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Neonatal Jaundice Risk Factors at a District Hospital in Rwanda

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ABSTRACT

Background
Neonatal jaundice is one of the most common reasons for hospital admission in the neonatal unit, and it is associated with significant morbidity and mortality.

Objective
To assess risk factors associated with neonatal jaundice among newborns at a District Hospital in Rwanda.

Methods
A quantitative approach has been used with a retrospective cross-sectional design. Two hundred and ten files were used as sample size. Stratified proportional sampling was used for the years 2016-2018 to select files. Data was collected using a structured questionnaire. Descriptive statistics and inferential statistics were used for the data analysis.

Results
The study findings showed that nearly half (44.3%) of 210 newborns were diagnosed with neonatal jaundice. The majority (87.2%) was term, and male gender (60.5%). Nearly a third (29.5%) were Low Birth Weight. Significant risk factors for neonatal jaundice were birth weight (p=0.015), gestational age of the newborn (p=0.002), neonatal gender (p=0.004), method of delivery (p=.000), blood group incompatibility (p=0.001); infections (p =0.000), cesarean section (p= 0.000) and prematurity (p=0.017).

Conclusion
There was a high prevalence of neonatal jaundice. Neonatal jaundice risk factors were predominantly demographic, maternal and neonatal. Hence there is need to formulate tailored interventions that mitigate neonatal jaundice.

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Keywords: Neonatal jaundice, risk factors, newborn, district hospital, Rwanda

BACKGROUND

Neonatal jaundice is a condition that affects 60%-80% of newborns worldwide.[1] Though most neonates experience mild jaundice, a Global Burden of Disease (GBD) study in 2016 showed that neonatal jaundice accounted for 1,008 deaths per 100,000 live births and ranked seventh in mortality during the early-neonatal period (0 – 6 days).[2] Severe hyperbilirubinemia is estimated to affect 1.1 million neonates every year in South Asia and sub-Saharan Africa (SSA), where it is ranked the 7th and eighth leading cause of neonatal mortality, respectively.[3] In South Africa, the prevalence of neonatal jaundice was 55.2%,[1] whereas, in Pakistan, the prevalence of neonatal jaundice was 27.6%.[4]

Severe hyperbilirubinemia, with or without encephalopathy, is associated with substantial mortality and long-term morbidity in low-to-moderate income countries (LMIC),[5] including Rwanda. High levels of bilirubin can cause permanent brain damage (kernicterus), and therefore screening and prompt treatment are important strategies.[5] At three years of age, full neurological symptoms of kernicterus, including

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bilateral athetosis with involuntary muscular spasms, extrapyramidal symptoms, seizure, mental retardation, dysarthria, high-frequency hearing loss, and strabismus and eye movement abnormalities can appear.[5]

Another study conducted on the magnitude of neonatal jaundice and in a NICU in Mekelle City Public Hospitals, Northern Ethiopia, revealed that risk factors such as prolonged duration of labor, male neonates, and "O" blood group was associated with neonatal jaundice.[6] A study conducted hyperbilirubinemia in newborns in Kaiser Permanente Northern California showed that boys, nonwhite, large for gestational age, and of lower gestational age were associated with neonatal jaundice.[7]

Rwanda Health Sector has registered significant achievements in the previous years. However, challenges need to be addressed to improve the quality of service delivery for the prevention and control of some conditions. The identification of needs and a concerted effort to improve management at different levels of the health system can significantly reduce acute bilirubin encephalopathy (ABE) and improve opportunities for thousands of newborns around the world.[8] Rwanda, as one of the LMIC, needs to know the prevalence and risk factors associated with neonatal jaundice to reinforce the existing policies in maternal and neonatal child health. Risk factors like maternal, prenatal, and neonatal are significantly or not significantly associated with severe hyperbilirubinemia in LMIC.[9]

Several studies have identified factors associated with neonatal jaundice. A study conducted in Iran addressed the complications of neonatal jaundice and predisposing factors in newborns with idiopathic jaundice, ABO incompatibility, Rh incompatibility, and G6PD deficiency as risk factors.[5] A study in Southern Nepal indicated that male gender, high birth weight, breastfeeding, warm ambient temperature, primiparity, skilled birth attendance, place of delivery, prolonged labor, oil massage, paternal education, and ethnicity were critical risk factors.[10] However, data about the prevalence and related risk factors in Rwanda are limited.[3]

