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Original Article

Factors Influencing the Competency of Head Nurses When Assisting With Inhospital Cardiopulmonary Resuscitation

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Abstract

Objective: Head nurses in a hospital setting work to maintain the quality of nursing care and ensure that staff nursing skills are up-to-date. Although cardiopulmonary resuscitation (CPR) is most often performed by physicians in a hospital, nurses play crucial assistance roles, including the administration of medication, record-keeping, obtaining intravenous access, and helping with intubation. Patient outcome is therefore related to nurses' skill level in CPR. We hypothesized that the more senior head nurses would be more skillful at assisting with CPR.

Materials and Methods: We conducted an observational study of 55 head nurses, who were asked to perform a 4-minute simulation in which they assisted with CPR using a resuscitation manikin. We collected demographic data, including age and years since becoming a nurse and becoming a head nurse, together with a stress score, which assessed the stress felt by the nurses while taking the test. These measures were analyzed along with the accuracy of the nurses' skills while performing CPR.

Results: Twenty-two skills were evaluated, with each skill graded as either a pass or fail. Only 30/55 (54.5%) of the head nurses passed all 22 skills. There was a significant difference in the numbers of skills with a pass rating ($p=0.043$) in relation to the units where the head nurses were employed. Their performance also showed a strong negative correlation with age ($p=0.001$), work experience ($p=0.028$), and time since becoming head nurse ($p<0.001$). However, there was no significant difference between the numbers of skills with a pass rating and pre-test stress score ($p=0.129$).

Conclusion: In our study, the head nurses of surgical wards, medical wards, and intensive care units had better scores than the head nurses of pediatric, obstetrics-gynecology, and other units. In contrast with our

original hypothesis, we found that the more senior head nurses' skills when assisting with CPR were poorer than those of their more junior colleagues. This suggests that senior head nurses should undergo frequent refresher courses, not only to help maintain their life-saving abilities, but also so that they can better mentor less experienced nurses in situations requiring CPR. [*Tzu Chi Med J* 2009;21(3):233–238]

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1. Introduction

Healthcare professionals are required to have certain skills and knowledge in the area of resuscitation. Nurses working in hospital wards are expected to deal with situations requiring cardiopulmonary resuscitation (CPR) in a competent manner. However, they are exposed to these situations relatively infrequently. Previous studies have indicated that CPR skills of nurses are often poor [1–6], which may in turn make them less effective when assisting physicians during CPR.

The factors that affect retention of CPR skills are varied and difficult to pinpoint. In previous studies on healthcare workers and lay rescuers who had undergone CPR training, the time for retention of knowledge of CPR was longer than for the retention of actual CPR skills [3,7–9]. There are many factors that negatively affected retention. Lack of supervision is one of the factors that have been identified [3,7–9]. However, to date, very little has been published on the relationship between head nurses' age, time as a head nurse/nurse manager, and skill level when assisting with CPR.

Head nurses have a responsibility to supervise and teach their staff how to respond to situations requiring CPR, as well as helping with CPR themselves. Understanding the factors associated with the quality of their performance when assisting with CPR is important—such knowledge may lead to improvement in the quality of CPR and ultimately the CPR success rate of their respective units. Most previous studies of CPR skills and training have focused on nursing staff in general rather than head nurses specifically [6,10,11]. In addition, the quality of CPR assistance by head nurses has not been analyzed.

Therefore, we conducted an observational study of head nurses assisting with CPR. Potential determinants of CPR assistance quality were studied by analyzing the associations between demographic data, the different units where the head nurses were employed, the head nurses' stress scores, and the accuracy of CPR assistance provided (assessed with a manikin). The primary objective of the study was to analyze the factors associated with the CPR assistance performance of head nurses.

2. Materials and methods

A cross-sectional observational research design was utilized, with a questionnaire designed to assess the relevant variables. Data were collected from 55 head nurses employed at a 1200-bed medical center that provides healthcare to approximately 1.5 million people within the metropolitan area of southern Taiwan. Before becoming a head nurse, the study subjects were not required to have undergone advanced cardiac life support training—except for 12 nurses who had worked in emergency departments and intensive care units. As head nurses, the study subjects had not been required to undergo CPR training. The frequency at which the nurses stated they had participated in CPR was different across the various hospital units. Twenty-six head nurses had participated in more than 10 CPRs per year, 17 participated in five to nine CPRs, and the remainder had participated in fewer than five. Head nurses from all units of the hospital were required to attend a CPR-assistance skills test during February 2008. They first completed a demographic questionnaire that included sex, age, work experience, the unit in which they worked, time since being appointed as a head nurse, and the frequency of CPR in their unit. After completing the questionnaire, they were asked to rate the stress they felt while taking the test on a scale of 0 to 100, with 100 being the maximum amount of stress.

