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Evaluation of Electronic Health Records on the Nursing Process and Patient Outcomes Regarding Fall and Pressure Injuries

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Digitalizing the nursing process has become a trend in medical care. The purpose of this study was to evaluate implementation of the Standardized Computerized Nursing Process Documentation System and patient outcomes. We analyzed hospitalized patients' electronic health record database with a total of 19 659 patients in 2015. The analysis focused on nurses' selection of nursing care plans for patients with a high risk of falls or pressure injuries through admission assessments. The effectiveness of implemented nursing care plans following falls or pressure injuries was explored. The results reveal that 55% of the hospitalized patients had a risk of falling, and 27.85% of patients were at risk of pressure injuries. Patients receiving nursing care plan who experienced falls or pressure injuries were significantly higher than those without a nursing care plan ($P < .001$). This study could not provide direct evidence for the effect of nursing care plans on reducing the incidence of falls and pressure injuries, which may be attributable to patient characteristics. Furthermore, an analysis on data from 2007 to 2017 using a run chart revealed that the mean incidence rate for pressure injuries decreased, whereas that for falls remained stable. The results indicate that the system did not increase the occurrence of such incidences.

KEY WORDS: Electronic health record, Fall, Nursing care plan, Pressure injuries

Falls and pressure injuries are critical indicators of the quality of nursing care. According to the Agency for Healthcare Research and Quality, 700 000 to 1 000 000 patients fall in hospitals each year. A study on data obtained from the National Database of Nursing Quality Indicators revealed that across a total of 6100 units the fall rate during the study period was 3.56 per 1000 patient-days and the rate of falls with injury was 0.93 per 1000 patient-days.[1]

An analysis of 10 years of data obtained through the Hill-Rom International Pressure Ulcer Prevalence Survey found that overall prevalence of facility-acquired pressure injuries declined from 6.2% (2006) to a range of 3.1% to 3.4% (2013–2015). An analysis of 10 years of data survey found that the overall prevalence of pressure injuries across all facilities declined from 13.5% in 2006 to 9.3% in 2015.[2] These data reflected the severity of falls and their influence on the difficulty of reducing pressure injuries. Relevant international care guidelines suggest conducting adequate assessments and interventions. In particular, the Braden scale and Norton scale[2] are recommended for assessing pressure injuries, whereas the Morse and Hendrich II scales[1] are recommended for falls. Specific nursing care plans (NCPs) are established and implemented based on specific risks. Interventions based on assessment results that include an evaluation of effectiveness constitute adequate NCPs. However, this nursing process faces numerous challenges during implementation, such as being time consuming, lacking a systematic method of implementation, and lack of clarity in the nursing diagnosis or the role of this process in a given framework.[3] As health information technology (HIT) has become widely applied in healthcare settings, researchers and clinicians have conducted studies in order to evaluate the outcomes and effectiveness of using technology in patient care.[4]

Medical institutions actively integrate various HITs to meet the expectation that the electronic health record (EHR) will assist nurses with confirming health problems and implementing the nursing process effectively, thus reducing nursing documentation time and increasing care quality.[5,6]

Because the nursing process can improve patient care provided by qualified nurses, it is increasingly combined with EHRs. However, a literature review conducted by the Cochrane Library revealed that a total of nine trials involving 1846 people have been conducted by combining the nursing process with EHRs. Studies of nursing care planning systems and total nurse records demonstrated uncertain or equivocal results.[7] Relevant literature indicates that even though EHRs are considered capable of improving the quality of patient care,

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This study was supported by a grant (105-CCH-IRP-151) to M.-W.W. from ChangHua Christian Hospital, Taiwan.

The authors have disclosed that they have no significant relationships with, or financial interest in, any commercial companies pertaining to this article.

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DOI: 10.1097/CIN.0000000000000548

whether electronic nursing documentation improves the quality of care for hospitalized patients remains unknown.[8] A possible reason for this research gap was different views and understanding of nursing process, lack of awareness and knowledge among nurses related to the execution of process, lack of support systems, and problems related to recording the nursing process.[3] According to suggestions provided by the new sociotechnical model,[9] the intervention of new technology systems that apply to clinical care must assess hardware and software computing infrastructure; clinical content; human-computer interface; people, workflow, and communication; internal organizational policies, procedures, and culture; external rules, regulations, and pressures; and system measurement and monitoring. In particular, designs for the measurement and monitoring infrastructure are lacking.

