

# A 'nice to have' or a 'non-negotiable': South African healthcare workers' knowledge, attitudes, practices and perceptions of vaccination

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## ABSTRACT

**Background:** Non-immune healthcare workers (HCWs) are at high risk of contracting and transmitting vaccine-preventable diseases. Data on the knowledge, attitudes and practices (KAP) of African HCWs regarding the World Health Organization (WHO)-recommended vaccinations is limited.

**Objectives:** We aimed to describe the KAP of HCWs regarding the WHO-recommended vaccinations, namely, those against hepatitis B, polio, diphtheria, measles, rubella, meningococcus, influenza, varicella and pertussis, and to assess the facilitators of, and barriers to, HCW vaccine uptake.

**Methods:** This was a cross-sectional study. A self-administered KAP survey was completed by 300 clinical (nurses, doctors, allied health) and non-clinical (laboratory, pharmacy, administrative, household staff and porters) HCWs at Tygerberg Hospital, Cape Town, from June to October 2018. Data were analysed using Stata Statistical Software version 13.0 IC to generate mean scores for KAP. Individual question scores were compared across job categories (clinical vs non-clinical) using Pearson's chi-square test.

**Results:** Most of the study participants were female (n = 228, 76.0%), aged 18–40 years (n = 190, 63.3%) and employed as clinical staff (n = 252, 84.0%). The overall mean KAP scores were 57.1%, 68.4% and 39.9%, respectively; clinical HCWs scored significantly higher than non-clinical HCWs in all three topics (p < 0.001). HCWs believed vaccines to be effective (n = 254, 84.7%) and safe with few side effects (n = 219, 73.0%). Vaccine uptake was highest for hepatitis B (n = 247, 82.3%), followed by measles (n = 159, 53.0%) and diphtheria/tetanus (n = 101, 33.7%), and lowest for influenza (n = 68, 22.7%). Common reasons for vaccination included HCWs wanting to protect themselves, their families and their patients. Fear of side effects and lack of workplace access were common reasons for not vaccinating.

**Conclusion:** Clinical HCWs had better KAP regarding vaccination than non-clinical HCWs. Strategies to improve HCW vaccine uptake should focus on vaccination education and facilitation of workplace access to vaccination.

## INTRODUCTION

Healthcare workers (HCWs) have a duty to ensure that they do not cause harm to patients or fellow workers. Despite this, many HCWs, worldwide, are not comprehensively vaccinated.<sup>1</sup> HCWs regularly care for patients who are at an increased risk of acquiring vaccine-preventable diseases (VPDs), e.g. children, pregnant women, immunocompromised individuals, and the elderly. Not being vaccinated as an HCW could have dire consequences for both the HCW and his/her patients.<sup>2</sup> Globally, HCWs have been implicated in the transmission of VPDs to their patients and colleagues, including influenza, measles and pertussis.<sup>3–5</sup> In addition, HCWs could be exposed to VPDs, such as hepatitis B, via the body fluids of infected patients.<sup>6</sup> Higher vaccination coverage rates among HCWs would contribute to improved patient safety and outcomes, reduced staff illness and work absenteeism, and decreased costs related to the containment of VPD outbreaks.<sup>7</sup>

The World Health Organization (WHO) has developed, and regularly updates, vaccination recommendations for HCWs in low-middle income countries to assist with the development of national HCW vaccination policies.<sup>8</sup> Importantly, the WHO recognises that HCWs comprise multiple personnel categories, including doctors, nurses, and allied health, laboratory, pharmacy, administrative and support staff.<sup>9</sup> The schedule of HCW WHO-recommended vaccinations includes

hepatitis B, polio, diphtheria, measles, rubella, meningococcus, influenza, and varicella; and was updated in August 2018 to include BCG and pertussis. The South African (SA) Department of Health recommends that all HCWs (including cleaning staff and porters) receive the 3-series hepatitis B virus vaccine, if not immune following the primary series at birth, and that all routinely exposed laboratory staff receive the meningococcus vaccine.<sup>10–11</sup> The National Institute for Communicable Diseases (NICD) recommends that all HCWs receive the influenza vaccine annually, the diphtheria vaccine in the event of an outbreak, and the measles vaccine if there is potential for contact with infected patients.<sup>12–14</sup>

