



Chlorhexidine 7.1% Cord Care Practices and Presentation of Neonatal Sepsis in Vihiga County, Kenya: A Cross-Sectional Study

Veronica Daisi Musiega, Mary Kipmerewo and John Arudo

Department of Health, County Government of Vihiga

Masinde Muliro University of Science and Technology

<https://orcid.org/0009-0002-8214-929X>

Email: vmusiega@gmail.com

Abstract: Neonatal sepsis remains a leading cause of neonatal morbidity and mortality in sub-Saharan Africa, with Kenya reporting 21 deaths per 1,000 live births in the first month of life. Unsafe umbilical cord care remains an avoidable source of neonatal infection, while chlorhexidine (CHX) cord care is recommended by WHO and Kenya Ministry of Health for prevention. However, correct use depends on mothers' practices and adherence. This study assessed the association between CHX cord care practices and presentation of neonatal sepsis in Vihiga County, Kenya. An analytical cross-sectional study using mixed methods was conducted among 378 mothers with newborns. Data were collected using structured questionnaires and key informant interviews. Odds ratios were determined and logistic regression was used to examine associations. Neonatal sepsis prevalence was 21.7%. Correct practices were protective, including once-daily application (OR=0.2, $p<.001$) and hand hygiene (OR=0.3, $p=.01$). Application for less than 7 days increased risk (OR=2.3, $p=.006$), while cultural practices significantly increased risk (OR=3.7, $p<.001$). Awareness alone was not protective. The study concludes that correct and consistent CHX use, rather than awareness alone, is critical in reducing neonatal sepsis. It recommends behaviour-focused interventions to improve CHX application. Findings are expected to inform neonatal sepsis prevention policy in Kenya.

Keywords: Chlorhexidine, Cord Care, Maternal Practices, Neonatal Sepsis

How to cite this work (APA):

Musiega, V. D., Kipmerewo, M. & Arudo, J. (2026). Chlorhexidine 7.1% Cord Care Practices and Presentation of Neonatal Sepsis in Vihiga County, Kenya: A Cross-Sectional Study. *Journal of Research Innovation and Implications in Education*, 10(4), 989 – 1000. <https://doi.org/10.59765/cr3>

1. Introduction

The first month of life is the most vulnerable period for child survival, with 2.3 million newborns dying in 2022 (WHO, 2025a) which accounts for 47% of all the deaths in children under 5 years. Sub-Saharan Africa recorded the biggest neonatal mortality at 27:1000 then Central and

Southern Asia at 21:1000. The majority of newborn deaths, around 75% take place within the first week after birth, with nearly one million babies dying within just the first 24 hours of life. The leading causes of these deaths include premature births, birth asphyxia and neonatal infections (WHO 2024). Neonatal sepsis contributes to 17% of all the deaths in Sub-Saharan Africa compared to 6% in developed countries (WHO, 2022). A study done in Nigeria involving

most countries revealed that, Nigeria had the biggest rate of under-five fatalities. Sepsis in the first week or two of life is a major cause of new born deaths with 60.2% of all causes of neonatal deaths being sepsis (23.3) and Tetanus and 13% two prominent complications of the umbilical infections (Israel, *et al* 2024). Seventy-five percent of all neonatal deaths in developing countries are linked to neonatal sepsis. In primary settings, poor cord hygiene is a major contributor to the occurrence of neonatal sepsis (Moraa, Mweu & Njoroge, 2019). Essential new born care services are key to reducing these mortalities. Among the key interventions that need to be fast tracked include thermal protection, hygienic umbilical cord care, skin care and early exclusive breastfeeding (WHO, 2025b). In a study in Jos plateau Nigeria, a newly cut neonatal Umbilical stump is a potential portal of pathogen entry leading to omphalitis, neonatal sepsis can complicate omphalitis, but good cord care practices can reduce this risk (Shwe, *et al* (2023).

The ratio of neonatal mortality in Kenya is 21 per 1000 live births (KDHS, 2022). In Kenya, the prevalence of neonatal sepsis was reported at 29.3% (Okube & Komen, 2020). Identification of risk factors and timely prevention and initiation of treatment can significantly reduce neonatal mortality and morbidity (Wondifraw, Wudu, Tefera, *et al.*, 2025). In order to achieve sustainable development goal, reducing newborn and under five mortality as low as 12 per 1000 and 25 per 1000, respectively is a key strategy (UNICEF, 2025). The Ministry of Health has established CHX 7.1% as the standard for umbilical cord care. This informed the inclusion of CHX 7.1% gel on the WHO model list of essential medicine for children especially in low-and middle-income countries. Draft guideline for application of CHX for new born umbilical care in Kenya has been shared. CHX application is now an intervention towards reduction of Neonatal Sepsis in Kenya and in Vihiga (MoH, 2022).