Care quality is the core value of healthcare, and the nursing process is the fundamental component of practical implementation. Through the use of information technology, which can be enhanced by including HIT, scholars can improve their understanding of nursing care and care quality results. This study applied the new sociotechnical model to assess the situation in one medical center in Taiwan after implementation of the Standardized Computerized Nursing Process Documentation System (SCNPDS) for 3 years. This study analyzed data from the 2015 EHRs of the hospital to understand the effect of information risk warnings (conducted using a fall and pressure injury risk evaluation tool) on the decision-making process of nurses in determining and establishing NCPs. In addition, the effect of NCPs on the case results of the corresponding patients was studied and documented. Finally, the incidence rates 10 years before and after the implementation of the system were compared to serve as a reference for evaluating and improving the development of computerized nursing documentation.

LITERATURE REVIEW

Assessment of the Challenges of Establishing Health Information Technology and Standardized Computerized Nursing Process Documentation System

Complete EHR data can come from an efficient HIT system, but an ongoing challenge to the design, development, implementation, and evaluation of HIT interventions is to operationalize their use within the complex adaptive healthcare system. That is, a systematic evaluation is required to identify and solve problems.[4] Regarding HIT intervention analyses, a sociotechnical model was developed in 1964, which was later modified into the new sociotechnical model under certain limitations. This model is a comprehensive eight-dimensional model that accounts for key factors that influence the success of HIT interventions. This model has been successfully applied to understand and improve HIT applications at various stages of development and implementation.[9]

The nursing record documentation system in HIT is equally complex. A review of information obtained from the Cochrane Library yielded these conclusions: although there were developments in technology and investment in electronic records in health systems over the last 10 years, there are uncertain results regarding nursing care planning systems. Record keeping is still seen as an extra burden; even the literature on the provision of decision support systems has failed to show conclusive benefits for nurses in practice. Regarding these problems, the author believes that the lack of first-line nurse participation in the design process may be a cause, leading to the conclusion that nursing is simultaneously regarded as a process, a problem-solving activity, and the art or science of caring, which all offer different ways of articulating what is done with patients. However, no demonstrably effective record systems have been developed to support any of these approaches, thus demonstrating the complexity of this problem. This study also suggests directing the attention of documentation systems for nursing records back toward the development of the theory of nursing.[7] That is, this system should return its focus to nursing, care environments, and patients rather than emphasizing the need for management or research.

Nursing theory may require new discussions and revisions in the context of the information age. Results of implementing a standardized nursing documentation model in 2010 revealed that applying a documentation model to the clinical nursing process requires additional training for nursing personnel because such a model employs the standardized Finnish Classification of Nursing Diagnoses and Finnish Classification of Nursing Interventions, both of which were difficult for staff to understand and use.[10] Another study included 24 articles that examined factors that influence the prevalence and accuracy of documentation on nursing diagnoses. Four domains were identified: (1) the nurse as a diagnostician, (2) diagnostic education and resources, (3) complexity of a patient's situation, and (4) hospital policy and environment.[11] This study also indicated that such international nursing terminology standards are mainstream. However, the majority of studies have revealed that these interface terminologies, such as Nursing Diagnosis and Nursing Intervention Classification, are clinically difficult to apply. Another method is focus charting, which is a tool developed in 1984. This system is used by the North American Nursing Diagnosis Association. With this system of documentation, the nurse identifies a "focus" based on any issues deemed important by the patient during the assessment. The nurse then describes the conditions, illnesses, symptoms, or events that occurred and records the nursing activities and patient outcomes after nursing care, by using categories such as data,

action, response, and teaching. This system is generally considered as a documentation model that is easy to understand and use. However, few studies have analyzed the results of the nursing documentation process using focus charting because this method has limited structured content; moreover, its content is not regulated by standard regulations and can be modified any time, rendering analysis difficult. The characteristics of the nursing record system reflect the focus on clinical content proposed by the new sociotechnical model. When the computerized nursing process database design of the research subject is different and requires continual revision according to the latest care guidance, determining which data information knowledge should be stored in the system becomes critical. Therefore, studies should track the operation process after decision making as well as its influence on the outcome to understand changes in systems and ensure patient safety.[9]

