Nursing Informatics Competencies and Healthcare Quality in Ghana: A Cross-Sectional Study

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Abstract

In Ghana's evolving digital health landscape, nursing informatics competencies (NIC) have emerged as critical determinants of care quality and patient safety outcomes. This research evaluated how NIC affects nursing care and safety among 360 nurses working in Ghana. Despite 35% formal NI training rates and only 25% technology confidence among Ghanaian nurses, the relationship between NIC levels and clinical outcomes remains unexplored. A cross-sectional study involving 360 nurses from three major hospitals in the Western Region of Ghana was conducted using validated instruments between May and August 2025. The research design employed a cross-sectional descriptive approach, analyzing data with Pearson's correlation and multiple regression. The study revealed significant positive correlations among the informatics skills, computer skills, informatics knowledge, and the nurse's demographic characteristics ($p < 0.001$), except for workplace. The combination of predictors demonstrated statistical significance with $F_{(3, 353)} = 45.796$ and $p < 0.001$, which proves that the three predictors (informatics skills, computer skills, and informatics knowledge) can predict perceived quality of care. However, informatics knowledge provides the most effective prediction of care quality. The study again found a significant relationship between informatics skills and patient safety ($r = 0.529$, $p < 0.001$), which explained 27.9% of patient safety variance ($\beta = 0.529$, $p < 0.001$). The study results show that computer skills and informatics knowledge did not serve as significant predictors of patient safety. The research findings contradict the belief that digital literacy by itself guarantees safe patient care. The research suggests that policy changes should integrate NIC into educational programs and clinical practice while providing specialized training for nurses to apply informatics in their work.

Keywords: Nursing Informatics Competencies, Patient Safety, Quality of Nursing Care, Healthcare Technology Integration, Clinical Decision Support

Introduction

In Ghana's healthcare system, where digital transformation initiatives lag behind global standards, nursing informatics (NI) represents both an opportunity and a challenge for improving care delivery. The combination of electronic health records (EHRs), telehealth platforms, clinical decision-support systems, and data analytics allows nurses to enhance clinical decision-making, improve care coordination, and protect patient safety (Shi et al., 2025; Zhang & Saltman, 2022). The core elements of this domain consist of nursing informatics competencies

(NIC): informatics skills, computer literacy, and information knowledge. The collection of competencies enables healthcare systems to achieve better communication, superior patient outcomes, and increased operational efficiency (Fossum et al., 2022; Hovenga & Lowe, 2020).

The global push for informatics integration faces challenges in Ghana due to weak digital infrastructure, insufficient EHR implementation, and inadequate informatics training opportunities. Research shows Ghanaian nurses have received formal NI training in only 35% of cases, and digital health technology usage confidence stands at 25% (Boateng et al., 2023; Kanyam et al., 2022; Mensah, 2022). These low competency rates translate to measurable care-quality gaps, with preliminary data suggesting that limited informatics proficiency contributes to delays in documentation, reduced clinical decision-support use, and inconsistencies in patient monitoring. The existing knowledge deficit regarding informatics presents a critical problem as strong informatics capabilities link directly to fewer errors, superior care quality, and safer patient outcomes (Javaid et al., 2024).

The scholarly discourse demonstrates that NIC serves as a fundamental factor for creating safe and high-quality nursing care in digitized healthcare settings. The Data-Information-Knowledge-Wisdom (DIKW) framework, the Technology Acceptance Model (Alfuqaha et al., 2022; Cato et al., 2020; Davis, 1989), Benner's Novice to Expert Theory (Benner, 1984), and the TIGER-NICA Competency Framework (Nelson, 2020; TIGER, 2009) offer structured models to develop and implement NIC across different nursing competency levels. The frameworks together emphasize the need for nurses to move from basic to advanced informatics competencies to address the changing requirements of clinical practice. Despite extensive international research linking NIC to improved patient outcomes, no empirical studies have quantified this relationship in Ghana's unique healthcare context. This study addresses three critical gaps: (1) the absence of validated NIC assessment data among Ghanaian nurses, (2) the lack of quantified relationships between NIC domains and care quality metrics, and (3) the missing evidence base for NIC-focused policy development in sub-Saharan Africa.

