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The Relationship between Intensive Care Unit's Nurses' Informatics Competency and Quality of Patients' Electronic Health Record's Documentation

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ABSTRACT

Background: Nursing informatics and the development and growth of health information technology are becoming a necessary part of all aspects of the nursing practice, especially in critical care settings. In addition, researchers agree on using standardized and electronic documentation to support the nursing process and promote nursing documentation quality. ***Purpose***: To examine the relationship between Intensive Care Unit Nurses' Informatics Competency and Quality of Patients' Electronic Health Record Documentation. ***Methods***: A descriptive, correlational, retrospective, cross-sectional design was used. Three hospitals that implemented the Electronic Health Records (EHRs) system were included in this study, using non-probability convenience sampling technique to recruit a total of 176 nurses. The nursing informatics competency was measured by the Self-assessment of Nursing Informatics Competencies Scale (SANICS). The Quality of Electronic Health Record Documentation was assessed by the audit instrument for nursing care plans in the patient record (Cat-ch-Ing). Descriptive and inferential statistics were utilized to answer research questions. ***Results***: The overall mean informatics competency score among nurses was 2.49 (*SD* = 0.73), with most of the nurses (81.79%) reporting a low competency score of less than three. The highest percentage of participants 29.4% (n = 52) have moderate quality of EHR documentation. Also, related personal and clinical characteristics account for 93.7% of the variance in quality of patients' electronic health record documentation (R^2 = 0.937, F = 8.707, p = 0.004). Once nursing informatics competency was entered into the model, R^2 *is* still the same, making a total explained variance of 93.7% (R^2 = 0.937, F = 6.907, p = 0.013). ***Conclusion***: The present study revealed low levels of nursing informatics competency among nurses, and the highest percentage of participants have moderate quality of EHR documentation. In addition, personal and clinical related characteristics account for 93.7% of the variance in the quality of patients' electronic health record documentation. ***Implications for Nursing***: This study provides evidence to guide nursing leaders, supervisors and policymakers in their planned actions and policies to support nursing capacity, nursing education, and nursing practice in the area of nursing informatics and electronic nursing documentation.

Keywords: Electronic health record, Nursing informatics, Nursing informatics competency, Quality of documentation.

What does this paper add?

1. NI is a highly specialized field, though there are foundational informatics competencies that all clinical nurses should own to meet the principles of delivering safe, quality, and competent care.
2. NI competency is crucial for successful use of EHRs and quality of nursing documentation.
3. High-quality nursing documentation aims to

improve standards, consistent and effective communication between health care providers, and improve continuity and patient safety.

Introduction

Health care systems are continuously expanding. The rapid expansion of the health care system into every part of modem nursing care and practice implies that nurses must establish and hold a great number of general computer competencies, and specific nursing competency. The national health care organizations have proposed a new health care system that places heightened emphasis on the use of health information technology (HIT) to enhance patient safety, improve care quality, and decrease costs (Arcos Belchez et al., 2019). HIT significantly influences nursing practice, wherein nurses actively contribute to the conceptualization, design, and implementation of HIT systems (Jouparinejad et al., 2020).

Since the onset of the third millennium, HIT has exerted a profound impact across all parts of health care (Liston, 2019). As HIT initiatives within nursing have evolved, the discipline of nursing informatics (NI) has emerged, due to the expansion of the knowledge required in this field (Elsayed, 2017). NI, in conjunction with HIT, has become an indispensable component of comprehensive nursing practice, particularly in critical care settings (Jouparinejad et al., 2020). Nurses regularly utilize computer systems for documenting and reviewing patient care data, accessing laboratory and imaging results, conducting resource searches, and formulating patient care plans (Liston, 2019). However, one aspect of NI is technology, which needs a certain competence to confirm effective nursing practice (Al-Hawamdih & Ahmad, 2018).

The Health Care Information and Management Systems Society (HIMSS) Nursing Informatics Workforce Survey (2020) indicated that nursing informatics plays a significant role in the development, implementation, and optimization of information systems and applications, including clinical documentation (CD), and electronic health records (EHRs) (HIMSS, 2020). Therefore, nurses should understand the essential role of NI in increasing or obtaining knowledge, that promotes nursing practice, education, management, training, and research (Al-Hawamdih & Ahmad, 2018).

Nursing documentation offers valuable feedback to health care organizations and providers for planning safe, high quality care, and improve positive client/patient outcomes (Adereti & Olaogun, 2019). In the early 1990s, a tendency in the shift from paper-based health records to electronic records was started for patient care documentation, as a result of improvements in technology as well as the advocacy of the Institute of Medicine in the United States (Evans, 2016). As a result of the insufficiencies of paper-based health records, EHRs have continued to be improved and anticipated with many expected benefits over the past 25 years (Tsai et al., 2020).

EHRs represent one application of HIT, being used by nurses, requiring nursing informatics competences for effective use (Kruse et al., 2018). However, nurses play a necessary role in the acquisition, evaluation and application of EHRs (Sarmah et al., 2019). EHRs increase the ability to utilize clinical data for observing of patient outcomes and directing audits and research (Kouroubali & Katehakis, 2019). Also, they offer access to patient information in a timely manner, allowing health care professionals (HCPs) to spend more time with patients (Warraich et al., 2018). In addition, they decrease repetition of tests and work, and promote the safety and quality of care provided (Fennelly et al., 2020). However, NI competency is crucial for successful use of EHRs and quality of nursing documentation. When nurses are competent in informatics, the accuracy of nursing documentation improves; therefore, the health care provider will have better access to nursing notes and can enhance decision-making about patient care (Al-Hawamdih & Ahmad, 2018).

