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Evaluation Of The Role Of Nursing Staff Accompanying Infection Cases In The Intensive Care Unit Of Health Facilities

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ABSTRACT

Intensive care units (ICUs) have a high risk of causing a healthcare-associated infection in a patient, and nursing staff members have a crucial role in preventing them. Nevertheless, there was no in-depth analysis of the factors that predetermined the adherence of the nurses to the infection control measures since the former research tended to analyze knowledge, practice, and contextual obstacles separately. This research paper was intended to perform a combined assessment of the ICU nursing staff involvement by conducting a simultaneous knowledge assessment, compliance assessment, and a perceived barriers assessment and facilitator assessment. The chosen method of study was a mixed-methods, cross-sectional study involving 120 nurses in two tertiary-care hospitals. Data were gathered using a knowledge questionnaire, which had been validated, a structured observational checklist, and in-depth interviews. Pearson correlation, t- tests, and multiple linear regression were applied in the analysis of quantitative data. The findings showed that there was a positive relationship between the knowledge scores and the compliance rate ($r = 0.821$, $p < 0.001$). Knowledge was reported to be the strongest predictor of compliance ($R 2 = 0.758$, $p < 0.001$, $\eta^2 = 0.610$, $p < 0.001$), and high workload ($= -0.190$, $p = 0.034$) and night shift duties ($= -0.101$, $p = 0.034$) were significant negative predictors in the regression model. Qualitatively, resource scarcity and excessive patient acuity were the most significant obstacles, and positive leadership and peer accountability were the most significant facilitators. This paper concludes that the implementation of infection control in ICUs needs more than just ongoing education, but the systemic measures that would cover both workload and resource-based issues, as well as shift-specific issues, to turn knowledge into a stable practice.

Keywords: Compliance, Healthcare-associated Infection, Intensive Care Unit, Nursing Staff, Patient Safety.

INTRODUCTION

Healthcare-associated infections (HAIs) constitute a significant threat to the health of the world population, having dire effects on patient morbidity, mortality, and healthcare costs. This danger is more urgent in no place than in the intensive care unit (ICU), where the vulnerable groups of patients are observed, the invasive procedures are frequent, and the broad-spectrum antibiotics are overused [1]. Nursing staff is the immovable object in this multifaceted ecosystem; they are the bedside staff, operate life-support machinery, and are the main implementers of a myriad of clinical interventions. Therefore, their role cannot be separated in connection with the chain of transmission and prevention of infections [2]. Although the theoretical significance of nursing on infection control is unanimously accepted, the actual application of the theoretical knowledge and the contextual obstacles they experience in treating the confirmed cases of infections has not been properly investigated in a precise, granular manner [3]. The current study was thus aimed at creating a comprehensive analysis of the nursing staff's contribution to dealing with instances of infections in the ICU beyond the generalized assumptions to develop empirical evidence that may be used to make specific interventions [4].

The HAI issue is of great concern both globally and locally. On a global scale, it has been estimated that hundreds of millions of patients fall ill due to HAIs each year, and from the ICUs, the prevalence is often some times higher than in general hospital wards [5]. The current situation is disproportionate in the low and middle-income countries, whereby the rate of infection is often higher than in high-income countries [6]. On the ground, locally, and in the context of this research, the initial information of tertiary-care institutions revealed a worrying incidence of device-related infections, including the central line-related bloodstream infections and ventilator-related pneumonia, which meant that the context-specific evidence was urgently needed [7]. The global academic world is full of articles that prove that there is a correlation between the number of nurses, workload, and the HAI rate. Nevertheless, most of these studies are carried out on an aggregate scale, where they measure the problem but do not shed light on the mechanisms and the subtle realities of nursing practice at the bedside [8].