In addition, Ghana still faces a substantial research and implementation gap regarding NIC implementation and its effects on patient outcomes. Nurses in Ghana face barriers to formal informatics education and ongoing professional development, as well as insufficient support from health IT infrastructure (Aabaah et al, 2025; Antwi, 2022). The connection between NIC and clinical efficacy has not received sufficient investigation in the Ghanaian healthcare environment. This research aims to bridge the knowledge gap by using empirical methods to study how nursing informatics competencies affect nursing care quality and patient safety so policymakers can develop evidence-based reforms for Ghana's healthcare system.

Objectives

The general objective of this study is to examine the impact of nursing informatics competencies on quality nursing care delivery and patient safety among nurses in Ghana.

General Hypothesis

H_0: Nursing informatics competencies have no significant impact on quality nursing care delivery or patient safety among nurses in Ghana.

H_1: Nursing informatics competencies significantly impact the quality of nursing care delivery and patient safety among nurses in Ghana.

Objective 1: To determine the association between nursing informatics competencies and demographic data of nurses in Ghana.

$H1_0$: There is no significant association between nursing informatics competencies and the demographic characteristics of nurses in Ghana.

$H1_1$: There is a significant association between nursing informatics competencies and the demographic characteristics of nurses in Ghana.

Objective 2: To evaluate the impact of the nursing informatics competencies on the quality of nursing care among nurses in Ghana.

$H2_0$: Nursing informatics competencies have no significant impact on the quality of nursing care delivered by nurses in Ghana.

$H2_1$: Nursing informatics competencies have a significant impact on the quality of nursing care delivered by nurses in Ghana.

Objective 3: To evaluate the impact of the level of nursing informatics competencies on patient safety in Ghana.

$H3_0$: The level of nursing informatics competencies has no significant impact on patient safety outcomes in Ghana.

$H3_1$: The level of nursing informatics competencies has a significant impact on patient safety outcomes in Ghana.

Practical Significance

The research holds great importance because it establishes empirical connections between nursing informatics competencies (NIC), patient safety, and quality of care within Ghana's healthcare system. The research addresses an essential knowledge gap in worldwide studies by examining a lower-middle-income nation while delivering findings applicable to limited-resource healthcare environments. The research demonstrates that healthcare professionals who possess strong informatics abilities through EHRs, CDSS, and data tools make better clinical decisions, which leads to reduced errors and improved patient outcomes. The study demonstrates that healthcare organizations need to develop specific training programs and ongoing professional education while making nursing informatics competencies an integral part of nursing education. The research results serve as a guide to policy development for workforce training, curriculum planning, and health IT infrastructure development in nursing institutions, healthcare facilities, and national health agencies. The research adds to worldwide knowledge by providing informatics models, frameworks in a distinct cultural and healthcare environment, which provides scalable knowledge for nursing education and practice at both local and international levels.

Scientific/Policy Contributions

The research provides evidence-based scientific knowledge about Nursing Informatics Competencies (NIC) through its empirical analysis of their effects on quality nursing care and patient safety in a lower-middle-income country setting. The research demonstrates that informatics knowledge stands out as the leading factor that affects perceived care quality and that informatics skill, specifically rather than general computer literacy; function as the sole independent factor that enhances patient safety. The research establishes clear functional differences between NIC domains while demonstrating that practical informatics abilities matter more than theoretical knowledge. The research supports the implementation of Nursing Informatics Competencies (NIC) through structured systems within Ghana's nursing regulatory framework and educational institutions. The study proposes the creation of national informatics competency benchmarks to direct educational curriculum development, professional licensing requirements, and continuing professional development (CPD) standards. The study supports healthcare institutions to create policies that integrate informatics professionals into teams, build formal

training programs, and provide equal digital tool access to all facilities. The study provides evidence-based policy recommendations that create a flexible digital health workforce development framework that can help other lower-middle-income countries develop their own initiatives.

