International Journal of Research in Medical Sciences
Janumpally R et al. Int J Res Med Sci. 2018 Aug;6(8):2562-2570
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20183233

Review Article

Oxygen delivery system in pre-hospital emergency care in india GVK EMRI 108: a review article

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Received: 04 April 2018
Accepted: 06 May 2018

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ABSTRACT

The goal of an effective emergency medical system should be to provide universal emergency care along with assured quality. Oxygen is often used drug in the pre hospital. Oxygen delivery can be monitored by pulse oximetry, typically with a goal of reversing hypoxemia. This paper describes the importance of oxygen in emergency care and its contribution to reducing avoidable death and disability. It also highlights the oxygen delivery systems and training processes /protocols in ambulance based pre-hospital care. In addition, it also shares the usage rates of oxygen and delivery methods in thermal and electrical burns in 108 GVK EMRI, India ambulances. A descriptive study methodology was adopted for explaining the training and pre-hospital care processes of oxygen delivery. Retrospective study method was adopted to measure the oxygen utilization rates in management of burns cases in 108 ambulances in the year 2015. EMTs consistently assessed vitals and provided oxygen to patients'. When EMTs found that patients' had oxygen saturation less than 95%, they provided supplemental oxygen 95% of the times. EMTs though adhering to the routine use of oxygen in 9 out of 10 cases "where indicated, refresher training should focus on use of oxygen in special circumstances and the benefit to be closely monitored for favourable clinical outcomes". There is a need to study such common and important essential pre-hospital interventions in all types of emergencies being served.

Keywords: Emergency ambulance services, Oxygen administration system, Oxygen delivery systems, Pre-hospital setting, Training process

INTRODUCTION

The goal of an effective emergency medical system should be to provide universal emergency care. Oxygen is a powerful drug that is commonly delivered in pre-hospital care all patients are benefited and there few contra indications. We are aware that our atmosphere is a mixture of gases. The atmosphere contains 78% nitrogen, 21% oxygen, 1% argon, 0.04% carbon dioxide, 0.5% water vapour. When we breathe in, we inhale the same mixture of gases contained in the atmosphere as our noses cannot filter out other gases to just take in oxygen. When we exhale, the composition of the air remains almost same as the air we inhale, only the percentage of carbon dioxide and oxygen changes. While the air we breathe out contains 16.4% oxygen and 4.4% carbon dioxide. The atmospheric oxygen partial pressure is 159mmHg, as the air enters the lungs, it is humidified by the upper airway and thus the partial pressure of water vapour (47mmHg) reduces the oxygen partial pressure to about 150mmHg. The alveolar oxygen Partial pressure (PaO_2) is 104mmHg, Arterial blood PaO_2 95-100mmHg,

Venous blood PaO_2 40-50mmHg, lung capillaries PaO_2 20-40mmHg and when reaches the tissues it is only 1-2mmHg.

Oxygen delivery can be monitored by pulse oximetry, typically with a goal of reversing hypoxemia. However, oxygen is rarely titrated in pre-hospital care once hypoxemia has been reversed. The only evidence-based indication for oxygen therapy is hypoxemia confirmed by pulse oximetry in pre-hospital care.[1-4] GVK Emergency Management and Research Institute (GVK EMRI) is the pioneer and professional organization providing integrated emergency response services (Medical, Police and Fire) in Public-Private-Partnership (PPP) framework in India. GVK EMRI is a registered not-for-profit organization established in 2005. GVK EMRI ambulance has been providing pre-hospital services by in-house trained EMTs in 14 states and 2 union territories across India and in 2 provinces in Sri Lanka.[8]

Prelude: Based on the literature review on oxygen delivery system, research team at GVK EMRI collected the information of standards from Automotive Industry Standard (AIS) National Ambulance Code' draft amendment notification to Central Motor Vehicle Rules (CMVR), 1989. Constructional and functional requirements for road ambulances topic on provision of medical devices, system design.

The ambulance whenever fitted with a stationary oxygen system, shall have all the essential components and accessories required for the piped oxygen system which shall include as a minimum one pressure regulator for each of the supply sources (stationary as well as portable). Oxygen piping concealed and not exposed to the elements, securely supported to prevent damage, and be readily accessible for inspection and replacement. Oxygen piped to a self-sealing duplex oxygen outlet station for the primary patient with a minimum flow rate of 100 LPM at the outlet. Stationary oxygen system shall be accessible from outside of the vehicle and shall be physically isolated from the patient as well as the driver compartment. Also reviewed specifications of medical equipment for ERS/Patient transport service ambulances under National Health Mission (NHM) and type of ambulances, under medical gas cylinder included information on B and D type.[6] According to NHM, Oxygen cylinder "D" type characteristics it should be a standard 'D' type molybdenum steel cylinder, should be used manually, the capacity should be of approx 7cumt. at pressure of 1800-2000lb/square inch, a pressure regulator/flow meter capable of reducing the pressure to appropriate level, capable of being stored and operating continuously in ambient temperature of 10 to 40 deg C. Cylinder should have Indian Standards Institution (ISI) mark and International Organization for Standardization (ISO) certificate for quality standard or Bureau of Indian Standards (BIS) equivalent; IS 3224, and National Fire Protection Association (NFPA) and explosive safety certificates and should be provided along with each cylinder during installation. Certificate of Calibration, NFPA certificate and inspection from the factory. Recommended for colour codes to be displayed on the cylinders and training of users in operation.[10]

