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ORIGINAL ARTICLE

Triage conducted by lay-staff and emergency training reduces paediatric mortality in the emergency department of a rural hospital in Northern Mozambique

Johanna Dekker-Boersema[a,*], Jonas Hector[b], Laura Frances Jefferys[b], Clemência Binamo[c], Deavis Camilo[c], Gerard Muganga[c], Mussa Manuel Aly[d], Ernesto Belario Rafael Langa[e], Penelope Vounatsou[f], Michael André Hobbins[g]

[a] Wooijstraat 2, 5373 LB, the Netherlands
[b] SolidarMed, Pemba, Mozambique
[c] District Health Directorate, Chiure, Cabo Delgado, Mozambique
[d] Operational Research Unit Pemba, Pemba, Cabo Delgado, Mozambique
[e] Provincial Health Directorate, Cabo Delgado, Pemba, Mozambique
[f] Swiss Tropical and Public Health institute, Basel, Switzerland
[g] SolidarMed, Lucerne, Switzerland

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ABSTRACT

Introduction: The majority of emergency paediatric death in African countries occur within the first 24 h of admission. A coloured triage system is widely implemented in high-income countries and the emergency triage and assessment treatment (ETAT) is recommended by the World Health Organization, but not put into practice in Mozambique. We implemented a three-colour triage system in a rural district hospital with lay-staff workers conducting the first triage.

Methods: A retrospective, before and after, mortality analysis was performed using routine patient files from the district hospital between 2014 and 2017. The triage system was implemented in August 2016. Inclusion criteria were children under 15 years of age that entered the emergency centre. Primary outcome was child mortality rate. Secondary outcomes included the percentage agreement between the clinical and non-clinical staff and the duration from triage to first treatment. We used a negative binomial model in STATA 15 to compare mortality rates, and Kappa statistics to estimate the agreement between clinical and non-clinical staff.

Results: 4176 admissions were included. The mortality rate ratio (MMR) was 45% lower after the start of the intervention (2016; MRR = 0.55; 0.38, 0.81; p = 0.002), compared to before. To estimate the agreement between non-clinical and clinical staff, 548 (of the 671) patient files were included. The agreement was estimated at 88.7% (Kappa = 0.644; p < 0.001). The median waiting time decreased with urgency of the triage: 2 h33 for 'green'/least serious (IQR 1 h58-3 h30), 21 min for yellow/serious (IQR 0 h10-0 h58) and nine minutes for 'red'/urgent (IQR 2–40 min).

Conclusion: In a rural setting with nurse-led clinical care and non-clinician staff working at the triage reception, implementation of a three-coloured triage system was feasible. Triage and ETAT training was associated with a decrease of 45% of paediatric deaths. The impact on mortality, low cost, and ease of the implementation supports scaling this intervention in similar settings.

Introduction

Despite substantial global progress since 1990, UNICEF reported in 2015 that 5.9 million children under five years old die worldwide each year, representing a rate of 43 deaths per 1000 live births [1]. The majority of these children still die of preventable or treatable diseases such as lower respiratory tract infections, malaria, diarrhoeal disease, and nutritional deficiencies (after the perinatal period) [2,3]. The mere improvement of the access to and quality of health care has been estimated to reduce this burden by 60% [4–6].

* Corresponding author.
E-mail address: JHDekker.work@gmail.com (J. Dekker-Boersema).

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Besides the long waiting times in the hospitals, caregivers do not always understand where to go if their child is severely unwell, and some caregivers are forced to negotiate in order to gain quicker access to health care [4]. Most deaths in hospitals in resource poor settings occur within 24 h of admission; therefore, it is important that severely ill infants and children are recognised in a timely manner and receive appropriate emergency care in the first hours of their admission [8–11]. Recognition of severely unwell children by triage can be done in 15–20 s by medical staff or by non-medical staff, as soon as the child arrives and without the need for special equipment [10]. In recent years, various triage systems have been developed, specifically tailored to low resource settings [12–14].

In Mozambique, a country with a human development index ranking of 180 [7], child mortality was 79 deaths per 1000 live births in 2015 [1]. In rural Mozambique, it is not common to use a triage system to screen patients at the entry of a hospital; furthermore, the population is not empowered to express their concerns about their child to the health workers, even when a child is very unwell [15].