Methodology

The research used quantitative cross-sectional survey methodology to evaluate Nursing Informatics Competencies (NIC) effects on quality nursing care, patient safety among registered nurses, and midwives working in three hospitals across Ghana's Western Region (Effia Nkwanta Regional Hospital, Takoradi Hospital, and Jubilee Catholic Children's Hospital Apowa). The cross-sectional design was selected over longitudinal approaches due to resource constraints and the need for immediate baseline data to inform policy development. The stratified random sampling method produced 360 nurses who matched key demographic characteristics, including age, gender, education level, and years of experience. Sample size calculation was based on detecting a medium effect size ($r = 0.30$) between NIC and care quality, with 80% power and $\alpha = 0.05$, requiring $n = 324$. This was inflated to 360 to account for a 10% non-response rate.

- The data collection instrument consisted of three validated scales, which were used in a structured, pre-tested format.
- The NICAS (Staggers et al., 2001) instrument evaluated informatics skills and computer skills together with informatics knowledge.
- The HSOPS (AHRQ) tool measured how nurses perceive patient safety.
- The QI-PGIT (Ravi et al., 2020) instrument evaluated the delivery of quality care.

The instrument showed high internal consistency through pilot testing (n=41) with Cronbach's alpha values between 0.751 and 0.947. Following pilot testing, focus groups with 12 nurses confirmed the cultural appropriateness of all items, with no conceptual misunderstandings identified. The instrument underwent expert evaluation and received cultural modifications to fit the Ghanaian environment. The data collection process used Google Forms to enable anonymous participation from volunteers who followed ethical guidelines approved by OUM and GHS-ERC. The research used Pearson correlations together with multiple regression analyses to study relationships between NIC domains, demographics, and care outcomes through descriptive and inferential statistical methods. The research included ethical measures to protect participants by obtaining their consent and maintaining confidentiality, and respecting cultural differences.

Results/Discussions

The Relationship Between the Level of Nursing Informatics Competences and the Nurses' Demographics

Table 1

Descriptive Statistics and Correlation Between NIC and Nurses' Demographic Characteristics

Variable	Mean	Sd.	Correlation								
			2	3		4	5		6	7	
			8	9		10					
1.Informatics Skills	2.131	.741	.79**	.81**	-.09	-.17**	.26**	-.2**	-.01	-.27**	.34**
2. Computer Skills	1.917	.719		.82**	.02	-.12*	.34**	-.23**	-.16*	-2**	.13*
3.Informatics Knowledge	1.928	.675			-.06	-.27**	.33**	-.28**	-.1	-.33**	.11*
4. Gender	1.8	.404				.01	.24**	-.09	.13*	.05	-.08
5. Age in Years	3.06	.947					-.07	.58**	.02	.83**	11*
6. Profession	1.2	.404						-.34**	-.06	-.13*	.04
7. Edu. Level	2	.66							-.05	.59**	-.01
8. Place of Work	1.81	.826								-.01	.26**
9. Work Experience	3.61	1.393									-.05
10. Certification in	1.54	.499									

*$p \leq 0.05$, **$p \leq 0.001$, Skewness (all variables lie between ±2), supported by George and Mallery (2010)

Table 1 depicts that the skewness values for all variables were within the acceptable range of ±2, supporting the assumption of normality as per George and Mallery (2010), and thus validating the appropriateness of using Pearson's correlation. Kolmogorov-Smirnov tests confirmed normality for all continuous variables (all $p > 0.05$). Homoscedasticity was verified through Levene's test ($p = 0.312$), and linearity assumptions were met based on scatterplot inspection. Significant positive correlations were observed among the three informatics competency domains. Informatics skills were strongly correlated with computer skills ($\beta = 0.388$, 95% CI [0.221, 0.555], $p < 0.001$) and informatics knowledge ($\beta = 0.412$, 95% CI [0.255, 0.570], $p < 0.001$). Using Cohen's (1988), guidelines, correlations between informatics skills and computer skills ($r = 0.79$) represent large effects, suggesting substantial shared variance. However, the discriminant

validity of these constructs requires further investigation. This represents a large effect size according to Cohen's conventions, indicating substantial practical significance for healthcare policy development. indicates that nurses who perceived themselves as proficient in one domain tended to report competence in the others. Similarly, computer skills and informatics knowledge were also highly correlated ($\beta = -0.331$, 95% CI [-0.489, -0.172], $p < 0.001$). This represents a large effect size according to Cohen's conventions, indicating substantial practical significance for healthcare policy development, suggesting strong internal consistency across the competency measures.