Oxygen equipment

GVK EMRI 108 ambulance services using the D-Type high-pressure seamless cylinder for medical oxygen gas, cylinders are ISI marked conforming to IS: 7285 part 2 certified by the Bureau of Indian slandered (BIS) and approved by the chief controller of explosive (CCOE) Government of India. Administered by the properly trained emergency medical technician (EMT) for oxygen deficiency and resuscitation. Cylinders made from manganese steel and have a built-in valve at the top. The oxygen in the cylinder is highly pressurized. The valve is the most vulnerable part of the cylinder. Dropping or mishandling an oxygen cylinder can damage the valve, turning the cylinder into a potential missile as the compressed gas escapes and propels the cylinder at a high rate of speed. Oxygen delivery and resuscitation are corner stone of emergency medical care. EMS should stock sufficient oxygen and appropriate delivery systems for all patients. Benefit form oxygen usage is near universal. This should be presumed at the beginning of the shift, and each ambulance should carry a quantity likely to be sufficient for the duration of that shift. In areas with long travel distances between ambulance bases and destination hospitals, it may be possible to have replacement arrangements with local hospitals as well.[11]

But at GVK EMRI an in Indian EMS systems this sort of replacement is not possible as per the services agreement with state government. Hence, having large stocks of oxygen within the ambulance is best option. Therefore, it is highly justifiable to have two D type of oxygen cylinders with each with a total capacity to overcome the issue of prolonged pre- hospital time and inability to replace oxygen at the local hospitals.

Oxygen refill process and cylinder maintenance

GVK EMRI uses D-type cylinders with 46.7 liter water capacity 220 Cu.Ft. at 2200 PSI pressure which is equal to 7000 liters of oxygen with the working pressure 150Kg.f/cm^2. GVK EMRI as a not-for-profit organisation, for low cost maintenance selecting a refill centre with the coordination of supply chain management (SCM) and operation team like the field coordinators in each district. Oxygen cylinders were indicated to refill when at $\leq$30Kg.f/cm^2. The ambulances near to "refill center" go to the center and refills and for the long-distance ambulances the centre vehicle goes to the location and refills the oxygen. We maintain and follow a standardised cleaning procedure for rusted cylinder. Every 10 years we do the pressure capacity testing. In the ambulance EMT calculate the cylinder lasting minutes by using below formula.

Cylinder lasting calculation: Minutes remaining = Cylinder pressure X cylinder factor/Liter flow

Portable cylinders

Small oxygen cylinders are suitable for treating patients at the scene and during transfer into or out of the ambulance. Once in the ambulance, patients should be transferred to on-board oxygen supply in order to preserve portable oxygen cylinder supply. More recently a CD type cylinder has been introduced that is made of lightweight composite material and can carry about 460 L. This is perhaps most suited to the pre-hospital environment, combining convenience with sufficient capacity to run at high flow (15L/min) for up to 30 minutes. On board oxygen carried depend on transport times and local geography at a minimum there should be sufficient to run at a high flow for the duration for the longest potential transport encountered in a particular EMS. Ideally more than this should be carried because to carry less would be to limit the ability of the ambulance to further calls until restocked. Further, more the possibility of delays in transport must also be taken into account. In GVK EMRI system, as an example of EMS in lower and middle income countries, therefore there is a need to strengthen portable oxygen cylinder being available. If found cost effective, two portable oxygen cylinders, may be one of the options. Government technical team involved in finalizing the medical equipment should also be sensitized about the need for portable oxygen cylinders, based on the facts and experiences. Recent technologies with light weight material should be considered after review of cost-effective as well. System generated information through GPS and GIS may be an option to identify the longest on-scene time across defined geographies, districts/ states. Accordingly, state level bench marks can also be considered in view of the variations between the states in terms of the distances to the hospitals.

Complete oxygen cylinder compartment riveted with 1 mm thickness GI SHEET. Outer edges of the GI sheet to be welded with body to avoid sharp edges of GI sheet. Three vents sizes 6 inches in length and one inch in height (from the centre of the door three inches LH side and three inches RH side) to be provided for oxygen doors. Vents to be inclining downward from inside. High pressure tubing: 280bar/4060 psi test pressure, with male female (5/8 inches) bull nose brass connectors (only forged brass connectors used) at both the ends, to connect it from the oxygen cylinder to the pressure regulator inside the patient cabin; 2 No's each of 2 meters length; preset pressure gauge cum two stages regulator, with static outlet pressure first stage of 20 bars/290psi and second stage of 4.12bars/60psi double safety valve type 2 No's each. Humidifier bottle: poly carbonate bowl with metal cap and t type inlet outlet nipples, 2 nos. All the connectors chrome plated on brass material. Flow Meter: Brass with chrome plated body, Poly carbonate tube, to regulate the flow from0 to 15 liters per mint. It should be a back pressure compensated. Humidifiers mounted @1100mm height from the floor on RH side wall in front ofthe wooden cabinet. Three plus one (3+1) four ports of Brass 3/8 inches nipple in size be provided in complete one assembly (One set) on a common rectangular Brass.