Quality of health care relies on health care providers. In Mozambique, as in many other resource poor settings, there is a shortage of health staff [16]. The minimum internationally acceptable health worker density (e.g., doctors, nurses and midwifes to population) is 230/100,000 [17]. In the rural district of Chiure, situated in the northern province of Cabo Delgado, this density was 67/100,000 in 2015 [18]. With such a shortage of human resources it is, of course, a challenge to implement a triage system [16]. There is limited literature about the implementation of a coloured triage system in a low-resource setting using non-medical staff for the triage [13,14].

On the basis of an in-depth analysis of the district paediatric patient records in 2015 in the Chiure District Hospital, where this study is set, the child mortality was 53 per 1000 children admitted at the paediatric ward in 2015 (excluding the newborns) of which 75% died in the first 24 h [18]. This article describes the effect of implementing a simple coloured triage system conducted by lay-staff on intra-hospital mortality, combined with an intensive training for the health staff of the emergency centre (EC) in Emergency Triage and Assessment Treatment (ETAT) as recommended by the World Health Organization (WHO) [10,14].

Methods

Chiure District Hospital (CDH) is a governmental hospital situated in the rural district of Chiure in the northern province of Cabo Delgado, Mozambique. The district has four medical doctors for roughly 300,000 inhabitants. CDH is a referral hospital for the eleven primary health care centres in the district. This hospital refers special cases to the provincial hospital, which is a two-hour drive away. In 2015, the hospital had 125 inpatient beds divided across five wards, with 38 beds on the paediatric ward. There was a basic intensive care unit, one oxygen concentrator, five oxygen bottles, and a surgical theatre with a focus on obstetrics. In the outpatient clinic, they attended on average 110 children per day (from 7 AM to 3 PM) and at the EC, around 50 children are seen per day, mainly after 3 PM. The EC was staffed with one technical nurse and three basic nurses during the day and two basic nurses for the evening and night. The medical doctors in the hospital were on call for advice, but were not based in the EC. The EC consists of a consultation room, a treatment room and an observation room with six beds [19]. No formal triage system was in place and every patient that arrived at the EC waited in line before being attended.

Based on an in-depth assessment, following the discussion of the high mortality in the EC with local health authorities, the NGO SolidarMed agreed to assist in the following areas with specific interventions:

1. Medical equipment - in the first trimester of 2016

The emergency centre was equipped (by mid-2016) with an oxygen concentrator, a pulse oximeter, a glucometer and new resuscitations masks. A plan and checklist were established with the head of the emergency centre to check/maintain emergency material and medication more regularly, to ensure equipment and medication availability in emergency situations.

2. Training and knowledge - the first and second trimester of 2016

Bedside teaching by the medical doctors was conducted for the clinical staff of the EC from the beginning of 2016. A three-day emergency triage and treatment course (ETAT) for the health staff of the EC was given in the second trimester. The ETAT guidelines involve the triage of patients according to emergency and priority signs using an A-B-C-D concept (Airway, Breathing, Circulation/Coma/Convulsion, Dehydration), and rely on clinical discriminators rather than physiologic parameters to stratify sick children [10,14]. Monthly refreshment trainings were provided to continually improve the clinical staff's paediatric emergency skills.

3. Reducing waiting time of severely sick children by implementing a three-coloured triage system in the second trimester of 2016.

A reception was installed at the EC and manned with four non-clinical receptionists, who were trained to conduct the coloured triage system. Fig. 1 and Table 1 show the triage algorithm used and the emergency (red colour) and priority symptoms (yellow colour) according WHO ETAT structure [14]. The green colour was given to the children without emergency or priority symptoms. The receptionists were given a two-day triage training, followed by 30 days (June 2016) of on-the-job training, given by the medical doctors from the clinical wards. After this, the receptionists started working at the reception, where they were supervised for one month by a clinician of the research team. Information about the new triage system was provided to the community and the parents before and during the implementation through signs and verbal communication in front of the hospital/at the reception and through the local radio station. Colour arrows were marked on the walls and doors of the EC to improve patient flow (linked to the triage system).