About 30% of births take place in the home environment in Vihiga County (KHIS, 2022). Most of these home births occur to women from low socio-economic status, under poor hygiene standards which predisposes the newborn to cord infection and Sepsis. The traditional birth attendance and the mother in laws who attend to these deliveries use unsterile equipment to clamp, tie and cut the cord which again risks sepsis to the new born (Report from TBAs, 2022). They also apply substances to the freshly cut cord stump such as ash, cow dung, herbs to hasten healing which predispose sepsis to the new born. The total number of neonatal deaths from hospital (skilled) deliveries were about 203 deaths in the year 2023 (Reports from New born Care Admissions Vihiga, 2023). In addition, the new borns

are bathed in water that has been treated with traditional herbs that could cause serious infection.

The major reason for new born admissions in Vihiga hospitals is Neonatal sepsis, asphyxia and prematurity (Hospital Report, 2023). The multiple risk factors in Vihiga and the persistent high numbers of neonatal deaths estimated at 22 per 1000 live births (KDHS, 2022) led to the implementation of CHX 7.1% cord care in December 2015. CHX 7.1% is applied to the cord after delivery and given to the mother to continue applying it on the cord for the next 7 days (MoH, 2022) however some babies are still readmitted back with Sepsis and some die at community in the first week of life (KHIS, 2023). Hence the study aimed to determine the association between maternal perceptions, 7.1% CHX umbilical cord-care practices, and the reported clinical presentation of neonatal sepsis among newborns in Vihiga County, Kenya.

2. Literature Review

2.1 Theoretical Framework

The research has been anchored on the Health Belief Model formulated by Rosenstock (1974). According to the theory, an individual's decision to take a preventive health action is affected by their perceptions about a health threat and about the recommended intervention. These perceptions comprised perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action and self-efficacy, among others, that interact to affect the behaviors and decisions of an individual. The main focus of the theory was to show the relevance of understanding both the experiences of an individual and the impact of beliefs, knowledge, attitudes, family, community and culture. It was appropriate for research aimed at addressing health problems like neonatal sepsis since it occurred in various systems of a mother's environment and affected her involvement in newborn cord care.

In addressing the research problem of investigating the influence of awareness about chlorhexidine on clinical presentation of neonatal sepsis, the Health Belief Model played a crucial role in understanding the concept of awareness in terms of the quality of knowledge about CHX, how to apply CHX, knowledge on side effects, knowledge on what to do about side effects, clinic attendance and information about the CHX. Mothers who were aware of CHX and understood how to apply it correctly and what to do in case of side effects developed

confidence and adhered to the recommended cord care, thus reducing the occurrence of neonatal sepsis.

It also helped achieve the second and third objectives in examining the influence of acceptability of CHX and cultural practices of cord care on clinical presentation of neonatal sepsis. These aspects emanate from perceived benefits and perceived barriers, where there are no adequate measures to promote the use of CHX since there is no community support and health workers who are involved. For example, when mothers do not accept CHX, do not carry CHX, do not apply CHX at the required frequency and do not know how CHX was applied, and when communities continue to use traditional substances for cord care and their own ways of diagnosing sepsis, newborns will be unable to benefit from CHX. As highlighted by Rosenstock, such a practice is not a one-off event but is influenced by the interaction between the mother's beliefs and the cultural system (Rosenstock, 1974).

With regards to the goal of studying the perceived effectiveness of CHX on clinical presentation of neonatal sepsis, the theory took into consideration factors like perceived benefits and self-efficacy that include the ability of CHX to reduce neonatal mortality and morbidity, reduce the risk of omphalitis and reduce superficial infection. This shaped their decision of how to either continue using CHX or drop out of its use. In case the needs of a mother are not met in terms of information, and the health system does not offer any help, she will get into traditional practices which will interfere with newborn health. Health Belief Model gave the research the ability to view neonatal sepsis not only as an individual problem but as a result of many interdependent perceptions and beliefs.

2.2 Empirical Review

Sexual Neonatal sepsis continues to contribute substantially to global neonatal mortality, with the greatest burden occurring in resource-constrained settings, particularly in low- and middle-income countries (Raturi & Chandran, 2024). It affects roughly 1 to 10 out of every 1,000 live births in high-income settings, but the burden is about three times higher in low-income countries. The occurrence of both early and late onset infections also differs considerably across regions. For example, the incidence of neonatal mortality was higher in rural than in urban settings in Senegal and in Kenya (Niyoyita, *et al.*, 2024). The case fatality rate of neonatal sepsis may reach 52% contributing to almost one million deaths in developing countries. Neonatal sepsis arising from an umbilical source often begins as omphalitis) carries a high

mortality rate of 7% to 15% globally and accounts for new born infections especially in low resource settings (M Singh) 2022.

A study conducted in Ethiopia identified prolonged rupture of membranes, maternal fever during labour, urinary tract infections, foul-smelling amniotic fluid, and low APGAR scores as key independent predictors of neonatal sepsis (Sheifera *et al.*, 2023).