In Rwanda, the only study conducted at Ruhengeri district hospital identified a high prevalence of neonatal jaundice, which was 41.3%, and the risk factors of pathologic hyperbilirubinemia in the same hospital were maternal age, birth weight and the number of parity.[3] The author of the only research conducted on neonatal jaundice in Rwanda recommended that other research studies should be conducted across the country to confirm the prevalence of pathologic hyperbilirubinemia in newborns. The present study assessed the prevalence and risk factors associated with neonatal jaundice at a selected district hospital of Rwanda.

METHODS

Design
A retrospective design was used to collect data from the files of newborns admitted in the neonatal unit of Kabgayi District Hospital in Muhanga District during 2016-2018. The study was conducted between 05 March and 31 May 2019.

Study setting
The study was conducted in the neonatology ward at Kabgayi District Hospital in the Southern Province, Muhanga District. The setting was selected as it had over a dozen cases of neonatal jaundice admitted in the neonatal unit in a two-week period.

Inclusion and exclusion criteria
The inclusion criteria were all newborns born and later readmitted to the neonatal unit of Kabgayi District Hospital in Muhanga District during 2016-2018. Exclusion criteria were newborns admitted before or after the designated dates or born at other health facilities.

Sample size
The formula of Taro Yamane (1967) to calculate the sample size of newborns for representing all newborns admitted to the hospital has been used. n= $N/1+N*(e)^2$ where n= Sample size; n= the population size; e= the acceptable sampling error (e=0.05). The population of this study included 160 newborns in 2016, 157 in 2017, and 125 in 2018 for a total population of 442. The sample size was $442/1+442*(0.05)^2 = 210$ newborns.

Sampling strategy
A stratified proportional sampling for newborns born and readmitted at the hospital in 2016- 2018.

Measures
A modified data collection tool from Brits et al (2018), who conducted a similar study on the prevalence of neonatal jaundice and risk factors in healthy term neonates [1], has been used with permission to collect data needed to answer the research questions. The tool was modified and adapted to the Rwandan context, with the removal

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of the mother's race and the primiparity. Other items on the tool have been maintained, as they were applicable in the Rwandan context. The data collection tool had two sections:

Section 1: Demographic data of the newborn and mother (4 items) - maternal age (years), neonatal gender, birth weight (grams), age of admission to the neonatal unit (days) and participants medical diagnosis.

Section 2: Risk factors of the mother (7 items) and neonate (10 items). Maternal - labor induction with oxytocin, premature rupture of membranes (PROM), delivery method, and oral contraceptive use in pregnancy, alcohol use in pregnancy, sibling jaundice, and ABO incompatibility. Neonatal – prematurity, gestational age (weeks), not breastfeeding ≤ hour post-birth, ABO, and other blood group incompatibilities, infection, cephalohematoma, and early hospital discharge.

Validity and reliability of the data collection tool

The tool was submitted to an expert nurse with Doctorate in Nursing Practitioner (DNP) in neonatology science for a face validation to confirm if the tool would be measuring what it was supposed to measure (the prevalence and risk factors of neonatal jaundice). The tool was piloted on 10 cases admitted in the neonatal unit in 2018. For this study, Cronbach's alpha has been used to determine internal consistency. The tool had 22 items, and the Cronbach's alpha test was 0.856 meaning the instrument was a very good measure of concepts under study.

Data collection

After the permission of the University of Rwanda and the district hospital, the investigator reviewed the births recorded in the 2016 -2018 neonatal files. The information was retrieved from the neonatal files in the registry of the hospital.

Data analysis

Data were analyzed using SPSS software version 23. The data analysis used descriptive statistics in the form of percentages and frequencies was used to describe the demographic data of the child and the mother, the maternal and neonatal risk factors. Chi-square test was used to establish any association between demographics, neonatal, and maternal risk factors and neonatal jaundice. A p-value of < 0.05 was statistically significant.

