

# Effect of an Educational Intervention for Nursing Personnel on Emergency Inventory and Drugs Checklist of Resuscitation Trolley in a Tertiary Cardiac Center, Kathmandu.

Sunita Khadka<sup>1</sup>, Battu Kumar Shrestha<sup>1</sup>, Reshma Thapa<sup>1</sup>, Deoki Saru<sup>1</sup>, Nita Devi Dangol<sup>1</sup>, Dipanker Prajapati<sup>1</sup>, Suraksha Dhungana<sup>1</sup>, Murari Dhungana<sup>1</sup>, Chandra Mani Adhikari<sup>1</sup>

<sup>1</sup> Shahid Gangalal National Heart Centre, Nepal

**Corresponding author:** Sunita Khadka  
Shahid Gangalal National Heart Centre, Nepal  
**Email:** khadkasunta@gmail.com  
**ORCID ID NO:** 0000-0002-2280-315X

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## Abstract

**Background and Aims:** A crash cart is a trolley with emergency medicines and equipments required for medical emergencies. Nurses often witness cardiac arrest. They should be familiar with the placement of equipments and drugs in crash cart trolleys. Thus, this study was conducted to assess the effect of an educational intervention on knowledge of crash cart drugs and equipment management among nurses.

**Methods:** This is a pre-experimental research design conducted at Shahid Gangalal National Heart Center, Kathmandu, Nepal. A simple random sampling technique was adopted. A semi-structured questionnaire was used to identify the knowledge of nurses. A standard checklist was used to observe crash cart trolleys. Pre and post test data was taken. Outcome variables included knowledge of crash cart trolleys organization and well organized crash cart in different wards. Data were analyzed to compare the knowledge before and after the intervention. Chi-square test, pair t-test, and linear regression multivariable model used for statistical analysis.

**Results:** A total of 134 nurses were recruited in this study. The overall mean score of knowledge was significantly higher in post-intervention. The total knowledge mean score difference among nurses was -11.07, ( $p < 0.001$ ), drug content difference at crash cart was -16.85, ( $p < 0.001$ ), equipment content at crash cart was -24.42, ( $p < 0.001$ ). The linear regression showed significant improvement in knowledge at post-intervention ( $\beta$ ; 0.928, 95% CI; 10.52, 11.57,  $p < 0.001$ ), when adjusted for age, education, work experience, working unit and CPR training.

**Conclusion:** Knowledge and organization of crash cart was improved after educational intervention.

**Keywords:** crash cart; emergency; medical equipment; nurses

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## Introduction

A resuscitation trolley (Crash cart/ emergency trolley) is mobile trolley containing drugs and medical equipment to save life.<sup>1</sup> Resuscitation trolley is required in all patient care areas.<sup>2</sup> Nursing personnel should be familiar with crash cart content and location. In-service education and orientation training is mandatory to up-to-date nursing staff on crash cart trolley.<sup>3,4</sup>

In UK, in-hospital incidence of cardiac arrest is 1 to 1.5/1000 hospital admissions. Most of the cardiac arrest (85%) occurs in admitted patients. Shockable rhythm is 17%. Return of spontaneous circulation (ROSC) is achieved in 53%, who are treated by the resuscitation team.<sup>5</sup>

Effective (cardio pulmonary resuscitation) CPR depends on the availability of well-stocked crash carts. Basic device failure, inadequate knowledge, lack of experience, and training on the crash cart are some of the key issues in resuscitation.<sup>6</sup> Medication and material-related errors might occur during CPR that can increase morbidity and mortality.<sup>7</sup> Every hospital must have trained healthcare providers as well as adequate amount of essential equipment to deal medical emergency.<sup>8</sup>

Different studies have shown that initiation of CPR is delayed due to a lack of medicines and functioning equipment.<sup>9-11</sup> The incidence of cardiac arrest is high in cardiac hospitals. Therefore, crash cart and staff working in a cardiac center should always be ready to tackle cardiopulmonary resuscitation (whether it is in a critical care setting or a general ward). This study aimed to find out the baseline status of the crash cart observation of different inpatient ward, existing knowledge of crash cart management among the nursing staff and intervention as per requirement.

## Research methodology

This study was designed to measure the outcomes before and after an educational intervention in the same group without having control group.

## Study population

The study was conducted among staff nurses working in In-patient ward. Name list of nursing staffs was obtained from human resource department of hospital.

