

Early clinical experience with CardioCard® – a credit card-sized electronic patient record

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Summary

Questions under study: CardioCard® is a CD-ROM of credit card size containing medical information on cardiac patients. Patient data acquired during hospital stay are stored in PDF format and secured by a password known to patients only. In a consecutive series of patients, we assessed acceptance and utility of this new information medium.

Methods and results: a questionnaire was sent to all patients who had received CardioCard® over a one-year period. The questionnaire was returned by 392 patients (73%). 44% of patients had the card with them all the time. The majority of patients (73%) considered the CardioCard® useful (8% not useful, 19% no statement) and most (78%) would even agree to bear additional costs. Only 5% worried about data security. In contrast, 44% would be concerned of data transmission via internet. During an observation period of 6 (SD 3) months, data were accessed by 27% of patients and

12% of their physicians. The proportion of card users was lower among older patients: ≤50 years (y), 39%; 51–60 y, 38%; 61–70 y, 26%; >70 y, 16% and particularly among older women: 61–70 y, 9%; >70 y, 5%. Technical problems during data access occurred in 34%, mostly due to incorrect handling.

Conclusions: a majority of patients considered CardioCard® as useful and safe. Lack of hardware equipment or insufficient computer knowledge, but not safety issues were the most important limitations. As patients expressed concerns regarding protection of privacy if data were accessible via internet, this would remain a strong limiting factor for online use.

Key words: electronic patient record; smart card; prospective study; health information system

Introduction

The exchange of patient data between different healthcare providers is an issue of utmost importance, as it can help to improve management of patients and to avoid unnecessary investigations, treatments and hospitalisations. Modern commu-

nication technologies allow an information transfer whenever and wherever it is required. However, protection of privacy is extremely important in any health information system [1, 2] and concerns regarding this issue must be considered. Thus, a modern health data processing system must ensure protection of privacy, completeness of relevant data and availability at all times [3]. Pocket-sized electronic medical records (smart cards) are considered to be a useful tool as they meet all criteria of an appropriate information system [4]. Although smart cards were introduced more than twenty years ago [5, 6], a widespread application has not occurred yet. In addition, some of the systems that have been used thus far are already outdated [5, 7]. With the increasing use of computer technologies, even among elderly people, modern smart cards might be more readily applicable than ten years ago. Still, a limiting factor of many previous smart card systems was the requirement of specific hardware and software to

Figure 1

CardioCard® is applicable on every conventional personal computer or laptop with a CD-ROM reader equipped with a CD-carriage cradle.



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perform data accessing. In our clinic, we developed a pocket-sized electronic information system called CardioCard[®] containing all cardiological data collected at our clinic on a CD-ROM and secured by a password. Our aim was to implement a

safe information system applicable on every conventional computer system (figure 1). One year after introduction of CardioCard[®] we assessed the acceptance and the utility of this new information medium.

Methods

During a one-year period 536 consecutive patients, who were hospitalised in our short-term clinic for cardiac investigation, consented to the study and received a CardioCard[®].

Data of all different cardiac examinations (ie, reports of clinical examinations, echocardiography, angiography, myocardial perfusion scintigraphy, twelve-lead and Holter ECG) were processed as follows: in a first step, they were fed into a modular data bank (clinical information system) which was connected to a central server. Data were then automatically saved as a portable document format (PDF) report and stored on a mini-CD ROM, the data carrier of CardioCard[®].

Several important technical features are implemented on the card: In addition to patient data, Acrobat Reader[®] is stored on the card. If required, this program is able to install itself independently. Thus, data are applicable on every computer system equipped with a CD-ROM drive because specific software preconditions are not required. CardioCard[®] is a read-only medium and thus allows transfer of patient information in one direction only. The fact that data cannot be modified by the card user guarantees legal validity of the electronic examination reports. Data access is secured by an individual password, which is

known only to the patient. Additionally, only one specimen of the card exists. These features result in a maximal data safety, but more importantly, make the patient responsible for personal data protection.

Patients were given a questionnaire for self-completion with several questions asked in a multiple choice design to simplify answering and subsequent analysis. Patients were encouraged to give a short comment on the type of problems that occurred during the use of CardioCard[®].

Overall, the questionnaire focused on four subject areas: 1) usefulness of CardioCard[®]; 2) frequency of use; 3) reasons for possible non-use; 4) concerns about protection of privacy.

