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Identifying barriers to essential newborn care practices: An assessment among healthcare providers in rural northern Tanzania

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Abstract

Neonatal mortality remains a major global health burden, with sub-Saharan Africa most affected. This study assessed the knowledge and practice of Essential Newborn Care (ENC) among healthcare providers in rural northern Tanzania and identified barriers to effective ENC. A cross-sectional survey was conducted using self-administered questionnaires among providers involved in obstetric or immediate neonatal care in Rorya district. Of the 67/68 respondents (98.5% response rate), 35/67 (52%) demonstrated satisfactory knowledge and 45/67 (67%) satisfactory practice. Being a clinical officer or untrained in ENC was significantly associated with unsatisfactory practice. Key deficiencies included improper suctioning during resuscitation, delayed cord clamping and bathing, untimely administration of medicines, and lack of skin-to-skin contact. Barriers to good ENC practice included inadequate provider training, supply shortages, and resistance from mothers. To improve neonatal outcomes in similar contexts, targeted ENC training, particularly for clinical officers and untrained staff in non-hospital settings, are urgently needed. *(Afr J Reprod Health 2026; 30 [10]: 15-34).*

Keywords: Essential Newborn Care (ENC); Tanzania; knowledge; practice; healthcare workers

Résumé

La mortalité néonatale reste un problème de santé majeur à l'échelle mondiale, avec l'Afrique subsaharienne étant la région la plus touchée. Cette étude a évalué les connaissances et les pratiques en matière de soins essentiels aux nouveau-nés (ENC) chez les prestataires de soins de santé dans les zones rurales du nord de la Tanzanie et a identifié les obstacles à la mise en œuvre efficace des ENC. Une enquête transversale a été menée à l'aide de questionnaires auto-administrés auprès des prestataires impliqués dans les soins obstétricaux ou néonatals immédiats dans le district de Rorya. Sur les 67/68 répondants (taux de réponse de 98,5 %), 35/67 (52 %) ont démontré des connaissances satisfaisantes et 45/67 (67 %) des pratiques satisfaisantes. Le fait d'être agent clinique ou de ne pas avoir reçu de formation en matière de soins essentiels aux nouveau-nés était significativement associé à des pratiques insatisfaisantes. Les principales lacunes comprenaient une aspiration inadéquate pendant la réanimation, un clampage tardif du cordon ombilical et un bain tardif, une administration inopportune de médicaments et un manque de contact peau à peau. Les obstacles à une bonne pratique ENC comprenaient une formation inadéquate des prestataires, des pénuries d'approvisionnement et la résistance des mères. Afin d'améliorer les résultats néonatals dans des contextes similaires, une formation ENC ciblée, en particulier pour les agents cliniques et le personnel non formé dans les établissements non hospitaliers, est nécessaire de toute urgence. *(Afr J Reprod Health 2026; 30 [10]: 15-34).*

Mots-clés: Soins essentiels aux nouveau-nés (ENC); Tanzanie; connaissances; pratiques professionnels de santé

Introduction

Despite progress in reducing child mortality, under-five deaths remain a significant global health burden, with rates still exceeding Sustainable Development Goal (SDG) targets for 2030.[1] Nearly half (47%) of these deaths occur in the first 28 days of life.[2] Sub-Saharan Africa (SSA) is most affected, with 27 neonatal deaths per 1,000 live births in 2021 - ten times higher than in Western Europe (1.5–3/1,000).[3] Overall, 98% of neonatal deaths occur in low- and middle-income countries (LMICs).[4]

In Tanzania, neonatal mortality remains high at 20 per 1,000 live births (SD ±13–30) in 2021,[5] likely underestimated due to underreporting from home deliveries and health facilities.[6] Between 2005 and 2015, post-neonatal mortality halved, yet neonatal mortality stagnated.[6] Early neonatal deaths (1–7 days) account for over 75%, caused mainly by birth asphyxia, prematurity, respiratory distress, and sepsis; late deaths (8–28 days) often result from infections such as malaria and pneumonia.[7]This persistent burden contrasts sharply with the availability of cost-effective, evidence-based interventions,[8] summarised by the WHO as Essential Newborn Care (ENC) practices,[9] including immediate drying and warming after birth, skin-to-skin contact, adequate umbilical cord care, resuscitation for newborns with birth asphyxia, early and exclusive breastfeeding, and infection and bleeding prevention for all newborns.[10-12] Despite being integrated into national guidelines,[13] ENC practices remain inconsistently implemented in Tanzania.[14-16] The reasons why ENCP is not fully practiced according to the guidelines vary greatly across countries and regions and are highly context-specific.[17] To enhance ENC implementation, this study assessed ENC knowledge and practice among healthcare providers in Rorya district, examined factors associated with performance, and identified systemic barriers.

Methods

Study context

The Rorya district, located in the Mara region on the eastern shore of Lake Victoria in northernTanzania,[18] exhibits lower education levels compared to most other Tanzanian regions, with only up to 62.2% of adults having completed primary school and just up to 5.6% post-primary education.[19,20] Over 80% of residents live in homes with sand or earth floors; roofs are typically iron sheets (50%) or grass thatch (48%). The 2023 district population was estimated at 354,490,[21] primarily engaged in agriculture and husbandry.[22] Roads are mostly unpaved; rendering access difficult, particularly in the rainy season.[23]

The district has 43 dispensaries, nine health centers, and four hospitals, spread out over four divisions: Nyancha, Girango, Luo-imbo and Suba. The main referral hospital is Shirati Kannisa la Mennonite District Hospital (KMT).[21] Dispensaries typically have two to four health care workers (HCWs), typically a nurse and a clinical officer, facilitating approximately 40 patient visits per day.[24] Health centers and hospitals employ 14–161 HCWs with different functions: MDs, Clinical Officers (COs), Nursing Officers (NOs), Registered Nurses (RNs), Enrolled Nurses (ENs), and Medical Attendants (MAs).[24] COs are non-physician clinicians and undergo lower levels of training as compared to MDs. Among nurses, MAs, ENs, RNs and NOs have progressively followed higher education.[25]

Study design and participants

This cross-sectional study used a self-administered questionnaire with multiple-choice and semi-open questions. Participants included HCWs involved in neonatal care within Rorya. Those with less than three months of relevant practice or working outside Rorya were excluded. Invitations, distributed by the District Medical Office (DMO), were extended to all health facilities in Nyancha and the majority of those in Girango and Luo-imbo. Due to logistical reasons, none have been sent to the most distant division of Suba. A total of 31 health facilities were contacted, resulting in 29 facilities having at least one participating health official. The DMO officials manage the health budget, issues permits and administers health policies within Rorya district.

