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# Diagnosis and Management of Early-Onset Neonatal Sepsis (Eos) Among High-Risk Neonates in Kisii Teaching and Referral Hospital and Homabay County Referral Hospital, Western Kenya

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## Abstract

Neonatal sepsis (NS) is the third most common contributor to neonatal deaths worldwide, the majority of which occur within the first 72 hours of life (Early-onset sepsis [(EOS)]). Diagnosis of EOS is challenging due to limitations with blood volume, poor sensitivity of culture, delay in culture results, and most importantly, lack of bacterial blood culture capacity in high burden settings. Current syndromic algorithms for diagnosis of EOS lack validations and are needed to enable clinical decision making for management. To evaluate the diagnostic performance of a severe illness syndromic algorithm in distinguishing culture-proven or probable EOS from unlikely sepsis. Neonates with their mothers with suspected neonatal sepsis that gave a written consent and made the enrollment criteria that fulfilled the WHO case definition of septicemia within the first 72 hours of life were enrolled from maternity and newborn units at Kisii and Homa Bay District hospitals in Kenya. Blood samples (1-2 mLs) for culture were collected and cultured for bacteria. Between April 2015 to Jan 2016, Out of the 256 newborns infants were enrolled. Fourteen (5.7%) infants had a bacterial pathogen identified on culture, 3 were, 1 *Escherichia coli*, 1 *Klebsiella*, 1 *Staphylococcus* 1 *Aureus* and 3 *Enterobacter spp*. number at risk, 14 had sepsis giving an early onset sepsis prevalence of 5.7%, (81.6%) had a negative culture but had probable sepsis and (13.29%) Of the confirmed sepsis the majority the neonates had more than one neonatal and maternal factor of which premature rapture of membranes (PROM) was the most common maternal risk factor and refusal to feed and chest in drawing were the most common clinical featured. Out of the 223, which were followed up to day 7, we had 18(7.03%) death of probable sepsis and 0(0.00) of confirmed sepsis.

**Keywords** Diagnosis; Neonatal sepsis; Newborns; Mortality

## Introduction

Neonatal mortality account for 40% of all deaths of children under age 5 years [1]. The time of birth and first days of life are the riskiest period in the human life span. Each year, 3 million babies die in the first week of life, and up to two third (2/3) of this die in the first 24 hours after birth.

Middle- and low-income countries have provided seven danger signs that can be used to identify infants with very severe disease including neonatal sepsis [2]. These signs provide high sensitivity and moderate specificity for detecting serious illness in newborns in low-resource settings and have now been incorporated into the new neonatal WHO Integrated Management of Childhood Illness (IMCI) guidelines [3]. Obtaining accurate past and present medical history from the mother as well as identifying specific clinical and laboratory parameters can reasonably accomplish diagnosis. Validate predictors of positive blood culture and deaths among neonates with suspected neonatal sepsis in a tertiary hospital revealed a neonatal sepsis prevalence rate of 39% [4]. Convulsions, lethargy, inability to feed, cyanosis, Premature rapture of membranes (PROM) and meconium stained liquor were significantly found to predict a positive blood culture in both early and late onset neonatal sepsis [4]. Confirmation of pathogenic organisms allows targeted antibiotic therapy [5]. However, identification of pathogenic organisms in neonates with sepsis syndrome is fraught with difficulties [6]. Bacterial load may be low due to mothers receiving antepartum or intrapartum antibiotics and because only small amounts of blood can often be taken from newborns [7]. Contamination rates may also be very high due to the technical difficulties of sterile venipuncture in small babies [8]. There may also be misinterpretation of the role of coagulase-negative *staphylococci* e.g. *S. epidermidis*, as these organisms are both normal skin flora and pathogenic organisms in preterms and infants with indwelling blood vessel catheters [9].