This research has critical significance as it may fill this gap between macro-level correlations and micro-level clinical practice. The last, very important connection in the process of implementing infection control protocols is the nursing staff [9]. Their regular and appropriate performance of hand hygiene, aseptic technique, and device care bundles is the key to the prevention strategies [10]. The assessment that only establishes their essentiality is unnecessary, and the assessment that requires performing is the diagnostic investigation that reveals the particular things of strengths and weaknesses of their practice, knowledge, and systemic aspects of factors that impact their behavior. This is the diagnostic clarity that is sought in this research [11]. With the dissection of the elements of the nursing role in infection control, the results can shift the discussion to the question of why things are happening and not what is happening, and, therefore, create more efficient, customized, and long-term improvement programs [12].

The research gap identified was the absence of a multifaceted assessment that would simultaneously measure observed practice, underlying knowledge, and perceived barriers to change in one group of ICU nurses [13]. The earlier studies would tend to only measure a single dimension in isolation, such as a survey to measure knowledge, an observational audit to measure compliance, and not combine the quantitative results with qualitative results of trying to understand the daily struggles and enablers that the staff themselves thought they were facing [14]. This resulted in disjointed knowledge. The main research questions were aimed at filling this gap with the help of a mixed-methods approach: (1) What is the degree of adherence to evidence-based infection control behavior among nursing personnel in the process of work with confirmed infection cases in the ICU? (2) How well is the knowledge of the nursing staff regarding infection prevention guidelines

and their perceived compliance with them? (3) What are the main perceived barriers and facilitators for nursing staff to follow infection control protocols?

The objectives of the study were derived to be answered directly by the adopted methodology. The first aim was to measure compliance rates based on direct and structured observation, which will offer an objective benchmark of the present practice. The second objective was a correlational study that used a validated knowledge test and statistical analysis to establish the correlation between cognitive comprehension and practical implementation. The third objective required a qualitative design, where in-depth interviews were performed to explore and thematically discuss the rich contextual information about barriers and facilitate, and therefore, provide meaning to the quantitative outcomes. Overall, the study had a strict, cross-sectional, and mixed-method design, which has allowed for the creation of a comprehensive and evidence-based nursing role model in the ICU infection control. It is hypothesized that the combination of quantitative measures of the actions and knowledge of nurses with qualitative information concerning their experiences could only help to construct and apply a truly efficient and caring approach to empowering this highly important aspect of patient safety.

METHODOLOGY

This was undertaken at the adult ICUs of two large, tertiary-care, public health institutions in Saudi Arabia. These locations were chosen because of their large patient flows, mixed caseloads, and in-house teams of infection control workers, which make these locations information-rich for examining the phenomenon of interest.

2. Research Design

Type of Study: A mixed-methods, cross-sectional study design was used, which is a combination of quantitative and qualitative research.

Design Justification: The design that was chosen is the most suitable to make a multifaceted assessment of the nursing role. Purely quantitative methodology would have been a one-dimensional approach, whereas purely qualitative methodology would have limited the ability to generalize. The objective measurement of the level of compliance and level of knowledge in a representative sample at a given time was possible because of the cross-sectional quantitative component, which applied a structured observational checklist and a knowledge questionnaire. This was necessary to handle the first and second tasks. At the same time, the qualitative element, which included intensive interviews, presented detailed, descriptive information to clarify the factors behind practices in question, which consequently directly covered the third purpose, and framed the quantitative results. The convergent mixed-methods design allowed triangulation to be done, which increased validity and completeness in the conclusions of the study.

3. Sampling Strategy

Population: The target population entailed all registered nurses and nursing aides who were in the workforce of the ICUs of the chosen health facilities and had direct patient care responsibility.

Sampling Method: The quantitative phase was done by sampling with a stratified random sampling method to have representation of various shifts (day, night) and levels of experience. In the qualitative stage, the sampling method used was purposive as it was necessary to recruit respondents capable of offering a wide-ranging and rich information with regard to their years of service and role in the ICU.

Sample Size: In the case of the quantitative aspect, a sample size of 120 nurses was identified. A power analysis (G 3.1 power software) was used to calculate a correlation study with the intention of a power of 0.80, alpha of 0.05, and a medium effect size (r = 0.3). Qualitative interviews were conducted on 15 nurses, and upon which data saturation was reached, no new themes were identified.