Findings from two SA Gauteng province studies showed that 55.7% and 67.9% of HCWs had received at least one hepatitis B virus vaccine dose, but that only 15.4% and 19.9% were fully vaccinated with three or more doses.<sup>15,16</sup> Other African studies of hepatitis B virus vaccination found that doctors had the highest average knowledge, attitude and practice (KAP) scores compared to those in other occupations, and that vaccine knowledge improved, and vaccine uptake increased, with age.<sup>17,18</sup>

Another SA study showed that only 34.0% of HCWs were vaccinated against influenza in 2013/2014.<sup>19</sup> Vaccination was significantly associated with HCWs having received educational training on influenza

and influenza vaccines from the SA Government, and obtaining the vaccine at no cost. The main reasons for vaccination were protecting oneself, one's family and one's patients; more so than preventing work absenteeism. The main reasons cited for HCWs not receiving the influenza vaccine, in a Saudi Arabian study, were fear of vaccine side effects and poor vaccine access.<sup>20</sup>

Since the SA Department of Health and the NICD merely recommend HCW vaccination, there is little impetus for SA HCWs to be comprehensively vaccinated. Given the limited published data on HCW vaccination, we conducted a survey amongst HCWs at a tertiary hospital in Cape Town, to describe their KAP regarding vaccination and self-reported vaccination status, and to identify local facilitators of, and barriers to, vaccine uptake.

## METHODS

The cross-sectional study was conducted at Tygerberg Hospital, a 1 384-bedded public hospital (the second largest hospital in South Africa) with more than 4 000 staff members working in 67 wards, 29 operating theatres, and 10 intensive care units. The on-site occupational health service is staffed by two nurses and five doctors.

All HCW categories at Tygerberg Hospital were eligible for inclusion in the survey: clinical HCWs (medical doctors, nurses, nursing students and allied health professionals [dietitians, occupational therapists, physiotherapists and radiography staff]) and non-clinical HCWs (laboratory technicians, pharmacy, administrative, household/cleaning and porter staff).

The survey tool, a self-administered questionnaire, was compiled by the researchers and included quantitative questions (demographic characteristics, and vaccination KAP) and qualitative questions (local facilitators of, and barriers to, vaccine uptake). The 2017 WHO-recommended HCW vaccination schedule was used as the reference standard.<sup>8</sup>

A convenience sample of 380 HCWs who were on duty from June to October 2018 were personally approached and invited to participate. Approximately 10% of the 4 000 employed HCWs were targeted, owing to anticipated human, financial and time constraints.

The nurse in charge of the Tygerberg Hospital occupational health clinic was interviewed to document the current vaccination programme, her opinion of facilitators of, and barriers to, HCW vaccine uptake, and to obtain records of the last five years of vaccine uptake.

Permission to conduct the survey was obtained from the Stellenbosch University Health Research Ethics Committee and Tygerberg Hospital. Written informed consent was obtained from all participants.

## Data analysis

Data from the paper-based questionnaires were entered into a REDCap<sup>21</sup> database and exported into Microsoft Excel for cleaning. Data were analysed using Stata Statistical Software version 13.0 IC (StataCorp LP, College Station, TX). Demographic characteristics of the study participants were described using frequencies. Mean scores for KAP were compared by job category (clinical vs non-clinical), using a two-sample t-test. Individual question scores were compared by job category, using Pearson's chi-square test; statistical significance was set at 0.05. Potential predictor variables were included in a linear regression model to evaluate their association with knowledge and attitude scores (reporting adjusted co-efficients). Potential predictor variables were included in a logistic regression model to evaluate their association with self-reported practices (reporting adjusted odds

ratios). Responses to open-ended questions were manually coded, categorised into emerging themes, and analysed using the framework method for the analysis of qualitative data in multi-disciplinary health research, described by Gale et al. in 2013.<sup>22</sup>

## RESULTS

Questionnaires were returned by 300 of the 380 targeted HCWs (78.9% response rate) – approximately 8.0% of the total HCWs at Tygerberg Hospital. Most participants were female (n = 228, 76.0%), and most were 18–40 years old (n = 190, 63.3%) (Table 1). The majority of participants (n = 252; 84.0%) were clinical HCWs. Overall, nurses and nursing students made up the majority of participants (n = 137; 45.7%).

