

Improving child survival :Paediatric critical care training and education is the key

Sunit Singhi

Professor & Head, Department of Pediatrics, PGIMER, Chandigarh

SUMMARY

To reduce global under-five mortality by two-thirds by 2015 in low and middle-income countries and achieve that UN Millennium Development Goal 4, there is a need to strengthen health systems to provide good quality emergency and critical care services. This is one of the weakest area of the health system. Emergency triage and treatment has been developed for paediatric patients with promising results. Imparting training to health care providers in effective triage, fundamentals of critical care concentrating on ABC (airway, breathing, and circulation) and management of common medical emergencies can contribute substantially to child survival and improved quality of life without being resource intensive. Training increases short-term knowledge improves attitude and skills. Community education to administer simple emergency treatments at home and in village, and access the emergency care system is needed to bring down child mortality. Widespread use of radio and TV can be made to educate parents on early recognition, first-aid steps and care at health facility. All health care providers, be it Primary Health Center (PHC) workers, paramedics, nurses or doctors, should be trained in Basic Pediatric Emergency care, appropriate for their professional level. This, integrated with training in managing common medical emergencies, with appropriate guidelines, using simple emergency treatments such as suction and oropharyngeal airways to keep airways open, oxygen and bag-valve mask resuscitator for patients with breathing difficulty, pulse oximetry to treat hypoxemia and monitor oxygenation, oral rehydration solution, intravenous access and fluids for correction of dehydration and shock, antibiotics for pneumonia, sepsis and meningitis, emergency drugs such as diazepam etc. can be a successful way to organize critical care protocols in rural and small hospitals. Mothers and family members can be trained as care providers be it at home or in hospital to meet the resource deficit. Rather than attempting to create a system *de novo*, introducing effective triage and emergency treatments, and delivery system using established health care facilities is possible within the available resources. A framework for training commensurating with level of care and available facilities is outlined.

Correspondence : Dr. Sunit C. Singhi, Professor & Head, Department of Pediatrics, Post-graduate Institute of Medical Education & Research, Chandigarh – 160012.

DR. K.L. WIG ORATION delivered during NAMSCON 2013 at the All-India Institute of Medical Sciences, Jodhpur

Introduction

I thank the Academy for the honor and privilege to deliver an oration named after a great teacher, educationist and mentor, Padma Bhushan Dr K L Wig, in a city where I received my basic medical education. As a pediatrician with specialization in emergency and critical care, I have, for years, believed that critical care training and education can make a huge impact to health of our children. I am here today to convince you that we can bring down global under 5 mortality by imparting training and education in pediatric critical care to all the stake-holders in child health viz. families, school teachers, community leaders/health volunteers, primary level health workers, paramedical staff and physicians.

Global under-five mortality rate is to be reduced by two-thirds between 1990 and 2015 states the UN Millennium Development Goal 4 (1). There has been some progress, but under-five mortality 99% of which occurs in developing countries is not declining fast enough. No doubt, achieving this goal requires substantial strengthening of efforts to improve nutrition and hygiene, breastfeeding, immunization coverage and vitamin A supplementation as well as to improve maternal education and health. While these preventative measures are important, many children will still become ill and require treatment. Strengthening health systems and giving good quality health care is therefore vital in low-income countries. Emergency and

critical care services are often one of the weakest parts of the health system and improving such care has the potential to significantly reduce mortality (2). Emergency triage and treatment has been developed for paediatric patients with promising results. Imparting training to health care providers in effective triage, fundamentals of critical care concentrating on ABC- airway, breathing, and circulation - and management of common medical emergencies can contribute substantially to the child survival and quality of life without being resource intensive.

What is critical and Emergency care?

The concept of emergency care envisages provision of immediate or urgent medical interventions- necessary to prevent death or disability. The purpose of emergency care is to stabilize patients who have a life- or limb-threatening injury or illness.

The emergency care provider should be able to distinguish a child in need of emergency or urgent care from a large numbers of less serious presentations. Studies have identified that children have higher mortality rates than adults in similar emergency situations because health care is accessed late. They are often malnourished and arrive with advanced disease severity, which lead to poor outcome.

Why Emergency Medical Care for children?

Burden of critical illness is

especially high in low-income countries (3). Most of the conditions causing death in children 'under 5' in low-income and middle income countries present with critical illness that can be successfully treated and deaths can be averted by prioritization and provision of simple, inexpensive emergency and critical care interventions. These include neonatal illnesses, pneumonia, diarrhoea, malaria, road-traffic accidents, and surgical emergencies. Every year pneumonia and diarrhea cause 1.4 and 0.8 million child deaths, respectively, worldwide. Malaria kills one million and there are as many as three million deaths in the neonatal period annually (4). HIV, road-traffic accidents, trauma, and burns also cause significant mortality (5). All it requires is a trained health functionary and a functioning health facility. Good quality emergency care can indeed be the first step in improving child survival.

