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Streamlining the contents of resuscitation cart in a super specialty centre in North India

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Abstract: The equipment and medications that would be required to treat a patient in the first thirty minutes or so of a medical emergency are stored in resuscitation cart. The study was conducted in all the patient care areas of the super specialty hospital. Resuscitation cart policy and checklist were developed by seeking inputs from all the stakeholders and validating the same using the available literature. A training program was conducted and a total of 13 resuscitation carts were inspected against the approved checklist for checking its contents in both pre and post intervention periods. Resuscitation cart policy and checklist were prepared, validated by the domain experts and implemented. The compliance of all 13 resuscitation cart in terms of their contents increased from 77.82% to 97.87% with p value of <0.05 which is statistically significant. Maintaining resuscitation carts as per the checklist is a continuous process which will contribute to patient safety.

Index Terms - Resuscitation cart, Resuscitation care, Code Blue, Emergency medicines, Streamlining, Super specialty centre, Quality improvement

I. INTRODUCTION

Time is of essence when life of a patient who suddenly collapses, is at stake. Successful resuscitation of patients depends on timely response by the medical team and appropriate medication delivery. The equipment and medications that would be required to treat a patient in the first thirty minutes of a medical emergency are kept in readiness in resuscitation carts. The resuscitation cart is the commonly used term to describe a self-contained, mobile unit that contains virtually all of the materials, drugs, and devices necessary to perform a code blue. The configuration of resuscitation carts may vary, but most will be a waist high or chest high wheeled cart with multiple drawers.[1]

An effective emergency care/ code blue depends on how resuscitation carts are provisioned and response team's knowledge of the cart layout.[2] All resuscitation carts contain must contain the following basic list of items:

a) Basic airway equipment

b) Intravenous access equipment

c) Medications utilized in the treatment of cardiac arrest including epinephrine and amiodarone

d) Medications utilized to treat cardiac dysrhythmias

e) Monitor equipment with a defibrillator Medications to treat allergic reactions.

Additionally, carts being utilized for specialized areas may add or subtract from the basic list.

There was no standardization of resuscitation cart as observed during ward rounds in our super specialty hospital. The specific medications and organization of medications varied in the drawers of all the resuscitation carts. There was no defined checklist for inspecting the contents of the resuscitation cart and there was no policy for the maintenance of contents of a resuscitation cart in the hospital.

II. MATERIALS & METHODS:

The study was conducted in all the patient care areas of the super specialty hospital which included inpatient wards, Intensive care Units (ICUs), Cath Laboratories, Operation Theatres (OTs) as well as the outpatient department (OPD). The study was carried out with an objective of streamlining the contents of the resuscitation carts by developing a policy and a checklist.

The policy for maintenance of contents of the resuscitation cart was developed by obtaining inputs from the all the stakeholders and then comparing the same to the existing literature. This policy was implemented in the hospital after obtaining the requisite administrative approvals.

Similarly, a checklist was developed to enable the inspection of contents of resuscitation carts at periodic intervals. Again the inputs were sought from the stakeholders and the same was validated by domain experts.

A training programme was conducted on the implementation of the resuscitation cart policy and checklist for the entire nursing staff of the patient care areas that were included in the study. The training programme consisted of theory lecture as well as hands-on demonstration sessions at the resuscitation carts.

The validated signed checklist was distributed to all the nursing in-charges of respective patient care areas for inspection of the resuscitation carts and their compliance was measure in both pre and post intervention periods. The data was entered into MS Excel and cleaned in Microsoft Excel 2016. Analysis was done in Stata 11 (Stata Corp, College Station, Texas, USA). Data was analyzed using descriptive statistics and has been presented as proportions while bi variable analysis between two categorical variables was done using chi square test and p value less than 0.05 was considered significant.

III. OBSERVATIONS & RESULTS:

Resuscitation cart Policy

1. Purpose: To insure availability of all drugs, equipment and supplies necessary to initiate advanced life-support measures and ensure uniformity of emergency resuscitation carts throughout the hospital.
2. Scope: All patient care areas
3. Policy:
Resuscitation carts shall be available in all key patient care areas to initiate emergency life-support measures. Resuscitation cart in all patient care areas should be arranged in a uniform manner as per the checklist provided and should be located in a specific location that is easily accessible.
Two registers must be maintained for each resuscitation cart:

i. Register for daily checking (in each shift) based on the checklist.
ii. Register for maintaining record of opening the resuscitation cart with details of incident.

