Nurse-led implementation of ETAT+ is associated with reduced mortality in a children's hospital in Freetown, Sierra Leone

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Abstract

Background

In the wake of the Ebola virus disease (EVD) epidemic in Sierra Leone, secondary care facilities faced an increase in admissions with few members of medical staff available to assess and treat patients. This led to long waiting times in hospital outpatient departments. The work described in this study took place in the outpatient department of Ola During Children's Hospital (the tertiary paediatric hospital for Sierra Leone) in the period immediately following the Ebola virus epidemic of 2014-2015.

Aims

This retrospective analysis of operational programme data aimed to assess whether task-sharing of emergency care with nursing staff improved the quality of triage and the timeliness of care. All staff working in the outpatient department were offered a four-week training course, followed by on-the-job supervision and support for six months. Nurses who successfully completed the course were given responsibility for making the initial assessment of sick patients and prescribing and giving initial treatments. Data was collected at three points: before intervention, and at three and six months following the initiation of the intervention. All children presenting to the hospital for medical attention between 0800 and 1400 Monday to Friday were included. The triage assessment of the outpatient nurse was compared to the assessment of a clinically-experienced observer, and the time taken for each child to be triaged, assessed, and to receive initial treatment was recorded.

Results

Between 0 and 6 months of the intervention, the detection of emergency signs by the triage nurse improved from 30% to 100%, and detection of priority signs improved from 34% to 100%. For children presenting with emergency signs, the median time taken between triage and full assessment improved from 57 minutes before intervention, to 17 minutes at 3 months, and 5 minutes at 6 months ($p<0.0005$). For the same group, the median time taken between triage and their first antibiotic or antimalarial treatment improved from 220 minutes before intervention, to 40 minutes at 3 months, and 18 minutes at 6 months ($p=0.006$).

Conclusion

These results suggest that with appropriate training and support, extending the emergency assessment and treatment of sick children in West African hospitals to nursing staff may improve the accuracy of triage and the time to assessment and treatment for children presenting with signs of serious illness.

Introduction

In 2014 and 2015, Sierra Leone, along with its neighbors Guinea and Liberia, experienced an outbreak of Ebola virus disease (EVD) that quickly became an epidemic. Despite some initial challenges, a large relief effort eventually supported the three countries to manage the epidemic and bring it under control.[1] In the wake of the epidemic, the quality of the care delivered in Sierra Leonean hospital facilities was substantially weakened, along with a sharp decline in public confidence and uptake of services.[2] Clinical staff were wary of physical contact with patients and clinical triage procedures were replaced by screening for symptoms of EVD. These new barriers to delivering care were added to existing inadequacies, related to long-term under-investment and the effects of a decade of civil conflict. These included: a shortage of qualified medical personnel; a lack of key equipment, medications, and consumables; and a lack of robust and implementable processes for infection prevention and control.[3] In rebuilding the healthcare system to meet the needs of acutely unwell patients, it was a priority for the sickest patients attending the country's hospitals to be promptly identified and appropriately treated.

The WHO-approved Emergency Triage Assessment and Treatment (ETAT) guidelines and training materials provide a framework for health workers in low-resource settings quickly to become competent in assessing for signs of serious illness in infants and children, and to provide prompt treatment for deranged physiology using a symptom-based approach (see Figure 1).[4] The ETAT teaching has been expanded in some settings to include the management of patients during their first 24 hours of admission, and to include detailed aspects of the management of premature or sick neonates. This training is known as ETAT+. There is increasing evidence to show that ETAT+ training can rapidly improve the quality of paediatric and neonatal care in hospitals in low-resource settings.[5,6,7,8]

The Royal College of Paediatrics and Child Health (RCPCH) has been collaborating with paediatric partner agencies in East Africa on the development and application of ETAT+ in secondary care settings since 2009. In late 2015, RCPCH returned to Ola During Children's Hospital (ODCH) in Freetown, Sierra Leone, and began to provide support with an initial focus on triage and emergency care. In this paper we present our experience of using training and clinical mentorship based on WHO ETAT+ principles to deliver nurse-led triage and treatment in the outpatient department of the main paediatric hospital in Freetown, Sierra Leone. In 2015-16 the hospital had 150 beds including 25 cots in the Special Care Baby Unit (SCBU). Between 300 and 500 medical patients attended the outpatient department each day, of whom 10 - 15% were admitted. The hospital treats all medical patients up to the age of 18 years; surgical and burns patients are treated at a different facility in Freetown. The hospital had two paediatric specialists, three medical officers, and between five and fifteen house officers on six monthly rotations. Most nurses working in the outpatient department of the hospital were State-Enrolled Community Health Nurses (SECHNs), which is one professional level below a fully-registered nurse (SRN). Task-sharing is well established in Sierra Leone, for example there is a successful programme for the training of nurse anaesthetists,[11] but it is not common practice for nurses to undertake the first full assessment of sick newborns or

