



Physicians' Perceptions and Intentions Regarding a Mobile Medical Information System: Some Basic Findings

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ABSTRACT

The article describes a mobile medical information system developed to meet physicians' information needs in their daily work. As a basis for future studies, a questionnaire survey (n=500) was conducted at the initial adoption stage in April 2003. Follow-up telephone interviews (n=42) were conducted in June 2003. Basic findings of the two surveys indicated that usefulness and ease of use were important determinates of physicians' adoption of the system. Also the value-adding contents of the system are drivers for using it. The lack of enough mobile devices (Nokia Communicator 9210) is the biggest barrier to adoption. The physicians thought using the system would improve the productivity of their working time. They would use it mostly at home or while making house calls. Future research is discussed briefly.

INTRODUCTION

Despite promising increases in efficiency gained from IT investment, (Devaraj and Kohli 2000, Borzekowski 2002), healthcare organizations have generally been slow to adopt information technology (The Economist 2002). One possible explanation is that physicians are seldom at their desks and thus cannot use traditional desktop computers. Therefore mobile solutions must be sought to handle information (Stammer 2001). Goldberg and Wickramasinghe (2003) argue that mobile e-health services offer a panacea to meet healthcare challenges in the 21st century.

Duodecim Medical Publications Ltd, a publishing company owned by the Finnish Medical Society Duodecim, designed a mobile medical information system. It is a set of medical information and knowledge databases, containing evidence-based medical guidelines - EBMG (www.ebm-guidelines.com), also called a doctor's handbook (both in English and Finnish) with Cochrane abstracts, the pharmacology data-

base Pharmaca Fennica, an international diagnosis code guide (ICD-10) in Finnish, an acute care guide by Meilahti hospital, a medical dictionary of over 57000 terms, wireless update service for a complete medicine price list and a comprehensive database over healthcare-related addresses and contact information (pharmacies, hospitals, health centers). It is built on an XML database and can easily be modified to work in most mobile devices with different operating systems e.g., Symbian, Palm OS and Windows CE, etc. In Finland the device most commonly used as a platform is the Nokia 9210 Communicator. The mobile medical system is delivered on a 128 MB (later 256MB) memory card and is self-installing, containing the search engine, user interface programs and the core databases. The material is updated semi-annually. Currently the updates are delivered as physical memory cards, the users returning the older ones. In the near future the system will be able to update itself partly or completely through the wireless network.

In order to provide a basis for further studies on physicians' usage of the system, and its impacts on their working practice, a survey was conducted to detect physicians' perceptions and intentions regarding the system in April 2003 - the initial adoption stage. Follow-up telephone interviews were made in June 2003. We describe here some basic findings from these two surveys.

RESEARCH BACKGROUND

User Adoption of Technology

Users' perceptions of and intentions to adopt an information system (IS) and the rate of diffusion and penetration of technology within and across organizations are two important foci in IS research (e.g. Straub et al. 1995). They are understood to represent the essential aspect, property or value of the information technology (Orlikowski

and Iacono 2001). It is generally accepted that using information systems at work could increase employees' productivity in their work, and improve individual and organization performance. System use is an important way to measure IS success (DeLone and McLean 1992 and 2003). In the last few decades, the conclusions of many studies based on different theoretical approaches, e.g. diffusion of innovation, technology acceptance model, the Unified Theory of Acceptance and Use of Technology, etc. (e.g. Davis et al. 1989, Moore and Benbasat 1991, Venkatesh et al. 2003), have confirmed that usefulness or performance expectancy - the degree to which an individual believes the system will help to improve job performance - and ease of use or effort expectancy - the degree of ease associated with using the system - are two fundamental factors determining user acceptance of technology.

Pedersen and his colleagues have made several studies on user acceptance of mobile technology and services including mobile internet, text messaging, contact services, mobile payment, mobile gaming and mobile parking services based on these approaches (e.g. Pedersen 2002, Pedersen et al. 2003, Pedersen and Nysveen 2003). They also found that usefulness and ease of use are very important factors determining user acceptance of mobile technology.