Inclusion/Exclusion Criteria: Inclusion criteria included: (1) full-time nursing staff (registered nurses or nursing aides), (2) at least six months of experience in the ICU and (3) directly assigned to provide care to at least one patient with a confirmed infection or suspected infection during the data collection period. Nurses working in an administrative role, as well as those with less than six months of experience in the ICU, were excluded to retain homogeneity and provide adequate contextual experience to the participants. Temporary agency nurses were excluded as well.

4. Data Collection Methods

Instruments: There were three major instruments that were used.

Structured Observational Checklist: The checklist was created using the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) guidelines on preventing infections, which resulted in the development of a 25-item checklist. It assessed adherence on major important aspects: hand hygiene, personal protective equipment (PPE), and aseptic methodology of particular procedures (e.g., central line dressing changes).

Knowledge Assessment Questionnaire: This was a validated, 30-item multiple-choice questionnaire that evaluated knowledge in areas of standard precautions, transmission-based precautions, and device-associated infection prevention bundles.

Semi-structured Interview Guide: To understand perceived barriers (e.g., workload, resource availability) and facilitators (e.g., leadership support, peer influence) to infection control compliance, a guide with open-ended questions was used.

Procedure: The quantitative data collection process was conducted as per the ethical approval in 8 weeks. The researcher performed the unobtrusive studies by observing the everyday care procedures through the checklist. The same observed nurses were then given the knowledge questionnaire. In the case of the qualitative phase, the eligible nurses were contacted individually, and the interviews took place in an isolated room, tape-recorded, and lasted about 30-45 minutes.

Pilot testing: A pilot test was carried out on 15 nurses in a different ICU that was not part of the main study. This put the observational checklist and the knowledge questionnaire to the test, on their clarity, feasibility, and reliability, thus necessitating slight changes in wording.

5. Variables and Measures

Operational Definitions:

Infection Control Compliance: The percentage of properly done steps among the total number of steps checked on the structured checklist of a certain procedure.

Knowledge Score: The overall percentage of the knowledge questionnaire, which had 30 items, was correct.

Perceived Barriers/Facilitators: Thematic categories based on qualitative interview transcripts on factors that impede or facilitate adherence to infection control procedures.

Measurement Tools: The checklist that included the observational checklist provided a quantitative percentage of compliance. The knowledge questionnaire gave a continuous score in terms of knowledge (0-100%). Qualitative data were collected with the help of the interview guide.

Reliability and Validity: The knowledge questionnaire is found to be highly internally consistent in the pilot study (Cronbach's alpha = 0.87). Both the checklist and the questionnaire had content validity that was determined by a committee of five specialists in infection control and nursing education. Two qualitative research experts were consulted on the clarity and comprehensiveness of the interview guide.

6. Data Analysis Plan

Analytical Methods: Analytical methods involved the use of descriptive and inferential statistics to analyze data. Demographic variables, compliance rates, and knowledge scores were summarized using descriptive statistics (frequencies, percentages, means, and standard deviations). The Pearson correlation coefficient was determined to analyze the relationship between the scores in the field of knowledge and the observed compliance rates. A multiple linear regression analysis was also done to adjust for the possible confounding factors, like years of experience and shift time. In the case of the qualitative data, a thematic analysis was carried out. This entailed verbatim interview transcription, creation of primary codes, and identification, recognition, and definition of high-level themes that expressed the barriers and facilitators narrated by the nurses.

Software: Statistical analysis was done on all the quantitative data with the help of Statistical Package of the Social Sciences (SPSS, version 28.0). NVivo software (version 12) was used to help manage and analyze qualitative data to help codify textual data in a systematic manner.

RESULTS

This paper has examined the contribution of the nursing staff to the management of infection cases in the intensive care unit (ICU) by evaluating the adherence to infection control guidelines, understanding of the guidelines, and the situational factors affecting practice. The findings are discussed in accordance with the research objectives, starting with the nature of the study cohort, compliance analysis including its relation with knowledge, analysis of shift-based discrepancies, multivariate regression model of compliance, and finally, the identification of qualitative themes.