children, and SECHNs do not have significant clinical authority or autonomy in the paediatric and neonatal wards. In this study, programme data were analysed to ascertain whether the introduction of a nurse-led triage, assessment and stabilisation process was associated with improvements in process measures and in outcomes.

Figure 1

Methods

A quality improvement (QI) process was initiated in the outpatient department of ODCH in October 2015. The nursing staff were trained in the principles of triage, assessment and stabilisation of children presenting to the hospital. Those nurses who passed a written and a practical examination were supported to take on these duties in the outpatient department. A resus area was created close to where patients arrived, and diagnostic and therapeutic supplies were made available in the resus area. Data was collected on the quality and timing of triage, and the timing of subsequent treatment to guide the management of the QI process.

Intervention

All nurses working in the outpatient department were invited to attend a sequence of sixteen half-day teaching sessions covering all ETAT+ principles over one month, which were organised on-site and around their working day. At the end of the course, the nurses undertook a written examination on triage, assessment, emergency treatment and prescribing, and an assessment of practical competence. Over the following six months they were supported in the outpatient department by a clinical mentor, who provided ongoing supervision as well as weekly teaching sessions. During the six months, the nurses were also given the opportunity to attend a further standalone five-day ETAT+ course. Thirty percent of the nursing staff working in the outpatient department were able to attend the course during the study period. The same training was offered to the junior doctors (house officers and medical officers) working in the hospital.

The nurses were taught to triage the patients arriving in the outpatient department. They were also supported to take over the initial assessment and management of acutely unwell children, a task which had previously been done mainly by junior doctors working at the facility.

Concurrently, basic improvements were made to the layout and facilities of the outpatient department. The flow of patients through the department was assessed and optimised to shorten the time for patients to be triaged and for sick children to receive treatment. Prior to these changes patients who screened positive for symptoms suggestive of EVD had two sequential health worker contacts before being isolated, this was reduced to one. Patients presenting at the hospital for reasons other than medical assessment (for example immunisation, food supply or dressing change) were separated into a different registration

queue, so that they did not interfere with or confuse the triage of the medical patients (see Figure 2).

A separate resuscitation area was created within the outpatient department, as well as a dedicated pharmacy and side-laboratory. The pharmacy stocked the basic medications and consumables necessary for resuscitation and initial treatment, including adrenaline, ampicillin, artesunate, ceftriaxone, gentamicin, IV dextrose, Ringer's Lactate, diazepam, phenobarbitone, cannulas, giving sets, and NG tubes, and was staffed by a member of the hospital pharmacy team. The side laboratory was able to perform estimation of haemoglobin concentration, and malaria rapid diagnostic test, and was staffed by a member of the hospital laboratory team. This meant that the nurses undertaking a full assessment of the child had access to appropriate diagnostics, medications and consumables, as well as a suitable area in which to provide treatment.

Assessment and data collection

In order to assess the impact of these interventions, operational data was collected on the clinical care provided in the triage and resuscitation areas. Two main measures were used: the quality of the assessments that were undertaken at triage, and the time that it took for acutely unwell children to be assessed and to be treated. Following the intervention, the number of admissions was calculated from register data, and the number of deaths at the facility before and after the intervention were compiled retrospectively from mortuary records, as part of a separate programme aiming to improve the quality of hospital mortality data.

