Ward Characteristics Related to Quality and Pitfalls of Basic Life Support in Cardiopulmonary Resuscitation Simulated Survey

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ABSTRACT

Objective: To assess the quality of nurses' basic life support (BLS) and to determine pitfalls in BLS in relation to ward characteristics.

Setting: A 2,400-bed university hospital in Thailand.

Methods: A 1-year retrospective simulated audit for 2009 to assess nurses' BLS performance at each step. Each observer assessed the subjects' performance by using a scoring sheet and noting the objective manikin data related to chest compression.

Results: A total of 57 wards from intensive care units, critical wards, procedural units, general wards or outpatient units were audited. Only 24 out of 57 (42.1%) did airway maneuvers correctly, while only 2 out of 57 (3.5%) could rescue breathing with chest movement. For the circulation maneuvers, carotid pulse check, hand position, the depth and the rate of cardiac compression were mostly performed incorrectly. Exactly 14.0% of subjects did not palpate the carotid pulse, and 52.6% palpated it incorrectly. Thirty-three nurses (57.9%) located and placed their hands on the wrong position. Forty-one nurses (71.9%) did not achieve the requisite chest compression depth, while thirty-one nurses (54.4%) did not achieve the target chest compression rate. The overall BLS performance of nurses in the High Risk Zone was better than that of nurses in the Low Risk Zone, except in the case of the airway sector.

Conclusion: The CPR audit evaluated the resuscitation performance during simulated cardiac arrest in the service setting, and compared wards nurses in 2 categories related to the risk of cardiac arrest. Improvement in the organisation of training and the systematic approach to CPR should be adopted.

Keywords: Cardiopulmonary resuscitation, simulation, audit, basic life support

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INTRODUCTION

Cardiac arrest is one of the most critical situations in healthcare practice. A few minutes can mean the difference between life and death. Preparedness for the optimal handling of cardiac arrest is recommended, in particular, that healthcare workers be required to undertake all standardized educational programs and routine training to ensure their effective performance in administering cardiopulmonary resuscitation (CPR).[1,2] According to published literature, most in-hospital cardiac arrests are discovered by nurses, so there is a need to emphasize the importance of performing good quality CPR by ward nurses.[1-5]

CPR audits at Siriraj Hospital have been conducted since early 2000 as a tool to evaluate the resuscitation performance during simulated cardiac arrests in a service setting in order to identify areas for improvement of CPR training as well as to provide motivation for healthcare personnel to acquire and maintain the necessary skills. This particular research is a secondary study of a previously-conducted retrospective study which reported data related to the time management of CPR teams and which

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identified the ward characteristics which were associated with delays in CPR management.[5] The purpose of this current study was to assess the quality of nurses' basic life support (BLS) and to determine the pitfalls in BLS in relation to ward characteristics.

MATERIALS AND METHODS

Methodology

This retrospective study was approved by the Institutional Review Board (Si. 424/2553 [Exempt]). Data for the present study was originally part of an annual simulated survey which was conducted in August 2009.

Study setting and subjects

The study was conducted in an academic, tertiary-care facility with approximately 2,400 in-patient beds and an annual turnover of approximately 2,000,000 patients. The Siriraj CPR training center trains all nurses in the American Heart Association (AHA) guidelines. Most nursing personnel working in each ward had attended a refresher course in basic life support (BLS) and/or advanced cardiac life support (ACLS) within three years of the study period.

Hospital CPR zones are described elsewhere. In brief, ICU, CCU, critical wards and procedural areas are classified as High Risk Zones, and general wards and outpatient units are categorized as Low Risk Zones.[5]

Subjects were randomly assigned from on-duty clinical nursing staff who were expected to respond to sudden cardiac arrest as part of their clinical responsibilities. Only nursing personnel were included in the study, in accordance with data from literature identifying nurses as the most common, in-hospital, sudden-cardiac-arrest, first responders.[1-5]

An observation team consisting of four BLS or ACLS instructors viewed the subjects performing BLS on the Resusci Anne SkillReporter manikin (Laerdal Medical, Stavanger, Norway). Each observer assessed the subjects' performance by using a scoring sheet (Appendix A) and noting the objective manikin data related to chest compression (hand placement, rate, depth and complete recoil). During the simulation, this SkillReporter was kept close to the subjects under observation. An agreement was reached by the observers after discussion and comparison of their judgments and their analyses of the report of the compression scores and errors detailed on the SkillReporter's printout.