The non-clinical receptionists were instructed to consult a clinician if they were in doubt about the appropriate triage colour. Furthermore, the clinicians were instructed to check the colour given by the receptionists, and to change the colour whenever needed and give feedback to the receptionist. During this process nothing changed in the admission policy. A child was admitted to the paediatric ward from the EC

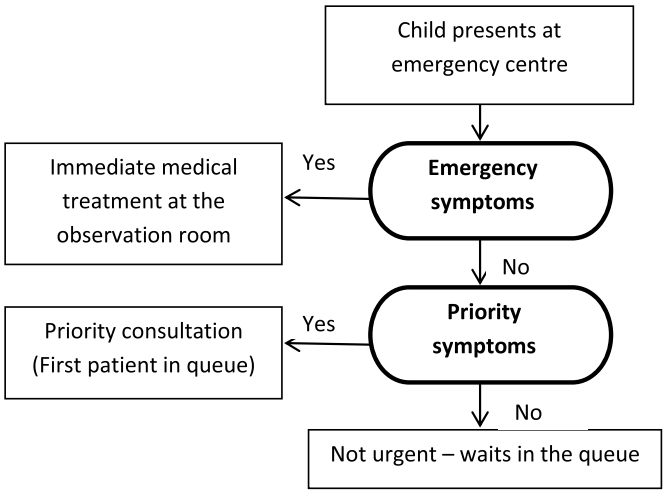

Fig. 1. Triage algorithm.

Table 1
Emergency and priority symptoms according to WHO ETAT [14].

Emergency symptoms	Priority symptoms
Airway and breathing	Tiny baby (< 2 months)
	Temperature very high
• Obstructed or absent breathing	Trauma
• Severe respiratory distress	Pallor
• Central cyanosis	
Circulation (cold hands with)	Poisoning
	Pain
• Capillary refill < 3 s	Respiratory distress
• Weak and fast pulse	
Coma	Restless
Convulsions (now)	Referral (urgent)
Severe dehydration (Diarrhoea and 2 of these)	Malnutrition (visible severe wasting)
	Oedema of both feet
• Lethargy	Burns (major)
• Sunken eyes	
• Very low skin pinch	

when he or she was stable and no further emergency treatment was needed.

The primary outcome was the change in child mortality rate in the EC. The mortality rate was calculated as the number of deaths per children admitted to the paediatric ward within a six-month period over the total number of children admitted within the same timeframe. The mortality rate ratio was expressed as the ratio between the mortality rates before and after the intervention. For the primary outcome, we selected children aged from 28 days to 14 years and 11 months that had been observed at the emergency observation room and that were then admitted at the paediatric ward or the children that died at the EC, from January 2014 until December 2016. Children that died on the paediatric ward after 24 h of admission were excluded, as we considered the death uninfluenced by the triage system or the acute care in the EC. Paediatric medical records and registration books were analysed, and all deaths were recorded following the routine process. We used a negative binomial model in STATA 15 to compare child mortality rates between the intervention year (2016) and the years before (2014 and 2015).

The first secondary outcome was the percentage agreement between the non-clinical receptionists and health professionals regarding the categorisation of the patients into “green”, “yellow” or “red”. The data for the secondary outcomes were recorded from the triage forms, medical files and the reception registration book. All patient files of children who attended the emergency room between 01-08-2016 and 31-01-2017 were included in the analysis. Children that presented during the night were excluded, as the triage system had not been implemented 24 h a day due to staffing constraints. Uncompleted patient files (i.e. no medication form or hours filled in about treatment/admission), or patient files without study triage form were also excluded from further analysis. Kappa Statistics were used to estimate the level of agreement between the lay-staff and clinicians. The null hypothesis was that there is no agreement between the two and allocation of categories to patients occurred by chance.

Waiting time was assessed as an independent descriptive outcome assessing the clinical reaction time resulting from the triage of the patient according to their symptoms. Descriptive analysis using medians with interquartile ranges (IQR) were used to summarise the waiting times by their allocated colour category.

Uptake and performance of newly trained skills by the health staff were recorded with proxy-indicators such as the use of intra-osseous needle and successful resuscitation.

Ethical clearance was obtained from the national Mozambican bioethics committee (reference number 505) and permission for data gathering and collaboration was granted by the hospital.

