2

Improving Newborn Interventions in Sub-Saharan Africa – Evaluating the Implementation Context in Uganda

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1. Introduction

It has been proposed that the performance of a health system should be measured primarily by the effect on mortality. Childbirth is the time of greatest risk of mortality for a mother and a baby [1] and thus care at birth is a good marker of the performance of any health system. Yet every year, a staggering 7 million children die either in the first four weeks of life (3.8 million) or as still births (3.2 million) [2]. Despite this unbelievable magnitude of avoidable premature deaths, historically neonatal health was a forgotten area left in the cracks of safe motherhood and child health programs [1, 3-5].

The Millennium Development Goals (MDGs) that are directly related to newborn survival are MDGs 4 and 5. MDG 4 focuses on child survival and its target is to reduce under-5 child mortality by two-thirds by 2015, with a global target of 32 per 1000 live births [5, 6]. However, at current rates, most low income countries will not achieve this MDG target [6]. Available data shows that there has been no measurable reduction in early neonatal mortality in Sub-Saharan Africa (SSA) over the last decade, and the gap between the rich and the poor continues to widen [6]. Hence reducing neonatal deaths, especially early neonatal mortality is crucial to meeting MDG 4 [1]. However, evidence shows that most of the neonatal deaths are intimately linked to maternal problems especially those related to the management of the intra-partum period [1, 7, 8]. A solution addressing both maternal and newborn health is cost-effective.

Although we have an estimate of the huge magnitude of neonatal deaths and their importance to achieve MDG 4 target in the next few years to 2015, SSA has had no measurable reduction in neonatal deaths for about a decade now [5, 6]. This despite the existence of evidence that low cost interventions that have the potential to reduce neonatal mortality by 41–72% worldwide [8]; and most of these are relatively simple [9].

In order to accelerate efforts towards achieving MDG 4, a number of SSA countries including Uganda are designing programs to integrate newborn interventions into current

maternal and newborn programs, hitherto a neglected area. Most of these efforts are based on global recommendations. Moreover, most of the evidence is based on small scale studies from Asia and a few from South America, and none to date from SSA. In fact, WHO and UNICEF have already recommended community based interventions through home visits as one of the key strategies [10]. Yet it is known that the health system context including cultures and practices in SSA is different from that in Asia. However, we know that there is no magic "one size fits all" program to address neonatal mortality. Many countries such as Uganda have already translated this evidence into policy. However, evidence or policy on paper does not usually translate into practice, leading to the so called "know-do-gap" or the "knowledge-implementation gap" [11]. The local epidemiology as well as health system design and performance and community demand are key factors that need to be considered [12, 13]. This is crucial for identifying and recognizing the extent of the "know-do-gap" in current programs.

Key "knowledge-implementation gaps" related to neonatal health at the implementation level in SSA health systems include: identifying missed opportunities or modifiable delays within the health care delivery system that lead to newborn deaths; understanding whether the evidence-based globally recommended practices are acceptable in the local context (home care practices, community perceptions and underlying cultural beliefs); and the current uptake of neonatal interventions including the quality of newborn care gaps across the maternal and newborn care continuum.

In this paper, I assess the implementation context for evidence-based newborn interventions, namely, primary health care health facilities, households/communities, and the linkages there of in the continuum for maternal and newborn care in terms of time and place), in order to inform program design and policy. The findings described in the paper were used to design the Uganda Newborn trial (UNEST) (trial register ICRCTN 50321130)

2. Methods

2.1 Study area and population

The studies described here were conducted in Iganga and Mayuge districts (Figure 1), which are part of the Busoga region, and situated in the south-eastern part of Uganda. Including Iganga and Mayuge, the Busoga region has seven administrative districts – the others being Bugiri, Kamuli, Kaliro, Namutumba and Jinja. Busoga region is composed of 11 principalities of the Basoga tribe and is one of the largest traditional kingdoms of Uganda. Study II, III, and the health facility component of IV, where conducted in the Iganga/Mayuge health and demographic surveillance system (HDSS), whereas study I, and the qualitative component of study IV, were conducted elsewhere outside the surveillance area in the two districts of Iganga and Mayuge. Busoga region has a population of about 2.8 million people, of mixed tribal identification, and represents approximately 8.4% of the Ugandan population, living in an area of about 7100 sq. miles. To the west of the Basoga tribe live the Baganda tribe, the largest tribe of Uganda. However, their two languages, traditional practices and cultures are similar to each other.

Iganga/Mayuge HDSS is situated in the Eastern part of Uganda, and it covers an area across the two districts of Iganga and Mayuge. This area covers 155sqkm, comprising 18 parishes and 65 villages. At the time of data collection, the Health Demographic Surveillance System

(HDSS) population was about 68,000 people, staying in roughly 12,000 households. The average household size is five persons per household, and the main occupation is subsistence agriculture.

The HDSS is comprised largely of a rural area with only Iganga town council being peri-urban. The HDSS is currently expanding to new areas along with an increase in the specific demands for more research.

In Iganga/Mayuge HDSS, there is one general hospital, 15 health centres, about two dozen small private clinics and other informal health providers, mostly traditional birth attendants, drug shops and private clinics that are most often found in small trading centres, as well as in Iganga proper (Figure 5). All government and NGO facilities have clinical officers and nurses for health care delivery, apart from delivery provided by the hospital, which also has doctors. Malaria is endemic, and pneumonia is prevalent in the district.

