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MORTALITY AFTER INPATIENT TREATMENT FOR DIARRHEA IN CHILDREN: A COHORT STUDY

[1]Dr.Samra Asif, [2]Dr.mevish Altaf 3 Dr.Tayyaba Asma

[1]Services Institute Of Medical Sciences Lahore, [2]Faislabad Medical University , Faislabad

[3]Dr.Tayyaba Asma ;Fatima Jinnah Medical University

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Abstract:

Background: *Children remaining at higher risk of death following discharge from health facilities in resource-poor conditions and settings the awareness is increasing. Diarrhoea has previously been highlighted as a risk factor for post-discharge mortality.*

Methods: *This retrospective study was undertaken to estimate the incidence and demographic, clinical, and biochemical features associated with inpatient and 1-year post-discharge mortality amongst children aged 2–59 months admitted with diarrhoea from December 2017 to 2019 in mayo Hospital lahore . The method used to identify risk factors for inpatient mortality was Log-binomial regression. From the date of discharge to the date of death the time of risk, out-migration, or 365 days later. Post-discharge mortality rate was computed per 1000 child-years of observation, and Cox proportion regression used to identify risk factors for mortality.*

Results: *Two thousand six hundred twenty-six child residents were admitted with diarrhoea, median age 13 (IQR 8–21) months, of which 415 (16%) were severely malnourished and 130 (5.0%) had a positive HIV test. 121 (4.6%) died in the hospital, and of 2505 children discharged alive, 49 (2.1%) died after discharge: that is 21.4 (95% CI 16.1–28.3) deaths per 1000 child-years. Admission with signs of both diarrhoea and severe pneumonia or severe pneumonia alone had a higher risk of both inpatient and post-discharge mortality than admission for diarrhoea alone. No significant difference was found in both inpatient and post-discharge mortality between children admitted with diarrhoea alone and those with others excluding severe pneumonia. HIV, low mid-upper arm circumference (MUAC), and bacteraemia were associated with both inpatient and post-discharge mortality. Age, stunted growth, and persistent or bloody diarrhoea were not associated with mortality before or after discharge.*

Conclusions: *The results of this study highlight the need for more research should be undertaken to improve the uptake and outcomes of services for malnutrition to elucidate causal pathways and test interventions to mitigate these risks.*

Corresponding author:

Dr. Samra Asif,

Services Institute Of Medical Sciences Lahore.

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INTRODUCTION:

Children who are admitted to the hospital, treated and cleared to discharge are at higher risk of mortality in the following period compared to healthy children [1]. Diarrhoeal disease is a common cause of paediatric admission and is reported to be associated with increased risk of post-discharge mortality in several settings in resource-poor countries [1, 2, 3]. Although sub-Saharan Africa has the highest incidence of diarrhoeal disease, few studies have examined the mortality following treatment for diarrhoea [4].

A systematic review of paediatric post-discharge mortality in resource-poor countries in 2013 identified only three studies specifically evaluating mortality following diarrhoea and all were from Bangladesh [2, 3, 5, 6]. These studies and their review identifies as a leading risk for mortality after paediatric admission reported by three [7, 8, and 9].

The Global Enteric Multicentre Study (GEMS) reported that 2.0% of children with diarrhoea died within 90 days of admission, representing a markedly increased risk of death as compared to children without diarrhoea [10]. 2/3 of these diarrhoea-associated deaths occurred more than 7 days after enrolment, and mortality was highest in children less than 2 years old.

Definitions:

Diarrhoea was defined by WHO criteria (2005): the passage of unusually loose or watery stools, at least three times in a 24-h period [15]. Persistent diarrhoea was defined as diarrhoea lasting at least 14 days. Dysentery was defined as observation of blood in stools during acute diarrhoea by parents or physicians. "Some dehydration" was defined as the presence of two or more signs from as follows: restless, irritable condition; sunken eyes; thirsty, drinks eagerly; and skin turgor: skin pinch goes back slowly. "Severe dehydration" can be considered when two of the following signs are evident in a patient: lethargic or unconscious condition, sunken eyes, drinks poorly or unable to drink, and slow skin pinch return. At least one sign of weak or absent peripheral pulse, minimized alertness, temperature gradient and cold hands, or capillary refill time more than 3 seconds was defined as shock.