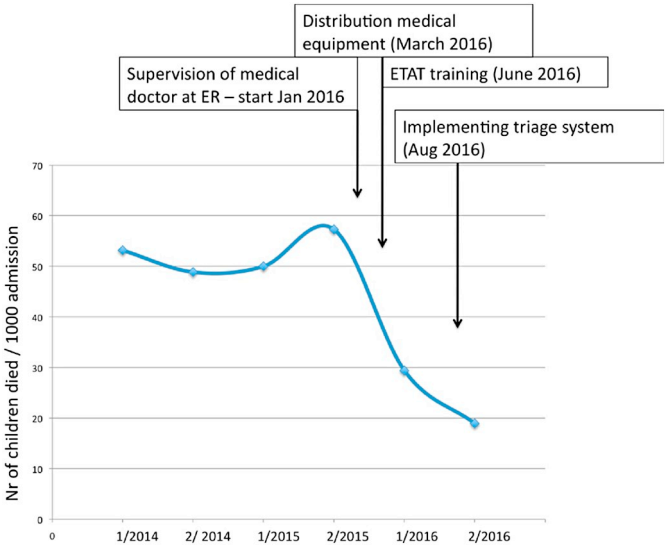

Fig. 2. Mortality rate per semester (number of deaths/1000 admissions) in the years 2014, 2015 and 2016.

Results

The number of children admitted to the paediatric ward was 1223, 1428 and 1525 in the years 2014, 2015 and 2016, respectively. The number of registered paediatric deaths in the same timeframe was 64, 76 and 44, respectively.

The paediatric mortality rate ratio was not significantly different between the years 2014 and 2015, but the mortality rate dropped in 2016 (Fig. 2). According to the regression model, the mortality rate ratio was 45% lower in the intervention year (2016; MRR = 0.55; CI: 0.38, 0.81; p = 0.002), compared to the year 2014, while no significant difference was detected between the years 2015 and 2014 (MRR = 1.01; CI: 0.73, 1.42; p = 0.921) (Table 2).

Further analysis between the different semesters of the last three years (Fig. 2) shows a decrease in child mortality between the second semester of 2015 (no interventions in place) and the second semester of 2016 (all interventions in place) of 56/1000 to 19/1000 (p < 0.001). The figure shows that the decrease in mortality started in 2016 after the initial ETAT training and it continued to decline after implementing the triage system.

Further analysis of the mortality within the cohort doesn't show any significant differences between age distribution: median age in 2014 was 1.75 years, in 2015 2.0 years and in 2016 1.25 years. The majority of children were diagnosed with malaria: 67% in 2014, 64% in 2015 and 65% in 2016. The second most common diagnosis was pneumonia: 23% in 2014, 27% in 2015 and 30% in 2016. Around 20% (18%–23%) of the children died within the first two hours of admission to the EC, and comparing the years 2014–2016; there was no significant difference.

Over the six-month period after the implementation of the triage system, 11,959 children were attended at the EC, 10,919 children were

Table 2
Output of the negative binomial model to compare mortality rates between years.

	MRR	95% CI	P-Value
2014	1		
2015	1.02	0.73, 1.42	0.921
2016	0.55	0.38, 0.81	0.002
Constant	0.05	0.04, 0.07	

MRR, mortality rate ratio; CI, confidence interval.

Table 3
Overview of the given (by the receptionist and clinician) triage colour (n = 548).

		Clinician			
		Green	Yellow	Red	Total
Receptionist	Green	11	19	0	30
	Yellow	1	414	31	446
	Red	0	11	61	72
	Total	12	444	92	548

triaged with a green colour (91%), 960 (8%) a yellow colour, and 80 (1%) a red colour. None of the children in the green category died, ten children triaged as yellow (1%) and ten children triaged as red died (12.5%) in the emergency observation room.

The mortality rate at the paediatric in-patient ward showed a decrease from 26/1000 admission in 2014 and 21/1000 in 2015 to 14/1000 admission in 2016.

To describe the waiting times and reliability of the categorisation of the children, we looked at children that were admitted from the observation room to the paediatric ward during the study period (705 children). Of these, 647 patient files were included in the analysis. In addition, the 24 patient files of the children that died at the emergency centre were considered, resulting in 671 patient files that were analysed for the secondary outcomes. The patient files of the children that died were archived in special boxes and therefore they were in better condition and all 24 patient files could be used for further analysis.