Focal Points of Care for Patients Who Have Sustained Falls or Pressure Injuries

Several studies have investigated the computerized nursing process and incidences of falls and pressure injuries, with the aim of offering evidence-based professional guidelines through a computerized system to provide nursing personnel with clinical decision support (CDS) in order to reduce the occurrence of falls and hospital-acquired pressure ulcers (HAPUs). Additionally, this system is expected to employ risk assessment tools in hospitals to identify patients at risk of incurring falls or pressure injuries. Nurses are alerted and prompted to make NCPs and implement preventive measures. After conducting surveys at 29 hospitals, the current study revealed that this system increased the completeness of records, but the final EHR implementation was associated with a 13% decrease in HAPU rates (coefficient = −0.76; 95% confidence interval, −1.37 to −0.16) but no decrease in fall rates (−0.091; −0.29 to 0.11). The run chart showed that between 2003 and 2009 mean HAPU rates decreased, while mean fall rates remained fairly stable.[12] The causes and improvement measures for this care outcome are complex. According to the latest international guidelines compiled by the Emergency Care Research Institute (ECRI) in 2018, falls and pressure injuries are primarily related to internal and external factors. Internal factors include patient characteristics and drug use; patient characteristics include complex diagnosis, history of falls, gait, presence of mental illness, lower body weakness, vitamin D deficiency, impaired balance, vision problems, and foot pain or improper footwear. External factors include use of physical activity equipment, environmental hazards, and caretaker education.[1] The most commonly used assessment tool is the Morse Fall Scale, which includes patient information regarding history of falling, secondary diagnosis, ambulatory aid, intravenous therapy, gait, and mental health status. The Morse Fall Scale has a sensitivity of 95.2% and specificity of 64.0%. The internal consistency (Cronbach's α) of Morse Fall Scale was estimated at .278, which shows that the items assess differentiated information.[13] Internal factors for pressure injuries include age, illness, nutrition, and surgery within the preceding 72 hours, whereas external factors include equipment and personnel. The assessment tool recommended in the guidelines is the Braden scale. The six assessment items are as follows: sensory perception, moisture, activity, mobility, nutrition, and friction/shear. Sensitivity for the Braden scale is 73.1% and the specificity is 73.7%. The internal consistency (Cronbach's α) of Braden scale was .78, and interrater reliability varied between 0.71 and 0.86 (Cohen's κ). The results indicated that the Braden scale is an ideal assessment tool for pressure injuries. The treatment of pressure injuries must emphasize the following aspects: assessment, nutrition, pressure-reducing tools such as mattresses and dressing, nursing labor force, and relevant education for the patient's family.[2] Because the influence of the patients' characteristics is substantial, international guidelines are renewed every year, and hospital conditions vary, selection of the factors that should be included in the documentation system and that can be executed is the primary difficulty.

All international guidelines emphasize risk evaluation tools. Although each new edition renews its recommended tools, the guidelines specifically state that each tool must be adjusted and designed according to the subject. A study on the effect of the risk evaluation tools of the Morse Fall Scale and Braden scale on falls and pressure injuries analyzed the medical records and reporting documents of 157 hospitalized patients older than 18 years, 51.6% of whom were women and 77.1% were aged 26 to 65 years. Moreover, 78.9% of these patients had cardiovascular disease or oncological disease, and 50% of male patients and 33.3% of female patients had a high risk of falls. Finally, an association between the risk of falls and their occurrence was found, with a higher statistical ratio for "none" and "low risk" versus nonoccurrence, as well as for "moderate" and "high risk"; analysis of only pressure injuries revealed that the Braden scale is effective at identifying the risk. Therefore, the current study suggests that when using risk assessment tools to guide nursing actions, design must first be verified as being capable of completing such objectives.[14] Another study examined the use of the Braden scale in 11 wards. Results showed that the original Braden scale was a reliable instrument and that the sensitivity and specificity were sufficient. However, reformulating the factors moisture and nutrition and adding the risk factor age could enhance its sensitivity.[15] The results revealed that hospitals encountered difficulties in selecting a risk tool because

patients' characteristics vary and continually change. Patients' characteristics render the design of risk assessment tools difficult, and measures for implementing the selected NCP must be thoroughly discussed. A study on using standardized North American Nursing Diagnosis Association classifications for diagnosis and nursing interventions to establish a system for documenting falls designated 48 different nursing tasks for this NCP and analyzed 174 patients with a nursing diagnosis of risk of falls. The results revealed the number of prescribed treatments per patient was 4.8 ± 3 on average.[16] These results were obtained for only one NCP. However, when considering the number of departments and size of each hospital, the number of NCPs and the complexity of interventions designed for the system were much greater. A human-computer interface is superior because of its design, which displays all information on a single screen. The need for multiple clicks often frustrates personnel and increases the difficulty of selection.

In addition, different supervisory approaches to decision support systems often affects the resulting care plan, which also concerns the policies and people involved in the organization. A study on the effects of paper records and EHRs on pressure injuries revealed that integrating risk templates and NCPs into the system did not directly improve patient outcomes. Specifically, 14.3% of the 413 total patients had records of pressure injuries in 2002, and this percentage increased to 20.7% in 2006. To verify the differences between records and actual situations, a 1-day study was conducted on three departments. The results indicated that because supervisors in these three departments promoted the system in different ways, different outcomes were obtained. The geriatric department worked to fulfill the team goal set by the supervisor, implemented training and promotion focused on pressure injury evaluation and handling documentation using a specifically designed system, and regularly discussed relevant matters in interdepartmental meetings. Outcomes of this endeavor revealed that 13.6% more patient pressure injuries were observed on site than were documented; moreover, 22.0% more patient pressure injuries in which no specific measures were taken regarding pressure injury care were observed on site in the medical department than were documented. These results reflected the influence of the supervisors' promotion styles.[17]

Research Hypothesis

1. Applying the SCNPDS designed by applying focus charting to identify patients at high risk and implement NCPs had no effect on the outcomes of patient falls or pressure injuries.
2. The reported incidence rate of falls and pressure injuries has remained stable over the 10 years before and after the application of the SCNPDS designed by applying focus charting, as indicated in the run chart.