Severe pneumonia was defined using the WHO syndromic criteria as cough or difficulty breathing plus either lower chest wall in drawing or inability to breastfeed/drink/vomiting everything, impaired consciousness, peripheral oxygen saturation < 90% by pulse oximetry and central cyanosis[14].

Definition of hypothermia was defined if the temperature was less than 36 °C, and fever as axillary temperature > 37.5 °C. Severe anaemia was defined as haemoglobin < 5 g/dl. An abnormal white blood cell count was defined as < 4 or > 12 × 10^9/L.

METHODS:

The study was conducted at Mayo Hospital Lahore , located in a rural area [11]. Children aged 2 to 59 months who were admitted between December 2017 to 2018, were eligible for inclusion. The death in the hospital, during the 1 year period after discharge was taken into consideration as the base of this study. Demographic, nutritional, clinical and biochemical data was obtained at the time of hospitalization.

Procedures

Tests were offered to all paediatric admissions [12]. Systematic blood culture was undertaken at the time of admission by methods that are stated in previous reports [13]. Biochemistry and blood tests were performed on children at physician discretion.

Inpatient management; children with diarrhoeal disease received rehydration as required and oral zinc for 10 days. Antibiotics were prescribed for bloody diarrhoea [14].

Statistical analysis

All clinical, anthropometric, and the biochemical parameters that were systematically measured at admission are considered as primary analysis (HIV, bacteraemia, malaria, haemoglobin, and CBC). The categorization of anthropometry was divided into groups. SAM was defined as MUAC more than 11.0 cm and less than 6 months for children, MUAC < 11.5 cm for children ≥ 6 months, or presence of edema at any age in this analysis. Moderate or acute malnutrition (MAM) was demarcated as MUAC 11.0 to 12.0 cm as well as MUAC 11.5 to 12.5 cm for children of less than 6 months old and equal or more than 6 months respectively. The score for height/length for age was calculated using the WHO growth standards of 2006 [16]. The categorization of Age in months was divided into four groups: < 6, 6–11, 12–23, and ≥ 24 months. MUAC and HAZ were used as markers of malnutrition because they are less affected by dehydration rather than weight-based indices [17].

Among the children with diarrhoea, the associations of characteristics at admission with inpatient mortality was examined using a backward stepwise log-binomial regression retaining variables with $P < 0.1$. The reported risk ratios and their respective 95% confidence intervals for variables in the final model were $P < 0.05$. A sensitivity analysis was performed to

examine admission features associated with inpatient mortality amongst children admitted with diarrhoea.

To classify the admission diagnosis, we created four groups of children, diarrhoea only (excluding children with a severe pneumonia co-morbidity), diarrhoea and severe pneumonia, severe pneumonia only (excluding children with a diarrhoea co-morbidity), and other diagnoses (without diarrhoea and without severe pneumonia), and compared the risk of both inpatient and post-discharge mortality of each group with the diarrhoea only as the reference.

Hospital discharge to 365 days was considered as the time of risk of mortality. A single discharge analysis was performed, which only considered the latest admission during the study. The Kaplan-Meier curves were plotted and used Cox-proportional regression to test associations with post-discharge mortality. The interactions were tested through comparisons interaction term both with and without using likelihood-ratio χ^2tests. Survival distributions were compared using a log-rank test. Potential risk factors for post-discharge mortality based on the previous work variables were investigated [7, 18]. We assessed the multivariable regression models' goodness of fit using Akaike information criterion (AIC) and area under receiver operating characteristic curves (AUC).

