Critical Care Nurses' Attitudes about Influences of Technology on Nursing Care

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Authors' contributions

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ABSTRACT

Aims: This paper begins with developing a quantitative instrument to examine the opinions of critical care nurses' regarding the influences of technology on nursing practice.
Study Design and Methodology: After reviewing related literature, the draft of a 29-items questionnaire was developed. Based on the review of a panel of 3 experts, it was reduced to 23 items because 6 items measured similar criteria. Content validity index (CVI) of this instrument, based on the opinions of another panel of ten experts reached 0.92. Face validity was established via two focused groups of critical care nurses. All of the items were clear, relevant, and simple for these two groups. Principal component factor analysis with varimax rotation resulted two factors

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which altogether accounted for 52.5% of the total variance. These factors revealed negative and positive aspects of influence of technology on nursing practices. Coronbach's α coefficient (α= 0.824) Showed acceptable internal consistency for the entire questionnaire and it's the negative and positive aspects (0.896 and 0.925, respectively). In the next phase of the study, a convenience sample of 200 critical care nurses, in a cross-sectional study, filled the questionnaire.

Results: The mean score for this sample was calculated as 82.21±9.88, indicating this sample of nurses held positive opinions regarding influences of technology on their practice. Younger nurses and those working in intensive care units had significantly higher mean scores in negative subscale compared to others.

Conclusion: Considering the important role of technology in diagnosis, treatment and caring of various health conditions, adequate training of nurses for managing different technological tools and understanding the culture and values of technological care, can help them balance technological and humanized aspects of care, make technological caring more efficient and improve the quality of nursing care.

1. INTRODUCTION

In the early 1960s, intensive care units (ICUs) were established [1], at Kommunehospitalet in Copenhagen [2] with the purpose of treating and taking care of seriously ill patients by specially trained nurses and using advanced technical tools [1]. Each year, more than 100,000 patients are admitted to intensive care units in the United Kingdom (UK) [3]. Eleven percent of hospitalizations in Canada, include spending time in such units; In the United States, more than half of all people experience ICU care during their final year of life, many patients die there and the demand for intensive care units is rising [3]. Nurses who work in critical care units have to meet the physical and emotional needs of patients and their families [4]. However, the use of technology itself has stimulated many conflicting issues related to the patients' care in the critical care environment [5]. Marden [6] defines technology as modern drugs, instruments, devices, methods and procedures used by health care professionals to provide care. Wikström et al. [7] asserted that technology means equipments, medical treatment, documentation systems and related skills to handle and manage those.

Caring is often considered as a significant concept in the science and art of nursing. Nursing is commonly defined as a caring profession [8]. Gout (1983) mentioned that the concept of caring can be demonstrated in the ideas of 'caring for' – the doing aspect of caring, and 'caring about' – is related to the valuing of another person [9]. Caring is a practical activity associated with the perspectives, attitudes and expectations of those caring [10].

Technology has a multifaceted and extensive impact on contemporary nursing practice [11]. Patient care technology has become increasingly complex; transforming the way nursing care is conceptualized and delivered. Before extensive application of technology, nurses relied heavily on their senses of sight, touch, smell, and hearing to monitor patient status and to detect changes. Over time, theses senses of nurses were replaced with technology designed to detect physical changes in patient conditions [12,13].

Early scholarly discussions regarding technology and nursing, described these two as irreconcilable opposing forces [13]. Leininger motivated nurses to study technology in relation to caring and hypothesized that, as the signs of technological care giving increase, the signs of interpersonal care manifestations decrease [14].

Some researchers believe that critically ill persons dependent on technologies are often seen as objects of care. Thus the vital challenge for nursing in intensive care settings is to use technologies competently and harmonize technology, nursing and human care [15-19]. Other researchers, however, concluded that technology may dehumanize patient care in that technology can restrict the nurses' focus on the patient's social needs [20-22] and that technology restricts the registered nurses' freedom of action [18,23,24]. Intense debate continued and new ways of viewing technological aspects of caring emerged. Bernardo (1998) contemplated that technology may create an opportunity to bring the nurse closer to the patient [25], while Barnard resisted literatures claimed that technology has a neutral effect on

nursing practice and asserted that technology was associated with specific values and culture [26]. Debates have continued regarding positive or negative effects of using technology in nursing care [13]. Cooper [27] examined technology and care using interviews and observation of nine nurses, their patients, and families in an intensive care unit (ICU), and found that care and technology, in many instances, were integrated and that technology did not hamper care. Leners [28] in a study of 40 nurses, concluded that in an environment where there is less technology, nurses tend to use their intuition more. In a phenomenological study, McGrath interviewed 10 experienced nurses from 2 cardiothoracic critical care unit in Ireland. Her study findings provide the optimistic/pessimistic views on technology in nursing. The study, also, revealed a new finding:" life-saving technology that supports the lives of critically ill patients can bring experienced nurses very close to their patients/families" [12].