METHODS

Study Design

The present study employed EHR system data from 2015. A retrospective study was then conducted to identify patients at high risk of falls using the fall risk tool of the hospital and the Braden scale results for pressure injury obtained when the patients were hospitalized. Subsequently, this study explored the relationship of NCPs and falls or pressure injury incidences during hospitalization. Finally, the run chart of the fall and pressure injury incidence rate from 2007 to 2017 was employed to determine the effect of this SCNPDS.

Setting and Subjects

According to the eight main influential factors of HIT indicated by the new sociotechnical model, "content factor" refers to the content setup support provided through computerized decision making. After introducing CDS information to establish content, system measurement and monitoring must be conducted to ensure system operation, thereby yielding final patient outcomes.[9] The SCNPDS of the study setting employed focus charting in its design rather than international nursing terminology standards. Additionally, other dimensions, including hardware and software, human-computer interface, people, workflow, policies, and regulations, were considered. The documentation quality and attitude of nursing personnel were investigated for the 3 months following the implementation of this system,[18] and improvement measures were implemented in accordance with open-ended comments received. Therefore, the current study focused on analyzing the EHR data of all hospitalized patients in 2015, that is, the fourth year of full implementation of the SCNPDS. Moreover, this study focused on evaluating the content design and outcome of nursing process.

The health information system (HIS) of the study setting included the following subsystems: a physician order-entry system, a testing and laboratory system, and a nursing information system (NIS). The mobile nursing documentation information system was integrated with the NIS, and the EHR for the mobile nursing documentation system includes functions such as admission assessment and NCP with data, action, response, and teaching (DART) format, which correspond to the elements of nursing process (assessment, intervention, reassessments, and evaluations).

Nursing documentation input on mobile nursing stations included shift reports, medication administration records, nursing admission notes, NCP, and DART format in 2011. In addition, the charting function for nursing reassessments was completed in 2012. Other charts such as records of scheduled turns for patients with pressure injuries, wound documentation charts, and scheduled observation records for constrained patients were developed in 2013. Finally, the EHR system, which involves transmitting vital signs from

measuring devices to computerized systems, was introduced in 2015.

In this study, templates for risk assessment and NCP content used during the hospitalization of patients were written in accordance with foreign and national care guidelines and the hospital's nursing care standards. These documents were discussed and verified by the senior nursing personnel of each department and then submitted to the nursing quality committee for review and modification. In the beginning, falls were assessed using the Morse Fall Scale, which remains the primary tool recommended by the guidelines.[1,14] However, the team reviewing fall incidences began focusing on hospital-specific scales in 2015, including main risk items for adults if they are older than 65 years, are male, have an unsteady gait, use high-risk medication (sedative-hypnotic agents, narcotic analgesics, antipsychotic agents), experience dizziness, experience paresthesia of foot, require assistance or supervision for mobility, have had a previous fall in the last 12 months, and are without a caregiver. After reaching 71.1% sensitivity, this tool was finalized and put to use. Regarding the pressure injury risk evaluation tool, the Braden scale consists of six categories: sensory perception, moisture, activity, mobility, nutrition, and friction/shear, and remains the tool recommended by most guidelines.[1,15] This tool has been employed in the study setting since 2011 and has not been changed. Data from a total of 40 309 patients from that year were analyzed using a receiver operating characteristic curve analysis, which verified that 16 points on the Braden scale was the threshold for high risk of pressure injuries, and the sensitivity of the scale was 92.3%. When a patient was admitted to the hospital, a nurse would enter assessment data into the SCNPDS to run nursing admission notes, which include scores on the risk assessment template and health assessment. Subsequently, the nurse enters the NCP data set to select a personal NCP for this patient and recommended intervention in terms of action (A) and teaching (T) content to complete focus charting. For quality control purposes, each focus must be reevaluated every shift to complete the nursing documentation process. If a patient is observed to have a fall or pressure injury, the nurse must report the incident on the incident report system (upper part of Figure 1) before the end of the shift.