In this analysis, the missing laboratory results were classified as a separate category as they were assumed to not have been missed at random.
No formal sample size estimation was done because the data from all children admitted with diarrhoea in the study period were included in the analysis. We analysed approximately one independent variable for every 10 outcomes [19]. Statistical analyses were done using STATA 13.1 (College Station, TX, USA).

RESULTS:

Overall, 2626/17,442 (15%) of eligible admissions were admitted with diarrhoea and were residents (Fig. 1). Amongst these 2626 children admitted with diarrhoea, 2573 (98%), 53 (2.0%), and 57 (2.2%) children had acute, persistent, and bloody diarrhoea respectively. Their median age was 13 months (interquartile range (IQR) 8–21), and 1109 (42%) were female (Table 1). One hundred and thirty children (5.0%) had a positive HIV antibody test, and 415/2626 (16%) children were severely malnourished. Signs of some dehydration and severe dehydration were present in 674 (26%) and 884 (34%) children respectively. The overall median (IQR) days of hospitalization was 3 (2 to 5) amongst survivors and 2 (0 to 8) amongst those who died ($P = 0.01$.) The leading discharge diagnoses for the 2626 children admitted with diarrhoea were gastroenteritis (1568 (60%)), malnutrition (339 (13%)), and lower respiratory tract infection (274 (10%)) (Additional file 1: Table S1).