Statistical considerations

Continuous data are expressed as the mean value (standard deviation). In a subset of questions responses were cross classified by gender and age in years (y): ≤ 50 y (n = 33); 51–60 y (n = 90); 61–70 y (n = 139); >70 y (n = 130). Because the responders of the questionnaire did not represent a random sample of those receiving a card we refrained from performance of group comparisons by statistical analysis.

Results

Three-hundred and ninety-two (73%) of the 536 patients who received CardioCard[®] during the study period answered the questionnaire. 76% among them were male, mean age was 65 (10) years, and age ranged from 26 to 91 years. 173 patients (44%) carried the card with them all the time, whereas 210 patients (54%) reported usually keeping it at home. Table 1 depicts a summary of the questionnaire listing the actual wording of the questions and patients' answers. The majority (287 patients; 73%) considered CardioCard[®] to be

a very useful or useful information system. Only 8% (31 patients) judged it to be not useful, 19% (74 patients) did not respond on this topic. 235 patients (78%) would even agree to cover additional costs for card production. During an observation period of 6 (3) months only, 27% of patients and 12% of their family doctors retrieved data from CardioCard[®]. Figure 2 shows the proportion of patients using the card, stratified by age and gender. The rate of card users was higher among younger patients (≤ 50 y, 39%; 51–60 y, 38%; 61–70 y, 26%; >70 y, 16%). The lowest proportion of card users was found in the subgroup of older women (9% in those 61–70 y of age and 5% in those >70 y, respectively). The proportion of physicians using the card, stratified by patients' age and gender, is shown in figure 3. According to patients' responses, the highest rate of data interrogation by physicians occurred in patients aged 51–60 y (19%), whereas in the other age groups card use by physicians was less frequent (≤ 50 y, 12%; 61–70 y, 10%; >70 y, 9%).

The most common reason (63%) for not using CardioCard[®] was lack of adequate computer equipment. In the 163 (42%) patients who used or intended to use the card, technical problems oc-

Figure 2

Proportion of patients using CardioCard[®] at least once during the observation period: stratification by age and gender (number of patients given at the top of each bar).

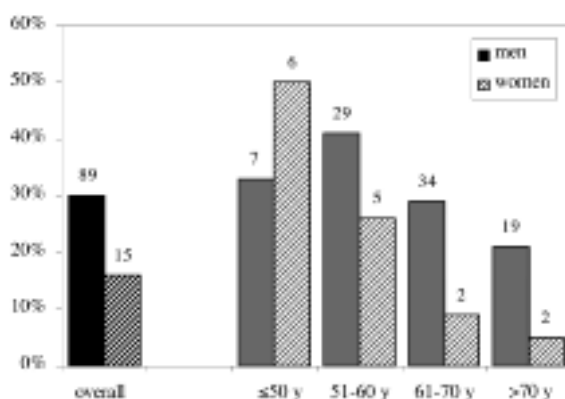
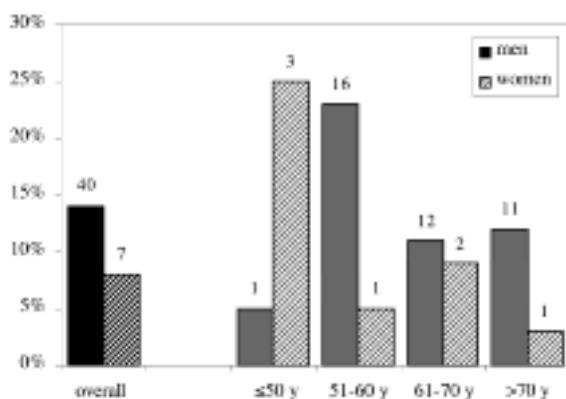


Figure 3

Proportion of patients affirming that their physicians accessed data from the CardioCard®: responses stratified by patients' age and gender (number of patients given at the top of each bar).



curred in 34%. The causes of technical problems were incorrect handling in 62%, technical incompatibility in 9%, and damaged or broken cards in 29%, respectively.

Only 5% of patients expressed concerns about data safety of the password encoded CardioCard®. On the other hand, when asked about the hypothetical possibility of data access by internet, 44% of the patients expressed serious concerns regarding protection of privacy.

Table 1

Evaluation of first experiences with CardioCard® using a mailed questionnaire.