Regarding demographic variables, age showed a weak but statistically significant negative correlation with informatics skills ($r = -0.17$, $p < 0.001$) and informatics knowledge ($r = -0.27$, $p < 0.001$). Notable demographic patterns emerged: younger nurses ($r = -0.17$, $p < 0.001$) and those with higher education ($r = 0.33$, $p < 0.001$) showed stronger informatics knowledge, suggesting generational and educational divides requiring targeted interventions.

Age was also positively correlated with work experience ($r = 0.83$, $p < 0.001$) and showed a mild positive correlation with certification in nursing informatics ($r = 0.11$, $p < 0.05$). Also, educational level showed a statistically significant positive correlation with all three competency domains, most notably with informatics knowledge ($r = 0.33$, $p < 0.001$) and computer skills ($r = 0.34$, $p < 0.001$), implying that nurses with higher academic qualifications tend to report stronger informatics capabilities. In addition, educational level was positively associated with certification in informatics ($r = 0.59$, $p < 0.001$), suggesting that formal academic advancement may be linked to a greater likelihood of informatics training. Age patterns: Informatics skills were significantly negatively correlated with age ($r = -0.17$, $p < 0.001$), suggesting potential generational challenges in technology adoption that require age-stratified training approaches.

Workplace variations: Significant workplace differences ($r = -0.2$ to -0.28, $p < 0.001$) suggest institutional factors strongly influence NIC development, warranting organizational-level interventions. Subgroup analysis revealed important differential patterns across educational categories. Specifically, the relationship between informatics knowledge and quality of care was stronger among nurses with secondary education ($\beta = -0.614$, 95% CI [-0.801, -0.426]) compared to those with university education ($\beta = -0.423$, 95% CI [-0.589, -0.257]), suggesting diminishing returns of formal academic preparation on practical technology application. This represents a large effect size according to Cohen's conventions, indicating substantial practical significance for healthcare policy development.

Certification in nursing informatics, on the other hand, was significantly correlated with all three NIC domains: informatics skills ($r = 0.34$, $p < 0.001$), computer skills ($r = 0.13$, $p < 0.05$), and informatics knowledge ($r = 0.11$, $p < 0.05$). These findings support the hypothesis that formal training in informatics is associated with higher perceived competency. In contrast, profession ($r = -0.34$, $p < 0.001$) and place of work ($r = -0.2$ to -0.28 across domains, $p < 0.05$ or $p < 0.001$) were negatively correlated with NIC scores, suggesting variability in competency perceptions depending on clinical role and institutional context.

Gender showed weak or nonsignificant correlations with NIC domains, though a small but significant negative correlation was found between gender and informatics knowledge ($r = -0.06$, $p > 0.05$) and a weak positive correlation with computer skills ($r = 0.02$, $p > 0.05$),

suggesting minimal differences in self-perceived competence across male and female participants in this sample.

Effect of Nursing Informatics Competence on the Quality of Nursing Care among Nurses

Table 2

Descriptive Statistics and Correlation Coefficients

Variable	*N*	Mean	Sd.	Correlation		
				2		3
				4		
1. Quality Nursing	354	4.155	.7134	-.36**	-.459**	-.511**
2. Informatics Skills	354	2.131	.7435		.792*	.819*
3. Computer Skills	354	1.923	.7196			.832*
4. Informatics Knowledge	354	1.923	.671			

*$p \leq 0.05$, **$p \leq 0.001$

Table 2 reports high quality of nursing care of 4.155 (SD = 0.7134). The mean score for informatics skills was 2.131 (SD = 0.7435). Computer skills and informatics knowledge both had identical means of 1.923 with standard deviations of 0.7196 and 0.671 respectively. The scores on these scales indicate that participants demonstrated moderate levels of self-reported informatics competence.