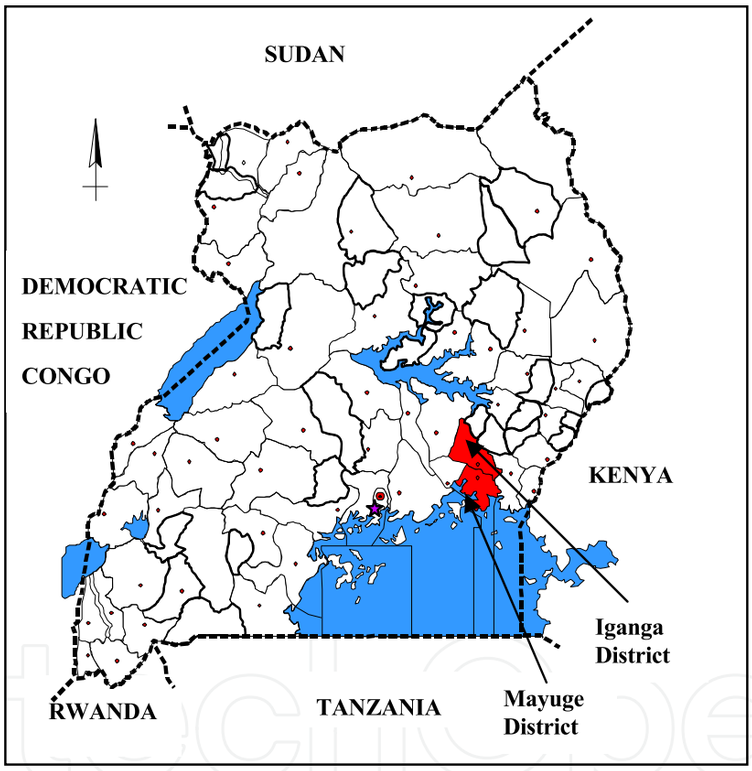

Fig. 1. Map of Uganda showing the location of Iganga and Mayuge Districts

2.2 Study design, sampling and data collection

This paper summarises four studies, with a general aim to inform design of a newborn intervention as tailored to the local context. This was a cross-sectional study with both qualitative and quantitative methods of analysis. The studies were designed such that they complement one another. An assessment was done of causes of newborn deaths, and identified where major delays occurred as they contribute to death. Exploration of the acceptability of the evidence-based newborn practices, and it helped to inform the design of the variables that assessed uptake of newborn care practices among babies who survived the

neonatal period. Finally, the picture was completed by seeking to understand the care provided to preterm babies at home and in health facilities as an example of the current care for newborn babies in the study area. Table 1 summarises the studies, their designs and sample sizes.

Study objective	Methods	Study population and sample size
Acceptability of evidence-based newborn care practices	10 FGDs and 10 KI interviews	Mothers, fathers, grandparents Child minders Total 98 people
Uptake of newborn care practices	Cross-sectional population based study	Mothers of babies 1-4 months N=414
Modifiable delays leading to newborn deaths	Case series	Neonatal deaths N=64
Care of preterm babies	Health facility survey IDIs FGDs	1 hospital and 15 health units 11 CHWs 10 mothers of preterm babies 6 fathers of preterm babies 3 grandmothers of preterm babies 3 FGDs

Table 1. Summary of methods

2.3 Qualitative studies

2.3.1 Acceptability of evidence-based newborn care practices

A qualitative approach was used to explore the aacceptability of evidence-based neonatal care practices in rural Uganda. Ten FGDs were conducted as follows: two with younger mothers less than 30 years; four with older mothers more than 30 years or having grandchildren; two with fathers and another two with child minders (older children who take care of other children) of up to 13 years of age. Selection of young mothers and fathers was limited to those having children less than six months of age in order to ensure that responses reflect recent/current practices. In addition, we also conducted key-informant interviews (KIs) with six health workers and four traditional birth attendants (TBAs). Villages were selected for interviews from both near and far from the hospital to represent the rural-urban divide. Using guidelines from the research team, community leaders identified participants for the FGDs, and district leaders of health services identified health workers and TBAs for the KIs. Pre-tested checklists guided discussions about the acceptability and barriers to adapting practices within the continuum of care approach [14-16] with special focus on ANC, intra-partum care, and postnatal care for the mother and the baby, and to home visits by a volunteer to promote improved care during pregnancy, delivery and in the postnatal period. Participants were asked to present their own experiences and actions, or otherwise to describe general attitudes.

2.3.2 Care of preterm babies

In order to understand the perceptions and care of preterm babies at home and at health facilities, three different methods were used in order to triangulate findings: participant

observations [17], focus-group discussions and in-depth interviews (IDIs). Field work took place in two sub-counties in each district. The respondents for each method are shown in table 2.