Current state of Pediatric Emergency Services :

The availability and access to emergency services in India is far from satisfactory. Pediatric Emergency Care, which exists as a separate specialty in United States since 1970, is still in early stages of development in India. Further, 20 -60 % of all patients presenting to the emergency departments have urgent yet simple and uncomplicated problems that can be cared for quickly and efficiently. The situation can be improved, without much demand on resources, by training the available manpower in identification of a child in need of emergency or urgent

care and management of common emergencies.

Access to Emergency and Critical Care:

Access to medical care for urgent or life-threatening conditions is a key expectation of community. Enhancing health systems responsiveness to people's expectations leads to improved utilization of services. In Sri Lanka, people expected to receive emergency care from the primary care system. They turned to primary care medical facilities for acute complaints or when a child seemed seriously ill (6). In rural Nepal, people used their health care centre more often for medical emergencies than for preventive services (7). *People expect and use primary health care in emergency.*

In India, 30% of emergency patients die before they reach a hospital. In many places it is difficult or dangerous to walk after dark and private transport is costly, so a guardian must wait until morning to start journey to hospital. A child may have been breathless or lying comatose or seizing whole night before reaching the health care facility. It is not surprising that such children arrive moribund at the hospital. Cases referred from PHC's have to wait for hours on the road for an ambulance/transport. When a transport vehicle is available, it may start only when it is full, which makes logistic sense but delays emergency care.

Over 80% of accident victims do not achieve access to medical care within one

hour of the incident. Bystanders usually perform prehospital care, including patient transport. In a study at our centre in 2004, of 733 pediatric patients, two-third had travelled more than 100Km, 2% arrived dead (8). The situation has not improved much in 2012. Only 6.6 % referred patients arrived in ambulance; almost 50% travelled by bus, for a mean SD distance of $53.4 \pm$ Kms shows a recently completed study of 900 arrivals to our Pediatric Emergency (unpublished data). In urban Guinea-Bissau, 20 of 124 acutely ill children died either on their way to hospital or while waiting in the reception area of an outpatient clinic (9).

There are no successful models for improving the overall provision of emergency medical care in developing countries. Prevailing models of emergency medical transport used in North America and Western Europe are costly and impractical for most LICs. *Severe resource constraints, the poor condition of roads or trails, and a lack of fuel may dictate the utilization of a wider range of option, including availability of basic emergency care at the door-step.*

Prehospital care: training of mothers as care provider :

Most emergencies start at home. But often because of family or cultural beliefs to seek traditional medication, high transport costs, and distance from health facilities delays in seeking medical care are common. Mothers may be unaware of danger signs of ill health in their children; simple

instructions as to when to access a health facility if a child is ill or not improving can improve the access. Many of the benefits of pre-hospital emergency care could be realized by teaching parents about danger signs (fast breathing, inability to feed, fever, loose stools etc.) and community volunteers in simple triage and vital interventions such as establishing and maintaining a patent airway, controlling bleeding. *It requires the community to be aware of danger signs in sick and injured children and to have the ability and facility to react to them.*

In Mexico, training of mothers and first-level health care workers in the basic principles of triage- led to more prompt care seeking and significant reduction in child mortality: deaths attributed to respiratory and diarrhoeal illness by 43% and 39% respectively among children under 1 year of age and by 36% and 34% respectively in children <5 years (10). In Tigray, Ethiopia, mothers were taught to give antimalarials promptly in the home to their sick children and this was followed by a 40% reduction in under-five mortality (11).

Prehospital care: training of community volunteers as Health workers :

Community participation on emergency care is one of the weakest links in healthcare approaches in India. The community, through schools, community and religious centres can be made aware of danger signs in sick and injured children and be taught what to do when

they are found or when trauma occurs. Training a lay health worker in counting respiratory rate, heart rate, measuring temperature, use of oral rehydration solution and zinc for diarrhea, antibiotics for non severe and severe pneumonia is feasible, and it can reduce risk of death considerably. Training of lay people as community health workers have proved successful in managing simple ailments and advising parents when to go to a hospital for care. Essential clinical signs in sick children such as counting of respiratory rate and ability to drink can be easily taught to them. In rural India, the home-based management of neonatal sepsis halved mortality, and the evaluation of clinical signs showed that the presence of two of seven clinical signs were 100% sensitive and 92% specific in identifying neonatal deaths due to sepsis (12, 13). In South-East Asia and Africa, pneumonia case management at home by trained lay responders or paramedics resulted in a reduction of pneumonia mortality by 36% among infants and children under 5 (14).