Study protocol

The CPR audit period and all the checklist details of the simulated process were announced to all 178 service units, and they were also made available on the website of the Siriraj CPR training center (www.si.mahidol.ac.th/th/division/cpr/audit53.html). The checklist used for evaluation was based on the guidelines of the American Heart Association 2005. This checklist included criteria for "preliminary first action" and "skill performance of BLS." Criteria for preliminary first action (P) included "recognition of unresponsiveness" (P, one item); and "call for doctor", "call for CPR team", "ask for resuscitation cart", and "ask for defibrillator" (H, four items). The criteria used for skill performance of BLS consisted of "open airway" (A, one item); "breathing assessment", and "bag-valve-mask ventilation" (B, four items); and "cardiac compression" (C, nine items). Each skill criterion on the checklist was ranked into three categories which were marked as: done correctly and effectively, done incorrectly, and not done.

In the case of mistakes or improper performance of the BLS, the observers recorded comments and reasons about how and why the subjects' performance in the relevant checklist item was inadequate. After the performance of the simulation, the observers provided the subjects with feedback of 15 minutes.

Each manikin represented a cardiac arrest patient and was presented to the subjects as a newly arrived patient who had collapsed on a stretcher. The surveyed wards were selected by simple sampling in the morning of the day of the audit. Nursing personnel working on that day (i.e., the subjects) were required to perform a two-rescuer CPR on the manikin as if they had found a patient collapsed on a stretcher during working hours. The pairs performed around two minutes or five cycles of cardiac compression on each manikin (Fig 1).

Data collection

Data collected included the type of hospital ward and the complete scores on the checklist in order of BLS sequence (Appendix A).

Statistic analysis

Descriptive statistics were calculated to describe the different types of nurses, the proportion of correct BLS actions, and the overall, individually-weighted scores. The checklist was divided into five sectors which were: P, H, A, B and C. The value of each part was determined by agreement among the four observers, with maximum scores of 10 points for P, 10 points for H, 15 points for A, 20 points for B and 45 points for C. An independent student's t test was used to test the difference in the weighted score derived from each action. Nurses were categorized into two groups, based on the risk of cardiac arrest; High Risk Zone nurses were defined as nurses who worked in the ICU, the procedural units or the critical wards, while Low Risk Zone nurses were defined as nurses who worked

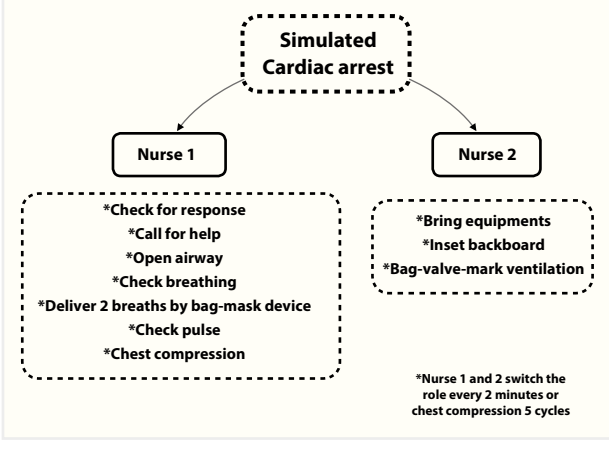

Fig 1. Flowchart for nurses in surveyed wards to perform two-rescuer CPR.

Appendix A. Adult BLS checklist.