Designated nursing staff in the patient care area shall be responsible for:

a) Notifying after content(s) of resuscitation cart has/have been used.
b) Ensuring that medicines consumed are replenished within 1 hour of use.
c) Ensure resuscitation cart is moving freely. The wheels should be in good condition and repair, if necessary should be arranged timely.
d) Checking the presence and expiration date of all items on carts at least once every month and replacing short-expiry medicines with fresh stock.
e) Checking for near expiry medicines and other consumables and replacing it with new stock. Any drug whose expiry is within 3 month should be immediately replaced.
f) Signing of resuscitation cart register daily in each shift after verifying the availability of contents as per the checklist by a designated staff.
g) Checking internal and external contents of cart, including quantity and expiration date.
h) Checking oxygen cylinder and its attachment to the resuscitation cart every day.
i) The defibrillator and cardiac monitor shall be checked and appropriately documented for performance of both, the battery and electrical current once every 24 hours. The defibrillator shall

remain plugged into an electrical outlet at all times, except during battery testing. The Machinery and Equipment Stores shall be contacted immediately when a defibrillator is found to be non-functional for prompt action by the vendor concerned. A loaner defibrillator shall be obtained from other areas.

j) Checking all drawers of the resuscitation cart are properly labelled e.g. name of the medicines with quantity and expiry dates.

k) Checking all external contents of cart shall be checked and verification documented once every 24 hours except when the unit is closed.

An incident report shall be generated after any unauthorized entry into the cart or when routine supplies are found to be missing from the cart.

Any request for change in resuscitation cart contents, shall be reviewed by multi-disciplinary meeting of all the stakeholders.

If any item to be replenished in the crash is not available in the Store section, requisition must be sent to the store immediately and that item must be obtained on loan from other areas.

Resuscitation cart checklist:

The following checklist was prepared and validated in consultation with all the stakeholders:

S.No	Article	Quantity	Dose	Packaging
TOP SHELF				
1	AMBU Bag kit with mask	One each		
2	Oxygen Mask(0-4)	One each		
3	Gloves(5.5-7.5)	Two each		
4	Facemask (all sizes)	One each		
5	Defibrillator	One each		
MIDDLE SHELF(Coloured cups from left to right)				
6	Inj Atropine	10	0.6mg/ml	one ml
7	Inj Adrenaline	10	1.8mg/ml	one ml
8	InjPheniramine Maleate	10	22.75mg/ml	two ml
9	InjDeriphyllin	10		
10	Inj Furosemide	10	10mg/ml	two ml
11	Inj Hydrocortisone	5	100mg/ml	
SIDE (IN CLOTH BAG)				
12	Bougie	two each		
13	Suction Catheter	two each		
TOP DRAWER(LEFT IN ACCESS)				
14	Syringes(2,5,10,50ml)	five each		
15	I.V. Cannula(16-24G)	two each		
16	Alcohol Swabs	10		
17	Elastoplast Tape	1		
18	IV Sets	5		
19	Three Way	5		
20	Hydrocath	2		
21	Extension Line	two each		
TOP DRAWER (RIGHT)- AIRWAY MANAGEMENT				
22	Laryngoscope with blade	one each		
23	Battery cell (Big and small)	two each		
24	Endotracheal Tube(all sizes)	one each		
25	Airway(0, 1, 2 & 3)	one each		
26	Nasopharyngeal Airway(4-8)	one each		
27	Tracheostomy Quick Set	one		
28	Oxygen enriched Mask	one		
29	Tracheostomy Tube	one each		