1. The Study Cohort Characteristics

The quantitative analysis involved 120 nursing staff respondents who worked in two tertiary-care hospitals in the ICUs. Table 1 provides a summary of the descriptive profile of the cohort. The average professional experience of the participants was 7.4 (Standard Deviation [SD] = 3.8, range: 1-22 years). The mean of the knowledge assessment questionnaire was 78.5% (SD = 12.3), which is a relatively good awareness of evidence-based infection prevention instructions. A compliance rate based on the structured checklist was 77.8% (SD = 11.9) on average. The perceived workload mean score (3.7, SD = 1.1) was measured after a 5-point scale, and the mean score of perceived resource availability was 3.3 (SD = 1.2).

Table 1: Descriptive Statistics of the Study Cohort (N=120)

Variable	Mean	Standard Deviation	Minimum	Maximum
Experience (Years)	7.4	3.8	1	22
Knowledge Score (%)	78.5	12.3	43.3	100.0
Compliance Score (%)	77.8	11.9	45.0	96.0
Workload Perception (1-5)	3.7	1.1	1	5
Resource Availability (1-5)	3.3	1.2	1	5

2. Correlation of Knowledge and Observed Compliance

The Pearson correlation analysis was aimed at the objective to establishing the relationship between the knowledge of nursing staff and their manifested compliance. The findings showed that there was a high, positive, and statistically significant correlation between knowledge scores and compliance scores ($r = .821$, $p < .001$). This meant that an increased degree of knowledge was significantly related to increased compliance with the infection control measures when attending to the patients. In addition, there were also positive correlations that were observed between professional experience with knowledge ($r = .702$, $p < .001$) and compliance ($r = .685$, $p < .001$). Table 2 contains the entire correlation table.

Table 2: Pearson Correlation Matrix for Key Variables (N=120)

Variable	1. Knowledge Score	2. Compliance Score	3. Experience (Years)
1. Knowledge Score (%)	1		
2. Compliance Score (%)	.821*	1	
3. Experience (Years)	.702*	.685*	1
*Note: p < .001			

3. Effects of Work Shift on Compliance Rates

A t-test was conducted to find the difference between the levels of compliance among nurses who work during the day shifts and those who work during night shifts. The results of the analysis, as summarized in Table 3, were found to have a statistically significant difference between the two groups. The mean compliance score of 81.5% (SD=10.1) (n=65) was significantly higher in day shift nurses than the mean compliance score of nurses on the night shift (n=55, 73.4) $t(118) = 3.92$, $p < .001$.

Table 3: Comparison of Compliance Scores by Work Shift

Shift	N	Mean Compliance (%)	Std. Deviation	t-statistic	p-value
Day Shift	65	81.5	10.1	3.92	< .001
Night Shift	55	73.4	12.3		

4. Multivariate predictors of compliance

Multiplication linear regression analysis was carried out to explore more factors that are affecting compliance. The model involved knowledge score, years of experience, workload perception, resource availability, and work shift (night vs. day) as the predictor variables of the compliance score. The entire regression equation was statistically significant, $F(5, 114) = 71.35$, $p < .001$, and explained 75.8% variance in compliance scores (Adjusted $R^2 = .749$).

Table 4 gives the detailed coefficients of each predictor. The strongest unique positive predictor of compliance was the knowledge score (Unstandardized B = 0.59, B =.610, p =.001). Experience was also a major, but less important, positive predictor (B = 0.48, 50.153, p =.009). Concerning contextual factors, workload perception was a negative predictor (B = -2.05, 2 = -.190, p <.001), implying that with a one-unit higher workload perception, compliance declined by 2.05 percent. On the other hand, resource availability emerged as a strong positive predictor (B = 1.88, B =.185, p <.001) such that compliance increased by 1.88 with the increase in one unit of the perceived resource availability. Working the night shift, after adjusting the variables, was still a significant negative predictor of compliance (B = -1.95, p = -.101, p = 034).