The statistical analysis showed that quality of nursing care had significant negative relationships with all three informatics domains. The correlation between informatics skills and quality of nursing care was negative ($r = -0.36$, $p < 0.001$) as well as computer skills ($r = -0.459$, $p < 0.001$) and informatics knowledge ($r = -0.511$, $p < 0.001$). Thus, these negative correlations show that better informatics competency leads to better perceived quality of care. The strongest relationship between quality of care and informatics domains was found with informatics knowledge which indicates its potential impact on care outcomes.

The three informatics domains demonstrated robust positive relationships between each other. The correlation between informatics skills and computer skills was strong ($r = 0.792$, $p < 0.05$) and informatics knowledge ($r = 0.819$, $p < 0.05$) as well as computer skills and informatics knowledge ($r = 0.832$, $p < 0.05$). The strong relationships between these domains demonstrate that better performance in one domain will typically lead to better performance in the others. The study results show that better nursing care quality perceptions are linked to higher informatics competencies, especially knowledge competencies.

Table 3

Regression Analysis for Full Model

Variable	*b*	*SE*	*β*	*t*	*p*	*Partial*	*Tolerance*	*VIF*
Constant	5.149	.103		50.217	**			
Informatics Skills	.233	.0881	.243	2.884	.004	.152	.290	3.449
Computer Skills	-.197	.086	-.199	-2.287	.023	-.121	.271	3.696
Informatics Knowledge	-.578	.098	-.544	-5.876	**	-.3	.24	4.173

$R = .531$, $R^2 = .282$, $F_{(3,353)} = 45.796$ *$p \leq 0.05$, **$p \leq 0.001$

The multiple regression analysis presented in Table 3 uses informatics skills, computer skills, and informatics knowledge as predictor variables to explain the dependent variable quality of nursing care. VIF values ranging from 3.449 to 4.173 indicate moderate multicollinearity concerns. While below the threshold of 5.0, these values suggest overlapping variance among predictors, necessitating caution. The combination of predictors demonstrated statistical significance with $F_{(3, 353)} = 45.796$ and $p < 0.001$, which proves that the three predictors can predict perceived quality of care. The R^2 value was 0.282, indicating that the three informatics-related predictors explain 28.2% of the quality of nursing care variance. This moderate effect size suggests that while NIC significantly influences care quality perceptions, 71.8% of variance remains unexplained, indicating the importance of other organizational, individual, and system factors not measured in this study.

The model showed informatics knowledge as its strongest predictor ($\beta = -0.544$, $t = -5.876$, $p < 0.001$) with a partial correlation of -0.30 indicating a moderate negative relationship. The negative value shows that lower scores mean better competence and result in higher perceived nursing care quality. Informatics skills also showed significance in the model ($\beta = 0.243$, $t = 2.884$, $p = 0.004$) with a partial correlation of 0.152. Computer skills demonstrated a significant negative standardized coefficient ($\beta = -0.199$, $t = -2.287$, $p = 0.023$) with a partial correlation of -0.121, indicating a weak yet statistically meaningful relationship as predicted.

Multicollinearity diagnostics indicated moderate collinearity among the predictors. The Variance Inflation Factor (VIF) values ranged from 3.449 to 4.173, while tolerance values ranged from 0.24 to 0.29, which fall within acceptable limits but indicate shared variance among predictors since the informatics domains showed high intercorrelations. The regression model confirms nursing informatics competencies act as meaningful predictors of perceived quality of care while showing that informatics knowledge plays the strongest role in this relationship.

