VACCINATION OF PRETERM INFANTS: KNOWLEDGE AND PRACTICES OF HEALTHCARE WORKERS IN SOUTH AFRICA

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DECLARATION

I, Jesca Nakibuka, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgments indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signed by candidate

Jesca Nakibuka 22/12/2022

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Special thanks to all the participants that provided data for the study

Last but not least I am grateful and thankful to God and my family, Daniel, Jonathan, Maria and Christine who supported me throughout the training and especially during the harsh COVID-19 experience

CHAPTER ONE: INTRODUCTION

1.1 Context

World Health Organisation (WHO) and other international health authorities recommend that vaccination of preterm infants be at the same chronological age as their full-term counterparts (1, 2). Vaccination remains a critical cost-effective public health intervention in reducing childhood morbidity and mortality (3). Preterm infants have a higher risk for vaccine-preventable diseases (VPDs) with concomitant excess in morbidity and mortality. Timely vaccination is thus critical in preterm infants because of an immature immune system, a higher risk for complications of prematurity, and the inadequate transplacental transfer of maternal antibodies (4). Globally, delays and under-vaccination of preterm infants are common with a resultant excess in disease severity, frequency, and need for hospitalization(4, 5). This strongly underpins the importance of healthcare workers (HCWs) need to be knowledgeable about vaccination of preterm infants and being advocates for adherence to the vaccination guidelines (6). However, there is a paucity of data on HCWs' knowledge and practices on vaccination of preterm infants in resource-constrained settings such as South Africa.

Several knowledge, attitude, and practice studies among HCW have been done in the UK, USA, Canada, and China to evaluate the relationship between knowledge and some vaccination practices for varied populations (7-10). Notably, the focus of most of these studies is not on preterm infants and the majority are from developed countries yet the evidence for significant delays and under-vaccination of preterm infants is from both developed and developing countries (11-16). In 2019, 19.7 million children worldwide were not reached by routine vaccination and almost 60% were in low and middle-income

countries (LMICS) (17, 18). Varied reasons for the delay to vaccinate children remain complex and some developed and developing countries have documented some factors (12, 19, 20). In 2009, a WHO review by the Strategic Advisory Group of Experts on immunization (SAGE), identified several reasons that are due to health system characteristics such as service inaccessibility, vaccine delivery challenges, and healthcare worker-related concerns (6, 20). In addition, increasing parental refusal of vaccines and anti-immunization campaigns may hamper vaccine uptake (6, 21-23) further highlighting the need for this study.

South Africa is a developing country with approximately 84,000 preterm births every year (24). In 1995, the Expanded Program on Immunization (EPI) was introduced in S.A to ensure access to high-quality childhood vaccines (25). The EPI in South Africa has made significant progress in the control of vaccine-preventable diseases despite several challenges (6). There are variations between the private sector and the resource-constrained public sector which potentially influences clinical practice (26). Recent reports indicate suboptimal immunization coverage for some childhood vaccines in South Africa (27) but it unclear whether health worker knowledge and practices especially regarding vaccination of preterm neonates maybe contributing to this problem.

The aim of this study therefore set out to determine practices and knowledge of healthcare workers (HCWs) regarding vaccination of preterm infants in South Africa (S.A)

1.2 Ethical considerations

There is minimum risk associated with this study. It posed no risks to patients. The potential benefit of this study is related to improving vaccine uptake in preterm infants. No identifying

information was requested to preserve the anonymity of participants and all data was preserved in a password-protected computer.

Ethical approval was attained from the Human Research Ethics Committee, Faculty of Health Sciences, University of Cape Town. Ref number 852/2020

1.3 Author guidelines of the journal for which the paper has been formatted.

This study has a manuscript that has been formatted for submission to the journal of perinatology. The journal of perinatology is an American-based journal that publishes articles on perinatal topics and improving neonatal outcomes. Our study was on the knowledge and practices of healthcare workers regarding the vaccination of preterm infants who are highly susceptible to vaccine-preventable diseases and death. The results of our study are important in the design and plan for training programs for healthcare workers involved in caring for preterm infants in both hospitals and the community. There is a dearth of data on adherence to the Expanded Program on Immunization by healthcare workers in our setting and yet evidence indicates there are delays to vaccinating this vulnerable paediatric population. It will be informative to readers to identify some of the reasons why healthcare workers have variable practices on vaccination.

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CHAPTER TWO: PUBLICATION READY MANUSCRIPT

VACCINATION OF PRETERM INFANTS: KNOWLEDGE AND PRACTICE OF HEALTHCARE WORKERS IN SOUTH AFRICA

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Declarations of interest; none

ABSTRACT

Objective: To determine practices and knowledge of healthcare workers (HCWs) regarding vaccination of preterm infants in South Africa (S.A)

Study design: Online cross-sectional survey of HCWs involved in neonatal care in state and private neonatal intensive-care units in S.A.

Results: A total of 245 health workers participated in the survey **(**36.4% response rate). Majority were paediatricians (35.9%), had more than 10 years practice (55.5%) and majority were from the public sector (62.9%). Up to 80.4% of the respondents correctly responded that preterm infants should be vaccinated according to the chronological age. The average knowledge score was 10 points out of 16 points. Factors associated with knowledge of preterm vaccination were current practice role, years of practice, facility location, and having a written policy. The private sector compared to the public sector had significantly higher proportion of written policies to guide on vaccination of preterm infants, systems to keep record of preterm vaccinations and systems to follow-up preterm infants who default on vaccination.