Sample size

Assuming 70% ENC satisfactory knowledge and practice of ENC on the basis of one comparable

study from Ethiopia,[26] with α = 0.05 and 95% confidence, a minimum of 46 participants was required, adjusting for a 95% response rate. The initial sample was based on providers from Nyancha division, but to enhance diversity and external validity, it was expanded to include Girango and Luo-Imbo divisions.

Questionnaire

The survey comprised 15 multiple-choice questions assessing knowledge and 15 three-step Likert-scale items assessing practice. Questions covered five WHO ENC domains: postpartum care, cord care, thermoregulation, breastfeeding, and infection/bleeding prevention. The questions were based on, adopted from, or modified from related literature.[9,26-30] Each domain consisted of three knowledge and three practice questions. The questionnaire (Supplementary Material 1) was translated into Kiswahili and translated back to ensure accuracy. Piloting with 10 HCWs from KMT and nearby dispensaries confirmed clarity and relevance. Questions were revised based on in-hospital peer and local council feedback. To reduce social desirability bias, verbal administration and alternative phrasing were tested in piloting. Questions lacking response variability (<95%) were replaced with alternatives. Despite efforts to correctly translate and formulate the survey, many participants misunderstood the question asking about the duration since their training in ENC. Consequently, this question was excluded from the analysis.

Data collection procedure

The data was collected by SBM at dispensaries, health centers and hospitals during a period of two days. Participants received written consent forms and instructions in English or Kiswahili. The survey was divided into two parts: demographics and knowledge, followed by practice. Researchers checked each part for completeness before moving to the next. Thirteen HCWs from KMT were later invited separately. All participants received expense reimbursements.

Scoring the questionnaires

Knowledge questions were scored as one (correct) or zero (incorrect). Practice answers ('never', 'sometimes', always") were scored as 2 (correct), 1 (partly correct), or 0 (incorrect), respectively. Total knowledge scores ranged from 0–15; practice scores from 0–30. Supplementary explanations in the practice section helped identify barriers.

Data analysis

Data analysis was conducted using Microsoft Excel 14.7.7 and RStudio® version 1.2.1335[31].

HCW and facility characteristics were analyzed using categorical summaries (frequencies, percentages). Age, experience, and deliveries/week were categorized into equal-width intervals. In addition, two supplementary tables were created to further describe the characteristics of professions and health facility type. Due to non-normal distribution (Shapiro-Wilk $p < 0.05$), continuous variables were summarized with medians**.**

Outcomes of knowledge and practice scores

Scores ≥75% were defined as 'satisfactory'[32] consistent with similar studies.[33,34] This threshold replaced the original 62% (the original chosen threshold mentioned in the study protocol (Supplementary Material 4) to align with the published literature and to best reflect adequate knowledge and practice. In addition, the correlation between knowledge and practice was calculated using linear regression on the continuous values of the questionnaire scores.

Logistic regressions

Knowledge and practice scores were dichotomized using the mean as the cut-off.[26] Dependent variables included facility type (hospital, health center, dispensary), location (Nyancha vs. outside), funding type, age, gender, profession, ENC training, years of experience, and deliveries/week.[34] For analysis, professions were recategorized: NO and RN as 'higher-educated nurses' (HENs); MAss and ENs as 'lower-educated nurses' (LENs). Girango and Luo-imbo were merged as 'outside Nyancha' due to small sample sizes in these groups. Bivariate logistic regressions assessed associations, using $p < 0.05$ as the significance threshold. Crude odds ratios (COR) and 95% confidence intervals (CI) were calculated. A multivariate logistic regression with forward stepwise selection was

conducted to identify predictors. Model fit was assessed via the Akaike Information Criterion (AIC) and deviance; assumptions were tested using Durbin-Watson (autocorrelation), Shapiro-Wilk (normality), residual plots (homoscedasticity), and Variance Inflation Factor (VIF; <5 for multicollinearity). For further visualization, the significant bivariate analyses of interest were depicted using box plots, for profession one-sides ANOVA and Tukey's honestly significant difference (HSD) testing was performed. For health facilities, a Kruskal-Wallis test with Mann-Whitney U and Bonferroni correction was performed. To assess training in relationship to knowledge, a Mann-Whitney U test was conducted.

Assessment per question

To assess which themes and steps of ENC were well known and practiced, scores per theme and question were calculated and presented as percentages. For both knowledge and practice questions, the scores were calculated using binary outcomes. Only correct answers were shown. Questions with an overall response score < 75% were classified as poor.

Barriers per question

To identify barriers, the supplementary explanations that were provided with the practice questions were analyzed. If notes were written in Kiswahili, they were translated by an independent translator into English. If the answer deviated from the national guidelines and hence were classified as 'incorrect' or 'partially incorrect', comments were transcribed and later coded. Microsoft Excel was used to generate a frequency table displaying the most common reasons noted for inability to practice the specific subject including three or more mentionings or the most-frequently mentioned comments.

Ethical considerations

The research was conducted in performance with the principles stated in the Declaration of Helsinki (https://www.wma.net/policies-post/wma-declaration-of-helsinki). Ethical approval for the study was obtained from the KMT ethical board (granted on 16 November 2023) and subsequently endorsed by the Rorya District Health Management Team. All participants were assured of their anonymity and the confidentiality of their responses, with written informed consent obtained prior to participation in the study.

Results

Socio-demographic characteristics

Of the 68 participants, one was excluded due to practicing less than three months in obstetrics or neonatal care, rendering the response rate 98.5%. Table 1 shows the socio-demographic characteristics of the participants and the healthcare facilities. There were more male participants (39/67; 60%) than female participants (26/67; 40%; p = 0.02). Ranging from high to low frequency, professions of the healthcare providers included RNs (n=23), COs (n=14), ENs (n=14), MDs (n=11), NOs (n=4) and MAs (n=1). Two-thirds (45/67;67.2%) of those healthcare providers had followed special training of ENC or HBB, with some professions having received more training than others (p=0.01). The median age was 32 years (IQR: 28.0; 35.0), ranging from 21 to 54 years. Furthermore, median years of experience of healthcare providers was 4.0 [IQR: 1.0; 9.0], with no significant differences between professions (p=0.23). The number of deliveries per week differed between professions (p=0.04) with a median of 6.0 (IQR: 3.0; 10.0).