Data Collection and Analysis

We analyzed admission risk assessment and problem-focused nursing databases in 2015 (with a total of 19 659 patients) in two steps (Figure 1). In step 1, we exported and classified patient admission assessment data and risk assessment results and identified high-risk patients fall risks assessment at greater than or equal to 5 points and Braden scale pressure injury risk factor at less than or equal to 16 points. In step 2, we focused on concerns identified during the hospitalization of the patient and matched them with the patients who were identified as having a fall risk or high-pressure injury risk during their admission risk assessment. We did this to analyze the NCP selection status. We implemented a χ^2 test using IBM SPSS Statistics version 17.0 (IBM, Armonk, NY) to analyze spontaneous report results from fall and pressure injury incident reporting systems to evaluate the difference between the event incident and the identification of being at high risk and the selection risk in the NCP (lower part of Figure 1). We used a run chart analysis to demonstrate fall and pressure injury reporting incident rates. These two indicators are standard items regulated by Taiwanese assessment institutions. Therefore, the standard definition was applied: documented falls per patient day and total number of new pressure injuries per patient day.

Ethical Consideration

This research was approved by the institutional review board of the study setting (IRB105-CCH-IRP-151).

RESULTS

Demographic Data

Demographic data were from hospitalized patients aged 18 years or older who had been documented by the SCNPDS in 2015. The documentary records of 19 695 patients were analyzed after completing data collection. The results indicated that 11 824 patients (80.05%) were hospitalized once, 1870 patients (12.66%) were hospitalized twice, 609 patients (4.12%) were hospitalized three times, and 468 patients (3.17%) were hospitalized four or more times. Because hospitalization conditions and diagnoses may vary, this study included all data from each hospitalization. The research subjects included 10 987 (55.9%) male patients with a mean age ± SD = 66.31 ± 18.30 years. Patients aged 60 years or older accounted for 68.62% of the research subjects. Admission departments were as follows: intensive care unit, 3143 (15.99%); medical division, 10 140 (51.58%); surgical division, 3191 (16.23%); other, 3185 (16.19%). Chief problems that led to admission were as follows: diseases of respiratory system, 3231 (16.44%); neoplasms and diseases of blood and blood forming organs, 3154 (16.04%); diseases of circulatory system, 2816 (14.32%); injury and poisoning, 2261 (11.50%); diseases of digestive system, 1834 (9.33%); diseases of genitourinary system, 1591 (8.09%); signs, symptoms, and ill-defined conditions, 1455 (7.40%); diseases of musculoskeletal and connective tissue, 867 (4.41%); and others, 2450 (12.9%).

Correlation of the Standardized Computerized Nursing Process Documentation System Nursing Process to the Incidence of Falls and Pressure Injuries

This study assessed the outcome of using the SCNPDS to assist NCP decision making for patients at high risk of falling.