Studies also showed that different countries, with their varying systems of care and culture, may have different viewpoints regarding technology, caring and nursing [1,7,13,29,30].

The studies above were essentially descriptive and explanatory and were hampered by small Sample size and lack of randomization, therefore the studies are difficult to replicate, and caution must be exercised when generalizing results. Furthermore, no study was found that quantitatively measured the views of critical care nurse on influences of technology on their caring. The aim of this study, thus, is to determine the opinions of a sample of critical care nurses in south western Iran, regarding the influences of technology on their caring behaviors.

2. MATERIALS AND METHODS

In order to assess nurses' opinions on influences of technology on nursing actions, a questionnaire was developed. The development sequence of the Influence of Technology Questionnaire (ITQ) was as follows: 1) an item development phase that comprised of a review of existing literature on the experiences of nurses working in a technological environment and using existing instruments developed for the assessment of nurses' beliefs about influences of technology on nursing care 2) a validation phase conducted within critical care units (coronary care unit, intensive care units & hemodialysis) of teaching hospitals of Kerman university of medical sciences.

In the first phase of the study after review of related literature a number of major themes about influences of technology on nursing actions were shaped. In view of the literature, Arthur et al. [31] developed the CAPSTI questionnaire. Part of this instrument is a 14 item questionnaire measuring nurses' beliefs pertaining to the influences of technology on their care. Using this questionnaire and the themes from literature [1,5,7,17-20,22-27,30-42], a 29-item questionnaire was developed. This primary draft was sent to 3 experts via e-mail with a letter of introduction mentioning the purpose of developing the instrument. A content validation form was also developed for this procedure. The form consisted of the 29-items of the Influence of Technology Questionnaire along with the degree of agreement presented next to each statement with regard to its relevance, simplicity, and clarity. The degree of agreement for relevance aspect ranged from "irrelevant", "needs serious revision", "relevant but needs revision" and "completely relevant", the simplicity aspect ranged from "not simple", "needs serious revision", "simple but needs revision" and completely simple" and clarity ranged from "ambiguous", "needs serious revision", "clear but needs revision" and "completely clear". The first two choices were indicative of disagreement on the validity of items while selecting the last two choices indicated agreement. Based on the expert responses, 6 items were excluded as they measured the same thing. Again, the remaining 23 items were mailed to 10 experts along with the same form, for assessing content validity.

The total number of items on which the 10 experts agreed were 19, the content validity index (CVI) was, therefore, equal to 19/23, i.e. 0.82.

Face validity of the instrument was established via 2 focus groups that consisted of nurses working in the adult critical care units (ICU & dialysis) of teaching hospitals of Kerman University of medical sciences.

Construct validity was assessed through factor analysis. Principal component factor analysis using varimax rotation was the technique used to explore the factor structure of the new instrument. The sample used to test the factor structure of the instrument was a convenience sample of nurses working in intensive care units (ICU, CCU and dialysis) of teaching hospitals of Kerman Universities of Medical Sciences. With respect to the general rule of thumb that 5–10

subjects per variable is acceptable for factor analysis, 200 subjects were thus appropriate to test a 23-item questionnaire. Items with component weights of more than 0.4 were grouped under each of the PCs to which they belonged.

To test the instrument for reliability, Cranach's alpha coefficient was used. A pilot study with a sample of 30 adult intensive care nurses was conducted. This sample was excluded from the study.

2.1 Ethical Approval

Ethical approval for the study was obtained from Ethics Committee of Kerman University of Medical Sciences.

Copies of the ITQ along with 6 questions related to demographic information and inform consent sheet were distributed by 3 trained data collectors to the convenience sample of 200 adult critical care nurses in different shifts (Shafa, Shahid Bahonar and Afzalipour hospitals of Kerman University of Medical sciences) and were collected the next shifts.