The same study also observed that the onset of neonatal sepsis was higher in the first week of a neonate's life. Common risk factors for neonatal sepsis in sub-Saharan Africa have been identified as: resuscitation (OR2.7, 95%, low birth weight <1-5kg (OR3.37), low Apgar Score (OR3.37), prematurity < 37 weeks (OR 1.19) and premature rupture of membranes (Bech, *et al* 2022). Other factors include maternal pyrexia during pregnancy genital urinary ascending infections (Habak, Carlson & Griggs, 2024). Social economic factors like low-income countries, HIV infection, Maternal Under nutrition or Placental Malaria, low birth weight, difficult delivery (obstructed labor and asphyxia), black race in the case of Group B Streptococcus bacteria; male infants are more susceptible to sepsis and meningitis due to gram negative bacteria. Breaks in skin and mucous membrane, and environmental factors such as hygiene, have also been associated with increased risk of sepsis.

Bacterial infections are the most common cause of sepsis in newborns. Bacteria such as *E. coli*, *Listeria* and Group B streptococcus (GBS) are common bacteria that can cause infections that lead to sepsis (Singh, Alsaleem & Gray, 2022). Neonatal sepsis may be categorized as early onset (day of life 0-3) or late onset (day of life 4 or later). Of newborns with early-onset sepsis, 85% present within 24 hours (median age of onset 6 hours), 5% present at 24-48 hours, and a smaller percentage present within 48-72 hours (Ozmear & Bulbul, 2020.) The condition tends to develop most quickly in preterm infants. Early-onset infection is usually linked to organisms transmitted from the mother, either through the bloodstream and across the placenta or, more commonly, by an ascending infection from the cervix. During delivery, the baby may also be exposed to microbes present in the mother's genitourinary tract while passing through the birth canal. Because early signs of sepsis in the newborn are nonspecific, diagnostic studies are often ordered and treatment initiated in neonates before the presence of sepsis has been proven (El-Mashad, *et al.*, 2019).

Viruses, fungi and parasites can also lead to the condition. For instance, the herpes simplex virus (HSV) can cause

severe infections in newborns (King & Khalili, 2023). Early onset sepsis (EOS) is usually related to peri-partum factors, before and during delivery while late onset sepsis (LOS) is acquired in the newborn nursery, neonatal intensive care unit or in the community (Ogundare, *et al.*, 2019). Organisms that have been implicated in late onset sepsis include coagulase- negative staphylococcus, staph aureas, E coli, Klebsiella, Group B Streptococcus (GBS), candida (WHO 2022). Review of culture positive cases of neonatal sepsis in India, Africa and the middle east showed that klebsiella species was most frequently isolated organism although S.aureaus, E coli and pseudomomas also occurred. Less than 10% of the cases were due to GBS (Rudzani, *et al.*, 2022). Most patients (94.3%) presented with LOS. Coagulase negative staphylococuss was the most common cause in Johannesburg (Franca, 2023).

Numerous host factors predispose newborns to sepsis. This is more prominent in premature babies and involves a combination of factors such as: cellular immunity, humoral immunity, barrier function, immature immune defence and environmental and maternal factors (Singh, Alsaleem & Gray, 2022). Before birth, maternal antibodies are passed to the baby through the placenta, providing initial protection. After delivery, however, the infant's ability to produce its own antibodies is still limited. By the end of the first month, these inherited antibodies drop to less than half of their original levels, leading to a marked decline in the baby's immune protection. However, the antibodies obtained from the mother before birth can protect the infant from most infectious diseases for around six months (Niewiesk, 2014).

The human immune system begins developing very early in pregnancy. At first, the fetal liver produces the cells that help fight infections, before this role gradually shifts to the bone marrow. As the baby grows, different types of protective cells are formed, including those that help recognize and respond to infections. By about seven weeks of pregnancy, some of these early immune cells move to a specialized organ called the thymus, where they mature and become more effective. Others develop along a slightly different pathway but still contribute to the body's defence system.

Overall, the newborn's immune system is carefully built through a complex but well-coordinated process influenced by natural body signals and supportive tissues. However, despite this early development, a baby's immune protection is still not fully mature at birth, which makes newborns more vulnerable to infections and highlights the importance of preventive care. GM-CSF along with IL-4 and tumor necrosis factor (Wang & Mehta, 2020).

Polymorphonuclear neutrophils (PMNs) play a key role in destroying bacteria, but in newborns these cells are not yet fully effective. They have a reduced ability to move toward sites of infection and are less efficient at killing invading organisms. In addition, their limited flexibility makes it harder for them to pass through body tissues and reach areas of inflammation. Their already weak capacity to engulf and eliminate bacteria becomes even more compromised when the infant is unwell. Newborns—especially those born prematurely—also have smaller reserves of these cells, as their bone marrow cannot rapidly replenish them. Although monocyte levels in infants are similar to those in adults, their function is still underdeveloped, with reduced movement and activity that can persist into early childhood. Although T cells are found in total circulation, they represent a premature population (Kobayashi, DeLeo & Quinn, 2023).

The fetus receives only limited immunoglobulins from the mother through the placenta, resulting in a weak immune response to antigens. Additionally, the final cytotoxic components of the complement system, which help destroy harmful organisms, are present at low levels. In addition, Neonatal sera have reduced opsonic efficiency against GBS, E coli, streptococcal pneumonia because of decreased levels of fibronectins serum protein that assists with neutrophil adherence and has opsonic properties (Kobayashi, DeLeo & Quinn, 2023).