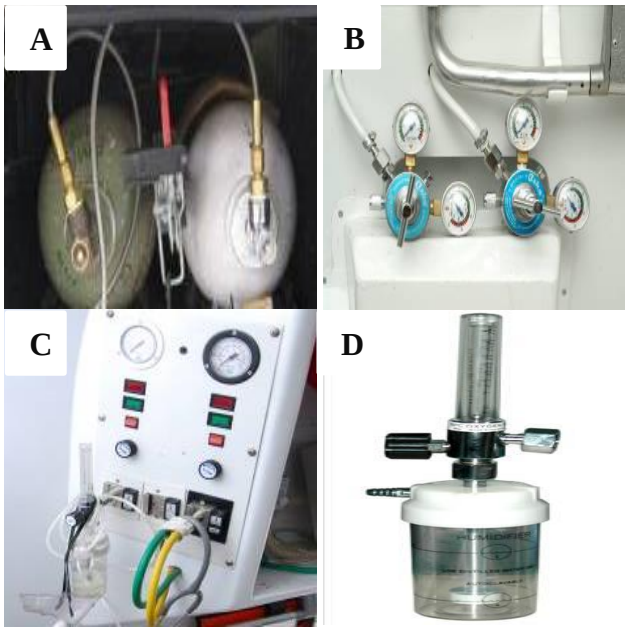


Figure 1: Oxygen delivery system-GVK EMRI. A. Two oxygen cylinders-D TYPE. B. Oxygen regulator. C. Humidifier. D. Flow-meter.

Training

GVK EMRI in collaboration with Stanford University USA has been attempting to provide world-class expertise in basic and advanced EMT courses. EMT-Basic course consists of 400 hours training in triaging, basic airway, ventilation, circulation and stabilization skills. Skill practices including airway management, assessment of vitals (pulse, respiration, blood pressure, oxygen saturation measured by pulse oximetry, temperature, random blood glucose, pupils) patient assessment, BLS, spinal motion restriction devices, pharmacology and IV access and normal delivery.[5] Majority of basic EMTs are also trained in Global Certification Programs (Basic Life Support (BLS) by American Heart Association (AHA), International Trauma Life Support (ITLS) by American College of Emergency Physicians (ACEP), Basic Life Support in Obstetrics (BLSO) by American Academy of Family Physicians (AAFP).

EMT-Basic course have 12 hours of training on oxygen administration, duration of theory 2 hours and practice 10 hours. In these 12 hours, EMT learns about how to open the main valve and check pressure on regulator, check for leaks, how to attach face mask or nasal cannula, and how to adjust the flow meter to the required level and administer oxygen to the patient. Oxygen is delivered from a cylinder, through a pressure regulator, oxygen

tubing, and into a flow meter and delivery devices such as a mask, nasal cannula, or bag mask.[7]

Table 1: Comparison of EMT training hours between HSSC and GVK EMRI, India.

Training	Total course duration	Institutional phase	Lab training/class room	Skill practice	OJT/internship/clinical/ hospital and ambulance phase
Healthcare Sector-Skill Council (HSSC)	360 Hours	240 Hours	240 Hours		120 Hours
GVK EMRI	400 Hours	240 Hours	100 Hours	140 Hours	160 Hours

Oxygen delivery devices

Non rebreather mask also known as a 'high-flow' device, is the preferred device because of its capacity to deliver high concentrations of oxygen with each breath. It consists of a clear mask, one-way valve, oxygen reservoir, and oxygen tubing to connect the device to the pressure regulator. The non-rebreather mask works best with a flow of 15 LPM. When applied properly, it can deliver oxygen concentrations between 90% and 100%. Simple face mask when it has an oxygen inlet, emergency oxygen can be used to increase the concentration of oxygen delivery. It works best with a flow between 6-10 LPM. It can deliver oxygen concentrations between 35% and 60%. Nasal cannula is a low-flow oxygen device. It can only provide a flow between 1-6 LPM, and a maximum concentration of about 44% oxygen. The nasal cannula consists of a loop of oxygen tubing with two prongs that are inserted into the nostrils of the patient. The tubing is looped around the ears, and then secured under the chin with an adjusting band that works like a drawstring. Use the nasal cannula when a patient is non-critical or cannot tolerate a non-rebreather mask. Bag mask also known as a bag valve mask or BVM is used for a patient who needs rescue breathing and/or CPR. It can deliver almost 100% of oxygen. During resuscitation, the bag mask can increase the amount of oxygen delivered with rescue breathing and reduce rescuer exposure to pathogens.