Conclusion: Non-specialized health workers, those with fewer years of practice, those working in rural facilities and facilities with no written policy on preterm vaccination are more likely to have knowledge gaps in preterm vaccination. Inclusion of preterm vaccination in prequalification training of non-specialized cadres, knowledge transfer through mentorships, continuous medical education and written policies may improve preterm vaccination knowledge among health workers caring for preterm infants in South Africa.

INTRODUCTION

World Health Organisation (WHO) and other international health authorities recommend that vaccination of preterm infants be at the same chronological age as their full-term counterparts (1, 2). Vaccination remains a critical cost-effective public health intervention in reducing childhood morbidity and mortality (3). Preterm infants have a higher risk for vaccine-preventable diseases (VPDs) with concomitant excess in morbidity and mortality. Timely vaccination is thus critical in preterm infants because of an immature immune system, a higher risk for complications of prematurity, and the inadequate transplacental transfer of maternal antibodies (4). Globally, delays and under-vaccination of preterm infants are common with a resultant excess in disease severity, frequency, and need for hospitalization(4, 5). This strongly underpins the importance of healthcare workers (HCWs) need to be knowledgeable about vaccination of preterm infants and being advocates for adherence to the vaccination guidelines (6). However, there is a paucity of data on HCWs' knowledge and practices on vaccination of preterm infants in resource-constrained settings such as South Africa.

Several knowledge, attitude, and practice studies among HCW have been done in the UK, USA, Canada, and China to evaluate the relationship between knowledge and some vaccination practices for varied populations (7-10). Notably, the focus of most of these studies is not on preterm infants and the majority are from developed countries yet the evidence for significant delays and under-vaccination of preterm infants is from both developed and developing countries (11-16). In 2019, 19.7 million children worldwide were not reached by routine vaccination and almost 60% were in low and middle-income countries (LMICS) (17, 18). Varied reasons for the delay to vaccinate children remain

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South Africa is a developing country with approximately 84,000 preterm births every year (24). In 1995, the Expanded Program on Immunization (EPI) was introduced in S.A to ensure access to high-quality childhood vaccines (25). The EPI in South Africa has made significant progress in the control of vaccine-preventable diseases despite several challenges (6). There are variations between the private sector and the resource-constrained public sector which potentially influences clinical practice (26). Recent reports indicate suboptimal immunization coverage for some childhood vaccines in South Africa (27) but it unclear whether health worker knowledge and practices especially regarding vaccination of preterm neonates maybe contributing to this problem.

This aim of this study therefore set out to determine practices and knowledge of healthcare workers (HCWs) regarding vaccination of preterm infants in South Africa (S.A)

METHODS

Study design and study site

The study was a cross-sectional survey of healthcare workers involved in neonatal care in primary health care facilities and private neonatal intensive care units (NICUs) in South Africa

Study population

Potential participants were identified using a contact database of healthcare workers working in over 150 public and private neonatal units across South Africa. The database was compiled by the Division of Neonatal Medicine at the University of Cape Town via engagement with the heads or operational managers in those units as well a previous email correspondence. The cadres that participated in the study included, certified neonatologists, paediatric registrars, paediatricians, medical officers, registered nurses and other health practitioners.

Inclusion criteria and exclusion criteria

All practicing healthcare workers in the database were contacted via their e-mail address to confirm whether they were involved in the treatment and care for neonates and were invited to participate in the survey. Healthcare workers who did not treat neonates in their practice were excluded. Participants were offered the opportunity to be entered into a draw to wina voucher code to download a paid neonatal guidelines mobile app.

Sample size and sampling procedure

The sample size for the study was determined using the Leslie Kish (28) sample size formula for cross-sectional surveys. We assumed that 50% of the respondents would be score above average using a linear scale knowledge score. This gave rise to a sample size of 384 participants for a 95% level of confidence.

Participants were sampled consecutively by sending out 672 emails and received 245 responses translating into a 36.4% response rate. This response rate is comparable to the response rates of 3 previous studies that did online surveys in South Africa; 28.3% (29), 31.2% (30) and 37.8 (31).

Data collection tool

The survey questionnaire was created and hosted using Microsoft Forms (https://forms.office.com), an online survey website. The 26-part questionnaire enabled the compilation of data regarding the vaccination of preterm infants. Each question addressed a single point and, in most cases, required a 'yes' or 'no' or 'I don't know the response. An e-mail containing a link to the survey was sent to 672 healthcare workers on 20 January 2021. The survey collector tool collected all responses anonymously and automatically sent reminder e-mails to those who had not responded. Survey collection closed on 07 February 2021. The data collection tool is in the appendix section.

Data analysis

Responses were exported to a Microsoft Excel file. Stata version 16.0 (Stata Corporation, College Station, USA) was utilized for statistical analysis. Participant characteristics and the responses to the 26-part questionnaire were summarized using frequency and

percentages. To obtain knowledge scores, the correct responses were given a score of 1 (one) and the incorrect or unsure responses were given a score of 0 (Zero). This was adapted from a similar study by Mukhtar, Abdul Kadir (32). Knowledge of preterm vaccination was analysed using a linear scale by obtaining the sum of the correct responses following the recommendation by Kaliyaperumal (33) for analysis knowledge. The maximum score was 16 while the lowest score was 0 (zero). The average total knowledge scores and corresponding standard deviations were then computed for the study variables. Simple and multiple linear regression was used to determine the associations between the participant characteristics and preterm knowledge at 5% level of significance. Chi-square and Fisher's exact test was used for compare the preterm vaccination practices between the public and private sector. A *p*-value of <0.05 was considered significant

Ethical considerations

There was minimum risk associated with this study. It posed no risks to patients. The potential benefit of this study was related to improving vaccine uptake in preterm infants. No identifying information was requested to preserve the anonymity of participants and all data was preserved in a password-protected computer.