To estimate the agreement between non-clinical and clinical staff at the EC, 548 patient files were included in the analysis that had a triage colour allocated by both receptionist and clinician (Table 3). The Kappa statistics calculated an agreement of 88.7% (Kappa = 0.644; $p < 0.001$). The null hypothesis that the clinicians and non-clinicians were making their ratings randomly, which would have coincided in 63.8% of the cases, was therefore rejected.

The median waiting time decreased with the urgency of the triage: 2 h33 for 'green' (IQR 1 h58-3 h30), 21 min for yellow (IQR 0 h10-0 h58) and nine minutes for 'red' (IQR 2–41 min). For the children that died, the median waiting time was 15 min (IQR 9–40 min).

Four children who subsequently died were triaged by the receptionist as yellow, however, the clinician considered one of the children to be emergency (red). Three of these children were treated within 15 min, however, one child had a delay of 40 min.

For the observations of skills conducted by the health staff, intra-osseous needle for intra-venous access and cardio-pulmonary resuscitation (CPR) were selected as proxy-indicators of the use of newly learned skills after the ETAT. Intra-osseous needle was used in five children during the study phase; five children were resuscitated after cardiac or pulmonary arrest, with success. Two of them died in the following 72 h, however, the three remaining children survived and were discharged from the hospital. According to the patient files, no children were resuscitated after cardiac or pulmonary arrest with success prior to the intervention phase.

Discussion

This observational, before and after study found that child mortality decreased by 45% in the EC after the paediatric emergency care training of clinical staff and the implementation of a coloured triage system conducted by lay-staff, in a rural district hospital. Comparable results were also reported from Malawi and Sierra Leone, with mortality reduction from 47/1000 to 37/1000 and 124/1000 to 59/1000, respectively [20–22]. While these study interventions also combined training with provision of medical equipment and improved patient flow, our study appears to be the first to verify the responsiveness of the system to the new protocols by measuring the waiting times, and it explores the possibility of using lay-staff workers as receptionists instead of clinical staff.

As would be expected, the waiting times recorded in this study decreased with the urgency of the cases, indicating that the clinical staff was responsive to the new triage system. While the numerical value of the waiting time should be interpreted with caution due to reporting errors, the marked difference of the median waiting times between the colour-categories represents a strong indication that the implemented system triggered clinical responses.

Our study further indicates that the training of lay-staff as receptionists in EC triage is a valid alternative to clinical staff, given that the agreement between raters was very high at > 88%. Nevertheless, continuous training and supervision of such staff is needed to maintain knowledge and increase experience. A recent study in South Africa showed similar results; namely, that a first screening conducted by a lay-worker could reduce the waiting time for a critically-ill child by tenfold [23]. Furthermore, the EC must foster an atmosphere where second opinions (from clinicians) are available when needed and/or wished for. From a practical side, the receptionists were trained to rather "over-classify" than "under-classify", to avoid missing serious cases. The coloured triage system with non-clinicians as receptionists can increase the efficiency of clinical staff and reduce waiting times for severely sick patients which results in improved emergency care, especially where human resources are limited.

In this study, the ETAT training in combination with the distribution to health staff of the WHO pocket handbook appeared to have had an important positive effect on the skills and knowledge demonstrated by the health staff. The increased use of intra-osseous needles for intravenous access and increased frequency of successfully resuscitated children via CPR are indicative of such positive effects. In addition, continuous refreshment trainings were important to maintain knowledge and skills at the EC in such a setting, where staffing changes occur regularly. Other studies confirm this observation and showed that the ETAT training is an important tool to improve paediatric emergency care [25,26].

This study is an observational, before and after study, at a hospital in rural Northern Mozambique and comes with known limitations. We cannot fully exclude possible, yet unknown, confounding factors or biases that may have occurred at the same time as the intervention and which may have impacted child mortality at the EC of the hospital. The comparison of context indicators of the district over time, however, did not insinuate the existence of such bias. Furthermore, we compared the same months over the different years to account for known seasonal differences. There was no mortality shift from the EC to the in-patient ward because both mortality rates reduced over the same period.

The high agreement between non-clinical staff and clinicians may be overestimated due to the un-blinded approach of the evaluation. We therefore cannot exclude the possibility of the clinician being influenced by the non-clinicians' rating. The study was purposefully implemented in a real-life setting, where the implementation of the intervention was performed jointly with partners and blinding was not appropriate. Furthermore, the clinicians were highly critical of the non-clinicians' rating, which could also bias the evaluation towards reducing the agreement between the two raters.

