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Infection control and treatment guidelines and neonatal mortality in a rural hospital in Uganda

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ABSTRACT

Background: In Uganda the neonatal mortality has remained between 24 and 27 deaths per 1000 live births for the last 14 years.

Aim: To determine the impact on neonatal mortality of the introduction of infection prevention and treatment guidelines in a resource poor setting.

Methods: A prospective study was carried out in Kagando Hospital, a rural hospital in Western Uganda of infants live-born in hospital and infants admitted from the community or other hospitals between 2013 and 2017. Guidelines were developed from a literature review and informed by local doctors and nurses and a visiting paediatrician. The guidelines highlighted that unwell infants should be admitted to the neonatal unit which was a section of the paediatric ward, emphasized hand hygiene, separation of infants with and without sepsis, unwell infants should be treated with evidence based antibiotic regimes and enteral feeds withheld from unwell infants. Mortality within 28 days from birth was audited for three months prior and post intervention; the audit was repeated three and five years later.

Results: Pre-intervention, there were 137 neonatal admissions and 79 neonatal deaths in three months (0.58 deaths per admission). Post-intervention there were 187 admissions, the death rate was lower (0.26 deaths per admission, $p<0.001$). Three years post intervention, there were 60 deaths of 233 admissions (0.26 deaths per admission, $p<0.001$) and at five years 53 deaths of

315 admissions (0.17 deaths per admission, $p<0.001$).

Conclusion: These data suggest introducing infection, prevention and treatment guidelines can reduce neonatal mortality in a resource poor setting.

Key words: Admissions; Antiobiotics; Guideline; Hand hygiene; Infection control; Mortality; Neonate; Uganda.

Short title: Neonatal mortality in Uganda.

INTRODUCTION

In Uganda, the reported neonatal mortality has remained between 24 and 27 deaths per 1000 live births for the last 14 years [1], whereas the UK neonatal mortality rate was 3.8 deaths per 1000 live births in 2016 [2]. Poor antenatal care, limited access to postnatal care and lack of maternal health education have been highlighted as contributing factors to the high neonatal mortality rate in Uganda [3, 4]. In low income countries the loss of a child can lead to divorce and social isolation [5]. Furthermore, the financial cost to the family unit of an infant death has been estimated at between US$6000 to US$11,000 in sub-Saharan Africa [6] and the overall cost of an infant death is estimated at 6% of gross domestic product (GDP) of all African countries [7].

Although the majority of Ugandan people live in a rural setting, neonatal specialist care is rare in rural hospitals. National interventions to improve neonatal mortality have focused on community-based care []. A meta-analysis of mortality before and after community interventions in Sub-Saharan Africa showed that interventions, such as home visits and facilitated community women's meetings, had limited success with no significant change in mortality (RR 0.95, 95% CI 0.88 to 1.02) [9]. The trials included in the meta-analysis [9] reported difficulties implementing their interventions due to poor training and adherence of local clinical workers.

The aim of our study was to determine if, in Uganda, interventions in a hospital setting could reduce neonatal mortality. We hypothesised that mortality could

be reduced with the introduction of low cost evidence-based guidelines focusing on infection prevention and treatment. Our aim was to determine the immediate and long-term impact of introduction of such guidelines to reduce in-hospital neonatal mortality in a low-income setting.

METHODS

The study was undertaken at Kagando Hospital, a resource poor, rural hospital in Western Uganda, which, despite a rapidly growing population, has not had specialist neonatal care. The nearest referral centre for neonatal care was in the capital city which was over eight hours away by road. Unwell infants were cared for at Kagando in a separate section of the paediatric ward on the labour ward or the surgical ward. Between 20 and 50 infants were cared for in a designated neonatal section of the paediatric ward called the neonatal unit at the time of the intervention. In the neonatal unit, on a shift there was one nurse, between one to three nursing students and one doctor. The staffing levels remained the same throughout the five years post intervention. Nurses cannulated the infants and started treatment, but were expected to inform the on-call doctor if they were concerned about an infant. Nurses administered medications and passed nasogastric tubes, but other aspects of patient care such as feeding, changing and bathing, were performed by the infant's parents or extended family. Infants were assigned a bed based on available space and up to three infants would share an adult bed. Junior nursing staff were rotated between the neonatal unit and other wards in the hospital every one to two years.

A paediatrician from the UK with neonatal experience was present in the hospital

between March 2012 and March 2013. A literature review was performed by the visiting paediatrician, local clinicians and paediatric nurses and the results discussed at ward guideline meetings. These consensus discussions then formed the basis for developing guidelines which were introduced in April 2012. There were no capital costs to the guidelines and ongoing costs, such as staffing and equipment, were cost neutral. Written protocols were developed and 'At a Glance' posters were placed on the walls of the neonatal area and this was followed up by focused ward round teaching on the management of common neonatal conditions and emergencies.