Ethical approval was attained from the Human Research Ethics Committee, Faculty of Health Sciences, University of Cape Town. Ref number 852/2020. Written informed consent was provided by the participants prior to filling the questionnaires. The study procedures adhered to national and international ethical standards such as the Declaration of Helsinki and ICH Good Clinical Practice.

RESULTS

We received responses to 245 of the 672 emails sent out (36.4% response rate).

The characteristics of the respondents surveyed

Table1 shows the respondents characteristics. The majority of respondents were paediatricians (35.9%) followed by medical officers (18%). Neonatologists and other healthcare workers from the community were the least respondents at 6.5% and 5.3% respectively. More than half (55.5%) of the respondents had more than 10 years of active medical practice. Majority of the respondents (62.9%) were from the public sector only and 27.3% were from the private sector only. More than half of the respondents (58.8%) worked in tertiary level neonatal units and only 40.8% of the respondents reported they had a written policy on vaccination.

Knowledge of preterm vaccination

Regarding timing of vaccination, 80.4% of the respondents believed that preterm infants should be vaccinated according to the chronological age not according to corrected age. Regarding birth weight and gestational age, 31% of the respondents believed that preterm infants with a birthweight of less than 750g and those with less than 26weeks of gestation who are well should have vaccination delayed. More than half of the respondents (53.1%) believed that when vaccinating preterm infants, the timing of vaccines for preterm infants are influenced by concurrent medicine. The rest of the responses to questions assessing Knowledge of preterm vaccination are presented in table 2.

The number of correct responses for each respondent were enumerated and this sum was considered as the knowledge score for each participant. The maximum score achieved was

16 and the minimum was 0. The highest score obtained by the respondents was 15. The average knowledge score was 10 (SD=3). The distribution of the scores is shown in figure1

Certified neonatologists and paediatricians had the highest mean knowledge score at 12+-2. The Paediatric Registrars had a mean score of 11+-3. The Medical Officers and nurses had mean score of 9+-2. Other health practitioners had the lowest mean score at 7+-3. The mean scores appeared to increase with years of practice as shown in table 3.

Figure 2 shows that while the median knowledge score appears to increase by current practice role, 2 paediatric registrars had knowledge scores below 6

Table 4 shows that at multivariate analysis factors associated with Knowledge of preterm vaccination were current practice role, years of practice, facility location, and having a written policy. Mean Knowledge scores appear to be significantly lower among medical officers, -1.95 (-3.46, -0.44), registered nurses -3.08 (-4.55, -1.61) and other health practitioners -3.81 (-5.68, -1.94) compared to the certified neonatologist. Respondents with less than 5 years of practice have significantly lower mean knowledge scores -1.52 (-2.55, -0.48) compared to those with more than 20 years of practice. Respondents from urban facilities have a significantly higher mean knowledge score 1.69 (0.75, 2.64) than respondents from rural facilities. Respondents from facilities with a written policy appear to have significantly higher mean knowledge scores 0.94 (0.26, 1.62) than respondents from facilities without written policy on preterm vaccination. The level of health care and sector were not associated with knowledge of preterm vaccination.

Practice of preterm vaccination by sector

Table 5 shows Practice of preterm vaccination by sector. A significantly higher proportion of respondents from the public sector compared to the private sector reported presence of written policy for the vaccination of preterm infants (41.9% vs 38.5%, p=0.024), however private sector had more systems at the facility to keep a record of preterm vaccinations than public sector (70.5% vs 44.3%, p<0.001) More than half of the respondents in private sector (56.4%) delayed vaccination of preterm compared to less than half (38.9%) of respondents in public sector (p=0.027).

DISCUSSION

This study set out to assess the knowledge and practices of health workers regarding vaccination of preterm infants in South Africa. The study also set out to determine the factors associated with knowledge of health workers regarding vaccination of preterm infants in South Africa. Regarding timing of preterm vaccination, 80.4% correctly responded that preterm infants should be vaccinated according to chronological age which is in line with WHO recommendations. The average knowledge score was 10 points out of a possible 16 points, representing a knowledge level of about 62.5%. Knowledge score generally increased with medical practitioners' level of training and years of practice. Specialized medical personnel such as neonatologists, paediatric registrars and paediatricians had higher knowledge scores overall. Further, factors associated with knowledge of preterm vaccination were current practice role, years of practice, facility location, and having a written policy on preterm vaccination. Regarding preterm vaccination and nature of practice, the private sector compared to the public sector had significantly higher proportion of written policies, systems to keep record of preterm vaccinations, systems to follow-up preterm infants who default on vaccination and correct health worker practice regarding timing of preterm vaccination.

This study shows that overall knowledge regarding preterm vaccination is just above average and that specific knowledge regarding different aspects of preterm vaccination is highly varied. In this study, 8 out of 10 participants knew the correct timing of preterm vaccination was at chronological age. In addition, more than half were likely to delay vaccination of preterm infants with ongoing or concurrent medications. Our study findings are similar to findings reported elsewhere. In Uganda, a study of preterm infants and

vaccination (12) found that more than half of the health workers had delayed preterm vaccination due to limited knowledge. In the USA, an online survey by Gopal, Edwards (34) found that 55% of the respondents delayed vaccination of preterm infants for up to two months chronological age. The reasons given for this delay were low gestation age, lowbirth weight, clinical instability and provider preference similar to those in our study. Otherstudies have reported similar reasons for delaying preterm vaccination which indicates a knowledge gap (11, 35).