It can be used with or without emergency oxygen. The bag mask consists of a rigid face mask and self-inflating bag attached to an oxygen reservoir. Tubing connects the bag mask to the oxygen tank. During cardiac arrest, the bag mask uses positive pressure ventilation to push air into the lungs when the rescuer squeezes the bag. Oxygen blow-by for infants and young children may be afraid to have an oxygen delivery device on his or her face. If an oxygen delivery device is not tolerated, use the 'blow-by' oxygen technique. Using an oxygen mask with high-flow, keep the mask about 2 inches from the child's face, and wave it slowly from side-to-side. This action allows oxygen to pass over the child's mouth and nose and be inhaled.

Oxygen monitoring device

Pulse oximeter is a non invasive device that tells us what percentage of the patients haemoglobin has oxygen attached to it. Oxygen saturation greater than 95% is considered normal. Most healthy people would feel shortness of breath at a rate of less than 90%. A pulse oximeter must "see" a palatile capillary bed to read properly. If the patient is wearing nail polish, need to remove it. Pulse oximeter displays the patient's heart rate. Pulse oximetry does not recognize the difference between an oxygen molecule attached to haemoglobin and a carbon monoxide molecule attached to haemoglobin. In GVK EMRI EMS system, EMTs follow the oxygen administration standardized protocol when applying/delivering oxygen to the patients.

Step 1: Request turning 'ON' O_2 from main pressure release valve on receiving patient only.	
Step 2: Check the reading at regulator gauge(s) to be in safe and usable range.	
Step 3: Connect required O_2 delivery device to flow-meter and turn on by pressing if required.	
Step 4: Turn flow-meter valve to required flow rate and check by feeling in the O_2 delivery device for flow.	
Step 5: Connect to patient.	

Figure 2: GVK EMRI standard operating procedure.

GVK EMRI standard operating procedure

Oxygen administration protocol

GVK EMRI and Stanford school of medicine international designed and developed standardized pre-hospital emergency care protocol manual for EMTs in a simple and in brief, such that EMT can easily memorize the protocol and implement on the patient to save the lives. Manual of pre-hospital emergency care protocol is used for the EMTs to treat the patient in a systemic approach without any delay in transporting the patient.[9]

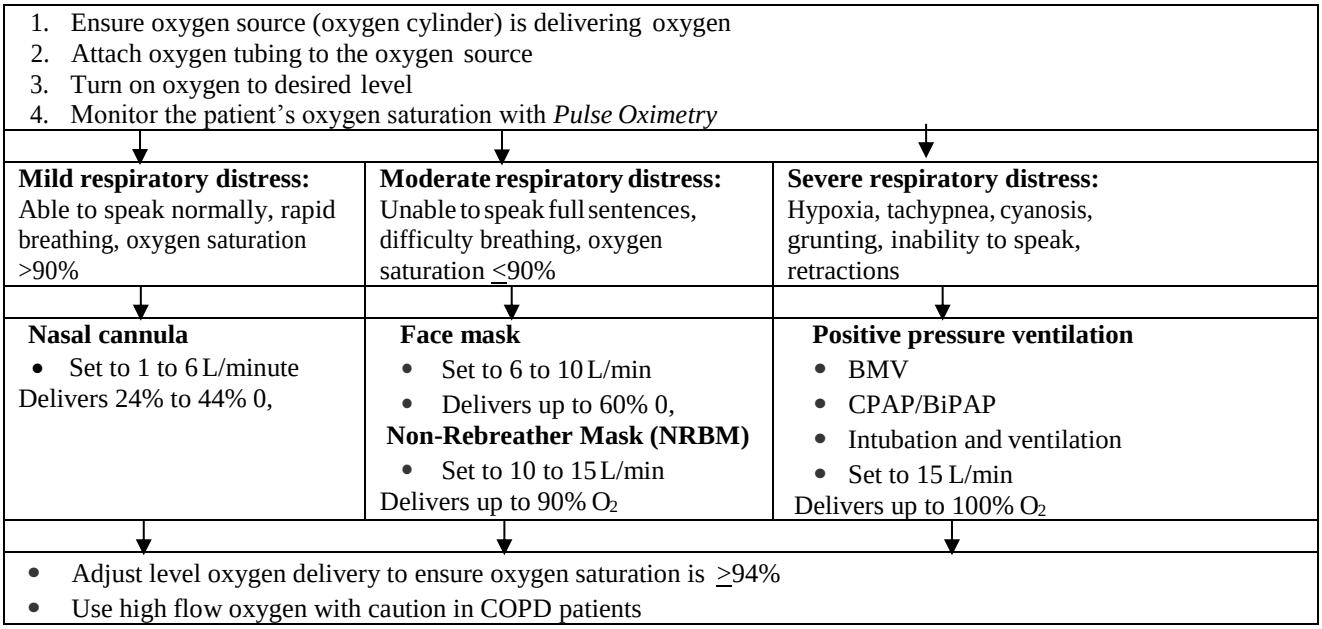


Figure 3: Oxygen administration protocol-GVK EMRI.