Immediately after the questionnaire, the head nurses were asked to individually perform a 4-minute simulation of CPR assistance. The test was conducted on a resuscitation manikin. The manikin, the Resusci Anne® Simulator (Laerdal Medical Corp., Wappingers Falls, NY, USA), is a commonly used tool for teaching CPR in Taiwanese hospitals and institutes that train head nurses. The sequences of the test were consistent with the 2005 guidelines for basic life support (BLS) as suggested by the International Liaison Committee on Resuscitation. Nurses were graded by BLS instructors using pass/fail criteria on a CPR assistance evaluation sheet. This was based on the BLS guideline skills checklist. The instructors were nurses—all of whom were certified in BLS and had

experience in practice, in teaching, and in evaluating performance. All tests used the same scenario, evaluation sheet, and a private simulated environment. After orientation to equipment and supplies, and time for unaided practice, the scenario requiring resuscitation was read. The instructor assessed the participant's response and graded each nurse overall as a pass or fail.

The CPR assistance evaluation sheet included and evaluated 22 CPR skills (Table 1). The pass/fail for each skill was determined by how close the response was to the BLS guideline, with two hints at most. Failure in one skill resulted in failure of the entire test.

2.1. Statistical analysis

Statistical analysis was performed using SPSS version 14.0 (SPSS Inc., Chicago, IL, USA). The results were reported as mean±standard deviation or percentage/count. For univariate analysis, the χ^2 or Fisher's exact test was used for categorical variables, and a linear correction test was used for the continuous variables. A least significant difference test (LSD) *post hoc* analysis was performed to estimate the difference within groups if there was a significant difference after one-way analysis of variance (ANOVA). An interrater reliability analysis using the Kappa statistic was performed to determine consistency among the instructors. Logistic regression was performed to assess the relationship between demographic characteristics, the stress score, the quality of CPR assistance, and to determine independent predictors of CPR assistance skills accuracy. A value of $p \leq 0.05$ was considered statistically significant. To allow multivariate logistic regression analysis, the CPR assisting skill scores were dichotomized into either pass (totally correct) or fail (any error).

Table 1 — Rate of being correct for individual CPR skills (n=55)*

1. Recognition of the need for resuscitation	54 (98.2)
2. Establishing unresponsiveness	55 (100.0)
3. Activating the emergency medical system	53 (96.4)
4. Opening the airway and clearing any airway obstruction	53 (96.4)
5. Rescue breathing and correct use of the bag valve mask	45 (81.8)
6. Establishing a lack of pulse	54 (98.2)
7. Cardiac compression	48 (87.3)
8. Preparing various devices (electrocardiogram monitor, oximeter) at the bedside	40 (72.7)
9. Pulling the patient toward the head of the bed and removing any false teeth	53 (96.4)
10. Ventilating the patient several times with the BVM using a 100% O_2 supply	54 (98.2)
11. Testing the cuff and making sure there is no leakage	54 (98.2)
12. Insertion of the guide wire into the tube to within 1 cm of the tip	55 (100.0)
13. Checking the light on the laryngoscope and its proper size	55 (100.0)
14. Suction of secretions from the mouth	55 (100.0)
15. Assisting with intubation and compression of the cricothyroid cartilage	47 (85.5)
16. Removal of the guide wire immediately	51 (92.7)
17. Suction of secretions from the endotracheal tube	55 (100.0)
18. Connecting the BVM to the endotracheal tube	54 (98.2)
19. Making sure the endotracheal tube is correctly positioned and inflating it with 8–10 cc of air into the cuff	52 (94.5)
20. Insertion of the biter	55 (100.0)
21. Fixation of the tracheal tube with an elastic bandage	55 (100.0)
22. Elevation of the head of the bed to 30–45 degrees and connection to the ventilator	53 (96.4)

*Data are presented as n (%). CPR = cardiopulmonary resuscitation; BVM = blood volume monitor.