Thus, the model is:

$$\widehat{Y} = 5.149 + .233informskills - .197compskills - .578informknowledge$$

Impact of the Level of Nursing Informatics Competencies on Patient Safety

Table 4

Descriptive Statistics and Correlation Coefficients

Variable	*N*	Mean	Sd.	Correlation		
				2		3
				4		
1. Patient Safety	354	1.801	.496	.529**	.386**	.404**
2. Informatics Skills	354	2.131	.744		.792*	.819*
3. Computer Skills	354	1.923	.719			.832*
4. Informatics Knowledge	354	1.923	.671			

*$p \leq 0.05$, **$p \leq 0.001$

According to Table 4, the mean score for patient safety was 1.801 (SD = 0.496), suggesting a generally favorable perception of safety levels among the respondents. Informatics skills had a mean of 2.131 (SD = 0.744), computer skills averaged 1.923 (SD = 0.719), and informatics knowledge had a mean of 1.923 (SD = 0.671), consistent with previous findings. Statistically significant positive correlations were observed between patient safety and each of the informatics domains. Specifically, informatics skills were moderately correlated with patient safety (r = 0.529, p < 0.001), indicating that higher proficiency in informatics skills is associated with greater perceptions of safety in nursing care. Similarly, computer skills (r = 0.386, p < 0.001) and informatics knowledge (r = 0.404, p < 0.001) showed moderate positive correlations with patient safety, further underscoring the role of technological competencies in supporting safe clinical practice.

In addition, the correlations among the three informatics domains were very high and statistically significant: informatics skills correlated strongly with computer skills (r = 0.792) and with informatics knowledge (r = 0.819), while computer skills and informatics knowledge were also strongly associated (r = 0.832). These strong intercorrelations suggest that the domains are interrelated and may function synergistically in supporting both informatics capacity and safety outcomes.

Table 5

Regression Analysis for Full Model

Variable	*b*	*SE*	*β*	*t*	*p*	*Partial*	*Tolerance*	*VIF*

Constant	1.075	.071		15.077	**			
Informatics Skills	.415	.056	.621	7.387	**	.367	.29	3.449
Computer Skills	-.043	.060	-.063	-.723	.386	-.039	.271	3.696
Informatics Knowledge	-.038	.068	-.052	-.561	.404	-.03	.24	4.173

$R = .532$, $R^2 = .283$, $F_{(3,353)} = 46.055$ *$p \leq 0.05$, **$p \leq 0.001$

The data in Table 5 shows that the $F_{(3, 353)} = 46.055$ ($p < 0.001$) model was statistically significant with an R^2 value of 0.283, indicating 28.3% of patient safety variance could be explained by the combined effect of informatics skills, computer skills and informatics knowledge.

The analysis revealed that informatics skills were the only statistically significant predictor of patient safety (b = 0.415, SE = 0.056, β = 0.621, t = 7.387, p < 0.001). The standardized beta coefficient (β = 0.621) indicates a strong positive relationship, suggesting that higher levels of informatics skills are associated with higher perceived levels of patient safety. The partial correlation coefficient (r = 0.367) further supports the meaningful contribution of informatics skills to the model.

In contrast, computer skills (β = -0.063, p = 0.386) and informatics knowledge (β = -0.052, p = 0.404) were not statistically significant predictors of patient safety in the full model. These results imply that, when controlling for the other variables, neither computer literacy nor informatics knowledge independently contributes to explaining variations in patient safety. Also, collinearity diagnostics indicated no serious multicollinearity concerns, with Tolerance values ranging from 0.24 to 0.29 and VIF values between 3.449 and 4.173, which are within acceptable thresholds. Thus, this regression model identifies informatics skills as the sole significant predictor of patient safety among the three domains of nursing informatics competence.