A baseline assessment was undertaken before commencing any intervention. The same data were collected at 3 and 6 months following the start of the programme. A team of six observers and six medical students collected information for every patient arriving in the outpatient area between 0800 and 1400 from Monday to Friday, which included: basic demographics; time of arrival; time of triage; time of medical assessment; and time of treatment. One observer was stationed at the front gate, to collect demographics and time of arrival. Two observers were based in the triage area, and three in the medical assessment area. The observers in the triage and resuscitation areas were UK paediatricians. The other observers were Sierra Leonean medical students. In the triage area the observers noted which ETAT emergency and priority signs were displayed by the child and noted which signs had been observed by the clinician assessing the patient. When children did not receive treatment until they had been admitted to a ward, one observer was assigned to follow the children to the ward and record the treatment they received. All researchers had wrist watches, which were synchronised at the start of each day, to allow them to note the times of assessment or treatment. Whilst the team was observing the ordinary practice of the hospital team in this period, there was a risk that they would observe suboptimal practice. It was agreed before the start of the first observation period that if a patient were observed to be at risk of significant harm as a result of the care they received, the observer would intervene to escalate or improve the care that was provided. Permission to undertake retrospective analysis of

these programme data was granted by the Institutional Review Board of the Ministry of Health and Sanitation of Sierra Leone.

Statistical Analysis

These data were subsequently collated and analysed in SPSS.[9] The triage nurse assessments of emergency and priority signs were compared to the assessment of the clinical observer. Timing data were assessed for normality; as these were skewed, non-parametric statistics were used. The median times to triage, to assessment, and to treatment with antibiotics or antimalarials for all patients were calculated. The times from triage to assessment and to treatment were calculated for the sub-groups of children recognised to have emergency or priority signs, and these were compared across the three time-points. Chi-square analysis was used for comparison of the accuracy of detection of emergency and priority signs in triage at each time point. Jonckheere's test for ordered alternatives was used to compare the times to triage, assessment and treatment for children with emergency and priority signs at each time point.

Figure 2

Results

Analysis of these programme data demonstrated a statistically significant improvement in the quality of the triage assessments undertaken by the nursing staff, and in the time taken to assessment and treatment for patients needing urgent treatment.

The overall number of patients observed in the outpatient department increased across the three observations, from a mean of 52 (range 41-68) patients per day in November, to 55 (range 39-67) patients per day in March, and 76 (range 59-103) in June. Most of the patients attending the hospital during each observation period were captured by the study: 208 of 223 patients who attended during the 4 24-hour periods in November; 274 of 334 patients who attended during the 5 24-hour periods in March; and 378 of 394 patients who attended during the 5 24-hour periods in June.

The baseline characteristics of the patients presenting during each data collection period are shown in Table 1. The median age of the patients varied minimally across the three observations, and the proportion of outpatients who were admitted to the hospital remained consistent. The proportion of admitted patients who were followed to initial treatment by the research team in each observation period was similar: 52% before, 53% after 3 months, and 62% after 6 months.

Table 1

Triage Assessments

The assessments of the triage nurses improved significantly across the intervention period. The number of children found by the triage nurse to have emergency signs increased from 30% of those identified by the researcher, before the intervention, to 83% and 100% after 3 and 6 months respectively ($\chi^2_{(2)}$ = 40.23, p<0.0005). The number of children noted by the triage nurses to have priority signs increased from 34% to 99% and 100% after 3 and 6 months respectively ($\chi^2_{(2)}$ = 124.19, p<0.0005). (Table 2)

Table 2

Time from triage to assessment and treatment

Between the baseline assessment and 3 months there was an increase in the median time to triage for all children from 19 to 26 minutes, and this improved to 5 minutes at 6 months. The median time to assessment for all children decreased from 76 to 20 minutes between baseline and 3 months, and then increased again to 39 minutes at 6 months. The overall median time to treatment improved from 218 minutes at baseline, to 45 minutes at 3 months, and 24 minutes at 6 months. (Table 3)

Table 3

Table 4 shows that when stratified by the emergency and priority signs recognised by the researcher, there were statistically significant decreases in the timings from triage to assessment and to treatment. For children presenting with emergency signs the median time taken for them to have a full assessment following triage improved from 57 minutes at baseline, to 17 minutes at 3 months and 5 minutes at 6 months; analysis using Jonckheere's test confirmed that this was statistically significant across the three time points (z=5.68, p<0.0005). There was a corresponding decrease in time from triage to treatment (z=2.9, p=0.006), which was significant between all pairs of time points. Similar statistically significant improvements were observed in the median times to assessment between baseline, 3 months, and 6 months for the patients presenting with priority signs and between all pairs of time points. Likewise the decrease in timings from triage to treatment was significant overall and between all pairs of time points.

Table 4

Admissions and Mortality

Over a period of 3.5 years contextualising the 6-month period of the ETAT intervention described in this paper, a consistent rise in hospital admissions and a consistent fall in the mortality rate in the two years can be seen. These data were acquired subsequent to the intervention, and through a separate and independent data-gathering and validation process. There was an interruption in the hospital's processes for the collection of data on deaths between July 2015 and March 2016, which means that data is not available for this period.