The data used for this study were based on hospital registries. While all efforts were taken to check and improve the quality of the records, we cannot exclude reporting bias of child death at the EC, despite independent clinical observers from the study team confirming the positive effect of the intervention. The poorly organised patient filing system and the fragile patient registry led to a reduction in sample size which in turn could have biased the results of this study. However, due to the presence of the study team, regular checks of the patient files and the support given, the patient registry is thought to have improved compared to pre-intervention times, which would result in an underestimation of the real effect.

Overall, the results suggest that the introduction of a simplified

triage system in a Northern Mozambican rural district hospital, which is managed by non-clinical and clinical staff after repeated ETAT trainings can reduce child mortality significantly and can reduce waiting times for critically-ill children. Furthermore, and importantly, the study highlights the feasibility of involving non-clinical staff in the process, which is especially valuable in areas deprived of human resources for health.

The study adds to the scarce literature about the about paediatric emergency care and triage systems in resource-limited settings, and suggests that this simple and cheap intervention may have an important potential to reduce child mortality through improving efficacy and efficiency of emergency care in the hospital setting [24,27]. More evidence is needed to estimate the impact of such an intervention on a larger scale. The research team left after two years. It would be interesting to evaluate the mortality rate after this period. After sharing the results of this study with local government, the intervention has been taken up by the provincial government and was implemented in other hospitals in the province from 2018 onwards.

Conclusion

In a rural setting with nurse led clinical care and non-clinician staff providing the initial triage, implementation of a three-coloured triage system was feasible. Triage and ETAT training was associated with a significant decrease of paediatric deaths in the emergency centre. Such an impact combined with the low cost and ease of implementation makes this intervention highly recommended for scale in similar settings.

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Dissemination of results

Results from this study were shared with staff members at Chiure District Hospital, with the provincial health authorities and on a national level during a scientific symposium.

Authors' contributions

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: JDB contributed 40%; MAH contributed 25%, JH and LFJ contributed 10% each, PV and CB contributed 5% each, DC contributed 2%, and GM, MMA and EBL contributed 1% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declare no conflicts of interest.