As the utilization of HIT continues to expand, the need for health care providers to possess essential knowledge and competencies in managing health information becomes increasingly pronounced. To meet this need, it is imperative that nurses have the right knowledge, skills, and preparation in informatics, to accurately assess and document the patient-health condition for health care professionals (Dionne, 2016). However, existing literature recognized the NI competency gap across various work settings, particularly within critical care settings (Jouparinejad et al., 2020). Nurses working in critical care units need to be competent in NI because of the sensitivity of these units. In addition, researchers highlighted the association between low NI competency and adverse

outcomes related to HIT in patient care (Arcos Belchez et al., 2019). However, without informatics principles and competencies, information technology would be ineffective in the health care field and pose risks on patient safety (Farzandipour et al., 2021).

Quality of nursing care documentation helps convey the information about the care planned, patient observation, intervention administered, and patient outcomes (Kebede et al., 2017). The quality of documentation within coronary care units assumes paramount importance due to the sensitivity of patients diagnosed with chronic illnesses, critical conditions, and high mortality rates in these units. However, even though nursing care documentation is a significant part of nursing practice, it is usually left undone (Kebede et al., 2017). Also, the care that has been provided, interventions administered to the patient, and outcomes observed are not consistently written (Kebede et al., 2017). Therefore, nursing documentation is not being used by other health care providers, because of poor quality (Adereti & Olaogun, 2019). Poor quality of documentation causes negative effects on the health care of patients, such as trouble in knowing what care has been provided to the patient, lack of support once legal and ethical problems occurred, and trouble in doing retrospective audits and research actions (Bizimana & Bimerew, 2021).

NI is a prerequisite for EHR's documentation and is the infrastructure required to improve patient care. However, a few researchers have examined informatics competencies for practicing nurses (Abd El-Fattah, 2017). Also, the improvement of nursing informatics (NI) competency among critical care nurses remains insufficiently addressed in the existing literature (Jouparinejad et al., 2020). In addition, literature recommends the use of self-assessment scales for testing informatics knowledge and competency among practicing nurses (Verma & Gupta, 2019). Furthermore, a previous study in Jordan reported a lack of qualified nursing documentation in general hospitals and a lack of knowledge among nurses about the structure and components of the electronic nursing documentation systems used (Akhu-Zaheya et al., 2018). Moreover, there is no published study about the relationship between nursing informatics competency and quality of patients' electronic health record documentation in Jordan. Therefore, this study aims to examine the relationship between intensive care unit nurses' informatics competency and quality of patients' electronic health record documentation.

The proposed study is expected to enhance our understanding of NI competency levels and the quality of patients' EHR's documentation. Additionally, this research seeks to address existing gaps in the literature and holds the potential to impact clinical practice. Furthermore, it will heighten health care managers' awareness regarding the requirements for enhancing NI competency and EHR's documentation quality. Lastly, the study would help determine which areas of NI and quality of patients' EHR's documentation need greater focus in designing better educational programs.

Research Questions

1. What's the relationship between intensive care unit nurses' informatics competency and quality of patients' electronic health record documentation?
2. To what extent do nurses' informatics competency and quality of patients' electronic health record documentation vary by personal and clinical-related characteristics?
3. Did nursing informatics competency predict quality of patients' electronic heath record documentation after controlling personal and clinical-characteristics?

Methods

Design and Settings

A descriptive, correlational, retrospective, cross-sectional design was used in this study. This design was utilized to describe the study variables and identify the relationships between them. In addition, the data was collected at a single point of time, and auditing previously documented medical records was observed. This study was conducted in three hospitals, which were chosen because they completely implemented EHRs: one hospitals in the north, and two hospitals in the middle region. The total number of beds in the intensive care units in these hospitals were 137. All hospitals are affiliated to the Jordan Ministry of Health. The selected hospitals were chosen because they completely implemented EHRs.

Sampling

A non-probability convenience sampling method was used to select the study participants. The total number of nurses working in the intensive care units in

these hospitals was 219. The inclusion criteria for participation were: registered nurses, willing to participate in this study, having access to and using an HER system, working in intensive care units and critical care units, and having at least three months of nursing experience.

There were no specific sample size restrictions imposed for this study. All intensive care unit nurses within the selected hospitals were invited to participate in the study once the inclusion criteria have been met. Calculations for sample size determination were utilized using G-power software, based on several parameters: a medium effect size (0.15), a significance level of 0.05, and a statistical power level of 0.8. Employing multiple regression analysis with twelve predictors, a minimum of 127 participants were deemed necessary. However, to account for potential attrition or incomplete responses, an over-sampling approach was adopted, resulting in an anticipated total sample size of 153 nurses.

Instruments

A three-parts questionnaire was utilized in this study: demographic and clinical-related characteristics, self-assessment of nursing informatics competencies scale (SANICS), and auditing checklist (Cat-ch-Ing).

The first part of the questionnaire was demographic characteristics, which include age, gender, educational level, working experience, time spent on EHR documentation, shift, nurse to patient ratio, receiving an HER documentation training in the hospital, studied a health informatics course in the university, previous experience with EHRs, working in an accredited hospital, and presence of managerial motivation.

