Advances In Medical Informatics (ISSN 2819-8298) https://aimi.quantechquest.com
2026; 2: 14 https://doi.org/10.22034/AIMI.2026.26.14 Open Access

Insights into nurses' perceptions of nursing information systems in educational hospitals: A cross-sectional survey

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Article Info

Article type:
Research

Article History:
Received: 2026-09-13
Accepted: 2026-10-31
Published: 2026-11-03

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Keywords:
Nursing Information Systems
Hospital Information Systems
Perceptions
Quality Improvement
Nurses

A B S T R A C T

Introduction: Nursing information systems are a subset of hospital information systems designed to enhance nurses' clinical and managerial efficiency. By understanding nurses' perceptions, researchers can identify the system's strengths and weaknesses and improve it to maximize effectiveness. This study aims to investigate nurses' perceptions of NIS use, quality, and user satisfaction.

Material and Methods: This study is a descriptive cross-sectional study. The study population consists of 1049 employed nurses in eight educational hospitals in Rasht, Iran. From this population, 252 individuals were selected through quota sampling. The instrument used in this study is a standardized questionnaire developed by Ottino, which assesses nurses' perceptions of the use, user satisfaction, and quality of NIS.

Results: In this study 97% of the participants were female, and 3% were male. The mean age of the participants was 36.5±7.9. The mean scores for nurses' perceptions regarding the use, quality, and user satisfaction of the nursing information system were 2.38, 3.11, and 2.93, respectively. Additionally, a statistically significant positive correlation was observed between "user satisfaction" and "use" with "quality" ($p<0.001$).

Conclusion: The findings show that the scores related to nurses' perceptions concerning the use, quality, and user satisfaction of the nursing information system were inadequate. As a result, managers must consider the needs and expectations of nurses during the procurement or design of an NIS to avoid its potential failure.

Cite this paper as:
Hojjat S, Rahmatizadeh S, Zayeri F, Kohzadi Z, Valizadeh-Haghi S. Insights into nurses' perceptions of nursing information systems in educational hospitals: A cross-sectional survey. Adv Med Inform. 2026; 2: 14.

INTRODUCTION

Information systems are one of the indicators of health development [1]. Information systems are powerful tools in facilitating and improving processes and increasing efficiency in hospitals and are one of the most essential components of the healthcare sector [2]. The nursing information system (NIS) is a subsystem of the hospital information systems that supports the clinical, administrative, and managerial activities of nurses [3]. Nurses play a prominent and irreplaceable role in patient care; therefore, they should be able to share information promptly and effectively using solid communication channels. The main goal of the NIS is to distribute and transfer data between nurses to facilitate the process of patient care and improve clinical decision-making [3, 4]. The clinical activities of nurses are divided into direct and indirect activities. Direct activities involve direct interaction with the patient, such as checking vital signs.

The clinical activities of nurses are divided into direct and indirect activities. Indirect activities focus on the care environment and support the effectiveness of direct activities, such as documenting patient care and communicating with other service providers [5-7].

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Documentation is one of the most time-consuming indirect activities for nurses. With its capabilities and use of technology, information science, and nursing science, the NIS can increase nurse satisfaction by reducing repetitive writing and improving quality, encouraging nurses to use the system in their routine work [5, 8]. Since high-quality documentation is a prerequisite for effective and efficient communication among providers, the NIS, with a wide range of information, helps nurses find, interpret, organize, and evaluate various information from relevant sources to make appropriate and timely decisions to improve the quality of patient care [9-11].

Studies have shown that many health information systems face challenges after development and need to be better received by users [12]. Security issues, technical problems, changes in work processes, negative attitudes, and user resistance to using the system are among these challenges. Human factors such as negative user attitudes, disinterest, and lack of confidence in the system are more important than other categories [13].

Recent studies have underscored the importance of user satisfaction, as well as the behavioral outcomes of both the user and system, as critical and often contested topics [14]. It will fail when information systems fail to execute specific tasks aligned with user needs. Consequently, all the resources invested in its creation could be well-spent. By evaluating and examining the system, challenges can be identified. Then, with appropriate intervention, the efficiency and effectiveness of the system can be improved, thereby increasing the likelihood of its success [15-17].

Various studies show that different users have different perspectives on the quality of hospital information systems, so when evaluating an NIS, the methods and tools should suit its specific users, namely nurses [18-20]. Nurses, as NIS users, are more than just simple users. Every time they use the system, they practically evaluate its quality. If the quality of the system or the quality of the services it provides is not satisfactory to them, they will not use it effectively and efficiently [21, 22].