Automated blood culture systems have long been considered the gold standard for microbiological diagnosis. However, despite improvements in growth media and instrumentation, results of blood culture can be delayed by up to 48 hours [10-12]. The condition of a neonate with true sepsis can deteriorate quickly; thus, the most common approach is to initiate empiric broad-spectrum antibiotic therapy in all young infants with suspected bacterial infection [2]. A negative blood culture after 48 hours may allow cessation of antibiotic therapy in a well infant [7]. While appropriately cautious, this practice leads to antibiotic exposure in a large number of newborns for whom antibiotic treatment may be unnecessary since blood cultures are positive in only 5%-10% of suspected sepsis cases, even at highly resourced facilities [13].

It is important to establish how clinical diagnosis and management of septicemia can be done, routinely using the WHO organization criteria, (IMCI guidelines), this would assist in planning for preventive measures and misuse of antibiotics. We report the results of a study conducted in Kisii Teaching and Homabay county referral Hospitals in Western Kenya.

## Materials and Methods

All neonates with their mothers with suspected neonatal sepsis that gave a written consent and made the enrollment criteria that fulfilled the WHO case definition of septicemia were enrolled, so long us, and blood culture was taken, for those who were not yet on treatment, it was initiated immediately. We excluded neonates, who had been on antibiotics for more than 24 hours and those that were very sick on support treatment. The sample size was 256.

### Study side

The study was carried out in new born units (NBU) of Kisii teaching and Homabay County referral Hospitals in Western Kenya. The NBU admits sick neonates from home, other peripheral health facilities and from theatre or Maternity ward, outpatient within the hospitals. Participant files and study questionnaire responses were used to obtain relevant information. The participants were selected using the WHO case definition of septicemia as used in intergraded management of child illness (IMCI). If the neonate had one or two signs and symptoms of septicemia a clinical diagnosis was made. The two referral hospitals based their diagnosis and management of septicemia on IMCI guidelines.

### Target population

Neonates aged less than 0-72 hours old and their mothers were the taget population this was based on maternal risk factors or clinical presentation of the neonate. The neonate and mother were only enrolled in the study after consent was obtained for participation of the neonate and the mother (pair).

### Procedures

Standardized questionnaire was used to obtain demographic and clinical information which included details of abstracted from the infant medical records and a head-to-toe neonatal physical examination. Neonatal variables that were collected at entry included location of birth, admission diagnosis, gestational age at birth, birth weight, Apgar score at 1, 5 and 10 minutes, and congenital abnormalities. Other data that were collected included feeding method, medical complications, antibiotic use, need for resuscitation, laboratory and culture results, and discharge diagnosis. Maternal data were abstracted from obstetric records and included maternal age, frequency of prenatal care, demographics, obstetrical history, Gestational age was estimated using reported last menstrual period (LMP). Prematurity was defined as an infant delivered <37 weeks gestation. Birth weight was categorized as normal (>2500 g), low (1500 g-2500 g), very low (1000 g-1499 g), and extremely low (<1000 g). The primary outcome of interest was neonatal death, defined as death within day 3 and day 7 of a live delivery. Infants were considered to be alive if there was no record of death at last contact or by day 3 up to 7 days of life. The cause of death was determined by the first discharge diagnosis.

Blood samples were collected from the neonates with suspected sepsis for complete blood count (CBC) and blood cultures. Approximately 1 ml to 2 mls of venous blood was aseptically drawn from each neonate and inoculated into a pediatric blood culture bottle.

The blood cultures were incubated aerobically at 37°C and observed daily for the first 3 days for the presence of visible microbial growth by one of the following: haemolysis, air bubbles (gas production), or coagulation of broth. At the same time, subcultures were made during 3 successive days on enriched and selective media including blood, chocolate, MacConkey, and mannitol salt agar plates and examined for growth after 24-48 hours of incubation. The same protocol was repeated until the 7th day before blood culture was considered to be free of microorganisms. Isolates obtained were identified by standard microbiological techniques.