The second part of the questionnaire was SANICS. This tool was developed by Yoon et al. (2009), and contains 30 items. This instrument comprises 30 items, with respondents providing ratings on a 5-point Likert scale for each item, ranging from "1" representing not competent to "5" representing expert. The instrument items consist of five sub-scales: five items for clinical informatics role (1-5), 15 items for basic computer knowledge and skills (6-20), four items for applied computer skills (21-24), four items for clinical informatics attitudes (25-28), and two items for wireless device skills (29-30). Among the sub-scales, "Basic Computer Knowledge and Skills" and "Wireless Device Skills" measure computer skills. Two sub-scales; namely, "Clinical Informatics Roles" and "Clinical Informatics Attitude" measure informatics knowledge. Finally, the sub-scale "Applied Computer Skills: Clinical Informatics" measures informatics skills (Yoon et al., 2009). A minimum score of three on the SANICS indicates being informatics competent (Yoon et al., 2009).

In the current study, the SANICS was translated into Arabic language and back-translated. The translation process for the instrument involves both forward-and back-translation procedures to ensure content and semantic validity, following the methodology proposed by Brislin (1970). The original English SANICS questionnaire, comprising 30 items, is categorized into five distinct domains. Two proficient translators undertook the translation of SANICS into Arabic, and subsequently, two additional qualified translators conducted the back-translation. The resulting version was meticulously reviewed and approved in terms of content and format.

The psychometric properties of SANICS were robustly substantiated through factorial validity, high internal consistency reliabilities, and scale responsiveness. Five distinct factors account for 63.7% of the observed variance (Yoon et al., 2009). The Cronbach's α coefficients for the SANICS sub-scales were as follows: clinical informatics role, $\alpha = 0.91$; basic computer knowledge and skills and clinical informatics attitude, $\alpha = 0.94$; applied computer skills: clinical informatics $\alpha = 0.89$; and wireless device skills, $\alpha = 0.90$ (Yoon et al., 2009). In addition, previous studies were conducted to examine the psychometric properties of SANICS, which found that the instrument is valid and reliable for measuring nursing informatics competency among nurses and nursing students (Choi & Bakken, 2013; Seo et al., 2019).

The third part was the Cat-ch-Ing, which was developed by Bjorvell (2002) using the VIPS model. The Cat-ch-Ing audit instrument consists of 17 questions: 10 reflecting the steps of the nursing process; one about VIPS keywords; one about the discharge note that measured the content attribute; four about data entry, nurses' signatures, the RN's name, and clarification of nurses' signatures that measured the process attributes; and one is about record legibility that measured the structure attributes.

Each question was constructed on a rating scale to reveal both the quantity and the quality of the written content. The quality and quantity values were based on

a 4-point Likert-like scale, wherein zero to three measuring quantity (3 = complete, 2 = partly, 1 = occasionally and 0 = none) and quality (3 = very good, 2 = good, 1 = less than good and 0 = poor) (Björvell, 2002). The total score ranges from 0–80 points, reflecting both the quantity and the quality of the records (Björvell et al., 2000). A higher total score indicates that the quantity portion of the content attribute has better nursing documentation (Björvell, 2002).

The scoring system in this study for quality of documentation attributes was classified into intervals to determine the level of the documentation's quality. The observed total mean-score percentage ranging between (0%-25.99%) indicates poor quality, between (26.00%-50.99%) indicates moderate quality, between (51.00%-75.99%) indicates good quality, and more than (76%) indicates very good quality. To categorize the participants' quality of documentation based on their scores, quartiles were used.

In the current study, the expected outcome, and nursing status at discharge, measured by both quantity and quality aspects of the content attributes, were excluded from the instrument, since they are not available in the documentation form in the selected hospitals. In addition, nursing discharge notes which are measured by quantity aspect of content attributes, were excluded from the instrument, since all the documentation notes were for inpatients. Also, the primary nurse item was modified to Registered Nurse (RN) responsible for patient care, since we are dealing with RNs, not primary nurses, in these hospitals in Jordan. Therefore, (14) questions remained with a total score of process, content, attributes, ranging from 0-64 for both quality and quantity aspects.

The inter-rater reliability coefficients were 0.98, 0.98, and 0.92 (Björvell et al., 2000). The criterion-related validity was illustrated by a significant correlation ($r = 0.68$, $p \leq 0.0001$, 95% CI = 0.57 to 0.76) between the scores of items of the Cat-ch- Ing audit instrument and the Ehnfors audit instrument (Björvell et al., 2000). Content validity ratio ranged between 0.20 and 1.0 (Björvell et al., 2000).

Pilot Study

The pilot study was conducted before data collection to check the readability and psychometric properties of the nursing informatics competency instrument (SANICS), and quality of nursing documentation instrument (Cat-ch-Ing). The pilot study included 30 participants (who were excluded from final analysis of data). The Cronbach's alpha for both instruments was above 0.80.

Ethical Considerations

Ethical approval for study conduction was obtained from the Institutional Review Board (IRB) at the Jordan University of Science and Technology (JUST), number (45/143/2021). Additionally, authorization was obtained from the Ministry of Health (MOH), number (16065). Full information about the study's goal and objectives, the time required to complete the questionnaires, in addition to the possible disadvantages and benefits of participation in the study was explained. The participants were treated anonymously. Also, they were explicitly informed that their participation was entirely voluntary. In addition, participants were assured that they had the right to decline or withdraw from the study at any point without the need for justification or fear of any adverse consequences. Written consents were obtained from the participants, and all participants received explicit assurances regarding the confidentiality of their identity. The researchers remained accessible throughout the data collection process to answer any questions. Finally, formal permission was obtained for the utilization of the instruments.