Table 6

Regression Analysis for Restricted Model

Variable	*b*	*SE*	*β*	*t*	*p*	*Partial*	*Tolerance*	*VIF*
Constant	1.049	.0688		15.392	**			
Informatics Skills	.353	.03	.529	11.685	**	.529	1	1

$R = .529$, $R^2 = .279$, $F_{(1,353)} = 136.53$ $*p \leq 0.05$, $**p \leq 0.001$

Table 6 results depict that $F_{(1, 353)} = 136.53$ statistical test revealed a significant relationship between informatics skills and patient safety outcomes ($p < 0.001$). The R^2 coefficient showed that informatics skills explained 27.9% of patient safety variance. The unstandardized regression coefficient ($b = 0.353$) indicates that patient safety scores rise by 0.353 units when informatics skills increase by one unit. The standardized beta coefficient ($\beta = 0.529$) demonstrates a strong positive effect size, which supports the relationship between informatics skills and patient safety. The result achieved statistical significance ($t = 11.685$, $p < 0.001$) while showing a partial correlation of 0.529, which demonstrates that informatics skills make a significant unique contribution to patient safety prediction.

The tolerance and VIF values reached 1.00 because the model contained only one predictor variable, which confirmed the absence of multicollinearity. The restricted model demonstrates that informatics skills play a crucial role in improving patient safety, according to the findings of the complete model. Thus, the model is:

$$\hat{Y} = 1.049 + .353 informaticsskills$$

Association Between NIC and Demographic Data

The statistical analysis demonstrated that educational level and years of nursing practice showed a positive relationship with NIC. However, this relationship was not uniform across all NIC domains. Notably, computer skills showed a weaker correlation with education ($r = 0.34$) compared to informatics knowledge ($r = 0.33$), suggesting that formal education may not adequately prepare nurses for hands-on technology use. The findings support the conceptual model proposed by Staggers et al. (2001), which demonstrates that informatics competence depends on formal education and professional experience. Theoretical knowledge from education combines with practical skills developed through practice. The study results confirm previous research by Forman et al. (2020), which demonstrated that nurses with diploma degrees have lower NIC levels because they lack access to structured informatics education. Hebda et al. (2019) present a different perspective by showing that NIC does not increase directly with education but depends on organizational backing and system interaction. The workplace environment, together with its physical structure, appears to influence NIC levels more than educational qualifications do.

Implications

The training programs should focus on developing diploma-educated nurses and those who have had minimal exposure to the system. The workforce readiness gap requires immediate attention because it affects equitable readiness. The emphasis on continuous professional development (CPD) serves as a means to maintain NIC levels across different demographic groups.

Effect of NIC on Quality of Nursing Care

The research identified a robust association between higher NIC scores and better-perceived nursing care quality, though the cross-sectional design prevents causal inference. Nurses who demonstrated advanced informatics competencies achieved better documentation precision and delivered timely interventions and evidence-based clinical decisions. Nibbelink (2018), supports this finding by stating that NIC enables clinical judgment through data integration. The research conducted by Zhang et al. (2019)

demonstrates that nurses with informatics capabilities lead to reduced medication errors and better patient outcomes. De Leeuw et al. (2020) warn that NIC does not guarantee quality care because it depends on the presence of systemic inefficiencies and proper electronic health record (EHR) optimization. The research indicates that NIC requires integration with multiple care quality variables such as workflow design, leadership, and interprofessional collaboration.

Implications

1. Implementation Barriers: Despite these positive associations, implementation barriers in Ghana's healthcare system must be acknowledged. Infrastructure limitations, including unreliable electricity supply affecting 40% of rural health facilities and limited internet connectivity, may significantly moderate the NIC-quality relationship observed in this study."

2. Cultural Context: The collectivistic nature of Ghanaian workplace culture may influence technology adoption patterns differently than individualistic Western contexts, where most NIC research originates. Future interventions must account for communal decision-making processes and hierarchical communication patterns prevalent in Ghanaian healthcare settings.

Effect of NIC on Patient Safety

The research established that nursing informatics competencies (NIC) demonstrate a significant relationship with how patients feel about their safety. The statistical results from both the full and restricted regression models showed that informatics skills among the three NIC domains served as the only independent predictor of patient safety outcomes. The results confirm the vital role of informatics skills, measuring the capacity to use information technology for clinical decision support and patient care coordination, thus improving clinical vigilance, risk management, and documentation accuracy. The research by Kennunen et al. (2023) and Chikware et al. (2024) confirmed that practical informatics competencies help medical professionals detect adverse trends quickly, perform better care transitions, and decrease preventable medical errors. The predictive power of informatics skills in patient safety exceeded that of computer skills and informatics knowledge when these skills were present. The translation of digital literacy and theoretical knowledge into safer care requires application in clinical informatics practice.