These children were followed up day three and day 7 post-delivery and treatment instituted/ evaluated as follows: Those defined as proven sepsis were to be put on Crystalline Penicillin and Gentamycin for 10 days, however this was not the case, as the majority of the neonates enrolled were already on treatment of the same, thus they continued with the treatment. Those defined as probable sepsis continued with Crystalline Penicillin and Gentamycin empirically blood culture negative results, did not have impact on the empiric antibiotic therapy as the treatment continued in the well-appearing neonate for 10 -14 days. Follow up was done up to 7 days to ascertain the wellbeing of the neonate. Those defined as no sepsis were observed for at least 24 hours. If they remained clinically stable, they were discharged home. On discharge, follow up continued to up to 72 hours' post-delivery via telephone interviews.

### Ethical considerations

Ethical approval for this study was obtained from University of Washington institution review committee (Appendix 3) and Ethical review committee of Kenya Medical Research Institute (KEMRI).

## Results

Two hundred and fifty-six neonates were enrolled. The incidence of suspected neonatal sepsis among the admitted neonates at the Newborn units of the two hospitals during the study period was 5.7% (14/256) as indicated in Figure 1. Two hundred and fifty-six neonates with a median age of 3 days (range 0-4) were enrolled. 149 (58.00) were male, 107 (42.00) were female, aged between 0-4 days. Table 1 shows demographic characteristics of participants. Most frequently reported clinical features were chest in drawing (47.7%), difficult feeding (42.9%), respiratory rate >60 before 72h (38.8%), low temperature (33.3%), elevated temperature (15.4%), and jaundice (2%), as shown in Table 1.

| Variables | n=256 | % | No sepsis | Peobable sepsis | Culture positive | p-value |
|---|---|---|---|---|---|---|
| Male | 149 | 58.00 | 12(8.33) | 123(85.42) | 9 (6.23) | 0.051 |
| Female | 107 | 42.00 | 19(18.8) | 77(76.24) | 5(4.95) | |
| Weight (gm) | | | | | | |
| <2500 | 155 | 68.5 | 30(96.30) | 119(58.30) | 8(57.10) | 0.0001 |
| >2500 | 89 | 36.5 | 1(3.20) | 82(41.21) | 6(42.90) | |
| Maturity | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Preterm | 92 | 61.50 | 2(6.70) | 84(42.90) | 6(46.20) | 0.001 |
| Term | 147 | 38.50 | 28(93.30) | 112(57.10) | 8(57.10) | |
| Clinical features (Signs and Symptoms) | | | | | | |
| Chest indrawing before 72 hours | 96 | 47.7 | 0(0.00) | 92(47.70) | 4(40.00) | 0.572 |
| 5- minute Apgar less than 6 | 82 | 41.1 | 0(0.00) | 78(41.70) | 4(30.80) | 0.001 |
| Difficult feeding feeding before 72 hours | 53 | 28.0 | 0(0.00) | 47(26.90) | 6(42.90) | 0.001 |
| Convulsions before 72 hours | 44 | 20.6 | 0(0.00) | 44(22.00) | 0(0.00) | 0.002 |
| Respiratory rate > 60 before 72 hours of life | 35 | 38.9 | 0(0.00) | 33(38.8) | 2(40.00) | 0.572 |
| Lethargy before 72 hours of life | 22 | 10.2 | 0(0.00) | 20(10.40) | 2(18.20) | 0.498 |
| Apnoe before 72 hours of life | 19 | 8.9 | 0(0.00) | 17(8.50) | 2(14.60) | 0.183 |
| Low temperature before 72 hours of life | 17 | 34.0 | 0(0.00) | 1(533.30) | 2(40.00) | 0.741 |
| Failure to move before 72 hours of life | 15 | 7.3 | 0(0.00) | 15(7.70) | 0(0.00) | 0.514 |
| High temperature before 72 hours of life | 9 | 15.5 | 0(0.00) | 8(15.40) | 1(16.70) | 0.909 |
| Jaundice | 5 | 2.4 | 0(0.00) | 4(2.00) | 1(10.00) | 0.270 |
| All the data was analyzed using Chi-square test | | | | | | |