Data Collection

The nurses and patients' electronic nursing documentation files were approached by the researchers during different days and shifts. Data collection was carried out between November 25, 2021 and December 7, 2021. The records were conveniently selected to start the study. Each nurse was asked about what patient he/she was documenting, and the patient's file number was taken. The records and questionnaires were numbered and coded, and one researcher audited the records to minimize the risk of subjectivity bias. The participants were informed that the time required to fill the questionnaire is about 5-10 minutes. Additionally, the time required to audit each record was between 5 minutes and 10 minutes. The study was explained, and the nurses were provided with the study questionnaire along with a cover letter explaining the purpose and the outcomes of the study. In addition, the researchers collected the completed questionnaires from the nurses as soon as they were completed.

Data Analysis

The Statistical Package for Social Sciences (SPSS, version 27) for Windows was used for data analysis. Descriptive statistics have been used to describe the demographic and clinical-related characteristics of the participants and the study variables based on the level of measurement. Inferential statistics including *t*-test, one-way ANOVA, correlation and regression analysis were used to answer the research questions.

Results

Participants' Demographic Characteristics

The questionnaire was distributed to 195 nurses. A total of 176 nurses completed the study questionnaire, with a response rate of (90.2%). In addition, a total of 176 patient records were audited.

The highest percentage of participants are working in Irbid Field Hospital (n=55, 31.25%). The mean age of the participating nurses was (M = 27.99, SD = 4.00) years, with ages ranging between 24 years and 46 years. A half of participants were females (n = 88, 50%). Also, most of participants held bachelor's degree in nursing (n=160, 90.9%). The participants' years of experience ranged between 1 year and 23 years (M = 5.03, SD = 3.41). The highest percentage of participants (83.5%) had less than 7 years of work experience. In addition, most of participants completed a health informatics course in the university (n=128, 72.7%). Table 1 describes the demographic and clinical-related characteristics.

Table 1. Participants' demographic and clinical-related characteristics

Variable	Categories	*F*	%	Mean	*SD*
Hospital	Irbid Field Hospital ICU	55	31.25		
	Al-Basheer Hospital Medical ICU	51	29.0		
	Al-Basheer Hospital Surgical ICU	35	19.9		
	Al-Basheer Hospital CCU	15	8.5		
	Al-Zarqa Governmental Hospital ICU	20	11.4		
Working in an Accredited Hospital	Yes	20	11.4		
	No	156	88.6		
Managerial Motivation	Yes	20	11.4		
	No	156	88.6		
Age				27.99	4.00
	<28 years	118	67.04		
	29-33 years	37	21.02		
	>34 years	21	11.9		
Gender	Male	88	50		
	Female	88	50		
Educational Level	Bachelor degree	160	90.9		
	Master degree	16	9.1		
Studied a health informatics course in the university	Yes	128	72.7		
	No	48	27.3		
Years of experience as a registered nurse				5.03	3.41
	<7 years	147	83.5		
	8-14 years	26	14.8		
	> 15 years	3	1.7		
Shift	A	80	45.5		
	BC	96	54.5		
Ratio (Nurse: Patient)	1:2	13	7.4		
	1:3	126	71.6		
	1:4	37	21		
Received training related to electronic health record (EHR) documentation	Yes	84	47.7		
	No	92	52.3		

Mean duration of the received training related to electronic health record (EHR) documentation	<25 26-50 >51	76 6 2	90.5 7.1 2.4	11.30	13.41
Previous experience with electronic health record (EHR) documentation	Yes No	48 128	27.3 72.7		
Previous experience with electronic health record (EHR) documentation (years)	<5 6-10 >11	45 2 1	93.8 4.2 2.1	2.31	2.04
Time spent on the electronic health record (EHR) documentation	<4 hours 5-9 hours >10 hours	164 9 3	93.2 5.1 1.7	2.73	1.70

N=176.

Most nurses reported working on a ratio of 1:3 nurse: patient (n=126, 71.6%). The highest percentage of nurses in this study were working in the evening shift BC (n=96, 54.5%). Furthermore, 20 participants (11.4%) reported that they are working at an accredited hospital and have managerial motivation. In addition, (n=128, 72.7%) of nurses do not have a previous experience with EHRs. Moreover, 92 participants (52.3%) did not receive training related to EHRs. The number of hours spent on the EHR during the shift ranged from 1 hour to 12 hours (M = 2.73, SD = 1.70).

Nursing Informatics Competency Level

The results revealed the overall mean informatics competency score among nurses was 2.49 (SD = 0.73), with most of the nurses (81.79%) reporting a low competency score of less than 3 (Table 2). The highest mean score was for computer skills (M = 2.56, SD = 0.89), followed by informatics knowledge (M = 2.46, SD = 0.74), and the lowest mean score was for informatics skills (M = 2.23, SD = 0.92).

Table 2. Nurses informatics competency scores

	Number of Items	**Actual Total Score**	**Mean**	***SD***
Informatics Knowledge - **Clinical Informatics Role**	9 5	45 5-25	2.46 2.05	0.74 0.79
- **Clinical Informatics Attitude**	4	4-20	2.87	0.99
Computer Skills - **Basic Computer Knowledge and Skills**	17 15	85 15-75	2.56 2.59	0.89 0.81
- **Wireless Device Skills**	2	2-10	2.55	1.1
Informatics Skills - **Applied Computer Skills**	4 4	20 4-20	2.23 2.23	0.92 0.92
Total	30	150	2.49	0.73

N = 176.