Oxygen role in medical conditions

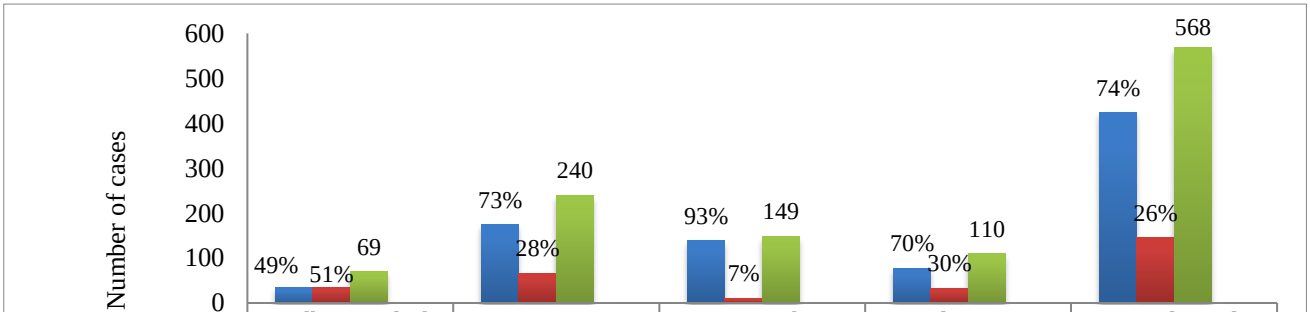
Cardiovascular oxygen therapy has been advocated for the treatment of acute myocardial infarction (AMI) and chest pain for nearly three quarters of a century. The current recommendations suggest that emergency medical services (EMS) providers may deliver oxygen during the initial assessment of patients with acute coronary syndrome. In the presence of dyspnea, hypoxemia as judged by pulse oximetry, or signs of heart failure, oxygen should be titrated to an SpO_2 of <94%.[12] In GVK EMRI EMS system, for the management of acute coronary syndrome (ACS) in the field the goals of treatment are to limit the size of the infarct, to decrease the patient's fear and pain. The EMT will begin the treatment by putting the patient physically at ease to decrease the patient's myocardial oxygen requirements. The patient will be placed in the position in which cardiac work is minimal as the semi-fowler's position. The oxygen is administered in the following order, Oxygen, Aspirin, and Nitro-glycerine. Oxygen may limit ischemic myocardial injury and reduce the amount of ST-segment elevation. Its effects on morbidity and mortality in acute infarction are unknown. In the field EMT recommended to initiate oxygen at a rate of 4 to 6L/Min via nasal cannula, although a non rebreathing mask with a rate of 12 to 15 L/min is also acceptable. Stroke has a number of similarities to AMI, in terms of both the presence of ischemia and reperfusion. The most recent guidelines for treating stroke suggest that routine use of oxygen should be avoided and that the presence of hypoxemia is the best indication.[13] In GVK EMRI pre-hospital care of the stroke patients begin with ensuring adequate Airway, Breathing and Circulation (ABCs) and blood pressure. Establish the patient's oxygen and glucose level. During the assessment phase, the EMT follows the Cincinnati pre-hospital stroke scale for rapid identification of stroke. Cardiac arrest during cardiopulmonary resuscitation, delivery of 100% oxygen during ventilation remains the current recommendation.[14] In GVK EMRI the approach to every patient in cardiac arrest will start with the American Heart Association (AHA) Basic Life Support (BLS) health care provider algorithm. The EMT will carry a portable oxygen cylinder and a "jump kit" if available. Jump kit contains equipment for managing the airway, breathing, and IV equipment. Respiratory disease while the presence of hypoxemia in the face of unknown lung disease should be treated with oxygen without delay in the pre-hospital environment, there are specific areas where oxygen therapy should be more carefully addressed. In GVK EMRI our EMTs has a relatively