30	Magill Forceps	one		
31	Ryle's Tube(10,12,14 & 16)	one each		
32	Stylet	one each		
33	Tie for fixation	one		
34	Proseal LMA(ADULT)	one		
35	I-Gel all sizes	one each		
36	T-piece	one		
MIDDLE DRAWER (LEFT)- NON-CARDIAC DRUGS				
37	Inj Diazepam	5	5mg/ml	
38	Inj Dexamethasone	5	4mg/ml	two ml
39	25%, 50% Dextrose	five each		
40	Inj Promethazine	5	25mg/ml	two ml
41	InjOndansetron	5	2mg/ml	two ml
42	Inj Sodium Bicarbonate	5	7.50%	ten ml
43	Inj Calcium Gluconate	5	10%	ten ml
44	Inj Aminophylline	2		
45	Inj Phenytoin	10	50mg/ml	one ml
46	Inj Haloperidol	2	5mg/ml	one ml
47	Inj Magnesium Sulphate	2	50%	two ml
48	Inj Metoclopramide	2	5mg/ml	two ml
49	Inj Protamine Sulphate	5	10mg/ml	five ml
50	Inj Sodium Valproate	5		
41	Inj Naloxone	2		
MIDDLE DRAWER (LEFT)- CARDIAC DRUGS				
52	Inj Adenosine	2	3mg/ml	two ml
53	InjAmiodarone	2	50mg/ml	three ml
54	Inj Nitro-glycerin	2	5mg/ml	ten ml
55	Inj Dopamine	2	40mg/ml	five ml
56	InjDobutamine	2	50mg/ml	five ml
57	Inj Nor-Adrenaline	2		
58	InjEsmolol	2	10mg/ml	ten ml
59	InjXylocard	2		fifty ml
60	Inj KCL	3	1mg/ml	five ml
61	Inj Digoxin	2	15%w/v	ten ml
62	InjDiltiazem	2		two ml
63	Inj Labetalol	5		
64	Inj Phenylephrine	1	10mg/ml	one ml
65	Inj Ephedrine	5		
66	Inj Streptokinase	2		
67	Tab Aspirin 325mg	5		
LOWER DRAWER(LEFT)-MISC				
68	Respule Asthalin	5		
69	Respule Ipratropium Bromide	5		
70	Respule Budecort	5		
71	Xylocaine Jelly	1		
72	Head Ring Gel (adult/peads)	1		
73	Spatula	2		
74	Hand Sanitizer	1		
75	Povidone Iodine	1		
76	Benzoin 50ml	1		
77	Stethoscope	1		
78	ECG electrode	20		
79	Torch	1		
80	InjParacetamol	1	100ml	hundred ml
LOWER DRAWER(RIGHT)-ANAESTHETIC DRUGS				

81	InjThiopentone Sodium	2	1gm	
82	Inj Ketamine	2	50mg/ml	two ml
83	Inj Midazolam	2	1mg/ml	five ml
84	Inj Fentanyl	5	50mg/ml	ten ml
85	InjLorazepam	5		
86	InjPropofol 1%	1	10mg/ml	ten ml
87	Inj Morphine	2	15mg/ml	one ml
88	InjRocuronium	2	4mg/ml	two ml
89	Inj Succinylcholine	2	50mg/ml	ten ml
90	InjEtomidate	2		
91	Xylocaine 2%	1		
BOTTOM TABLE				
92	Kidney Tray	1		
93	Dressing Pack	1		
94	IV Fluids DNS, RL & NS	one each		

A total 13 resuscitation carts were inspected against the approved checklist for measuring the compliance in terms of their contents, during the pre and post intervention periods. The compliance of individual items of the resuscitation is described in Table-1.

It was observed that during the post intervention period, the compliance to all items was 100% except kidney tray and tracheostomy quick set, which was not found in any of the resuscitation carts in post intervention period. Although the compliance was always better or at least equal to the pre intervention period, significant difference was seen only in three items, which were I-Gel, Inj Adenosine and Tab Aspirin 325mg, the p value being 0.019 in all three.