2.2 Statistical Analysis

All statistical analyses were performed using SPSS version 17 (SPSS Inc., Chicago, Illinois, United States). Descriptive statistics (frequency and percentage, mean and standard deviation) and inferential statistics (Mann Whitney-u, Kruskal Wallis, factor analysis, coronbach's α coefficient) were used to analyze the data. Internal consistency of the instrument was assessed using coronbach's α coefficient. Confirmatory factor analysis with varimax rotation was the method used to assess construct validity of the instrument. Mann Whitney-U and kruskal wallis tests were used to compare demographic characteristics of the study population with influences of technology questionnaire scores. In this study a P-Value of 0.05 was considered significant.

3 RESULTS

3.1 Demographic Characteristics

From the 200 nurses who participated in the study, 82% were female, and 79% were married. Mean age of participants was 35.06(±6.78), and the majority of participants (52.5%) were

between 31-40 years old. 94% of the participants had a bachelor's degree, 55% had less than 10 years of work experience and 51.5% had less than 5-years of experience of working in a critical care unit. The majority of the study participants (65.5%) were working in Intensive Care Units (ICU) (Table 1).

3.2 Validity and Reliability

Confirmatory factor analysis (CFA) using principal component analysis with varimax rotation was carried out to examine the questionnaire's construct validity.

Conducting PCA with varimax rotation resulted in 4-factor solution with Eigen value >1. These 4 factors explained 63.99% of the variance, yet items loaded in the third and fourth factors were weak and overlapping with the two others. Theoretically (according to the review of literature), there are two views about influences of technology on nursing care, therefore, we conduced PCA with 2 factors and a 2-factor solution with Eigen values of 7.13(31% variance) and 4.95(21.54% variance) which together accounted for 52.5% of the total variance resulted. From 23 items of the Influences of Technology Questionnaire (ITQ), 22 item loaded more than 0.4, 13 items loaded into factor one, representing negative views, and 9 items loaded into factor two, which were indicative of positive views of nurses about influences of technology on nursing care (Table 2).

Coronbach's α coefficient (α= 0.824) showed acceptable internal consistency and reliability for the entire questionnaire. For the negative and positive aspects of the questionnaire, Coronbach's α coefficient was established at 0.896 and 0.925, respectively. Scores of each item, based on Likert continuum were as follow: strongly disagree=1, disagree=2, no idea= 3, agree= 4, and strongly agree=5. Overall score of the questionnaire ranged between 22 -120, and a higher mean score (after reversing negative items) reflected a positive view and value of the technology on nursing care.

After reversing negative items, the overall mean scores for 22 items of Influences of Technology questionnaire was 82.21±9.88, which showed a positive attitude towards the influence of technology on nursing care. Out of a total possible 120 scores, the minimum score was 59 and the maximum was 96. Items that solicited strongest response on 5 point Likert scale were:

"Technology facilitates patient care" (4.02±1.16), "Life sustaining technologies in intensive care units, limit the space needed for patient care" (3.97±1.06), "technology enhances patient care and recovery" (3.90±1.23), "The entrance of technology has promoted nursing profession" (3.85±1.2). Those with the lowest scores on Likert continuum were: "Technology is the priority, not the patient "(1.85±0.895), "Using technology in caring for patients often interferes with providing adequate nursing care" (1.87±0.94), "The increased use of technology in nursing care has downgraded nursing profession" (1.88±0.98), "I am not sure that technology is useful for my practice" (1.91±0.97). These items stated negatively, therefore their weak responses reflected a tendency toward positive end of the continuum. In the positive subscale, all responses were above the midpoint of likert continuum and in the negative subscale, all responses were below the midpoint of the continuum.

The results of normality tests showed that items of ITQ did not have normal distribution, so we used kruskal- Wallis test to examine the effects of age, ward, level of education and work experience, and employed Mann- Whitney-U tests to examine the effects of gender and marital status on the ITQ scores.

There were no statistically significant differences between mean scores of the total scale and demographic variables, however, as for the mean scores of the negative subscale, Kruskal Wallis test showed that the younger age group had the highest mean scores, there was a significant difference between the younger and older age groups, and the middle age group had the lowest mean score in this subscale (P=0.02). Considering that this subscale is negative, lower mean scores reflects positive views of the middle age group on the influences of technology. The results also showed significant difference between the scores of the group whose participants had 11-20 years of work experience and the other two groups , the former group also had significantly lower mean scores in the negative subscale, indicative of their positive attitudes (P=0.03). There was no significant correlation between intensive unit work experience and mean scores of the total