Even though antibodies are passed from mother to baby through the placenta, infants remain highly susceptible to severe RSV infections during their first few months. This heightened vulnerability lasts for several months and is thought to result from the newborn's immature and still-developing immune system. However, despite infection, some. earliest control of 11w221viral infection and an evolving role for strain independent RSV Pre-F-specific immunity in the resolution of disease (Atwell, *et al.*, 2022).

In overwhelming sepsis, cardiopulmonary response is present. This is marked by pulmonary hypertension, diminished heart output and less oxygen to the tissues. These are due to granulocytes derived biochemical mediators such as hydroxyl radicals and thromboxane B2. These agents have a constrictive action that results in pulmonary hypertension. The gut may be infested by microorganisms in utero or at delivery through swallowing infected amniotic fluid. The immunologic defenses of the Gastro intestinal tract are not mature especially in preterm. Necrotizing enterocolitis has been associated with the presence of several species of bacteria in the immature intestines (Cilieborg, *et al.*, 2011).

Clinical presentation of neonatal sepsis varies as there are no pathognomonic features. Some of the signs and symptoms associated with neonatal sepsis include: Not able to breastfeed, general body weakness, convulsions, chest in drawing, jaundice and umbilical redness. Other symptoms included: fevers, metabolic acidosis, hypertension (5%), hypo perfusion, tachycardia, hypo-hyperglycemia, vomiting, abdominal distention, diarrhea, respiratory distress, apnea 55% hypoxias vent flaring, grunting, seizures, disseminated intravascular coagulation, patechie, hepatosplenomegaly. Meningitis symptoms include irritability, lethargy, poorly responsive and changes in muscle tone (Singh, Alsaleem & Gray, 2022).

Empiric antibiotic treatment should be started when sepsis is clinically suspected (Strich, Heil & Masur, 2020) even without confirmatory lab data. In practice, the initial choice of antibiotics should be guided by the known antimicrobial resistance patterns of common bacteria within the neonatal intensive care unit. Typical treatment regimens include intravenous (IV) ampicillin and aminoglycosides to cover the most common pathogens in EOS (GBS, E. coli, and L. monocytogenes). In late-onset infections, treatment should cover hospital-acquired organisms such as coagulase-negative *Staphylococcus**, *Staphylococcus aureus**, and *Pseudomonas** species, with Ministry of Health paediatric guidelines recommending initial therapy using vancomycin combined with an aminoglycoside. Where central nervous system involvement is suspected, a third-generation cephalosporin may be added due to the poor CNS penetration of aminoglycosides, although ceftriaxone is avoided in newborns because of the risk of hyperbilirubinemia and harmful calcium-related complications. The rising trend of antimicrobial resistance further complicates effective management. Antibiotic stewardship teams play an essential role in preventing the unjustified prolonged use of antibiotics (Singh, Alsaleem & Gray, 2022).

In Kenya, medical management of neonatal sepsis is as per WHO integrated management of childhood illness (IMCI) guidelines which currently recommend sepsis be managed according to pediatric protocol (WHO, 2025d): penicillin 50,000 international units or a combination of Ampicillin or Flucloxacillin (50mg/kg) with Gentamycin 5mg/kg if newborn is less than 2kg. Ceftriaxone 50mg/kg and Metronidazole 7.5 mg/kg can also be given. In Kenya, the management of neonatal sepsis involves comprehensive supportive care, including respiratory support, administration of intravenous fluids, use of phototherapy when indicated, and careful regulation of temperature and blood glucose levels, alongside measures to prevent

hospital-acquired infections. Application of CHX 7.1% is a key component in preventing infection.

Chlorhexidine gluconate preparation for cord care prevention Solution

Chlorohexidine topical solution contains Chlorohexidine 7.1% digluconate equivalent to 4g chlorohexidine constituting purified water, Sodium hydroxide and Benzalkonium chloride (USAID, 2022).

CHX gel is a topical gel in a suitable water- miscible basis containing CHX digluconate equivalent to 4%. Each Sachet contains a-g dose containing 213mg of CHX with purified water, Sodium acetate trihydrate (USAID, 2022).

3. Methodology

The study adopted a cross-sectional research design to examine maternal awareness, perception and practices of cord care using 7.1% CHX and its association with clinical presentation of neonatal sepsis in Vihiga County. The target population comprised mothers with neonates attending health facilities in Vihiga County. A sample of 378 respondents was selected using the Modified EPI formula at 95% confidence level, 5% margin of error and 50% expected prevalence. Respondents were selected using systematic random sampling from the facilities. Mothers who consented and had neonates within the neonatal period were included, while those who were critically ill, declined consent, or had neonates with conditions unrelated to the study were excluded.

Data were collected using an interviewer-administered questionnaire for mothers. The questionnaire captured socio-demographic characteristics, maternal awareness, perception and practices of cord care using 7.1% CHX, and clinical presentation of neonatal sepsis. Both quantitative and qualitative data were collected. Data collectors were trained prior to data collection on the study objectives, interviewing techniques and ethical conduct. The instruments were pretested in a neighbouring facility and corrections made before the main study. Validity was established through expert review, while reliability was assessed to ensure consistency of the instrument.