Quality of Patients' HER Documentation

The results revealed that the highest mean score was for process attribute/quantity (M =13, SD = 0.00), while the lowest mean score was for content attribute/quantity (M =12.31, SD = 6.23). The total mean score for quality of documentation in the attributes (process/quantity, content/quantity with quality, structure/quality) was (M = 37.5, SD = 10.921) (Table 3).

Table 3. Quality of patients' electronic health record documentation

	Number of Items	Actual Total Score	Observed Total Score	%	*SD*
Process Attribute / Quantity	4	0-13	13	100	0.00
Content Attribute / Quantity	9	0-27	12.31	45.59	6.23
Content Attribute / Quality	7	0-21	10.53	50.14	4.16
Structure Attribute / Quality	1	0-3	1.69	56.33	0.531
Total	**21**	**64**	**37.53**	**63.01**	**10.921**

N=176.

Based on the scale interval created for the current study, the results revealed that the score for quality of documentation for process attribute was very good (100%), content attribute / quantity and quality had moderate quality of documentation (45.59%, 50.14%, respectively), and good quality in structure attribute (56.33%). In order to categorize the participants based on their scores, quartiles were used. The analysis showed that the highest percentage of participants (29.4%, n = 52) have moderate quality of HER documentation, while the lowest percentage of participants (22.4%, n = 39) have very good quality of HER documentation.

Relationship between NI Competency and Quality of Patients' HER Documentation with Continuous Variables

The results revealed that there is no association between nursing informatics competency sub-scales and quality of patients' EHRs documentation (Table 4). Also, there is a weak, but significant, association between age and quality of patients' EHR documentation (r = 0.279, p = 0.000). In addition, there is a weak significant association between years of experience and quality of patients' HER documentation (r = 0.259, p = 0.001). Also, there is a moderate significant association between training duration and quality of patients' HER documentation (r = 0.333, p = 0.002).

Table 4. Relationship between nursing informatics competency and quality of patients' electronic health record documentation with continuous variables

		Nursing Informatics Competency	Quality of Patient Electronic Health Record Documentation	Age	Years of Experience	Time Spent on the (EHR) Documentation	Duration of the Received Training Related to (EHR) Documentation	Previous Experience with (EHR) Documentation
Nursing Informatics competency	*r*	1	0.025	0.023	0.043	-0.03	0.044	0.230
	p		0.741	0.763	0.571	0.632	0.690	0.116
Quality of Patient Electronic Health Record Documentation	*r*	0.025	1	**0.279****	**0.259****	0.044	**0.333****	0.024
	p	0.741		**0.000**	**0.001**	0.561	**0.002**	0.870

P<0.05.

Variation in NI Competency and Quality of Patients' EHRs

The results revealed no statistically significant differences between personal, and clinical-related characteristics and NI competency (Table 5). However, there are statistically significant differences between the following personal and clinical-related characteristics: Hospital (F =148.35, p =0.000), Ratio (F =38.13,

p =0.000), Studied a Health Informatics Course in the University (t = -2.22, p =0.029), Accreditation (t =18.11, p =0.000), managerial motivation (t =18.11, p =0.000), and quality of patients' HER documentation.

Table 5. Differences in nursing informatics competency and quality of patients' electronic health record documentation

Variable	*N* (%)	Nursing Informatics Competency Mean (SD)	Test Statistic	*P*	Quality of Patients Electronic Health Record Documentation Mean (SD)	Test Statistic	*P*
Hospital							
- Irbid Field Hospital ICU	55 (31.25)	2.53 (0.835)			38.29 (5.83)		
- Al-Basheer Hospital Medical ICU	51 (29.0)	2.50 (0.597)			30.96 (3.48)		
- Al-Basheer Hospital Surgical ICU	35 (19.9)	2.48 (0.675)	*F =0.*254	p =0.907	28.63 (6.73)	*F* =148.35	***p* =0.000****
- Al-Basheer Hospital CCU	15 (8.5)	2.32 (0.631)			53.27 (3.80)		
- Al-Zarqa Governmental Hospital ICU	20 (11.4)	2.44 (0.935)			56.15 (4.10)		
Gender							
- Male	88 (50)	2.51 (0.751)	*t =0.*582	p =0.561	37.4 (11.1)	*t = -0.*175	p =0.861
- Female	88 (50)	2.45 (0.715)			37.6 (10.3)		
Educational Level							
- Bachelor Degree	160 (90.9)	2.45 (0.731)	*t* = -1.56	p =0.120	37.2 (10.59)	*t* = -1.32	p =0.186
- Master Degree	16 (9.1)	2.75 (0.708)			40.9 (11.88)		
Ratio (Nurse: Patient)							
- 1:2	13 (7.4)	2.70 (0.702)			32.2 (7.25)		
- 1:3	126 (71.6)	2.51 (0.740)	*F* =1.53	p =0.218	34.7 (7.95)	*F* =38.13	***p* =0.000****
- 1:4	37 (21)	2.32 (0.703)			48.9 (12.3)		
Shift							
- A	80 (45.5)	2.59 (0.745)	*t* =1.82	p =0.070	38.8 (9.94)	*t* =1.45	p =0.147
- BC	96 (54.5)	2.39 (0.712)			36.4 (11.2)		
Studied a Health Informatics Course in the University							
- Yes	128 (72.7)	2.52 (0.742)	*t* =1.03	p =0.304	36.3 (9.92)	*t* = -2.22	***p* =0.029****
- No	48 (27.3)	2.39 (0.703)			40.7 (12.1)		
Working in an Accredited Hospital							
- Yes	20 (11.4)	2.44 (0.935)	*t = -0.*200	p =0.843	56.15 (4.10)	*t* =18.11	***p* =0.000****
- No	156 (88.6)	2.49 (0.705)			35.17 (8.81)		
Managerial Motivation							
- Yes	20 (11.4)	2.44 (0.935)	*t = -0.*200	p =0.843	56.15 (4.10)	*t* =18.11	***p* =0.000****
- No	156 (88.6)	2.49 (0.705)			35.17 (8.81)		

P<0.05.