In a 5 year (1997—2001) prospective study in Iraq and Cambodia, a pre-hospital trauma system was put in place in which first responders and local paramedics were taught simple danger signs and treatment protocols. 135 local paramedics and 5200 lay First Responders were trained to provide trauma care in field. 1061 trauma victims with mean evacuation time 5.7 hours. The trauma mortality rate was reduced from pre-

intervention level of 40% to 14.9% over the study period (95% CI 17.2 – 33.0%), and from 23.9% in 1997 to 8.8% in 2001 (15). Lay people trained in first aid can effectively respond to emergencies in a community with a high burden and low cost rural trauma systems could have a significant impact on trauma mortality in low income countries.

Poorly trained health staff, and poor access to drugs are barriers to good health service provision. Previous encounters with demoralized health staff is not conducive to rapid re-attendance. Mothers may not be encouraged to return for review and so tend to seek help from one health unit after another. This causes delay and fails to provide any continuity of care.

In a nutshell, the community and family empowerment, by building the capacity of the community in health promotion and emergency care, is needed. India has provided the evidences of the possible role of community participation in child survival through highly acclaimed Jamkhed Project and Gadchiroli model. However, it has not been utilized for policy making at a large scale. The country is at an advantage by having more than 700,000 ASHA workers to further build and strengthen the community participation and mobilization. The Village Health and Sanitation Committees (VHSCs), strong *Panchayati Raj* Institutions mechanism are the right fora, and the only need is for integrated efforts and strong political will (16).

Training at Primary Health Centre and first level referral facility :

In rural areas emergency medical care is expected and delivered from sub center to a primary health center to a community health center, and privately run small clinics and hospitals managed by general practitioners. All these health care providers must receive training in rapid assessment of severity of illness, to decide the treatment and referral. They should be able to triage, provide basic ABC care- oxygen, IV fluids, antibiotics, early referral, trauma care. Training of health care providers (doctors and nurses) in a structured approach to emergency care, like the one used in most developed countries, is needed.

Training in Integrated Management of Childhood Illness (IMCI) can prepare health workers at primary healthcare units to assess, treat and refer children appropriately. Integrated management of Childhood illnesses (IMCI) developed by WHO, however, focuses on five major causes of death in childhood: diarrhea, pneumonia, malaria, measles, and malnutrition. It has been recognized that implementing IMCI guidelines implies referring up to 20% of the patients. It is these children who are severely ill and at the highest risk of death. However, many children in need of emergency/critical care do not reach the next level health facility. It is important to train PHC worker in recognition and management of time sensitive critical conditions viz. hypoxia due to respiratory illness, hypovolemia due to diarrhea or

blood loss caused by injury, severe sepsis, and timely use of oxygen, fluids and antibiotics for these conditions. It may be integrated within framework of IMCI to save lives and transport costs.

Training increases short-term knowledge and improves attitude and skills. Short courses in emergency and critical care of either 20 hours or 2 weeks have had impressive effects. Training of staff in WHO's Emergency Triage Assessment And Treatment (ETAT) course which uses the same approach as other life support courses and has been validated against that in APLS has led to 50% reduction in patient mortality Malawi (17). Introducing pulse-oximeter for identification of hypoxia and monitoring the oxygen therapy, and training of health care providers in its use, reduced case fatality rates for pneumonia by 35% in Papua New Guinea (18).

Pre-hospital Transport :

In a study at our centre in 2004, of 733 pediatric patients only 2% of patients were transported to the emergency department (ED) by ambulances, only 15% had emergency drugs and fluids during transport, 2% arrived dead (8). In 2012, the proportion that travelled by an Ambulance was 6.6% . Given the current scenario, any mode of transportation that gets a patient to a facility where definitive care is available, is acceptable. Motorized transport for moving patients to the nearest health care facility, using triage criteria to ensure efficient and timely utilization of existing resources is needed

at every level.

Ambulance drivers, as a minimum, should be taught basic first aid. National or regional guidelines for triage, patient delivery decisions, and prehospital treatment plans are needed. An efficient ambulance service manned by trained paramedics can make a significant contribution. With 1 team to 50000 people the response times could be as low as 4-6 min; (19) while with 1 team per 600000 people recorded an average response time of 30 minutes (20). Training paramedics in basic life-saving skills improves patients' outcome (20).