The overall knowledge scores were acceptable, with HCWs achieving a mean score of 57.1% (Table 2a). Knowledge scores were higher in clinical than non-clinical HCWs (p < 0.001). Many HCWs correctly identified hepatitis B virus (n = 265, 88.3%) and influenza (n = 204, 68.0%) as WHO-recommended vaccines (Table 2b). Regarding knowledge of VPD transmission, most HCWs knew that influenza is spread in respiratory droplets (n = 284, 94.7%) and that hepatitis B virus can be contracted from a needlestick injury (n = 252, 84.0%), but fewer knew that measles is transmitted via airborne particles (n = 186, 62.0%). Clinical HCWs were significantly

**Table 1. Demographic characteristics of healthcare workers (N = 300)**

Characteristic	n	%
Sex		
female	228	76.0
male	72	24.0
Age (years)		
18–40	190	63.3
≥ 41	104	34.7
unknown	6	2.0
Job type		
nurse/nursing student	137	45.7
medical doctor	80	26.7
allied health professional*	35	11.7
laboratory staff	12	4.0
pharmacy staff	11	3.7
administrative staff	14	4.7
household staff/ porter	11	3.7
Job category		
clinical <sup>†</sup>	252	84.0
non-clinical <sup>‡</sup>	48	16.0

\* dietician, occupational therapist, physiotherapist, radiography/imaging staff; <sup>†</sup> nurses, doctors, allied health professionals; <sup>‡</sup> laboratory, pharmacy, administrative and household staff, porters

**Table 2a. Healthcare workers' knowledge scores\* regarding vaccination (N = 300)**

Measure	all	clinical HCWs n = 252	non-clinical HCWs n = 48	p value
mean	17.7	18.3	14.7	< 0.001
SD	5.2	4.8	5.9	
%	57.1	59.0	47.4	

\*maximum = 31

more knowledgeable than non-clinical HCWs about hepatitis B virus infectivity ( $p = 0.001$ ). Only 50.7% ( $n = 152$ ) of HCWs knew that influenza-infected HCWs may be asymptomatic. Nearly three-quarters of HCWs ( $n = 221$ , 73.7%) knew that the influenza vaccine should be received yearly; fewer ( $n = 161$ , 53.7%) knew that a tetanus/diphtheria (Td) booster vaccine is needed every 10 years; and 67.3% ( $n = 202$ ) were unaware that women require a tetanus/diphtheria/pertussis (Tdap) vaccine during each pregnancy.

Responses to questions about attitudes from 68.4% of participants were 'appropriate', with higher scores among clinical than non-clinical HCWs ( $p < 0.001$ ) (Table 3a). More than 80% of HCWs felt that all HCWs should receive the WHO-recommended vaccines ( $n = 250$ , 83.3%) and that the SA Department of Health should enforce hepatitis B virus vaccination ( $n = 242$ , 80.7%), as shown in Table 3b. Conversely, there was limited support for the notion that HCWs refusing vaccination should be disciplined ( $n = 42$ , 14.0%). The majority of HCWs believed that vaccines are effective ( $n = 254$ , 84.7%), and safe with few side

effects ( $n = 219$ , 73.0%). Few HCWs felt that the Tygerberg Hospital vaccination service was comprehensive ( $n = 90$ , 30%). Most agreed that vaccines should be freely available ( $n = 279$ , 93.0%) and administered on the wards ( $n = 254$ ; 84.7%). Many HCWs felt that their work placed them at an increased risk of acquiring hepatitis B virus infection ( $n = 238$ , 79.3%).

Questions related to practice received an overall desired response of 39.9% with higher scores among the clinical than non-clinical HCWs ( $p < 0.001$ ) (Table 4a). A total of 123 participants (41.0%) had received vaccinations at the Tygerberg Hospital occupational health clinic (Table 4b); mostly for hepatitis B virus ( $n = 86$ ; 52.4%) and influenza ( $n = 61$ ; 37.2%). For hepatitis B virus vaccine uptake, 82.3% of HCWs ( $n = 247$ ) had received the vaccine, but only 56.7% ( $n = 170$ ) recalled receiving all three doses (hepatitis B virus vaccination 3-series completion rates were higher in clinical HCWs;  $p < 0.001$ ). Common reasons cited for receiving both the influenza and the hepatitis B virus vaccine were to protect themselves, their families and/or their patients;