In our study, fear for side effects was not a major reason for delaying vaccination. Less than a third of the respondents believed that preterm neonates were more at risk of side effects than the term neonates. On the contrary, other studies have reported fear for side effects as a major reason given by health workers for delayed preterm vaccination (36-38). Several vaccines have been established to be safe among preterm infants but there are ongoing debates regarding their efficacy in this pediatric population. Recent studies show the route of administration of vaccines among preterm infants may be key in improving their efficacy (39). This strongly underpins the benefits of vaccinating preterm neonates outweigh the risks.

In our study, primary health care workers, with less than 5 years of experience and did not have specialized training had the lowest knowledge of preterm vaccination yet they are the ones who interface directly with preterm infants on the first day of life and often administer the first vaccinations. Our findings are consistent with a study in Italy were nurses and non-NICU pediatricians were more likely to delay vaccination of preterm infants than NICU pediatricians (38). Similar findings are reported by Mukhtar, Abdul Kadir (32) in Malaysia were doctors had 3 times more knowledge than paramedics and health workers with degrees

or advanced degrees were two times more knowledgeable than those with diploma or certificate qualification. Regarding years of experience our study contradicts findings in a Saudi Arabia hospital were duration of service was not significantly associated with knowledge (40). Given that non-specialized health workers in most settings are the ones who provide the first vaccination opportunities for preterm neonates, improving the knowledge of preterm vaccination is paramount.

Further in our study, among those with specialized training, 12.5% of the neonatologists, 20.9% pediatric registrars and 20.5% pediatricians scored less than 10 points out of the total 16 points, implying that even among those with specialized training, knowledge gaps regarding preterm vaccination existed. This is not surprising because similar findings have been noted in Italy were 35.9% primary care pediatricians did not consider vaccines safe for preterm infants (38). This finding calls for refresher trainings for specialized health workers who are assumed to acquire preterm vaccination knowledge during their specialized training.

Factors associated with knowledge of preterm vaccination were current practice role, years of practice, facility location, and having a written policy. Medical officers, registered, nurses and other non-specialized health practitioners had significantly lower overall preterm knowledge compared to the certified neonatologists, pediatricians and paediatric registrars in training. These findings are consistent with existing literature (32, 38, 40, 41). This indicates that prequalification training of medical officers, registered, nurses and other non-specialized health practitioners does not adequately cover preterm vaccination. Health worker training institutes should add this component to their learning curriculum.

In our study, there was a positive correlation between years of experience and knowledge

of preterm vaccination. This may be due to continuous medical education (CME) in many facilities or learning through self-driven initiative. Long servicing health workers are also more likely to encounter information regarding preterm vaccination. This may however not be the case in settings where information sharing is not the norm. In Saudi Arabia , a hospital study for instance, showed that duration of service was not associated with preterm vaccination knowledge (40). Therefore, facilities should have formal information sharing platforms such as CMEs, written policies and information desks. Routine preterm knowledge assessment should also be considered to ensure that long serving health workers have updated knowledge regarding preterm vaccination.

Other factors associated with preterm vaccination knowledge were location of facility and having written policies. Health workers from urban facilities were more knowledgeable about preterm vaccination than health workers from rural facilities and having a written policy was positively associated with knowledge of preterm vaccination. Having a written policy not only alleviates fear for litigation in the event of adverse events but also acts as an information source for preterm vaccination. However, an integrative review of literature on vaccination timeliness in preterm infants (11) notes that even with written policies in place, health workers are likely to delay vaccination of preterm neonates if other determinants of preterm vaccination are at play. Therefore, having a written policy may be necessary but not sufficient to address the knowledge and practice gaps on preterm vaccinations among healthcare providers.

The private sector had better preterm vaccination practices in terms of having written policies, systems to keep record of preterm vaccinations, systems to follow-up preterm infants who default on vaccination and correct health worker practice regarding timing of

preterm vaccination. This is not in keeping with findings from other parts of Africa were the private sector has been found to have less knowledge and practice of preterm vaccination (42). This difference may be due to a highly developed and regulated private sector in South Africa compared to other parts of Africa.

Strengths and weakness

This is the first study to survey preterm infant vaccination practices among healthcare workers in a resource-constrained setting like South Africa. While the online self-administered survey provides for confidentiality, anonymity and ensured a wide coverage of the healthcare workers involved in neonatal care, the respondents and non-respondents may have self-selected based on their knowledge of preterm vaccination.

CONCLUSION

Findings illustrate variations in knowledge and practices of preterm vaccination among health care workers caring for preterm infants in SA. Non-specialized healthcare workers, those with few years of practice, those working in rural facilities and facilities with no written policy on preterm vaccination are more likely to have knowledge gaps.

Inclusion of preterm vaccination educational programs in prequalification training of non-specialized healthcare cadres, knowledge transfer through mentorships, continuous medical education, support supervision and written policies may improve preterm vaccination knowledge among health workers caring for preterm infants in South Africa and in similar settings in Africa.

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I thank the African-Paediatric Fellowship Program (APFP) for sponsoring my sub-specialty training in Neonatology. I extend my heartfelt gratitude to my supervisors Prof. Michael Harrison and Dr. Yaseen Joolay whose guidance and encouragement was invaluable.

Special thanks to all the participants that provided data for the study.

Last but not least I am grateful to God, my teachers the neonatologists at Groote Schuur Hospital and Mowbray Maternity Hospital, colleagues, and family who supported me throughout this training and during the harsh COVID-19 experience in SA.

DISCLOSURE OF CONFLICT OF INTEREST

The authors declare no conflict of interest and confirm we have read the journal`s position on issues related to the ethics of publication and affirm this report is consistent with the guideline

AUTHOR CONTRIBUTIONS

1. JN was responsible for the conceptualization of the idea, development of the proposal, data collection and analysis, and writing of the draft manuscript.
2. AK assisted with data analysis inclusive of the statistical screens and manuscript writing.
3. YJ was responsible for the development of the protocol, and the data collection tool assisted with data analysis and manuscript writing.
4. MH; Supervised the entire project development, with major contributions from conceptualization, design, analysis, and writing of the manuscripts.