Data were analysed using SPSS. Descriptive statistics, frequencies and percentages were used to summarise socio-demographic characteristics, awareness, perception and practices. Likert scale items were collapsed into agree/disagree categories. Odds Ratios were used to determine the association between maternal awareness,

perception and practices of cord care and clinical presentation of neonatal sepsis. Variables with p -value ≤ 0.1 in bivariate analysis were entered into multivariable logistic regression to determine independent predictors. Statistical significance was assessed at $p < 0.05$, and findings were presented using tables and narrative descriptions. Ethical considerations included informed consent, confidentiality, anonymity, voluntary participation, and the right to withdraw. Clearance was obtained from the relevant authorities, data were securely stored and reported in aggregate form, while measures were taken to minimise potential harm and protect participants' welfare.

4. Results and Discussion

4.1 Descriptive Statistics

This chapter presents findings deduced from the questionnaire with regard to research objectives namely: to examine association between the level of awareness on use of CHX on cord care and clinical presentation of neonatal sepsis among newborn babies in Vihiga.

4.2 Response Rate

Out of the sample of 378 that was proposed, a total of 345 respondents interviewed had completed questionnaires which were used for data analysis giving a response rate of 91.3% which is considered acceptable. Mugenda and Mugenda (2003) assert that a 50% response rate is adequate for analysis. The difference was attributed to refusals.

4.3 Socio-demographic factors influencing the clinical presentation of neonatal sepsis

Table 1 presents bivariate analysis on socio-demographic factors influencing neonatal sepsis among the babies under study. Only one independent variable had statistically significant association with the outcome while two others had borderline association. Babies of mothers who were not employed or were housewives were 80% less likely to have presented with clinical signs and symptoms suggestive of neonatal sepsis (OR: 0.2; 95% CI: 0.1 – 0.4; $p < 0.0001$). Although not statistically significant, babies of younger mothers (less than 30 years of age) were up to 3.2 times more likely to have presented with such signs and symptoms (OR: 0.7; 95% CI: 1.0 – 3.2; $p = 0.07$). On the other hand, babies whose mothers were of Tiriki sub-tribe were 40% less likely to have presented with the signs and symptoms of neonatal sepsis (OR: 0.6; 95%CI: 0.3 – 1.1; $p = 0.07$).

Table 1: Association between socio-demographic factors influencing clinical presentation of neonatal sepsis

Independent variable	Categories	N	Neonatal sepsis signs & symptoms		OR	95% CI	P value
			Yes	No			
Age group in years	< 30	242	24.4	75.6	0.7	1.0 – 3.2	0.07
	≥ 30	103	15.5	84.5			
Level of education	None / Primary	102	15.7	84.3	0.6	0.3 – 1.1	0.08
	Secondary / Tertiary	243	24.3	75.7			
Religion	Catholic	271	20.3	79.7	0.7	0.4 – 1.2	0.2
	Protestant / Muslims	74	27.0	73.0			
Occupation	None / Housewife	103	5.8	94.2	0.2	0.1 – 0.4	< 0.0001
	Self-employed / Employed	242	28.5	71.5			
Sub-Tribe	Tiriki	122	16.4	83.6	0.6	0.3 – 1.1	0.07
	Maragoli, Bunyore, Butsotso, Others	223	24.7	75.3			
	Maragoli	135	25.2	74.8	1.4	0.8 – 2.3	0.2
	Tiriki, Bunyore, Butsotso, Others	210	19.5	80.5			

4.4 Obstetric history and clinical presentation of neonatal sepsis

Table 2 shows results on the relationship between mothers' obstetric history and clinical presentation of neonatal sepsis. Even though none of the four independent variables examined resulted in any statistically significant outcomes,

it can be seen that mothers whose babies were delivered in the hospital by skilled birth attendants were up to 6.5 times more likely to have presented with clinical signs and symptoms suggestive of neonatal sepsis. It should be borne in mind that CHX is applied at home after mothers have been discharged and are away from close supervision of healthcare providers.

Table 2: Relationship between obstetric history and clinical presentation of neonatal sepsis

Independent variable	Categories	N	Neonatal clinical sepsis signs & symptoms		OR	95% CI	P value
			Yes	No			
Number of children	One	92	16.3	83.7	0.6	0.3 – 1.2	0.1
	Two or more	253	23.7	76.3			
Place of delivery	Hospital	311	22.8	77.2	2.2	0.8 – 6.5	0.1
	Home	34	11.8	88.2			
Who conducted delivery	Skilled birth attendant	311	22.8	77.2	2.2	0.8 – 6.5	0.1
	Self / Mother-in-law / Relative	34	11.8	88.2			

4.5 Obstetric History and child information

The respondents were also asked about the obstetric history and results presented in Table 4.4. Most of the mothers had between 2 and 3 children (60.3%) with majority having delivered in the hospital (90.1%) and delivered by skilled birth attendants (90.1%). The status of the index child

revealed that majority (98.8%) were alive while 1.2% (4/345) had died. The circumstances that led to their death included baby not crying well, refusal to breastfeed, hypothermia, birth injuries and oozing from the cord, most of which are suggestive of clinical signs of neonatal sepsis. Over half of the children (58.6%) were aged 0 – 11 months with 9.9% being aged 24 months and above and mean age of 11.9 with a standard deviation of ± 7.9 months. The youngest was 2 weeks and the oldest 36.8 months.