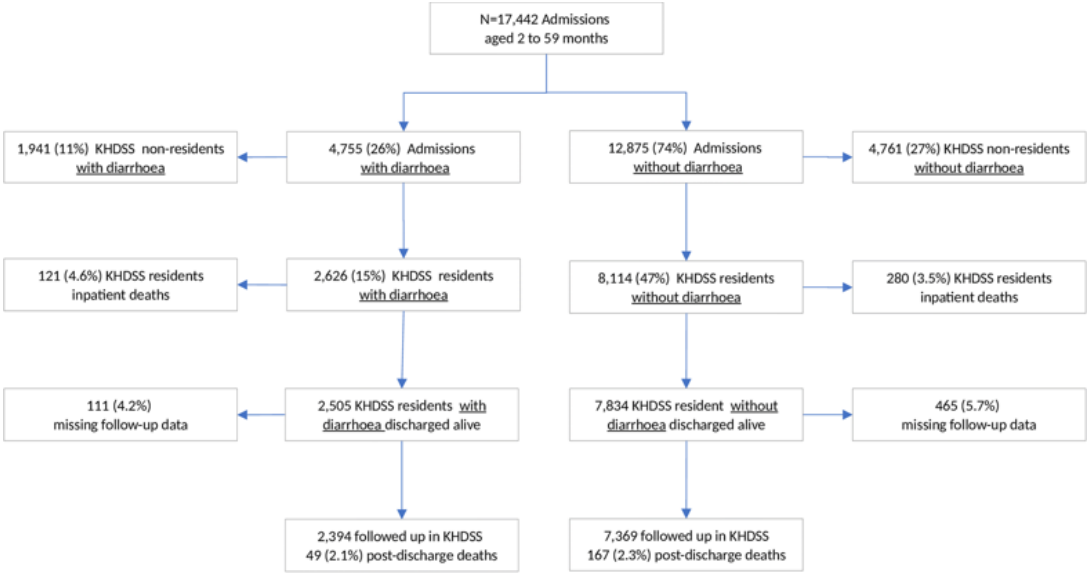

Fig. 1
Flow diagram of recruitment and follow-up

Table 1
Study participants' characteristics at admission

	All eligible admissions (*N* = 17,442)[a]	**Resident admissions with diarrhoea (*N* = 2626)**	**Resident admissions without diarrhoea (*N* = 8114)**	***P*-value**
Demographics				
Age in months, median (IQR)	18 (9–32)	13 (8–21)	22 (11–37)	< 0.001
Sex (female)	7518 (43)	1109 (42)	3545 (44)	0.19
Prior hospital admission	2782 (16)	347 (13)	1565 (19)	< 0.001
Clinical features				
Axillary temp < 36 °C	596 (3.4)	79 (3.0)	305 (3.8)	0.02
Axillary temp 36 to 37.5 °C	13,840 (79)	1154 (44)	3339 (42)	
Axillary temp > 37.5 °C	3006 (17)	1393 (53)	4470 (55)	
Tachypnea[b]	6368 (37)	768 (29)	3144 (39)	< 0.001
Tachycardia[c]	8255 (47)	1049 (40)	4171 (51)	< 0.001
Indrawing	4609 (26)	404 (15)	2362 (29)	< 0.001
Hypoxia (SaO2 < 90%)	907 (5.2)	75 (2.9)	393 (4.8)	< 0.001
Capillary refill > 2 s	604 (3.5)	152 (5.8)	143 (1.8)	< 0.001
Temperature gradient	1045 (6.0)	264 (10)	306 (3.8)	< 0.001
Weak pulse	496 (2.8)	151 (5.6)	92 (1.1)	< 0.001
Lethargy	2068 (12)	598 (23)	665 (8.2)	< 0.001
Sunken eyes	2552 (15)	1251 (48)	186 (2.3)	< 0.001
Reduced skin turgor	1540 (8.8)	733 (28)	91 (1.1)	< 0.001
No dehydration	12,074 (69)	1068 (41)	6568 (81)	< 0.001
Some dehydration	3466 (20)	674 (26)	1399 (17)	
Severe dehydration	1902 (11)	884 (34)	147 (1.8)	
Shock[d]	55 (0.3)	17 (0.7)	8 (0.1)	< 0.001
Impaired consciousness[e]	1737 (10)	178 (6.8)	763 (9.4)	< 0.001
Laboratory features				

	All eligible admissions (*N* = 17,442)[a]	**Resident admissions with diarrhoea (*N* = 2626)**	**Resident admissions without diarrhoea (*N* = 8114)**	***P*-value**
HIV antibody positive	719 (4.1)	130 (5.0)	209 (2.6)	< 0.001
Malaria slide positive	2352 (13)	110 (4.2)	1431 (18)	< 0.001
Bacteremia	634 (3.6)	88 (3.4)	282 (3.5)	0.76
Severe anemia (Hb < 5 g/dL)	1.301 (7.5)	100 (3.8)	638 (7.9)	< 0.001
Leucopenia[f](WBC < 4×10^9/L)	164 (1.0)	25 (1.0)	65 (0.8)	< 0.001
Leucocytosis (WBC > 12×10^9/L)	9265 (53)	1323 (50)	4372 (54)	
Nutritional status				
Kwashiorkor	807 (4.6)	117 (4.5)	243 (3.0)	< 0.001
MUAC (cm) ± SD	13.5 ± 1.8	13.0 ± 1.6	13.9 ± 1.7	< 0.001
HAZ ± SD	− 1.4 ± 1.7	− 1.4 ± 1.7	− 1.3 ± 1.6	0.09

SD standard deviation, *MUAC* mid-upper arm circumference. [b]Tachypnea was defined as respiration rate > 50 for children < 12 months and > 40 breaths/min for children ≥ 12 months. [c]Tachycardia was defined as heart rate > 180 for children < 12 months and > 140 beats/min for children ≥ 12 months. [d]Shock was defined as unconscious or weak pulse volume or the presence of temperature gradient or capillary refill > 3 s. [e]Impaired consciousness level if "prostrate" or "unconscious." [f]Normal white blood cell range (WBC) was 4 to 12×10^9/L.

The 8114/17,442 (47%) Resident children admitted without diarrhoea were older as compared (median (IQR) 22 (11–37) months, ($P < 0.001$)) and their clinical signs differed from children admitted with diarrhoea (Table 1).