Component	Not done	Done		Comments & Suggestions
		Incorrectly	Correctly	
1.Preliminary first action				
P1 Conscious assessment				
P2 Call for help:				
H1 Call doctor				
H2 Call CPR team				
H3 Call for defibrillator				
H4 Call for emergency cart				
2.BLS checklist				
A-Airway				
A1 Open airway				
B-Breathing				
B1 Check breathing				
B2 O2 ≥ 10 LPM supply within 2 mins				
B3 Connect O2 reservoir bag				
B4 Adequacy of chest movement ≥ 8 beats/5 cycles				
C-Circulation				
C1 Carotid pulse check				
C2 Insert backboard within 2 mins of pulse check				
C3 Lower half of sternum for hand position				
C4 1.5-2 inches compression depth				
C5 Compression rate 100/min				
C6 Compression and count				
C7 Compression: ventilation ratio = 30:2				
C8 Change compression every 2 mins or 5 cycles				
C9 Complete release				

Skill definitions

P1 – Assess the victim for a response by tapping the victim on the shoulders and asking "Are your all right?" loudly enough (the patient was unresponsive)

P2 – Shout for help and activate:H1 the doctor, H2 Cardiac arrest team and asking to get H3 defibrillator and H4 emergency cart

A1 – Open the airway by performing the head tilt-chin lift or jaw thrust

B1 – Check for adequate breathing by looking for chest movement, listening at the patient's mouth for the sound of breathing, and feeling for air on the rescuer's cheek for at least at five seconds and no more than ten seconds (there was no breathing)

B2 – Supply O2 ≥ 10 LPM in two minutes

B3 – Connect O2 reservoir bag

B4 – Deliver each breath and make the chest rise ≥ eight beats/five cycles with a bag mask device

C1 – Palpate the carotid pulse (the groove between the trachea and the muscles at the neck) for at least five seconds and no more than ten seconds (there was no pulse)

C2 – Insert backboard within two minutes of pulse check

C3 – Place the heel of the hand on the sternum in the center of the manikin's chest between the nipples, and then place the heel of the second hand on top of the first

C4 – Compression depth: press down 1.5 to 2 inches (or 38 to 51 millimeters), with a compression score of at least 80%

C5 – Push hard and fast at a rate of 100 compressions per minute (accept between 90 and 110 per minute)

C6 – Compression and count

C7 – Performing cycles of 30 compressions and 2 breaths

C8 – Change compression every 2 minutes/5 cycles, which take no more than 10 seconds

C9 – Completely release all pressure from the chest

in the general ward or the outpatient units. Statistical analysis was conducted using the software program SPSS (version 17), SPSS Inc., Chicago, IL, USA. Data has been presented as mean ± standard deviation (SD), minimum, maximum, and proportion (%), as appropriate. $P < 0.05$ was considered to indicate a statistically significant difference.

TABLE 1. Total results of subjects' performance in BLS.

Component	Number (%) Not done	Incorrectly done	Correctly done
1.Preliminary first action			
P1 Conscious assessment	5 (8.8)	11 (19.3)	41 (71.9)
P2 Call for help			
H1 Call doctor	1 (1.8)	2 (3.5)	54 (94.7)
H2 Call CPR team	2 (3.5)	2 (3.5)	53 (93)
H3 Call for defibrillator	5 (8.8)	1 (1.8)	51 (89.5)
H4 Call for emergency cart	4 (7)	1 (1.8)	52 (91.2)
2.BLS checklist			
A-Airway			
A1 Open airway	3 (5.3)	30 (52.6)	24 (42.1)
B-Breathing			
B1 Check breathing	3 (5.3)	33 (57.9)	21 (36.8)
B2 O2 ≥ 10 LPM supply within 2 mins	15 (26.3)	18 (31.6)	24 (42.1)
B3 Connect O2 reservoir bag	7 (12.3)	2 (3.5)	48 (84.2)
B4 Adequacy of chest movement ≥ 8 beats/ 5 cycle	1 (1.8)	54 (94.7)	2 (3.5)
C-Circulation			
C1 Carotid pulse check	8 (14)	30 (52.6)	19 (33.3)
C2 Insert back board within 2 mins after pulse check	7 (12.3)	10 (17.5)	40 (70.2)
C3 Lower half of sternum for hand position	1 (1.8)	32 (56.1)	24 (42.1)
C4 1.5-2 inches compression depth	0	41 (71.9)	16 (28.1)
C5 Compression rate 100/min.	0	31 (54.4)	26 (45.6)
C6 Compression and count	2 (3.5)	13 (22.8)	42 (73.7)
C7 Compression: ventilation ratio = 30:2	2 (3.5)	3 (5.3)	52 (91.2)
C8 Change compression every 2 mins or 5 cycle	3 (5.3)	19 (33.3)	35 (61.4)
C9 Complete release	1 (1.8)	17 (29.8)	39 (68.4)