short list of tools to treat respiratory compromise. At the most basic level, administer high-concentration supplemental oxygen therapy, monitoring and transporting patients. There is little change in the field EMTs take the help from online medical direction from Emergency Response Center Physicians (ERCP) and provide bronchodilators to help relax bronchial smooth muscle. If the patient is in respiratory failure the primary treatment should be ventilating the patient. Congestive heart failure and pulmonary edema represent a common etiology behind the pre-hospital complaint of shortness of breath.[15] While hypoxemia is a clear symptom of pulmonary edema, administration of oxygen has limited value in a fluid-filled lung. In GVK EMRI our EMT's will administer 100% supplemental oxygen, preferably by bag-mask device with positive pressure, because positive pressure is helpful in driving fluid out of the alveoli. If the patient will not tolerate, EMT will administer oxygen with the non rebreathing mask and monitor the oxygen saturation. Trauma traumatic illness and injury represent a wide variety of pathologies, commonly classified globally as blunt or penetrating. The spectrum of traumatic injury includes orthopedic fractures, pulmonary contusion, pneumothorax, airway obstruction, blood loss, traumatic brain injury, and solid organ injuries. Traumatic injury the requirement for oxygen in the treatment of trauma patients is not well described. With short transport times and multiple tasks required of the EMS provider, the use of the non rebreathing mask simplifies care and reduces the number of required oxygen delivery devices in stock. The use of oxygen in hemorrhagic shock is based on providing adequate oxygen delivery following massive blood loss.[16] In GVK EMRI EMS services the platinum ten minutes refers to the goal of the maximum the time spent at a scene for a critical trauma patient. EMTs in case of trauma provide high-flow supplemental oxygen, and assist ventilation if needed, paying special attention to cervical spine control.

In case of head injury EMT administers 100% oxygen via non-rebreathing mask if the patient breathing adequately, if inadequate breathing ventilation starts in adult at a rate of 10 breaths/min as per the GVK EMRI pre-hospital emergency care protocol.

Thermal and electrocution burns

GVK EMRI conducted a prospective observational study of patients calling 108 for chief complaint thermal and electrocution burns in four states in India, namely Andhra Pradesh, Gujarat, Karnataka, and Telangana in 2015. At initial enrolment, trained research assistants used a standardized questionnaire to collect data in near real time through the phone from the EMTs caring for patients. In total, a convenience sample of 582 patients were enrolled who called 108 for a chief complaint of either "burns" (N= 424) or "electrocution" (N=158) during the study period from May 11, 2015, to August 29, 2015. Of 582 patients, only 6 patients did not have a cause of burn recorded, and these patients were excluded from analysis. Total 568 patients who either had electrical burns (N=145) or thermal burns (N=423), including fire-related, contact burns and scalds.



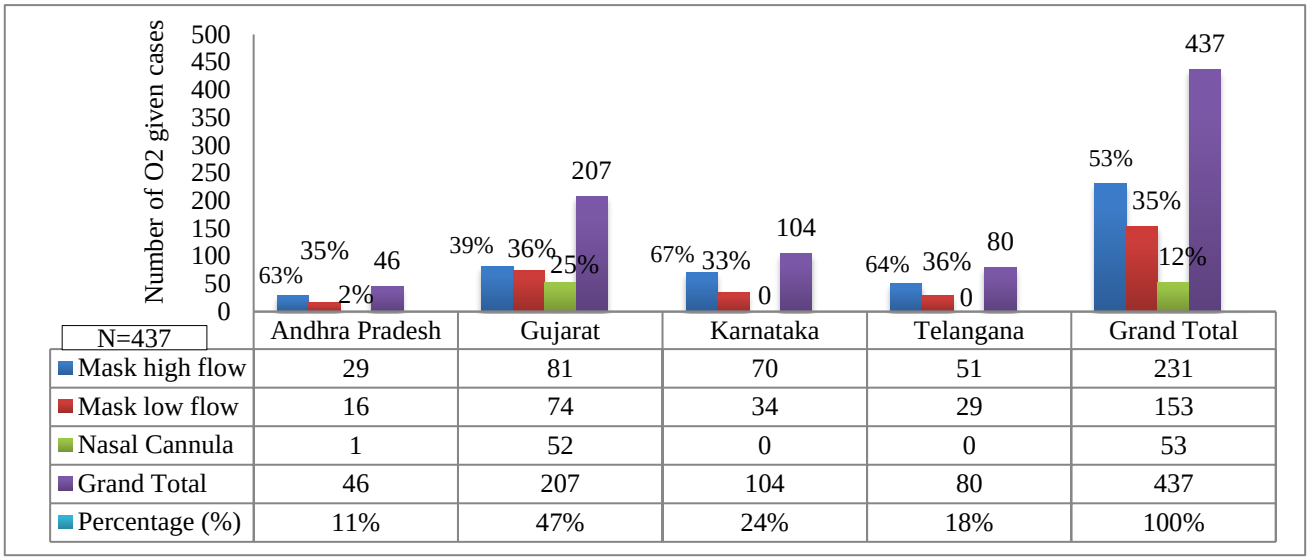
N=568	Andhra Pradesh	Gujarat	Karnataka	Telangana	Grand Total
Burn	34	174	138	77	423
Electrocution	35	66	11	33	145
Grand Total	69	240	149	110	568
Percentage (%)	12%	42%	26%	19%	100%

Figure 4: Burn and electrocution-state wise distribution of cases.