Table 1. Demographic characteristics of the study participants

Variable		Frequency	Percent
Age	20-30	57	28.5
	31-40	105	52.5
	41-52	38	19.0
Sex	Female	164	82
	Male	36	18
Marital status	Single	42	21.0
	Married	158	79.0
Ward name	CCU	44	22.0
	ICU	131	65.5
	Dialysis	25	12.5
Level of education	Diploma	9	4.5
	Bachelor	188	94.0
	Master	3	1.5
Work years	0-10	110	55.0
	11-20	74	37.0
	21-30	16	8.0
Intensive unit work years	0-5	103	51.5
	6-15	86	43.0
	16-25	11	5.5
	Minimum	Maximum	Mean	SD
Age	22	51	35.06	6.87
work experience	1(month)	29	10.52	6.12
Intensive unit work experience	1(month)	20	6.83	4.6

Table 2. Factor analysis with varimax rotation for 23 items of Influences of technology questionnaire (ITQ)

	Item	Negative aspects	Positive aspects
1	Using technology makes nurses professionally uncertain	0.76	
2	Using technology in caring for patients often interferes with providing adequate nursing care	0.75	
3	I am not sure that technology is useful for my practice	0.77	
4	The increased use of technology in nursing care has downgraded the nursing profession	0.74	
5	technology enhances patient care and recovery		0.80
6	Using technology in care requires high-tech skills		0.83
7	Mastery of technology has helped nurses to control their work environment		0.834
8	Technology directs and controls medical treatment		0.80
9	Technology makes treatment more secure		0.84
10	Technology decrease nurses' workload	0.425	
11	Technology is not easy to handle	0.62	
12	Technology distracts nurses' ability to connect with or relate to their patients	0.70	
13	Collaboration in care(interrelationship between the patients, their families and the health team) can help the patients live with technology safely and comfortably		
14	Technology can create ethical dilemma(when physician used to decide whether or not withdraw medical treatment)		0.67
15	Involving technology in care means participants demanded more time to caring for patients	0.65	
16	Technology is the priority, not the patient	0.57	
17	Life sustaining technologies in intensive care unit, limit the space needed for patient care	0.52	
18	Technology dose not interfere with patient care		0.80
19	Technology facilitates patient care		0.796
20	The influx of technological machines often make nurses neglect patients	0.74	
21	Because of the application of modern machineries, in case of inevitable death of a patient nurses often become frustrated.	0.74	
22	I think even with the help of technology, there is not any more spare time in nursing	0.71	
23	The entrance of technology has promoted the nursing profession		0.70

scale or each subscale. nurses working in the CCUs had the lowest mean score in the negative sub scale, followed by the dialysis' nurses, and ICUs' nurses had the highest mean score in this subscale(P=0.01), and there was significantly low mean scores(in the negative subscale) for bachelor nurses compared with master's and practical nurses(P=0.01). Practical nurses had significantly low mean scores in the total scale (P=0.02). Results of Mann-Whitney-U test showed that women had significantly high mean scores in positive subscale compared to men (P=0.02).

4. DISCUSSION

The present study began with developing an instrument which measured attitudes and opinions of critical care nurses about influences of technology on their practice. Construct validity

of the questionnaire showed two dimensions in studied nurses regarding influences of technology on nursing practice: positive and negative attitudes. Review of literature and articles written on philosophy and influences of technology on caring behaviors showed a dualistic perspective. Researchers believed that enhancement of technology has changed professional and public values of caring and using technological equipments in nursing care has challenged the meaning of caring and its' position in nursing [15-17,20,27,33-35,43,44]. Some of the reported benefits of technology in literatures include: improving safety and efficacy of patient care, saving time with providing a lot of information for nurses' clinical decision making, freeing nurses from performing repetitive daily tasks and allowing them to spend more time with their patients and help them to relieve patient's pains and discomforts that could not palpable or observable [27,45]. However, the technology has some disadvantages which some researchers argued that these disadvantages have outweighed its' benefits. Critical care nurses using technology in their everyday work have been reported that technology can impair the communication because of creating a physical barrier between machine and the patient. Technology can also contribute to fragmented and depersonalized patient care due to inanimate machines and devices, it can change the focus of care from patient to use of the machine and create a hazardous and stressful work environment for nurses [16,18,46,47]. On the other hand, technology may expose nurses with ethical dilemma of using high- technological procedures and equipments to maintain life but not necessarily patients' dignity and quality of life [1,24].

The results of this study showed that this sample of Iranian Intensive care nurses strongly believed that technology facilitates and enhances patient care, helps nurses control their work environment and leads to promotion of nursing profession. They also were obviously opposed to the idea that priority is given to the technology; technology interferes with providing adequate nursing care; the increased use of technology in nursing care has downgraded nursing profession; and handling technology is difficult. From all this we can conclude that these nurses were comfortable with technology and perceived technology as a useful aid for their nursing care. They believed that the only disadvantage of technology is limiting the required space for patient care.