Predictors of Quality of Patients' EHR Documentation

Results from hierarchical multiple regression revealed that personal and clinical-related characteristics account for 93.7% of the variance in quality of patients' HER documentation (Model 1) (R^2 = 0.937, F = 8.707, p = 0.004) (Table 6). Once NI competencies were entered into the model (Model 2), R^2 did not change, making a total explained variance of 93.7% (R^2 = 0.937, F = 6.907, p = 0.013). In (Model 3), three categorical predictors (do you receive HER training in the hospital? Do you have a previous experience with HER documentation? and Accreditation) were used. These predictors account for 39.6 % of the variance in quality of patients' HER documentation (R^2 = 0.396, F = 37.582, p = 0.000). All of these models were statistically significant.

Table 6. Predictors for quality of patients' electronic health record documentation

	Predictors	Unstandardized β Coefficients	Standard Error	Standardized Coefficients Beta	*t*	*p*	Semi-partial Correlation	F	*p*	R^2
Model 1	**Age**	-0.995	1.46	**-0.419**	-0.635	0.534	-0.062	8.707	**0.004**	0.937
	Gender - Male = 0 - Female = 1	-1.04	4.68	-0.043	-0.244	0.829	-0.021			
	Educational Level - Bachelor = 0 - Master = 1	1.95	4.51	0.066	0.434	0.678	0.041			

	Years of Experience	0.249	1.65	0.107	0.150	0.885	0.014			
	Time Spent on (EHR) Documentation	-0.291	0.589	-0.062	-0.494	0.637	-0.047			
	Shift - A = 0 - BC = 1	-10.5	3.64	**-0.434**	-2.89	0.**023**	-0.274			
	Duration of Training Related to (EHR) Documentation	-2.70	1.52	-0.348	-1.77	0.119	-0.168			
	Studied an Informatics Course in the University - Yes = 1 - No = 0	1.01	4.86	0.034	0.210	0.840	0.020			
	Years of Previous Experience with (EHR) Documentation	1.23	1.41	0.272	0.878	0.409	0.083			
	Managerial Motivation - Yes = 1 - No = 0	-7.00	7.06	-0.236	-0.992	0.354	-0.094			
	Ratio (Nurse: Patient) - 1:2 vs 1:3 - 1:2 vs 1:4	 2.92 27.1	 4.69 8.01	 0.120 **0.986**	 0.622 3.38	 0.554 **0.012**	 0.059 0.320			
Model 2	**Nursing Informatics Competency**	0.238	-1.95	0.018	0.122	0.907	0.012	6.907	**0.013**	0.937
	Age **Gender** - Male = 0 - Female = 1	 -1.01 -1.10	 1.64 5.07	 -0.444 -0.046	 -0.615 -0.218	 0.561 0.835	 -0.063 -0.022			
	Educational Level - Bachelor = 0 - Master = 1	2.05	4.93	0.069	0.416	0.692	0.043			
	Years of Experience	.337	1.92	0.145	0.175	0.867	0.018			
	Time Spent on (EHR) Documentation	-00.301	0.641	-0.064	-0.469	0.655	-0.048			
	Shift - A = 0 - BC = 1	-10.1	4.82	-0.420	-2.11	.079	-0.216			
	Duration of Training Related to (EHR) Documentation	-2.58	1.90	-0.333	-1.36	0.223	-0.139			
	Studied an Informatics Course in the University - Yes = 1 - No = 0	0.741	5.71	0.025	0.130	0.901	0.013			
	Years of Previous Experience with (EHR) Documentation	1.20	1.54	0.266	0.783	0.463	0.080			
	Managerial Motivation - Yes = 1 - No = 0	-6.96	7.62	-0.234	-0.913	.396	-0.093			
	Ratio (Nurse to Patient) - 1:2 vs 1:3 - 1:2 vs 1:4	 3.11 27.0	 5.30 8.65	 0.128 **0.984**	 0.587 3.38	 0.579 **0.020**	 0.060 0.319			
Model 3	**Do you receive (EHR) documentation training?** - Yes = 1 - No = 0	-2.10	1.33	-0.098	-1.57	0.117	-0.093	37.5	**0.000**	0.396
	Do you have a previous experience with (EHR) documentation? - Yes = 1 - No = 0	0.180	1.42	0.008	0.126	0.900	0.007			
	Accreditation - Yes = 1 - No = 0	-19.9	2.099	**-0.592**	-9.51	**0.000**	-0.564			

Model 1: Adjusted R^2 = 0.830, df= (12), F = 8.707. **Model 2**: Adjusted R^2 = 0.802, R^2 change = 0.000, df= (13), F = 6.907. **Model 3**: Adjusted R^2 =0.385, df= (3), F = 37.582.

In the first model, working on 1:4 ratio explained significantly about (10.24 %) of the variance in quality of patients' HER documentation, and it was the strongest predictor (B = 0.986, p = 0.012). In addition, being on shift A explained significantly about (7.50%), and it was the second strongest predictor (B = -0.434, p

= 0.023). In the second model, working on 1:4 ratio explained significantly about (10.17 %) of the variance in quality of patients' HER documentation, and it was the strongest predictor (B = 0.984, p = 0.020). In the third model, accreditation explained significantly about (31.80%) of the variance in quality of patients' HER documentation, and it was the strongest predictor (B = -0.592, p = 0.000).