Access to Emergency Care in a Large City Hospitals: Clearing the Maze

Trouble is not yet over when a sick child arrives in a large hospital in a city despite all the barriers discussed above, be it a District Hospital, Medical College Hospital or a Corporate Chain Hospital. Fifty percent of deaths of children in hospital occur within 24 hours of admission. While some of these children are too ill to be saved, most have reversible disease that can respond to quick resuscitative therapies such as oxygen, fluids and antibiotics. But very often precious time is lost in locating the place and the personnel that will render emergency/critical care. There is often no separately identified emergency care area, and here I am not asking for a separate area for emergency care of children as needs of critically children differ from those of adults. Patients are first seen in

outpatients or ward. Clinicians see the patients in the order they arrive. There is usually little prioritizing of patients and no formal triage system. Once a critically ill patient is identified, there can be delays in accessing emergency drugs and providing essential treatment. The critically ill are often admitted to general ward in first level hospitals or pediatric wards in a referral/district hospital. Most of the hospitals do not have an ICU. Essential clinical signs in sick children such as respiratory rate and ability to drink are frequently not sought or recorded. Established treatments and supportive therapies are not used and global strategies or national guidelines are not followed.

Plan an emergency receiving area :

Critically ill children need rapid identification, prioritization and urgent treatment, and where hospital systems don't provide this the result can be disastrous. The receiving area in a hospital should be planned: it should be accessible and well sign-posted; have a resuscitation room or area with emergency equipment at hand, and an area where the doctor examines and treat children. No doubt, there is a resource limitation; there is a severe lack of doctors, nurses, and other health staff (21). Too few health professionals have been trained, and many are subsequently lost to other jobs or to the 'brain drain' to richer countries (22). The quality of care, however, can be improved by ongoing training in critically care.

Triage and Resuscitation Training :

Triage is a brief clinical assessment that determines the time and sequence in which patients should be seen in the casualty or, if in the field, the speed of transport and choice of hospital destination. These decisions are based on a short evaluation of the patient's overall appearance, history of illness and/or injury, and an assessment vital signs and mental status within 30-60 seconds. Triage gets priority over registration in Emergency. Children presenting in cardiopulmonary failure or arrest, shock or respiratory distress need to be identified and treated without delay. *Training the doctors and nurses through short courses, lasting one to one and half days, in a systematic approach to patient assessment, categorization of illness and treatment using clear guidelines can achieve these goals.* In a study from a large volume pediatric emergency department from Chennai central-peripheral temperature gap and respiratory failure requiring manual ventilation were found to be major risk factors for mortality in the children aged > 1 year. Among the post neonatal group, poor pulse volume and respiratory failure were strong risk factors (23). Given these observations, the clinical features of circulatory and respiratory failure at presentation as proposed in Pediatric Advanced Life Support (PALS), APLS and ETAT guidelines with some modification can be useful for triage decisions even in the under resourced emergency departments' of the

developing countries. Further, the training in resuscitation priorities can focus on appropriate use of oxygen, bag mask ventilation, intravenous access, fluid boluses and timely administration of antibiotics. Resuscitation training in developing countries is well received and viewed as valuable. Trauma and newborn resuscitation in developing countries has significantly reduced mortality, but similar data on patient survival after pediatric resuscitation are not available (24).

Basic Critical Care Training :

World Health Organization states that every hospital where surgery and anesthesia are performed should have an ICU, but only a handful of hospitals do so. There is a misconception that critical care has to be complicated and technologically sophisticated. Physicians and nurses are rarely trained in critical care and lack the knowledge and methods for caring for the critically ill. Working in such under resourced hospitals can lead to a sense of fatalism whereby very sick children are presumed to be beyond saving and left to take their chances. It is therefore important to have limited-resource intensive care unit offering treatment for time sensitive conditions such as severe sepsis and shock, upper and lower respiratory illness causing respiratory failure, severe dehydration and hypovolemia, suited to local needs, and establish appropriate training for all levels of personnel in critical and emergency care.

