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# Managing Nursing Assistants with a Web-Based System: An Empirical Investigation of the Mixed-Staff Strategy

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**Abstract** Under the global shortage of Registered Nurses (RNs), some hospitals have integrated nursing assistants (NAs) into their teams to help to provide maximum quality care for acute patients, while keeping the hospital's staff-related costs down. However, the RNs may have to shoulder an increased burden of assigning and overseeing NAs. A web-based Nursing Assistants Management System (NAMS) was developed and evaluated for a case hospital in Taiwan to compare the processes of assigning and managing NAs before and after the NAMS intervention. The results showed that NAMS saved 80% of the time needed for manual operation and there were no more complains about NAs being slow in dealing with patients after the system intervention. The satisfaction levels of all NA managers and RNs were acceptable. Based on the research findings, the implication and limitations of this study were discussed.

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## Introduction

By nature, hospitals are in an information-intensive industry and will reap great benefits by adopting information technology (IT), such as medical and administrative systems. The proper adoption of IT can significantly improve the quality and performance of the medical services provided by a hospital. Much of the technology in healthcare has been directed at the diagnosis and treatment of disease, and not enough technologies that transform the work environment for nurses have been implemented [1].

The current registered nurse (RN) shortage is projected to worsen and has become a global problem, as both the nursing work force and the baby boom generation age [2–6]. As the baby boomers begin their retirement phase en masse starting in 2010, the United States will face a deficit of more than one million nurses [2, 6]. Meanwhile, the rapid pace of change in the work environment such as the healthcare organizations become more complex, the definition of quality care changes constantly, and the number of outbreaks of unknown epidemics increases, also diversified the role

and responsibilities of RNs and often caused their workload to exceed reasonable expectations. Therefore, hospitals need to use every means possible to support nurses and improving their working conditions [7].

In Asian countries, such as Taiwan and the Philippines, the basic personal care of patients, such as feeding, bathing, oral hygiene, and incontinent care, is usually left to the families. Patients who are not accompanied by a member of the family usually pay extra for a nursing assistant while they are in hospital. In 1993, the Department of Health (DOH) of Taiwan granted NAs (Nursing Assistants) non-specialist status to provide qualified personal attendants to accompany those who need them while in hospital. Each NA has to attend 60 h of lectures and complete 40 h of clinical practice in order to receive accreditation as a certified NA. The tasks of the NAs include basic personal care and communicating between the family and the hospital. Although nurses in the US are expected to perform these tasks [8], some hospitals train volunteers in the protocols of the mobility, feeding, hydration, socialization, and orientation of older hospitalized adults [6]. In other words, the workload of basic personal care can be delegated to less professional staff or volunteers.

With the current reforms of insurance reimbursement in Taiwan, hospitals are being forced to reduce their overall staffing to save on expenses, and are hiring more low-waged NAs. Most hospitals in Taiwan have a co-operative relationship with the NAs, who work on contracts and are not directly employed by the hospitals. Hospitals have little or even no control over the service quality provided by NAs. Meanwhile, owing to the lack of training standards, the quality of certified NAs varies [9]. One incident which revealed the need to ensure a professional standard of NA quality occurred during the severe acute respiratory syndrome (SARS) epidemic, when one NA died as a result of caring for SARS patients [10]. Furthermore, the substandard NAs' care for large numbers of patients in numerous hospitals may have contributed to the spread of the epidemic.

A general policy of hiring more low-waged NAs to focus primarily on increasing efficiency and reducing costs has damaged the relationships between nursing staff in a variety of ways. Despite the difficulty in defining which responsibilities best suit NAs or RNs and ongoing tension between the two groups [11, 12], NAs bring in more administrative activities and paperwork, such as co-ordination and supervision, and leave less time for the RNs to care for patients [13]. Assigning work to NAs is the first step towards integrating them into the acute care team. Since the assigning operations are time-consuming and usually performed manually, more NAs would increase the workload for the RNs in charge of the NAs' management. Also, the long assignation procedure gives those uncertified

nursing aides a chance to have more contact with the patients and to replace the certified NAs assigned by the hospitals. This may pose a great threat to the quality of nursing care and the hospitals' reputation. Moreover, flexibility and speed are two key concerns when patients request services. Therefore, how effectively to identify and allocate the appropriate NA to provide a quality service while considering the waiting time and needs of the patient, are important issues faced by the hospital administrators.