**Table 1:** Demographic and clinical characteristics of participant.

## Baseline characteristics of the mothers

The baseline characteristics of the mothers are shown in Table 2 and Figure 1. The mothers had a mean age of 30 years, 195 were married, A total of 221 mothers had gone to school, with primary 37.2% and secondary 39.2% being the highest level attained. A majority of the mothers across all groups had attended ≤ 4 antenatal clinic visits. HIV sero-positive rates varied across the three groups with the proven sepsis group having the highest rate (28.57%) followed by no sepsis groups and probable at rates of 38.71% and 6.53% respectively. The highest PROM rates were found in the no sepsis group at 34.5% as compared to 25% and 12.2% in the proven and probable sepsis groups respectively. The commonest mode of delivery was vaginal delivery with 150 (61.22) across all the groups with rates of 2.00%, 97.33% and 0.67% in the no sepsis, probable and proven sepsis groups respectively.

| Characteristic | n=255 | No sepsis | Probable sepsis | Proven sepsis | P-value |
|---|---|---|---|---|---|
| Married | 195 (79.59) | 20(1.03) | 164(84.61) | 11(5.64)) | 0.057 |
| Never Married | 53(20.70) | 8(25.81) | 31 (15.50) | 3(21.43) | |
| Educational leve 242 | | | | | |
| Primary | 9(37.19) | 10 (32.26) | 75 (37.50) | 5(35.71) | 0.018 |
| Some Primary | 21(8.68) | 8(25.81) | 13(6.50) | 3(21.43) | |
| Secondary | 95(39.26) | 9(29.03) | 81(40.50) | 5(35.71) | |
| Vocational | 19(7.85) | 4(12.90) | 14(7.00) | 1(7.14) | |
| University | 17(6.94) | 0 (0.00) | 17(8.50) | 0(0.00) | |
| HIV status n=244Pearson chi2(2) = 30.4655 Pr = 0.000 | | | | | |
| Negative | 215(88.11) | 19(38.71) | 186(93.47) | 10(71.43) | 0.0001 |
| Positive | 29(11.89) | 12(38.71) | 13(6.53) | 4(28.57) | |
| Mode of Delivery n=245 | | | | | |
| Vaginal | 150(61.22) | 3(2.00) | 137(97.33) | 1(0.67) | 0.0001 |
| Vaginal attempt with | 9 (3.68) | 0 (0.00) | 8 (88.89) | 1(11.11) | |
| C-section | 86(35.10) | 28(90.32) | 55(27.50) | 3(21.43) | |
| All the data was analyzed using Chi-square test | | | | | |

**Table 2:** Maternal characteristics.

A comparison was done between the different risk factors assessed; 68.75% of recruited newborns presented with maternal risk factors, 73.8% had neonatal risk factors and 45.3% had both maternal and neonatal factors and only about 84.6% exhibited clinical features suggestive of sepsis. Both maternal and clinical risk factors were found in 84% of the newborns (Table 3).

| Characteristics | N | % |
|---|---|---|
| At risk* | 176 | 68.75 |
| Not at risk | 80 | 31.25 |
| Clinical | | |
| At risk** | 189 | 73.83 |
| Not at risk | 67 | 26.17 |
| Maternal and clinical | | |
| At risk*** | 116 | 45.31 |
| Not at risk | 140 | 54.69 |
| *refers to newborns presenting with maternal risk factors | | |
| ** refers to newborns presenting with clinical features of sepsis as a risk factor | | |

***refers to newborns presenting with both maternal risk factors and clinical features of sepsis

**Table 3:** Distribution of risk factors for sepsis (n=256).

From Table 4 and Figure 2 the majority of the neonates enrolled had higher maternal factors as compared to infant factors, lack of infant factors could be attributed to poor documentation of neonatal factors, which was one of the major limitations in this study and the use of intravenous antibiotics to resuscitate sick infants as the general population were enrolled into the study after receiving antibiotics.