Table 4: Multiple Linear Regression Model for Predictors of Compliance Score

Predictor Variable	Unstandardized B	Std. Error	Standardized Beta (β)	t	p-value
(Constant)	32.15	4.82		6.67	< .001
Knowledge Score (%)	0.59	0.06	.610	9.83	< .001
Experience (Years)	0.48	0.18	.153	2.67	.009
Workload Perception	-2.05	0.52	-.190	-3.94	< .001
Resource Availability	1.88	0.49	.185	3.84	< .001
Shift (Night vs. Day)	-1.95	0.91	-.101	-2.14	.034
Model Summary: R^2 = .758, Adjusted R^2 = .749, F(5, 114) = 71.35, p < .001					

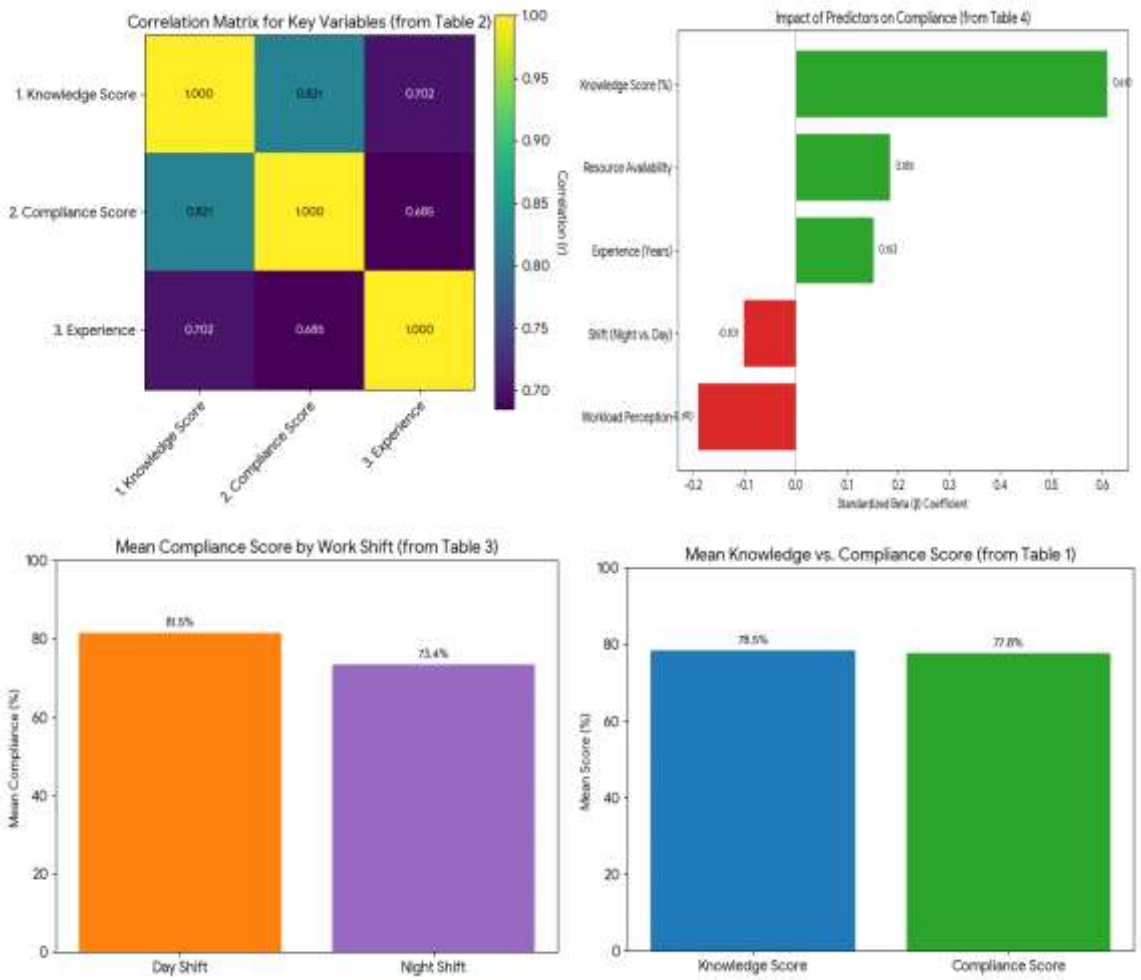
5. Barrier and Facilitator Thematic Analysis