Method of data collection	Number of subjects/interviews/groups
Health facility observations	16 health facilities
In-depth interviews	n = 31
Community health workers (CHWs)	8
Traditional birth attendants (TBAs)	4
Mothers of preterm babies	10
Fathers of preterm babies	6
Grandmothers of preterm babies	3
Focus group discussions	
Health workers	1 FGD (six midwives/nurses)
Men	1 FGD (8 men)
Women	1 FGD (10 women)

Table 2. Respondents/subjects and methods

A neonatal midwife from a tertiary hospital worked in health units for a month while also observing health workers, care givers and events to find out about behaviours and interactions using a semi-structured checklist and also recorded both peculiar and mundane activities and observations in a field diary [17].

IDIs were conducted with 8 CHWs (3 community drug distributors, 2 breastfeeding peer educators, and 4 safe motherhood volunteers). Ten preterm babies originating from the study areas were identified from among 42 preterm births recorded in the hospital over a six months period and traced at home for interviews. Three mothers could not be traced. Three mothers of preterm birth which occurred at home where identified by community members for interview. We conducted interviews till we realized saturation– that is we continued interviews till no new information came up. We also interviewed 6 fathers and 3 grandmothers. Finally, we conducted 3 FGDs one for midwives in the hospital and two in the community with parents but not necessarily of preterm babies (one FGD for men and one for women) to get general community perceptions. Towards the end of each community FGD, participants were shown pictures of a mother practicing kangaroo mother care (KMC) in order to assess knowledge, perceptions and acceptability.

2.4 Quantitative studies

2.4.1 Uptake of newborn care practices

A population-based cross-sectional was conducted among women with a baby aged 1-4 months (n=414) in order to determine socioeconomic differences in uptake of newborn care practices. Socio-demographic and household socio-economic status (SES) information were collected in a separate survey a year earlier. The tool was pre-tested among 25 mothers attending a postnatal clinic at the local hospital. Mothers who had had a stillbirth or a neonatal death were not interviewed for this study.

2.4.2 Modifiable delays leading to newborn deaths

For all deaths occurring in the DSS, community informants, locally known as community scouts, report to interviewers. After a period of 4-6 weeks of mourning, a verbal and social autopsy questionnaire was administered by one of three trained native interviewers to a close caregiver of the deceased. Sixty-four newborn deaths were investigated covering the period January 2005-December 2008. In addition, a health facility survey was conducted in all 16 major public and private health facilities serving the DSS, which included a general hospital. Data were collected on physical infrastructure, staff inventory, and on the presence of essential and desirable equipment for newborn care. Finally, knowledge assessment on maternal and newborn care was conducted using a self-administered questionnaire adapted from one used for a similar study [18]. The assessment was conducted among 52 health providers selected proportionally to represent level of care.

Two experienced, practicing physicians independently reviewed each death and assigned cause of death using a hierarchical approach [19]. Whenever there was a disagreement, they met to review the case, and if agreement was reached, the diagnosis was accepted as the definitive cause of death. However, if this was not possible, the cause of death was coded as undetermined. We defined delays as follows: Delay 1, which is the delay to recognise illness and the need to seek medical care, included any newborn baby who died at home or where it took more than 12 hours to seek outside care; Delay 2, the transport delay, included newborn babies whose care givers expressed problems with getting transport; and Delay 3, the delay in receiving quality care, included delay in receiving or failure to receive quality care at a health facility (as judged by the audit physician).

2.5 Data analysis

For the qualitative studies, analysis of the in-depth interviews, key informant interviews and FGDs used latent thematic content analysis. Transcripts were first read several times to get an overall picture and then meaningful units were coded, condensed and categorized into broad themes [20]. Barriers to care seeking were characterized according to the three delays model which includes delays in deciding to seek care, delay in reaching the health facility, and delay in receiving care once at the health facility [21, 22]. Relevant quotes were extracted and some were presented verbatim.

For the quantitative data, univariate, bavariate and multi-variate analysis with logistic regression was done in stata 10. Households were stratified into quintiles of socioeconomic status. Data on newborn care practices was analysed through creating the following composite outcomes: good neonatal feeding, good cord care, and optimal thermal care. This was done by combining related individual practices from a list of twelve antenatal/essential newborn care practices. Multiple logistic regression analysis was used to identify determinants of each dichotomised composite outcome.

Ethical approval for all studies was given by the Uganda National Council for Science and Technology following review by the Institutional Review Board of Makerere University School of Public Health. Verbal autopsy is culturally sensitive, interviews are conducted 4-6 weeks after a death occurred in order to allow a period of mourning as per local customs. Interviewers were recruited locally and trained to respect cultural issues. In all the four studies, all moderators and interviewers were experienced and their minimum education

was to diploma level for moderators and twelve years of formal education for interviewers. Verbal informed consent was sought and obtained from all participants.

3. Results

3.1 Similar low uptake of essential newborn care practices among the poorest and least poor

In general, there were low levels of coverage of the desired practices (table 3). A total of 46% of the respondents delivered in the hospital or in a health unit, 26% delivered in private clinics (most informal with unqualified staff and poor infrastructure) and 28% at home or with a TBA. Cord cutting was done mostly by use of a razorblade (67%) of which 11% were reused, and only 28% reported to have used cord scissors. About half of the mothers put substances on the cord (such as powder, surgical spirit, salty water, or lizard droppings). To keep warm, 86% babies were immediately wrapped, but skin-to-skin (STS) care was almost non-existent (2%). Early bathing was the norm, with 56% of the babies bathed within the first 6 hours, 82% within the first 12 hours, and almost all during the first 24 hours. Although all babies were breastfed, only about half were initiated within the first hour of birth, with 41% initiating within 1 - 6 hours. Other feeds besides breast milk including cow's milk, plain water, sugar or glucose water, gripe water and tea were given to 35% of babies in the neonatal period, contrary to recommendations.