Table-1: Percentage compliance of individual items in resuscitation cart (pre and post interventions)

S.No	Item	Quantity	Pre (n)	Pre (%)	Post (n)	Post (%)	p value
1	AMBU Bag kit with mask	One each	13	100.00	13	100	1
2	Oxygen Mask(0-4)	One each	13	100.00	13	100	1
3	Gloves(5.5-7.5)	Two each	13	100.00	13	100	1
4	Facemask (all sizes)	One each	11	84.62	13	100	0.768
5	Defibrillator	One each	11	84.62	13	100	0.768
6	Inj Atropine	10	13	100.00	13	100	1
7	Inj Adrenaline	10	13	100.00	13	100	1
8	InjPheniramine Maleate	10	13	100.00	13	100	1
9	InjDeriphyllin	10	13	100.00	13	100	1
10	Inj Furosemide	10	13	100.00	13	100	1
11	Inj Hydrocortisone	5	13	100.00	13	100	1
12	Bougie	two each	10	76.92	13	100	0.648
13	Suction Catheter	two each	13	100.00	13	100	1
14	Syringes(2,5,10,50ml)	five each	13	100.00	13	100	1
15	I.V. Cannula(16-24G)	two each	13	100.00	13	100	1
16	Alcohol Swabs	10	7	53.85	13	100	0.309
17	Elastoplast Tape	1	7	53.85	13	100	0.309
18	IV Sets	5	13	100.00	13	100	1
19	Three Way	5	11	84.62	13	100	0.768
20	Hydrocath	2	7	53.85	13	100	0.309
21	Extension Line	two each	10	76.92	13	100	0.648
22	Laryngoscope with blade	one each	13	100.00	13	100	1
23	Battery cell (Big and small)	two each	10	76.92	13	100	0.648
24	Endotracheal Tube(all sizes)	one each	13	100.00	13	100	1
25	Airway(0, 1, 2 & 3)	one each	13	100.00	13	100	1

26	Nasopharyngeal Airway(4-8)	one each	8	61.54	13	100	0.414
27	Tracheostomy Quick Set	one	4	30.77	0	0	0.083
28	Oxygen enriched Mask	one	6	46.15	13	100	0.217
29	Tracheostomy Tube	one each	11	84.62	13	100	0.768
30	Magil Forceps	one	10	76.92	13	100	0.648
31	Ryle's Tube(10,12,14 & 16)	one each	10	76.92	13	100	0.648
32	Stylet	one each	12	92.31	13	100	0.886
33	Tie for fixation	one	13	100.00	13	100	1
34	Proseal LMA(ADULT)	one	5	38.46	13	100	0.14
35	I-Gel all sizes	one each	2	15.38	13	100	**0.019**
36	T-piece	one	12	92.31	13	100	0.886
37	Inj Diazepam	5	12	92.31	13	100	0.886
38	Inj Dexamethasone	5	12	92.31	13	100	0.886
39	25%, 50% Dextrose	five each	12	92.31	13	100	0.886
40	Inj Promethazine	5	9	69.23	13	100	0.529
41	InjOndansetron	5	12	92.31	13	100	0.886
42	Inj Sodium Bicarbonate	5	13	100.00	13	100	1
43	Inj Calcium Gluconate	5	12	92.31	13	100	0.886
44	Inj Aminophylline	2	10	76.92	13	100	0.768
45	Inj Phenytoin	10	13	100.00	13	100	1
46	Inj Haloperidol	2	4	30.77	13	100	0.083
47	Inj Magnesium Sulphate	2	9	69.23	13	100	0.529
48	Inj Metoclopramide	2	11	84.62	13	100	0.768
49	Inj Protamine sulphate	5	5	38.46	13	100	0.14
50	Inj Sodium Valproate	5	10	76.92	13	100	0.768
51	Inj Naloxone	2	7	53.85	13	100	0.309
52	Inj Adenosine	2	2	15.38	13	100	**0.019**
53	InjAmiodarone	2	11	84.62	13	100	0.768
54	InjNitroglycerin	2	9	69.23	13	100	0.529
55	Inj Dopamine	2	11	84.62	13	100	0.768
56	InjDobutamine	2	11	84.62	13	100	0.768
57	Inj Nor-Adrenaline	2	13	100.00	13	100	1
58	InjEsmolol	2	8	61.54	13	100	0.414
59	InjXylocard	2	13	100.00	13	100	1
60	Inj KCL	3	12	92.31	13	100	0.886
61	Inj Digoxin	2	9	69.23	13	100	0.529
62	InjDiltiazem	2	6	46.15	13	100	0.217
63	Inj Labetalol	5	12	92.31	13	100	0.886
64	Inj Phenylephrine	1	9	69.23	13	100	0.529
65	Inj Ephedrine	5	9	69.23	13	100	0.529
66	Inj Streptokinase	2	4	30.77	13	100	0.083
67	Tab Aspirin 325mg	5	2	15.38	13	100	**0.019**
68	Respule Asthalin	5	12	92.31	13	100	0.886
69	Respule Ipratropium Bromide	5	6	46.15	13	100	0.217
70	Respule Budecort	5	12	92.31	13	100	0.886
71	Xylocaine Jelly	1	12	92.31	13	100	0.886
72	Head Ring Gel (adult/peads)	1	4	30.77	13	100	0.083
73	Spatula	2	9	69.23	13	100	0.529
74	Hand Sanitizer	1	13	100.00	13	100	1
75	Povidone Iodine	1	9	69.23	13	100	0.529
76	Benzoin 50ml	1	7	53.85	13	100	0.309
77	Stethoscope	1	13	100.00	13	100	1
78	ECG electrode	20	13	100.00	13	100	1
79	Torch	1	12	92.31	13	100	0.886
80	InjParacetamol	1	11	84.62	13	100	0.768