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FIGURE LEGENDS

Figure 1: Showing overall distribution of knowledge scores

Figure 2: Showing distribution of knowledge scores across health worker cadres

Table 1: Respondents Characteristics

	Frequency n=245	percent
My role in my current practice is best described as:		
Certified Neonatologist	16	6.5
Medical Officer	44	18
Other health practitioner	13	5.3
Paediatric Registrar	43	17.6
Paediatrician	88	35.9
Registered Nurse	41	16.7
How many years have you been in active medical practice		
More than 20 years	65	26.5
11 to 20 years	71	29
5 to 10 years	63	25.7
less than 5 years	46	18.8
Health sector of current practice		
Predominantly private with some public sector	11	4.5
Predominantly public with limited private sector	13	5.3
Private sector only	67	27.4
Public sector only	154	62.9
What level of care does your health facility offer?		
Primary health care	26	10.6
Secondary health care	75	30.6
Tertiary health care	144	58.8

Where is your facility located?		
Rural	30	12.2
Urban	215	87.8
Do you have a written policy for the vaccination of preterm infants?		
I don’t know	52	21.2
No	93	38
Yes	100	40.8

Table 2: Response to questions assessing Knowledge of preterm vaccination

	No	I don't know	Yes
Preterm infants should be vaccinated according to the corrected age:	197 (80.4)	3 (1.2)	45 (18.4)
Preterm infants should be vaccinated according to the chronological age:	40 (16.3)	8 (3.3)	197 (80.4)
Preterm infants initially produce insufficient antibodies to vaccines	104 (42.4)	67 (27.3)	74 (30.2)
Extreme preterm infants (less than 26weeks) who are well should have their vaccination per schedule	133 (54.3)	36 (14.7)	76 (31)
Preterm infants with a birthweight of less than 750g who are well should have their vaccines	139 (56.7)	30 (12.2)	76 (31)
Preterm infants can start their vaccine schedule while they are still inpatients	19 (7.8)	3 (1.2)	223 (91)
Preterm infants who are severely sick during their hospital stay should have vaccination delayed	49 (20)	8 (3.3)	188 (76.7)
Preterm infants with prolonged hospital stay should be considered for delayed vaccination	200 (81.6)	22 (9)	23 (9.4)
Preterm infants are given vaccines according to the schedule of term infants	23 (9.4)	7 (2.9)	215 (87.8)
Preterm infants should not be given any vaccines	243 (99.2)	0 (0)	2 (0.8)

Adjustments should be made in the dosage of vaccines for preterm infants	217 (88.6)	14 (5.7)	14 (5.7)
Preterm infants should not be given some vaccines	195 (79.6)	17 (6.9)	33 (13.5)
Preterm infants should be given vaccines according to the readiness of the parents	216 (88.2)	6 (2.4)	23 (9.4)
When vaccinating preterm infants, the timing of vaccines is influenced by concurrent medications	152 (62)	10 (4.1)	83 (33.9)
Preterm infants have a higher risk of side effects from vaccines compared to term infants	131 (53.5)	49 (20)	65 (26.5)

Table 3: Distribution of knowledge scores across respondents' characteristics

	mean	sd	min	max
current practice role				
Certified Neonatologist	12	2	8	15
Paediatrician	12	2	6	15
Paediatric Registrar	11	3	3	15
Medical Officer	9	2	4	13
Registered Nurse	9	2	4	15
Other health practioneer	7	3	3	11
Years of practice				
11 to 20 years	11	2	5	15
5 to 10 years	11	3	3	15
More than 20 years	10	3	4	15
less than 5 years	9	3	3	14
Sector of current practice				
Predominantly private	10	2	6	14
Predominantly public	11	3	6	14
Private sector only	10	3	4	15
Public sector only	10	3	3	15
Level of care				
Primary health care	9	3	3	13
Secondary health care	10	3	3	15
Tertiary health care	11	3	3	15

Facility location				
Rural	8	3	3	15
Urban	11	3	3	15
Written policy				
I don’t know	9	3	3	15
No	10	3	4	15
Yes	11	3	3	15

Table 4: Multivariable regression analysis of the relationship between knowledge scores and respondent characteristics

	Knowledge score			
	Coef. (95% CI)	**p value**	**Adj. Coef. (95% CI)**	**P value**
Current practice role				
Certified Neonatologist	0		0	
Medical Officer	-2.81 (-4.20,-1.43)	<0.001	-1.95 (-3.46 , -0.44)	**0.012***
Other health practitioner	-5.06 (-6.83,-3.29)	<0.001	-3.81 (-5.68 , -1.94)	**<0.001*****
Paediatric Registrar	-0.76 (-2.15,0.63)	0.282	-1.1 (-2.53 , 0.34)	0.134
Paediatrician	-0.51 (-1.80,0.78)	0.441	-0.16 (-1.42 , 1.09)	0.799
Registered Nurse	-3.36 (-4.75,-1.96)	<0.001	-3.08 (-4.55 , -1.61)	**<0.001*****
Years of practice				
More than 20 years	0		0	
11 to 20 years	0.89 (-0.02,1.79)	0.054	0.27 (-0.57 , 1.1)	0.528
5 to 10 years	0.52 (-0.41,1.45)	0.274	0.41 (-0.53 , 1.35)	0.389
less than 5 years	-1.61 (-2.62,-0.59)	0.002	-1.52 (-2.55 , -0.48)	**0.004****
Level of care				
Primary health care	0		0	
Secondary health care	0.8 (-0.42,2.03)	0.198	-0.19 (-1.26 , 0.88)	0.728
Tertiary health care	1.79 (0.64,2.94)	0.002	-0.1 (-1.19 , 1)	0.86
Facility location				
Rural	0		0	