Supplementary Material 2 – Supplementary Table 1a displays socio-demographics of healthcare providers included; HCW from 29 different health facilities were included; of which 19, six, and four were from dispensaries, health centers, and hospitals, respectively. Among the healthcare providers included, most worked in hospitals (27/67; 40.3%) and dispensaries (27/67; 40.3%), and fewer worked in health centers (13/67; 19.4%). Notably, the professions were not uniformly distributed over health facilities (p<0.01). Most (9/11; 81.8%) MDs worked in hospitals, all NOs worked in hospitals (4/4;100%) and no COs worked in a hospital (0/14; 0%). As well, RNs tended to work more in hospitals than ENs (p=0.05). Supplementary Material 2 – Supplementary Table 1b displays health facility characteristics. Of the different health facilities

Table 1: Socio-demographic characteristics of healthcare providers and health facilities

Healthcare provider characteristics			
	Frequency, n	Percentage, %	Missing values, n (%)
Total health care providers	67	100.0	
Sex			2 (3.0)
Male	39	60.0	
Female	26	40.0	
Profession			0 (0.0)
Clinical Officers	14	20.9	
Enrolled Nurses	14	20.9	
Medical Attendants	1	1.5	
Medical Doctors	11	16.4	
Nursing Officers	4	6.0	
Registered Nurses	23	34.3	
Training in ENC or HBS			0 (0.0)
Yes	45	67.2	
No	22	32.8	
Age (years)			2 (3.0)
20 - 29	23	35.4	
30 - 39	29	44.6	
≥ 40	13	20.0	
Deliveries per week attended			2 (3.0)
0 - 4	22	33.8	
5 - 9	17	26.2	
≥ 10	26	40.0	
Years of experience			4 (6.0)
0.25 - 2.9	23	36.5	
3 - 5.9	13	20.6	
≥ 6.0	27	42.9	
Health facility characteristics			
Total health facilities	29	100.0	
Type of health facility			0 (0.0)
Dispensary	19	65.5	
Health Center	6	20.7	
Hospital	4	13.8	
Number of providers per facility			0 (0.0)
Dispensary	27	40.3	
Health Center	13	19.4	
Hospital	27	40.3	
Location of facility			0 (0.0)
Nyancha	18	62.1	
Girango	10	34.5	
Luo-imbo	1	3.4	
Funding			0 (0.0)
Public	20	69.0	
Private	8	27.6	
Public-private	1	3.4	

Abbreviations: ECN: Essential New-born Care, HBS: Helping Babies survive

Table 2: Outcomes of the questionnaire on knowledge and practice on Essential Newborn Care among healthcare providers

	Outcome Knowledge	Practice
Score level		
Satisfactory, n (%)	35 (52.2)	45 (67.2)
Unsatisfactory, n (%)	32 (47.8)	22 (32.8)

'Satisfactory level' is defined as a score ≥75% of the total points, unsatisfactory is defined as <75% of the total

include, 18 were in Nyancha, 10 in Girango, and 1 in Luo-imbo. Most facilities were publicly funded (n=20), followed by privately funded facilities (n=8). Only KMT was public-privately funded (n=1). Missing values resulted from incomplete questionnaire entries.

Knowledge and practice outcomes

Of all healthcare providers, 52.2% scored satisfactorily and 47.8% scored unsatisfactorily on the knowledge section. Moreover, 67.2% exhibited satisfactory practice, as shown in Table 2. The mean score was 11.3 ± 2.2 (out of 15) for knowledge outcomes and 22.3 ± 3.0 (out of 30) for practice outcomes. Knowledge and practice scores showed to have a weak positive correlation (0.21, p=0.13).

Knowledge outcomes

Bivariate analysis showed significant correlations in knowledge scores (Table 3a). Variables such as profession, health facility type, training in ENC, and funding of the facility showed significant correlations. Specifically, medical doctors (MDs) and higher educated nurses (HENs) scored higher compared to COs (Supplementary Material 3 - Figure 1). Additionally, healthcare providers employed by hospitals had higher scores than those working in dispensaries and health centres (Supplementary Material 3 - Figure 2). Furthermore, training in ENC (Supplementary Material 3 - Figure 3) and funding source of the facility were associated with differences in knowledge scores, with public-private funded facilities scoring higher than solely public or privately funded facilities.

The final multivariate logistic regression model successfully met the assumptions. Of all nine socio-demographic independent variables, the model was able to reduce them to two groups, containing profession and training. Consistent with the bivariate analysis, among the professionals, MDs and HEN performed better than COs. Additionally, training in ENC showed to be an independent predictor for good knowledge (Table 3a). In contrast with the bivariate analysis, health facility type and funding source did not show to be an independent predictor for knowledge outcome.

Practice outcomes

Topics that were well practiced included: (1) immediate drying of newborns; (2) keeping of the new-born on mother's abdomen or chest directly after delivery; (3) umbilical cord treatment; (4) the use of sterile equipment for cord cutting; (5) immediate breastfeeding; (6) exclusive breastfeeding for six months; (7) proper breastfeeding assessment; and (8) Apgar scoring. No significant difference between the socio-demographic characteristics and practice scores were observed in the bivariate logistic regressions (Table 3b). No predictor values were included in the final model of the forward step multivariate logistic regression analysis and hence not presented in Table 3b. Table 4 presents the scores of both the knowledge and practice sections per question and per theme. Table 5 shows providers' comments on practice topics that deviated from the national guidelines and were thus scored as 'incorrect' or 'partially incorrect'.

Discussion

Main findings

This cross-sectional study assessed knowledge and practice of ENC and identified barriers to ENC practice in the Rorya district, Tanzania. Knowledge and practice of ENC in the district showed to be poor. Little over half of the providers had satisfactory knowledge of ENC and two-thirds of providers demonstrated satisfactory practice levels. Profession, health facility type, training status and funding source showed to be related to knowledge. Independent variables that predicted unsatisfactory

Table 3a: The relation between healthcare provider and facility characteristics and knowledge of essential newborn care

Knowledge	COR [95% CI]	P-value	AOR[c] [95% CI]	P-value
Sex				
Female	ref	ref		
Male	1.44 [0.53, 3.98]	0.48		
Profession				
Higher Educated Nurse[a]	ref	ref	ref	ref
Clinical Officer	0.04 [<0.01, 0.24]	<0.01**	0.06 [<0.01, 0.61]	0.02*
Lower Educated Nurse[b]	0.50 [0.13, 1.90]	0.30	0.55 [0.14, 2.20]	0.39
Medical Doctor	1.29 [0.30, 7.21]	0.72	1.60 [0.31, 8.07]	0.58
Training				
No	ref	ref	ref	ref
Yes	6.80 [2.05, 22.0]	<0.01**	4.04 [1.10, 16.22]	0.04*
Age (years)				
20-29	ref	ref		
30 - 39	0.67 [0.22, 2.00]	0.478		
≥40	0.90 [0.23, 3.60]	0.877		
Deliveries (number per week)				
0 - 4	ref	ref		
5 - 9	0.99 [0.28, 3.46]	0.987		
≥ 10	1.50 [0.47, 4.86]	0.492		
Experience in ENC (years)				
0 – 2.9	ref	ref		
3 – 5.9	1.19 [0.33, 4.38]	0.789		
≥ 6	0.667 [0.21, 2.06]	0.483		
Facility type				
Dispensary	ref	ref		
Health center	0.44 [0.01, 2.03]	0.28		
Hospital	5.09 [1.59, 16.73]	<0.01**		
Location				
Outside Nyancha	ref	ref		
Nyancha	0.80 [0.26, 2.37]	0.688		
Funding source				
Public	ref	ref		
Private	0.49 [0.12, 1.89]	0.30		
Public-private	3.89 [1.14, 13.19]	0.03*		