Indoor mortality

Of the 2626 Resident admitted with diarrhoea, of which 121 (4.6%) died in the hospital and disseminations of deaths did not differ by age ($P = 0.12$) (Fig. 1) (Additional file 1: Table S2). Mortality was found to be higher in children who were admitted with both diarrhoea and severe pneumonia (age- and sex-adjusted RR 5.13 (95% CI 3.64 to 7.23, $P < 0.001$)) and severe pneumonia only (age- and sex-adjusted RR 2.26 (95% CI 1.69 to 3.04, $P < 0.001$)) but not among children admitted without diarrhoea or pneumonia (age- and sex-adjusted RR 0.78 (95% CI 0.57 to 1.07, $P = 0.12$)) compared to children admitted with diarrhoea alone.

Risk factors for inpatient mortality for children with diarrhoea

Circulatory impairment was associated with inpatient mortality, positive HIV antibody test, bacteremia, leukocytosis, and nutritional status (Table 2). No evidence of interaction between HIV status and HAZ was found ($P = 0.08$), age ($P = 0.15$), or MUAC ($P = 0.70$) on inpatient mortality. Children with missing MUAC or HAZ had very high inpatient mortality, 11/48 (23%) and 19/125 (15%) respectively, a large number of deaths occurred before they could be measured (Additional file 1: Table S3). A 36% reduction in risk of inpatient death was associated with increase in MUAC 1-cm (Table 2). However, in multivariate models, age, sex, HAZ, and prior admission to Mayo Hospital Lahore were not associated with inpatient mortality (Table 2). MUAC had similar predictive value for mortality amongst children admitted with and without diarrhoea (AUROC 0.78 (95% CI 0.72 to 0.83) and AUROC 0.76 (95% CI 0.70 to 0.81) respectively, $P = 0.76$).

Table 2:
Univariable and multivariable analyses of factors associated with inpatient death amongst children admitted with diarrhoea

	Deaths (*N* = 121)[a]	**Univariable analysis**			**Multivariable analysis**		
		Crude RR	**95% CI**	***P*value**	**Adjusted RR**	**95% CI**	***P*value**
Demographics							
Age (months)	–	1.00	0.98–1.01	0.98			
Sex (female)	61 (50)	1.39	0.98–1.97	0.06			
Prior hospital admission	23 (19)	1.54	0.99–2.39	0.05			
Clinical features							
Persistent diarrhoea	6 (5.0)	2.53	1.17–5.49	0.02			
Bloody diarrhoea	3 (2.5)	1.15	0.38–3.50	0.81			
Dehydration status							
No dehydration	22 (18)	1.0	Reference				
Some dehydration	33 (27)	2.38	1.40–4.04	0.001			
Severe dehydration	66 (55)	3.62	2.26–5.82	< 0.001			
Tachypnea[b]	62 (51)	2.58	1.82–3.66	< 0.001	1.98	1.34–2.93	0.001
Tachycardia[c]	43 (36)	0.86	0.60–1.24	0.42			
Lower chest wall indrawing	46 (38)	3.37	2.37–4.79	< 0.001			
Hypoxia (SaO2 < 90%)	25 (21)	8.86	6.09–12.89	< 0.001			
Capillary refill > 2 s	48 (40)	10.70	7.73–14.82	< 0.001	2.31	1.35–3.95	0.002
Temperature gradient	56 (46)	7.71	5.52–10.76	< 0.001			
Weak pulse	47 (39)	10.41	7.51–14.43	< 0.001			
Impaired consciousness[d]	53 (44)	10.72	7.74–14.84	< 0.001	3.29	195–5.54	< 0.001
Systematic laboratory test features							
HIV antibody positive	24 (20)	5.59	3. 65–8.58	< 0.001	2.40	1.44–3.99	0.001
Bacteremia	24 (20)	7.14	4.82–10.57	< 0.001	2.05	1.18–3.57	0.01