RESULTS

A total of 57 of the hospital's 178 service units (32%) participated in this audit. The surveyed wards included five ICUs, ten critical wards, eleven procedural units, sixteen general wards and fifteen outpatient units.

The overall BLS performance data from the simulated cardiac arrests during the period of the CPR audit has been summarized in Table 1. In terms of the individual skills, only a few subjects either skipped the step of conscious assessment (proceeding immediately to the performance of BLS) or checked for consciousness inadequately, i.e., by tapping only one shoulder or by attempting to awaken the manikin only by speaking loudly. All subjects performed the call for help (H) sector correctly, although mistakes were found in some wards, which provided a defibrillator and an emergency cart before the subjects asked for them.

The subjects performed the opening of the airway (A) and the breathing (B) sectors poorly, with only 24 out of 57 (42.1%) doing the airway maneuver correctly, and 2 out of 57 (3.5%) rescuing breathing with a chest movement of more than eight breaths in five-cycles of cardiac compression. The mistakes were due to impaired skill of head tilt-chin lift (or jaw thrust), and failure to remove the pillow from the manikin's head while continuing to check breathing without opening the airway. Moreover, while subjects often remembered that they had to connect a bag mask device with oxygen, they forgot to open the oxygen flow meter.

Four out of nine skill parameters in the circulation (C) part showed an inadequate performance or were missed which were carotid pulse check, hand position, and the depth and rate of cardiac compression. Forty-nine (85.9%) of subjects checked the carotid pulse, but 30 (52.6%) palpated it in the wrong place or were too hasty.

TABLE 2. Weighted score of each action of nurses in High Risk Zones and Low Risk Zones.

Actions	Mean ± SD High Risk Zone nurses (n=26)	Low Risk Zone nurses (n=31)	P value	Mean difference (95%CI)
P score **(10)**	9.6 ± 1.4	6.9 ± 3.8	0.001	2.7 (1.2, 4.2)
H score **(10)**	10 ± 0	8.8 ± 2.7	0.016	1.2 (0.2, 2.2)
A score **(15)**	9.8 ± 3.5	10.6 ± 5.0	0.47	-0.8 (-3.1, 1.4)
B score **(20)**	13.5 ± 1.8	11.7 ± 4.0	0.027	1.8 (0.2, 3.5)
C score **(45)**	36.4 ± 4.9	32.6 ± 7.8	0.031	3.8 (0.4, 7.2)
Total Weighted score **(100)**	79.3 ± 7.9	70.6 ± 19.3	0.028	8.7 (1.0, 16.3)

Eight out of 57 subjects (14%) omitted to check the pulse due to their misunderstanding of the CPR 2000 guidelines, which deleted reference to pulse check training for lay rescuers. Thirty-three nurses (57.9%) placed their hands on an improper position, i.e., on the epigastrium rather than in the center of the chest. Forty-one nurses (71.9%) did not achieve the specified chest compression depth, and thirty-one nurses (54.4%) did not achieve a chest compression rate of 100 per minute (the accepted range is 90 to 100 per minute).