3. Results

Results of the questionnaire were as follows. The mean age of head nurses was 41.8±7.5 years, the mean working experience was 18.8±6.7 years, and the mean time since being appointed as head nurse was 9.1±7.6 years. All head nurses were female. The 55 head nurses included 15 (27.3%) from the medical wards, eight (14.5%) from the surgical wards, 10 (18.2%) from intensive care units, five (9.0%) from pediatric and obstetrics-gynecology wards, and 17 (30.9%) from other units. The result for the stress scale was a mean of 60.53±21.18 (Table 2).

Only 30 of 55 (54.5%) head nurses passed the CPR assistance skills test. The results of the skills tests are summarized in Table 3. There were significant differences between the units and the correct numbers of skills tested as passed for the nurses (p= 0.043) after analysis with one-way ANOVA. LSD *post hoc* analysis was then performed. While there was no difference in scores for CPR assistance skills of head nurses among surgical wards, medical wards and intensive care units, these groups had significantly higher scores than head nurses from pediatric wards, obstetrics-gynecology wards, and other units.

Table 2 — Participants' demographic information*

Age (yr)	41.8±7.5
Work experience (yr)	18.8±6.7
Time since becoming a head nurse (yr)	9.1±7.6
Sex (male/female)	0/55
Department	
Medical unit	15 (27.3)
Surgical unit	8 (14.5)
Intensive care unit	10 (18.2)
Pediatric or obstetrics-gynecology unit	5 (9.09)
Other units	17 (30.9)

*Data are presented as mean±standard derivation or n (%).

Table 3 — Percentage of head nurses who performed cardiopulmonary resuscitation correctly (n=55)

Number of items performed correctly	Number	Percentage of head nurses
12	1	1.8
15	1	1.8
18	2	3.6
19	3	5.5
20	6	10.9
21	12	21.8
22	30	54.5
Total	55	100.0

The scores also had a strong negative correlation with age (p=0.001), work experience (p=0.028), and time since becoming head nurse (p<0.001). There were no significant differences between the skill scores and pre-test stress (p=0.129). The interrater reliability for the instructors was calculated as a kappa of 0.766. Therefore, there was a good level of agreement between the instructors.

Multivariate logistic regression analysis showed that work experience (odds ratio, 0.884; 95% confidence interval, 0.804–0.973) was associated with pass rate. With increasing years of working as a nurse, the inaccuracy rate increased. The other variables were excluded.

4. Discussion

According to guidelines from the American Heart Association (AHA), among patients with heart disease who have sudden onset of respiratory failure or cardiopulmonary arrest, the survival rate increases to 40–60% if CPR is administered within 4 minutes and advanced cardiac life support is performed within 8 minutes. Rosenberg et al evaluated 300 hospitalized patients who experienced inhospital cardiopulmonary arrest and found a 54% initial post-CPR survival followed by a 23% survival to hospital discharge. Predictors of a good resuscitation outcome included an initial ventricular tachycardia or fibrillation rhythm, and a brief duration of CPR (less than 30 minutes) [12]. Therefore, it is very important for health providers to have CPR skills and to be able to perform these skills in a timely fashion. As nurses are part of the resuscitation team, their skills and level of comfort when recognizing signs of cardiopulmonary arrest, the presence of malignant cardiac rhythms, and initiating CPR are vital for good patient outcome. Head nurses in particular are in a position to have great influence on their team's overall CPR skills. Our results showed that age, work experience, time since becoming head nurse, and the unit of employment are all strongly related to skills in assisting with CPR.

Cardiopulmonary arrest is not uncommon in hospitals. The AHA National Registry of Cardiopulmonary Resuscitation recorded 14,720 cardiac arrests in 207 hospitals over 2.5 years [13]. However, the level of severity of patients' medical illnesses and the frequency of CPR among hospital units are likely to be highly variable. In our study, the performances of head nurses when carrying out CPR assistance skills was different among the various units found in a hospital. The head nurses of surgical wards, medical wards, and intensive care units, in which the prevalence of cardiopulmonary arrest can be assumed to be higher, scored higher than head nurses of all the other types of units. One possible solution that will help to improve the performance of head nurses in the units that encounter cardiopulmonary arrests less frequently is to provide more frequent CPR and CPR assistance training.