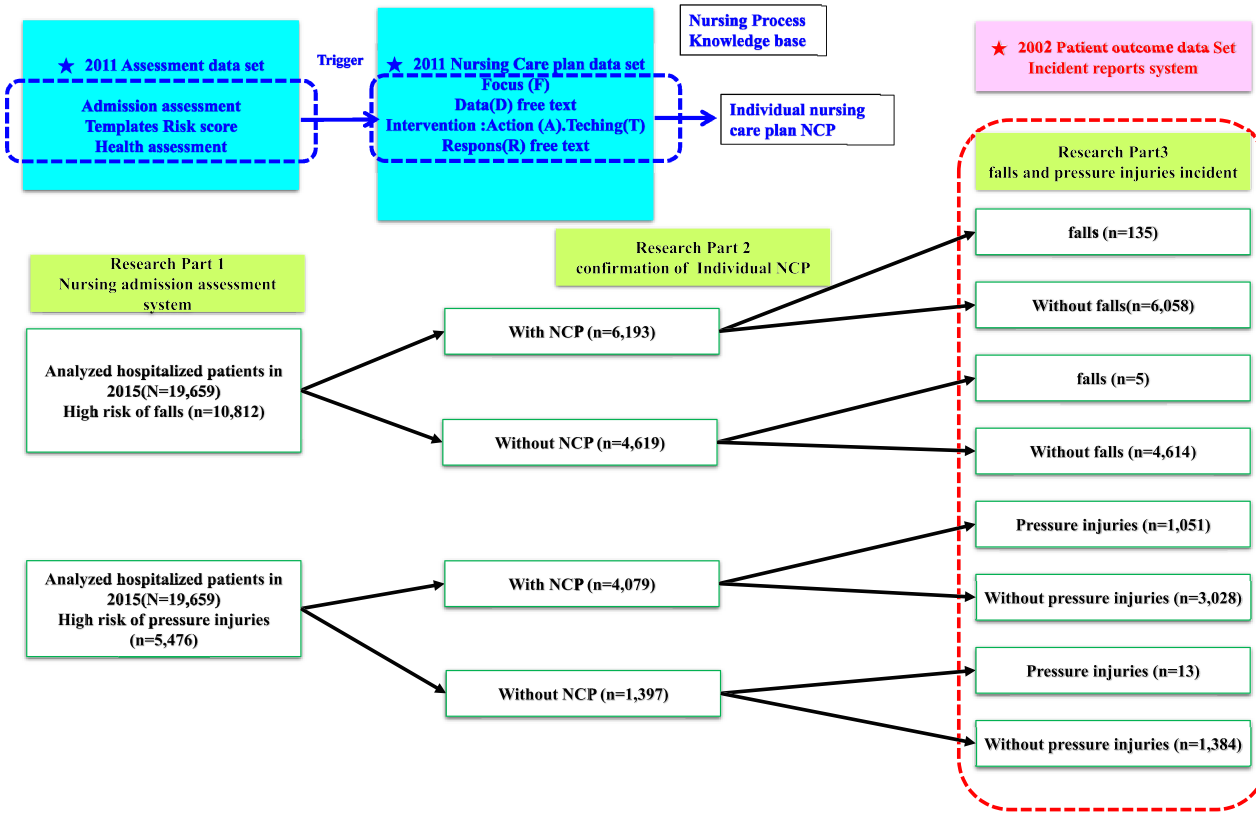

FIGURE 1. Research flow diagram.

The system revealed that all 19 659 patients underwent the hospitalization risk evaluation. We analyzed the relationship between fall and pressure injury incidents and the related NCP for patients at a high risk of fall and pressure injuries. The χ^2 results indicated that for high-risk hospitalized patients with NCPs compared to those without NCPs, 55% of all hospitalized patients had a risk of falling; of these, 57.27% were involved in an NCP for falls. In total, 2.2% of patients receiving an NCP fell, significantly higher than that of patients without an NCP (0.1%; $P < .001$). A total of 27.85% of hospitalized patients were at risk of sustaining pressure injuries; of these, 74.49% had an NCP for pressure injuries. Overall, 25.80% of patients receiving NCP experienced pressure injuries, significantly higher than that of those without an NCP (0.90%; $P < .001$), as shown in Tables 1 and 2.

Table 1. NCP for the Occurrence of Falls Among High-Risk Patients With Falls (N = 10 812)

Activities	Fall	Not Fall	P
	Frequency (%)	Frequency (%)	
High risk without established NCP	5 (0.10)	4614 (99.90)	
High risk with NCP	135 (2.20)	6058 (97.80)	<.001

Nursing Outcome Measures

By using a 10-year incident reporting system database from 2007 to 2017, we were able to use a run chart for fall and pressure injury incident rates. The results indicated that implementation of SCNPDS may positively affect the quality of care. Between 2007 and 2017, mean fall rates remained fairly stable, while mean pressure injury rates decreased (Figure 2).

DISCUSSION

Of all of the patients with a high risk of falling during hospitalization, 57.27% received an NCP, whereas of all the patients with a high risk of pressure injuries, 74.49% received an NCP, according to the decisions made by nursing personnel. This

Table 2. NCP for the occurrence of pressure injury among high-risk patients with pressure injury (N = 5476)

Activities	Pressure Injury	Not Pressure Injury	P
	Frequency (%)	Frequency (%)	
High risk without established NCP	13 (0.90)	1384 (99.10)	
High risk with NCP	1051 (25.80)	3028 (74.20)	<.001

