

A Retrospective Study of Serial Inspection of ACLS Ambulances in a Tertiary Care Facility

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Abstract

Aim: To maximize availability of Ambulance equipment before dispatch. *Design:* Retrospective observational study. *Material and Methods:* A team of doctors, nurses and paramedics of our tertiary care central government hospital of capital city in a lower middle income economy background country were assigned the task of inspection of ambulances prior to sending these for a national event. These ambulances were inspected for preparedness for patient care. The tertiary care center was the nodal center for inspection where ambulances from different organizations like CATS and corporate tertiary care hospitals were assembled for inspection on day 1, day 3 and day 7, while on the 8th day these ambulances were dispatched for patient care. Ambulances were checked consecutively for three days according to existing standardized check list [3]. A separate logistic cell was managed by the inspection team for procurement and maintenance of equipment. The ambulance pilot supervisor was responsible for checking the mechanical component of ambulances. *Statistical Analysis:* Quantitative variables were compared using Wilcoxon signed- rank test (as the data sets were not normally distributed) across follow up. A p value of <0.05 was considered statistically significant. *Results:* In between series of inspections, the task of functional completion of ambulance equipment significantly improves thereby pointing out to the success of methods employed in the present study. Our inspection was successful in terms of maximizing the availability of life saving equipment. *Conclusions and Recommendation:* A series of Ambulance inspection is essential for ascertaining the availability of disposable and consumable items in a fully equipped ACLS ambulance. The Ambulance team should be open to adding new evidence-based life- saving equipment to the existing standardized checklist.

Keywords: Advanced Cardiac Life Support Ambulances; Inspection; Shortfalls; Stock; Emergency Medical Services; Pre-hospital Care.

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Introduction

The researchers felt the importance of this study as very little data was available in literature about the standard of equipment inside the Ambulances. The importance of first golden hour, and platinum minutes [1] in managing patients of Road Traffic

Accident (RTA), acute coronary syndrome and stroke necessitates the importance of state of art facility inside the Ambulances. The ACLS ambulance plays pivotal role in quick management of victims in the pre-hospital scenario and rapid transfer to appropriate and nearest health care facility.

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The shortage of life saving disposable and equipment stock in ambulances can affect the performance of medical and paramedical staff adversely by several folds as pre-hospital emergency management needs quick and protocol-based management and rapid transport of victim to nearest health care facility [2].

Materials and Methods

Twenty-three ACLS ambulances were inspected for life saving equipment on Day 1, Day 3 and Day 7 by a team of doctors and paramedics. These ambulances were dispatched for patient care on Day 8.

The inspection was carried out by checking the ambulance equipment of 23 ACLS ambulances as per the existing standardized checklist [3]. After each inspection, the team tried to fill in the deficiencies. Moreover, a separate logistic cell was setup by tertiary care facility to manage procurement of various items, liaison for repair of equipment, arrangement for refilling of oxygen cylinders and specific items.

All the 23 ambulances were from different organizations and therefore there was variation in stock of equipment. To overcome this variation and shortage of items, the logistic team prepared emergency kits of life saving medicines, consumables and disposables for each of the 23 ambulances. This emergency lifesaving kit was handed over to ambulance staff before the dispatch of ambulances on the 8th day.

A team of doctors, paramedics and Ambulance Supervisor and Ambulance pilots performed inspection of various equipment of 23 Ambulances on Day 1, Day 3 and Day 7 before the dispatch of Ambulances on Day 8. Some of the team members were assigned the task of managing the logistic cell.

Item 1-23 were fixed items inside the Ambulance. These included defibrillators, cardiac monitor with ECG electrodes, sphygmomanometer, glucometer, stethoscope, Ventilator, AED with Pads suction machine, spine board, cervical collar, scoop stretcher, immobilization devices, torch, electronic thermometer, bag valve mask resuscitator, Macintosh laryngoscope with blades, oxygen cylinder type D with regulator with key, Oxygen cylinder type A with key, oxygen flow meter, IV stand, pneumatic splints with pump, nebulizer and safety items like fire extinguishers.

Certain items like auto pulse, cricothyrotomy set with jet ventilator, central venous catheters and

intraosseous needles are desirable and lifesaving but were not mentioned in the existing standard checklist.

Availability of Trained staff (item 33), mechanical fitness of Ambulance (item 40) and maintenance of records is a standard pre-requisite.