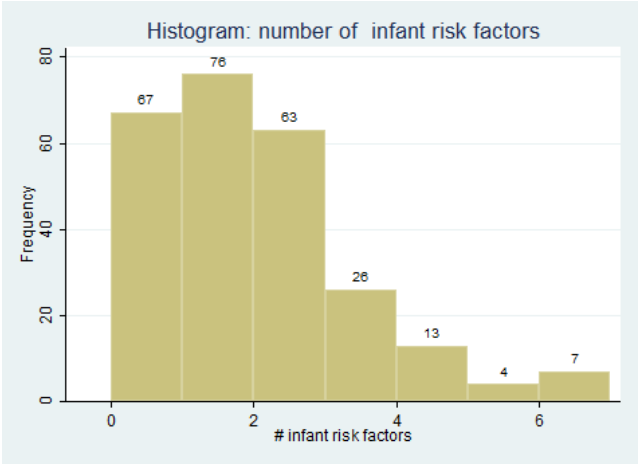


**Figure 1:** Infant risk factors.

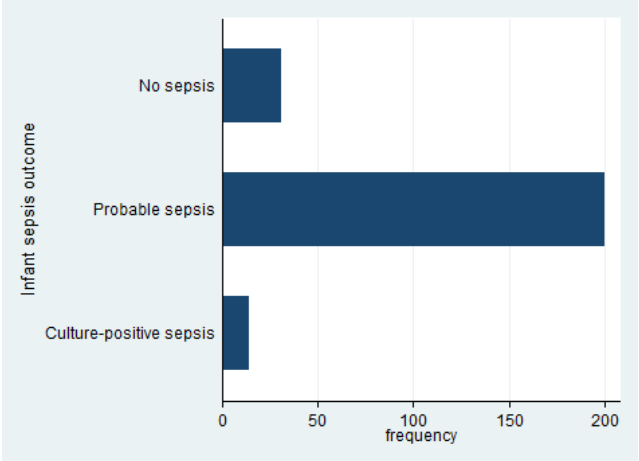


**Figure 2:** Comparing maternal risk factor (PROM) a cross the three out comes.

## Comparison of risk factors to sepsis

Maternal risk factors were then compared to sepsis outcome. PROM was the most common risk factor identified in those with proven sepsis, but was not unique to this group (p=0.006) (Figure 3). Delivery <37 completed weeks, common across all the three groups, was a unique identifier of sepsis in those at risk (p=0.816). Respiratory rate >60 before 72 hours and Chest in drawing before 72 hours of life had an equal rate of 40% were the only clinical features identified in those with proven sepsis (Table 4). Several clinical features were identified in those with probable sepsis with a majority chest in drawing (47.7%) and with hypothermia (33.3%).

| Characteristics | no= 245 (100) | No Sepsis 29 (100.00) | Probable sepsis 175(100.00) | Proven Sepsis 11(100.00) | P-value |
|---|---|---|---|---|---|
| Fetal DistressPearsonchi2(2) = 13.1554 Pr = 0.001 | | | | | |
| No | 197 (91.63) | 22(75.86) | 166(94.86) | 9(81.82) | 0.001 |
| Yes | 18(8.37) | 7(24.14) | 9(5.14) | 2(18.18) | |
| PROMPearson chi2(2) = 10.0846 Pr = 0.006 | | | | | |
| | 221 (100) | 29(100.00) | 180(100.00) | 12 (100.00) | |
| No | 186(84.1600) | 19(65.52) | 158(87.78) | 9(75.00) | 0.203 |
| Yes | 35(15.84) | 10(34.48) | 22(12.22) | 3(25.00) | 0.006 |
| All the data was analyzed using Chi-square test | | | | | |