Delivering cost-effective and high-quality healthcare services under high-demand circumstances has become a driving force for hospital executives to adopt IT [14]. The RN shortage and the ever-growing demand for patient care leverage the specific technology strategy of the nursing administration research imperative [4]. While most of the technology in healthcare is directed towards the diagnosis and treatment of disease, not enough technology that transforms the work environment for nurses has been introduce [1]. Among the nursing-related technology applications, nursing information systems (NIS) and on-line education were discussed [15–18], but not enough are implemented to support RNs in managing NAs. Therefore, an information system prospect may be helpful in solving the drawbacks of integrating NAs to amend the shortage of RNs, such as the questionable quality of NAs, tension between RNs and NAs, and additional administrative tasks.

## Materials and methods

The NAMS was developed using a prototyping method for a case hospital in Taiwan. The data collection was conducted to compare the results of the manual operation and system intervention in assigning work to NAs, in order to evaluate the system's performance. Finally, the RNs in charge of the NAs' management were interviewed to access their satisfaction level about the system.

### The case hospital

The case hospital is located in southern Taiwan and belongs to a famous private hospital chain that has a good reputation for tertiary care since 1976. There are six hospitals (include this case hospital) in the chain which contain totally 6,800 beds and, on average, serve 27,000 out-patients per day. The case hospital is the first "e-hospital" with the most updated Hospital Information Systems (HIS) and is acknowledged to have a paradigm shift from paper-based to computer-based operation in the Taiwanese medical industry. Also, continuing quality improvement is their purpose, and they won the national innovation award for care quality in 2003. In order to improve quality and share the workload of both the RNs

Fig. 1 The system development process of the NAMS
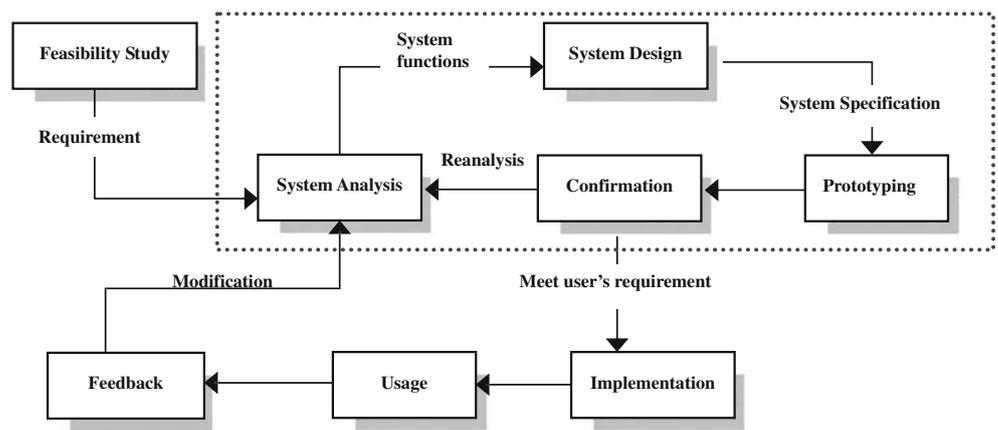


and the family members of the patients, the chain of hospitals employs many NAs on contracts.

With the demands of the additional administrative activities and the inherent frustrations involved in managing NAs, the senior head nurses (also known as "NA managers" in the case hospital) were once so frustrated that they were considering resigning just before they cooperated with the information system department to design the NAMS. The NAMS and computerized operation in assigning work to NAs would not only ease their workload by carrying out the efficient delegation of work to NAs but also fit the needs of the patients through its flexibility and rapid response.