With regard to the two groups of nurses, Table 2 has presented the weighted score of each BLS action of the High Risk Zone nurses and the Low Risk Zone nurses. Overall, the performance of the BLS actions by nurses from both groups showed significant differences in the P, H, B and C sectors. On the other hand, no significant difference in the nurses' performance in the A sector was found between both groups (P value 0.47, 95% CI: -3.1, 1.4)

DISCUSSION

The results of our study show the nurses' BLS performance at each step during the period of the CPR audit in August 2009. The CPR audit utilized an in situ simulation of a cardiac arrest within a clinical environment to assess CPR skills which closely correlated with BLS ability in a real life situation without compromising patient safety.[4,6,14] We employed an in situ simulation conducted during office hours and utilized real time assessment by the observers to evaluate many actions, such as responsiveness assessment, opening of the airway, the extent of chest rising resulting from bag mask ventilation, and hand placement for compression. Observation of the mistakes in the BLS performance of ward nurses who were nearby and who were the first to arrive on the scene was essential to develop a meaningful audit which could be reported to the instructor team responsible for CPR training improvement.

Cardiopulmonary arrest can happen at anytime and anywhere, so BLS and ACLS training, resuscitation equipment and cardiac arrest teams are in-place in many large hospitals.[11,12] The time to respond to a CPR situation and the quality of the CPR are important aspects for a successful outcome after a cardiac arrest.[7,8] In the previous study, the median times to initiate chest compression in the High and Low Risk Zones were not different.[5] However, the quality of BLS presented in this study displayed varying degrees of performance of BLS actions, with the overall BLS performance of nurses in the High Risk Zone being better than that of nurses in the Low Risk Zone. As for individual skills, more than half of the subjects failed to open the airway or to perform effective bag valve mask ventilation and effective chest compressions. Correlation with most research found that the quality of CPR often deviates from guideline recommendations in several specific parameters, including chest compression rate, compression depth and ventilation rate.[7,8] In this audit, we found that some subjects hesitated to commence CPR with the manikin placed on a stretcher either because they had practiced CPR training on a manikin that was placed on the floor, or because the height and width of the stretcher were inadequate to permit the subjects to kneel next to, or stand beside, the manikin in order to perform chest compression. Therefore, given this awkward position, the compression depth of the manikin's chest was often below standard even if a backboard was inserted. Wards need to provide a step stool to enable rescuers to stand vertically above the patient and to allow leveraging of the body weight above the waist to facilitate chest compressions in a real situation.[9]

Despite past efforts to improve CPR procedures and training, the quality of the in-hospital CPR was less than satisfactory, even with trained medical or paramedical personnel who are often exposed to cardiac arrests.[10,11,13] Poor performance occurred due to stressful and disorganized cardiac arrest settings, rescuer fatigue, and a lack of knowledge and skills, any of which may contribute to the low survival rate of sudden cardiac arrest patients.[7] Nowadays, the 2010 American Heart Association Guidelines emphasize the majority of CPRs should involve chest compressions and early defibrillation.[14] Strategies aimed to shorten the time from recognition of cardiac arrest to initiation of resuscitation should be activated to improve patients' chances of survival and preserve their neurologic function.[15] In practice, a cardiac arrest team responsible for the whole of a large hospital with many separate buildings may not be available on time, so effective first-responder resuscitation is essential.[11] Fifty percent of the non-monitored areas in our hospital are covered by code A (consisting of an internal medical resident/fellow and an anesthetic resident),[5] and the overall BLS performance of nurses in those areas was quite low compared with that of nurses in the monitored areas. Experience of treating cardiac arrests in real life may increase skill and confidence. The prevalence of in-hospital cardiac arrest in regard to ward characteristics in High Risk Zone and Low Risk Zone should be the focus of the next study. The prevalence of in-hospital cardiac arrest in regard to ward characteristics in High Risk Zone and Low Risk Zone should be the focus of the next study. Furthermore, parameters such as leadership, communication and teamwork should be evaluated in the next CPR simulated survey.

There are several limitations of this study. Firstly, the study assessed simulated resuscitations, so the subjects' responses may not represent what might occur during real cardiac arrests. Secondly, participants may not have fully engaged in the simulations due to personal emotions such as anxiety, worry or shame.

This section includes some recommendations which may be more appropriately located in the "Conclusion".

CONCLUSION

The CPR audit evaluated the resuscitation performance during simulated cardiac arrest in a service setting, comparing the performance of ward nurses in two categories related to the risk of cardiac arrest. It is recommended that improvements be made to CPR training and that a systematic approach to CPR should be adopted.

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