Table 4 shows the independent predictors of safe cord care. Multiparous mothers were less likely to have good cord practices when compared to primiparas (OR 0.5, CI 0.3 – 0.9); and so were mothers whose labour began at night compared to those whose labour began during day time (OR 0.6, CI 0.4 – 0.9). Although significantly more mothers in the high SES delivered in health facilities ($p < 000$), we found that place of delivery did not predict any of the ENC practices assessed.

Characteristics	Total	%
Time labour began n= 356		
Day	146	42
Night	205	58
Time of delivery n=391		
Day	195	50
Night	196	50
Health facility delivery n=393		
Yes	181	46
No	212	54
Surface of delivery n=392		
Clean	258	66
Dirty	134	34
Instrument used to cut the cord n=391		
Clean	333	85
Not clean	58	15
Material used to tie the cord n=391		
Clean	387	99
Not clean	4	1

Characteristics	Total	%
Type of instrument used to cut the cord n=391		
Un used new razor blade	223	57
Used razor blade	41	10
Scissors	110	28
Other/ Don't know	17	5.0
What was used to tie the cord n=391		
Cloth strip	39	10.0
Clean thread	338	86.4
Rubber band	3	0.1
Other/Don't know	11	2.8
What was put on the cord n=389		
Nothing	198	51
Medical drugs	11	3.0
Powder	87	22.2
Ash	3	0.8
Salty water	43	11
Other	47	12
How long after birth baby was breastfed n=392		
Immediately	199	51
Less than 6 hours	159	41
6 – 24 hours	24	6.0
>24 hours	10	2.0
If at all, bottle fed in neonatal period n=391		
Yes	42	11
No	349	89
How long after birth was baby first bathed n=244		
Less than 1 hour	13	5
2- 6 hours	125	51
7 – 12 hours	63	26
13 - 24 hours	34	14
>24 hours	9	4
Safe cord care n=387		
Yes	149	39
No	238	61
Good neonatal feeding n=378		
Yes	216	57
No	162	43
Optimal thermal care n=398		
Yes	166	42
No	226	58

Table 3. Level of selected care practices during delivery and neonatal period

Variable	Univariate Unadjusted		Multivariate Adjusted*	
	OR	95% CI	OR	95% CI
Maternal Age				
<19	1		1	
19-25	0.52	0.24-1.11	0.68	0.31-1.51
26-30	0.47	0.21-1.03	0.62	0.26-1.47
>30	0.89	0.41-1.93	1.19	0.48-2.95
Parity				
1	1			
2-4	0.44	0.25-0.76	0.45	0.25-0.79
>4	0.68	0.40-1.13	0.57	0.30-1.08
Time labour began				
Day	1			
Night	0.66	0.44-1.01	0.61	0.0 -0.94

*Adjusted for maternal age, parity and time labour began
* p for the whole model = 0.003

Table 4. Logistic models with safe cord care practices as dependent variable versus all independent variables having significant chi-square values in bivariate analysis

3.2 Newborn babies die close to time of birth due to care-seeking delays

Of the 64 newborn deaths investigated, 37% (24/64) had been born in a hospital or a health centre, 23% (15/64) in a private clinic and 39% (25/64) at a TBA, at home or on the way to hospital. Of these deaths, 47% (30/64) occurred within the first 24 hours after birth and 78% in the first week, and only 22% occurred in the remaining three weeks of the neonatal period (Figure 6). The median age at death was two days (IQR 1-4). During the same period, most births were reportedly conducted by a trained health worker (58%, 37/64). Twenty deaths (33%) occurred either in a hospital or a health centre, 8 (13%) in a clinic, with the majority (54%) dying away from a health facility (TBA, at home or on the way to hospital).

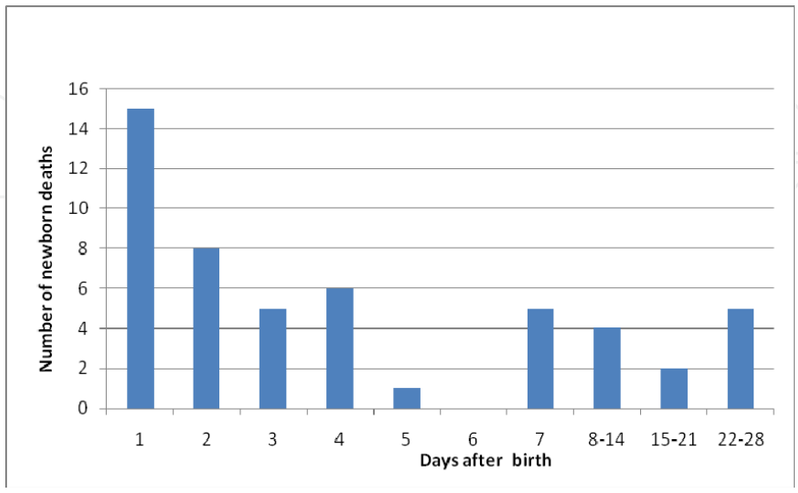

Fig. 2. Distribution of newborn deaths by day after birth in Iganga/Mayuge DSS, eastern Uganda

The leading causes of death were sepsis or pneumonia (31%), birth asphyxia (30%) and preterm birth (25%) (Figure 3). Delay in problem recognition/deciding to seek care outside the home (Delay 1) was the greatest contributor to deaths (50%, 32/64). Most newborn babies who died had started being unwell during or immediately after birth (57%, 36/64), and were unwell for a short period, with the median duration of illness being two days (IQR 1-6). Care-seeking was generally delayed, with the median duration to seeking care from outside the home being three days from illness onset (IQR 1-6 days).

