper sets out to investigate military physicians’ usability evaluation of a mobile medical information system functioned in a smart phone that supports their access to medical knowledge and information in field conditions. Characteristics of the medical database and characteristics of the mobile device in relation to the mobile system operated in field conditions were investigated.

The results indicate that both the mobile system and the mobile device which are originally adopted for civilian medicine have some degree of readiness for military purposes. However, further usability improvements of the system and the device are required.

The contents of the medical database were deemed adequate, being level with the information available in printed books and in the Internet portal. But some important tables and picture should be transferred to the system, as well as some lower levels of detail information would be very necessary. The system in its present form was not perfectly suited for use in crisis situations, but information about emergency procedures, such as first-aid and shock treatment information, should be included and made easily available. This has given us a good direction in order to improve the military readiness of the system. More contents on military medicine should be included into the system, such as, major trauma handling, pain relief, detoxication and cleansing of chemical/radiation injury in combat situations; hygiene, epidemiology, prevention of infectious disease outbreaks while soldiers are living under rough conditions (in field and out of casern); and some peculiarities of “military health”—mass vaccinations, epidemiology, skin disease, and occupational safety/risk issues specific to the military in casern/barracks. In order to provide more information on physicians’ needs in the practice, as discussed in section 2.3, possible integration with soldiers’ health data, and possible diagnosis support would be very beneficial. Such improvements would
The use of the system in real crisis or combat situations.

The very simple navigation interface of the system did not cause problems for the military physicians, apart from the fact that the separate databases were not linked to each other, causing multiple searches. The capability to retrieve or log earlier searches, or bookmark links to information is a useful addition to a new version of the system. Such capabilities may improve the speed of the system in urgent care situations.

This field study was also the opportunity to gather suggestion improvements for use of the device in field operations. Along the questions that were asked, the military physicians added their own suggestions for improvement and underlined critical features and properties of the device that would fit their needs. In general, the device is, to some extent, suitable for use. The readability and font size did not pose any problem. Text input via the large keyboard did not bring any major problems in most cases, except some special signs; but it is not possible to use the keyboard with gloves in extreme cold weather conditions. The device also seemed robust in most stationary conditions, but not in extreme moving conditions (e.g. crawling in the field). Batter life is a major problem which has limited the usage of the system in field operations, especially in places where no charging facilities were available. Further improvements to the device in order to serve military physicians and enhance the operation of the system in field conditions, are very demanding. It is a good strategy to expand the limits of the device so that it serves better the military physicians: for example, more robust material, good battery management, larger screen and keyboard, as well as a special protection case.

Before discussing the implications of this study, it is worth pointing out its limitations. The main limitation results from the method that we used for performing the usability evaluation. The semi-structured interview may not necessarily give the sufficient data for finding out all the usability problems of the system to the task. Most probably a further set of interviews and contextual observations, in addition to proper task analysis of the military physicians work would be needed. Another limitation concerns the fact that users we interviewed here lack of real usage experience under crisis situations or in the battle field. Simulated conditions have also given us little insights of the actual contextual requirements. In other words, the results do not provide rich and sensitive insights about the use of the system in real crisis or combat situations.

7 Implications and conclusions

The study presented here has practical implications. The findings suggest that a mobile device as a medium to access medical knowledge and information is welcomed by military physicians. The results show that there is potential to fine-tune the usability of medical database. The fine-tuning or design of a future mobile system should take into account the following points: The contents of a medical database for military and crisis use should be tailored to the actual usage contexts. Even if the civilian version of the system was useful even in field conditions, it could be improved by adding some even faster guidelines for treating acute trauma and other special information for military purposes.

The feature separating the Nokia 9210 and its successors from other types of mobile devices such as pen-based PDA’s, the qwerty keyboard, was found adequate in warm and stable conditions. Usage in extreme conditions shows that there is room for further improvements. But it is not an easy task; as a multi-purpose device, the producer may lack of interest to improve it for military purposes. Cooperation between the producer and the military seems very necessary.

Several other mobile devices, e.g. PDAs, pocket PC, have been adopted to deliver different mobile e-health services³. A few studies have been conducted to compare these device properties in their suitability of delivering mobile e-health services. Future research on the direction will give us more know-how to help healthcare providers to select a good mobile device to accomplish their tasks in mobile e-health. An “awkward” mobile device might undermine the usefulness and ease of access to a particular mobile product or service. It is very important to deliver the mobile system through a user-friendly and easy to use device, which in turn, would increase the quality of healthcare at the point of care, even if the point of care is on a battlefield.

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9 References


2 The results regarding the properties and the features of the device have been partly published in Tétard F., Han S., Harkke V. and Collan M., “Smart phone as a medium to access medical information: a field study of military physicians”, in Proceedings of the 5th Global Mobility Roundtable, 31-May-2 June, 2006, Helsinki, Finland.

3 More information can be found: http://www.pdamd.com; www.ehit.fi; http://www.e-health-insider.com, just name a few.