### Study area/setting

This research was conducted in Shahid Gangalal National Heart Centre (SGNHC), Bansbari, Kathmandu, the tertiary cardiac center of Nepal. It is a semi-government hospital that serves 1.5 lakh patients in outpatient department every year. In 2021, 7240 patients were admitted in hospital from emergency. There were 14 wards/units that serve the in-patient cardiac patient at the time of study.<sup>12</sup>

### Sampling techniques/ methods

Study participants were recruited through simple random sampling. Random numbers for the required sample size were generated from total list of staff. Those who refused to participate were excluded. There were 203 staff nurses working at inpatient units. Total of 134 nursing staffs were recruited. Sample size was calculated with a population proportion formula with margin of error of 5% and 95% confidence interval. A sample proportion was considered 50%.<sup>13</sup>

### Method of data collection

The data was collected before-after education intervention. Pre-intervention data was taken at conference hall of SGNHC by researchers themselves by using self-administered semi-structured questionnaire, in May 2022 (started on May 4 till May 8, 2022). Same procedure was repeated to get post-intervention data after one month of education intervention. A checklist was used to observe crash carts by researcher. It took about 25-30 minutes to observe a crash cart.

### Ethical consideration

Ethical approval was taken from the Institutional Review Committee of Shahid Gangalal National Heart Center, Bansbari, Kathmandu. The objectives of the study were explained to participants and written consent was obtained.

### Inclusion criteria and Exclusion criteria

All the Staff nurses working at In-patient ward of SGNHC were included in the study. All the nursing supervisors, staffs on study / maternity leave, staffs working at outpatient department, operation theatre and catheterization laboratory were excluded in study.

### Data collection tool/instruments

A semi-structured questionnaire was developed to identify knowledge of the resuscitation trolley among staff nurses. Consultation with subject expert was done (anesthesiologist, CPR expert, nursing supervisors, and cardiologist), observation of the existing crash cart was done and extensive literature review was done to develop the tool. The questionnaire was divided into two sections; part I: Socio-demographic questions, part II: Knowledge related Multiple Choice Questions of resuscitation trolley organization and management. A standard resuscitation trolley checklist of SGNHC was used to observe crash cart in different inpatient ward.

### Validity and reliability

A Validity of the instrument was maintained by extensive literature review, consultation with the subject expert (Anesthesiologist, CPR instructor, nursing supervisors, and Cardiologist) and colleagues. Reliability of the instrument was maintained by pre-testing the questionnaire in participants with 10% sample in similar characteristics and setting and they were excluded in the study. The instrument was modified and finalized as required.

### Intervention

This study examined the effect of educational intervention among staff nurses on resuscitation trolley management and organization of crash cart in inpatient wards. Education was focused on: content

of emergency trolley, organization of drugs on it, post-resuscitation crash cart maintenance, and emergency inventory checklist. A Power Point presentation was prepared. All the nursing staff working at in-patient wards were invited to attend the class. One-hour education session was done in the conference hall of the hospital for consecutive four days by the research team. A demonstration was done for organization of drugs and equipment on a crash cart.

### Statistical analysis

Data were analyzed using chi-squared test and pair t-test to identify the difference between the crash cart drug and inventory management before and after intervention. Associated factors with knowledge were examined by using linear regression (multivariable analysis) model. Percentage difference between pre-intervention and post-intervention group was calculated by using percentage difference calculator. To calculate total knowledge score, participant's responses were recoded. Recoded variables were computed to total knowledge score. Same process was followed for total drug and equipment content in crash cart.

## Results

### General characteristics of respondents

Table 1 describes the general characteristics of respondents. There were 134 staff nurses in pre-intervention and post-intervention.

The mean age was 29.80 ( $\pm 3.90$ ) years. Around 50.0 % of them had got post basic bachelor of nursing (PBN/BSN) degree and 36.6 % of them had a B.Sc. nursing. Overall, 56.7 % of them were worked in the critical care unit. Mean work experience was 6.48 ( $\pm 4.49$ ). About 50.0 % of them had taken cardiopulmonary resuscitation training (CPR) before.