**Table 2b. Healthcare workers' correct knowledge regarding vaccination (N = 300)**

Question	all		clinical HCWs n = 252		non-clinical HCWs n = 48		p value
	n	%	n	%	n	%	
1. Which vaccinations are recommended by the WHO?							
Diphtheria	69	23.0	61	24.2	8	16.7	0.255
Hepatitis B	265	88.3	230	91.3	35	72.9	< 0.001
Influenza	204	68.0	180	71.4	24	50.0	0.004
Measles	119	39.7	106	42.1	13	27.0	0.052
Meningococcus	71	23.7	68	27.0	3	6.3	0.002
Polio	72	24.0	60	23.8	12	25.0	0.860
Rubella	79	26.3	71	28.2	8	16.7	0.097
2. Do you know of an employee vaccination programme at Tygerberg Hospital? (yes)	148	49.3	125	49.6	23	47.9	0.830
3. How often should you get the influenza vaccine? (yearly)	221	73.7	193	76.6	28	58.3	0.008
4. Influenza virus is spread by large respiratory droplets, e.g. coughing, sneezing, etc. (true)	284	94.7	240	95.2	44	91.7	0.313
5. Up to 50% of infected healthcare workers do not have symptoms of influenza (true)	152	50.7	125	49.6	27	56.3	0.399
6. Hepatitis B virus is 50 to 100 times more infectious than HIV (yes)	177	59.0	159	63.1	18	37.5	0.001
7. You can get hepatitis B from a needlestick injury (yes)	252	84.0	218	86.5	34	70.8	0.007
8. You can get hepatitis B from getting the vaccine (no)	240	80.0	208	82.5	32	66.7	0.012
9. If you get all three doses of the hepatitis B vaccine, you do not need testing for immunity (no)	149	49.7	137	54.3	12	25.0	< 0.001
10. Measles is transmitted via airborne particles (true)	186	62.0	153	60.7	33	68.8	0.293
11. I should notify the local/district health services when I have a patient with measles (true)	256	85.3	219	86.9	37	77.1	0.078
12. Measles, mumps and rubella can cause congenital defects in babies of pregnant health staff (true)	256	85.3	217	86.1	39	81.3	0.383
13. Adults infected with pertussis cause half of all pertussis cases in babies and children (true)	186	62.0	159	63.1	27	56.3	0.371
14. Tetanus, diphtheria and pertussis immunity/protection from the vaccine declines over time (true)	177	59.0	154	61.1	23	47.9	0.088
15. A tetanus and diphtheria (Td) booster vaccine is needed every 10 years (true)	161	53.7	138	54.8	23	47.9	0.383
16. Pregnant women need to get the Tdap vaccine during every pregnancy (true)	98	32.7	82	32.5	16	33.3	0.914
17. All HCWs at risk of exposure to the meningococcus bacteria (e.g. laboratory workers, casualty ward staff) should receive the meningococcal vaccine (yes)	184	61.3	160	63.5	24	50.0	0.079

free-of-charge administration; and recommendation by authorities. Common reasons cited for not receiving the hepatitis B virus vaccine were lack of workplace access, non-requirement based on occupation, and not considering themselves to be at risk of contracting hepatitis B.

The practice of presenteeism (working while ill) was commonplace, with 69.0% of HCWs (n = 207) either occasionally or often coming to work while sick. Most study participants attributed this practice to HCW shortage and not considering themselves to be contagious to others. The majority of nurses and doctors (n = 185, 85.3%) recommended influenza vaccination to their patients. In contrast, very few HCWs themselves (n = 68, 22.7%) had received the influenza vaccine in either of the two preceding winter seasons. Common reasons cited for not receiving the vaccine were forgetting, fear of side effects, lack of workplace access, and concerns about contracting influenza from the vaccine. Tetanus and diphtheria vaccine uptake was also poor, with only 33.7% of HCWs (n = 101) having received the Tdap/Td vaccine and only 28.7% (n = 86) indicating that they had received/intended to receive a Td booster. Self-reported measles vaccine uptake was 53.0% (n = 159).

