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Research Article

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In-patient mortality analysis following establishment of a separate pediatric emergency care in Eastern Nepal

Abstract

Objective: High quality hospital care for sick neonates, infants and older children are not readily available and is highly demanding in low- middle income countries. It results in high childhood mortality in resource- limited settings. We hypothesize that interventions in the form of creation of separate pediatric emergency care can prevent in-patient hospital mortality.

Methods: The intervention initiatives undertaken in pediatric emergency care were: (i)-creation of new pediatric emergency care block adjacent to the general ward, (ii)-allocation of resident doctors supporting at triage and stabilization of patients before transfer to the ward and (iii)- availability of life saving medical equipment and monitoring in emergency care block. Primary outcome measure was to assess in-patient hospital mortality and mortality within 48 hours, one year before (September 2012- August 2013) and a year after the intervention (October 2013- September 2014).

Results: The total deaths of patients decreased from 6.27% to 5.19% during the later period (RR 0.89, 95% CI 0.81-0.99, P=0.019). Deaths within 48 hours also decreased from 4.29% to 3.42% (RR 0.88, 95% CI 0.78- 0.99, P= 0.021). Reduction in neonatal deaths also followed the similar trend (0.88, 95% CI 0.77-0.99, P =0.032). Overall pattern of diseases, except central nervous system involvement (6.66% vs 5.44%, P 0.009), and duration of hospital stay remained same during both the study periods.

Conclusions: Thus, there was a significant reduction in in-patient pediatric mortality after creation of separate pediatric emergency facility. Such measures can be undertaken to reduce childhood mortality.

Keywords: paediatric emergency, children, mortality

Volume 12 Issue 3 - 2022

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Received: September 09, 2022 | **Published:** October 13, 2022

Abbreviations: IUGR, intrauterine growth retardation; LRTI, lower respiratory tract infection; ALL, acute lymphoblastic leukemia; AML, acute myeloid leukemia; DOR, discharge on request; IQR, inter-quartile range; RR, relative risk; CI, confidence interval

Introduction

About 29,000 children under the age of fives die every day, mainly from preventable diseases in the developing countries. Majority of deaths in these children occur in low-middle income countries and due to easily preventable or treatable conditions.[1] Nepal is one of such countries in the world with rapid population growth rate and over half of this, almost 27 million populations, living below the international poverty line. Access to health care facility differs considerably due to wide geographical locations, inadequate transport and non-availability of tertiary- care centers at most the places. With an under 5-year mortality rate of 54 per 1,000 live births and infant mortality rate of 46 per 1,000 live births,[2] some of the deaths can be averted by simple and community- based strategies. However, other major strategy like creating pediatric emergency services for triage, early recognition, hospitalization and stabilization of acutely sick children are also required to improve the outcome.

There have been deficiencies in the triage, assessment and emergency treatment to children in countries with resource- limited settings.[3–5] These deficiencies lead to high rate of mortality rates among hospitalized children.[6,7] Besides this, the delay in seeking care and inadequate pre-hospital care services are the other contributors of high in-patient mortality. Inability to provide emergency care services upon patients' arrival at a tertiary care level further aggravates the problem. There is scarcity of published reports that how intervention can improve the emergency care in hospital like ours which can affects the child survival?

B.P. Koirala Institute of Health Sciences is referral care center plus a community oriented teaching hospital located in the Eastern region of Nepal. The profile of children referred to this hospital is mainly of acute respiratory infections, infectious diseases, acute encephalitic syndrome, birth asphyxia and septicemia etc. The Pediatric ward is a 60 bedded unit and has approximately 5000 admissions per annum. Acknowledging to own responsibility, with aim of improving the quality care and to decrease in-hospital mortality and morbidity of neonates and children, the department created a separate pediatric emergency block in order to provide urgent attention, monitoring and treatment to sick children brought to this hospital. This article describes the comparative analysis of pre- and post- pediatric emergency services and evaluates its effectiveness in reduction of total in-patient childhood mortality and also early mortality (deaths within 48 hours) at our center.