**Table 1 General characteristic of respondents**

	Pre-intervention (N=140)
	n (%)
<b>Education</b>	
PCL	18(13.4)
PBN/BSN nursing	67 (50.0)
Bsc. in nursing	49 (36.6)
<b>Working areas</b>	
General ward	58 (43.3)
Critical ward	76 (56.7)
<b>CPR training</b>	
Yes	67 (50.0)
No	67 (50.0)

Table 2 represents the knowledge of crash cart management among the nursing personnel in both groups. A higher proportion of nursing staff in the post-intervention group had greater knowledge of crash cart placement, drugs, equipments placement, and safety

checks of the equipment used in resuscitation of the patient. A higher percentage difference was observed in almost all the questions regarding crash cart management in the post-intervention group. The highest percentage difference was seen in maintenance of crash cart (182.3), contents of the drawer (177.4), and safety check of equipment (173.2%). The proportion of knowledge in the post-intervention group was significant with  $p < 0.001$ .

**Table 2 Pre-intervention and post-intervention knowledge of respondents on resuscitation trolley management**

Questionnaire Item	Pre-intervention N=134	Post-intervention N=134	PD <sub>diff</sub>	
	n (%)	n (%)	%	P-value
What is a crash cart?	134 (100.0)	133 (99.3)	0.70	1.00
<b>Placement of items and drugs</b>				
Crash cart should be placed	124 (92.5)	131 (97.8)	5.49	0.088
A defibrillator should keep	63 (47.0)	107 (79.9)	51.85	<0.001
The oxygen cylinder has to keep	125 (93.3)	102 (76.1)	20.30	<0.001
<b>Content of drawer</b>				
The top shelf of the crash cart contains	82 (61.2)	104 (77.6)	23.63	0.005
The fourth drawer of the crash cart contains	31 (23.1)	113 (84.3)	113.96	<0.001
Laryngoscope, airways, and Magill forceps have to keep on	14 (10.4)	111(82.8)	155.36	<0.001
First drawer of the crash cart is supposed to keep	23 (17.2)	133 (99.3)	140.94	<0.001
The fifth drawer of the crash cart contains	49 (36.6)	126 (94.0)	87.90	<0.001
Additional supplies/equipment for emergency should keep on	53 (39.6)	80 (59.7)	40.48	0.001
The function of the defibrillator is assured	131 (97.8)	133 (99.3)	1.52	0.614
You can find IV cannula, free needles, and micro drip set in	87(64.9)	129 (96.3)	38.95	<0.001
Inj.Dopamine, inj dobutamine, and inj dextrose 25/50 percent have to keep on	114 (85.1)	122 (91.0)	6.7	0.187
The third drawer of the crash cart contains	7 (5.0)	117 (87.3)	178.33	<0.001
Iv fluids povidone-iodine (Betadine)10% has to keep on	29 (21.6)	131 (97.8)	127.63	<0.001
<b>Safety check of equipment</b>				
While checking the Ambu bag, what do you look for?	8 (6.0)	134 (100.0)	177.35	<0.001
You are working in ICU; how often do you check laryngoscopes?	7 (5.2)	127 (94.8)	179.2	<0.001
Oxygen cylinder has to refill when the gauge of needle get to the	11 (7.9)	63 (47.0)	142.44	<0.001

Questionnaire Item	Pre-intervention N=134	Post-intervention N=134	P <sup>Diff</sup>	
	n (%)	n (%)	%	P-value
What is the ideal time to exchange near expiry drug with hospital dispensary?	24 (17.9)	107 (79.9)	126.78	<0.001
What do you do when the bulb of the laryngoscope is dim?	59 (42.1)	114 (85.1)	67.6	<0.001
How often do you need to do a basic check of a defibrillator at your shift?	120 (89.6)	119 (88.8)	0.89	1.00
What do you do if basic checks fail?	121 (90.3)	132 (98.5)	8.6	0.008
<b>Maintenance of crash cart</b>				
What do you do if found an unlocked crash cart at your working unit?	5 (3.7)	105 (78.4)	181.97	<0.001
Who is the responsible person to check a crash cart?	6 (4.3)	130 (97.0)	183.02	<0.001
How often do you do maintenance of the crash cart at your unit?	5 (3.7)	113 (84.3)	183.18	<0.001

*P<sup>Diff</sup> = percentage difference between pre-intervention and post-intervention group.*

Table 3 represents the percentage differences in knowledge of resuscitation trolley organization after educational intervention among nursing staff. A total of 14 crash cart trolleys were observed. We had seen up to 200% differences in post-intervention crash cart drugs and contents management. However, no percentage difference was observed in some items. Such as, defibrillator and oxygen cylinder placement were not kept as instructed by checklist protocol. Likewise, inj. Aminophylline, inj. Phenobarbitone was 0% in the crash cart before and after an intervention. Most of the other items were updated in the crash cart after educational intervention. Crash cart contents and equipment changed significantly ( $p < 0.001$ ).