System development, functions and the operational process

A project team was formed to construct the NAMS. One full time programmer of the case hospital from the information system department, who spent 2 weeks with the NA managers and used the existing hardware, software, materials, and equipment of the case hospital to develop the NAMS, and was responsible for the system implementation and technical support. The NA managers were responsible for specifying the functions required of the system and for monitoring it to fit their workflow. The structure of NAMS is a Client/Server type with a relational database system. Following the method of prototyping, the development of the system (see Fig. 1) starts at analyzing the needs of the users, who in this case are the NA managers and RNs in the stations who use the system. According to the analysis of the users' needs, a system prototype was developed and tested to identify any problems and fix them as they arose. During the development process, feedback from the users was collected so that the system could be further modified if new requirements were subsequently identified.

The NAMS was designed to enable each RN to perform what used to be done by the NA manager in assigning jobs to the NAs efficiently (time saving), and so further reduce the necessary paperwork. There are four basic functions in the NAMS, includes "Application of NA service", "Job assignment of NAs", "Statistical report generation", and "Performance assessment of NAs". The "use case diagram" was used to present the system functions and interact with users (see Fig. 2), and the "status diagram" was used to present the NAs' assignment workflow before and after the NAMS intervention (see Fig. 3a and b) in this study. When RNs use the system to assign tasks to the NAs, the RNs will refer to the patients' needs and the prior and accumulated services quality score of the NAs. Regarding the patients' needs, any special requirements, such as the NA's gender, language skills, specialty skill or experience, are established as criteria and built into the system. The RNs select appropriate conditions and criteria, further to decide the task assignment and candidate. Each NA has a chance to fulfill all jobs, and the job assignment will refer to each NA's current status (idle or on duty).
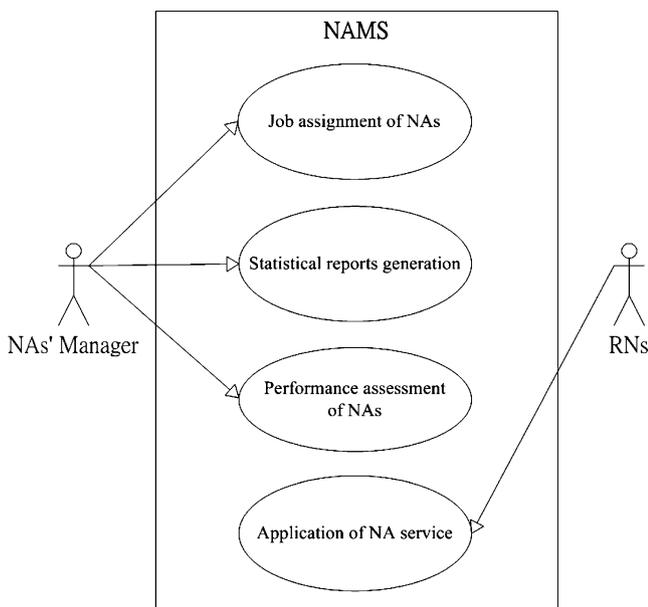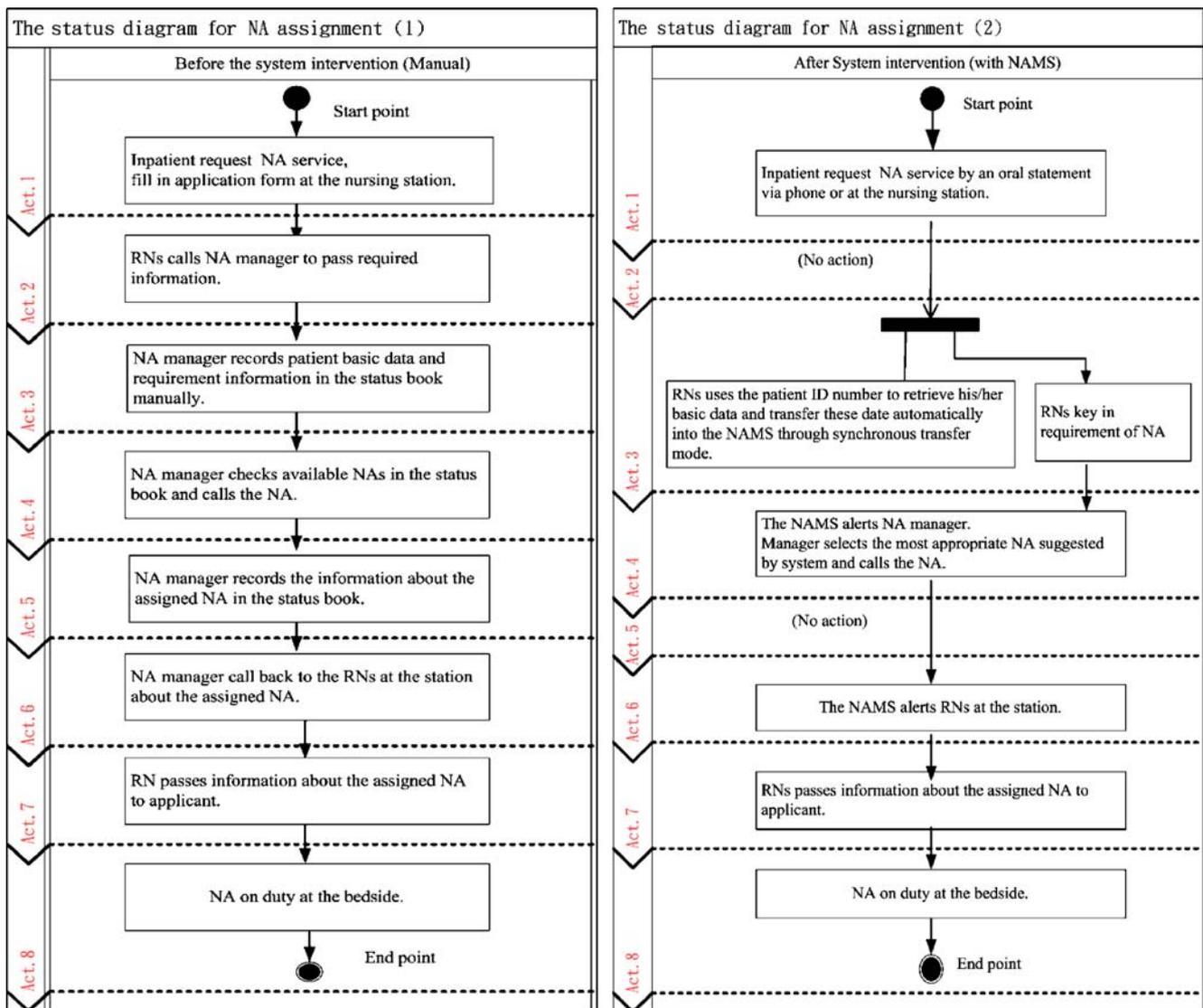