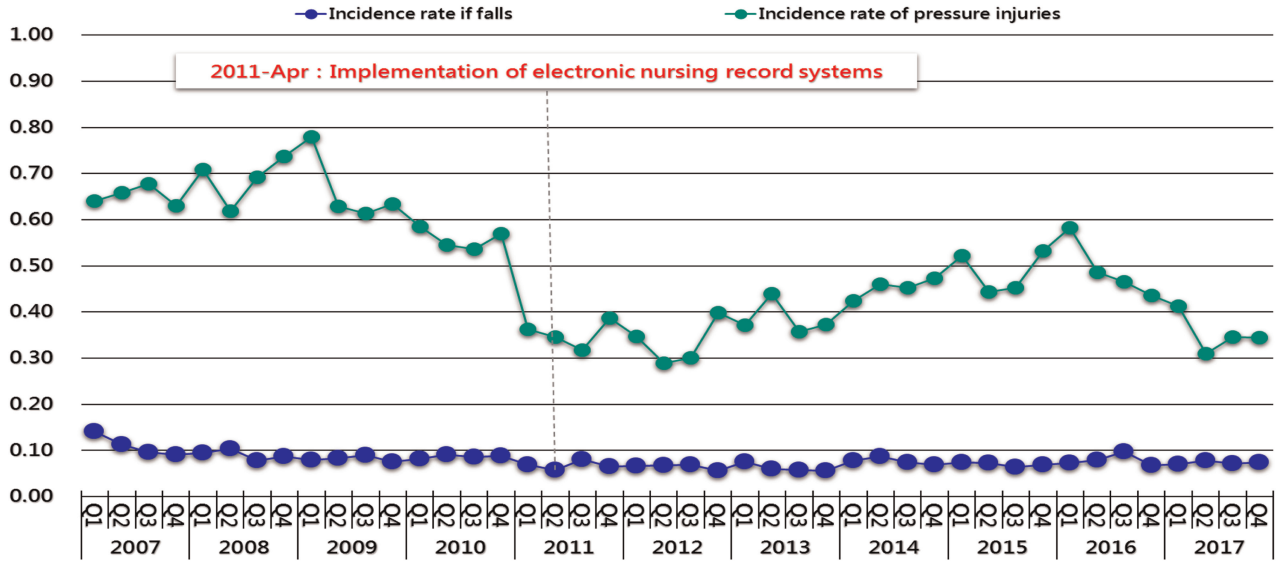

FIGURE 2. Run chart of falls and pressure injuries incidences per 100 bed days (2007–2017).

observation revealed the professional decision making of nurses regarding high-risk recognition and NCP implementation, which is a finding that differed from the expectations of a connection between computerized design and decision-making processes. Nevertheless, this observation corresponded with reports in relevant literature. In other words, effectively applying nursing processes to clinical decision making requires a true understanding of the critical thinking process of nursing personnel. Nursing requires complex and nonlinear critical thinking.[3] Additionally, the risk evaluation tool used is an influential factor. The hospital employed the tool recommended by the guidelines. However, these guidelines also advised selecting, testing, and validating the tool. The international guidelines that are renewed each year illustrate the influence of different subjects on outcomes.[1,2] The evaluation tool may need to be designed in accordance with different care recipients. Moreover, reevaluations must be clearly scheduled to establish a plan for precise integration of high-risk evaluation tools with CDS, which would reduce the occurrence of errors and problems caused by excessive reminders.

Of all patients with a high risk of falling, 2.2% received an NCP, which was higher than the percentage of patients with a high risk of falling without an NCP (0.1%; $P < .001$). Of all the patients with a high risk of pressure injuries, 25.77% received an NCP, which was higher than the percentage of those without an NCP (0.90%; $P < .001$). This observation revealed that patients who received NCPs have a greater risk for the incidence of fall or pressure injuries. However, the NCP cannot directly prevent the occurrence of these incidences because of various clinical factors, such as workload, time constraints, and difficulty for nurses with respect to contemplating and writing out a complete and appropriate NCP. Ensuring balance of information control, cross-team discussions, and continuous revisions must take place to improve critical thinking and problem-solving abilities while simplifying work and enhancing performance. If information design cannot simplify staff workflow, staff will be unwilling to use such a system.[19,20] This study considered the computerized operating screen of each NCP data set and controlled the number of items in the action (A) and teaching (T) content of the interventions. For example, the number of items for focus charting of falls was only half of the 48 items of the nursing intervention classification.[16] Taking the same form, all 644 NCPs of this hospital went through reviews and modifications requested by clinical personnel or performed by the nursing quality committee on the scheduled 3-year renewal according to hospital guidelines. Regardless, these NCPs were often unable to keep up with the latest guidelines, which may have resulted in their failure to improve. The comparison of the content from 2015 and the literature compiled by the ECRI in 2018[1,2] revealed that the content selected in 2015 was insufficient. The policy requires nursing personnel to evaluate and record patient NCPs on a three-shift basis. Consequently, a significant difference was observed between the selected hospitalized patients who received an NCP because of high risk scores and the actual fall or pressure injury events. This observation indicates that nurses may have their own resources for identifying these incidences and may be unable to prevent them even if they detected such problems in a timely manner. This situation may be related to whether NCPs are thoroughly implemented. For example, nursing personnel

may have checked the action of turning every 2 hours, but the actual implementation of scheduled turning is impossible to verify. A study on the effect of employing an EHR system with standardized risk evaluation and prevention measures revealed that even with increased completeness of records actual differences were noted with respect to observed patient conditions and recorded data, which indicated a discrepancy between electronic records and reality.[17]

Finally, according to the run chart in the incidence report database, between 2007 and 2017, mean fall rates remained fairly stable, while mean pressure injury rates decreased. The results were consistent with those from 29 other hospitals that implemented the SCNPDS. Reasons for these results are unclear. Studies have inferred that the positive effect of such systems on care for fall or pressure injuries is insufficient to provide a direct explanation, which may be a result of the complexity of both indicators.[12] Falls and pressure injuries are related to the characteristics of individual patients. However, this study was conducted in a Taiwanese medical center, where demographic data revealed that most patients had multiple diagnoses and were older. The 2018 ECRI literature suggested that professionals must respond to the risks and measures of each patient rather than making decisions based on overall risk points. The literature also emphasizes the value of collaboration among teams of different specialists. For example, a single nutrition-related risk factor will prompt a consultation with a nutritionist to address nutrition-related pressure injury problems.[1,2] Similar data have been renewed yearly on the basis of empirical studies and guidelines. Moreover, continual renewal after the completion of an NCP data set is critical.