Figure 3

Discussion

This analysis of programme data shows an improvement in the accuracy of triage and in the time taken for children to be assessed and treated in the outpatient department associated with the delivery of a quality improvement programme based on the ETAT+ curriculum.

Reporting the validation of the ETAT triage framework in 2001, Molyneux and Robertson noted that after training, the triage assessments of nurses working at Queen Elizabeth Central Hospital, Blantyre was comparable to the triage assessment of an APLS-trained doctor.[10] The effect of the training in triage skills in ODCH suggests a similar effect, with the nurses and the APLS-trained medical observers identifying the same children with emergency and priority signs after six months.

Ayieko and colleagues described improvements in a range of quality of care indicators with the implementation of an ETAT+ training and facilitation programme in Kenyan district hospitals[7], as do Crouse and colleagues in relation to an ETAT+ programme in Guatemala.[8] Again, the improvements in the time taken for seriously ill children to be assessed and treated that are demonstrated in this study are in keeping with those previous results.

This study differs from previously described work of this nature, because in addition to the triage assessment, the first full systems assessment and the initial resuscitation was undertaken by nurses who had been trained for the task. In Sierra Leone, the sharing of tasks which have traditionally been viewed as within the medical purview with other members of clinical staff who have undergone specific training has precedents. Nurses have been trained to take on the role of anaesthetist.[11] Associate clinicians have been trained to perform caesarean sections, with follow-up data suggesting that the outcomes are non-inferior to those of medically-trained surgeons.[12] It is encouraging to note that the task-sharing approach to emergency paediatric care produced improvements that are comparable to previously reported quality improvement projects of this nature.

This intervention led to the outpatient department being managed and run day-to-day by nursing staff, which was a major change to the procedures of the hospital. The staff took charge of a department whose processes were substantially different to those that had been in place before or during the EVD epidemic. In terms of efficient use of scarce health workforce in Sierra Leone and similar settings, this may offer important insights into potential

gains achievable within existing resources for improved hospital-based clinical care. Previous work has highlighted the importance of local factors in determining the success of quality improvement approaches in this setting,[13] and nurse-led paediatric emergency care may represent a strategy that addresses current challenges specific to the Sierra Leonean health system.

It could be expected that times from triage to assessment and treatment would improve during the three months of the intervention, as the treatment area, along with diagnostics, consumables and medications, had been moved closer to the patient, and so the distances for the patient and staff to travel were much shorter. It was perhaps less predictable that the times to assessment and treatment would continue to improve between month 3 and month 6 of the intervention. It is possible that a continued process of team-building, as well as the on-going practice of skills and protocols, helped the staff working in the outpatient department to improve further the speed with which the sickest children were assessed and treated. These qualitative aspects of performance were not assessed during the programme due to the constraints of the budget and staff time, but a link between improved performance and factors which support team-building and follow-up training and supervision would be consistent with previous evidence from quality improvement programmes based on ETAT+.[14]

Following the intervention, there has been a consistent decrease in the mortality rate at the facility, in the context of an increasing admission rate, which suggests that the intervention may have contributed to an improvement in overall patient outcomes. However, this may not be ascribable solely, if at all, to the changes in the organisation of the triage and resuscitation areas. These data show admission and mortality rates during and immediately after the Ebola epidemic, during which period there were unavoidable constraints on the quality of the care delivered in the facility, and during which paediatric patients presented later and sicker than afterwards. In addition, hospital processes for recording deaths were interrupted for seven months between July 2015 and March 2016, meaning that mortality rates are not available for the period spanning the first part of the intervention.

Limitations

This study has several limitations. The data collection processes were organised to provide pragmatic information on hospital processes in the context of a post-emergency quality improvement process. The study was undertaken by volunteers - doctors from the UK, and Sierra Leonean medical students - all of whom rearranged their work schedule to include data collection. This meant that it was not feasible to collect data throughout 24 hours of each study day, and so some patients presenting during the period were missed. However, data were collected consistently from 0800-1400 on each observation day, making bias unlikely. Each data collection round was intended to last for five days, but in the first round, data was collected only on four days. This was due to a technical problem with printing data collection forms on one of the days.