Oxygen delivery methods

EMTs measured oxygen saturation with pulse oximetry in 364 (64%) patients; the oxygen saturation values are as follows 95 to 100%-216 (60%), 90 to 94%-74 (20%), <89%-74 (20%). Even when EMTs did not measure oxygen saturation in 204, (36%), they often still provided supplemental oxygen, resulting in 437 patients receiving

oxygen (77%) as follows, oxygen delivery method using Mask high flow in 231 (53%), mask low flow in 153 (35%), nasal cannula in 53 (12%), and bag mask ventilation used in (N = 18) 10% of the patients.



N=437	Andhra Pradesh	Gujarat	Karnataka	Telangana	Grand Total
Mask high flow	29	81	70	51	231
Mask low flow	16	74	34	29	153
Nasal Cannula	1	52	0	0	53
Grand Total	46	207	104	80	437
Percentage (%)	11%	47%	24%	18%	100%

Figure 5: Burn and electrocution-state wise oxygen delivery methods.

DISCUSSION

GVK Emergency Management and Research Institute (GVK EMRI) is the pioneer and professional organization providing integrated emergency response services in India. GVK EMRI ambulance services are using the (D-type high-pressure seamless cylinder for medical oxygen gas. D-Type oxygen cylinder with 46.7 liter water capacity 220 Cu.Ft). At 2200 PSI pressure, this pressure to be reduced to 5 PSI in stages by using 2 stage regulators or in some places 3 stage regulators. In other EMS system in USA, D-Type cylinder named as H, A, K having 6900 Liters volume of oxygen.[17] They are using two-stage regulator similar to GVK EMRI. If pressure is not reduced it can cause pressure trauma to the lungs. Oxygen delivery and resuscitation are corner stones of emergency medical care. EMS should stock sufficient oxygen and appropriate delivery systems for all patients in areas with long travel distances between ambulance bases and destination hospitals; replacement is not possible as per the services agreement with state government. Hence, having large stocks of oxygen within the ambulance is best option. Therefore, it is highly justifiable to have two D type of oxygen cylinders overcome the issue of prolonged pre-hospital time and inability to replace oxygen at the local hospitals. In GVK EMRI system, there is a need to strengthen portable oxygen cylinder being available. Recent technologies with light weight material should be considered after review of cost-effective as well. System generated information through GPS and GIS may be an option to identify the longest on-scene time across defined geographies, districts/ states. The distances and travel times should be the references for oxygen stock and their replacement. Oxygen in liquid state should be vertical and in the patient compartment. But as we are using in gases state the cylinder can be made lying down or horizontally as we are using in our ambulance below the patient compartment. In GVK EMRI operating states, each state with the help of supply chain management and district level operations team identifies about 20 to 30 oxygen refilling vendors, at low cost around 180 to 400 INR (3 to 6 $). There is check list for oxygen system at the time of shift change EMTs follow the standard procedure - check the pressure level of oxygen cylinder, if inadequate (at 30Kg.f/cm^2) replace the cylinder, check water level in the humidifier, check whether oxygen mask is connected to the system (should be clean), ensure the spanner is near the cylinder and check for leakage. Leakage may possible at all the joints, most commonly near pressure release valve. EMT checks the leakages by using soap water test. If leakage is present, fixes the problem with following method, turn off the system and opens joint, applies Teflon tape and tighten back then repeat soap water test.

EMT-Basic course has 12 hours of training on oxygen administration, duration of theory 2 hours and practice 10 hours. In these 12 hours. GVK EMRI and Stanford school of medicine international designed and developed standardized pre-hospital emergency care protocol manual for EMTs in a simple and in brief, such that EMT can easily understand, memorize the protocol and implement on the patient to save the lives. Emergency Response Centre Physicians (ERCP) is available round the clock at GVK EMRI to support the EMTs for medical oversight. EMTs follow the oxygen administration standardized protocol when applying/delivering oxygen to the patients by using four basic oxygen delivery

devices namely non-rebreather mask, simple face mask, nasal cannula and bag mask (with oxygen inlet). Different sizes of delivery devices are available for adult, child and infant patients. The EMTs will choose the appropriate technique depending on the patient oxygen saturation level using pulse oximeter, condition, age and for infants and young children, use the 'blow-by' oxygen technique. If the patient will not tolerate, EMT administer oxygen with the non-rebreathing mask and monitor the oxygen saturation.