This study obtained noteworthy results, namely, that nursing personnel did not implement NCPs for all patients who received high risk scores and that the presence of fall or pressure injury NCPs showed a significant correlation with such incidences. On the basis of the new sociotechnical model, the hardware and software platform was established in 2011 alongside the mobile nursing documentation system under the HIT framework of the hospital. The process was influenced by the human-computer interaction; because the hospital employed an internally developed interface, the NCP data set was limited to a single page to avoid an increase in procedure and time. Moreover, high-risk alerts and measures were not connected to this interface, and only written descriptions stating that a patient was at high risk were displayed on the screen for nurses to determine relevant actions on their own without disturbance. The people factor depended on the clinical personnel selected from each department to determine the focus charting content, instead of using complex international nursing terminology standards. Therefore, per the research conducted by the author 3 months before and after the implementation of this system in 2011, overall documentation compliance significantly increased from 93.04% to 94.42% ($P = .039$). The average scores for patient care, nursing efficiency, education/training, usability, and usage benefits were 2.92, 2.78, 2.98, 2.61, and 2.87 (on a 4-point Likert scale), respectively.[18] Open-ended questions in the user survey have been improved in the 3 years since this research was conducted. These questions include those related to "frequent system downtime" and "slow system response time." Additionally, the factors of organizational policies and external regulations played a part. The hospital policies and the computerized nursing documentation in Taiwan both abided by the Electronic Signatures Act. These data were sent to the national medical record database within 24 hours and transformed to legal documents. The passage of time and development of technology appear to have improved various factors.

The clinical content factor was complicated, involving data, information, and knowledge. However, this factor was not sufficient to guarantee that all patients who had incurred falls or pressure injuries would be identified, even when the high-risk tool was administered during the admission process. Additionally, the NCP set content must be updated in accordance with various evidence and guidelines. This requirement is a crucial challenge for system continuity management, which is also affected by the time factor. In the final stage, namely, the support phase[4] of the system development life cycle, the focal point was to ensure that a nursing process documentation system, regardless of its year of establishment, continues to manage and modify its knowledge according to patients' conditions. Finally, understanding which data nurses adopted for decision making and consistently conducting intersystem linking and design were related to the workflow and communication factor. After the hospital implemented the SCNPDS framework in 2011, they continued to expand the functions of this documentation system, such as integrating computerized turning and pressure injury wound documentation sheets. According to Figure 2, the "add the position of the pressure injury wound" function initiated in June 2014 for data input was automatically integrated with the pressure injury report system. A rise could be observed in the run chart, and the trend lasted until the beginning of 2016, indicating that computerization was related to workflow. Future applications may include connecting to examination data for pressure injury nutrition factors or a nutritionist consultation system to help the risk tool to make the correct decisions and propose suitable actions. However, designing a computerized CDS system requires clear empirical and clinical paths. The nursing profession belongs to the field of social sciences, and nursing staff are affected by complex factors that must be systematically and independently discussed.

CONCLUSION

Computerization helps to incorporate empirical data into systems and assist nursing personnel in decision making.

However, no study has conclusively determined its ability to improve care quality. The results of this study revealed that the ability of NCP to reduce the occurrence of falls or pressure injuries could not be directly described, possibly because of the strong influence of patient factors for these indicators and the complexity of the HIS system, as indicated by the new sociotechnical model. This study recommends that the established computerized nursing process system be constantly updated with the data, information, and knowledge of the clinical content. Additionally, the workflow and communication factors should be tracked to verify the influence of the new system and monitor the relationship between patient outcomes and the care process. Finally, the computerized CDS must be set to constantly perform modifications and tracking based on the latest and most complete empirical results.[9]

Study Limitations

This study addresses the impact of an EHR on nursing care processes and outcomes. However, it does not address how nurses used the system in practice or sociotechnical factors that may influence its use. Because this focus charting system only provides standardized columns for risk evaluation at admission and NCP, whereas other actions and evaluation records can be modified at any time, the relationship between these data and the occurrence of falls or pressure injuries could not be directly analyzed. Other research limitations include the fact that the reported data on falls and pressure injuries submitted by relevant personnel during the 10 years before and after the implementation of this system may be inconsistent with reality.

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The authors and planners have disclosed that they have no financial relationships related to this article.

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