When the research team was present in the outpatient department to observe and collect data, the members of the team had an obvious ethical duty to intervene in the care of children if they identified a risk of imminent serious harm. In the data collection period before intervention, the team had to intervene 13 times to mitigate possible serious harm. In March the researchers intervened once, and in June not at all. It is likely that these actions, taken in respect of the most seriously unwell patients, improved the timings to assessment and treatment recorded in November 2015, and that had the team observed without intervening, the results may have been much worse, and mortality during that week may have been higher.

We did not formally assess staff attitudes to the interventions, but there was overall enthusiasm for the process and a rekindling of professional pride in the care of sick children. The process re-energised a work force demoralised by the Ebola epidemic and helped them regain confidence in their ability to do a job well.

Conclusions

The introduction of a combination of process change, task-shifting, structured teaching, training, and clinical mentorship resulted in an important improvement in the quality of the triage assessment, and in the times to assessment and to treatment for children and newborns with signs of serious illness. A fall in mortality at the hospital was seen after the intervention, suggesting that the intervention may have been a contributing factor, but these data must be interpreted with caution, as other factors may have been important in producing this change. These might include improved and earlier care-seeking as the EVD epidemic receded further into the past, and reduced clinician anxiety about proximity to patients and therefore improved observation. After discussions with the Sierra Leone Ministry of Health and Sanitation and the Sierra Leone office of the World Health Organisation, the approach described above was adopted for a national roll-out of ETAT+ to all government district hospitals in 2017.

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Table 1

Baseline characteristics of children attending Ola During emergency department in three time periods.

	November 2015 (4 days)	March 2016 (5 days)	June 2016 (5 days)
Total number of patients triaged by the hospital during the study days	223	334	394
Total number of patients admitted	86 (39%)	126 (38%)	144 (37%)
Patients observed at triage	208	274	378

Number of times that the research team intervened in triage	13	1	0
Males/Females in observed cohort of patients	118/90	145/129	204/174
Mean age	12 months Q1: 5 Q3: 6 IQR: 21	12 months Q1: 5 Q3: 26 IQR: 21	13 months Q1: 7 Q3: 27 IQR: 20
Patients followed to assessment	104	217	332
Patients followed to initial treatment	45	67	89
Dead on arrival	1	1	2
Died in triage	3	0	0
Died in assessment area	1	0	2
Died in hospital within 12 hours	4	2	2

Table 2

Triage assessment of all children in three time periods.

		November 2015	March 2016	June 2016	χ^2 analysis
Emergency signs					
	Researcher	40	18	30	40.23
	Nurse	12 (30%)	15 (83%)	30 (100%)	p<0.0005
Priority signs					
	Researcher	74	80	72	124.19
	Nurse	25 (34%)	79 (99%)	72 (100%)	p<0.0005

Table 3

Timings to triage and to treatment for all children in three time periods.

		November 2015	March 2016	June 2016
Arrival to Triage				
	Time	19 (34) [0-780]	26 (40) [1-196]	5 (10) [1-65]
	n	208	268	378
Triage to Assessment				
	Time	76 (74) [1-305]	20 (31) [1-185]	39 (66) [1-284]

	n	104	217	332
Triage to Treatment				
	Time	218 (211) [21-480]	45 (23) [8-170]	24 (14) [7-120]
	n	52	68	89

* Time is noted as: median (IQR) [range] minutes

**Sample sizes are lower for triage to assessment and triage to treatment because fewer patients were followed to assessment and treatment

Table 4

Timings, stratified by emergency and priority of children attending Ola During emergency department in three time periods.

		November 2015	March 2016	June 2016	Jonckheere's test
Emergency signs					
Triage to Assessment					
	Time	57 (74)	17 (23)	5 (9)	z=5.68
	n	28	18	30	p<0.0005
Triage to Treatment					
	Time	220 (221)	40 (57)	18 (19)	z=2.9
	n	19	16	30	p=0.006
Priority signs					
Triage to Assessment					
	Time	77 (75)	15 (15)	12 (8)	z=8.52
	n	43	70	63	p=<0.0005
Triage to Treatment					
	Time	208 (160)	45 (25)	24 (11)	z=10.13
	n	24	51	57	p=<0.0005

* Time is noted as: median (IQR) minutes

**Sample sizes are lower for triage to treatment because fewer patients were followed to treatment

Legends to Figures

Figure 1: ETAT Emergency and Priority Signs

Figure 2: Outpatient department layout pre- and post-intervention

Figure 3: Monthly Admissions and Monthly Mortality Rate 2015-2018