The multivariate logistic regression analysis used a forward stepwise entry method. AIC-value: 79.38, null deviance: 91.44, residual deviance: 69.38. [a]: consisting of Nursing Officers (n=4) and Registered Nurses (n=23). [b]: consisting of Enrolled Nurses (n=14) and Medical Attendants (n=1), [c]: Odds ratios are adjusted for Profession and Training, other variables were not included in the final model. Abbreviations: COR: crude odds ratio, CI: confidence interval, P-value = probability value, * = significant 0.01> p <0.05, ** = significant p <0.01, AOR: adjusted odds ratio, ref: reference category, ENC: essential Newborn Care

knowledge were CO as profession and HCWs untrained in ENC. In addition, this study elicited gaps on topics of ENC that need addressing, including avoiding routine suctioning during resuscitation, implementing delayed cord clamping, delayed bathing, administering essential medicines, awareness of the importance of handwashing and promoting skin-to-skin contact between mother and child. Reasons for poor practice were mainly knowledge related, consisting of misconceptions or poor knowledge of best practice.Further reasons why ENC was not practiced according to the

Table 3b: The effect of healthcare provider and health facility characteristics on practice of essential newborn care

Practice	COR [95% CI]	P-value
Sex		
Female	ref	ref
Male	1.53 [0.56, 4.20]	0.41
Profession		
Higher Educated Nurse[a]	ref	ref
Clinical Officer	0.92 [0.25, 3.39]	0.90
Lower Educated Nurse[b]	0.92 [0.25, 3.39]	0.90
Medical Doctor	0.83 [0.20, 3.39]	0.79
Training		
No	ref	ref
Yes	0.91 [0.32, 2.57]	0.86
Age (years)		
20 - 29	ref	ref
30 - 39	0.84 [0.28, 2.54]	0.76
≥40	0.75 [0.19, 2.97]	0.68
Deliveries (number per week)		
0 - 4	ref	ref
5 – 9	2.10 [0.55, 8.00]	0.28
≥ 10	0.64 [0.20, 2.05]	0.46
Experience in ENC (years)		
0 – 2.9	ref	ref
3.0 – 5.9	1.71 [0.48, 6.16]	0.41
≥6	2.40 [0.75, 7.65]	0.14
Facility type		
Dispensary	ref	ref
Health center	0.71 [0.18, 2.87]	0.63
Hospital	0.36 [0.12, 1.10]	0.072
Location		
Outside Nyancha	ref	ref
Nyancha	1.24 [0.72, 2.13]	0.45
Funding		
Public	ref	ref
Private	0.63 [0.15, 2.38]	0.51
Public-private	0.30 [0.064, 1.21]	0.10

[a]: consisting of Nursing Officers (n=4) and Registered Nurses (n=23). [b] : consisting of Enrolled Nurses (n=14) and Medical Attendants (n=1), Abbreviations: ENC Essential New-born Care, COR: crude odds ratio, CI: confidence interval, P-value = probability value, ref: reference category. No predictor values were included in the final model; hence no adjusted odds ratios are shown

Table 4: Percentage of correct answers of knowledge and practice per theme and per individual questions on essential newborn care

Knowledge question topic	Correctly answered knowledge questions (%)	Practice question topic	Correctly answered practice questions (%)
Immediate post-partum care			
Respiration rate	62.7	Immediate drying	90.8
Apgar-score	82.1	Apgar-score	93.8
Suction during resuscitation	28.4	Suction during resuscitation	58.5
Total	**57.7**	**Total**	**81.0**
Umbilical cord care			
Delayed cord clamping	58.2	Delayed cord clamping	18.5
Neonatal Sepsis	98.5	Neonatal sepsis - sterile instrument use	96.9
Umbilical cord treatment	88.1	Neonatal sepsis - treatment of cord	75.4
Total	**81.6**	**Total**	**63.6**
Thermoregulation			
Delayed bathing	64.2	Delayed bathing	32.3
Immediate skin-to-skin contact	79.1	Immediate skin-to-skin contact	89.2
Skin-to-skin contact within 24h[a]	95.5	Skin-to-skin contact within 24h[a]	52.3
Total	**79.6**	**Total**	**63.9**
Breastfeeding			
Exclusive breastfeeding	100	Exclusive breastfeeding	90.8
Breastfeeding benefits	67.2	Assessment of successful breastfeeding	78.5
Immediate breastfeeding	92.5	Immediate breastfeeding	90.8
Total	**86.6**	**Total**	**86.7**
Infection and bleeding prevention			
Tetracycline appliance	91.0	Tetracycline appliance	58.5
Vitamin-K administration	50.7	Vitamin-K administration	27.7
Hand washing	74.6	Hand washing	81.5
Total	**72.1**	**Total**	**55.9**
Overall total	**75.5**		**70.2**

Apgar-score: score to evaluate neonates directly after birth [37]. [a]: defined as at least 3 hours of skin-to-skin contact during the first 24 hours of life. Notably, only correct answers are represented by the outcomes. The partially correct answers of the practice section are assessed as incorrect

Table 5: Overview of the most mentioned reasons for practising steps of essential newborn care by healthcare providers whose practice deviates from the guidelines