Studies have shown that many health information systems face challenges after development and need to be better received by users [12]. Considering the importance and role of the nursing profession in the treatment cycle and the importance of NIS and its significant role in facilitating processes and improving the cycle of information transfer and retrieval in a timely and effective manner, this study aims to investigate the perceptions of nurses regarding the use, quality, and user satisfaction of NIS.

MATERIAL AND METHODS

This study is a descriptive cross-sectional study conducted in November 2022. The statistical population of this study encompassed all nurses employed in educational hospitals affiliated with the Gilan University of medical sciences in Rasht, Iran, amounting to 1049 individuals. The inclusion criteria consisted of 1) nurses actively serving at an Educational Hospital in Rasht and having completed the PHCC CIS training program, 2) nurses with experience using the NIS, and 3) nurses willing to participate in the study. The sample size, determined through the utilization of Cochran's formula with a 95% confidence level and 95% accuracy, was calculated to be 252 individuals. The sampling method employed was a combination of quota sampling and random sampling. Niemann's allocation method was utilized to allocate the sample size across different hospitals, proportionate to the number of nurses in each hospital (Table 1).

Table 1: Sample distribution by hospital based on Niemann allocation.

Hospital's Name	Number of Nurses	Ratio	Number of Samples
17 Sharivar	130	0.12	31
Velayat	71	0.07	17
Shafa	128	0.12	31
Razi	236	0.22	57
Doctor Heshmat	151	0.14	36
Pour Sina	206	0.20	49
Amir al-Momenin	37	0.04	9
Al-Zahra	90	0.09	22
Total	1049	1	252

The data were collected using a questionnaire. The first part of the questionnaire pertained to demographic information (gender, age, level of education, hospital work experience, and work experience with the system); the second part was the Ottino questionnaire. After obtaining the necessary permissions for conducting this study and coordinating with hospital managers, the researcher visited hospital departments, explained the study objectives, the confidentiality of the information, and voluntary participation to all participants, and obtained informed consent. Data were collected using the questionnaire.

The instrument used in this study to collect data was a standardized questionnaire developed by Ottino in 2007 [18], which examines nurses' perceptions in three areas: use, user satisfaction, and quality of NIS. The Likert scale (never=1, rarely=2, sometimes=3, often=4, always=5) is used for scoring. The questionnaire consists of 12 items for the Use variable, divided into two aspects: nursing care management (seven items) and utilization of system modules (five items). The quality variable (13 items) includes 11 items for information quality and 2 items

for service quality. The user satisfaction variable has 9 items [18].

The questionnaire was initially translated using the forward-backward method [23]. A bilingual translator translated the questionnaire into Persian. The translation was then assessed by a panel of experts, including two medical informatics specialists and two nurses, for clarity and understandability. Cultural modifications were taken into consideration during this process. After comparing two English versions of the questionnaire, the revised translation was back-translated into English to produce the final version.

In the next stage, we investigated the reliability and content validity of the questionnaire using both quantitative and qualitative methods. To evaluate face validity, we used two methods: quantitative and qualitative. To determine the qualitative face validity of a questionnaire, a panel of 15 medical informatics specialists and nurses was consulted. The aim was to identify any difficulties, inconsistencies, ambiguities, or inadequacies in the meaning of words. The panel provided their opinions in the form of minor changes to the questionnaire. To determine the quantitative face validity, the Impact Score of each question was calculated. All questions with a score equal to or greater than 1.5 were included in the questionnaire, as indicated by the Impact score results.

After a thorough examination of the instrument, 5 nursing experts were asked to conduct a qualitative review of its content validity. Any feedback should be submitted in writing. It is important to note that in the evaluation of content validity, grammar, word choice, question relevance, and question placement should be carefully considered, while also taking into account the completion time of the tool. After gathering expert opinions, we considered the required changes to the tool.

To quantitatively assess the validity of the content and ensure that only the most important and accurate content (i.e., necessary questions) were selected, we used the content validity ratio (CVR) and content validity index (CVI) to measure the content. To quantitatively assess the validity of the content and ensure that only the most important and accurate content (i.e., necessary questions) were selected, we used the CVR and CVI to measure the content. This helped us ensure that the tool's questions were directed in the best possible way. To quantitatively assess the validity of the content and ensure that only the most important and accurate content (i.e., necessary questions) were selected, we used the CVR and CVI to measure the content. The CVR of 0.86 indicates that all questions were equal to or greater than the Lawshe criteria [24, 25].