Materials and methods

A working committee to create pediatric emergency care was formed by the institute, which consisted of Head of Department of Pediatrics, Chief of hospital administration and Head nurse. The areas prioritized for the improvement of emergency care were: (a) Improvement in emergency care by allocation of senior level resident doctor at the emergency department for triage, initial assessment and stabilization before transfer to the ward (b) Improvement in emergency care layout by providing new pediatric

emergency care block adjacent to the ward and (c) availability of life saving medical equipment at the emergency care block. All these interventions were implemented simultaneously from October 2013 onwards.

Ethical approval

Ethical clearance was obtained from Institutes Ethical Review Board.

Description of interventions

The interventions were as follows:

Pre- intervention Services	Intervention
Improvement in emergency care	
House officer were the first to provide emergency care and junior residents used to provide emergency care on call. No fixed numbers of staff nurses were allocated for the pediatric care.	One Pediatric junior resident for emergency care was posted in each shift along with two house officers. Pre- posing training was imparted to resident and house officers by faculty of Pediatrics and Anesthesiologist in providing emergency care. It included identification of common pediatric emergencies, management of fluid and electrolyte imbalance, different forms of oxygen therapy, use of vasopressors, interpretation of arterial blood gas analysis, endotracheal intubation and ventilation etc. Thereafter, patients were either managed in emergency care block or shifted to Pediatric intensive care unit (PICU) or neonatal intensive care unit (NICU), depending upon the need of further care. Experienced nursing staffs (2- 3 per shift of 8 hours rotation) were allocated and supervised directly by the Nursing In- charge and /or faculty of College of Nursing.
Improvement in emergency care layout	
No separate pediatric emergency building was there and the care was provided at the common emergency care block (both for adults and children). It was an approximate 10 min walk distance from main emergency to pediatric wards. No fixed numbers of beds were available and at times 2-3 patients were kept on the same bed, when the patient flow to emergency was more in number. No separate neonatal corner was present to render point of care to sick neonates.	A new dedicated Pediatric Emergency care block was created just adjacent to pediatric wards, PICU and NICU. The distance was reduced to just 1-2 min walk from pediatric emergency to admission units to avoid delay in providing care. A total of 16 dedicated beds were set -up. Well-equipped neonatal corner was made available to provide instant resuscitation.
Improvement in medical equipment	
There were deficient numbers in basic medical equipment and life supporting measures, especially for the pediatric patients, were available.	Basic medical equipment was made available which included weighing machine, thermometer, pulse oximeter, glucometer, central oxygen and suction lines, transport trolley and resuscitation equipment, radiant warmers, phototherapy, patient care monitor, glucometer, portable ECG and X-ray machine were installed.

Data collection

Demographic and outcome data of all the children admitted to pediatric emergency or subsequent transfer to Pediatric ward, PICU and NICU one year before (September 2012 to August 2013) and a year after (November 2013 to October 2014) the establishment of separate Pediatric Emergency were recorded. Demographic and outcome data from September 2012 to August 2013 were obtained from medical record section. The demographic data of the post-intervention period were prospectively recorded in medical record book at the nurse station maintained by pediatric nursing staff and counter-checked by resident doctor/faculty. The primary outcomes of interest analysis were total in-patient mortality and early mortality (deaths within 48 hours of hospital stay).

Statistical analysis

All the data were entered in MS Excel and was analyzed using Stata 11.2 Stata Corp. Early and total inpatient mortality was compared by Chi-square test in pre- and post-intervention periods. Data following non- Gaussian distribution are presented as median and inter-quartile range (IQR) and compared with Mann- Whitney U test. The Relative Risk (RR) of mortality with 95% confidence interval (CI) was calculated to find out the effectiveness of the intervention. P value of <0.05 was considered as significant.

Results

The basic patient characteristics in pre- and post-intervention periods were found to be comparable, except significantly a greater number of males brought to hospital in pre-intervention period (Table 1). Pattern of diseases in pre- and post- intervention periods was also analyzed and the data are shown in Table 2. Proportions of most of the diseases were similar in both periods, except the central nervous system disorders, which were significantly lesser in the post-intervention period (P=0.009).