	Deaths (*N* = 121)[a]	Univariable analysis			Multivariable analysis		
		Crude RR	95% CI	*P*value	Adjusted RR	95% CI	*P*value
Malaria slide positive	2 (1.7)	0.43	0. 11–1.71	0.23			
Severe anaemia (Hb < 5 g/dL)	16 (13)	3.98	2.43–6.50	< 0.001			
Leucopenia[e] (WBC < 4×10^9/L)	8 (6.6)	13.93	6.98–27.78	< 0.001			
Leucocytosis (WBC > 12×10^9/L)	77 (64)	2.53	1. 62–3.95	< 0.001	2.24	1.41–3.58	0.001
Nutritional status							
Kwashiorkor	19 (16)	3.99	2.54–6.29	< 0.001			
MUAC per centimetre	–	0.61	0.59–0.64	< 0.001	0.64	0.57–0.71	< 0.001
Height-for-age zscore	–	0.65	0.59–0.73	< 0.001			
Model performance							
AUC (95% CI)					0.89 (086–0.93)		
AIC					1655.5		

The area under receiver operating characteristics AUC, AIC stands for Akaike information criterion. [a]Number of deaths and proportion of deaths. [b]Tachypnea was defined as respiration rate > 50 for children < 12 months and > 40 breaths/min for children ≥ 12 months. [c]Tachycardia was defined as heart rate > 180 for children < 12 months and > 140 beats/min for children ≥ 12 months. [d]Impaired consciousness if "prostrate" or "unconscious." [e]Normal white blood cells (WBC) were 4 to 12×10^9/L.

Mortality after discharge

Of the 2505 children admitted with diarrhoea, who were discharged alive, 2394 (96%) were followed up for 1 year post-discharge, giving 2295 child-years of observation (cyo), during which 49 (2.1%) children died (Fig. 1).The mortality rate was 21 deaths (95% CI 16–28) per 1000 cyo and did not differ across the age groups (P = 0.54) (Additional file 1: Table S2). Only 2/49 (4.1%) deaths occurred during subsequent re-admission from 49 post-discharge deaths. The first 3 months saw twenty-six (53%) deaths, during 177 cyo, 147 deaths (95% CI 100–216) per 1000 cyo. Overall, of the 170 deaths during admission and post-discharge, amongst children admitted with diarrhoea, 49 (29%) occurred after the discharge.

Children admitted with diarrhoea alone and discharged alive when compared with the hazard of post-discharge mortality was not significantly different amongst admissions without diarrhoea or severe pneumonia (age- and sex-adjusted hazard ratio 1.40 (95% CI 0.90 to 2.18), P = 0.13) (Fig. 2a, and Additional file 1: Table S5). However, admissions with both diarrhoea and severe pneumonia or severe pneumonia alone had significantly higher hazards of post-discharge mortality (age- and sex-adjusted hazard ratio 3.64 (95% CI 2.05 to 6.45), P < 0.001; 2.33 (95% CI 1.52 to 3.56), P < 0.001 respectively) compared to admissions with diarrhoea only (Fig. 2a, and Additional file 1: Table S5).