References

1. Unicef. Levels and trends in child mortality, report 2015. https://www.unicef.org/publications/files/Child_Mortality_Report_2015_Web_8_Sept_15.pdf, Accessed date: 15 May 2017.
2. Bhutta ZA, Black RE. Global maternal, newborn, and child health – so near and yet so far. N Engl J Med 2013;369(23):2226–35. https://doi.org/10.1056/NEJMra1111853.
3. GBD 2013 Mortality and Causes of Death Collaborators. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the global burden of disease study 2013. Lancet 2015;385(9963):117–71. https://doi.org/10.1016/S0140-6736(14)61682-2.
4. Jones CHD, Ward A, Hodkinson PW. Caregivers experiences of pathways to care for seriously ill children in cape town, South Africa: a qualitative investigation. PLoS One 2016;11(3):e0151606.
5. Turner EL, Nielsen KR, Jamal SM, Andre von Saint, Mussa NL. Review of pediatric critical care in resource-limited settings: a look at past, present, and future directions. Front pediatric 2016 Feb 18;4:5. https://doi.org/10.3389/fped.2016.00005. [eCollection 2016].
6. Molyneux E, Ahmad S, Robertson A. Improved triage and emergency care for children reduces inpatient mortality in a resource-constrained setting. Bull World Health Organ 2006;84(4):314–9. https://doi.org/10.2471/BLT.04.01950.
7. United nations Development programme. Human developments reports Mozambique. http://hdr.undp.org/en/countries/profiles/MOZ, Accessed date: 15 May 2017.
8. Baker T. Pediatric emergency and critical care in low-income countries. Paediatr Anaesth 2009;19(1):23–7. https://doi.org/10.1111/j.1460-9592.2008.02868.x. 12 February 2016|Volume 4|Article 5.
9. Campbell H, Duke T, Weber M, English M, Carai S, Tamburlini G. Pediatric Hospital Improvement Group Global initiatives for improving hospital care for children: state of the art and future prospects. Pediatrics 2008;121(4) Available at www.pediatrics.org/cgi/content/full/121/4/e984pmid:18381526.
10. WHO. Duke et al. New WHO guidelines on emergency triage assessment and treatment. Lancet. 2016 Feb 20; 387 (10020): 721–4. Doi:https://doi.org/10.1016/S0140-6736(16)00148-3.
11. Manchester triage system. www.triagenet.net, Accessed date: 22 January 2018.
12. Hansoti B, Hodkinson P, Wallis L. Prioritizing the care of critically ill children in south África: how does SCREEN perform against other triage tools? Pediatr Emerg Care 2017. https://doi.org/10.1097/PEC.0000000000001107. Mar 21.
13. Hansoti B, Jenson A, Keefe D, et al. Reliability and validity of pediatric triage tools evaluated in low resrouce settings: a systematic review. BMC pediatric 2017;17(37). https://doi.org/10.1186/s12887-017-0796-x. Published online 2017 Jan 26.
14. WHO. Emergency triage assessment and treatment course (ETAT). Facilitator guide. 2005. Acessado no dia 10 de Maio 2016 Available at http://www.who.int/maternal_child_adolescent/documents/9241546875/en/, Accessed date: 13 June 2017.
15. Wagenaar BH, Gimbel S, Hoek R. Waiting and consult time for health care services in central Mozambique: a time-motion study. Glob Health Action 2016;9. https://doi.org/10.3402/gha.v9.31980.
16. WHO. Mozambique country health profile. http://www.afro.who.int/en/mozambique/country-programmes/health-systems.html; 2013, Accessed date: 5 May 2016.
17. WHO. A universal truth: no health without a workforce. Geneva: WHO; 2013http://www.who.int/workforcealliance/knowledge/resources/GHWAa_universal_truth_report.pdf, Accessed date: 10 June 2016.
18. Boersema JH. Annual report of the child health malaria project in Chiure district 2015. Solidarmed Moçambique e Suíça. Jan 2016 [Available on request].
19. Moçambique. Relatório anual de 2015 de serviço distrital de Saude, Mulher e acção social de Chiure. Núcleo estatísticos distrital de Chiure; 2015.
20. Clark M, Spry E, Daoh K, et al. Reductions in inpatient mortality following interventions to improve emergency hospital care in Freetown, Sierra Leone. Plos one 2012;7(9):e41458https://doi.org/10.1371/journal.pone.0041458. Epub 2012 Sep 19.
21. Robison JA, Ahmad ZP, Nosek CA, et al. Decreased pediatric hospital mortality after an intervention to improve emergency care in Lilongwe, Malawi. Pediatrics 2012 Sep;130(3):e676–82. https://doi.org/10.1542/peds.2012-0026. Epub 2012 Aug 13.
22. Dalwai MK, Tayler-Smith K, Trelles M, et al. Implementation of a triage score system in an emergency room in Timergara. Pakistan Public Health action 2013;3(1):43–5. https://doi.org/10.5588/pha.12.0083. Mar 21.
23. Hansoti B, Jenson A, Kironji AG et al. SCREEN: a simple layperson administered screening algorithm in low resource international settings significantly reduces waiting time for critically ill chidren in primary healthcare clinics. PLoS One. 2017 Aug 29; 12(8): e0183520. doi:https://doi.org/10.1371/journal.pone.0183520. eCollection 2017.
24. Molyneux EM. Paediatric emergency care in resource-constrained health services is usually neglected: time for change. Ann Trop Paediatr 2010;30(3):165–76. [20828449].
25. Irimu G, Wamae A, Wassuma A, Were F, Ntoburi S, Opiyo N, et al. Developing and introducing evidence based clinical practice guidelines for serious illness in Kenya. Arch Dis Child 2008;93:799–804. https://doi.org/10.1136/adc.2007.126508.
26. Grouse HL, Torres F, Vaides H, et al. Impact of an emergency triage assessment and treatment (ETAT) - based triage process in the pediatric emergency department of a Guatemalan public hospital. Paediatr Int Child Health 2016 Aug;36(3):219–24. https://doi.org/10.1179/2046905515Y.0000000026.
27. Molyneux E. Emergency care for children in resource-constrained countries. Trans R Soc Trop Med Hyg 2009;103(1):11–5. pmid:18768191.