There are two temporal dimensions of adoption behavior. One is pre-adoption or initial adoption behavior (initial adoption, first-time usage, and possible rejection at the pre-implementation stage). The other is post-adoption or post-implementation behavior, (sustained continuous usage, and discontinued usage). As users gain more experience of a system, ease of use will have weakened effects on user adoption behavior but usefulness is a strong determinant for continued usage regardless of temporal impacts. (e.g., Parthasarathy and Bhattacharjee 1998, Karahanna et al. 1999, Venkatesh et al. 2002).

IT and User Productivity

We have to be aware that system usage by individuals is only a necessary, not a sufficient condition for bringing about performance improvements (Davis et al. 1989). Basically, we could focus on three measurements to understand IT impacts on individual productivity: *efficiency* means IT could speed up processes and activities, *effectiveness* indicates IT may change the means of pursuing desired goals, and *expansion of limits* means IT might save individual limited time and allow attention to be directed to other activities (Kvassov 2002).

Green (2002) indicated that mobile computing and telecommunications technologies mediate time in relation to mobile spaces, but the practical construction of mobile time in everyday life remains firmly connected to "working time" and "family time". When people are working on the move (geographical movement), they have less control over the configuration of their environment and the way they organize their work (Perry et al 2001). Mobile technologies promise to remove these bindings between fixed time and space and try to create a seamless working context regardless of time and space. Mobile technologies have the potential to improve the productivity of mobile workers.

DATA COLLECTION AND ANALYSIS

In April 2003 the Publisher, with support from Pfizer Finland Oy, started a trial involving 500 physicians who would be provided with a Nokia 9210 communicator with the databases for free. Our survey questionnaires were handed out during initial training sessions when they received their communicators. The questionnaire was to investigate how the physicians perceived the mobile system and whether they intended to use it as well as other details about their work considered important by the publisher. Our main attention here is to present findings concerning their perceptions and intentions regarding the mobile system. With 379 returned questionnaires, the response rate was 75.8%. The variation in useful data is due to missing answers.

In addition to the questionnaires, Pfizer Finland Oy conducted a telephone interview in June 2003, after the physicians had been using the systems for some 2 months. Forty-two doctors were interviewed. Half of them were health-center general practitioners (GPs) and the other half specialists.

The SPSS 11.0 was used to analyze the data. The frequency and descriptive statistics were run to get first insights into the issue.

FINDINGS

Physicians' Perceptions and Intentions Regarding the System at the Initial Adoption Stage

Table 1 displays the frequencies and valid percentages of the results. Mobile phone usage was very widespread among the respondents: of the 120 valid responses only 2 did not have a mobile phone. The remainder had, and 77% had owned one for 4 years or more. One hundred and twelve had used it to send SMS messages. However, only one had used WAP services. Of the 118 valid responses 115 believed that ease of use was a very important feature of mobile services for physicians. Limiting the content to information useful only to physicians was considered important by 51 and very important by 54. Services covering only their own specialty were a very important feature for 40 and an important feature for 58. A total of 298 of 365, or 81.6%, respondents would like to use the system at home. Two hundred and eighty seven out of 359 believed they would use it at work. Even though house calls are not common in Finland, 174 of 328 thought they would use it when making house calls. Less than half (158 of 337) of the respondents said they would use it when on rounds visiting patients in hospitals.

The main reason given for not using the system, 42 of 69 answers or nearly 61%, was that mobile services were too slow. Only 28% (19 of 67) indicated "no need to use" as a barrier to usage while 33% (24 of 73) said usage might influence the physician's "encounter manner".