Ethical considerations

An ethical clearance from the University of Rwanda, College of Medicine and Health Sciences, Institutional Review Board (IRB), and the recommendation from the Ministry of Health (MOH) was obtained. The approval from the study site had also been obtained.

RESULTS

Demographic characteristics

Table 1 displays results on maternal age, gender, birth weight, and postnatal age.

Table 1. Demographic data of mother and newborn (n=210)

Demographic variables of the baby		frequency	Percentage
New-born age of admission in neonatal unit(days)	≤7days	176	83.8%
	>7days	34	16.2 %
	Total	**210**	**100%**
Gender	female	83	39.5%
	male	127	60.5%
	Total	**210**	**100%**
Birth weight	1501g-2000g	1	0.5%
	2001g-2500g	62	29.5%
	2501g-3000g	147	70%
	Total	**210**	**100%**

Table 1 shows demographic data of neonates. The majority (83.8%) of neonates were less or equal to 7 days and 16.2% with more than 7 days. There were 127 (60.5%) males and 83 (39.5%)

females. For the birth weight, the majority range of weight for 210 participants was 2501g-3000g 147 (70%), 1 (0.5%) was in the range of 1501g-2000g of birth weight, and 62 (29.5%) were in the range of 2001g-2500g of birth weight. For maternal age, the majority ranged from 25 to 34 years, 131(62.4%).
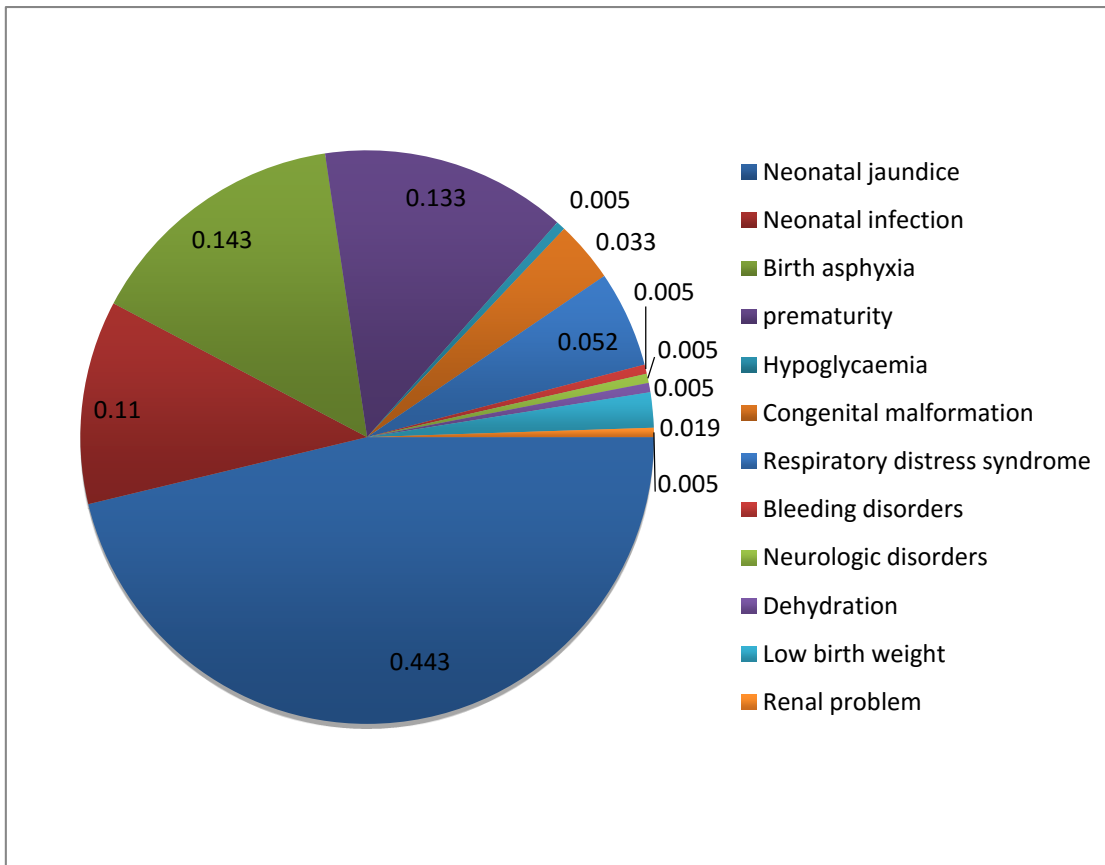