**Table 4:** Comparing the most common risk factors to sepsis.

Despite being classified into the "no sepsis" group, some of the newborns presented with clinical features of sepsis; 10% had jaundice, 16.7% elevated temperature, and 14.30% had tachypnea. This had some clinical significance (Table 5).

| Characteristics | No Sepsis No=31 | | Probable sepsis No =175 | Proven Sepsis No=14 | P-value |
|---|---|---|---|---|---|
| Breast feeding N=202 | | | | | |
| Normal | 149 | 31(100.00) | 128(73.10) | 8(57.10) | 0.005 |
| Difficult/refusal | 53 | 0(0.00) | 47(26.90) | 6(42.90) | |
| Stimulation n=209 | | | | | |
| Appropriate | 187 | 6(100) | 172(89.60) | 9(81.80) | 0.498 |
| Inappropriate/ lethargy | 22 | 0(0.00) | 20(10.40) | 2(18.20) | |
| Sucking reflex | | | | | |
| No | 6 | 4(10) | 10(13) | 1(6) | 0.858 |
| Yes | 105 | 36(88) | 64(83) | 15(94) | |
| Anterior Fontanelle | | | | | |
| Flat | 128 | 1(0.39) | 113.08(98.04) | 14(100.00) | 0.610 |
| Bulging | 92 | 30(99.61) | 62(1.95) | (0.00) | |
| Jaundice | | | | | |
| No | 203(97.60) | 1(100.0) | 194(98.00) | 9(90.00) | 0.498 |
| Yes | 5(2.40) | 0(0.00) | 4(2.00) | 1(10.00) | |

All the data was analyzed using Chi-square test

**Table 5:** Comparing newborn clinical features with the three sepsis groups.

## Distribution of sepsis

Out of the 256 newborns at risk, 14 had sepsis giving an early onset sepsis prevalence of 5.7%, (81.6%) had probable sepsis and (13.29%) had no sepsis.

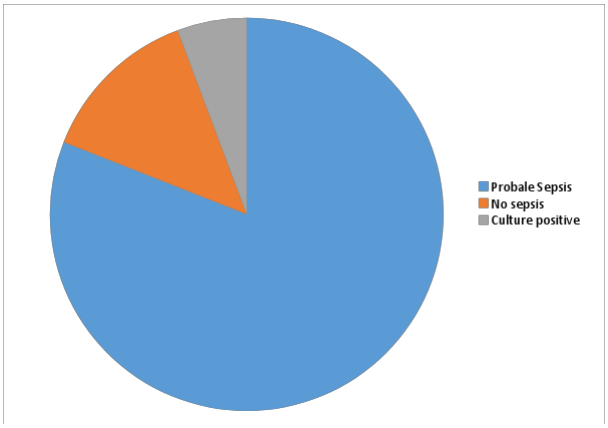


**Figure 3:** Sepsis classification of the newborns at risk (n=256).

## Etiology of sepsis

The etiological pathogens were mostly gram negative bacteria, gram positive isolate were *Staphylococcus aureus*. The gram-negative bacteria isolated were *Escherichia coli, Enterobacterspp, Klebsiellaspp* and a fungus of *yeast spp* (Table 6).

| Bacteria | Before blood draws | After blood draws | Proven sepsis | Total |
|---|---|---|---|---|
| *Coagulase Negative staphylococcus* | 1 | 0 | 1 | 1 |
| *Coagulase Negative* | 1 | 0 | 1 | 1 |
| *Enterobactercoacae* | 3 | 0 | 0 | 3 |
| *Entereococae cloacae st* | 1 | 0 | 0 | 0 |
| *Escherihia coli* | 3 | 0 | 0 | 3 |
| *Gram positive cocci* | 0 | 0 | 1 | 1 |
| *Staphylococcus Aureus* | 0 | 0 | 1 | 1 |
| *Yeast present* | 1 | 0 | 0 | 1 |
| *Kalbeshiapneumonia* | 1 | 0 | 0 | 1 |

**Table 6:** List of bacteria.

Crystalline penicillin and Gentamycin were used for empiric treatment for all the neonates that were clinically diagnosed. Treatment was never stopped, even after results were confirmed as no sepsis. Thus to say both negative blood cultures and positive blood cultures received similar treatment of antibiotics for 10 to 14 days. However, the proven sepsis group, those who never responded to the 1st line treatment, were later prescribed 2nd line treatment, based on the antibiotic sensitivity test.