The availability of EBMG and Pharmaca in the communicator was the most important reason for buying a communicator; in favor were 57.3% (59 of 103) and 51.5% (51 of 99) respectively. Features such as the office package and Internet connection were less important but still

Table 1 Findings

Questions	N.	%	Questions	N.	%
<i>Usage of mobile phone</i>			<i>The most important features</i>		
Have mobile phone	120		Easy to use and fast	118	
Yes	118	98.3	Very important	115	97.5
No	2	1.7	Important	3	2.5
Years owned			Only medical information	118	
Less than 1 year	3	2.5	Very important	51	43.2
1 year	2	1.7	Important	54	45.8
2 years	7	5.9	Not very important	11	9.3
3 years	15	12.7	Not important	2	1.7
4 years or over	91	77.1	Only own specialties	117	
Send SMS			Very important	11	9.4
Yes	112	93.3	Important	40	34.2
No	8	6.7	Not very important	58	49.6
Use WAP services			Not important	8	6.8
Yes	1	.8			
No	119	99.2			
<i>Mobile contents</i>			<i>Effects on work efficiency</i>		
Mobile Pharmaca	121		Mobile Pharmaca speeds up the work	115	
Yes	87	71.9	Yes	60	52.2
No	34	28.1	No	55	47.8
Mobile EBMG	121		Mobile EBMG speeds up the work	115	
Yes	97	80.2	Yes	91	79.1
No	24	19.8	No	24	20.9
Mobile textbooks	114				
Yes	61	53.5			
No	53	46.5			
<i>Possible reasons for non-use</i>			<i>Situations of using the system</i>		
Too slow for patient work	69		At home	365	
Yes	42	60.9	Yes	298	81.6
No	27	39.1	No	67	18.4
Feel no need to use	67		On practice, e.g. reception	359	
Yes	19	28.4	Yes	287	79.9
No	48	71.6	No	72	20.1
Influence the encounter with patients	73		On house calls	328	
Yes	24	32.9	Yes	174	53.0
No	49	67.1	No	154	47.0
			On ward rounds	337	
			Yes	158	46.9
			No	179	53.1
<i>Reasons for buying a communicator</i>			<i>Barriers to use</i>		
Internet features	102		Not enough communicators	116	
Yes	43	42.2	Completely agree	76	65.5
No	59	57.8	Agree	32	27.6
SMS features	102		Neutral	3	2.6
Yes	29	28.4	Disagree	4	3.4
No	73	71.6	Strongly disagree	1	.9
Office applications: Word, Excel, PPT	99		No time to learn	115	
Yes	40	40.4	Completely agree	21	18.3
No	59	59.6	Agree	43	37.4
Mobile EBMG	103		Neutral	22	19.1
Yes	59	57.3	Disagree	25	21.7
No	44	42.7	Strongly disagree	4	3.5
Read mobile journal	99		Not useful	113	
Yes	18	18.2	Completely agree	1	.9
No	81	81.2	Agree	14	12.4
Mobile Pharmaca	99		Neutral	41	36.3
Yes	51	51.5	Disagree	44	38.9
No	48	48.5	Strongly disagree	13	11.5
Read mobile news	98		<i>Future usage of mobile Internet</i>		
Yes	25	25.5	to access Internet EBMG	118	
No	73	74.5	Daily	48	40.7
Interested in mobile devices in general	100		2-4 times/week	41	34.7

worth mentioning. The service contents were the main reasons for physicians to buy a communicator in Finland.

Lack of enough communicators for physicians was the most important hindrance to widespread use of the system; 93% (n = 116) of the respondents recognized it. Another considerable obstacle was that time was lacking to learn to use the new mobile system. This was recognized in 56% (n = 115) of the answers. Only 13% (n = 113) considered the mobile EBMG useless in their work.

