International Journal of Medical Informatics (2006) **75**, 173—181

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International Journal of Medical Informatics

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The impacts of smart cards on hospital information systems—An investigation of the first phase of the national health insurance smart card project in Taiwan

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Received 6 September 2004; received in revised form 6 April 2005; accepted 11 July 2005

KEYWORDS
Smart cards;
Health insurance cards;
Patient data cards;
Hospital information systems

Summary
Purpose: To investigate the impacts of the first phase of Taiwan's Bureau of National Health Insurance (TBNHI) smart card project on existing hospital information systems.
Setting: TBNHI has launched a nationwide project for replacement of its paper-based health insurance cards by smart cards (or NHI-IC cards) since November 1999. The NHI-IC cards have been used since 1 July 2003, and they have fully replaced the paper-based cards since 1 January 2004. Hospitals must support the cards in order to provide medical services for insured patients.
Methods: We made a comprehensive study of the current phase of the NHI-IC card system, and conducted a questionnaire survey (from 1 October to 30 November, 2003) to investigate the impacts of NHI-IC cards on the existing hospital information systems. A questionnaire was distributed by mail to 479 hospitals, including 23 medical centers, 71 regional hospitals, and 355 district hospitals. The returned questionnaires were also collected by prepaid mail.
Results: The questionnaire return rates of the medical centers, regional hospitals and district hospitals were 39.1, 29.6 and 20.9%, respectively. In phase 1 of the project, the average number of card readers purchased per medical center, regional hospital, and district hospital were 202, 45 and 10, respectively. The average person-days for the enhancement of existing information systems of a medical center, regional hospital and district hospital were 175, 74 and 58, respectively. Three months after using the NHI-IC cards most hospitals (60.6%) experienced prolonged

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1386-5056/$ — see front matter
doi:10.1016/j.ijmedinf.2005.07.022

service time for their patients due to more interruptions caused mainly by: (1) impairment of the NHI-IC cards (31.2%), (2) failure in authentication of the SAMs (17.0%), (3) malfunction in card readers (15.3%) and (4) problems with interfaces between the card readers and hospital information systems (15.8%). The overall hospital satisfaction on the 5-point Likert scale was 2.86. Although most hospitals were OK with the project, there was about 22% dissatisfied and strongly dissatisfied, that is twice as many hospitals with satisfied (about 10%).

Conclusions: Our recommendations for those who are planning to implement similar projects are: (1) provide public-awareness programs or campaigns across the country for elucidating the smart card policy and educate the public on the proper usage and storage of the cards, (2) improve the quality of the NHI-IC cards, (3) conduct comprehensive tests in software and hardware components associated with NHI-IC cards before operating the systems and (4) perform further investigations in authentication approaches and develop tools that can quickly identify where and what the problems are.

1. Introduction

A smart card is a credit-card sized plastic card with an embedded computer chip that can be memory or also include a microprocessor [1,2]. A microprocessor chip can add, delete and otherwise manipulate information in its memory and hence offer complex data security schemes [3—6]. Smart cards have been in use as health cards for more than 10 years [7—11]. Several large-scale projects have demonstrated the practical use of smart cards in healthcare in Europe such as The Health Coverage's (Mutualités Belges) Social Identity System (SIS) cards in Belgium, versicherten-karte (Insurance cards) in Germany, carte vitale (vitale card) in France, health insurance cards in Slovenia [12], and so on. The European council of Barcelona of March 2002 decided to launch an European health insurance card on 1 June 2004. The card will replace all the current paper forms needed for health treatment in European union (EU) member state by 31 December 2005 [13,14].

Taiwan's bureau of national health insurance (TBNHI) has implemented National health insurance (NHI) program since 1 March 1995. All people in Taiwan must be enrolled in the NHI program. Based on the results of a survey on NHI program in terms of adequacy and accessibility of medical care, 75% of the insured persons were satisfied with the program [15]. However, in order to provide better quality of services and to improve the effective use of medical resources, TBNHI therefore launched a project for implementing smart cards as the health insurance cards since November 1999. The smart cards, known as ''NHI-IC'' cards in Taiwan, allow patients to access medical services electronically, and carry a certain amount of critical patient information. Because of its electronic nature, the NHI-IC cards also allow TBNHI to timely discover the inappropriate use of medical resources and to investigate medical frauds.

The NHI-IC cards have been used since 1 July 2003, and they have fully replaced the paper-based cards since 1 January 2004. Currently more than 22 millions NHI-IC cards have been issued, and more than 17,000 hospitals, primary care providers and health care institutions are involved in this project. Incorporation of NHI-IC cards into hospital medical services demands both information technology and financial support for building up the information infrastructure and enhancing the existing hospital information systems.

In this paper, we will describe the current status of the project, the NHI-IC card system, and present the results of a questionnaire survey investigating the impact of the cards on hospital information systems. These results reveal the problems and potential issues that might be useful for those who are planning to implement similar projects.

2. The NHI-IC card system

The NHI-IC card system consists of the following major components: NHI-IC cards, the card readers for manipulation of the NHI-IC cards, the hospital information systems that controls the operations of the card readers and the communication networks that make the entire system work properly for medical services.

2.1. NHI-IC cards

Similar to a bank IC card, a NHI-IC card has an IC chip consisting of a CPU and 32 KB (10^3 bytes) of mem-