



Adoption of medication alert systems in hospital outpatient departments in Taiwan



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ABSTRACT

Objective: The adoption of medication alert systems in the health care sector varies among regions. In Taiwan, the health authority introduced policies in 2005 to encourage the adoption of medication alert systems in hospitals. This study aimed to understand the adoption of medication alert systems in the outpatient departments of hospitals in Taiwan using a nationwide survey.

Methods: A questionnaire was developed and mailed to 380 accredited general hospitals in Taiwan in 2013. The information collected from the questionnaire concerning the outpatient department included (1) the time of adoption of a medication alert system; (2) the operation of individual alert functions: availability, management, and stability; and (3) hospital characteristics: accreditation level, teaching status, ownership, and number of beds.

Results: A total of 216 hospitals completed and returned the questionnaire, corresponding to a response rate of 56.8%. The adoption rate of medication alert systems in hospital outpatient departments increased from less than 10% in 1997–95.83% in 2012. Approximately two-thirds of the hospitals developed and maintained the alert systems independently or collaboratively with vendors. Teaching and large hospitals tended to develop more advanced alert functions such as drug–drug interaction functions. Improving the safety and quality of pharmaceutical services and meeting the policy requirements are reasons for hospitals to establish medication alert systems.

Conclusion: The adoption rate of medication alert systems reached 95% in accredited general hospitals in Taiwan. Government policy and available health information professionals and vendors may somewhat contribute to the high adoption rate.

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1. Introduction

Along with the increasing prevalence of chronic conditions in aging societies worldwide, the administration of potentially inappropriate medication has been an important issue in health care delivery. Computerized provider order entry systems (CPOEs) are designed to assist practitioners in issuing medical orders electronically using a standardized format. Additionally, a clinical decision support system (CDS) is usually embedded in the CPOE with a medication alert function, which is considered a key piece of technology for improving medication safety [1–3].

The Institute of Medicine (IOM) in the United States and organizations in other countries have recommended that hospitals adopt a CPOE/CDS to improve health care efficiency and safety; however,

the adoption of such systems varied significantly in many countries. A survey in the United States conducted in 2011 showed that approximately 34% of hospitals have adopted an inpatient CPOE/CDS, an increase from less than 3% reported in 2003 [4]. Arts and Koppel indicated that in 2009, the percent of CPOE utilization in the health care system was only 20% in the Netherlands, whereas CPOE utilization was less than 10% in Germany, the United Kingdom, France, Switzerland, and Austria [5]. The CPOE adoption rate (87%) was determined to be much higher in acute care hospitals (tertiary teaching and general hospitals) in Korea because these hospitals were encouraged by the Health Insurance Review & Assessment Services (HIRA) to submit reimbursement documents electronically [6]; however, the adoption rate of CDS in tertiary hospitals was less than 30% in 2010 [7]. In Japan, the percentage of hospitals with more than 400 beds adopting CPOE increased from 31.2% in 2007–78.6% in 2011 after a financial incentive policy was implemented [8,9].

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In 1995, Taiwan implemented a universal health insurance system to cover its 23 million residents. Subsequently, approximately 95% of hospitals in Taiwan were contracted with the National Health Insurance (NHI) system. With no referral requirements under the NHI system, patients could visit a physician at a community clinic or an outpatient department in a hospital. Hospitals typically possess sizable outpatient departments; approximately 30% of physician visits conducted in Taiwan are provided by hospitals. Most of the general hospitals (approximately 90%) were accredited as academic medical centers, regional hospitals, and district hospitals in Taiwan. Medical centers are required to be teaching hospitals, and most of the regional hospitals also obtained teaching status [10,11].

Beginning in 1999, the NHI Administration encouraged contracted hospitals to submit all insurance claims via electronic filing systems. In 2004, the NHI Administration required electronic claim filing. Moreover, the health authority incorporated the adoption of medication alert systems (a function of CPOE/CDS) in the criteria for hospital accreditation in 2005. Hospitals with more than 100 beds were required to establish a medication alert system in outpatient and inpatient departments, including duplication, drug-allergy, and drug–drug interaction (DDI) alert functions. However, the dosage alert function was not incorporated until 2011.

Therefore, the adoption of medication alert systems in Taiwan was expected to grow rapidly between 2000 and 2010. This study conducted a nationwide survey to understand the adoption of medication alert systems in hospital outpatient departments in Taiwan.