Table 3.: Obstetric History and child information

Variable	Response	N	%
Number of children	1	92	26.7
	2 – 3	208	60.3
	≥ 4	45	13.0
Place of delivery	Home	34	9.9
	Hospital	311	90.1
Who conducted delivery	Mother-in-law/Relative	11	3.2
	TBA	23	6.7
	Skilled birth attendant	311	90.1
Status of the index child	Alive	341	98.8
	Dead	4	1.2
Age group of child in months	0 – 11	202	58.6
	12 – 23	109	31.6
	≥ 24	34	9.9
Child's Mean age $\pm$ SD (Range) in months		11.9 $\pm$ 7.9 (0.6 – 36.8)	
	Baby did not cry well, refused to breastfeed	1	25.0

Circumstances leading to death of child	Baby refused to breastfeed and died	1	25.0
	Hypothermia and birth injuries	1	25.0
	Oozin cord, refused to feed	1	25.0

4.6 Awareness about CHX

Table 4 presents results on respondents' awareness about CHX use on cord care. Whereas majority (98.8%) attended antenatal clinic, there was a reduction in terms of the

proportion that were given CHX tube at the clinic (82.7%), although more (85.6%) were given information about it. Majority were informed about its application, frequency, where to apply it and the side effects (93.6%). The main source of such information included healthcare workers (72.1%) and CHVs (26.9%)

Table 4.: Awareness about CHX

Variable	Response	N	%
Where attended ANC	Hospital	341	98.8
	Did not attend	4	1.2
Given CHX tube at the clinic	Yes	282	82.7
	*No	59	17.3
Was given information about CHX	Yes	292	85.6
	No	49	14.4
Kind of information provided	What it is	9	3.0
	How to use it	10	3.4
	Application, frequency, where to apply it and side effects	278	93.6
Who provided the information	Healthcare worker	214	72.1
	Pamphlets and posters	1	0.3
	Local media	2	0.7
	CHV	80	26.9

*Excluded the four (4) children whose mothers did not attend ANC

Mothers stated that CHX is mostly applied to cord after delivery. While others stated that it is applied 2 to 3 times after. One mother stated that "I used to apply morning lunch time and evening, but the community volunteer corrected them that I should only apply once."

4.7 Recognition of clinical signs and symptoms neonatal sepsis

Asked about whether the baby had other clinical symptoms within the next one month following delivery, 23.8% confirmed with the most common symptom being fever (80.5%). Based on the self-reported signs and symptoms, 75 out of 345 of the babies presented with neonatal sepsis-

like condition giving a prevalence rate of 21.7% (fever, refusal to breastfeed, lethargy). Most of the mothers who reported such cases took their babies to hospital (80.5%). Apparently, majority of the mothers (88.1%) do not know other ways of making neonatal sepsis diagnosis. Similarly, most of the mothers (85.5%) do not know factors that are associated with neonatal sepsis. Four (4) respondents mentioned poverty as one of the factors associated with neonatal sepsis. Poverty is associated with neonatal sepsis mainly because it can increase exposure to infection and reduce access to timely, appropriate prevention and treatment. It is not poverty itself that directly causes sepsis; rather, poverty operates through several pathways.

Table 5: Recognition of clinical signs and symptoms of neonatal sepsis

Variable	Response	N	%
Did the baby have other symptoms within the next one month following delivery	Yes	82	23.8
	No	263	76.2
Symptoms the baby had	Fever	66	80.5
	Refusal to breastfeed	3	3.7
	Lethargy	6	7.3
	Difficulty in breathing	7	8.5
	Took to hospital	71	86.6
What the mother did about the symptoms	Did nothing	10	12.2
	Other	1	1.2
	Don't know	304	88.1
Other ways of making neonatal sepsis diagnosis	Refusal to feed	12	3.5
	If baby has fever	12	3.5
	Fever oozing cord	7	2.0
	Baby vomiting and dehydration	5	1.5
	Rashes on body	2	0.6
	If baby dies	1	0.3
	Lab test	1	0.3
	Premature rupture of membrane	1	0.3
	Don't know	295	85.5
	Unhygienic cord care	21	6.1
Factors associated with clinical signs of neonatal sepsis	Infection	14	4.1
	Home delivery	6	1.7
	When herbs are applied to the cord	5	1.5
	Poverty	4	1.2

4.8 Association between level of awareness about CHX and clinical presentation of neonatal sepsis

Table 6 shows bivariate analysis results on the association between level of respondent's awareness about CHX on cord care and signs of neonatal sepsis. Findings reveal that

babies of mothers who were given information about CHX by healthcare workers were thrice as likely to have presented with clinical signs and symptoms suggestive of neonatal sepsis than those whose mothers did not get such information (OR: 3.0; 95% CI: 1.2 – 7.9; $p = 0.02$), or mothers who got the information from other sources (OR: 3.0; 95%CI: 1.6 – 5.5; $p = 0.0004$), results being statistically significant.