When performing the 22 evaluated CPR skills, less than 90% of the head nurses scored correctly for the following assessed components: rescue breathing, the use of a bag valve mask, cardiac compression, preparing the various devices needed (electrocardiogram monitor, oximeter) at the bedside, and assisting with intubation and compression of the cricothyroid cartilage. Future CPR training should place emphasis on these skills.

Moser and Coleman's literature review found differences in the rate of deterioration of CPR skills versus the rate of decline in knowledge about CPR [14]. Skills declined faster than knowledge and begin to decline as early as 2 weeks after training. The skill level diminished to a pretraining level after 1–2 years. Other authors have also noted the different rate of skills and knowledge deterioration [4,14–17]. Smith et al studied 133 nurses with a repeated-measures and quasiexperimental design and found significant results: the retention of both basic and advanced resuscitation skills was short, and many nurses in a clinical setting do not perform life-saving BLS and CPR skills up to AHA standards [9]. Thus, it would appear that retention of both basic and advanced resuscitation skills is short. Nevertheless, nurses are often the first responders on the scene during a cardiopulmonary arrest, and head nurses are expected to supervise and advise less experienced nurses during such an event. Our initial hypothesis was that, since senior head nurses were more likely to have had more experience with CPR, then their skills and knowledge of CPR ought to be greater than that of more junior nurses. Nevertheless, in our study, age, work experience, and time since becoming head nurse were all negatively correlated with CPR assistance skills. If senior head nurses do not refresh their CPR or CPR assistance skills for a long time, it appears that their skill level will only be equal to, but probably not better than, that of junior nurses.

Patient safety is an important part of nursing. Head nurses are the leaders and supervisors of their units. Therefore, they should be assessed formally—with a feedback mechanism—by an expert instructor on a regular basis to ensure that their skills are adequate. A previous study showed that the CPR skills of nurses had diminished to pretraining levels after 1–2 years (14), Therefore, CPR refresher training should be provided at least once every other year to ensure that the CPR skills of head nurses are kept fresh and up-to-date.

While some head nurses in our study had poor CPR assistance skills according to the 2005 BLS Guidelines, greater age, longer work experience and longer time since becoming head nurse were associated with poorer levels of CPR-assistance. The various different units within the hospital also had distinctly different results. These findings suggest that, in units experiencing fewer cardiopulmonary arrest events, head nurses should have refresher training more frequently than the head nurses in units that undertake CPR more often. Although the logistic regression excluded other variables, instructors should be aware that seniority is neither a guarantee of good skills nor a predictor of good CPR quality during refresher courses. Therefore, we rejected the hypothesis of our study.

The present study is important because it has identified that the CPR assistance skills of some head nurses may not be adequate. It also provides evidence that senior head nurses should attend resuscitation refresher courses frequently in order to help maintain their life-saving skills. Therefore, we suggest that the CPR training course should be standardized and included in the annual nursing quality evaluation and survey. Nursing supervisors and BLS instructors should train head nurses in order to maintain their CPR skills as part of their supervision of staff performance. The nursing department should verify the quality regularly to make sure that the nurses' knowledge and CPR skills are sufficient.

There are some limitations of our study. It examined only a single institution—generalization to other institutions would therefore be problematic. However, other institutions may have the same problems because senior nurses are the last ones to be requested to attend refresher courses. Another limitation is that our study's context was simulated, rather than an observation of the nurse performing in a real situation. Our demographic data was self-reported and the accuracy of how frequently CPR is performed in their units may be somewhat inaccurate. In addition, this study was undertaken in the context of a BLS system and, therefore, the findings cannot be extrapolated to advanced life support situations. Furthermore, linear regression could not be used because the residuals were not normally distributed; as a result, logistic regression was performed, which required the objective variables to be dichotomized. This might have resulted in possible information loss.

In conclusion, a significant number of head nurses in our study did not pass the CPR assistance skills test. Work experience was negatively associated with the quality of the head nurses' skills. These findings highlight the need for frequent refresher training for senior head nurses. Moreover, senior head nurses should have their skills refreshed frequently, not only to help maintain their life-saving abilities, but also to help them mentor less experienced nurses in situations that require CPR.

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