Fig. 2 The use case diagram

Fig. 3  a 3-1 NA assignment workflow before the NAMS intervention. b 3-2 NA assignment workflow after the NAMS intervention

Other functions are generating the statistical reports and assessing NA performance. The data component is designed as a repository which includes the patient's primary data and care parameters. Finally, the interface and menu components are designed to be as user-friendly as possible. The NA managers participate in the entire system development process to ensure that the final product matches their specified requirements. Also, the NAMS is a Web-based system (using the Intranet) and therefore can be accessed from every nursing station.

Evaluation of the nursing assistants management system

After the NAMS was found to be stable, the authors conducted a field study to obtain data from the case hospital in order to evaluate the impacts of the system. The

economy of time was used to measure the efficiency brought by the system and compare before (manual) and after (computerized) system intervention. In addition, the NA service quality was assessed, as perceived by the patients and their families in terms of their satisfaction on a five point scale to measure the effectiveness brought by the system. In this study, the NAMS users included two NA managers and nearly 1,000 RNs in three shifts of the 20 nursing stations to assign and manage 57 NAs in the case hospital. They were involved in the data collection process. A descriptive analysis, involving comparing the time consumed by the NAs' assignment and management of the manual operation and system intervention, was first carried out. The time for each case started from the patient or their family applying for the NA at the nursing station and stopped when the NA went on duty at the bedside was