Table 6: Association between level of awareness about CHX and clinical presentation of neonatal sepsis

Independent variable	Categories	N	Neonatal sepsis clinical signs & symptoms		OR	95% CI	P value
			Yes	No			
Given CHX tube at the clinic	Yes	282	20.6	79.4	0.7	0.4 – 1.3	0.3
	No	63	27.0	73.0			
Was given information about CHX	Yes	292	24.0	76.0	3.0	1.2 – 7.9	0.02
	No	53	9.4	90.6			
	All information about CHX	278	23.0	77.0	1.5	0.7 – 3.1	0.2

Kind of information provided	Selected information, how used, application, etc	67	16.4	83.6			
Who provided the information	Healthcare worker	215	27.9	72.1	3.0	1.6 – 5.5	0.0004
	CHV, media	130	11.5	88.5			

4.9 Acceptability and practice of CHX cord care

As shown in Table 7 which displays results on acceptability and practice of CHX cord care, majority of the respondents (80.5%) carried the application when they went to hospital. Sixty-three were not given CHX at the clinic during antenatal visits. A slightly higher proportion (87.8%) actually applied it on the baby's cord suggesting that some were given the tube in the hospital during delivery. Among those who did not have CHX, six (54.6%) applied nothing

on the cord while two used spirits. Most of the respondents (72.6%) applied CHX for less than 7 days compared to 18.5% who did so for 7 days. An equal proportion (47.5%) applied it once or 2 – 3 times daily. Most of the respondents applied it gently around the tip and base of the cord (41.8%) while another 20.7% washed hands and applied it after bathing the baby. One mother applied spirit daily after washing the baby. Most mothers stated that the duration it took for the cord to dry and drop was less than 7 days (81.9%) though a smaller proportion (70.6%) confirmed that the cord dropped and was completely dry.

Table 7: Acceptability and practice of CHX cord care

Variable	Response	N	%
Carried CHX when went for delivery	Yes	227	80.5
	#No	55	19.5
Applied CHX on baby's cord after delivery	Yes	303	87.8
	No	42	12.2
If, No, what was applied on the cord	Spirit	2	18.2
	Nothing	6	54.6
	Don't know	3	27.3
Duration CHX was applied on the cord	Less than 7 days	220	72.6
	7 days	56	18.5
	More than 7 days	27	8.9
Frequency of application of CHX on the cord	Once a day	144	47.5
	2 -3 times daily	144	47.5
	More than 3 times daily	15	4.9
How CHX was applied	Applied gently around the tip and base of the cord	125	41.8
	Washed hands and applied after bathing baby	62	20.7
	Use one finger to spread the umbilical and cut stump	56	18.7
	Washed my hands and applied around the cord	48	16.1
	Wipe cord and apply with finger	3	1.0
	Put on gloves and applied it around the cord	2	0.6
	The nurse applied it on baby's cord	2	0.7
	Applied spirit daily after washing baby	1	0.3
	Dropped and completely dry	214	70.6
	Dropped but not dry	73	24.1
Status of cord after use	Dry but did not drop	14	4.6
	Other	2	0.7
	Less than 7 days	248	81.9
	7 days	28	9.2
Duration it took for the cord to dry and drop	More than 7 days	27	8.9

63 were not given CHX at the clinic

Mothers said that they do not use CHX the way it is supposed to be used because some still think that spirit and the other methods of cord care as still very effective so they mixed with other method such as with spirit. Some even applied herbs when they realized the cord was not drying and dropping as faster.

“TBA discouraged me so I resorted to the herbs”. KII 2

Most mothers would encourage other new mothers to use CHX.

However, there is need to increase advocacy on the use of CHX, with one mother stating that “Most mothers are not given adequate information so they are not aware.” KII 3.

4.10 Practice of CHX application and clinical presentation of neonatal sepsis

Table 4.9 presents findings on the influence of acceptability of CHX on neonatal sepsis. Babies whose mothers applied CHX for less than 7 days (OR: 2.3; 95%CI: 1.3 – 4.1; $p = 0.006$), or applied CHX gently around the tip and base of the cord (OR: 5.6; 95%CI: 3.2 – 9.8; $p < 0.0001$) were 2.3 and 5.6 times more likely to have shown signs and symptoms suggestive of neonatal sepsis. On the other hand, babies whose mothers applied CHX once daily (OR: 0.2; 95%CI: 0.1 – 0.4; $p < 0.0001$), washed hands and applied CHX after bathing baby (OR: 0.3; 95%CI: 0.1 – 0.8; $p = 0.01$) were 80% and 70% less likely to have presented with signs and symptoms of neonatal sepsis, respectively. Results also indicate that babies whose cords dropped and were completely dry (OR: 0.1; 95%CI: 0.03 – 0.13; $p < 0.0001$) or whose cords took 7 days to dry and drop (OR: 0.1; 95%CI: 0.01 – 0.91; $p = 0.02$), were 90% lower chances of having presented with such clinical signs and symptoms, respectively.