Table 1 Baseline characteristics in pre- and post- intervention period

Parameters	Pre-intervention n = 5586	Post-intervention n= 4853	P
Age	9 (2-38)	10 (2-36)	0.591
Gender Male Female	 3550 (63.55 %) 2036 (36.44 %)	 3182 (65.56%) 1671 (34.43%)	 0.032
Neonates	1994 (35.69 %)	1809 (37.27%)	0.094
Duration of hospital stays (Days)	3 (1,6)	3 (1,6)	0.86

Outcome of patients in pre- and post-intervention is presented in Table 3. After the intervention, total deaths decreased significantly from 6.27% to 5.19% during one year period of comparative analysis (RR 0.89, 95% CI 0.81-0.99, P = 0.019). Early death (deaths within 48 hours) also decreased significantly from 4.29% to 3.42% during next one year period (RR 0.88, 95% CI 0.78- 0.99, P= 0.021).

Admission of the neonates contributed 35.69% and 37.27% of the total admissions in pre- and post-intervention, respectively. Fifty nine percent (358/602) of total in-patient children's deaths was seen in neonatal age group in both periods. After the intervention, total neonatal deaths decreased from 10.38% to 8.35% (RR 0.88, 95% CI 0.77-0.99, P =0.032) and early deaths also decreased from 7.37 to 5.31% (RR 0.82, 95% CI 0.70- 0.96, P= 0.021) in next one year period.

Table 2 Pattern of diseases in pre -and post- intervention period

Disease spectrum	Pre-intervention n= 5586	Post-intervention n= 4853	P
1. Neonates	**1994 (35.69%)**	**1809 (37.27%)**	**0.094**
Neonatal sepsis	978 (17.50%)	930 (19.16%)	
Birth asphyxia	408 (7.30%)	315 (6.49%)	
Meconium aspiration syndrome	80 (1.43%)	81 (1.67%)	
Neonatal hyperbilirubinemia	154 (2.75%)	139 (2.86%)	
Congenital anomalies	39 (0.69%)	43 (0.88%)	
Low birth weight (Prematurity/ IUGR)	307 (5.49%)	275 (5.67%)	
Tetanus neonatorum	3 (0.05%)	4 (0.08%)	
Transient tachypnea of newborn	16 (0.28%)	13 (0.26%)	
Apnea of prematurity	4 (0.07%)	5 (0.10%)	
Necrotising enterocolitis	5 (0.08%)	4 (0.08%)	
2. Respiratory system	**1553 (27.80%)**	**1357 (27.96%)**	**0.855**
Pneumonia	1016 (18.18%)	906 (18.66%)	
Bronchial asthma	153 (2.74%)	133 (2.74%)	
Empyema	8 (0.14%)	2 (0.04%)	
Wheeze associated LRTI	117 (2.09%)	119 (2.45%)	
Bronchiolitis	244 (4.37%)	177 (3.65%)	
Croup	2 (0.03%)	4 (0.08%)	
Foreign body aspiration	13 (0.23%)	16 (0.33%)	
3. Gastrointestinal system	**1039 (18.60%)**	**883 (18.19%)**	**0.594**
Acute gastroenteritis	670 (11.99%)	580 (11.95%)	
Acute hepatic failure	6 (0.10%)	8 (0.16%)	
Viral hepatitis	100 (1.79%)	65 (1.34%)	
Nonspecific abdominal pain	156 (2.79%)	132 (2.72%)	
Surgical abdomen	107 (1.91%)	98 (2.02%)	
4. Central nervous system	**372 (6.66%)**	**264 (5.44%)**	**0.009**
Meningitis	135 (2.42%)	110 (2.27%)	
Meningoencephalitis	42 (0.75%)	18 (0.37%)	
Febrile convulsion	129 (2.31%)	93 (1.92%)	
Epilepsy	22 (0.39%)	15 (0.31%)	
Acute flaccid paralysis	16 (0.28%)	8 (0.16%)	
Intra cranial space occupying lesions	13 (0.23%)	11 (0.23%)	
Movement disorder	2 (0.03%)	1 (0.02%)	
Cerebral palsy	13 (0.23%)	8 (0.16%)	
5. Hematological system	**121 (2.17%)**	**106 (2.18%)**	**0.949**
Hemolytic anemias	29 (0.52%)	25 (0.51%)	
Nutritional anemia	38 (0.68%)	29 (0.59%)	
Aplastic anemia	15 (0.27%)	18 (0.37%)	
Leukemias (ALL/ AML)	19 (0.34%)	11 (0.23%)	
Idiopathic thrombocytopenic purpura	16 (0.29%)	17 (0.35%)	
Hemophilia	3 (0.05%)	3 (0.06%)	
Henoch- Schonlein purpura	1 (0.01%)	3 (0.06%)	
6. Cardiovascular system	**94 (1.68%)**	**62 (1.28%)**	**0.089**
Acute rheumatic fever	34 (0.61%)	22 (0.45%)	
Congenital heart diseases	52 (0.93%)	35 (0.72%)	
Rheumatic heart diseases	8 (0.14%)	5 (0.10%)	
7. Infectious diseases	**98 (1.75%)**	**83 (1.71%)**	**0.885**
Malaria	8 (0.14%)	1 (0.02%)	
Kalaazar	15 (0.27%)	13 (0.26%)	
Tuberculosis	11 (0.19%)	9 (0.18%)	
Enteric fever	37 (0.66%)	39 (0.80%)	
Dermatological infections	27 (0.48%)	21 (0.43%)	
8. Nephrology	**136 (2.43%)**	**137 (2.82%)**	**0.679**
Post infectious glomerulonephritis	90 (1.61%)	88 (1.81%)	
Nephrotic syndrome	19 (0.34%)	22 (0.45%)	
Acute kidney injury	9 (0.16%)	6 (0.12%)	
Urinary tract infections	17 (0.30%)	19 (0.39%)	
Chronic kidney disease	1 (0.02%)	2 (0.04%)	
9. Toxicology	**130 (2.327%)**	**114 (2.35%)**	**0.941**
Organophosphorous poisoning	26 (0.46%)	28 (0.57%)	
Kerosene oil poisoning	47 (0.84%)	43 (0.88%)	
Dhatura poisoning	17 (0.30%)	19 (0.39%)	
Mushroom poisoning	8 (0.14%)	1 (0.02%)	
Snake bite	24 (0.43%)	11 (0.23%)	
Scorpion bite	8 (0.14%)	12 (0.25%)	
10. Accidental injuries	**49 (0.877%)**	**38 (0.783%)**	**0.597**