Items 22-32 and 34-39 were disposable and consumable items like airway adjuncts, medicines like lifesaving injections, first-aid material including tablets, sprays, ointments, dressing material, antiseptics, disinfectants, waste disposal color-coded containers and Personal Protective Equipment (PPE).

Moreover, inspection of equipment was followed by organizing procurement of equipment for ambulances and filling up the existing deficiencies. The inspection team had double responsibility of finding shortcomings in equipment, mechanical component of ambulances and making arrangement for the same before dispatch. The inspection team also prioritized inspecting safety aspect of patient care in the pre-hospital scenario.

Thus, this study helped us to understand the deficiencies in ACLS Ambulances and fulfill the demands that arose after identifying the shortages according to the standardized checklist.

The result of the study was analyzed statistically.

Statistical Analysis

Continuous variables were presented as mean \pm SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected then non-parametric test was used. Quantitative variables were compared using Wilcoxon signed-rank test (as the data sets were not normally distributed) across follow up. A p value of <0.05 was considered statistically significant. The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

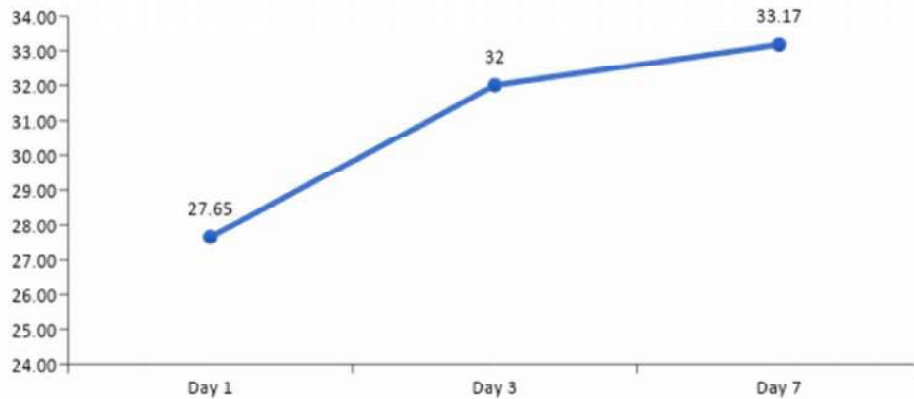
Results

Availability of total items increased from 1st day of inspection to 7th day of inspection as shown in graph1 and table 1 which was statistically significant. ($p < 0.0001$). Individual total (fixed and disposable) items in each of the 23 ambulances on 3 days of inspection shown in Graphs 2, 3 and 4 respectively.

Availability of fixed and disposable items increased on subsequent days which was statistically significant as shown in Table 2 ($p < 0.083$) and Table 3 ($p < 0.0001$) respectively.

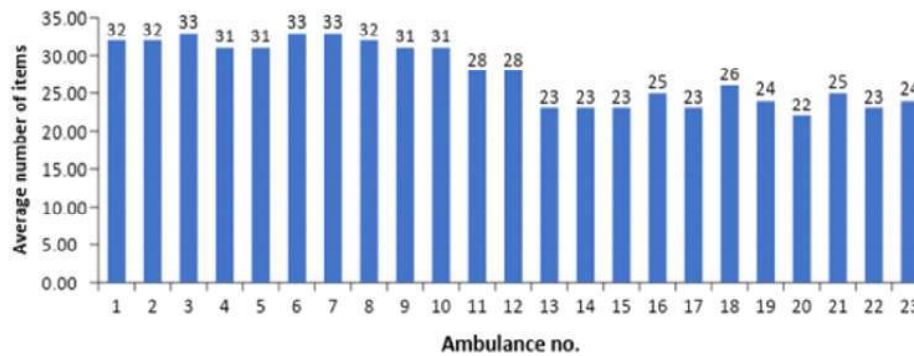
Fixed items in each 23 ambulances on 3 days of inspection are shown in Graphs 5, 6 and 7. Disposable items in each 23 ambulances on 3 days of inspection are shown in Graphs 8,9 and 10.