2. Materials and methods

2.1. Hospital sample

To collect information concerning the adoption of medication alert systems in outpatient departments of hospitals, we conducted a nationwide survey in July 2013. According to the most updated statistics at that time, there were 508 hospitals in Taiwan. A list of hospitals that applied for accreditation in 2010 (i.e., the most updated information as of 2013) was obtained. We excluded 16 traditional Chinese medicine hospitals and 41 psychiatric hospitals, which provided different services from those of general hospitals. In addition, we also excluded 57 hospitals that failed to pass accreditation, which were mainly small-scale hospitals with a lack of necessary contact information [12]. For hospitals with smaller branch hospitals, only the main hospital was included in the survey because both the main and smaller branch hospitals shared the same electronic information system. Finally, 380 out of a total of 508 hospitals in Taiwan were included in the survey.

2.2. Survey management

The questionnaire was designed to collect information concerning the development and operation of the medication alert system in each hospital. The present study focused on only the circumstances of the outpatient departments in the hospitals. The questionnaire consisted of four parts: the development, implementation, and management of the medication alert systems with four basic functions (duplication, drug-allergy, DDI, and dosage); the practitioners' attitudes toward the systems; other strategies adopted for medication safety in the hospital; and the basic characteristics of the hospitals. The questionnaire was finalized after a pilot survey in five hospitals and was constructed based on the review and comments of five experts in this area. The questionnaire was mailed to the director of the pharmaceutical department of selected hospitals, and a cover letter was attached to the questionnaire that explained the purpose of the survey along with our

contact information. We identified the hospital's pharmaceutical director as the respondent for this survey because he/she is typically in charge of or deeply involved in the establishment of any type of medication alert system. This project was approved by the Research Ethics Committee of National Taiwan University Hospital, and the mailed survey was conducted between July and September 2013 to collect information retrospectively.

The variables of interest were defined as follows: first, the "time of adoption" was defined as the first time at which the hospital developed or adopted any basic function of the medication alert system. After identifying the adoption time in the hospitals, we were able to determine the trend of system adoption in Taiwan. The adoption time was categorized into 6 periods: prior to 1997, 1998–2000, 2001–2003, 2004–2006, 2007–2009, and 2010–2012. Second, the "operational status" of the alert system included the availability, stability, and management of the system. The term "stability" meant the medication alert system was thoroughly operational and the prescribers were not interrupted due to system repair or maintenance. Each of the four basic alert functions was listed separately to collect detailed information. Third, the "characteristics of the hospital" included the accreditation level (medical center, regional hospital, and district hospital), teaching status (yes or no), scale/size (number of beds: ≥ 500 , 100–499, <100), and ownership (public or non-public).

2.3. Statistical analysis

The statistical software SAS was used for calculations and statistical analyses in this study. Differences in hospital characteristics, such as accreditation level, teaching status, and ownership, were obtained by the responding hospitals and the surveyed hospitals. Descriptive statistics were applied to determine the time trend of medication alert system adoption. Finally, the availability and stability of the systems in hospitals were analyzed by chi-square tests.

3. Results

A total of 216 of the 380 hospital outpatient departments included in the survey completed and returned the questionnaire, corresponding to a response rate of 56.8%. We first compared the characteristics of the hospitals between the respondents and the surveyed hospitals. Table 1 shows that there were no significant differences in accreditation level ($p=0.3638$) or ownership ($p=0.3656$) but marginally significant differences in teaching status ($p=0.0374$). The number of hospital beds was based on the respondents' reports; therefore, we could not examine the differences regarding this variable.

3.1. Adoption trend

The overall adoption rate of medication alert systems in hospital outpatient departments increased from less than 10% prior to 1997–95.83% in 2012. Fig. 1 shows that the adoption rate among hospitals with more than 500 beds was the highest in each time period and reached 100% in 2012. The adoption rate appeared to be lower in hospitals with less than 100 beds, but the rate increased over time to 92.0% in 2012. Furthermore, the adoption rate in teaching hospitals increased from 14.81% to 100.0%, which was a much higher rate increase than that in non-teaching hospitals (Fig. 2). Concerning individual alert functions (Fig. 3), 94.91% of the respondents had a drug duplication alert function, 94.44% had a drug-allergy alert function, 93.98% had a DDI alert function, and 89.81% had a dosage alert function in 2012.

In the questionnaire, we also asked about the main reasons for a hospital to develop or adopt a medication alert system. Notably,

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