**Table 1** Workflow and time consumed of NA assignment before and after the NAMS intervention

| Act | Before (Manual) | After (Computerized) |
|---|---|---|
| 1 | Inpatient requests an NA service, fills in the application form at a nursing station. (105.3 s) | Inpatient requests an NA service by an oral statement via phone or at the nursing station. |
| 2 | RNs calls the NA manager to pass on the required information. | (No action) |
| 3 | The NA manager records the patient's basic data and required information in the status book manually. (98.2 s) | RNs keys in the patient's ID number and NA requirements, the system will retrieve the patient's basic data from HIS and automatically transfer these data into the NAMS through the synchronous mode. (13.5 s) |
| 4 | NA manager checks available NAs in the status book and calls the NA. (884.3 s) | 4.1 The NAMS alerts NA manager. 4.2 NA manager selects the most appropriate NA suggested by the system and calls the NA. (179.0 s) |
| 5 | The NA manager records the information about the assigned NA in the status book. | (No action) |
| 6 | The NA manager calls the RNs back in the station about the assigned NA. | The NAMS alerts the RNs in the station. |
| 7 | The RN passes information about the assigned NA to the applicant. (58.7 s) | The RNs pass information about the assigned NA to the applicant.(33.0 s) |
| 8 | NA on duty at the bedside. | NA on duty at the bedside. |
| **Total** | 1,146.5 | 225.5 |

Unit: second/per person-time

measured. Before and after the system intervention, a total of 444[1] (an average of 148 per month) and 468 (an average of 156 per month) person-times observations was collected separately, and the duration was 3 months in two separate stages. In addition, RNs and the NA managers were interviewed at convenient times in order to assess their level of satisfaction with the system.

**Results**

Before the NAMS intervention (under the manual process), a patient or his/her family member(s) must complete an application form and hand it to the nurse on duty at the station, who then has to inform the NA manager. The NA manager then manually records the required information,

checks the availability of the NAs in his/her status book, and calls them to assign the task. Usually, it takes a while to find the available NAs because they may not answer the call or the manager may make a mistake regarding their availability. If the NA accepts the assignment, the manager will then pass the NA's information to the nurse on duty at the station, and it is then forwarded to the service applicant.

After the NAMS intervention (under the computerized process), a patient or family member simply requested the NA service orally or by phone, or went to the nursing station and informed any RN about his/her NA requirements. After the RNs keys in the patient's identification number and NA requirements to the NAMS, the system will retrieve the patient's basic data (including the patient's name, room number, bed number and medical records) from HIS and automatically match each patient's special requirements, such as age, language used, and care notes, with the NA database to suggest a list of appropriate and available candidates. The manager then consults the list and calls the appropriate candidate for the job. If the NA

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[1] The number of NAs' assignment in 3month sections before the system intervention were 120, 157 and 167 per month, giving a total of 444.

**Table 2** Generating statistical reports before and after the NAMS intervention

| Item | Time Used | | Time Saved |
|---|---|---|---|
| | Before (Manual) | After (Computerized) | |
| Record NA Application Form | 242.2 | 0 | 242.2 |
| Daily NA Report | 336.1 | 0 | 336.1 |
| Monthly NA Report | 282.5 | 5 | 277.5 |
| NA Assignment Report | 72.0 | 0 | 72.0 |
| Sorting Status Book | 13.7 | 0 | 13.7 |
| Gathering Statistics | 26.7 | 0 | 26.7 |
| **Total** | 973.2 | 5 | 968.2 |

Unit: Minute/per month

accepts the assignment, his/her information will be passed back by the system to the nurse on duty at the station, and it is then forwarded to the service applicant. Figures 3a and b show the NA assignment workflow of before and after the NAMS intervention. Table 1 presents the time consumed for each action to compare the manual and computerized workflow for NAs assignment. The 2nd and 5th actions of manual process were reduced after the system intervention.