## Outcomes

The infants were followed up on the 7th day of life. Overall (223) 98.2% were alive and (4) 1.76%. For those that were a life, we had 30 with no sepsis, 180 with probable sepsis and 13 with proven sepsis. For the 3rd follow up visit, we had 92.8% alive and 16 (6.25%) neonates that were reported dead. Out of the 223, which were followed up to day 7, we had 18(7.03%) (Table 7).

| Outcome | No sepsis n(%)= 31 | Probable sepsis n(%)=200 | Proven sepsis n(%)=14 |
|---|---|---|---|
| Died | 0 (0.00) | 4(2.17) | 0(0.00) |
| Alive | 30(100.0) | 180(97.83) | 13(100.0) |
| Lost to follow up | 1(3.23) | 16(8) | 1(7.14) |

**Table 7:** Outcome of the newborns deemed at risk of sepsis.

## Discussion

This study set out to look at the proportion of neonates in Newborn units at risk of sepsis. This group was further evaluated for sepsis and causative agents identified. The clinical signs and symptoms of neonatal sepsis are subtle and nonspecific, making its early diagnosis difficult, and it can interfere with other life-threatening diseases, perinatal asphyxia. Blood culture is still the gold standard for definitive diagnosis of neonatal sepsis, in spite of some drawbacks of blood cultures as being time consuming, low sensitivity, and possible contamination especially with commensal CoNS that could be produced.

Sepsis represent the main cause of neonatal mortality accounting for more than one million neonatal deaths worldwide every year [14], and antibiotics are the most commonly prescribed medications in the neonatal intensive care units (NICU) [5,15]. The prescription of antibiotics in Homabay and Kisii New born units was not different from the global common practice. Sepsis has often nonspecific signs which may also have serious consequences; as a result, empirical antimicrobial therapy is promptly initiated in symptomatic infants with suspected sepsis. However, neonates who do not have infection often receive antimicrobial agents. This finding by Stoll et al. was not different from this study, where 256 of the enrolled participants received antibiotics, whereas only 14 (5.7%) had confirmed neonatal sepsis. This shows inappropriate empirical antibiotic treatment may have serious side effects [16-18].

The reported low rates of confirmed pathogens in this study were not different as compared to other studies done in the developed countries as indicated by Chiabi et al. very low rates were reported in the developed countries [19] which can be explained by the high quality of life and high standard measures of health care and hospital services in these countries was also not different from the study done in Boston by Mukhopdyay et al. which revealed 14.7% of 7226 of neonates that were evaluated for early neonatal sepsis.

During the study period, 256 neonates with suspected neonatal sepsis (using clinical criteria) were enrolled. Only 14 (5.71%) were confirmed to have bloodstream infection by using blood culture. This rate is comparable to rates reported in other developing African and Asian countries as Bangladesh [20-23]. However, negative blood culture does not exclude sepsis as about 26% of all neonatal sepsis could be due to anaerobes , which was the case in this study, that as the majority who were culture negative, but were sick looking, got better and were discharge after a dose of antibiotics.

The study also revealed that of the all newborns admitted in Newborn units and postnatal wards, 45% were at risk of sepsis and of whom 5.71% had proven sepsis. These findings reveal the need to screen all newborns for sepsis during routine clinical practice. A study done in 2009-2010 at the Muhimbili National Hospital in Dar essalaam assessing the prevalence of sepsis, among other things, in 330 babies, both term (77%) and preterm (23%), mean age of three days, reported a proven sepsis rate of 22.4% [4]. This higher rate could be explained by the addition of preterm in the study population who pose a greater risk of having sepsis.