Figure 1. Prevalence of neonatal jaundice

An analysis of the participants' medical diagnosis in Figure 1 indicated that the majority of participants, 93 (44.3%) were presenting with neonatal jaundice, 23(11.0%), infection, 30(14.3%) birth asphyxia, 28(13.3%) prematurity, 11(5.2%) respiratory distress syndrome, 7(3.3%) congenital malformation, 4(1.9%) LBW, 1(0.5%) hypoglycaemia, 1(0.5%) bleeding disorders, 1(0.5%) neurologic disorders, 1(0.5%) dehydration, 1(0.5%) and renal problems. Therefore, the results indicated the prevalence of neonatal jaundice among the studied population as 44.3%.

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Maternal risk factors of neonatal jaundice

Table 2. Maternal risk factors of neonatal jaundice (n=210)

Variables				frequency	Percentage
Maternal age	15-24		Yes	46	21.9%
	25-34		Yes	131	62.4%
	35 and more		Yes	33	15.7%
			Total	**210**	**100%**
Induction of labor with oxytocin			No	210	100%
			Total	**210**	**100**%
Method of delivering			Natural	104	49.5%
			C-Section	106	50.5%
			Total	**210**	**100**%
Oral contraceptive in pregnancy			Yes	0	0%
			No	210	100%
			Total	**210**	**100**%
Alcohol use during pregnancy			Yes	0	0%
			No	210	100%
			Total	**210**	**100**%
Sibling jaundice			Yes	0	0%
			No	210	100%
			Total	**210**	**100**%
ABO incompatibility			Yes	3	1.4%
			No	207	98.6%
			Total	**210**	**100**%
premature rupture of membranes			Yes	1	0.5%
			No	209	99.5%
			Total	**210**	**100**%

Table 2 shows results on the maternal risk factors of neonatal jaundice. For the method of delivery, the majority of mothers 106 (50.5%) delivered by cesarean; 104 (49.5%) delivered by natural method. For ABO incompatibility, only 3 (1.4%) of mothers were presenting ABO incompatibility. For premature rupture of membranes, only one mother, 1 (0.5%) had experienced the premature rupture of membranes.

Table 3. Neonatal risk factors of jaundice

Variables		Frequency	Percent
ABO and other blood group incompatibilities	No	200	95.2%
	Yes	10	4.8%
	Total	**210**	**100.0**%
Infections	No	160	76.2%

	Yes	50	23.8%
	Total	**210**	**100.0**%
Prematurity	No	164	78.1%
	Yes	46	21.9%
	Total	**210**	**100.0**%
gestation age of the baby(weeks)	28	3	1.4%
	30	3	1.4%
	31	2	1.0%
	32	9	4.3%
	33	1	0.5%
	34	4	1.9%
	35	6	2.9%
	36	15	7.1%
	37	9	4.3%
	38	26	12.4%
	39	62	29.5%
	40	62	29.5%
	41	8	3.8%
	Total	**210**	**100.0**%
non breastfeeding within one hour after birth	No	199	94.8%
	Yes	11	5.2%
	Total	**210**	**100.0**%
Early hospital discharge	No	199	94.8%
	Yes	11	5.2%
	Total	**210**	**100.0**%
Cephalohematoma	No	209	99.5%
	Yes	1	0.5%
	Total	**210**	**100.0**%

Table 3 displays the neonatal risk factors of jaundice. For ABO and other blood group incompatibilities, the majority [200 (95.2%)] were not presenting it. A significant number of new- borns160 (76.2%) did not present with any kind of infection. Approximately 46 (21.9%) presented with prematurity and 164 (78.1%) were not. For gestation age of the baby (weeks), 3 (1.4%) were having 28 weeks, 3 (1.4%) were having 30 weeks, 2 (1.0%) were having 31 weeks, 9 (4.3%) were having 32 weeks, 1 (0.5%) was having 33 weeks, 4(1.9%) were having 34 weeks, 6 (2.9%) were having 35 weeks, 15 (7.1%) were having 36 weeks, 9 (4.3%) were having 37 weeks, 26 (12.4) were having 38 weeks, 62 (29.5%) were having 39 weeks, 62 (29.5%) were having 40 weeks, 8 (3.8%) were having 41 weeks. For non-breastfeeding within one hour after birth, 11 (5.2%) were able to breastfeed within one hour after birth, and 199 (94.8%) were not. For early hospital discharge, 11 (5.2%) have been early discharged, and 199 (94.8%) were not. For cephalohematoma, 1 (0.5%) newborn was presenting it, and 209 (99.5%) were not.