Practice question on:	Remarks on the reason behind the practice	Number of mentions
1. Immediate drying after delivery of healthy new-born	No availability of towels	3
	Total*	**6**
2. Keeping of the new-born on mother's abdomen or chest directly after delivery in healthy child and mother	Bad condition of mother	3
	Total*	**7**
3. Usage of APGAR-score at delivery	Lack of knowledge	2
	Total	**5**
4. Suction of the airway in healthy children without visible or audible obstruction	To clear or clean the airway	13
	To improve breathing	4
	This should be done routinely	3
	Total*	**28**
5. Immediate cutting of the umbilical cord	To prevent infection from mother to child	16
	No need to delay cutting/ immediate cutting is best practice	14
	To separate mother from child	6
	To proceed with further care	5
	Total*	**48**
6. Leaving the umbilical cord untreated after is has been cut	In case of infection the cord is treated	6
	In order to keep the cord clean	3
	Total*	**12**
7. Use of sterile equipment to cut the umbilical cord	No sterile equipment available	1
	Total*	**3**
8. Skin-to-skin contact for at least three hours for the duration of admission after delivery	Only practiced with preterm	7
	Resistance with mothers	5
	Lack of knowledge	4
	Total*	**19**
9. Bathing of new-born within the first 24 hours	To clean the baby	19
	Mother want to bathe early	7
	Only preterm or LBW new-borns need delayed bathing	4
	To prevent infection	3
	Total*	**38**
10. Immediate breastfeeding (within one hour)	Mothers are not informed or have no knowledge	3
	Total*	**6**
11. Information given on exclusive breastfeeding for 6 months	Lack of staff	2
	Total*	**6**
12. Assessment of proper feeding of new-born during admission after delivery	Lack of staff	9
	Total*	**12**
13. Application of tetracycline eye ointment to every new-born	Supply issue	14
	Only new-borns with eye infection are treated	6
	Total*	**25**
14. Administration of vitamin-K to every new-born	Supply issue	22
	Only preterm or high risk new-borns are treated	18
	No knowledge of vitamin-K	4
	Total*	**48**
15. Hand washing before delivery	Only gloves are worn	6
	Not practised in case of emergency	5
	Total*	**14**

Abbreviations: LBW: low-birth weight, *: the total amount of remarks given per question. The remarks that were mentioned 3 times or more, or the highest amount of mentions per question, are shown. Comments to correctly answered questions were not analysed and hence not included in this table

guidelines include issues with providing essential medications due to supply constraints and resistance from mothers to practicing specific aspects of ENC.

Outcomes of ENC in related literature

This study assessed basic ENC knowledge and practice, both found to be poorly practised despite being outlined in national guidelines.[13] Caution is needed when comparing with other Tanzanian regions and LMICs due to variation in defining 'satisfactory' knowledge and practice. Some studies used a mean-based cut-off, such as in Zanzibar[35] and Ethiopia,[26,36,37] reporting satisfactory knowledge levels of 36.2%, 53.8%, 66.5%, and 72.1%, and practice scores of 26.8%, 62.7%, 68.4%, and 62.7%, respectively. In contrast, our study applied a fixed 75% threshold, like studies in India[32] and Ethiopia,[33] which reported knowledge scores of 78% and 64.8%, and practice scores of 34% and 59.8%. The Indian study used true/false questions and assessor-rated practice,[32] likely influencing results, while the Ethiopian study[33] used similar tools but a lower 70% cut-off. Given differences in methods and definitions, direct comparison should be done cautiously.

These findings emphasize the importance of standardizing cut-off values for the purpose of comparing studies. Keeping these differences in mind, the knowledge outcomes of the current study seemed to be on the lower edge compared to other studies, while comparable results in terms of practice were seen in Ethiopia.[26,36,37]

The lower knowledge scores could possibly be explained by the inclusions of relatively low scoring COs, where other studies mainly assessed nurses, midwives and MDs. As well, it could be possible that ENC proficiency is poor in Tanzania compared to other countries, as can be seen in the other study conducted in Zanzibar, Tanzania,[35] where knowledge and practice outcomes were much lower than other studies. However, an additional explanation could be that the Zanzibar study had a study population among whom only two thirds practiced neonatal health care, leading to poorer outcomes.

well-practiced topics

The well-practised topics are by-and-large all in line with the study done in Ethiopia,[26] except for Apgar scoring, which was not assessed in that study.

Barriers to practicing ENC

Knowledge-related barriers

To identify the most relevant barriers, the poorly-scoring topics were analyzed. With respect to the recommendations concerning routine suctioning, delayed cord clamping, delayed bathing and vitamin K administration, poor knowledge contributed to inadequate practice. This was shown by the supplementary explanations that participants provided with (incorrect) answers to the practice questions. For instance, regarding delayed cord clamping, many providers (n=16) had the misconception that delayed cord clamping might lead to infections from mother to child. Concerning this topic, others (n=14) believed immediate cord cutting being best practice. Thus, lack of knowledge on this topic resulted in poorer practice, which was also shown in the theme of immediate post-partum care elsewhere in northern Tanzania.[38] In addition, health workers scored low in motivating parents to practice skin-to-skin contact, with some workers believing that its benefits were limited to preterm infants only. Although not explicitly stated, this might imply lack of knowledge of best care or lack of knowledge of the national guideline.

Resistance from mothers to practice certain topics of ENC

Some health providers cited resistance from mothers as a barrier to implementing skin-to-skin contact. With respect to delayed bathing, it was mentioned that mothers preferred to bathe the child within 24 hours, highlighting the important role of mothers within the practice of ENC and the need for adequate health education.

Essential medicine supply issues

Whereas knowledge on tetracycline use was satisfactory, supply issues withheld healthcare

providers from providing this essential medicine. Supply issues also applied to vitamin K. The findings of issues with essential medicine supply align with similar studies on ENC conducted elsewhere in Tanzania.[39,40] Medicine supply challenges in Tanzania extend beyond ENC related issues. Delays in government funding, financial constraints in acquiring expensive medicines and inadequate stock control have been described as extensive challenges.[41] Additionally, insufficiently trained staff in the pharmaceutical sector, together with minimal local production of medicine, have been identified as further issues.[42,43] Collectively, these studies suggest a comprehensive, context specific approach in which both the government and the private sector play an important role. Such an approach should include enhanced funding, education, support for local manufacturing and infrastructure improvement. Addressing this problem is undoubtedly challenging. That notwithstanding, this study underscores the importance of resolving medicine supply issues.

Staff shortage

Though to a lesser extent than in other studies,[32,33] lack of staff was mentioned as a barrier, even without specifically assessing this topic. This barrier for practicing ENC has been mentioned in related studies in Tanzania as well.[44,45] Therefore, it is likely that a shortage of staff plays a role in adequate ENC provision, although it remains unclear to what extent.

Handwashing

Knowledge on handwashing showed to be poor and practice was borderline satisfactory. Hence, considering its importance, this topic also deserves attention when improving ENC practices.