In this study refusal to feed and chest in drawing were the most common clinical features associated with proven sepsis. With a similarly study in Kenyatta hospital in Kenya found feed intolerance as the most common clinical finding in those found to have sepsis, in addition to lethargy and irritability [24]. However, this is in contrast to the Muhimbili study whose participants with fever and hypothermia were noted to have higher frequency of sepsis [4]. This difference could be due to the variation in the population or missed opportunities in the wards of identifying fever/hypothermia (at night, primiparous women who may not be clear on what fever is). Patient education about newborn health should therefore be re-emphasized in our day to day patient management. Of note is that this study was limited to a three, seven day follow up of the newborns via telephone interviews. A longer follow period of the babies and face to face interviews with the mother may have revealed more clinical features associated with proven sepsis. In addition, newborns in the proven and probable and no sepsis groups were started on antibiotics empirically and this may have altered identified clinical features of sepsis [25].

Premature Rapture of Membranes (PROM) was the most common maternal risk factor in those with proven sepsis. However, this was not unique to the proven sepsis group as it was present in the probable and no sepsis groups. This is in contrast to a multi-center study done by Kumar et, al. that estimated the probability of neonatal early onset infection based on maternal risk factors. Post-term delivery, maternal fever, and prolonged ROM were strong individual predictors of infection [26]. Notably, the greatest percentage of post-term delivery was in the proven sepsis group.

Advanced maternal age has been associated with early neonatal sepsis [27]. A study done by Mhada, et al. noted, that once a woman's child bearing age is postponed, with the extended period between the sexually mature phase and childbirth and an increase in the proportion of unplanned pregnancies, many women have induced abortions. This can lead to adverse effects on pregnant women and their newborns during delivery and following childbirth hence an increase in risk factors for neonatal sepsis. On the contrary, the mean maternal age of this study participant was 25 years which may also explain the lower sepsis rates in this study as compared to other studies.

The 2009-2010 Muhimbili study revealed *Escherichia Coli* (3.71%) and *Enterobacter Cloacae* (3.71%) as the commonest isolate, though, predominantly from pus swabs [28]. Similarly, a ten-year review study (2000-2009) done at Aga Khan University Hospital in Kenya in one hundred and thirty-two neonates revealed gram-positive organisms were the predominant cause of both early and late onset sepsis; their common isolates were *staphylococcus epidermidis* (34%) and *staphylococcus aureus* (27%). There were no isolates of group *B streptococcus* [29]. These two studies are similar to this study as this study had 3.17% *Escerichia coli* a similar percentage of *Enterobacter cloacae*, within ten months, this means more pathogens would have been found if the study population was hire and for a long period.

Almost 50% of the newborns were doing well by day 3. Unfortunately, some were lost to follow-up after discharge. Notably, all the 7.1% who died were from the probable sepsis group. From the rising trend of sepsis rates from previous studies and findings from this study, keen clinical practice by clinicians is necessary for early diagnosis of sepsis.

## Conclusion

The current syndromic management as stipulated by the World health Organization guidelines of 2012 could be the way to go, if only the algorithm could be validated for neonates as early as seventy two hours to twenty eight days of age. This position acts against the current guidelines which seem to be responsive to sepsis that happens to children of one month to five years. In that regard therefore IMCI guidelines should be streamlined and made use of and every health work, nurses, clinicians who are responsible for taking history on admission be trained. This will facilitate both on early diagnosis and management of neonatal sepsis.

These guidelines will also inform the number of children that will require having other tests like blood cultures which are invasive, expensive and time There is 100% use of antibiotics for every neonate that is admitted, there is urgent need, to evaluate the current pediatric protocols on management of the neonate's verses evaluate the training and knowledge the clinicians have on the current guidelines of antibiotic use.

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