Table 1: Distribution of 43,800 patients attending pediatric emergency (PGIMER between 1990-2000, with respect to major diagnosis)

Major Illness	No. of patients (percentage of total)
Gastrointestinal	10173(23.3%)
Diarrhoea	7724
Intestinal obstruction	536
Acute liver failure	49
Others	1387
Respiratory	10269(23.44%)
Upper respiratory infection (URI)	3183
Pneumonia	2695
Asthma	2302
Others	2089
Central Nervous System	7038(16.07%)
Seizures	3096
Meningitis (bacterial, aseptic)	1222
Encephalitis	669
Others	2051
Neonatal illnesses	6830(15.59%)
Suspected sepsis	1657
Jaundice	1577
Birth Asphyxia	951
Others	2645
Systemic infections	2849(6.73%)
Septicemia	1126
Malaria	822
Enteric Fever	493
Others	408
Cardiac	2070 (4.9%)
Acyanotic heart disease	960
Congenital cyanotic heart disease	863
Others	247
Hematological	2034(4.8%)
Renal	1996(4.3%)
Poisoning	253 (0.58%)

Adapted from – Reference no. (26)

Table 2: Important causes of morbidity in patients attending pediatric emergency service: comparison of a tertiary care hospital vs a community hospital

Type of Morbidity	Number of patients (%) seen at	
	Community Hospital Naraingarh (%)	Tertiary care hospital PGIMER (%)
Total	596	8301
GIT	249(41)	1713(21)
Diarrhea	228	1175
With no dehydration	151	823
With some dehydration	77	352
Hepatitis	3	96
Abdominal pain	11	129
ARI	108(18)	2003(24)
Pneumonia	87	494
URI	11	703
Asthma	4	468
Foreign body	Nil	53
Neonates	69(11)	1360(16)
Neonatal sepsis	65	408
Neonatal jaundice	4	402
CNS	35(6)	1374(17)
Seizures generalized	17	195
Febrile seizures	3	64
Focal Seizure	NA	325
Hematological	5(1)	223(3)
Sepsis	13(2)	80(1)
Fever without focus	60(10)	31(<1)
Poisoning	5(1)	184(2.3)

Adapted from Reference (7)

Planning the Training of Health care providers :

Periodic audit is essential to prioritize contents of training and allocation of resources. Knowledge of the spectrum of the diseases along with

seasonal and temporal variations can help in planning the services and training suitable for given time and place. The spectrum of pediatric emergencies as seen in our hospital is given in the Table 1. In our experience, the comparative disease burden of pediatric emergencies in a

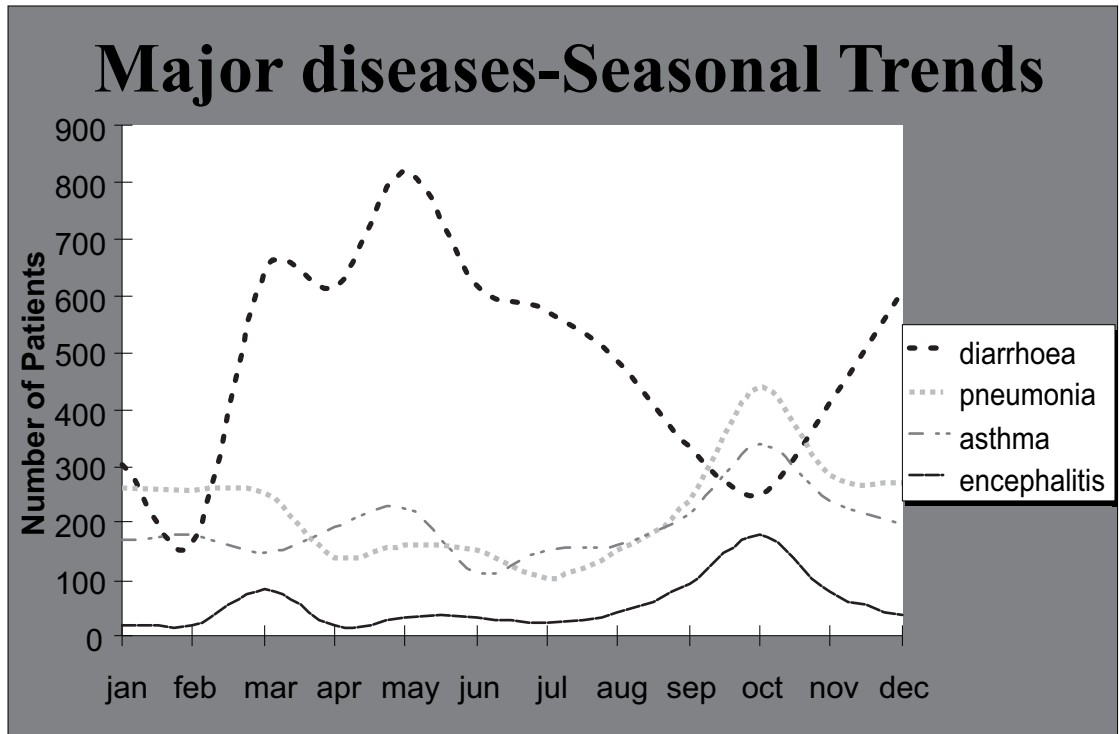


Figure 1: Seasonal variations in major emergencies presenting to Pediatric Emergency Service, PGIMER, 1995-2000, based on data of 45000 patients.