Urban	2.22 (1.18,3.26)	<0.001	1.69 (0.75 , 2.64)	**0.001****
Written policy				
No	0		0	
I don't know	-0.93 (-1.87,0.01)	0.051	-0.18 (-1.01 , 0.64)	0.661
Yes	0.63 (-0.15,1.40)	0.115	0.94 (0.26 , 1.62)	**0.007****
Sector of current practice				
Public sector	0		0	
Private sector	-0.36 (-1.12,0.40)	0.349	-0.26 (-1.04 , 0.53)	0.519

*** p<.001, ** p<.01, * p<.05

Table 5: Response to questions assessing Practice of preterm vaccination by sector

	Public sector n=167	**Private sector n=78**	**p value**
Do you have a written policy for the vaccination of preterm infants?			
I don't know	42 (25.1)	10 (12.8)	**0.024***
No	55 (32.9)	38 (48.7)	
Yes	70 (41.9)	30 (38.5)	
Are responsible to ensure that preterm infants are optimally vaccinated			
Both parent and health worker	149 (89.2)	73 (93.6)	0.495
Health worker	16 (9.6)	4 (5.1)	
Parent/caregiver	2 (1.2)	1 (1.3)	
There are systems at my facility to keep a record of preterm vaccinations			
I don't know	39 (23.4)	5 (6.4)	**<0.001***
No	54 (32.3)	18 (23.1)	
Yes	74 (44.3)	55 (70.5)	
There are systems at my facility to follow-up preterm infants who default on the			
I don't know	40 (24)	8 (10.3)	**<0.001***
No	97 (58.1)	42 (53.8)	

Yes	30 (18)	28 (35.9)	
In your practice, preterm patients in hospital are predominantly vaccinated at			
chronological age according to EPI Schedule	102 (61.1)	34 (43.6)	**0.027***
corrected age according to EPI Schedule	8 (4.8)	10 (12.8)	
follow-up after discharge	5 (3)	2 (2.6)	
the time of discharge of patient	52 (31.1)	32 (41)	

*** p<.001, ** p<.01, * p<.05

Figure 1 showing overall distribution of knowledge scores

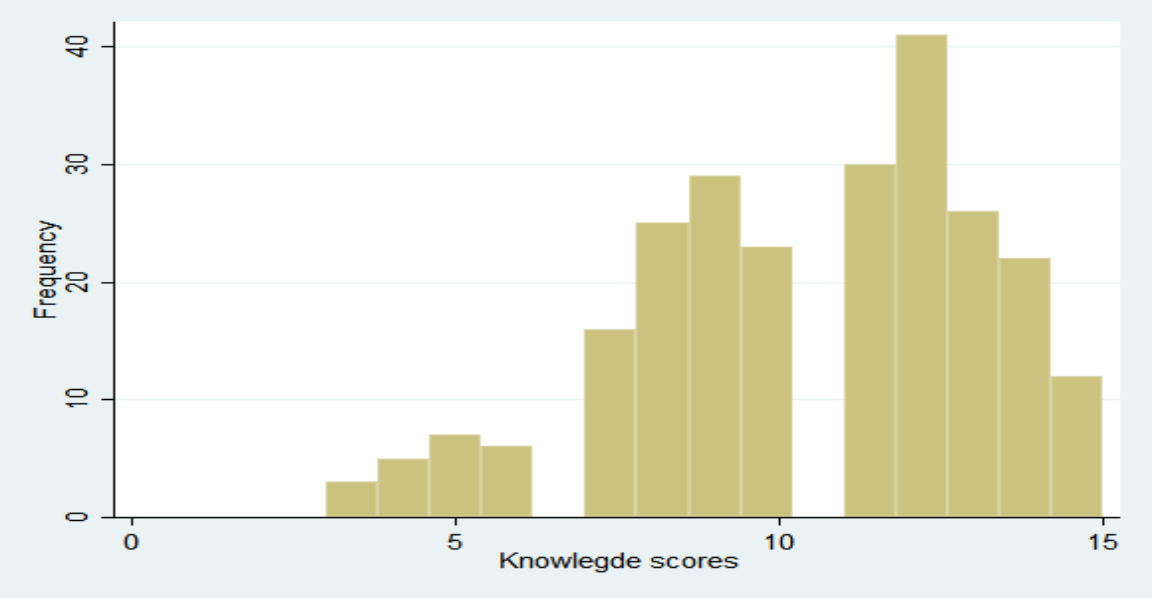
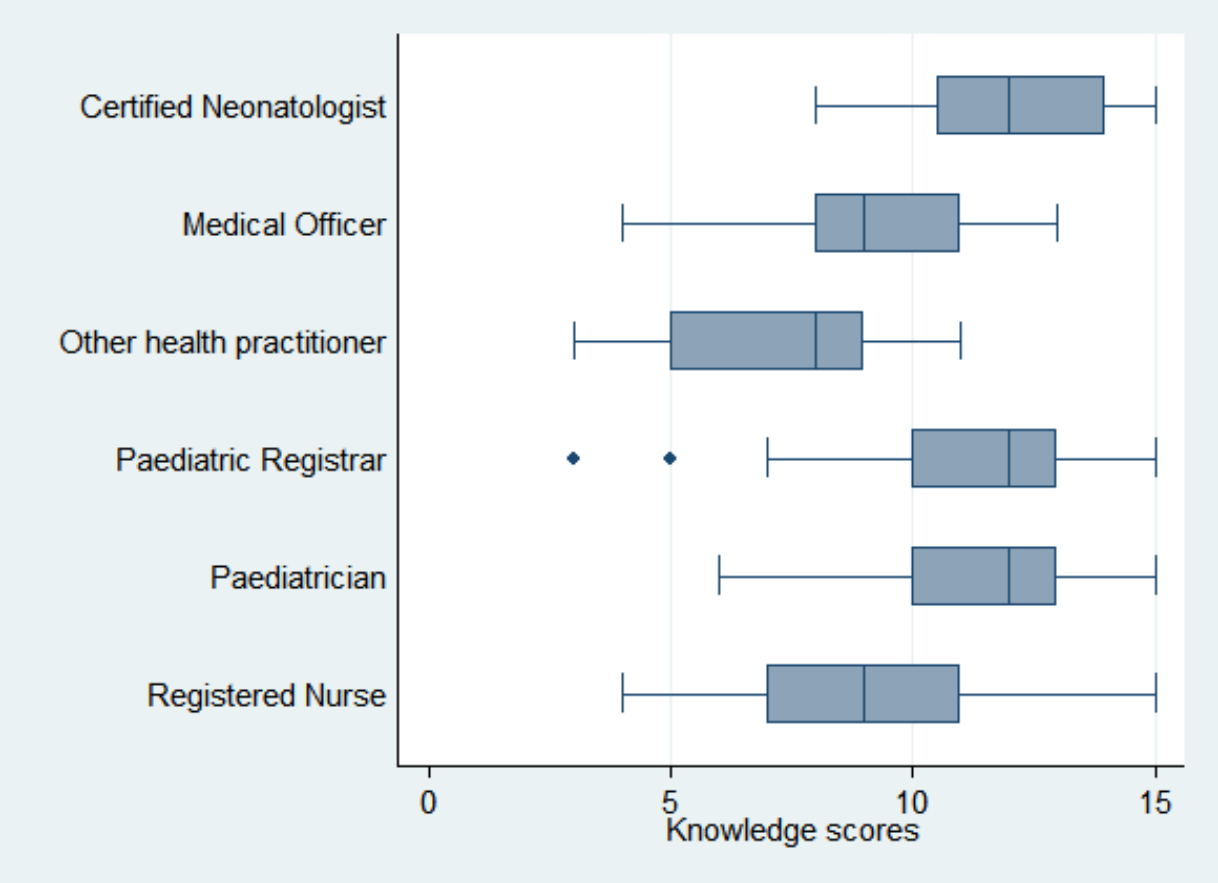