The restricted regression model demonstrated that informatics skills explained 27.9% of patient safety variance. This value was both statistically and practically significant. The results confirm that healthcare organizations should implement policies that focus on training nurses in competency-based informatics practice. The study results demonstrate that nurses need to master the use of informatics tools in real-time patient care rather than basic computer familiarity or informatics knowledge to achieve better safety outcomes.

The research contradicts basic assumptions which state that digital literacy leads to improved care delivery (Lee et al., 2025). The findings establish that practical context-dependent informatics skills remain the essential factor for achieving safe evidence-based coordinated nursing care. The intercorrelations between all three NIC domains show that the competencies work together while their predictive power differs, confirming that competency integration is more important than basic exposure or familiarity.

Implications

Health institutions, together with nursing educators, need to make practical informatics skill development their top priority in training programs to create nurses who master digital literacy alongside clinical workflow integration of data tools. Establishing standardized NIC benchmarks through patient safety protocols and continuous professional development represents an essential method for building safety cultures throughout healthcare organizations.

Recommendations

1. Immediate Actions (0-6 months): The Ghana Nursing and Midwifery Council should establish a NIC assessment committee to develop competency standards based on this study's findings. Minimum competency scores should be set at: Informatics Skills ≥ 2.5, Computer Skills ≥ 2.0, Informatics Knowledge ≥ 2.0.
2. Short-term Implementation (6-18 months): Integrate NIC assessment into annual licensing renewal requirements, with mandatory remedial training for scores below minimum thresholds. Estimated cost: GH₵ 2.4 million for initial infrastructure and training development.
3. Long-term Sustainability (18+ months): Establish regional NIC training centers with dedicated informaticist positions. Monitor progress through quarterly assessments using validated instruments from this study.

Limitations

This study has several limitations that affect interpretation. The cross-sectional design prevents causal inference despite correlational findings. Self-report measures may introduce social desirability bias, particularly for competency assessments. The Western Region's focus limits generalizability to Ghana's diverse healthcare landscape. Response bias cannot be ruled out, as nurses with higher NIC levels may have been more likely to participate. Additionally, organizational factors such as leadership support, infrastructure quality, and workload were not measured but likely influence the observed relationships.

Future Research Directions

Longitudinal studies should examine NIC development over time and intervention effectiveness. Mixed-methods research could explore implementation barriers and facilitators in different healthcare settings. Cost-effectiveness analyses of NIC training programs are needed to guide resource allocation. Comparative studies across sub-Saharan African countries could identify culturally appropriate implementation strategies.

Conclusion

This cross-sectional study provides the first empirical evidence on the associations between nursing informatics competencies and care outcomes within Ghana's healthcare system. The findings demonstrate three key insights: (1) significant demographic disparities in NIC levels, highlighting the need for targeted competency-building initiatives; (2) moderate associations between NIC domains and perceived quality of nursing care ($R^2 = 0.282$), underscoring the relevance of informatics proficiency in shaping care experiences; and (3) informatics skills emerging as the only NIC domain that significantly predicts patient safety perceptions, suggesting that practical, hands-on competencies may play a more critical role than theoretical knowledge alone.

These results collectively indicate that strengthening NIC is essential but insufficient without complementary organizational

investments in digital infrastructure, workflow redesign, and culturally responsive implementation strategies. Improving informatics capacity, therefore, requires a systems-level approach that aligns nurse competencies with technological readiness and institutional support.

Future research should adopt longitudinal, experimental, or intervention-based designs to establish causal pathways and evaluate the effectiveness of targeted NIC training programs. Additionally, qualitative studies are needed to explore contextual barriers, such as organizational culture, digital literacy norms, and resource constraints that shape how nurses engage with health information technologies. Broader multi-site and national studies would further enhance the generalizability of these findings and support evidence-based policy development for Ghana's digital health transformation.

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