If the information in Pharmaca and EBMG could be found easily with a mobile device, 87 of 121 respondents said they would use the mobile Pharmaca and 97 the mobile EBMG instead of a traditional book. If the information in medical textbooks was easily available both from a mobile device and a PC, 46.5% (n=114) said they would use a PC, but 53.5% would use a mobile device. We also asked physicians to rate the service contents - the core databases they found most important in the system. The statistics showed that EBMG, Pharmaca and ICD-10 were the three most important. The majority (66% of 368) agreed that EBMG and Pharmaca would be more useful to them in mobile form than in printed, Internet or CD versions.

Speeding up the work process by using mobile Pharmaca compared to using a book was considered possible by a slight majority; 52% (n = 115) of respondents agreed. Seventy-nine percent found using the mobile EBMG faster than a printed book.

A fast, always-on mobile Internet connection would affect the usage patterns of Internet-based services. Over 40% of the respondents thought they would use the Terveystietä portal (n = 117) and the Internet EBMG (n = 118) daily, and over 30% 2-4 times a week.

Actual Usage Patterns

The actual usage of the mobile system followed the lines of the pre-use survey. In the telephone interviews the respondents (n = 42) stated that the services were useful in their work (71%), the most important determinants of usefulness being immediate availability of information, fast Pharmaca, EBMG and ICD-10. The respondents (7%) who found the system unnecessary for their work had two main reasons for not needing it: health-center physicians that they always have a desktop computer at their disposal and direct access to the material on CD or Internet, and specialists that the package does not contain information about their specialty. The device itself was found somewhat bulky and awkward to use, and the Internet connection is slow. There were few directly negative experiences.

DISCUSSION

This paper sets out to investigate physicians' perceptions and intentions regarding a new mobile information system in healthcare. The information collected here is aimed as a basis for future research.

The findings from these 2 preliminary surveys are quite similar. First, physicians have positive perceptions and intentions regarding the mobile system. They are willing to use it in their work. Ease of use and usefulness of the system are main drivers for them to adopt it. Physicians showed, however, considerable interest in buying a Nokia Communicator the first time if the mobile system was available in it. The lack of enough such devices is the biggest barrier to adoption.

Second, the contents of the mobile system are crucial for its acceptance. EBMG, Pharmaca and ICD-10 were valued as the three most important contents. Higher quality information - the service content - constitutes a positive value for users (Landor 2003).

Third, the system is generally used either on the move or at home. The possible explanation for this is that physicians in Finland generally acquire information and manage their patient care through computers and Internet connections at their place of work. At home, they are away from those channels; consequently, they easily turn to the mobile system for help. Mobile services are seen primarily as supplements to rather than as substitutes for the wired Internet and PC-based tools at the moment.

User adoption theories assert that intention is a proper proxy to examine and predict a user's behavior towards information systems (e.g., Davis et al. 1989). Our study convinced us that such a mobile system designed for healthcare is needed by physicians. There is a high potential

for mass adoption in the future. Physicians could be the early adapters of mobile technology.

IT can usually enhance users' productivity in their work. As mobility becomes a must in modern world, professionals, such as physicians, have to seek support from mobile technologies (Kakihara and Sorensen 2002). Most of the physicians in our surveys expected the mobile system to speed up their work. It might improve efficiency of work, an important aspect of productivity. Such "speed up", could save physicians time as well, especially when they are on the move or making a house call. They can access information immediately. The mobile system also provides a good alternative for physicians to complete their information search and help them with patient care, which is effectiveness of productivity.

CONCLUSIONS

There seems to be a need for the kind of mobile information system Duodecim has developed. As a first version the system could still be improved. In our future research we will concentrate on actual usage of the system and the impact it has on the physicians' work. The system is being continuously developed and the usefulness of new features such as mobile prescription will be evaluated. One aspect of introducing new tools is that they may function as catalysts for changes in organizational cultures and work processes, thus enabling even greater efficiency gains than the tools per se can accomplish. One problem of modern-day medicine, at least in Finland, is the amount of paperwork deemed unnecessary by most actors in the field. Reducing unnecessary and frustrating red tape would free resources and capital for improving the most important aspect of healthcare, the care itself.

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