This article confirms that the tool used the necessary questions and importance. All questions had a CVI of 0.91, which is higher than 0.78, indicating their suitability. Additionally, the questionnaire was found to be comprehensible to the participants, demonstrating appropriate face and content validity. After evaluating the validity, the reliability of the questionnaire was checked using the test-retest method, which measures the repeatability of the results. The nurse was given a certified copy of the questionnaire and was asked to fill it out again two weeks later. The internal correlation coefficient (ICC) rate for the entire questionnaire was 0.85, with different sections ranging from 0.78 to 0.90, which is within an acceptable range [26]. Cronbach's alpha was used to analyze the internal consistency. Values greater than 0.70 were deemed acceptable and demonstrated a high degree of internal consistency [27]. The results showed excellent internal consistency for the investment (Cronbach's alpha=0.90).

This research was approved by our university's institutional review board. The research objectives were verbally explained to all participants by two members of the research team, and after addressing their questions, if they expressed interest, the questionnaire was provided to them for completion. Additionally, at the beginning of the questionnaire, the research objectives, methodology, and confidentiality were explained again, and participants were given the option to withdraw from the study at any time. No private information regarding the participants, such as their full name, phone number, email address, or similar details, was collected or used. The confidentiality of the participant's responses was also ensured.

Descriptive statistics (mean, standard deviation, percentage, minimum, and maximum) were used to describe the population's demographic characteristics. The mean scores of the questionnaires completed by the participants were used to obtain the nurses' perceptions, and these scores were then used to calculate the score for each of the three subscales. The Kolmogorov-Smirnov test was used in the inferential statistics section to examine usage, quality, and user satisfaction normality ($p>0.05$). the normality of the data was not rejected, and all three variables followed a normal distribution. Regression and Pearson correlation were used to examine the correlation between variables. SPSS version 27 was used for data analysis.

RESULTS

Two hundred and fifty-two participants entered this study, including 245 females (97.2%) and 7 males (2.8%). The participants' mean age was 36.59±7.9, with 40.48% aged between 31-40 years. Furthermore, 90.1% of the participants held a bachelor's degree, 33.33% had 11-15 years of Hospital work experience, and 61.90% had 6-10

years of work experience with the system (Table 2).

Examination of the overall status of the usage, quality, and user satisfaction

As shown in Table 3, the mean usage of the system was 2.38 ± 0.42, the mean quality was 3.11 ± 0.59, and the mean user satisfaction with the system was 2.93 ± 0.82. The overall perspective of the nurses was 2.81 ± 0.49.

Table 2: Demographic characteristics of participants

Variable		n	%
Sex	Female	245	97.2
	Male	7	2.8
Age	<=25	19	7.54
	26 - 30	46	18.25
	31 - 40	102	40.48
	41 - 50	76	30.16
	>50	6	2.38
	missing	3	1.19
Level of education	Bachelors	227	90.1
	Masters	25	9.9
Hospital work experience (years)	<=1	17	6.75
	2 - 5	46	18.25
	6 - 10	27	10.72
	11 - 15	84	33.33
	16 - 20	53	21.03
	> 20	25	9.92
Work experience with the system (years)	<= 1	16	6.35
	2 - 5	48	19.05
	6 - 10	156	61.90
	> 10	14	5.56
	missing	18	7.14

Table 3: Mean and standard deviation of the usage, quality, and user satisfaction (n=252)

Variable	Min	Max	Mean	SD
Use	1.33	4.67	2.38	0.42
Quality	1.77	4.77	3.11	0.59
User satisfaction	1	4.89	2.93	0.82
Total	1.69	4.70	2.81	0.49

Evaluation of the usage, quality, and user satisfaction with the NIS

The item 'obtaining the results from new tests or investigations' and the item 'obtaining results of tests and investigations' received the highest mean scores among the usage items. On the other hand, the item 'writing nurse care worksheets (Kardex)' received the lowest score. Among the quality items, the item 'How often does the system provide up-to-date information?' received the highest score, while the item 'How often is the system user-friendly?' received the lowest score. Table 4 shows that the item 'Do you feel the safety of patients has improved due to NIS?' received the highest score among the user satisfaction items, while the item 'Do you feel NIS has been successful in your hospital?' received the lowest mean.