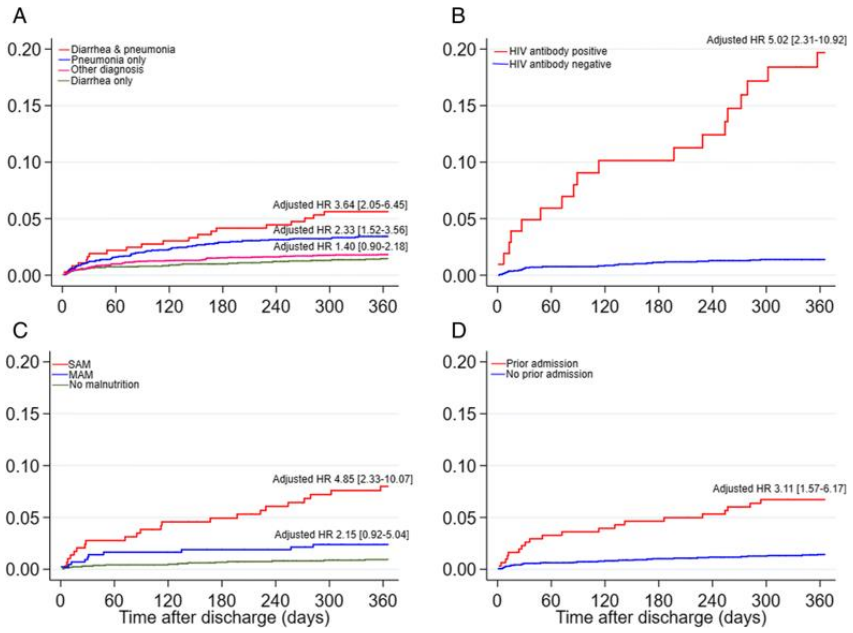

Fig. 2
Nelson-Aalen plots of cumulative hazard of post-discharge mortality by **a** admission diagnosis, **b** HIV antibody status, **c** nutrition status, and **d** prior hospital admission

Risk factors for post-discharge mortality after admission with diarrhoea

Amongst children admitted with diarrhoea, post-discharge mortality was associated with prior hospital admission, admission with lower chest wall indrawing, positive HIV antibody test, bacteremia, and nutritional status (Table 3, Fig. 2b–d, and Additional file 1: Table S6). No evidence of interaction was found between HIV status and age ($P = 0.54$), MUAC ($P = 0.12$), or HAZ ($P = 0.96$) on post-discharge mortality. No biochemical features were associated with post-discharge mortality in the secondary model.

Table 3
Univariable and multivariable analyses of factors associated with post-discharge deaths amongst children admitted with diarrhoea and residents

	Deaths ($N = 49$)[a]	**Uni-variable analysis**			**Multivariable analysis**		
		Crude HR	**95% CI**	***P*-value**	**Adjusted HR**	**95% CI**	***P*-value**
Demographic features							
Age (months)	–	1.00	0.97–1.02	0.80			
Sex (female)	22 (45)	1.12	0.64–1.96	0.70			
Prior hospital admission	20 (41)	4.71	2.66–8.32	< 0.001	3.11	1.57–6.17	0.001
Clinical features							
Persistent diarrhoea	3 (6.1)	3.51	1.11–11.13	0.03			
Bloody diarrhoea	1 (2.0)	0.90	0.12–6.46	0.92			
Dehydration status							

	Deaths (*N* = 49)[a]	**Uni-variable analysis**			**Multivariable analysis**		
		Crude HR	**95% CI**	***P*-value**	**Adjusted HR**	**95% CI**	***P*-value**
No dehydration	16 (33)	1.0	Reference				
Some dehydration	9 (18)	0.90	0.40–2.04	0.80			
Severe dehydration	24 (49)	1.92	1.02–3.61	0.04			
Tachypnea[b]	18 (37)	1.50	0.83–2.68	0.18			
Tachycardia[c]	19 (39)	0.95	0.53–1.68	0.85			
Lower chest wall indrawing	16 (33)	2.90	1.59–5.26	< 0.001	2.00	1.03–3.79	0.04
Hypoxia (SaO2 < 90%)	2 (4.1)	2.03	0.49–8.34	0.33			
Capillary refill > 2 s	6 (12)	3.16	1.35–7.43	0.008			
Temperature gradient	7 (14)	1.85	0.83–4.12	0.13			
Weak pulse	5 (10)	2.50	1.00–6.30	0.05			
Impaired consciousness[d]	6 (12)	2.75	1.17–6.45	0.02			
Systematic lab test features							
HIV antibody positive	18 (37)	13.76	7.60–24.91	< 0.001	5.02	2.31–10.92	< 0.001
Bacteremia	6 (12)	5.41	2.27–12.89	< 0.001	3.69	1.64–10.14	0.01
Malaria slide positive	3 (6.1)	1.52	0.47–4.93	0.48			
Severe anemia (Hb < 5 g/dL)	6 (12)	4.20	1.78–9.90	0.001			
Leucopenia[e] (WBC < 4×10^9/L)	1 (2.0)	4.07	0.52–32.09	0.18			
Leucocytosis (WBC > 12×10^9/L)	30 (61)	1.74	0.94–3.23	0.08			
Nutritional status							
Kwashiorkor	4 (8.2)	2.21	0.80–6.11	0.13			
MUAC per centimetre		0.55	0.47–0.64	< 0.001	0.67	0.56–0.81	< 0.001
Height-for-age zscore		0.62	0.52–0.73	< 0.001			
Model performance							
AUC (95% CI)					0.87 (0.81–0.94)		
AIC					637.9		