81	InjThiopentone Sodium	2	9	69.23	13	100	0.529
82	Inj Ketamine	2	12	92.31	13	100	0.886
83	Inj Midazolam	2	13	100.00	13	100	1
84	Inj Fentanyl	5	11	84.62	13	100	0.768
85	InjLorazepam	5	7	53.85	13	100	0.309
86	InjPropofol 1%	1	12	92.31	13	100	0.886
87	Inj Morphine	2	10	76.92	13	100	0.768
88	InjRocuronium	2	11	84.62	13	100	0.768
89	Inj Succinylcholine	2	10	76.92	13	100	0.768
90	InjEtomidate	2	7	53.85	13	100	0.309
91	Xylocaine 2%	1	13	100.00	13	100	1
92	Kidney Tray	1	0	0.00	0	0	0
93	Dressing Pack	1	13	100.00	13	100	1
94	IV Fluids DNS, RL & NS	one each	13	100.00	13	100	1

Overall compliance of each resuscitation cart was calculated and it was observed that during the pre-intervention period it ranged from 54.24% to 94.68%. During the post-intervention period, the compliance was 97.87% in all 13 resuscitation carts. (Table-2). The overall compliance during the pre and post intervention periods were 77.82% and 97.87% respectively and the difference was statistically significant with a p value of <0.5. (Figure 3)

Table-2: Comparison of pre and post intervention compliance percentage of each resuscitation cart.

Sl. No	Resuscitation cart Number	Pre (n)	Pre (%)	Post (n)	Post (%)
1	1	74	78.72	92	97.87
2	2	67	71.28	92	97.87
3	3	51	54.25	92	97.87
4	4	78	82.98	92	97.87
5	5	59	62.76	92	97.87
6	6	86	91.49	92	97.87
7	7	89	94.68	92	97.87
8	8	67	71.28	92	97.87
9	9	68	72.34	92	97.87
10	10	82	87.23	92	97.87
11	11	84	89.36	92	97.87
12	12	65	69.15	92	97.87
13	13	81	86.17	92	97.87