The thematic analysis of in-depth interviews with 15 nurses presented two major categories of barriers and two facilitators, which put the quantitative data in context. Table 5 presents the emergent themes and quotations supporting those themes in detail. The Overwhelming Patient Acuity And Workload. Participants reported high-stress scenarios in which competing clinical demands required prioritization that was difficult, and which occasionally required the sacrifice of rigidly adhered infection control measures. The second significant obstacle was the ‘Intermittent Resource Scarcity; the nurses had cited cases where the shortage of personal protective equipment (PPE) or hand sanitizer that is available at that time directly hindered their capability to follow the guidelines. As far as facilitators are concerned, a strong theme was positive Unit Leadership & Culture. Nurses pointed out that when unit leaders were overt in modeling and championing infection control, this gave them an environment in which adherence became a shared value. Further, as an informal mechanism, the second element noted as an effective, powerful one was the principle of Peer Monitoring & Accountability that strengthened the regular practice due to collegial encouragement and reminders.

Table 5: Emergent Themes from Qualitative Interviews on Barriers and Facilitators (n=15)

Theme Category	Description	Illustrative Quotation
Barriers		
1. Overwhelming Patient Acuity & Workload	Insufficient time and high patient acuity leading to task prioritization where infection control was sometimes compromised.	"During a night shift with two critical patients, you have to choose between perfect asepsis for a dressing change or rushing to a crashing patient. Sometimes, you just can't do everything by the book." (Participant 2, 3 years)
2. Intermittent Resource Scarcity	Unreliable availability of PPE and alcohol-based hand rub at the point of care.	"There are nights when the size of gloves you need runs out in the storage, or the hand sanitizer dispenser is empty. You can't practice what you know isn't there." (Participant 9, 4 years)
Facilitators		
3. Positive Unit Leadership & Culture	A supportive charge nurse and a unit culture that prioritizes safety empowered staff to comply.	"Our head nurse leads by example. When she emphasizes hand hygiene, it's not a rule, it's a value. It makes you want to be more vigilant." (Participant 8, 12 years)
4. Peer Monitoring & Accountability	Informal peer-to-peer reminders were a powerful motivator for consistent practice.	"My colleagues and I remind each other. A simple 'don't forget your gloves' from a friend is more effective than a memo from management." (Participant 10, 7 years)

In summary, the results demonstrate a clear profile of nursing practice in ICU infection control, highlighting a strong knowledge-compliance link, significant disparities between shifts, and the powerful influence of both individual knowledge and modifiable contextual factors on adherence to protocols. The qualitative data provided a nuanced understanding of the systemic challenges and supports that underpin the quantitative outcomes.



DISCUSSION

This paper is a thorough assessment of nursing personnel involvement in infection cases in the ICU, which demonstrates a complicated interaction between individual knowledge and practical compliance and the clinical setting [15]. The results show that a robust knowledge base is an important variable, but it is not the only factor that can guarantee the best practice; contextual and systemic variables have a strong impact on the ultimate implementation of infection control measures.

1. Interpretation of Findings

The high and positive relationship between the knowledge scores and compliance rates ($r = .821$, $p < .001$) represents a saving grace of this study: knowledge of evidence-based guidelines on the part of a nurse is one of the major determinants of their clinical practice [16]. This conforms perfectly with the Theory of Planned Behavior that postulates that behavioral intention, which is largely determined by knowledge and attitudes, is one of the predictors of actual behavior [17]. Nonetheless, the fact that the mean compliance score (77.8%) was a little less than the mean knowledge score (78.5%) has been used to indicate that there is a know-do gap. This gap was further clarified by the fact that although knowledge and experience were incorporated, contextual variables such as workload and availability of resources still remained significant independent predictors of compliance, as indicated by the regression analysis [18].