The guidelines specified that any infant deemed unwell for whatever reason by midwives, parents, nursing staff or doctors was to be admitted to the neonatal unit. In addition, any infant requiring intravenous fluids, oxygen or medication was to be admitted to the neonatal unit. The sickest infants were to be cared for nearest to the nurse's station. Infants with infections were not to be kept in the same bed as prematurely born infants. Hand washing was strictly to be enforced by the ward nurse who refused entry to anyone who did not comply. As the hospital was in a region without tarmacked roads and paths, the guidelines stated shoes were to be removed when entering the area to reduce the amount of dirt brought into the neonatal area. Parents were to be involved in recording routine observations such as helping to take their infant's temperature to reduce cross contamination. Antibiotic choice had previously been according to clinician preference. Intravenous antibiotic regimens were introduced based on review of the microbiology data from Uganda's national referral centre [10]. First line antibiotics were ampicillin and gentamicin, second line ceftriaxone and gentamicin and third line chloramphenicol and gentamicin. Antibiotics were

changed to the next line if the neonate became more unwell within 24 hours of admission or if the neonate showed no improvement after 48 hours. The timing of change of the antibiotics was influenced by the known high levels of antibiotic resistance in Uganda [11]. All infants admitted to the unit received intravenous antibiotics as infants were only admitted if they were thought to be unwell, whereas previously intravenous antibiotics were only prescribed if the infant was pyrexial. The antibiotic guidelines remained unchanged in the five years post intervention. Parents paid a subsidised rate for the antibiotics, but if this was unaffordable the antibiotics were given free of charge. Prior to the intervention, there was no specific guidance on when to withhold feeds or when to start intravenous fluids. The new guidance specified that all unwell infants were not to be enterally fed and intravenous fluids commenced. This ensured that the decision to enterally feed a neonate was not made by inexperienced nurses or doctors during the night or as an emergency situation. The guideline recommended that feeds were to be reintroduced once the clinical team felt the infant's condition was improving.

Audit of neonatal deaths

The numbers of neonatal deaths in the hospital and all deaths on the neonatal unit were recorded. Neonatal mortality was audited between January and March 2012. Following the introduction of the guidelines, neonatal mortality was immediately re-audited for three months. In addition, neonatal mortality data was collected from January to March in 2015 and in 2017.

Statistical analysis

To assess if differences were statistically significant, a Chi-squared test was

used. Post hoc analysis was undertaken using Fisher's exact tests with a Bonferroni correction for multiple comparisons. SPSS version 24 (IBM, UK) was used to perform the analysis.

RESULTS

In the three months prior to the intervention, there were 137 admissions to the neonatal unit and 79 neonatal deaths (0.58 deaths per admission). Immediately post intervention there were 187 admissions and 40 deaths (0.26 deaths per admission) ($p<0.001$). At three years post intervention there were 233 admissions and 60 deaths (0.26 deaths per admission, $p<0.001$) and five years post intervention 315 admissions and 53 deaths (0.17 deaths per admission, $p<0.001$). The birth rate in the hospital remained constant at 150 per month pre-intervention to three years post intervention. At five years post intervention there were 188 births per month.

DISCUSSION

The introduction of low-cost guidelines for the management of unwell neonates was associated with a reduction in the rate of neonatal deaths in a resource poor setting. The neonatal mortality rate remained lower five years after the intervention.

Other studies have shown that low cost interventions and training can improve neonatal practices and outcomes across Uganda and low and high middle income countries although many of these interventions have occurred in the community

setting. In a meta-analysis of 17 papers examining the effects of introducing pre and post-natal home visits and facilitated group meetings by trained community workers, did show an overall reduction in neonatal mortality (relative risk 0.86, 95% CI 0.82–0.89, p<0.001) [9]. A study of hospital admissions to a Ugandan hospital delivering neonatal care, highlighted that sepsis was the most common cause of admission (30%) [12]. This may explain why low-cost community interventions have had only modest effects on neonatal outcomes and why the in-hospital interventions used in this study may have had a more significant impact on neonatal mortality. In the hospital setting in Ethiopia, it has been reported that interventions focusing on the management of sepsis, provision on respiratory support, feeding support and neonatal life support training reduced the mortality in two locations by 7.5% and 6.5% respectively [13]. In that study, the interventions were costed at a total of US$17,000 and the changes were made by two visiting UK based doctors who were present for the six-month implementation period and the subsequent three-month audit period. In contrast, in the present study the neonatal mortality rate in the absence of a UK doctor was reduced five years post intervention.

At five years post intervention, admissions to the neonatal unit had more than doubled, despite the birth rate at the hospital increasing more modestly. The neonatal guidelines ensured all unwell infants were cared for only on the neonatal unit, rather than as previously, the surgical, paediatric, labour, postnatal or neonatal ward. Hence, the admission rate to the neonatal unit increased, but was due to increased admission of unwell not well neonates. It should be noted that the pre and post intervention mortality data included all live born infants that died in the hospital, not only those cared for on the

neonatal area of the paediatric ward, nevertheless, the overall mortality fell post intervention.

This study has some limitations. Infants were not randomised to receive the intervention. Unfortunately, the birth weight, gestational age at birth and the diagnosis on admission were not recorded. Thus, it is not possible to adjust our results for those confounders. In addition, data from blood cultures and post mortem examinations was not available. Hence, we cannot state whether the reduction in mortality post-intervention was due to a decrease in deaths due to sepsis. The initial results may have been influenced by the presence of a paediatrician with neonatal experience working full time at the hospital during the implementation period. The lower mortality rate, however, was still present at both three years and five years later. During those two observation periods, the paediatrician with neonatal experience was not present in the hospital and, many of the junior nursing staff present during the initial introduction of the guidelines had rotated and been replaced by other junior nurses who had now worked with the paediatrician. The neonatal guidelines, however, were still in place and being acted upon. Thus, we suggest that it was the use of those guidelines which resulted in the sustained reduction in mortality.

In conclusion, our data suggest that introduction of guidelines focusing on infection control and management might have reduced neonatal mortality in a rural hospital in South West Uganda.

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