**Table 3a. Healthcare workers' attitude scores\* regarding vaccination (N = 300)**

Measure	all	clinical HCWs	non-clinical HCWs	p value
		n = 252	n = 48	
mean	13.7	14.0	11.8	< 0.001
SD	3.0	2.7	3.5	
%	68.4	70.2	59.0	

\*maximum = 20

With regard to predictors of HCW vaccination, clinical HCWs had higher knowledge and attitude scores than non-clinical HCWs (p = 0.007 and p < 0.001, respectively). Specifically, medical doctors had higher knowledge and attitude scores overall (p < 0.001 and p = 0.010) (Table 5). Older HCWs (≥ 41 years) were more likely to attend the occupational health clinic than younger HCWs (p < 0.001), but medical doctors were less likely (although not statistically significantly so) than other HCWs to utilise the service (p = 0.136). Clinical HCWs were almost eight times more likely to have completed 3-series hepatitis B virus vaccination compared to non-clinical HCWs (p < 0.001). Older HCWs (≥ 41 years) were less likely to have completed the 3-series hepatitis B virus vaccination than younger HCWs (p = 0.002). Being a medical doctor was associated with a higher likelihood of having undergone serological testing post-hepatitis B virus vaccination series (p < 0.001). Surprisingly, clinical HCWs had lower influenza vaccine uptake than non-clinical HCWs (p = 0.024). There was a higher probability of measles vaccine uptake among female than male HCWs and medical doctors (p = 0.048 and p = 0.001, respectively).

According to the nurse in charge of the occupational health clinic at Tygerberg Hospital, the clinic spreads awareness about HCW safety (including vaccinations) via e-mails, communiqués, and in-service training. The clinic offers staff free vaccinations against hepatitis B virus, influenza, measles, tetanus and diphtheria, and hepatitis B virus surface antibody testing. The clinic reportedly had mass staff vaccination campaigns for measles and diphtheria during the 2017 outbreaks in the SA Western Cape province.<sup>13,23</sup> Furthermore, the clinic aims to vaccinate as many willing HCWs as possible during the influenza season

**Table 3b. Healthcare workers' desired attitudes regarding vaccination (N = 300)**

Question	all		clinical HCWs		non-clinical HCWs		p value
	n	%	n = 252		n = 48		
			n	%	n	%	
1. All healthcare workers should receive the influenza vaccine (yes)	245	81.7	213	84.5	32	66.7	0.003
2. Vaccines are effective at preventing diseases (agree)	254	84.7	221	87.7	33	68.8	0.001
3. Vaccines for healthcare workers are safe with few side effects (agree)	219	73.0	192	76.2	27	56.3	0.004
4. Healthcare employers should provide staff with the vaccines for free (agree)	279	93.0	238	94.4	41	85.4	0.025
5. Healthcare workers who refuse to be vaccinated should be disciplined (agree)	42	14.0	36	14.3	6	12.5	0.744
6. All HCWs should be vaccinated with the WHO-recommended vaccines (agree)	250	83.3	216	85.7	34	70.8	0.011
7. The vaccination service provided at Tygerberg is comprehensive (agree)	90	30.0	74	29.4	16	33.3	0.582
8. I am healthy so I don't need to be vaccinated against these diseases (disagree)	237	79.0	204	81.0	33	68.8	0.057
9. It is my responsibility as a healthcare worker to ensure I get vaccinated (agree)	247	82.3	216	85.7	31	64.6	< 0.001
10. I have been given sufficient information to know which vaccines I need and when they are due (agree)	89	29.7	77	30.6	12	25.0	0.440
11. Influenza vaccine should be administered on the wards to staff who want it (agree)	254	84.7	215	85.3	39	81.3	0.473
12. Hepatitis B is a great public health problem (yes)	221	73.7	193	76.6	28	58.3	0.008
13. The Department of Health should enforce hepatitis B vaccination for staff (agree)	242	80.7	208	82.5	34	70.8	0.060
14. Does your work put you at risk of getting hepatitis B infection? (yes)	238	79.3	205	81.3	33	68.8	0.048
15. Does your work put you at risk of getting measles, mumps or rubella? (yes)	195	65.0	175	69.4	20	41.7	< 0.001
16. Does your work put you at risk of getting tetanus, diphtheria or pertussis? (yes)	182	60.7	162	64.3	20	41.7	0.003

each year. On average, 95 HCWs are vaccinated each month; however, influenza vaccination peaks in the autumn and winter months. The clinic nurse in charge perceived facilitators of HCW vaccination at the clinic to be HCWs wanting to protect themselves, not wanting to miss work, vaccination guidelines (WHO and Department of Health), and vaccinations provided as a free service. She perceived the main local barrier to be fear of vaccine side effects (especially the influenza vaccine). HCW vaccinations documented at the clinic from 2013 to 2017 included 2 499 hepatitis B virus and 1 902 influenza vaccinations. Visits for needlestick injuries and prophylaxis following diphtheria and meningococcal exposure were frequent (Figure 1).