Risk Factors Associated with Neonatal Jaundice

Table 4 displays the association between maternal and neonatal risk factors with neonatal jaundice. Demographic factors associated with neonatal jaundice were birth weight (p = 0.015) and neonatal gender (p=0.004). Regarding maternal risk factors, there was a significant association between the method of delivery (p= 0.000) and neonatal jaundice. For neonatal risk factors, factors with significant associations were gestational age of the new born (p= .002), ABO and other blood group incompatibilities (p= 0.001), infections (p= 0.000) and prematurity (p= 0.017).

Table 4. Factors associated with neonatal Jaundice (N= 210)

Characteristics	Presence of jaundice	No jaundice	P value
Demographic characteristics of neonates			
Number of days of the new-born admitted in neonatal unit			
1 to 7 days	76(36%)	100(48%)	.150
Less than 7 days	17(8%)	17(8%)	
Neonatal Gender			
Female	41(19%)	42(20%)	.004
Male	52(25%)	75(36%)	
Birth weight			
1501 to 2000g	0 (0)	1(0.5%)	
2001 to 2500g	16 (8%)	46 (22%)	.015
2501 to 3000g	77 (37%)	70 (33%)	
Maternal risk factors			
Maternal age			
15 to 24 years	14 (7%)	32 (15%)	
25 to 34 years	62(30%)	69 (33%)	.255
35 years and greater	17 (8%)	16 (8%)	
Method of Delivery			
Natural	32	72	.000
C section	61	45	
ABO incompatibilities			
Yes	3 (1.4%)	0 (0%)	.147
No	90(43%)	117 (56%)	
Premature rupture of membranes			
Yes	1 (0.5%)	0(0%)	.532
No	92(44%)	117(56%)	
Neonatal risk factors			
Gestation age of the new-born			
28 to 32weeks	2(1%)	15(7%)	
33 to 36 weeks	8(4%)	18(9%)	.002
More than 37 weeks	83(39%)	84(40%)	
Infections			
Yes	37 (18%)	13 (6%)	.000
No	56 (27%)	104 (49%)	
Prematurity			
Yes	12(6%)	34(16%)	.017
No	81(38%)	83(40%)	
Non breastfeeding within one hour			
Yes	5(2%)	6(3%)	.858
No	88(42%	111(53%)	
ABO and other blood group incompatibilities			
Yes	10 (5%)	0 (0%)	.001
No	83 (39%)	117 (56%)	
Early Hospital discharge			
Yes	a2 (1%)	9(4%)	.107
No	91(42%)	108(51%)	
Presence of cephalohematoma			
Yes	0(0)	1	.505
No	93(44%)	116(55%)	

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DISCUSSION

Prevalence

The prevalence of neonatal jaundice was high as evidenced with 44.3% of newborns developing neonatal jaundice. The present study was in contrast to what has been found in the study conducted in Nigeria on the prevalence of neonatal jaundice in Eku Baptist community Hospital in Delta State, which showed that 70.5% of newborns developed neonatal jaundice within the first week of life.[11] For the gender, among jaundiced neonates, according to the cross-tabulation, males constituted a high number 127 (60.5%) . Males were higher in number than females. This finding shows that male infants are more susceptible to neonatal jaundice than female infants in the present study, in contrast to a study in Ibadan, which found that jaundiced female infants were presenting a significantly higher number (53.9%) than male infants.[12] Similarly to the study conducted in Nigeria on the of neonatal jaundice in a Community Hospital in Delta State showed that male newborns presented in higher numbers 67.4% with jaundice than females.[11]