The second major contributor to newborn deaths was delay in receiving quality care at the health facility (Delay 3) (30%, 19/64). A total of 53% (9/17) newborns that were taken outside the home for care reportedly made contact with a qualified health worker, but five caretakers went to drug shops and one to a spiritual leader.

Surprisingly, the transport delay to a health facility (Delay 2) was found to be a main contributor to only 20% (13/64) of newborn deaths. A second delay was identified as being a contributor to 22% of the newborn deaths investigated.

The major causes of death by main contributing delay were as follows: Delay 1 - sepsis or pneumonia (32%) followed by birth asphyxia (22%); Delay 2 - birth asphyxia (46%) followed by sepsis or pneumonia (31%); Delay 3 - preterm births (37%) followed by birth asphyxia (32%).

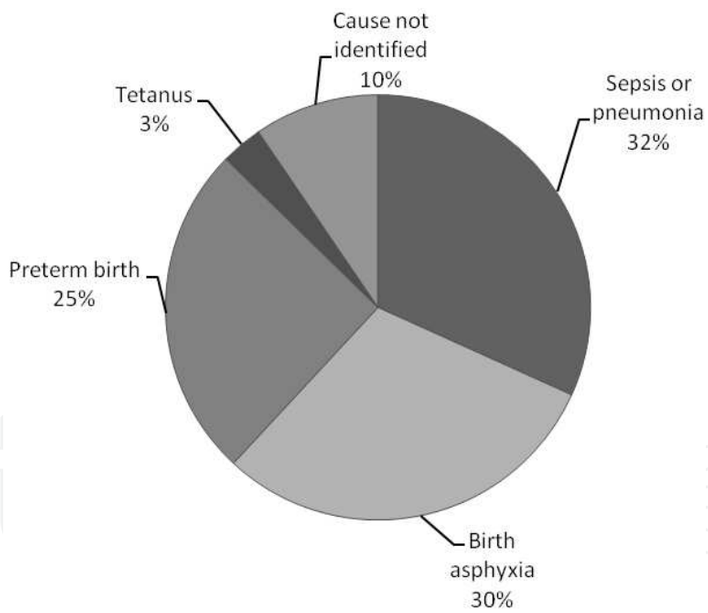

Fig. 3. Primary causes of newborn deaths

3.3 Readiness of health facilities for newborn care

Health facilities had just about half of the minimum Ministry of Health recommended qualified health workers, and almost all lacked the basic newborn equipment, drugs, supplies and an effective referral system. For instance, only 44% (7/16) of health facilities had a delivery kit, 44% (7/16) had a neonatal weighing scale, and only 6% (1/16) had a neonatal resuscitation kit.

Overall, in the knowledge assessment, participants were correct for only 58% of the questions across the maternal and newborn care continuum. Medical assistants/clinical officers had the best mean score (63%), followed by registered midwives (61%), enrolled midwives (56.5%) and enrolled nurses (50%). Participants were correct mostly for questions on ANC (65%), followed by intra-partum care (52%); the least correct answers were on newborn/postnatal care (31%).

These poor newborn care practices were confirmed in the qualitative studies. Findings from interviews revealed that most evidence-based newborn care practices were acceptable to community members; however exceptions do exist especially around dry cord care and delayed bathing. Most preterm babies are cared for at home, however, care practices are not only inadequate but also potentially harmful. A number of mothers are using powder and antiseptics for the cord, sugar or glucose water for initiation of feeding and bottles to feed babies. Health facilities lacked capacity (in terms of skilled staff, equipment, drugs, protocols and supplies) for newborn care.

4. Discussion

These studies explored both preventive and curative care for all newborn babies, at home and in health facilities, as well as related care-seeking delays contributing to newborn deaths in two districts of Uganda. Most evidence-based newborn care practices were acceptable to community members, however exceptions do exist. Newborn care practices were of poor quality and coverage was low across all socio-economic groups. Delays in problem recognition and decision-making (Delay 1), together with poor quality care at health facilities (Delay 3) were found to be the major delays related to newborn death in this setting. Most preterm babies are cared for at home, however, care practices are not only inadequate but also potentially harmful. A number of mothers are using powder and antiseptics for the cord, sugar or glucose water for initiation of feeding and bottles to feed babies. Health facilities lack capacity (in terms of skilled staff, equipment, drugs, protocols and supplies) for newborn care. These findings have important policy and programmatic implications for informing the design and delivery of evidence-based newborn interventions in Uganda, and other similar settings.