Determinants of knowledge outcomes

Role of clinical officers

When examining predictors for inadequate knowledge, significant independent variables included profession and training of HCW in ENC. Among the various professions, COs were found to have the lowest level of knowledge. This could possibly be explained by the notion that COs follow a relatively short three-year education program - which is not primarily focused on neonatal care - and are then expected to practice a wide range of tasks, with high responsibility.[46]These responsibilities often differ from the theoretical cadres outlined, which mainly include triage and treatment of outpatients.[47] In practice, they fulfil managerial roles and are responsible for a much wider range of patient care, including inpatient care, surgical and anaesthetical tasks.[46,47] These factors may contribute to the observed lower levels of knowledge within this profession. Moreover, this study revealed that COs received the least training in ENC among all providers. Only 28% received training in ENC, compared to over 70% for all other professions. This implies that they might benefit more from training compared to other professions. It is noted, however, that COs attended fewer deliveries per week compared to other professions, indicating less involvement of COs in obstetrics or ENC. That notwithstanding, they remain engaged in a significant number of deliveries and thus should be able to provide adequate ENC. Additionally, COs practice more often in non-hospital facilities where they might have more responsibilities compared to hospitals due to the low number of staff or supervision. In conclusion, these findings clearly underscore the need for improvement within this profession.

Effects of training

This study confirms that training helps to improve knowledge of ENC. Where other studies[48,49] have found that training also improves practice and thus health outcome; in our study, training did not seem to influence practice. Well-defined training programs like the WHO's ENC training program or AAP's Helping Babies Survive module[9,34] have proven to be effective in SSA to reduce neonatal mortality rates.[49] Also in the Tanzanian context, these trainings have shown to be effective in quality-improvement.[48] The gaps in knowledge and practice as stated above should receive extra attention. Besides, it is noted that repeated training is important, as it leads to longer-lasting improved practice outcomes.[34]

Relations between health facilities and knowledge outcomes

Healthcare providers with higher knowledge of ENC were found in hospitals and public-private funded facilities. However, these facility characteristics did not show to be independent predictors for good knowledge. This can be explained by the fact that these facilities employ professionals with higher education and also had more training in ENC, which both act as a confounder for better knowledge of ENC.

Unexpected findings

An unexpected finding was that practice scores exceeded knowledge scores. This may indicate an educational focus on practical skills over theory, as seen in the breastfeeding theme—where providers lacked knowledge of its benefits but demonstrated satisfactory practice. However, scoring methods likely contributed: knowledge was scored binarily, while practice allowed partial credit, inflating scores. Additionally, the method of assessment along with the presence of district officials, may have caused a bias in practice outcomes as further explained in the limitations section. The combination of these factors may have caused data noise, making it difficult to identify any predictors for good or poor practice. These biases and differences in scoring methods might have contributed to the observed weak and insignificant correlation between knowledge and practice. Alternatively, an explanation could be that the barriers faced by healthcare providers prevent them from applying their knowledge in practice across the topics, weakening the expected relationship between the two.

Strengths

In rural Tanzania, where neonatal mortality rates remain high, ENC practice has hardly been studied. To the best of our knowledge, this study is the first to assess ENC practice in the rural Mara region, Tanzania. Unlike most self-administered questionnaires on this topic,[26,32,33,35-37] which focused mainly on knowledge and practice levels of ENC practice, this study incorporated semi-open questions to identify barriers. This approach enabled the formulation of context-specific recommendations. Where most other studies on the subject focused on hospital care and nurses and MDs, this study included a diverse range of healthcare facilities and HCW professions. Questionnaires were conducted from healthcare providers from 19 out of 43 dispensaries in the Rorya district. Among these 43 dispensaries, not all offered ENCP services, leading to a higher proportion of included facilities involved in ENC. Additionally, 6/9 (66%) health facilities and all four hospitals of the district were included in the study. Furthermore, this study included a broad range of healthcare providers, including non-physician clinicians. Together this provided a good representation of the healthcare landscape of the Rorya district.

Limitations

Although the study included a diverse range of healthcare providers, the sample size (n=67) was moderate, limiting representativeness - especially within smaller subgroups, where low numbers may have reduced reliability or masked significant associations. Additionally, not all divisions of Rorya were included; Suba, the district's most remote area, was excluded due to logistical challenges. This may have introduced selection bias, particularly with the inclusion of nearby divisions from other districts, limiting generalizability to the entire district. The use of a self-administered questionnaire may also have introduced bias, with participants potentially overestimating their performance. In contrast, a study in India[32] used independent assessors and reported practice scores far lower than knowledge scores, highlighting the impact of assessment methods.

Furthermore, the questionnaire used in this study did not include all aspects of new-born care, such as attendance to preterm babies, since the focus of this study was on care that is applicable to all newborns. This limited the inclusiveness of the study findings. A further limitation might be the presence of officials from the DMO during data collection. This might have introduced social desirability bias, because participants might have felt pressured to provide favorable responses due to

the dependence on the official. Effort, however, has been put into minimizing these biases by ensuring that DMO staff could not view the completed questionnaires and that all surveys were anonymous. The DMO officials were invited to the research site and involved in participant recruitment in order to meet the required conditions for medical research in the region.

Recommendations for clinical practice

ENC training programmes

To enhance ENC practice, we propose the implementation of continuous (re-)training programs in ENCP. Detailed evidence-based training programs like the WHO's ENC training program and the AAP's Helping Babies Survive module[9,34] provide comprehensive guidance on training professionals in ENC and are freely accessible. They have demonstrated to be effective in reducing neonatal mortality rates in sub-Saharan Africa[49] and to improve quality of care in Tanzania.[48] Additionally, these training programs have been positively received by Tanzanian health providers.[50,51] Although training programs initially showed good results, knowledge and skills decrease over time after single training, hence re-trainings or refresher courses should be implemented to remain effective.[52] In the Tanzanian setting, the programs should be aimed at healthcare facilities outside of hospitals, particularly dispensaries and health facilities where professions with less knowledge of ENC are employed.

Improving essential medicine supplies

To improve the administration of medicines as part of ENC; ensuring a constant availability of essential medicines is required. Addressing these supply issues is complex and requires an approach that considers the country's specific context and challenges. However, this study reaffirms the importance of adequate medicine supply.

Recommendations for future research

This study highlighted the influence of mothers in practicing ENC. Understanding the motivations and beliefs of mothers, as well as any cultural differences surrounding the topic, is crucial for further implementation of ENC. These beliefs and cultural differences vary by background and have not been studied in the region, rendering this an important subject for future research. To evaluate practice beyond the perceptions of healthcare providers themselves, conducting research with an independent assessor could reveal additional ENC practice gaps. This approach has the potential to identify additional areas requiring improvement.