**Table 3: Percentage differences in knowledge of resuscitation trolley organization before and after intervention**

ITEMS		Define number	Pre-intervention	Post-intervention	P <sup>Diff</sup>	
			n(%)	n(%)		P-value
<b>TOP OF THE DRAWER</b>						
1	Cart inventory list	1	0 (100.0)	14 (100.0)	200.0	<0.001
2	Defibrillator with electrodes Defibrillator pads+electrodes+jelly	1	0 (100.0)	0 (100.0)	-	-
3	Anesthesia mask with different sizes (0-5)	5	0 (100.0)	12 (85.7)	200.0	<0.001
4	Ambu mask with a reservoir of different sizes connector	1-2	0 (100.0)	14 (100.0)	200.0	<0.001
5	Sharp container for disposal	1	0 (100.0)	0 (100.0)	-	-
6	Oxygen key	1	1 (7.1)	8 (57.1)	155.5	0.015
7	Oxygen cylinder	1	0 (100.0)	0 (100.0)	-	-
8	BP set and a stethoscope	1	0 (100.0)	12 (85.7)	200.0	<0.001
9	CPR board	1	3 (21.4)	8 (57.1)	90.90	0.122
10	Scissors	1	0 (100.0)	13 (92.9)	200.0	<0.001
11	ampule cutter	1	0 (100.0)	14 (100.0)	200.0	<0.001
12	Torchlight	1	0 (100.0)	14 (100.0)	200.0	<0.001

ITEMS		Define number	Pre-intervention	Post-intervention	<sup>p</sup> Diff	
			n(%)	n(%)		P-value
13	ET tube fixation tape	1	11 (78.6)	14 (100.0)	24.0	0.222
<b>First drawer(cardiac drugs)</b>						
1	Inj. Atropine	6	12 (85.7)	14 (100.0)	15.3	0.423
2	Inj. Adrenaline	6	12 (85.7)	14 (100.0)	15.3	0.423
3	Inj. Adenosine	6	4 (28.6)	13 (92.9)	105.8	0.002
4	Inj. Amiodarone	6	5 (35.7)	14 (100.0)	94.7	0.001
5	Inj. calcium gluconate	6	3 (21.4)	14 (100.0)	129.4	<0.001
6	Inj. Magnesium sulphate	6	8 (57.1)	14 (100.0)	54.5	0.021
7	Inj. Nor-adrenaline	6	5 (35.7)	14 (100.0)	94.7	0.001
8	Inj. Sodium bicarbonate	6	5 (35.7)	14 (100.0)	94.7	0.006
<b>Second drawer</b>						
1	Inj. Avil (Pheniramine)	6	0 (100.0)	13 (92.9)	200.0	<0.001
2	Inj. Aciloc (Ranitidine)	6	5 (35.7)	14 (100.0)	94.7	0.001
3	Inj. Dextrose 25%/ 50%	6/6	0 (100.0)	14 (100.0)	200.0	<0.001
4	Inj. Dopamine	6	6 (42.9)	14 (100.0)	80.0	0.003
5	Inj. Dobutamine	6	6 (42.9)	14 (100.0)	80.0	0.003
7	Inj. Lasix	6	9 (64.3)	14 (100.0)	43.47	0.048
<b>Third drawer</b>						
1	Inj. Metoprolol/esomolol	6	0 (100.0)	1 (7.1)	-	-
2	Inj. Nitroglycerin	6	2 (14.3)	14 (100.0)	150.0	<0.001
3	Inj. Protamine	6	1 (7.1)	11 (78.6)	166.6	<0.001
4	Inj. Vitamin K	6	1 (7.1)	4 (28.6)	120.0	0.324
5	Inj. Xylocard	6	0 (100.0)	11 (78.6)	200.0	<0.001
6	Inj.2% lignocaine	6	0 (100.0)	10 (71.4)	200.0	<0.001
7	Inj. Aminophyllin/derriphylline	6	0 (100.0)	0 (100.0)	-	-
8	Inj. Naloxone	6	0 (100.0)	0 (100.0)	-	-
9	Inj phenytion/phenobarbitone/STP	6	0 (100.0)	0 (100.0)	-	-
10	Inj. Flumazenil	6	0 (100.0)	0 (100.0)	-	-
<b>Fourth drawer</b>						
1	Laryngoscope with blades of different sizes	1-2 set	10 (71.4)	14 (100.0)	33.3	0.105
2	Oropharyngeal airway	1 of each	1 (7.1)	12 (85.7)	169.2	<0.001
3	Nasopharyngeal airway	1 of each	0 (100.0)	1 (7.1)	-	-
4	laryngeal air mask	1 of each	0 (100.0)	1 (7.1)	-	-
5	Stylet of different size	1 of each	1 (7.1)	13 (92.9)	171.4	<0.001
6	Bite block	Different size	0 (100.0)	1 (7.1)	-	-
7	Xylocaine jelly	3-5 piece	8 (57.1)	14 (100.0)	54.5	0.021
8	Magil forceps adult	1 of each	0 (100.0)	11 (78.6)	200.0	<0.001
9	Magil forceps pediatric	1 of each	0 (100.0)	6 (42.6)	-	-