In GVK EMRI EMS system, EMTs are also trained in how oxygen administration in medical conditions such as the management of Acute Coronary Syndrome (ACS) in the field EMTs are follows Oxygen, Aspirin, and Nitro-glycerine. In the field EMTs recommended to initiate oxygen at a rate of 4 to 6L/Min via nasal cannula, although a non-rebreathing mask with a rate of 12 to 15L/min is also acceptable. In pre-hospital care of the stroke patients, begin with the ensure adequate Airway, Breathing and Circulation (ABCs) and blood pressure. Establish the patient's oxygen and glucose level. During the assessment phase, the EMT use Cincinnati pre-hospital stroke scale for rapid identification of stroke. In approach to every patient in cardiac arrest will start with the AHA BLS health care provider algorithm. The EMT will carry a portable oxygen cylinder. In respiratory compromise at the most basic level, administer high-concentration supplemental oxygen therapy, monitoring and transporting patients and provide bronchodilators to help relax bronchial smooth muscle. If the patient is in respiratory failure the primary treatment ventilating the patient. In case of trauma provide high-flow supplemental oxygen, and assist ventilation if needed, paying special attention to cervical spine control. In case of head injury EMT administers 100% oxygen via non-rebreathing mask if the patient breathing adequately, if inadequate breathing ventilation starts in adult at a rate of 10breaths/min EMTs consistently assessed vitals and provided oxygen to patients'. When EMTs found that patients' had oxygen saturation less than 95%, they provided supplemental oxygen 95% of the time in burns and electrocution patients. Thus, trained Emergency Medical Technicians (EMT) in the ambulance provide evidence-based pre-hospital care under the guidance of ERCP on use of oxygen.

CONCLUSION

From the above study, we observed that when EMTs found that patients had oxygen saturation less than 95%, they provided supplemental oxygen in 95.3% of the times but there is room for improvement. Skill refresher courses should be as per the low dose high frequency approach in emergency care profession. It is hoped that such future studies show better protocol adherence. Standard literature, however, though stipulated different parameters for the oxygen storage systems in ambulances, current system of oxygen delivery at 108 GVK EMRI has reported zero inflammable incidences. It is important that EMS systems should have strong supply chain management process in place, more so, when operating in large geographies. GVK EMRI experiences revealed not only cost effective but safe delivery of oxygen usage systems in pre-hospital care.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by Institutional Review Board (IRB-GVK EMRI)

REFERENCES

1. Hopple J. No clue about O_2: teaching oxygen therapy to pre-hospital providers. JEMS. 2011;36(12):28-9.
2. Cornet AD, Kooter AJ, Peters MJ, Smulders YM. Supplemental oxygen therapy in medical emergencies: more harm than benefit? Arch Intern Med. 2012;172(3):289-90.
3. Metcalfe M. Improving the safety of oxygen therapy in the treatment of acute myocardial infarctions. International Emerg. Nurse 2012;20(2):94-97.
4. Anderson D. Behind the mask: is oxygen harming your patient? JEMS. 2011;36(7):50-5.
5. Emergency Medical Technician preparatory text book. Hyderabad: GVK Emergency Management and Research Institute; 2012.
6. The automotive research association of india. automotive industry standard, Constructional and Functional Requirements for Road Ambulances (National Ambulance Code). 2013. Available from: http://www.nisc.gov.in/PDF/AIS_125.pdf.
7. O'driscoll BR, Howard LS, Davison AG. BTS guideline for emergency oxygen use in adult patients. Thorax. 2008 Oct 1;63(Suppl 6):vi1-68.
8. GVK Emergency Management and Research Institute; 2005. Available at: http://www.emri.in.
9. Manual of Pre hospital Emergency Care Protocols 2nd Edition. October: Stanford Emergency Medicine International USA and GVK Emergency management and research institute India; 2012.
10. National Health Mission. Specifications of medical equipments for ERS Ambulances under National Health Mission and type of ambulances. 2017. Available from: http://nhm.gov.in/images/pdf/programmes/ERS/Specification_of_Equipments_for_ERS_Ambulance.pdf.
11. Tintinalli, Judith E. EMS: A Practical Global Guidebook. PMPH-USA, Ltd. for International Federation for Emergency Medicine, EMS equipment. 2010:266-267.
12. O'Connor RE, Brady W, Brooks SC, Diercks D, Egan J, Ghaemmaghami C, et al. Part 10: Acute coronary syndromes. 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation. 2010;2:122(18 Suppl 3):S787-S817.
13. Jauch EC, Cucchiara B, Adeoye O, Meurer W, Brice J, Chan YY, et al. Part 11: adult stroke: 2010

American Heart Association Guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation. 2010;122(18 Suppl 3):S818-S828.
14. Morrison LJ, Deakin CD, Morley PT, Callaway CW, Kerber RE, Kronick SL, et al. Part 8: Advanced life support: 2010 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Circulation. 2010;122(16 Suppl 2):S345-S421.
15. Kosowsky JM, Stephanides SL, Branson RD, Sayre MR. Prehospital use of continuous positive airway pressure (CPAP) for presumed pulmonary edema: a preliminary case series. Prehosp Emerg Care. 2001;5(2):190-6.
16. Kirkman E, Watts S, Cooper G. Blast injury research models. Philos Trans R Soc Lond B Biol Sci. 2011;366(1562):144-59.
17. American Academy of Orthopaedic Surgeons. AEMT: Advanced Emergency Care and Transportation of the Sick and Injured. Jones & Bartlett Publishers; 2011 Mar 30.

Cite this article as: Janumpally R, Gimkala A, Saie UM, Rao RGV. Oxygen delivery system in pre-hospital emergency care in india GVK EMRI 108: a review article. Int J Res Med Sci 2018;6:2562-70.