DISCUSSION:

Amongst resident children admitted to the hospital with diarrhoea alone, the risk of inpatient and post-discharge mortality was not significantly different from those with other diagnoses excluding severe pneumonia. Diarrhoea with concomitant severe pneumonia was associated with increased inpatient mortality and post-discharge mortality compared to admission with diarrhoea alone. As previously reported in the literature, we found hyperglycaemia which is a stress response common in critically ill children to be a risk factor for increased mortality during admission [20]. In contrast, the main features associated with post-discharge mortality amongst children with diarrhoea were prior hospital admission, lower chest wall indrawing, bacteraemia, HIV status, and undernutrition, despite the availability of follow-up care services for the latter two.

The proportion of paediatric admissions with diarrhoea in our study (15%) was lower than that amongst Tanzanian (27%) children, and the proportion with diarrhoea with dehydration amongst Kenyan children at 13 hospitals was ~ 33% [21, 22]. Mortality of 4.6% is similar to Tanzania (4.6%) and lower if compared in rural western Kenya (9%), Calcutta (14%), or Haiti (13%) [21, 23, 24, 25].

The 2.1% 1-year post-discharge mortality in this study is lower than the range of three studies in Bangladesh (2.8 to 7.5%), despite their follow-up being shorter (4 and 3 months respectively) [2, 3, 5]. Reduction in malaria transmission, introduction of Hib (*Haemophilus influenzae* type B) and pneumococcal vaccines, and the changing landscape of diarrhoeal disease since the introduction of a rotavirus vaccine is considered to be reduction in global child mortality [26, 27].

Age was not considered a risk factor for either inpatient or post-discharge mortality amongst children admitted with diarrhoea [18, 28]. Returning to the hospital could be a marker of incompletely treated severe illness or ongoing vulnerability and this finding is reported in the previous studies as well, undernutrition is considered as the main feature associated with both inpatient and post-discharge mortality [18]. Improving retention include treatment on smaller clinics that are not centralized [29].

Strengths of our study were the systematic collection of detailed data at hospital admission and large number of children followed up for more than 1 year after the hospital discharge. The limits in the analysis was the reducing number of independent variables. A backward stepwise method of analysis was used to find out and eliminate those variables that were not significant. The multivariable model which predicted the mortality required external authentication to test the generalizability, post-discharge. One more limitation is that it the source is a single hospital also the exclusion of data regarding the underlying pathogens related to diarrhoea. We did not analyse birthweight and gestational age as risk factors because many deliveries occurred at home and accurate data was not available. The exclusion of biochemical features introduced bias and so these factors could only be included in a secondary analysis.

The reduction of excess mortality after discharge should focus on improving methods of identification of early warning indicators, targeting care to the highest risk children, access to treatment, improving retention and outcomes of malnutrition. The CHAIN network cohort study is currently examining specifically biomedical and social mechanisms involving post-discharge mortality [30].

CONCLUSIONS:

We observed no difference in inpatient and post-discharge mortality between diarrhoea and other diagnoses excluding severe pneumonia. The post-discharge mortality in this analysis was not associated with most clinical signs of severity, but children with a history of previous hospital admission. The previous admissions include concurrent lower chest wall indrawing, SAM and bacteraemia to prevent excess deaths. The people responsible for healthcare should be made aware of post-discharge mortality and the risk factors related to advise parents to seeking help as soon as possible in case of any further problem. Vulnerable children should be facilitated through post-discharge follow-up and care.

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