4.1 Poor coverage and quality of newborn care practices

The overall level of coverage of newborn care practices was low when assessed as composite outcomes Of newborns, 46% had a facility delivery, and when assessed as composite outcomes only 38% were judged to have had good cord care, 42% had optimal thermal care, and only 57% were considered to have had adequate neonatal feeding. The low coverage levels of composite outcomes were contrary to that of some individual practices. For instance, good cord care as a composite outcome had a coverage of only 38%, and yet use of a clean instrument to cut the umbilical cord (85%) and clean thread to tie the cord (90%) were high, but no substance applied to the cord was low (51%). The trend was similar for optimal breastfeeding and good thermal care. Thus, coverage of some practices might be high when assessed as individual practices, but quite low when evaluated as composite practices. These findings imply that, put together, i.e. assessed as composite outcomes, the majority of newborn babies are not accessing adequate preventive practices.

The coverage of adequate newborn care practices was not influenced by place of delivery. These findings differ from those reported from rural Uttar Pradesh [23], where it was found that ANC and skilled attendance were associated with clean cord care and early breastfeeding.

The findings indicate that although almost all mothers breastfed their babies, about half of the infants were not breastfed within the first one hour as is recommended [24], thereby putting these neonates at an increased risk for death [25]. In addition, more than one-third of respondents reported that they gave feeds other than breast milk in the neonatal period. A study by Engebretsen et al. conducted in eastern Uganda [26] found that only 7% of infants were exclusively breastfed by age three months. In other words, both their study and ours show that as early as the neonatal period, over one-third of infants are not exclusively breastfed. The low coverage of essential newborn care practices means that the prevent aspect of care for the newborn is weak, and needs strengthening.

The coverage of composite newborn care practices did not differ between the least poor and the poorest, i.e. coverage seemed not to be modified by socioeconomic status. This was despite good physical access to health facilities. Usually, mortality is higher and coverage is lower among the poorest [27]. Further, it has been documented elsewhere that universal interventions often reach the least poor first and the poorest later [28], but this was not the case here.

There are several possible explanations for the lack of differences in coverage across socioeconomic groupings. First, in the study setting, there were no specific programmes promoting newborn care in the study districts during the previous five years (and therefore even the least poor were not accessing the desired care practices). Secondly, it may be that SES classifications in quintiles as based on assets (such as type of material used for floors in houses or as possession such as a bicycle) may not classify people in relation to newborn care practices. The study lacked power to find a difference in composite newborn care practices by SES.

4.2 Acceptability of evidence-based newborn care practices at community level

Despite the low coverage of newborn care practices shown above, most of the globally recommended newborn care practices were acceptable to community members (mothers, fathers, grandmothers, grandfathers and CHWs), but they were not well promoted by providers which might be the explanation for the low coverage. On the other hand, the majority of women reported that they would prefer to have a health facility delivery, although in practice women often did not manage, mainly because of a number of barriers, including costs, distances, rude health workers and the challenges of accessing health care at night. These same challenges were identified in two recent published reviews as contributing to care-seeking delays for delivery care [29, 30].

Among the globally recommended evidence-based newborn care practices, a few were deemed to be less acceptable to most community members. For example, although the WHO guidelines recommend that nothing should be put on the cord [31], and that bathing of babies should be delayed, this was not deemed acceptable many community members or health care providers because of various perceptions or barriers. The perceived need for early bathing was of the newborn is strong in this community. Some of the reasons given

included a belief that putting substances on the cord helps the cord to "heal fast", and that "babies are born dirty" or that mothers expected "visitors to find the baby clean". A study in Tanzania showed that many communities support the notion that the umbilical cord is thought to make the baby vulnerable to witchcraft, and great care is therefore taken to shield both the mother and baby from bad spirits until the cord falls off. Such forms of 'protection' include applying drugs, cow dung, and powder to help heal the cord. Bathing also plays a role here, and babies are bathed early, sometimes with cold water [32]. Studies in South Asia have reported similar findings, including unhygienic cord cutting and care, as well as early bathing [23, 33-36]. The implication of these findings is that interventions to promote dry cord care and delayed bathing must focus on both the individual and the community.

The finding that some globally recommended evidence-based newborn care practices might not be acceptable, and are therefore not promoted or implemented at the community level, raises the issue of "fit" and whether or not "evidence-based" interventions actually fit in the local implementation context (referred to as 'glocal'). There is no "one size fits all" to neonatal survival [12], and interventions proved effective in one setting, may, in another setting, need to be preceded by local adaptation so as to be 'tailored' to the local context before being scaled up [4, 37, 38]. This is important for understanding the "black box of implementation" [39, 40] A compromise of practices might be needed, such as wiping instead of early bathing, or applying a safe substance to the umbilical cord (such as chlorhexidine) [41, 42].