Table 4: Mean scores of participant responses to survey items

Item		Mean (SD)
Use	Review the patient's problems.	1.99 (0.98)
	Enter daily nursing care notes.	1.51 (0.74)
	Capturing patient observations at the bedside	1.88 (1.05)
	Write nursing care plans.	1.21 (0.61)
	Write nurse care worksheets (Kardex).	1.21 (0.64)
	Collect patients' info for discharge reports.	3.67 (1.01)
	Document physical assessment of patients.	1.80 (1.01)
	Obtain information on investigation or treatment procedures.	3.21 (1.32)
	Obtain the results from new tests or investigations.	4.25 (0.68)
	Answer questions concerning general medical knowledge (concerning treatment, symptoms, complications, etc.)	1.52 (0.78)
	Obtain results of tests and investigations.	4.15 (0.91)
	To check drug information (such as allergy and interactions)	2.11 (1.03)
Quality	How often does the system provide the precise information you need?	3.21 (0.85)
	How often does the information content meet your needs?	3.05 (0.95)
	How often does the system provide reports that seem to be just exactly what you need?	3.02 (0.86)
	How often does the system provide sufficient information?	3.11 (0.81)
	How often is the system accurate?	3.31 (0.94)
	How often are you satisfied with the accuracy of the system?	3.10 (1.02)
	How often do you think the output is presented in a useful format?	2.87 (1.12)
	How often is the information clear?	3.20 (1.05)
	How often is the system user-friendly?	2.86 (1.06)
	How often do you get the information you need in time?	3.31 (0.79)
	How often does the system provide up-to-date information?	3.40 (0.83)
	How often can you count on the system to be up and available?	3.31 (0.77)
	How often is the system subject to frequent system problems and crashes?	3.22 (0.79)
User satisfact	Do you feel NIS is useful?	3.10 (1.02)
	Do you feel your performance has improved due to NIS?	2.97 (1.06)

Item		Mean (SD)
	Do you feel the quality of your work has improved?	2.87 (1.05)
	Do you feel NIS is worth the time and effort required to use it?	2.91 (1.19)
	Do you feel the quality of information has improved due to NIS?	2.89 (1.05)
	Do you feel NIS has been successful in your hospital?	2.79 (1.00)
	Do you feel NIS is an important system for your hospital?	3.24 (1.04)
	Do you feel the safety of patients has improved due to NIS?	2.81 (1.16)
	Overall, are you satisfied with the NIS?	2.78 (0.89)

Evaluation of the regression coefficients between usage, user satisfaction, and quality

The study's findings revealed significant relationships between system usage quality and user satisfaction. The variable with the greatest influence on system usage was quality, accounting for 31% of the explained variance.

This suggests that higher levels of quality are associated with increased adoption and utilization of the system. The impact of user satisfaction on system usage was found to be 19 percent, indicating that higher satisfaction levels lead to increased engagement. Additionally, the study revealed that quality is a significant factor in user satisfaction, accounting for 53 percent of the observed variability. This underscores the importance of developing high-quality systems to improve user satisfaction. Lastly, the usage variable was found to have a 14 percent impact on user satisfaction, revealing that the extent of system usage by individuals also plays a role in their satisfaction levels (Fig 1). These results provide valuable insights into the relationship between quality, system usage, and user satisfaction in this context.

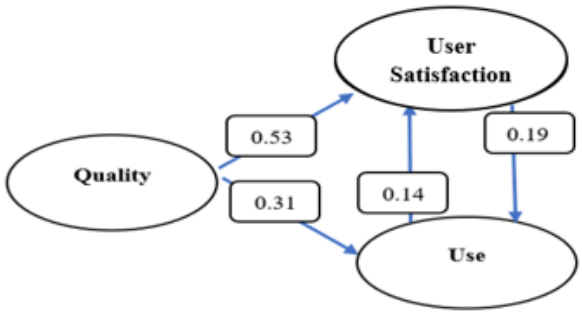


Fig 1: The model related to the impact of each variable

DISCUSSION

The present study evaluated nurses' perceptions of quality, user satisfaction, and usage of the NIS and the relationship between these variables. The results showed that the usage level was above 3 out of 5 in nursing care management, with the highest usage for the item "collecting patients' info for discharge reports" and the lowest usage for the item "writing nurse care worksheets (Kardex)" Since nurses in hospitals perform paper documentation simultaneously with system registration, and filling out nursing reports, plans, and Kardex is a time-consuming task that requires accuracy and concentration, redoing these tasks in the NIS is difficult for them, and they are less inclined to do so. Studies have shown that parallel use of paper and electronic systems leads to time waste, reduced workflow speed, and increased resistance to using information systems [28]. Besides, nurses believe that the system wastes the time they could allocate to patient care [29].