This finding is similar to a study on the incidence, risk factors, and outcome of G6PD among newborns presenting with hyperbilirubinemia in a tertiary care hospital in Punjab, which found jaundice was more prevalence in male infants 68.45% than female infants.[13] For the birth weight, the majority of jaundiced neonates were 2501g-3000g 147(70%). This finding is similar to a study at Ruhengeri Hospital in Rwanda, which showed that the majority (72%) of jaundiced newborns were higher than 2500 g at birth.[3]

Risk factors associated with neonatal jaundice

Birth weight, neonatal gender, ABO and other blood group incompatibilities, infections, prematurity, gestation age of the baby and the C/Section as a method of delivering were predominant associated risk factors with neonatal jaundice. Almost the same risk factors have been found in the study conducted in Nigeria in the Eku Baptist Community Hospital in Delta State, which showed that neonatal jaundice is related to sepsis, anemia, prematurity, ABO incompatibility and lack of breastfeeding.[11] A study conducted on the magnitude of neonatal jaundice and its associated factor in NICUs in Mekelle City Public Hospitals in Northern Ethiopia, infections were associated with neonatal jaundice.[6]

A study conducted in a tertiary care hospital in India indicated prematurity was associated with neonatal jaundice,[14] and septicemia. Similarly, a study in the Federal Medical Centre Abakaliki, Southeast Nigeria.[15] A study conducted on heliotherapy for neonatal hyperbilirubinemia in Southwest, Nigeria, blood incompatibility was associated with severe neonatal jaundice.[17] A study conducted on when babies turn yellow in Singapore, found liver disease, bruising, and metabolic disorders were associated with neonatal jaundice.[15] In Iran, a study found idiopathic jaundice, ABO incompatibility, Rh incompatibility, and G6PD deficiency as risk factors associated with neonatal jaundice.[5] A study in Southern Nepal showed that male sex, LBW, breastfeeding patterns, warm ambient temperature, primipara, skilled birth provider, place of delivery, prolonged labor, oil massage, paternal education, and ethnicity were critical risk factors.[10] At the National District Hospital in Bloemfontein, normal vaginal delivery was the only risk factor associated with neonatal jaundice.[1]

In contrast, a study conducted on risk factors for severe neonatal hyperbilirubinemia in LMIC showed that risk factors such as race, social class, primiparity, sibling treated for jaundice, LBW, and weight loss associated with severe neonatal jaundice.[9] In contrast, risk factors for Malaysian neonates included gender, birth weight, and gestation age of neonates were not associated with neonatal jaundice.[16] The study conducted on pregnancy obesity associated with hyperbilirubinemia in neonates with a high prevalence in Hawaiians and Pacific Island women, showed that obesity in pregnancy is associated with neonatal jaundice.[17] In the study conducted on the burden and management of neonatal jaundice in Nigeria, G6PD deficiency was a significant risk factor associated with neonatal jaundice.[20]

Limitations

As the study was retrospective for only admitted newborns in the neonatal unit in 2016-2018, it cannot be generalized to other areas. The investigator had many challenges with incomplete, missing, and inaccurate documentation in the NICU registers and neonatal files. The poor record-keeping was a big problem with the files. For example, the blood group of the mother and newborn were absent, the time of membrane rupture was missing in files, and the time of yellow color occurrence was missing in most of the files. Other information, such as the use of contraception during pregnancy, was missing.

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CONCLUSION

ABO and other blood group incompatibilities, infections, prematurity, gestational age of the baby, and the cesarean as a method of delivery were predominant associated risk factors with neonatal jaundice. There is a need for conducting further research on prevalence and risk factors associated with neonatal jaundice in other districts of Rwanda as it remains a challenge. Health care providers who work with neonates should play an essential role in identifying risk factors associated with neonatal jaundice on time and prevent their occurrence where possible. Health education is vital for the parents for the early detection of neonatal jaundice. Regular antenatal care must be done for all pregnant women, and the extended stay in the hospital after newborn birth can play an essential role in preventing neonatal jaundice. There must be more training of health care providers, especially nurses and midwives, in early diagnosis of the risk factors of neonatal jaundice. Guidelines and protocols about neonatal jaundice must be available in order to provide appropriate care to jaundiced newborns.

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