Ambulance item availability trend



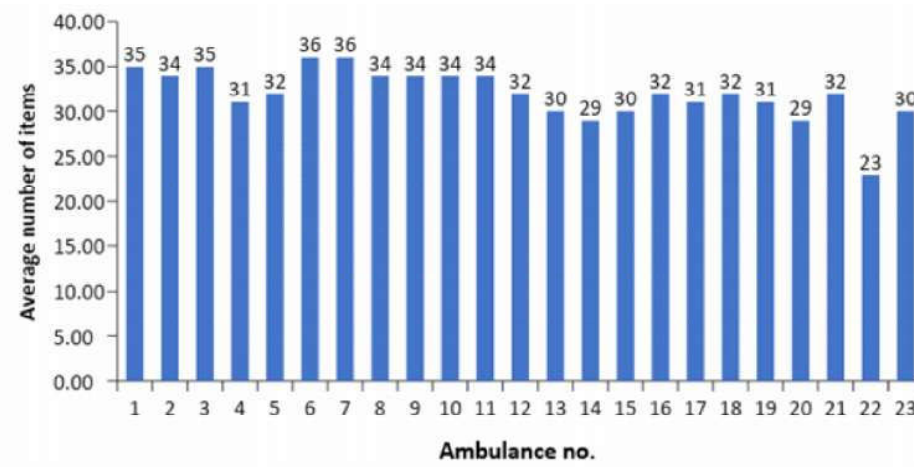
Graph 1: Showing total ambulance item availability trend