Conclusion

This study is the first to show that ENC knowledge and practice among HCW are unsatisfactory in the Rorya district of the Mara region, Tanzania. Just over half of the HCW interviewed demonstrated satisfactory knowledge, and two thirds exhibit satisfactory practice levels. The study has identified specific gaps in practice that require improvement, including avoiding routine suctioning during resuscitation, implementing delayed cord clamping, delayed bathing, administering essential medicines, and promoting skin-to-skin contact between mother and child. The inadequacy in practicing ENC was attributed to several barriers, primarily related to knowledge, but also due to a shortage of essential medical supplies and resistance from mothers towards certain ENC practices. Addressing these challenges necessitates repeated educational programmes, with a special focus on the mentioned gaps in knowledge and practice, especially for healthcare workers in non-hospital facilities. Furthermore, improving the supply chain of essential medicines is crucial for progress. The study underscores the critical need for the improvement of ENC to reduce neonatal mortality in Tanzania.

Data availability statement

Data will be made available upon reasonable request from the authors.

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Author contributions

SBM: Responsible for writing the research proposal, collecting data, submitting ethical clearance letters, conducting the primary analysis, interpreting data, and contributed to manuscript writing from the first draft to the final version.
MMIB: Provided direct and daily supervision on-site in all stages and contributed to manuscript writing from the first draft to the final version.
BEB: Supervised data analysis, contributed to data interpretation, and to the writing of the final version of the manuscript.
HKdJ: Provided supervision off-site, contributed to data interpretation, and to the writing of the final version of the manuscript.
BMC: Provided direct supervision on-site, contributed to data interpretation, and to the writing of the final version of the manuscript.
MPG supervised the process from the conception of the idea to the finalization of the manuscript writing process and contributed to the writing at all stages.
All authors endorsed the final version of the manuscript for submission.
Part of this manuscript formed part of the Master thesis of SM.

Disclosure statement

None of the authors declares any conflict of interest.

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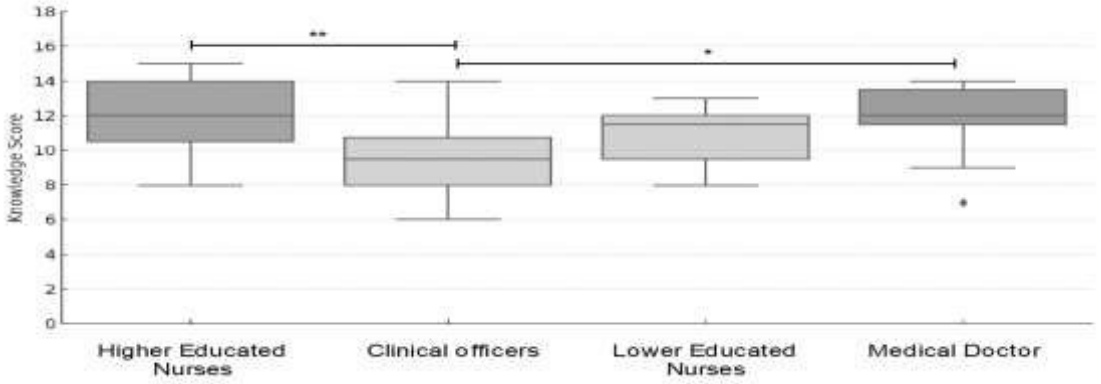
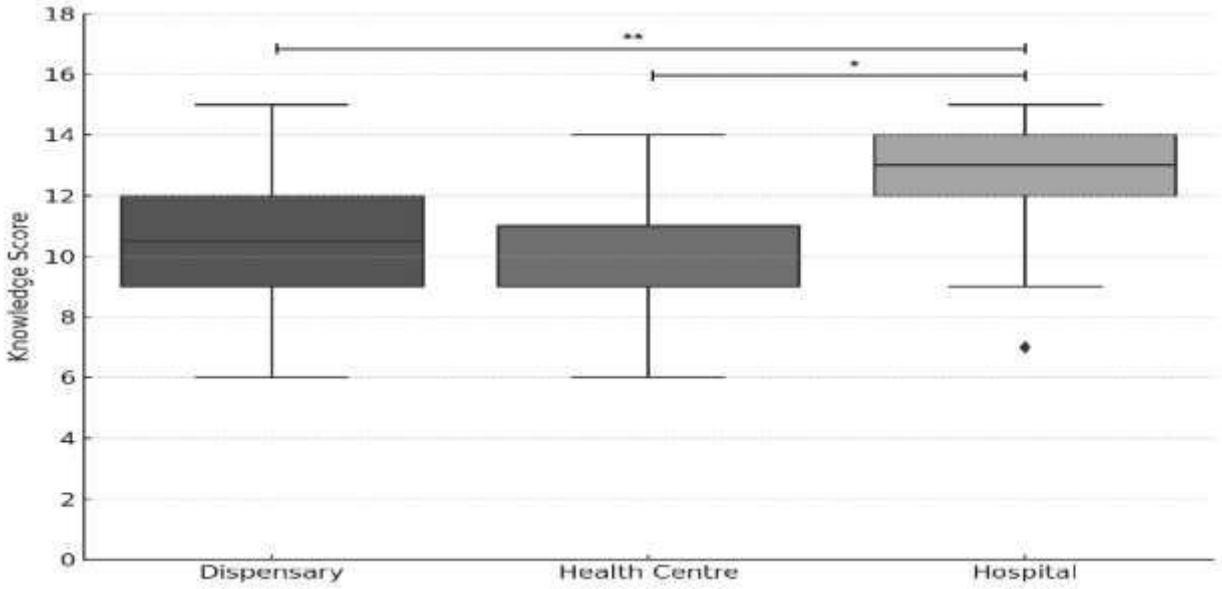


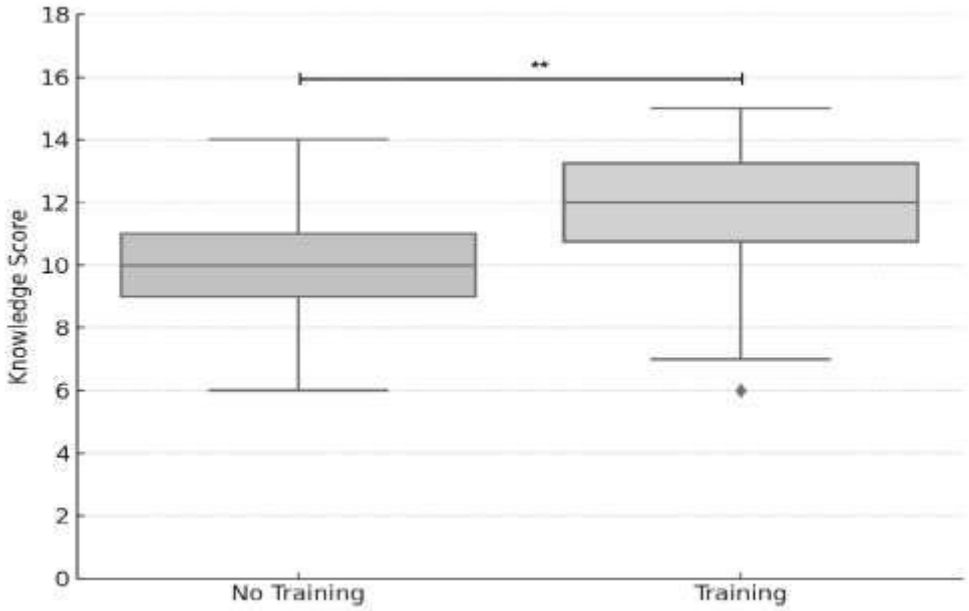
The minimum score was 0, and the maximum score was 15. One-sided ANOVA and Tukey HSD tests were conducted to calculate the significant differences between providers. Clinical Officer: n=14, Lower Educated Nurse: n=15, Medical Doctor: n=11, Higher Educated Nurse: n=27. '*' indicates a P-value of 0.01 > P < 0.05; '**' indicates a P-value of < 0.01.