Arthur et al. (2001) in the study on an international sample of nurses, found that the study participants believed high technology enhances patient care and mastery of technology can help nurses develop professionally, but they also believed that high technology needs high skills to handle [33]. In the study that was done by Nooh et al. [45] in Korea, nurses had positive opinions about the effects of technology on their work, but their mean scores were lower than those of the international sample; they also strongly believed that handling technology needs high skills. Overall, researchers concluded that their studied nurses were uncomfortable with technology.

Contrary to the international sample and Korean nurses, our study nurses believed that handling technology was not difficult. We can explain this difference by saying that one of the major differences between this study and the two mentioned studies is that compared to the two previous studies on the nurses of general wards; the present study was done solely on critical care nurses. These nurses are working with various technological tools and technology is intertwined with their daily care. In case of a problem or failure of the device, the manufacturer company will be contacted for troubleshooting. Moreover, the manufacturer company monitors annually all the existing technological tools in the intensive care units (CCU, ICU & Dialysis) for proper functioning. The reasons mentioned above can create the impression that handling technology is easy in our studied nurses.

Younger nurses and those working in the Intensive Care Unit(ICU), had the highest mean scores regarding the negative aspects of ITQ, which means they did not hold positive opinions regarding the effects of technology on nursing care. Female nurses had higher mean scores in positive aspects of technology reflecting their higher positive attitude compared to men, and graduate nurses had the highest mean scores in total ITQ. In the study of Wickstrom et al. [1], newcomer nurses were fearful and worried about technological machinery in terms of management and operation. Expert nurses in this study also believed that technology can complicate their work because of lack of knowledge and competence to interpret all the received data from the machines. In the present study, younger nurses were those who had started their work as a nurse in a critical care environment, and their negative attitude could be explain by presence of the large number of technological instruments

and the lack of knowledge to operate them and interpret the received data as well as its' consequences on patient condition. According to Leininger [48], as technological caring increases, signs of humane caring decrease, Cooper [27], also argued that one of the major challenges for the nurses who are working in critical care areas is technological dehumanization. These hypotheses may be confirmed in our study because the study participants working in the intensive care units (ICU) had higher mean scores in negative aspects of the questionnaire, as in the ICUs, the number of life-saving technologies is considerably higher than that of the other two wards (CCU & Dialysis) and patient's life is highly dependent on these technologies (e.g ventilator), these factors may force nurses to focus mainly on the proper functioning of the equipments, instead of communicating with the patient and, consequently, this can create a sense of dissatisfaction with caring and distrust of technology in this group of nurses. Our study participants were mainly women with bachelor degrees and their higher mean scores in the positive subscale and the total mean score could be explained by their large number.

4.1 Limitations

This study has limitations in terms of randomization, yet, due to the large sample size of the study, it seems that the study sample is representative of the population.

5. CONCLUSION

In the present study, a new questionnaire was developed to assess the views of critical care nurses on the influences of technology on nursing care and its validity and reliability showed acceptable values in a sample of Iranian critical care nurses. The results of this study, also showed that, this sample of nurses had positive attitudes towards the influences of technology on their care. Younger nurses and those working in the ICU had significantly negative opinions regarding technology.

6. RECOMMENDATIONS FOR PRACTICE, RESEARCH AND EDUCATION

The results of this study have implications in practice, research, and education. Because of the important role that technology plays in diagnosis, treatment and caring of various health conditions, it is recommended that all nurses designated to work in a critical care unit, receive proper training on how to operate different technological tools available in the ward and how to interpret the provided information they received from the equipment beforehand. Moreover, they must become familiar with the particular values and culture that is associated with technological caring. By establishing the balance between human and technological aspects of care, nurses will be able to provide more efficient care with higher quality. Barnard and Sandelowski [26] argued that experiences such as dehumanized care is not related to technology, rather, they are determined by usage and operation of individual technologies in a particular user context, specific definition of human being by different individuals or cultural groups, and organizational, human, political and economic technological systems(32). So, it is suggested that the present questionnaire be used in the future studies, to examine the views of general ward nurses, with various levels of exposure to technology in their daily care. Moreover, It is suggested that future researches investigate opinions of patients regarding the impact of technology on communication and caring behaviors of nurses working in high, medium, and low technological environments, to a examine if technology brings nurses closer to the patients and promote interpersonal caring or not.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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