Total Items (Fixed+Disposable) in day 1



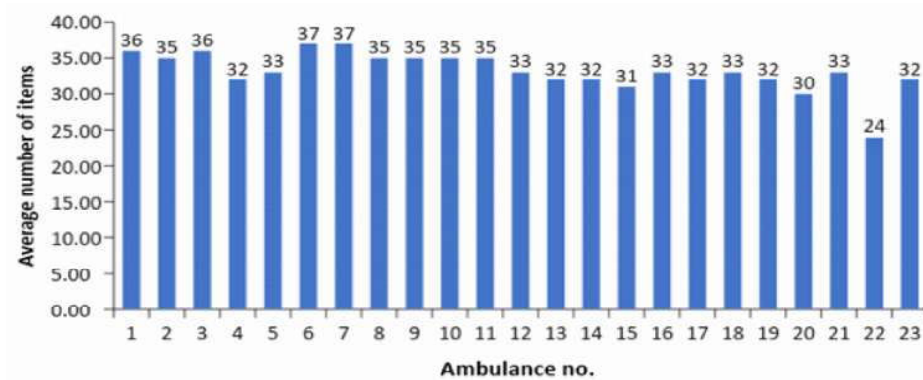
Graph 2: Total items on day 1

Total Items (Fixed+Disposable) in day 3



Graph 3: Total items on day 3

Total Items (Fixed+Disposable) in day 7



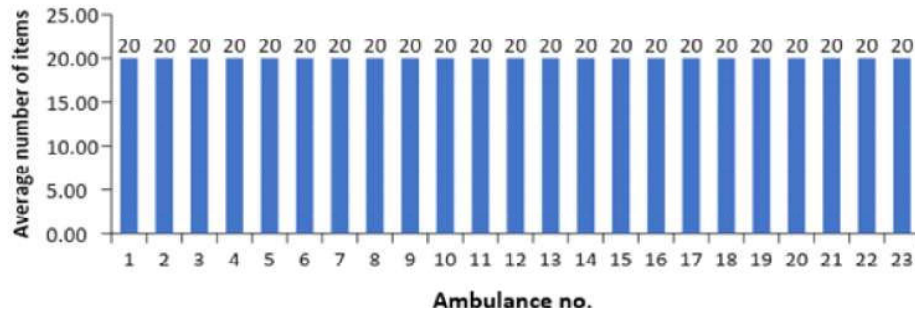
Graph 4: Total items on day 7

Total Items (Fixed) in day 1



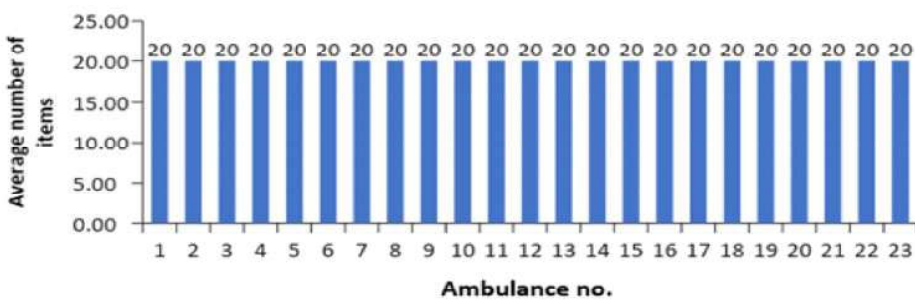
Graph 5: Total fixed items on day 1

Total Items (Fixed) in day 3



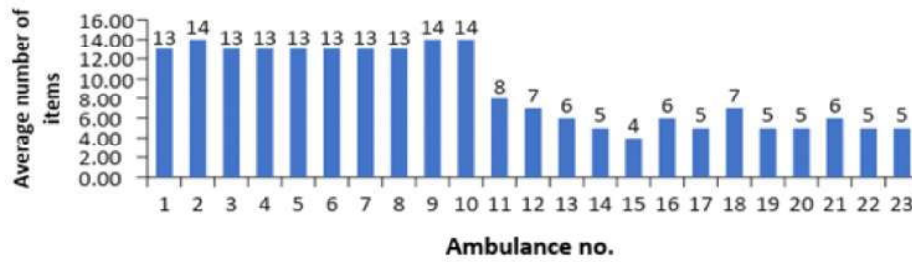
Graph 6: Total fixed items on day 3

Total Items (Fixed) in day 7



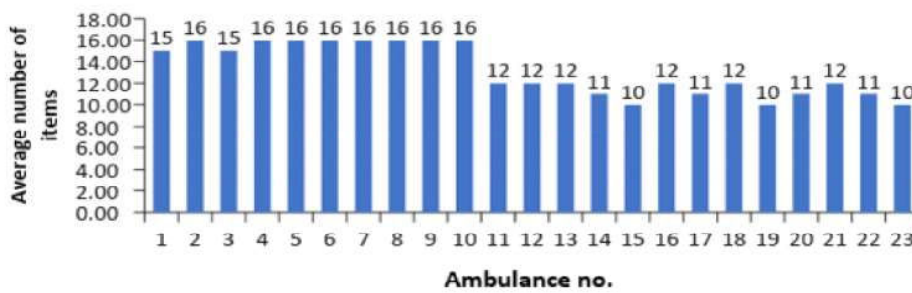
Graph 7: Total fixed items on day 7

Total Items (Disposable) in day 1



Graph 8: Total disposable items on day 1

Total Items (Disposable) in day 3



Graph 9: Total disposable items on day 3

Total Items (Disposable) in day 7



Graph 10: Total disposable items on day 7

Table 1: total equipments

	Sample size	Mean ± Stdev	Median	Min-Max	Inter quartile Range	P value
Day 1	23	19.87 ± 0.34	20	19-20	20 - 20	
Day 3	23	20 ± 0	20	20-20	20 - 20	0.083
Day 7	23	20 ± 0	20	20-20	20 - 20	0.083

Table 2: Fixed equipments

	Sample size	Mean ± Stdev	Median	Min-Max	Inter quartile Range	P value
Day 1	23	27.65 ± 4.11	28	22-33	23.250 - 31.750	
Day 3	23	32 ± 2.89	32	23-36	30.250 - 34	0.0001
Day 7	23	33.17 ± 2.77	33	24-37	32 - 35	<.0001

Table 3: Disposable equipment

	Sample size	Mean ± Stdev	Median	Min-Max	Inter quartile Range	P value
Day 1	23	9 ± 3.95	7	4-14	5 - 13	
Day 3	23	13.22 ± 2.41	12	10-16	11 - 16	<.0001
Day 7	23	14.44 ± 2.27	14	11-17	12.250 - 17	<.0001

Discussion

Fixed items were 99 percent stocked in comparison to consumable and disposable items on Day 1 of the inspection.

Defibrillator is a life saving device. Its functional working, battery backup, ECG electrodes (disposable item) was checked during inspection AED and pads (disposable item) were checked.

In our study it was found that ECG electrodes were not available in one ambulance and AED pads in another ambulance out of 23 ambulances. This result appears to be statistically insignificant, however, clinically it is very significant. Although, this finding is not statistically significant, without ECG electrodes, one cannot analyze the rhythm of heart. 12 lead ECG performed in pre-hospital care reduces door to balloon time improving prognosis in patients with short ischemic time in STEMI [4].