Figure 2: Showing distribution of knowledge score across cadre



APPENDICES

ETHICS APPROVAL

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room G50- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-enquiries@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

08 December 2020

HREC REF: 852/2020

Prof M Harrison
Division of Neonatology
Paediatrics & Child Health
H-Floor, OMB
Email: - mc.harrison@uct.ac.za
Student: nakibukajess@gmail.com

Dear Prof Harrison

PROJECT TITLE: KNOWLEDGE AND PRACTICES OF PRETERM INFANT VACCINATION AMONG HEALTH CARE PROVIDERS IN THE WESTERN CAPE PROVINCE OF SOUTH AFRICA-MPHIL CANDIDATE DR JESCA NAKIBUKA

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study, subject to adding the UCT FHS HREC contact details to the information sheet.

This approval is subject to strict adherence to the HREC recommendations regarding research involving human participants during COVID -19, dated 17 March 2020 & 06 July 2020.

Approval is granted for one year until the 30 December 2021.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledge that the student: - Dr Jesca Nakibuka also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

Signed by candidate

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

HREC/REF:852/2020sa

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
NHREC-registration number: REC-210208-007

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use: Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines. The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

INSTRUCTIONS TO AUTHORS

Article Description	ABSTRACT	WORD LIMIT	TABLES/FIGURES	REFERENCES
Original Articles: Generally, the Journal only considers original research materials that are directly relevant to clinical practice.Any text beyond the limit can be published as online-only supplementary material if you feel that it is necessary (see instructions below on supplementary material)	Structured abstract, max 150 words.	Length should not exceed 25 pages, including the abstract, text, tables, illustrations, and references.	Maximum of 5 tables/figures.	No more than 50 references.

House Style: Authors should adhere to the following formatting guidelines

- Text should be double spaced with a wide margin.
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- Statistical methods: For normally distributed data, mean (SD) is the preferred summary statistic. Relative risks should be expressed as odds ratios with 95% confidence interval. To compare two methods for measuring a variable the method of Bland & Altman (1986, Lancet 1, 307–310) should be used; for this, calculation of P only is not appropriate.
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- Abbreviations: On first using an abbreviation place it in parentheses after the full item. Very common abbreviations such as FFA, RNA, need not be defined. Note these abbreviations: gram g; litre l; milligram mg; kilogram kg; kilojoule kJ; megajoule MJ; weight wt; seconds s; minutes min; hours h. Do not add 's' for plural units. Terms used less than four times should not be abbreviated.

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Abstract

Abstract

A structured abstract is required for original articles and a standard abstract format is required for other types of articles. An abbreviated unformatted abstract is preferred for Review articles. For clinical trials, the abstract should also include details of where and when the trial was registered, and the Clinical Trial Number.

The structured abstract should be limited to 150 words, under the following headings:

Objective - reflecting the purpose of the study or the hypothesis that is being tested
Study Design - the setting for the study, the subjects (number and type), the treatment or intervention, and the type of statistical analysis
Result - include the outcome of the study and statistical significance, if appropriate
Conclusion - state the significance of the results

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The Introduction should assume that the reader is knowledgeable in the field and should therefore be as brief as possible but can include a short historical review where desirable.