community vs. tertiary care hospital reveal that Diarrhea, Acute Respiratory infections and Neonatal illnesses, which included birth asphyxia, sepsis and prematurity, were the frequent causes of morbidity at both the places (Table 2) (8). The peak numbers of emergency visits in both the hospitals were reached in the monsoon months of July-August (25). Peak of respiratory illnesses was seen in winters and diarrhea in summers (figure 1) (26). About half (52.5%) of the patients were infants. Fever (29.5%), breathing difficulty (17.4%) and diarrhea (14.5%) were the most common presenting symptoms. Respiratory and gastrointestinal illnesses were the two

commonest pediatric emergencies. About 2% (n-198) patients died within 24 hours of hospitalization; 42.3% deaths were in the age group of 0-28 days. Sepsis was the commonest diagnosis in patients who died (25). The allocation of resources and training priorities can be optimized according to the seasonal variation in disease frequency.

Planning the resuscitative measures and equipment required :

In a study of nearly 2000 children below 5 years brought to our Pediatric Emergency, 25% of the children required resuscitation in one form or other.

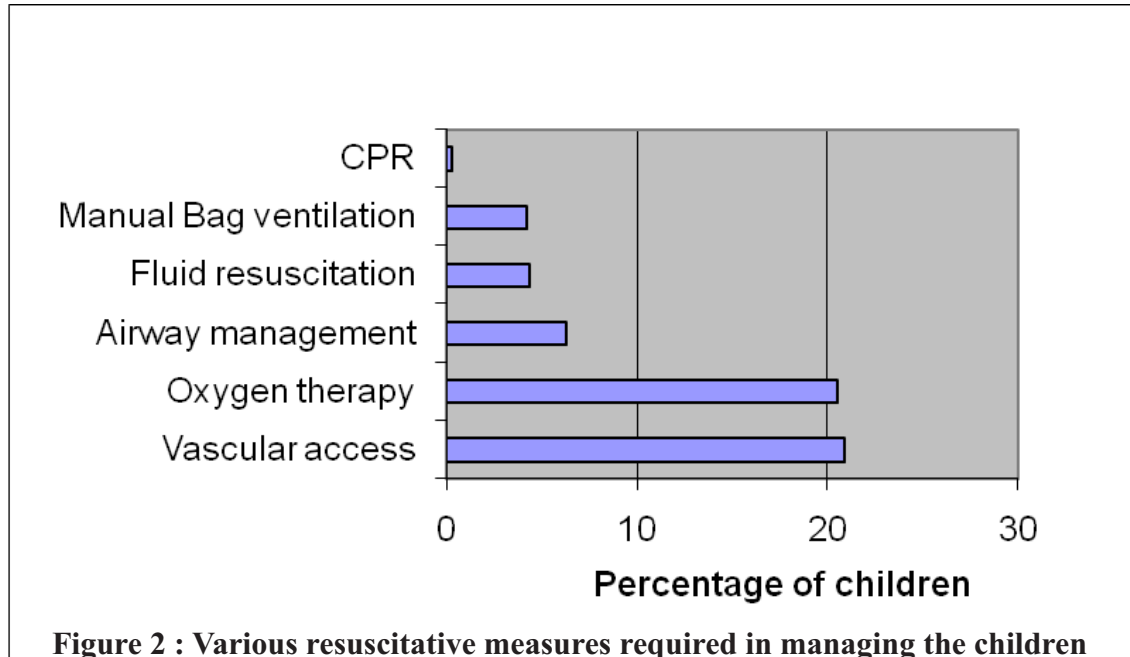


Figure 2 : Various resuscitative measures required in managing the children treated at Pediatric Emergency Unit, PGIMER, 2005-06.

Frequencies of various resuscitation measures in three different age groups are given in the Figure 2. The data implies that training in simple procedures like use of oxygen, airway management; manual bag ventilation, intravenous access and fluid administration are good enough for dealing with almost all the pediatric emergencies. These can be integrated in Pediatric Advanced Life Support training courses for primary care programmes to improve child survival.