According to the American Heart Association (AHA), use of an AED is the third and crucial step in the cardiac arrest chain of survival [5].

Again, in this study we found that AED pads were not stocked in one out of twenty - three ambulances. This may be statistically insignificant but clinically the equipment becomes worthless in life saving situations.

Thus, fixed items must be checked individually for attached disposable items for the entire equipment to be functional and lifesaving.

Disposable items associated with fixed items need careful replenishment according to this study.

In our study, none of the ambulances was equipped with Auto Pulse (Automated CPR machine). Manual CPR can be of poor quality because of rescuer fatigue, multitasking in ambulance, and transportation of victim on stretcher, interruptions in movement of patient and variations in technique of CPR.

Successful Cardiopulmonary resuscitation depends on right compressions, recoil, right technique of CPR and minimal interruptions.

One of the best predictors of ROSC is attaining CPP of greater than 15 mm of Hg. Interruptions during CPR drastically drops CPP. Multitasking by medical and paramedical personnel inside the moving ambulance can cause interruptions in CPR. Moreover, if the victim is managed on a stretcher then the possibility of interruptions is considerable [6].

Mechanical CPR like Auto pulse can deliver high quality CPR when the EMS personnel is multitasking or restrained [7].

In this study we found that none of the ambulances had any new item added to the existing checklist. Ideally with the advances in equipment development, the ambulance team should always be open to addition of latest evidence-based lifesaving equipment like auto pulse.

Another problem of adding new equipment to the existing list is difficulty in procurement in low middle income economy group countries.

Moreover, in this study we found that none of the Ambulances had NIV face mask in the equipment. Non-invasive mechanical ventilation can be used in emergency services in acute respiratory failure cases caused by acute pulmonary edema and chronic obstructive pulmonary disease exacerbation, but patients with variables related to a higher percentage of endotracheal intubation should be specially monitored [8]. Our study showed that the safety equipment like sirens and fire extinguishers and equipment like ventilator and defibrillator, monitors were better maintained in comparison to disposables, consumables including PPE and airway adjuncts.

On first and second inspection, airway adjuncts, ointments, medicines and dressing material were deficient in ambulances no. 12-23 in our study. The ambulance team faces many challenges in providing patient care while maintaining their own safety along with their patient safety [9]. All contagious diseases require Personal Protective Equipment (PPE) [10]. The inspection team in this study found that disposable, consumables, medicines and tablets fell short as per the standard checklist. Unpredictable scenarios can emerge while working in ambulances like fire in ambulances, ambulance crashes and power failure. Disposable and consumable items need constant replacement after consumption. A regular indent from stores of institutions of such items is essential for standard optimum care of casualty. These items were satisfactory on the third inspection done on 7th day.

In this study the inspection team studied the cleanliness of ambulance and its equipment.

After removal of debris from the ambulance decontamination was done. In this study the Ambulance cleaning plan included a cleaning schedule. Providers wiped down equipment that was in contact with a patient before the next call, focusing on what was used for patient care or was in contact with the patient during patient care. Ambulance is meant to be cleaned at the end of the day. Completely empty the vehicle at the end of the week for cleaning it thoroughly [11].

It was found that ambulance cleanliness and biomedical waste management was of optimum standards in ambulance number 1-10 and rest were clean on the third inspection i.e. on the 7th day of inspection (Ambulance no 11 to 23).

In this study it was found that ambulance number 1-10 had special demand of intraosseous needle. The physician in charge of ambulances placed a special demand for this item. Likewise, Special demands can be placed for items like cricothyroidotomy sets and open tracheostomy sets, central venous catheters depending on the skill and training of individual physician.

Mechanical Component of the Ambulance

The mechanical supervisor found that all ambulances were fit, safety devices were working and in place as advised in the checklist except for one ambulance which had non-availability of fire extinguisher during first and second inspection. One ambulance had arranged fire extinguisher at the last moment. (Ambulance No 23).

Conclusion

A series of ambulance inspection is essential for availability of disposable and consumable items. The fixed items in the ambulance need regular service and disposable items attached to fixed items in the ambulances require stock wise replacement. The ambulance team should be open to adding new evidence-based life-saving equipment to the existing standardized checklist. Setting up of separate logistic cell, exclusively for procurement of ambulance equipment and maintenance for the same, is an additional requirement.

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