Materials / subjects and Methods

This section should contain sufficient detail, so that all experimental procedures can be reproduced, and include references. Methods, however, that have been published in detail elsewhere should not be described in detail. Authors should provide the name of the manufacturer and their location for any specifically named medical equipment and instruments, and all drugs should be identified by their pharmaceutical names, and by their trade name if relevant.

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Acknowledgements

These should be brief, and should include sources of support including sponsorship (e.g. university, charity, commercial organization) and sources of material (e.g. novel drugs) not available commercially.

Conflict of interest

Authors must declare whether or not there are any competing financial interests in relation to the work described. This information must be included at this stage and will be published as part of the paper. Conflict of interest should also be noted on the cover letter and as part of the submission process. See the Conflict of Interest documentation in the Editorial Policy section for detailed information.

Author Contributions

Authors must include a statement about the contribution of each author to the manuscript (see section on Authorship). The initials of each author may be used.

This is an example for a systematic review: MAJ was responsible for designing the review protocol, writing the protocol and report, conducting the search, screening potentially eligible studies, extracting and analyzing data, interpreting results, updating reference lists and creating 'Summary of findings' tables. SBM was responsible for designing the review protocol and screening potentially eligible studies. She contributed to writing the report, extracting and analyzing data, interpreting results and creating 'Summary of findings' tables. DIH conducted the meta-regression analyses and contributed to the design of the review protocol, writing the report, arbitrating potentially eligible studies, extracting and analyzing data and interpreting results. NAL contributed to data extraction and provided feedback on the report. FRT and RAL provided feedback on the report.

To understand more about authorship definitions, please refer to the ICMJE Authorship Guidelines.

Funding Information

The funding section is mandatory. Authors must declare sources of study funding including sponsorship (e.g. university, charity, commercial organization). If no funding was received, please also state this.

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Journal article:
Martin JC, Bourgnoux P, Fignon A, Theret V, Antoine JM, Lamisse F et al. Dependence on human milk essential fatty acids on adipose stores during lactation. *Am J Clin Nutr* **58**: 653–569 (1993)

DATA COLLECTION TOOL (QUESTIONAIRE) FOR THE STUDY

Vaccination of preterm infants: knowledge and practice of health care workers in South Africa

Demographics

NO.	QUESTIONS	CODING CATEGORIES
01	In which health sector is your current practice?	1. Public sector only 2. Private sector 3. Predominantly private with some public sector 4. Predominantly public with limited private practice
02	My role in my current practice is best described as:	1. Medical officer 2. Pediatric Registrar 3. Pediatrician 4. Certified Neonatologist 5. Other health practitioner
03	How many years have you been in active medical practice (i.e. since graduating medical undergraduate)	1. Less than 5 years 2. 5 to 10 years 3. 11 to 20 years 4. More than 20 years
04	What level of care does your health facility offer?	1. Primary health care 2. Secondary health care 3. Tertiary health care
05	Where is your facility located?	1. Urban 2. Rural
06.	Does your facility offer independent pediatric health services or is pediatric care part of a general health facility?	1. Independent pediatric health facility 2. Offers pediatric health care as part of a general health facility

Knowledge and practices on preterm vaccination

07.	Do you have a written policy for the vaccination of preterm infants?	1. Yes 2. No 3. I don't know
08	Preterm infants should be vaccinated according to the corrected gestation age	1. Yes 2. No 3. I don't know
09	Preterm infants should be vaccinated according to the chronological age	1.Yes 2.No 3.I don't know
10	Preterm infants initially produce insufficient antibodies to vaccines	1. Yes 2. No 3. I don't know
11	Extreme preterm infants (less than 26weeeks) should have their vaccines delayed for safety reasons	1. Yes 2. No 3. I don't know
12.	Preterm infants with a birthweight of less than 750g should have their vaccines delayed for safety reasons	1. Yes 2. No 3. I don't know

13.	Preterm infants can start their vaccine schedule while they are still inpatients	1.Yes 2.No 3.I don't know
14.	Preterm infants with a high severity sick score during their hospital stay should have vaccines delayed	1.Yes 2.No 3.I don't know
15.	Preterm infants with prolonged hospital stay (≥100 days) should be considered for delay of vaccinations	1. Yes 2. No 3. I don't know
13.	Preterm infants are given vaccines according to the schedule of term infants	1. Yes 2. No 3. I don't know
17.	Preterm infants should not be given any vaccines	1. Yes 2. No 3. I don't know
18.	Adjustments should be made in the dosage of vaccines for preterm infants	1. Yes 2. No 3. I don't know
19.	Preterm infants should not be given some vaccines	1. Yes 2. No 3. I don't know
20.	Preterm infants should be given vaccines according to readiness of the parents	1. Yes 2. No 3. I don't know
21.	Timing of vaccines for preterm infants must be influenced by co-morbidities	1. Yes 2. No 3. I don't know
22.	Timing of vaccines for preterm infants must be influenced by medications infant is receiving at the time	1.Yes 2.No 3. I don't know
23.	Preterm infants are at more risk of side effects from vaccines compared to term infants	1.Yes 2.No 3. I don't know
24.	Whose responsibility do you think it is to ensure that preterm infants are optimally vaccinated?	1. Parent/caregiver 2. Health worker 3. Both above
25.	There are systems at my facility to keep record of preterm vaccinations	1.Yes 2.No 3.I don't know
26.	There are systems at my facility to follow-up preterm infants who default on their vaccination schedule	1. Yes 2. No 3. I don't know