Discussion

Nursing informatics competency has been identified as a major component influencing the quality of health care services (Khezri & Abdekhoda, 2019). The current-study results revealed that the overall mean informatics competency score among nurses was low. Part of these results would be related to that some participants didn't receive a health informatics course in the university during their study period. Also, the quality of informatics education in universities seems to be poor. In addition, the absence of an appropriate system for monitoring and evaluation in the hospitals might be another factor impacting the low level of informatics competency among nurses in this study. Furthermore, the absence of continuous education in governmental hospitals might lead to a low level of informatics competency. In addition, more than a half of the study's participants did not receive training sessions related to the CPRS application. Lack of exposure to electronic heath record systems in hospitals during the training period in undergraduate nursing programs is a significant barrier to nursing informatics practice among registered nurses (Shin et al., 2018). Moreover, lack of time and burden of responsibilities giving the importance to direct patient care imped nurses' capabilities to improve their informatics competencies. However, work demands and staff shortage limit the utilization of nursing informatics (Olajubu et al., 2014). The current-study result is congruent with previous studies which revealed low nursing informatics competency levels among their study participants (Liston, 2019; Olajubu et al., 2014). In contrast, the current-study results were incongruent with previous studies which revealed that participants were competent and very good in nursing informatics competency (Al-Balawi et al., 2020; Alshammari et al., 2017; Elsayed, 2017; Hassona & Ali, 2019; Khamis Mohamed & Tharwat Abouzaied, 2021; Kinnunen et al., 2019).

The current-study results revealed that the informatics skills, knowledge, and computer skills were low. This could be related to nurses spending most of their time in direct patient care, not paying attention to the informatics skills, and feeling that they are not important. Also, nurses in the current study had a different level of education, experience, and informatics education, which could influence nurses' informatics knowledge competency. In addition, nurses in the current study obtained their latest qualification many years ago, as their mean age is 27.99 years, and most of them held bachelor degrees. Moreover, the content of NI-related education might not be sufficient for nurses to earn computer skills.

According to the study findings, there is no relationship between NI competency and quality of HER documentation. Low level of computer skills, specifically using database applications to enter and retrieve information, would contribute to the results. In addition, most nurses had low NI competency. Al-Balawi et al. (2020) reported the requirements to utilize computer skills competency with the implementation of EHRs in health care institutions, to offer safe and effective nursing care. In contrast, previous studies concluded a positive correlation between nursing informatics competency and quality and accuracy of EHRs (Al-Hawamdih & Ahmad, 2018; Lin et al., 2014). The contradiction in the results between studies would be related to differences in the sample characteristics, settings, and instruments used.

The current-study results revealed that the quality of documentation for process attribute was very good, whereas content attribute/quantity and quality had moderate quality of documentation, with good quality in structure attribute. Also, the highest percentage of participants have moderate quality of EHR documentation. This result could be related to low NI competency level, variation in the tool used to determine the documentation quality, lack of training on nursing documentation, in addition to that units included in this study were intensive care units, which had a high workload, lack of time, inadequate staffing, absence of documentation supervision, and lack of national and/or local guidelines on nursing documentation. The results are consistent with those of a previous study, which found moderate quality of documentation (Ghaleb Jebur, 2016).

The current-study results revealed a significant association between (age, years of experience, and

training duration on EHRs) and quality of patients' HER documentation. This could be related to that older nurses were shown to have long years of experience, and their exposure to training sessions is more, which will make them more familiar with operational standards of nursing documentation and make tasks of documentation easier, faster, and more enjoyable for nurses (Tamir et al., 2021). In addition, a long period of work for a nurse will enhance the ability to do a job including documentation of nursing care. Andualem et al. (2019) reported that work experience had a significant association with nurses' attitudes towards nursing care documentation. Nurses who had a good attitude toward nursing care documentation were also more likely to have good documentation practice compared to those who had a poor attitude (Kebede et al., 2017). On the other hand, Norouzi et al. (2018) found indirect weak correlations between age, years of experience and quality of documentation; so, quality of documentation decreased with increasing age and years of experience. This can be due to the effect of increasing age on reducing accuracy, increasing fatigue, decreasing motivation and moving away from education courses. In addition, Mote et al. (2016) found no significant relationship between age and quality of documentation, because the largest-age group in his study was <30 years. Age under 30 years is a productive age; at that age, the person can only achieve optimal work results (Mote et al., 2016).

The current-study results revealed a statistically significant difference between personal and clinical-related characteristics (Hospital, Ratio, Studied a Health Informatics Course in the University, accreditation, and managerial motivation) and quality of patients' electronic health record documentation. This could be related to low sample size, presence of JCI accreditation, and documentation supervision in Al-Zarqa Governmental Hospital ICU. However, there are statistically significant differences in specific elements of nursing documentation at the institutional level (Lindo et al., 2016). Also, there is a lack of time available for nursing documentation. In addition, there is a high workload for nurses in the intensive care units, as most nurses have been working with 1:3 staff to patient ratio. Previous studies reported that nurses with insufficient time were less likely to have good nursing care documentation compared to nurses with sufficient time (Andualem et al., 2019; Bijani et al., 2016; Blake-Mowatt et al., 2013; Jefferies et al., 2010; Kebede et al., 2017; Taiye, 2015).