In the second section, the highest usage level was for "obtaining the results from new tests or investigations" and "obtaining results of tests and investigations." In contrast, the lowest usage level was for the items "answering questions concerning general medical knowledge (treatment, symptoms, complications)" and "checking drug information (such as allergy and interactions)." Since all tests in the hospitals of Rasht city are registered in the system by nurses, and the laboratory also provides responses via the system, this module is one of the mandatory modules that nurses must use. Therefore, the high usage level is because of the obligation to use it. However, other items in this area are optional, and nurses are not inclined to use them, which may be due to the high workload and shortage of staff, as well as the inadequacy and slowness of hardware and software systems, increasing the workload. In addition, the system's coordination with daily routines and actual workflow can be among the reasons for the need for more interest in using non-mandatory items.

According to nurses, the quality of the NIS was above 3 out of 5. In the information quality section, nurses considered accuracy and timeliness to have the highest level of quality. On the other hand, the items "How often is the system user-friendly?" and "How often do you think the output is presented in a useful format?" had the lowest level of quality. The results in the information quality section were consistent with other studies [29, 30]. The service quality variable included two items, with more than half of the nurses (58%) believing they could rely on the system being active and ready for use. Regarding system failures, most nurses believe the system experiences frequent breakdowns and disruptions in more than half of the cases.

The user satisfaction level with the system was reported almost 3 out of 5. The highest score was for the item "Do you feel NIS is an important system for

your hospital?" while the lowest score from the nurses' perspective was for the item "Do you feel the quality of information has improved due to NIS?". The results showed that nurses know the importance of the NIS for the hospital. However, the system has yet to improve the quality, efficiency, and effectiveness of information in the hospital. This finding is consistent with other similar studies [31].

Furthermore, the results showed that all three variables of quality, user satisfaction, and usage are significantly correlated. Therefore, the more satisfied nurses are with the NIS, the more they use it. Since user satisfaction is a part of the user's attitude towards the system, it can be said that the results are consistent with Mehraeen et al.'s study, which states that the more positive the user's attitude towards the system, the more they use it [32].

Furthermore, the higher the quality of the NIS from the perspective of nurses, the greater their satisfaction with the system. This result is in line with a previous study [33]. Additionally, the more nurses perceive the NIS to be of higher quality, the more frequently they use it. This finding is also consistent with another study [34].

Overall, in this study, NIS usage was below the mean, quality was above the mean, and user satisfaction was mean from the perspective of nurses. Although the system's quality and the nurses' user satisfaction were acceptable, its usage was below the mean. This result may be because NISs are not aligned with nurses' daily workflow and do not meet their expectations and needs. It seems nurses do not feel the need to use the system or consider it a facilitator of their daily work. Therefore, they only use it in mandatory cases. Thus, NIS developers should consider users as customers and prioritize their needs, expectations, and desires. The system should be easy to use and understand, high-quality and efficient, and not complicate working conditions. Healthcare organizations are complex and multifaceted, aiming to improve patient care quality. Therefore, all measures should be taken in line with this important goal.

CONCLUSION

The findings of this study demonstrate that the scores pertaining to nurses' perceptions regarding the Use, Quality, and User Satisfaction of the NIS were found to be deficient. This inadequacy highlights the need for healthcare managers to carefully consider the specific needs and expectations of nurses during the procurement or design phases of a NIS implementation in order to mitigate the risk of potential failure. Furthermore, it is imperative that the NIS be comprehensively aligned with the requirements of nurses. Many of the system's features are overlooked by nurses and remain underutilized within the healthcare environment. Consequently, healthcare managers must prioritize the incorporation of nurses' needs and expectations in order to ensure the practical utilization, efficiency, and overall success of the NIS.

ACKNOWLEDGEMENT

The authors extend their gratitude to the nurses employed in the educational hospitals affiliated with Gilan University of Medical Sciences in Rasht for their valuable contribution in facilitating the implementation of this study.

AUTHOR'S CONTRIBUTION

Conceptualization: SR, SH, FZ, SV; Data Collection: SH, SR; Formal Analysis: SR, SH, FZ, ZK; Methodology: SH, SR, FZ, SV; Resources: SH, SR, SV, ZK, FA; Supervision: SR, SV; Writing Original Draft: SH, SR, ZK, SV; Writing Review and Editing: SR, SV, ZK. All authors have read and agreed to the published version of the manuscript.

All authors contributed to the literature review, design, data collection, drafting the manuscript, read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

ETHICAL APPROVAL

This research has been approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (Ethics Code: IR.SBMU.RETECH.REC.1400.1188).

FINANCIAL DISCLOSURE

This research was supported by the School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran [Project NO. 32240].

AI USAGE

No AI was used. The authors assume full responsibility for the final manuscript.

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