ITEMS		Define number	Pre-intervention n(%)	Post-intervention n(%)	<sup>p</sup> Diff	P-value
10	Eschmannstylet adult	1 of each	2 (14.3)	5 (35.7)	85.7	<0.001
11	Eschmannstylet pediatric	1 of each	0 (100.0)	2 (14.3)	-	-
<b>Fifth drawer</b>						
1	ET tube of different size	1 of each	3 (21.4)	14 (100.0)	129.4	<0.001
2	Suction catheter of different size	3-5 of each	1 (7.1)	13 (92.9)	200.0	<0.001
3	Yanker suction adult	3-5	0 (100.0)	14 (100.0)	200.0	<0.001
4	Yanker suction pediatric	3-5	0 (100.0)	3 (21.4)	-	-
5	Tongue depressor	3-5	4 (28.6)	13 (92.9)	105.8	0.002
6	Elastopast, paper tape, leucoplast	3-5 of each	0 (100.0)	14 (100.0)	200.0	<0.001
7	Chest leads	3-5 piece	0 (100.0)	14 (100.0)	200.0	<0.001
8	Batteries	3-5pair of each	0 (100.0)	14 (100.0)	200.0	<0.001
9	Syringe of different size	3-5 pec	0 (100.0)	14 (100.0)	200.0	<0.001
10	Gloves clean/ sterile of different size	3-5pair of each	0 (100.0)	14 (100.0)	200.0	<0.001
<b>Sixth drawer</b>						
1	IV cannula of different size	3-5 of each size	4 (28.6)	14 (100.0)	111.1	<0.001
2	Tourniquet	3-5 piece	0 (100.0)	14 (100.0)	200.0	<0.001
3	Rubber sheet	3-5piece	0 (100.0)	14 (100.0)	200.0	<0.001
4	Needles 18 G	3-5piece	6 (42.9)	14 (100.0)	80.0	0.003
5	IV set, 3-way stop-clock, PMO line	3-5 piece	0 (100.0)	14 (100.0)	200.0	<0.001
6	Micro drip set	3-5 piece	1 (7.1)	14 (100.0)	200.0	<0.001

Table 4 shows the total difference in mean score of knowledge and crash cart organization pre- and post intervention crash cart management. Total knowledge difference was significantly seen in post-intervention, with mean knowledge of 10.71(1.91) in pre-intervention and 21.76 (2.45) in post-intervention group. Likewise, total drugs and equipment in the crash cart also was observed updated significantly with post-intervention mean was 23.28 (1.20), and 26.78 (1.3)  $p<0.001$

**Table 4: Difference in mean scores of knowledge and crash cart organization pre-and post-intervention (paired t-test)**

Parameters assessed	Pre-intervention mean (SD)	Post-intervention mean (SD)	p-value
Total knowledge score of nurses, mean (SD)	10.68 (1.94)	21.76 (2.43)	<0.001
Total drug contents in the crash cart, mean (SD)	6.4 (3.05)	23.28 (1.20)	<0.001
Total equipment in the crash cart, mean (SD)	2.35 (1.44)	26.78 (1.3)	<0.001

*≠Total knowledge score of nurses' pretest N= 134, Post-test N= 134*

*≠Total crash cart pretest N=14, posttest N= 14*

Table 5 shows a multiple linear regression model to assess the effect of intervention on knowledge of crash cart management and adjusted for age, education, working unit, and CPR training. The model showed significant improvement in knowledge at post-intervention as compared to pre-intervention ( $\beta$ ; 0.928, 95% CI; 10.52, 11.57,  $p<0.001$ ). There was no significant association of education, age, working unit, and CPR training in crash cart management.