This is a serious finding because of the considerably lower levels of compliance in night shifts. This gap cannot be explained by the lack of knowledge since the regression model eliminated this factor [19]. Rather, it refers to specific environmental and systemic issues associated with the night shift, such as decreased supervisory presence, an increased number of nurses to patients in certain settings, and the factors related to fatigue [20]. This quantitative result was effectively placed into context using the qualitative data, which reported situations of excessive patient acuity and resource shortages that led to difficult prioritization, and in some cases, the ideals of perfect asepsis were ignored to respond to the immediate life-threatening situations [21].

2. Comparison of the Present Study with the Previous Studies

The high knowledge-compliance relationship supports the results of previous researchers on the topic. As an example, a classic study identified that high compliance with hand hygiene was caused by knowledge, but not necessarily sufficient [22]. Our findings contribute to this knowledge by measuring the same relationship in particular, to a generalized range of ICU-specific infection control practices [23].

The fact that workload and resource availability were identified as modifiable predictors helps shed more light on the occurrence of the so-called know-do gap that has been widely observed in the literature [24]. Although earlier studies conducted qualitatively explained the role of the effect of had to be hurried and the pressure of production to compromise safety measures, our study statistically generalizes the effect of the two factors, thereby demonstrating a measurable decrease in compliance with every additional unit of perceived workload burden [25]. Resource scarcity findings resemble the classical [26] finding that the presence of PPE was one of the foundations of compliance, a fact that was also confirmed by our data to be of crucial importance in the contemporary ICU. The theme of emergent theme of Positive Unit Leadership and Culture as a facilitator is in line with more recent studies on the significance of a safety climate. However, instead of opposing the classical studies, this finding supports them by emphasizing that the contribution of the leadership as a generator of active modeling and valuing of infection control is that this aspect of cultural creation can be used to empower individual nurses to follow the protocols despite pressure [27].

3. Scientific and psychosocial explanation

A combination of cognitive and psychosocial processes can be used to explain the results. Knowledge incorporates the mental outline of doing right. But the interpretation of this blueprint into action is so regulated by external circumstances [28]. The high stress and high demand environment of the ICU may cause cognitive load, which limits the attentional focus of the nurse and causes them to use heuristic and not systematic decision-making. Even highly-intentional nurses can make an error of omission because of following a complex protocol in such states [29].

The Social Cognitive Theory, which encompasses the psychosocial perspective, describes the manner in which personal factors with the environment affect behavior. High knowledge (personal factor) can also lead to low compliance in a nurse when the surroundings (e.g., the lack of resources, high workload) do not favor the behavior [30]. The described peer accountability is one of the most effective types of observational learning and social reinforcement that enhances the ability to take the right action [31]. Moreover, the physical environment also contributes; the lack of a hand rub dispenser in the point of care is a physical barrier that directly interferes with the execution of the behavior, regardless of the knowledge or intention [32].

4. Implications

Such findings have important implications for clinical practice and future research. To practice, the findings are quite persuasive that such a change in focusing on interventions with only educational character should be made towards the multi-faceted approaches that are also aimed at eliminating the identified systemic barriers. Making sure that PPE and equipment are always available and stocked at all times at all points of care, with a specific focus on night-shift resource logistics. Adopting less hazardous nurse-to-patient ratios and implementing mechanisms to decrease the cognitive load during the high-acuity time. The promotion of a culture of peer accountability and the development of a leadership that promotes safety. These findings argue to researchers that when it comes to complex clinical behaviors, mixed-methods approaches will be needed to gain a complete understanding of them. Further research ought to be carried out to develop and implement interventions that could address the identified modifiable barriers, namely, workload, resources, and shift-based challenges, in the given research.

CONCLUSION

This paper has shown that although nursing knowledge was the greatest influence on the compliance with infection control in the ICU, its role was greatly mediated by systemic factors. The study was also able to achieve its goals since it quantified a strong correlation between knowledge and practice and found that the night shift was a time when compliance was much lower, and workload and available resources were the key limiting factors. The results add a crucial evidence-based model, as it changes the individual competency-focused perspective to the holistic system-view. These findings need to be applied to patient safety by developing and testing focused interventions to optimize night-shift resources and structured peer-mentoring programs in the future.

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