IUGR, intrauterine growth retardation; LRTI, lower respiratory tract infection; ALL, acute lymphoblastic leukemia; AML, acute myeloid leukemia

Citation: Shah GS, Shah SK, Thapa A, et al. In-patient mortality analysis following establishment of a separate pediatric emergency care in Eastern Nepal. *J Pediatr Neonatal Care.* 2022;12(3):151–155. DOI: 10.15406/jpnc.2022.12.00472

Table 3 Patient's outcome in pre- and post- intervention period

Outcome	Pre-intervention[a] (n=5586)	Post-intervention[b] (n=4853)	Relative risk (95%CI)	P
All admissions				
Total deaths	350(6.27%)	252 (5.19%)	0.89 (0.81-0.99)	0.019
Early death (<48 hr)	240 (4.29%)	166(3.42%)	0.88 (0.78- 0.99)	0.021
Left against medical advice + DOR	430(7.69%)	345(7.11%)	0.95 (0.88- 1.04)	0.252
All neonate admissions	(n=1994) (35.69%)	1809 (37.27%)		
Total death of Neonates	207(10.38%)	151(8.35%)	0.88 (0.77-0.99)	0.032
Early death (<48 hr)	147(7.37%)	96(5.31%)	0.82 (0.70- 0.96)	0.009
Left against medical advice + DOR	220(11.03%)	186(10.28%)	0.96 (0.86- 1.07)	0.464

a, September 2012- August 2013; b, October 2013- September 2014; DOR, discharge on request

Discussion

A significant decrease in total in-patient hospital mortality after intervention has been observed. Deaths during early period of hospitalization (within 48 hours) and in neonates also followed similar trend in post- intervention period. Decrease in mortality is due to better patients care in emergency. Since the pattern of diseases affecting different systems almost remained unchanged during pre- and post- intervention phase, therefore it can be concluded that whatever reductions in mortality were observed may be the result of a separate emergency care for sick children brought to this tertiary- care hospital. However, as such length of stay did not change. It may be because of the fact that length of stay does not depend only on the speed of recovery, but other factors also contribute like normalization of fluid, electrolyte and metabolic abnormalities, completion of duration of different drug courses and clinical stability of the patients.