**Table 5: Factors associated with knowledge of resuscitation trolley among nursing personnel**

Total knowledge score (N= 25)			
	Adjusted Standardized coefficients( $\beta$ )	CI 95%	P-value
<b>Intervention</b>			
Post-intervention	0.928	10.52, 11.57	<0.001
<b>Age in year</b>	0.023	-0.001, 0.003	0.311
<b>Education</b>			
PCL	Reference		
PBN/BSN	-0.025	-1.123, 0.523	0.474
BSc nursing	-0.003	0.880, 0.803	0.928
<b>Work experience in year</b>	0.015	-0.089, 0.046	0.537
<b>Working unit</b>			
Critical unit (compared to general unit)	0.008	-0.444, 0.637	0.726
<b>CPR training</b>			
No	Reference		
Yes	0.022	-0.825, 0.294	0.351

## Discussion

Updated resuscitation trolley is crucial for care of critical emergency in all inpatient wards. Its importance is even more if the health care center is tertiary cardiac center. Unlike developed countries, its importance is often underestimated in developing countries like Nepal. Many hospitals do not have a protocol/guideline of crash cart organization. The main reason for conducting this study is to assess the current knowledge of nurses on crash cart management followed by education intervention and follow up of post intervention crash cart organization.

In this study, nurses from the post intervention group had better knowledge regarding crash cart and inventory management. The resuscitation cart and equipment management was also observed improved in the post intervention phase.

The nurses from post intervention group had greater knowledge of right placement of crash cart at their unit, drugs and inventory placement on it, and safety check of emergency equipment. Similar study conducted by Lamkhede showed significantly increased knowledge level among nurses in post intervention.<sup>14</sup>

In this study, the post intervention group knew how to keep drugs and equipment in an organized manner so that it could be found easily. The percentage difference in post intervention was increased. Similar kind of increment on knowledge was seen in the study conducted by Makkar and Madaan in New Delhi.<sup>15</sup>

Common fault in resuscitation equipment, drugs used in cardiopulmonary resuscitation can have grave consequence, so they should be checked for their functioning condition.<sup>6</sup> Knowledge of safety check of equipment also increased with educational intervention among nurses in this study. They checked the equipment before their shift start every time.

Regarding the resuscitation equipment and drug organization in crash cart trolley, the post intervention crash carts observation was found well organized.<sup>4</sup> Almost all the drugs items and equipment were found in designated area in the crash cart during post intervention observation. Drawers were labeled clearly. Standardized layout of drawers was found in crash cart of different inpatient wards.<sup>16</sup> Clear labeling and organization of drugs in a crash cart decreases the chances of medication error during CPR.<sup>7</sup>

Some drugs like inj Metoprolol, Inj Aminophylline were not found on crash cart in pre and post intervention phase because hospital store and dispensary had not supplied these drugs. Some airway adjuncts like bougie, nasopharyngeal airway, bite block and laryngeal air mask was not there in crash in both phase because these items were lacking at hospital store supply.<sup>17</sup>

The resuscitation trolley was customized so the defibrillator and oxygen cylinder was kept in different trolley in an accessible place not in a crash cart in both pre-post interventions. There was no locking system in the resuscitation trolley, so the trolley was unlocked all the time but different literature recommended that the crash cart trolley should be locked all the time except in CPR.<sup>18</sup>

Resuscitation council of UK states that resuscitation trolley needs to lock all the time except in emergency, this standard protocol was not found in this study.<sup>5</sup> CPR training, age, and working unit were seen less likely associated with knowledge of crash cart, drug and inventory management but education intervention was seen significant.

## Limitation of the study

This study had no control group which may affect the interpretation. This is a one-time pre-post intervention study so it is difficult to generalize.

## Conclusion

Knowledge of crash cart organization help nursing staffs to initiate cardiopulmonary resuscitation promptly in medical emergencies. This study updated knowledge of crash cart organization to initiate early resuscitation. Knowledge of crash cart organization was improved and well organized crash carts were found in inpatient wards after educational intervention.

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