Learning the ABCD :

In a qualitative study of 21 hospitals (13 district hospitals and 8 teaching hospitals) in seven developing countries, emergency treatment areas were mostly poorly organized and lacked essential supplies, families were routinely

required to buy emergency drugs. Fourteen facilities (10 of 13 district hospitals) did not have an adequate triage system. Poor clinical assessments in 41% and potentially harmful delays occurred in 19% of children (27).

Paediatric emergency care is a relatively new discipline, only recognized as a separate entity in the 1980s. Traditional medical teaching has emphasized ward-based clinical skills. Little thought and less teaching has gone into healthcare delivery and the management of emergencies in which the diagnosis is not clear and treatment must be guided by the ABCD approach (Airway, Breathing, Circulation, Dehydration). There have been several appeals for emergency paediatric care in developing countries. The time has come

for paediatric emergency care to be recognized and established in health care system of developing countries. Emergency pediatricians should develop and deliver training courses for health staff and rapidly raise the standard of emergency care. They should provide the much-needed senior clinical supervision in the emergency department.

Pediatric Emergency Department in Tertiary Care Hospitals :

The emergency department (ED) should be located on the ground floor, with direct access from the main road with ample space for ambulances and parking. Though it should be physically separate from other areas in the hospital; it should be easily accessible from the intensive care unit (ICU), and all essential support services including radiology and blood bank. This will facilitate prompt care of the ill child in a facility close to an area where maximal resuscitation expertise is available. The emergency departments should always have a provision to cater to a major disaster involving many children'.

Our model of Pediatric Emergency is shown in figure 2. Clinical facilities include distinct areas for initial triage and resuscitation, Procedure/treatment area for both minor and major procedures, Monitoring and treatment area for the critically ill children and observation area for short stay. There is a separate area for the neonates and for children with diarrhea, as they constitute nearly 16% and 23% of our patients load. There is a separate isolation room for

children with communicable diseases. Administrative and public areas include reception, space /room for the staff, ambulance driver and attendant. Public waiting areas have toilet facilities, water coolers, public telephones and facility for charging the mobile phones, snack bar, a vending machine and an ATM.

Personnel and training :

Staffing an emergency department has always been a challenge. Ideally pediatricians with skills, knowledge and commitment to care for critically ill children and nurses trained in resuscitation and emergency care should be present 24 hours per day, 7 days per week in large hospitals. In small emergency rooms providing a basic facility, a trained assistant or a resident can supplement the work of a pediatrician who is promptly available for supervision and provide directions to the staff.

The training activities to improve the initial emergency management of severely ill children should receive substantial attention and resources so that the doctors and nurses are prepared to deliver the most updated standardized emergency management. Training courses such as the Pediatric Advanced Life Support (PALS) and nursing & paramedic pediatric emergency curricula can be adapted to local needs. National guidelines on setting up pediatric emergency care and life support courses have been developed by Indian Academy of Pediatrics for doctors and nurses & Basic Life Support training for lay people,

school teachers, high school students etc. Our endeavor is to train all the physicians and nurses involved directly in care of sick children in pediatric advanced life support course adapted and integrated for limited resources followed by recertification at regular intervals. In teaching institutions new resident doctors regularly replace the trained residents to provide 24-hour emergency coverage. Hence, ongoing training and teaching should be an inherent part of functioning emergency department. The management of common pediatric emergencies should follow set practices protocols determined prior to child attending the ED. These give a framework for junior and inexperienced physicians to practice safe and immediate care. Appropriate routines and protocols can result in better management of patients and more efficient use of resources (28, 29). Within this framework there should be supervision of experienced physicians to help and advice with difficult cases. As a general rule these protocols should be adhered to in the first instance and only varied by senior advice.

Conclusion :

We need to enhance healthcare professionals' education and training in pediatric critical care at all levels. We also need to define (and develop) minimal guidelines and "standards" for patient care and develop a pediatric data surveillance system, and standardization for facility recognition.

REFERENCES

1. UN. The Millennium Development Goals Report 2008. New York: United Nations, 2008.
2. Baker T (2009). Pediatric emergency and critical care in low-income countries. *Paediatr Anaesth* **19**:23-27.
3. Dunser MW, Baelani I, Ganbold L (2006). A review and analysis of intensive care medicine in the least developed countries. *Crit Care Med* **34**: 1234–1242.
4. Black RE, Morris SS, Bryce J (2003). Where and why are 10 million children dying every year? *Lancet* **361**: 2226–2234.
5. Mock C, Kobusingye O, Joshipura M, *et al* (2005). Strengthening trauma and critical care globally. *Curr Opin Crit Care* **11**: 568–575.
6. Wolffer I (1988). Illness behavior in Sri Lanka: results of a survey in two Sinhalese community. *Soc Sci Med* **27**:545-552.
7. MacRorie RA (1988). Births, deaths and medical emergencies in the district: a rapid participatory appraisal in rural Nepal. *Trop Doct* **128**:162-165.