Under the manual process, the managers generated reports by hand which include information such as daily and monthly statistics regarding the status and availability of NAs. With the computerized process, the NAMS provides and prepares such reports automatically, once an NA assignment has been completed. Unlike the previous manual operation, whereby the supervising RN should constantly observe the NA but had no time to do so, the NAMS provides a formal and structure interface to assess the NAs' attendance and working performance. There are six basic qualities that an NA should satisfy: attendance, punctuality, courtesy, attitude, caring skill and communication skills. A five-point scale is used to score these requirements, from 1 representing very poor to 5 representing very good. The weights for attitude and caring skill are higher, at 30%, with 10% for the other four requirements. This assessment procedure was not included in the manual process. The NAMS can easily generate various reports which can be used to audit the deployment of NAs. The results of the evaluation are used as a basis for performance reports and to make more informed decisions regarding the future priority when allotting assignments to NAs.

Economy of time

During the data collection period, the average number of applications for NA services was 148 per month. As aforementioned, a comparison of the manual and comput-

erized workflow of NA delegation is shown in Fig. 3a and b, and the time consumed for each action is shown in Table 1.

With the manual delegation process, abnormally long delays may occur in the following situations: the nurse on duty could not locate the manager; the manager did not have the status book to hand; the manager could not locate the NA; and the NA cancelled the assignment and the manager had to reassign it. These abnormally long delays usually cause unsatisfactory service quality for patients. The case hospital allowed "2 hours" for NAs that accepted an assignment to report on duty, which was also used as the service quality measurement indicator. Therefore, any NA reporting for duty after 2 hours after the assignment had been issued was defined as a delay. Excluding the delay caused by the above situations, the average assignation time needed to handle each patient's request for an NA was 1,146.5 s, which included the time for more important processes like filling out the application form, recording information, assigning, sending confirmation to the nurse on duty, and, finally, confirming with the applicants. These tasks are represented as acts 1, 3, 4 and 7, shown in Table 1. With NAMS, it took the NA manager an average of 225.5 s to delegate work to the NAs, which is 80% less than the time required by the manual system.

Using NAMS not only saved time in generating regular administrative reports, but also provided the manager with the most up-to-date status for each NA. The time consumed by generating reports is shown in Table 2. Except for the monthly NA report, all forms and reports can be generated by the system, which saved 968.2 min per month.

The NA managers used to take an average of 18 min to catch up with their paperwork and go over the assignment at the end of their shifts. With the help of the NAMS, all documentation is completed as the work is assigned and it takes only 2 min to hand over delegation information to the next shift.

**Table 3** Delaying Report before and after the NAMS intervention

| Frequency | Before (Manual operation) | | After (Computerized) |
|---|---|---|---|
| Delay hours | 3 Months total | Average/ Per month | 1 month total |
| 2–4 h (included) | 16 | 5.3 | 0 |
| 4–8 h (included) | 14 | 4.7 | 0 |
| 8–12 h (included) | 16 | 5.3 | 0 |
| 12–18 h (included) | 7 | 2.3 | 0 |
| 18–24 h (included) | 6 | 2.0 | 0 |
| Total | 59 | 19.6 | 0 |

Unit: person-times/per month

Enhanced NA service quality

Under the regime of manual operation, some assigned NAs might first check on the patient's condition and then decide at the last minute not to show up, with little thought of their absence being noted in a timely manner. Furthermore, the practice of many NAs being late for duty was uncontrollable and caused a lot of complaints from patients for NA managers to solve. The hospital would not know of such events until the client formally complained, at which time the manager would be notified. He/she would investigate the situation and reassign another NA to provide the service to the client. Such incidents have created enormous tension between the managers and NAs, and between the patients and the hospital.

With the new system, at the moment when an assignment is accepted by an NA, the NAMS starts to track the time and notify the nurse on duty to confirm the time at which the NA promised to show up. Previously, under the manual operation, NAs knew that an RN may be too busy to catch them being late. Although patients could fill out a paper-based complaint form under the manual operation, such forms might be easily lost or hard to retrieve and collate when auditing the NAs' performance. Three months before the trial of the NAMS, the nurses on duty were asked to collect incidents of NA delay (See Table 3). A delay was defined as being 2–24 h late for duty. There were a total of 59 times delays, and an average of nearly 20 assignment (19.6) delays per month. After using the follow-up quality evaluation of NAMS, there have been no NA delays reported by the patients. In other words, NAMS can track and report the situation automatically, which has enhanced the quality of the NAs' performance.