The current-study results were contrary to the fact that nurses who had a lower ratio could have a better quality of documentation. This could be related to that (1:4) nurse: patient ratio was in the hospital which had JCI accreditation and documentation supervision in the critical care unit. The current-study result is incongruent with previous studies, which found a positive association between nurse ratio and quality of documentation, as when the ratio decreased, the documentation quality increased (Asamani et al., 2014; Kebede et al., 2017; Tamir et al., 2021). Adequate nurse to patient ratio may decrease workload and increase time to document their activity, which makes documentation practice more likely (Tamir et al., 2021).

Recent introduction of nursing informatics as a course into the nursing education curriculum is essential, as some staff nurses didn't study the material in the university. Also, respondents might depend on their clinical experience to document nursing notes rather than on an informatics course. Furthermore, nursing staff may lack awareness regarding the significance of nursing informatics in enhancing patient safety and ensuring quality of care. The current-study results are incongruent with Kinnunen et al. (2019) who reported very good quality of documentation according to national standards, and fairly good quality according to Finnish Care Classification (FINCC) as a result of the effect of nursing informatics education.

Accredited hospitals give sufficient educational courses and training programs to their employees. In addition, because of availability of documentation standards and guidelines in these hospitals, their staff nurses adhere to these guidelines. The current-study results are consistent with previous studies, which found statistically significant differences in hospital pre-and post-accreditation (Ajay et al., 2021; Hossam Attia et al., 2020; Nomura et al., 2016). However, once the institution made the decision to get accredited, improved compliance with documentation was taken as a priority (Ajay et al., 2021).

Motivation may improve nurses' attitude toward nursing documentation and encourage them to document their activity. Motivation can certainly affect performance. If a nurse is motivated in work, then she/he will try to work as hard as possible to finish her/his job (Mote et al., 2016). In addition, Gizaw et al.

(2018) found that respondents who have been motivated from their supervisors were almost four times more likely to practice good documentation than non-motivated ones.

According to the study findings, the results revealed that shift, ratio, and accreditation were the statistically significant predictors of quality of EHR documentation. The current-study results could be related to different variables that have been used in other studies, different samples, and different settings. The current-study results are inconsistent with a previous study which found that the nursing informatics competency, clinical specialty and years of experience were the significant predictors of quality of information processing (Al-Hawamdih & Ahmad, 2018). Also, Tubaishat (2017) found that professional rank, and dealing with the computers comfortably were significant predictors of quality of electronic heath records.

Limitations and Strengths

This is the first study to examine the relationship between nursing informatics competency and quality of patients' EHR documentation. The present study included intensive care units in hospitals in the north and middle regions of Jordan, which has never been done in previous studies regarding nursing informatics competency and quality of electronic health record documentation. However, this study had several limitations. Firstly, participants and auditing records were selected following the convenience sampling technique and from three hospitals only. Thus, the results may not represent nursing informatics competency and quality of electronic health record documentation in other hospitals and different sectors. In addition, the nurses were also recruited conveniently, which limits the generalizability of the study findings. Also, this study included only bachelor and master degree holders; thus, it does not represent informatics competency and quality of EHR documentation for diploma-degree holders and nurses' mangers. Secondly, for the informatics competency participants, the auditing process was conducted only in the records of the intensive care units, which may not represent the records of other departments or units. Finally, nursing informatics competency was measured using a self-reported questionnaire, which may be practical, but may not reflect nurses' actual informatics competency. In addition, social desirability may have influenced the nurses' responses and hence the results, as nurses may have overestimated or underestimated their competences.

Implications for Nursing

The study's findings should be shared with all stockholders, including physicians and nurses who use the electronic health system in the selected hospitals, nursing informatics specialists, nurse leaders and managers in the education and practice sectors, hospital managers, policymakers, and technical specialists in the electronic health system. They should collaborate and begin a national policy conversation with active strategic discussions that enhance nurses' documentation quality in order to develop a solution and strategic actions to address the various issues and concerns raised in this study.

Nurses should be given proper training, and patients' EHRs must be audited on a regular basis. Also, nursing researchers may benefit from the findings of this study and conduct additional research that focuses on the findings and recommendations made in this study. In addition, improving nursing education programs in areas such as NI competency and basic computer skills, as well as the nursing process and its application in nursing practice and electronic documentation, can help nurses provide better nursing care and improve patient outcomes. Furthermore, solid policies, guidelines, protocols, standards, quality improvement indicators, and action plans, with strong monitoring and evaluation systems, should be placed, as they are crucial for improving nursing informatics competences, quality of EHR documentation, knowledge and application of the nursing process in electronic health records. In turn, this will confirm appropriate nursing practice and improve patient outcomes.

Conclusions

The present study revealed a low level of nursing informatics competency among the nurses, very good quality nursing documentation in process attribute, good quality in structure attribute, and moderate quality and quantity in content attribute, and problems regarding the integration of nursing process in electronic health record documentation are disappointing. In addition, the highest percentage of participants have a moderate quality of EHR documentation. Furthermore, personal and clinical-related characteristics account for 93.7% of

the variance in quality of patients' electronic health record documentation.

Wide national studies on nurse informatics competencies and electronic nursing documentation are needed, as is more in-depth qualitative and quantitative research. Studies are also needed to examine and guide knowledge of the key reasons for nurses' lack of nursing informatics competency, as well as the poor accuracy and quality of nursing documentation. Furthermore, additional analytical research examining factors that affect informatics competency among practicing nurses and nurse managers, as well as leaders, is needed.

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