Supplementary Figure 1. Boxplot of knowledge scores on Essential New-born Care per profession.



The minimum score was 0 and the maximum score was 15. A Kruskal-Wallis test, a Mann-Whitney U test and a Bonferroni correction was done to calculate significance. Dispensary n=27, Health centre n=13, Hospital n=27 '*' P-value: 0.01> P <0.05, '**': P-value: <0.01.

Supplementary Figure 2: Boxplot of knowledge scores on essential new-born care per health facility



Training on Essential New-born Care or Helping Babies Survive
Mann-Whitney U test was done to calculate significant difference. '**': P-value: <0.0

Supplementary Figure 3: Boxplot of knowledge scores on essential new-born care per trained and untrained healthcare provider

Supplementary Table 1.1: Socio-demographics of the included healthcare providers who practice Essential New-born Care (n=67)

			Sex					Health facility		
	Healthcare providers, n (%)	**Median age of providers (IQR)**	**Male, n (%)**	**Female, n (%)**	**Median years of experience (IQR)**	**Median deliveries per week (IQR)**	**Trained in ENC or HBS, n (%)**	**Dispensary, n (%)**	**Health Centre, n (%)**	**Hospital, n (%)**
Medical Doctor	11 (16.4)	31.5 (12.5)	10 (90.9)	1 (9.1)	5.5 (5.3)	6.5 (7.5)	8 (72.7)	1 (0.1)	1 (0.1)	9 (0.8)
Nursing Officer	4 (6.0)	30.0 (2.5)	2 (50.0)	2 (50.0)	1.5 (1.3)	12.5 (8.8)	4 (100)	0 (0.0)	0 (0.0)	4 (100)
Registered Nurse	23 (34.3)	32.0 (10.5)	10 (45.5)	12(54.5)	5.5 (7.8)	10.0 (6.3)	18 (78.2)	8 (34.8)	3 (13.0)	12 (52.2)
Clinical Officer	14 (20.9)	29.5 (6.0)	12 (85.7)	2 (14.3)	3.0 (2.0)	3.0 (8.0)	4 (28.6)	8 (57.1)	6 (42.9)	0 (0.0)
Enrolled Nurse	14 (20.9)	35.0 (7.0)	4 (30.8)	9 (69.2)	6.65 (4.8)	5.5 (4.5)	10 (71.4)	9 (64.3)	3 (21.4)	2 (14.3)
Medical Attendant	1 (1.5)	31 (0.0)	1 (100)	0 (0.0)	0.5 (0)	2.0 (0.0)	1 (100)	1 (100)	0 (0.0)	0 (0.0)
Total	67 (100)	32.0 (7.0)	39 (60.0)	26 (40.0)	4.0 (8.0)	6.0 (7.0)	45 (67.2)	27 (40.3)	13 (19.4)	27 (40.3)
Missing Data	0	0	2		4	2	0	0		
p-value		0.45[c]	0.02*[b]		0.23[c]	0.04*[c]	0.01*[a]	<0.01*[a]		

*Abbreviations: IQR = Interquartile Range, % = percentage, ENC = Essential New-born Care, HBB = Helping Babies Survive, p-value = probability value, * = significant 0.01> p <0.05, ** = significant p <0.01. [a]: Chi-square test of independence to assess distribution of professions between variables (training and health facility) [b]: two-proportion Z-test, to assess differences between the total amount of males and females . [c] = Kruskal-Wallis test to assess differences between healthcare providers per variable (age, experience and deliveries per week)*

Supplementary Table 1.2: Demographics of the included healthcare facilities where essential new-born care is practiced (n=29)

						Funding			Location		
	Included healthcare facilities, n (%)	**Included providers, n (%)**	**Median years of experience per provider (IQR)**	**Median number of deliveries per provider per week, (SD)**	**Trained providers in ENC or HBS, n (% of total providers)**	**Public, n (%)**	**Private, n (%)**	**Public-Private, n (%)**	**Nyancha, n (%)**	**Girango, n (%)**	**Luo-imbo, n (%)**
Dispensary	19 (65.5)	27 (40.3)	6.5 (6.25)	3.0 (2.0)	14 (51.9)	16 (84.2)	3 (15.8)	0 (0.0)	13 (68.4)	6 (31.6)	0 (0.0)
Health centre	6 (20.7)	13 (19.4)	2.0 (3.0)	10.0 (4.8)	6 (46.2)	3 (50.0)	3 (50.0)	0 (0.0)	3 (50.0)	3 (50.0)	0 (0.0)
Hospital	4 (13.8)	27 (40.3)	3.0 (5.0)	10 (9.0)	25 (92.6)	1 (25.0)	2 (50.0)	1 (25.0)	2 (50.0)	1 (25.0)	1 (25.0)
Total	29 (100)	67 (100)	4.0 (8.0)	6.0 (7.0)	45 (67.2)	20 (69.0)	8 (27.6)	1 (3.4)	18 (62.1)	10 (34.5)	1 (3.4)
Missing data	0	0	4	2	0	0	0	0	0	0	0
P-value			0.05*[b]	<0.01**[b]	<0.01**[a]		0.125[a]			0.127[a]	

*Abbreviations: IQR: Interquartile Range, %: Percentage, P-value = Probability value, * = significant 0.01> p <0.05, ** = significant p <0.01, ENC: Essential New-born Care, HBB: Helping Babies Survive. [a]: Chi-square test of Independence to assess distribution of facilities across the variable (funding and location) [b] = Kruskal-Wallis test to assess differences between health facilities across the variable (years of experience and number of deliveries).*