Satisfaction

Interviews with the two NA managers revealed that they were satisfied with the NAMS and the improved performance of the NAs. For the first time in the case hospital, they presented an award to honor the best NAs to show their appreciation. With an average of 148 requests from patients for NAs to multiply the time saved for each delegation of NAs (921 s, equals 15.35 min) plus the time saved in preparing reports per month (968.2 min), resulting in 54 h$^2$ saved by the NA managers, this meant that the role of the NA managers was no longer a full-time job. Both managers said that they would take the time to establish a community network team using the NAMS to provide in-house care for the aging patients in the neighborhood.

As far as the 57 NAs were concerned, most of them recognized the fairness of the evaluation system for the service they performed, especially those who demonstrated a positive concern for their patient's health status. Also, the appreciation shown by the RNs encouraged several NAs actively to join in the patient care process. An informal survey with a convenient sampling of patients and family members confirmed the efficiency of the new system. One patient remarked that, because of the system, he was able to find an NA who spoke his dialect. To sum up the results of this study, every group involved, from RNs, NAs and patients, said that the new system improved their experience, and none reported that they wanted to return to the old way of administering and tracking the patient care process.

Discussion

The NAMS was motivated by the studies of several scholars [4, 15–18] to explore whether technology can help the RNs shortage or not. The result of this study confirmed the observations done by the previous literature on the RNs shortage and NAs' questionable quality [3–5, 9, 11, 12, 19, 20].

The advantages of the NAMS attracted the attention of five other hospitals in the chain. Nowadays, the NAMS and related experience were adopted and diffused throughout the entire chain. Totally, six hospitals have set up the NAMS and integrated it into their 160 nursing stations of nearly 4,800 nurses to do the jobs of assigning and managing 450 NAs. The diffusion of the NAMS verified it's contribution. The inclusion of suggestions from the NAs is also useful in the design of a structured incentive system to reward quality performance. Maier (2002) suggested constructing a career ladder for NAs, since education has been cited as an important element of a future work vision [21]. Hence, adding planned career paths to the NAMS, such as on-the-job training or advanced care courses, empowers NAs with a better understanding of how patients respond to treatments. This can also help to retain NAs by giving them a sense of importance, control, and belonging.

Future research can extend to allow an NA to report the patient's condition through the NAMS which is to follow the "hands-off" communications approach of the Joint Commission's National Patient Safety Goals [22] and maintains consistent patient care during transfers or staff shift changes. With such an improvement to the system, RNs can obtain the most up-to-date information about patients and communicate in a way that encourages patients to be actively involved in their own care. Further integration of Computer Telephony Integration, Interactive

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$^2$ (15.35min × 148 person-time + 968.2min ) / 60min = 54h.

Voice Response technologies into the NAMS, a call center can be established to perform more activities, such as customer relationship management. A touch screen or voice recognition system will allow the NAs' managers, RNs, NAs, patients or their family members to fill in the information more easily.

## Conclusions

Nurses have to play diversified roles and perform multiple tasks on a time-share basis. Reengineering the nurses' work process to accumulate fragmented time (seconds or minutes) into hours is appreciated by them. In other words, any information system that saves time in this regard is valuable. Although the use of IT may not be directly correlated with the improved recruitment and retention of nursing manpower, it is becoming part of a comprehensive strategy to address nursing needs [7] to alleviate the RN shortage further.

This study showed that the online management of NAs is feasible and a mixed-staff strategy made both groups more satisfied with their jobs and allowed them to share a common patient care focus, cost-effective delivery of quality and safe services. Many factors influence the adoption of IT in hospitals [23]. The critical factor in NAMS success is the fact that the end-users themselves participated in the design and development stages of the system. Allowing users to match technology and their workflow is one of the most important factors for hospitals in order to establish an IT-friendly culture. The experience of the NAMS development can be used as a reference for other healthcare institutes with NAs in their acute team or some US hospitals for volunteer management.

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