4.3 Delays contributing to newborn deaths

As pathological causes, sepsis or pneumonia, followed by birth asphyxia, and then preterm births were the leading causes of death overall, as reported elsewhere for low income countries [5, 43]. However, as 'social causes' of deaths, when the modified three delays model [22]was applied, the findings showed that 50% of newborn deaths were mainly related to recognise delay (Delay 1 or delay in illness recognition and deciding to seek outside care), and 30% were due to treat (Delay 3 or poor quality care at health facilities), while 20% were due to access or transport problems (Delay 2). The delay to seek seemed not to be a major problem in the study setting due to a relatively good physical access to health facilities, which may not be the same across Uganda. Together, delays recognise and treat contributed to 80% of the newborn babies who died. These findings on the contribution of delays to newborn death differ from those in a Tanzanian study by Mbaruku and colleagues, which was one of the first studies to apply the three delays model to perinatal death [44]. The latter reported that most newborns died as a result of the third delay; however, Mbaruku's study only collected data from the hospital and did not include older neonates (>1 week).

4.3.1 Delay 1: Delays in problem recognition and delays in deciding to seek care

Of the newborn babies who did not die on the day of birth, most deaths occurred following delays at home. The majority were sick for at least three days before care was sought outside the home. Nearly half of the at-home deaths resulted from sepsis or pneumonia (III). According to the original model by Thaddeus and Maine [22], delays at home could be a reflection of problem recognition or a delay in deciding to seek care. Given the fact that newborn babies are very vulnerable, a delay of three days which we found before seeking

care outside the home is grave, and such sick newborns may not be helped by weak health facilities.

A recent ethnographic study in Ghana found that mothers might not be able to recognise serious illness in their newborns, and they also often do not seek care outside the home even when they do recognise serious illness [45]. It seems that even when parents are made to recognise the need to seek outside care, decision-making can be problematic. An intervention trial in Bangladesh, in which CHWs conducted intense surveillance of sick newborns, identified two challenges especially for young neonates: reaching neonates within the first two days after birth and 'parental compliance with advice to seek outside care' [46]. Studies in older children conducted in the same setting [47, 48], and elsewhere in Uganda [49], have identified challenges to care-seeking as mainly related to cost.

From the above it is clear that efforts to improve newborn survival in Uganda must address 'Delay 1' delays related to recognition and decision-making.

4.3.2 Delay 2: Delay in reaching a health facility

Of newborn babies who died, 20% were related to Delay 2, and the main cause of death was birth asphyxia . The seemingly low contribution of transport delays to babies who died may be explained by the fact that the study setting had generally good physical access to health services, and availability of bicycles and motorcycles as means of referral was good. However, for transportation to be effective, it must also be of the right quality. A limitation of the second delay as originally presented by Thaddeus and Maine [22] is that it does not call for assessing the quality of transportation. Transport of seriously ill children has been identified as an important but neglected issue in global health [50]. There is evidence that morbidity and mortality of critically ill patients are much reduced if specially trained teams availed transport and delivered life-saving treatments [51, 52]. However, such transport facilities cannot be met by the current bicycle and motorcycle services in the area. As such, transport for seriously sick children needs to be improved.

4.3.3 Delay 3: Delay in receiving quality care at a health facility

In total, 33% of newborn deaths were attributed to health facility-related delays and resulted mainly from prematurity (37%), followed by birth asphyxia (32%). The health facility assessment conducted in the area showed inadequacy in the number of qualified providers. Further, available providers lacked knowledge about managing newborn babies. A knowledge assessment on care during pregnancy, delivery and postnatal care showed the average score to be low, especially on questions related to newborn care (31%). These findings are similar to those reported elsewhere in low income countries [18, 53]. The health facility assessment also showed a general lack of basic newborn equipment, drugs (injectable ampicillin and gentamycin), supplies and an effective referral system. For instance, only 44% (7/16) of health facilities had a delivery kit, 44% (7/16) had a neonatal weighing scale and only 6% (1/16) had a neonatal resuscitation kit. Thirteen percent of newborn deaths occurred in small private clinics; where capacity to manage the newborn was also very weak. Similarly, a recent study of Kenyan hospitals also found that these did not have a capacity to manage sick newborn babies [54].

Thus, in terms of the three delays model, a lack of skilled staff, protocols, drugs and equipment coupled with weak management often lead to treat delays in providing quality care for sick babies as well as other newborns at risk of death, such as those with birth asphyxia or prematurity. The risk of deaths for newborn babies is made even worse when one considers that in Uganda, it is currently presumed that sick newborn babies can only be managed at higher level health facilities. This effectively means that because of policy regulations, the lowest level of health facilities (HC-IIs) are not allowed to have the basic newborn drugs and equipment, and their role in care is thereby limited to the initiation of treatment prior to referral. Such limitations remain, despite the fact that well documented, evidence-based constraints to care-seeking for sick children to attend health facilities have been identified [47, 48, 55-61]. Thus, reducing the treat delay by bringing qualified staff, equipment, antibiotics, supplies and guidelines to improve newborn care at health facilities of all levels is critical for newborn survival in this setting.

4.4 Addressing the delays that lead to newborn deaths

The findings suggest that besides problem recognition, referral for sick newborns also needs to be improved, both from the community and from first level health facilities, as findings show that most caretakers of sick newborns do not comply with referral advice. To improve newborn survival, interventions need to address both supply and demand-side practices and care. Thus, there is a need to strengthen both health facility and community programmes if newborn care is to be improved in low-income countries [8, 15, 62, 63]. To reduce newborn death, addressing delay 1 or delay in problem recognition and in deciding to seek outside care will be critical, as it was a major contributor to half of the deaths investigated in this study.