Question	Positive answer
"I consider the card as being:" (n = 392)	
- Very useful	157 (40%)
- Useful	130 (33%)
- Not useful	31 (8%)
- No statement	74 (19%)
"If required, I would agree to make a contribution of sFr. 10.- to the production costs of the card" (n = 301)	235 (78%)
"How many times have you accessed data from the card?" (n = 391)	
- Never	287 (73%)
- Once	62 (16%)
- 2-5 times	40 (10%)
- >5 times	2 (1%)
"What was the reason for non-use?" (n = 287)	
No or insufficient computer equipment	183 (64%)
No interest	5 (2%)
Other	99 (35%)
"How many times has your physician accessed data from the card?" (n = 387)	
- Never	340 (88%)
- Once	40 (10%)
- 2-5 times	7 (2%)
- >5 times	0
"Did you experience technical problems while using or trying to use the card?" (n = 163)	
"If yes, please specify?"	55 (34%)
- Incorrect handling	34 (21%)
- Incompatibility	5 (3%)
- Broken card	16 (10%)
"Do you have concerns regarding data security of the card?" (n = 371)	19 (5%)
"Would you have concerns regarding protection of privacy if your data theoretically could be interrogated via internet by specially authorised physicians?" (n = 359)	158 (44%)

Discussion

This study assessed the acceptance and utility of the new information medium CardioCard®. The majority of patients considered CardioCard® to be a useful and safe information system. However, this statement is attenuated by the fact that only 27% of patients and 12% of their physicians

actually accessed data from the card, which, may in part, have been due to the short observation period of 6 (3) months. The proportion of card users was higher in younger patients. Particularly older women were underrepresented among the users. The most important reasons for not using the card

were inappropriate computer equipment and lack of knowledge. There were only minor concerns regarding data safety with the system used. However, many patients would have major concerns if the same data could be obtained via internet access.

Obviously, a fast access to all relevant medical data whenever and wherever required can improve the management of patients and facilitate the decision making process [8]. Already more than a decade ago, a study investigating the influence of a card-based information system on patient management in 13 000 patients was performed. Use of the card was associated not only with faster access to relevant patient data, but also with a reduction in the risk of malpractice and with reduced costs for studies and drug prescriptions [9].

Protection of privacy and data confidentiality are essential requirements of any information system in health care [2, 10]. The use of encoded portable medical reports facilitates the implementation of a solid security setting, as the stored data are protected from being read by unauthorised persons [1, 10]. Our data suggest that CardioCard® provided the necessary confidence expected from such an information system.

The development of various digital patient information systems by different health care providers may represent a potential limitation for exchange of data using portable electronic medical records. A patient may receive different types of portable storage media containing medical information from multiple sources. Because in such a scenario interchange of data may be hampered by compatibility issues, a complex data transfer from the various portable medical records into a central communication system may be required to enable interrogation of all patient relevant data [11]. This problem, however, should not apply for the system used for CardioCard®, because all data are stored in PDF-format and the application (Acrobat Reader®), which is needed to read the data, is also on the card.

The internet is a readily available and widely used technology for data access and transfer which might also serve as a clinical information system [12], particularly because a more interactive information transfer between different health care

providers would be possible. However, as indicated by our study, patients had significant concerns, which might seriously limit its potential use in the medical sector.

A feasible alternative in the near future might be the combination of both internet and password encoded cards for the implementation of a highly mobile, safe and confidential electronic patient data information system [10, 13]. Interrogation of patient data would be limited to authorised persons by securing data using an encoded access card, thus ensuring protection of privacy and confidence. The patient himself would be responsible for data protection and lose his fear of insufficient data security due to internet use.

In the present study, the card was used by 27% of patients despite the relatively short observation period, lack of appropriate hardware and software was a limiting factor for more widespread use. Additionally, it has been shown that the skill level of the user is an obstacle to data access [14, 15]. This is underlined by our results which showed that younger patients, who are more familiar with computers, used the card more often than older patients. Furthermore, in one fifth of patients who intended to use the card, difficulties in handling were responsible for its non-use.

Instantaneous benefits from the use of a card have to be apparent to patients and physicians if they have to adopt a new technology [16]. Thus, insufficient information about purpose and features of a portable electronic patient record considerably influences the motivation of patients and health care providers to access data. As a consequence, careful instructions on how to use these cards are needed for patients, physicians, and hospitals for a better implementation of such systems in daily medical practice.

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