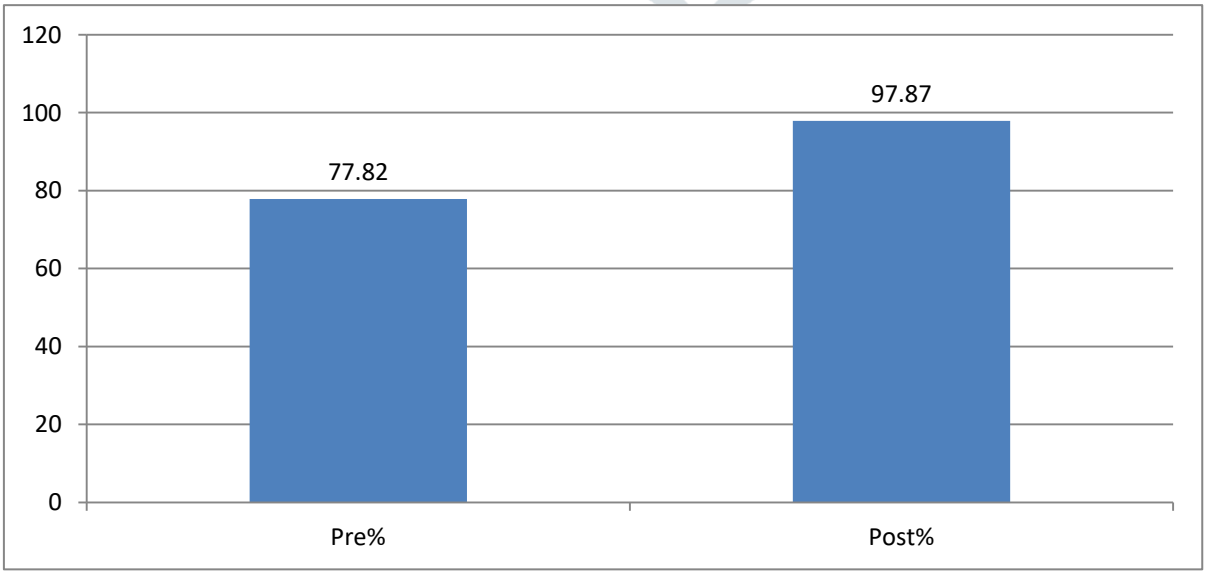

Figure 1: Overall pre and post intervention compliance against the approved checklist

IV. DISCUSSION:

This resuscitation cart policy and standardization in the checklist would promote safety and efficiency during a code blue event. It has been observed that the total compliance percentage of all 13 resuscitation cart contents have increased from 77.82% to 97.87% with p value of <0.05 which was statistically significant. All 13 resuscitation carts were made compliant for all the items as per checklist except tracheostomy quick set and kidney trays, which were not supplied in the hospital Stores section. However, these two items will also be made compliant once these are procured through Stores section.

In a study conducted by Aimee M. Pearson, Jeff K. Caird and Andrew Mayer titled Resuscitation cart Drug Drawer Layout and Design in 2012 concluded that a number of similarities and differences were found for drug usage and resuscitation cart drug drawer layout across hospitals.[2] In another study the Pennsylvania Patient Safety Authority identified 56 reports over the course of a 12-month reporting period of 2008 specifically related to emergency equipment; 35 reports referenced issues with emergency carts and 21 reports referenced issues with missing supplies or malfunctioning equipment during an emergency situation.[3] In a similar study conducted by Capt (Brig) Akash Raj et al, published in February 2019, it was observed that none of the hospitals in the study followed the standard checklist for resuscitation cart.[4]

V. RECOMMENDATIONS:

1. Look alike and sound alike (LASA) medicines to be identified as per The US Food and Drug Administration (FDA) and Institute for Safe Medication Practices (ISMP) and they might be kept in separate drawers in the resuscitation cart in order to avoid medication error.[5]

2. High alert medications and concentrated electrolytes to be identified as per Institute for Safe Medication Practices (ISMP) list and they might be put with stickers in the container in order to avoid mistakes during use as these medications having devastating consequences in case of error.[6]

3. All hospital must have Code blue team with defined roles and response time

4. Risk assessment with identifying the risk points like staff training and educational needs, location of resuscitation cart and contents of the resuscitation carts to be done. Evaluate and analyse the risks to determine the best solution and implement it and to continuously re-assess it.[7]

5. Staff members who provide patient care are to be trained in resuscitative techniques and the level of training appropriate to their role.

VI. LIMITATIONS:

One limitation of this study is that look alike, sound alike and high alert medicines were not identified in this study in the checklist which needs further deliberation by domain experts.

VII. CONCLUSION:

Maintaining resuscitation carts as per the checklist is a continuous process which will contribute to patient safety. The staff concerned must be familiar with all the items stored in the resuscitation cart. The location of the resuscitation cart must be accessible and the policy as well as the for resuscitation carts must be displayed appropriately. All resuscitation carts must be inspected in each shift by the respective nursing staff, which will help in sustaining the compliance. As resuscitation guidelines change and technologies advance, the resuscitation cart contents will also require modification.

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