Based on a number of small efficacy studies, almost all from Asia [62, 64-66], efforts to scale up newborn care in low income countries through community based interventions are gathering pace. Community-based interventions can address delays in problem recognition of sick newborns (delay 1) by promoting supervised deliveries, birth preparedness and raising awareness on maternal and newborn danger signs. These are some of the practices we have found to be deficient in this setting [67]. However, unless community interventions include treatment and care at home, their success will mainly depend on strengthening of health facilities so that women in labour and sick newborn babies receive quality care. It has been suggested that introducing maternal and perinatal audit in health facilities [68], and improving neonatal resuscitation skills among health workers [69] are effective strategies to address quality of care issues for newborn babies. However, operationalising this in low-income countries remains a challenge as recent reviews have shown that the understanding of how to reduce health facility based newborn deaths is still limited [70, 71].

4.5 Perceptions and care for preterm and other newborn babies

The study on preterm care demonstrated several missed opportunities for health promotion activities to improve care of preterm and other low birth weight babies. Mothers were doing their best to care for preterm babies, but care practices were of poor quality and potentially harmful. At community level and in health facilities, including the general hospital, no STS or KMC was practiced. To keep warm, e.g. babies were wrapped in many clothes. Although most preterm babies were managed at home, care practices were of poor quality. For instance, and in addition to practices already mentioned, mothers reported using hot objects

such as jerry cans filled with hot water and charcoal stoves to keep preterm babies warm. Therefore, these mothers perceived preterm babies as needing special care.

Furthermore, information from interviews showed that community members were generally not fatalistic in their attitudes, as was also found in Malawi [72]. Thus, in terms of the TRA, the mothers had a positive attitude towards preterm care, meaning that if health providers took advantage of this opportunity to promote newborn care practices, the chances of them being accepted was likely to be high (high outcome expectancy). However, missing was the promotion of desired practices by caregivers. Recent reviews have re-emphasised the importance of implementing interventions to improve the care of preterm births, which is not only the leading direct cause of neonatal mortality, but also accounts for an estimated 27% neonatal deaths every year and is a risk factor for many neonatal deaths resulting from other causes such as infections [43]. Providers of health care should take advantage of this perceived positive attitude towards preterm babies by promoting the recommended care practices at both health facility and community levels.

A number of mothers were putting powder or antiseptics, among other substances, on the cord, and were using a bottle to feed the baby or were mixing/replacing breastfeeding (especially at initiation of feeding) with various substitutes such as glucose or sugar water or honey. Whether these are replacing other "more dangerous" practices, such as putting cow dung, dust or ash on the cord (as prevalent in the study area in the past) could not be shown in a cross-sectional study. But powder, antiseptics and bottle feeding are relatively new phenomena.

Similar 'new' practices have also been reported from Bangladesh [34], India [33] and Tanzania [32]. Moran and colleagues reported that women apply several substances to the cord including talcum powder and savlon (an antiseptic liquid). In addition, initiation of breastfeeding is often done by giving other substances such as honey and sugar water, and the authors suggest that such practices are a consequence of increasing urbanisation [34]. The Uganda Demographic Health Survey [73] and a study from western Uganda found that use of pre-lacteals was common even among educated mothers [74]. Studies on breastfeeding patterns in low income countries suggest that changes in breastfeeding have been influenced by marketing of formula milk, urbanisation, and the need for women to work away from home [75]. Thus, applying the TRA, these findings seem to suggest that within a changing environment the practices of mothers may be influenced by perceived social norms in which caregivers are aware of the expected behaviour and are willing to comply with such expectations, that is, they may associate some of these practices with 'modernity'. If these assumptions are true, then the implication is for a need for interventions targeting the entire population so as to diffuse the perceived social norms that are evolving. Here, the example of infant formula replacing breastfeeding is a warning example of how 'modern' practice with commercial interests can lead to a practice transition [76, 77].

5. Conclusion

Newborn care practices are generally poor across all socio-economic groups. This is despite the fact that most evidence-based newborn care practices were acceptable to community members although a few were not deemed acceptable. Delays occur at all levels of the continuum of care including home, access and at health facilities. The design of interventions

for the implementation of evidence-based newborn care practices needs to be tailored to the local context. In order to reduce newborn deaths, a universal strategy targeting the entire population is needed and should utilise the many missed opportunities in current programmes. Capacity to manage newborns should be built at health facilities, including private clinics and those at the lower level. Community health workers in health facility-linked preventive and curative newborn programmes may assist in underserved areasPolicymakers need to mitigate a possible newborn care practices transition in which "suboptimal" practices are being replaced with "modern" practices. This can be done through proper training, provision of clear guidelines and support for health workers, and by especially ensuring that health facilities have adequate supplies.

Implementation research on how to reduce care-seeking delays and improve referral and care at home and in both private and public health facilities for newborn babies is recommended. In addition, exploration should be done on how to best integrate CHWs into maternal and newborn care in health facility-linked programs, especially the interface with primary level health facilities. Such an intervention, the Uganda Newborn trial (UNEST) (trial register ICRCTN 50321130), was designed based on the findings described in this paper and implemented in the two study districts. The study is thus an example of research-to-programmes and policy, since results and experiences from each stage are constantly fed to policy makers.

6. References

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