Interventions in the form of allocation of observation by senior level personnel, initiation of triage and stabilization of patients and continuous clinical support, before transfer to pediatric ward or intensive care units, resulted in total and early significant relative risks of reductions in mortality (RR 0.89, P= 0.019 and RR 0.88, P=0.021, respectively). Robison et al.[8] reported almost same relative risks of reductions in both total and early mortality in their patients after establishment of pediatric emergency care interventions in their set up.

Another report from Clark et al.[9] observed a significant reduction (6.4%) in mortality. Relative risk of death in post-intervention was 0.47. The areas prioritized for emergency care up gradation were staff training, staff allocation, hospital layout, medical equipment and maintenance of hospital records. Relatively better relative risk reduction of mortality compared to ours may be attributed to their shorter duration of comparison (4 months post- intervention). As such it has been observed that inadequate patient management of children can lead to inpatient mortality to as high as 15–18%.[11,12] Therefore, improvements in the emergency care are required for reduction of mortality in children.[3]

Deaths within 48 hours, a proxy indicator for performance of emergency care services of a hospital, were also significantly decreased. This reflects that some deaths, which were earlier could not be preventable, can be reduced by provision of extra early -care only. This fact has been also emphasized by previous reports authors.[5,9] Our hospital being a tertiary care facility of level III nursery admits larger number of neonates from this region of the country. Overall deaths in neonates also showed significant decrease in post- intervention period. However, we could not identify the impact of each intervention on the neonatal outcome. The majorities of neonates had sepsis, birth asphyxia and were low birth weight, and in addition to hypothermia which is an important accompanying feature causing death. We speculate that quick transfer of neonates might have reduced the occurrence of hypothermia in these cases.

Recently, there has been better understanding of as to why large number of neonatal deaths occurs in developing nations, conceptualizing the model of three delays used earlier for exploring the deaths.[10] The model comprised of delay in deciding to seek care (delay 1), delay in reaching the health care facility (delay 2) and delay in receiving quality care immediately on arrival at the health facility (delay 3). Here we believe that our intervention might have shortened the third delay by providing immediate health care support as soon as neonates and children arrived in pediatric emergency. Therefore, such improvement in emergency care support is required in developing countries for better child survival.

The limitations of the present study are immediate training and shorter follow-up period, which could be confounding factors in reduction of mortality. However, reduction of distance from emergency block to intensive care units could not be taken as a sole factor for this reduction. Further, we could not know the outcomes of children who left against medical advice. Since the expense of treatment is from parents' side and there is limited facility of health insurance in our country, parents tend to take away their children earlier without completing the full course of therapy. At the same time, some patients who were critically sick at the time of presentation in emergency and they were unable to afford the cost of inpatient care did not opt admission in the hospital under compulsion.

Although pediatric emergency medicine has emerged as separate pediatric sub-specialty discipline in the developed world and previous reports have demonstrated positive impact in reduction of childhood mortality. However, its importance is often ignored in hospitals of the developing world. Nevertheless, development of dedicated pediatric emergency care is essentially required in developing countries for better survival of sick children reporting to regional health care facility.[13]

Conclusion

Improvement in emergency care at the initial point of patient contact can have a significant impact on reduction in childhood, including neonatal mortality.

Acknowledgments

The authors are thankful to Institute and Hospital administration for establishment of a separate Pediatric Emergency Care.

Author's contributions

GSS and SPK – involved in concept and design of study, AT and LS- collection and analysis of data, OPM-analysis of data and drafting of manuscript. All authors read and approved the final manuscript.

Funding

None.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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