5. Conclusion and Recommendations

5.1 Conclusion

In conclusion, the study examined the association between maternal awareness, acceptability, cultural practices, and perceived effectiveness of chlorhexidine (CHX) 7.1% for umbilical cord care and the reported clinical presentation of neonatal sepsis among newborns in Vihiga County. The study found a statistically significant association between maternal awareness of CHX use for umbilical cord care and

the reported clinical presentation of neonatal sepsis, although higher awareness did not necessarily correspond to lower odds of reported neonatal sepsis despite most mothers receiving information particularly from healthcare workers and community health promoters

5.2 Recommendation

From the findings, discussions and conclusions and study makes the following recommendations:

1. The Vihiga County Department of Health should strengthen behaviour-focused and practical CHX 7.1% cord-care interventions, including hands-on demonstrations and return demonstrations before discharge and targeted household follow-up during the neonatal period
2. The county should do continuous standardized training on CHX should be enhanced for health providers, CHPs and mothers at both health facility and household level, with CHPs conducting postnatal household visits to support sustained correct use
3. The Department of Health at the county level should intensify public education on correct and consistent application of CHX, particularly targeting housewives, employed mothers, traditional birth attendants, CHPs and grandmothers, to discourage the use of unapproved substances on the newborn cord.
4. Vihiga county government should do continuous messages and reminders on proper application of CHX should be delivered to mothers, caregivers and the community through CHPs, even where mothers have been taught before, to promote positive perception and correct use of CHX.

World Health Organization. Newborn mortality. Geneva: *World Health Organization*; 2024.

World Health Organization. Newborn mortality. Geneva: *World Health Organization*; 2025.

Coffey PS, Brown SC. Umbilical cord-care practices in low- and middle-income countries: a

systematic review. *BMC Pregnancy Childbirth*. 2017;17(1).

Moraa PK, Mweu MM, Njoroge PK. Association between umbilical cord hygiene and neonatal sepsis among neonates presenting to a primary care facility in Nairobi County, Kenya: *a case-control study*. *F1000Res*. 2019; 8:920.

Imdad A, Mullany LC, Baqui AH, Arifeen SE, Tielsch JM, Khatry SK, et al. The effect of umbilical cord cleansing with chlorhexidine on omphalitis and neonatal mortality in community settings in developing countries: *a meta-analysis*. *BMC Public Health*. 2013;13 Suppl 3:S15.

Sazawal S, Dhingra U, Ali SM, Dutta A, Deb S, Ame SM, et al. Efficacy of chlorhexidine application to umbilical cord on neonatal mortality in Pemba, Tanzania: *a community-based randomised controlled trial*. *Lancet Glob Health*. 2016;4(11): e837-e844.

World Health Organization. WHO recommendations on postnatal care of the mother and newborn. Geneva: World Health Organization; 2014.

Ministry of Health, Kenya. The Kenya guideline for the use of chlorhexidine digluconate 7.1% for prevention of newborn umbilical cord infection. Nairobi: *Ministry of Health*; 2022.

Kenya National Bureau of Statistics. Kenya Demographic and Health Survey 2022. Nairobi: KNBS; 2023.

Okube OT, Komen M. Prevalence and predictors of neonatal sepsis among neonates admitted at the newborn unit of Kenyatta National Hospital, Nairobi, Kenya. *Open J Obstet Gynecol*. 2020;10(9).

Obiora OL, Ezenduka P, Ndie EC, Umeonwuka CI, Nwachukwu-Umeonwuka JO. Newborn cord care practices among parturient women in a rural contemporary Nigerian setting. *Int J Public Health Clin Sci*. 2019;6(3):1-10.

Asiedu SSO, Apatu NAA, Tetteh R, Hodgson A. Neonatal cord care practices among mothers and caregivers in the Volta Region of Ghana. *Int J MCH AIDS*. 2019;8(1):63-69.

Duah DPL, Adjieteh AA, Adjei S, Fuseini K, Obeng-Dwamena AD, Addo-Yobo J, et al. Use of chlorhexidine digluconate 7.1% gel for umbilical cord care in selected regions in Northern Ghana: qualitative perspectives of key stakeholders. *BMC Pregnancy Childbirth*. 2024;24(1):851.

Kok MC, Kane SS, Tulloch O, Ormel H, Theobald S, Dieleman M, et al. How does context influence performance of community health workers in low- and middle-income countries? *Evidence from the literature*. *Health Res Policy Syst*. 2015; 13:13.

Mochache V, Irungu E, El-Busaidy H, Temmerman M, Gichangi P. 'Our voices matter': a before-after assessment of the effect of a community-participatory intervention to promote uptake of maternal and child health services in Kwale, Kenya. *BMC Health Serv Res*. 2018; 18:938.

Sinha A, Sazawal S, Pradhan A, Ramji S, Opiyo N. Chlorhexidine skin or cord care for prevention of mortality and infections in neonates. *Cochrane Database Syst Rev*. 2015.