8. Singhi S, Gupta G, Jain V (2004). Comparison of pediatric emergency patients in a tertiary care hospital vs. a community hospital. *Indian Pediatr* **41**:67-72.
9. Sodemann M, Jacobsen MS, Molbak K, Alvarenga IC Jr, Aaby P (1997). High mortality despite good care-seeking behavior: a community study of childhood deaths in Guinea-Bissau. *Bull World Health Organ* **75**:205-212.
10. Guiscafre H, Martinez H, Palafox M, *et al* (2001). The impact of a clinical training unit on integrated child health care in Mexico. *Bull World Health Organ* **79**(5):434-441.
11. Kidane G, Morrow RH (2000). Teaching mothers to provide home treatment of malaria in Tigray, Ethiopia: a randomised trial. *Lancet* **356**:550-555.
12. Bang AT, Bang RA, Baitule SB, Reddy MH, Deshmukh MD (1999). Effect of home-based neonatal care and management of sepsis on neonatal mortality: field trial in rural India. *Lancet* **354**:1955-1961.
13. Bang AT, Bang RA, Reddy MH, *et al* (2005). Simple clinical criteria to identify sepsis or pneumonia in neonates in the community needing treatment or referral. *Pediatr Infect Dis J* **24**:335-341.
14. Sazawal S, Black RE (2003). Effect of pneumonia case management on mortality in neonates, infants and preschool children: a meta-analysis of community based trials. *Lancet Infect Dis* **3**:547-556.
15. Husum H, Gilbert M, Wisborg T, Van Heng Y, Murad M (2003). Rural prehospital trauma systems improve trauma outcome in lowincome countries: a prospective study from North Iraq and Cambodia. *J Trauma* **54**:1188-1196.
16. Lahariya C, Khanna R, Nandan D (2010). Primary health care and child survival in India. *Indian J Pediatr* **77**:283-290.
17. Molyneux E (2001). Paediatric emergency care in developing countries. *Lancet* **357**:86-87.
18. Duke T, Subhi R, Peel D, Frey B (2009). Pulse oximetry: technology to reduce child mortality in developing countries. *Ann Trop Paediatr* **29**:165-175.
19. McSwain N.E. 1991. Prehospital Emergency Medical Systems and cardiopulmonary resuscitation. In *Trauma 2nd ed.* E. E. Moore, K.L. Mattox and D.V. Feliciano (Eds), 99-107. Norwalk: Appleton & Lange.
20. Kobusingye OC, Hyder AA, Bishai D, Hicks ER, Mock C, Joshipura M (2005). Emergency medical systems in low- and middle-income countries : recommendations for action. *Bull World Health Organ* **83**:626-631.

21. Narasimhan V, Brown H, Pablos-Mendez A, *et al* (2004). Responding to the global human resources crisis. *Lancet* **363**: 1469-1472.
22. Lipman J, Lichtman AR (1997). Critical care in Africa. North to south and the future with special reference to southern Africa. *Crit Care Clin* **13**: 255-265.
23. Santhanam I, Pai M, Kasturi K, Radhamani (2002). Mortality after admission in the pediatric emergency department: A prospective study from a referral children's hospital in southern India. *Pediatr Crit Care Med* **3**: 358-363
24. Meaney PA, Topjian AA, Chandler HK, *et al* (2010). Resuscitation training in developing countries: a systematic review. *Resuscitation* **81**(11):1462-1472.
25. Salaria M, Singhi SC (2003). Profile of patients attending pediatric emergency service at Chandigarh. *Indian J Pediatr* **70**(8):621-624.
26. Singhi S, Jain V, Gupta G (2003). Pediatric Emergencies at Tertiary Care Hospital in India. *J Trop Pediatr* **49**:207-211.
27. Nolan T, Angos P, Cunha AJ, *et al* (2001). Quality of hospital care for seriously ill children in less-developed countries. *Lancet* **357**: 106-110.
28. Watters D, Wilson I, Leaver R, Bagshawe A (2004). Care of the critically ill patient in the tropics and sub-tropics. Oxford: Macmillan Press.
29. Van Zyl-Smit R, Burch V, Willcox P (2007). The need for appropriate critical care service provision at non-tertiary hospitals in South Africa. *S Afr Med J* **97**:268-270.