Two open-ended questions were posed to participants, viz. why are HCWs being/not being vaccinated, and what can be done to encourage staff to get fully vaccinated? Poor education-awareness and poor vaccine access (including HCWs being too busy, low vaccine stock, and the clinic being unable to accommodate HCWs) emerged as major reasons for HCWs not being vaccinated. Other reasons included freedom of choice, vaccine side effects, and fear of needles. The few participants who stated that HCWs were being vaccinated, attributed this to vaccines being recommended by the employer, and HCWs wanting to protect themselves, their families and their patients.

*"... A lack of knowledge or ignorance; the mindset that doctors do not ever get sick." [P7]*

**Table 4a. Healthcare workers' practice scores\* regarding vaccination (N = 300)**

Measure	all	clinical HCWs	non-clinical HCWs	p value
		n = 252	n = 48	
mean	60.0	6.2	4.8	< 0.001
SD	2.2	2.1	2.5	
%	39.9	41.3	32.2	

\*maximum = 15

*"Hospital management does not promote vaccination programmes." [P233]*

*"If it [the occupational health clinic] is not too full then the stock is finished or when they [clinic staff] say they will call but don't." [P207]*

*"Not enough vaccines and long waiting time at staff clinic." [P96]*

*"People are too busy to go out of the ward and still stand in a queue to be vaccinated." [P116]*

*"... I got severe acne after my hepatitis B vaccination. I refuse vaccines ever since." [P113]*

The major emerging themes for potential interventions to improve vaccine uptake were increased awareness, improved access, and stricter vaccination enforcement. Several HCWs suggested improving clinic vaccine stock levels, granting staff time off work duties to attend the occupational health clinic, and administering vaccinations on the wards. Some participants felt strongly that vaccination should be made compulsory, that punitive action should be taken against vaccine refusers, and that HCWs should be incentivised to receive vaccinations.

*"Providing on-going education regarding vaccination importance and making it readily available (free) to all staff – perhaps have the vaccinations come to the wards – encouraging nurses and healthcare workers to get vaccinated or have more health wellness days." [P253]*

*"Make vaccination programmes compulsory. No vaccination no pay!" [P42]*

**Table 4b. Healthcare workers' desired practices regarding vaccination (N = 300)**

Question	all		clinical HCWs		non-clinical HCWs		p value
	n	%	n	%	n	%	
1. Have you ever attended the occupational health service to receive a vaccination at Tygerberg Hospital? (yes)	123	41.0	103	40.9	20	41.7	0.918
2. Did you get the influenza (flu) vaccine last year/this year? (yes)	68	22.7	52	20.6	16	33.3	0.054
3. Have you ever had a needlestick injury or blood or body fluid exposure (no)	156	52.0	123	48.8	33	68.8	0.011
4. Do you always wear gloves when working with patients/doing procedures? (yes)	175	58.3	150	59.5	25	52.1	0.338
5. Have you ever received the hepatitis B vaccine? (yes)	247	82.3	224	88.9	23	47.9	< 0.001
6. How many doses of the hepatitis B vaccine did you receive? (3)	170	56.7	161	63.9	9	18.8	< 0.001
7. Was your immunity against hepatitis B checked after your vaccinations? (yes)	102	34.0	91	36.1	11	22.9	0.077
8. Have you ever received the measles vaccine (yes)	159	53.0	141	56.0	18	37.5	0.019
9. Have you ever received the Tdap or Td vaccine? (yes)	101	33.7	89	35.3	12	25.0	0.166
10. Do you/will you get the tetanus and diphtheria (Td) vaccine every 10 years? (yes)	86	28.7	78	31.0	8	16.7	0.045
11. Have you had your blood tested for immunity (antibodies) against chickenpox? (yes)	13	4.3	8	3.2	5	10.4	0.024
12. Working while sick (I never come to work when sick)	30	10.0	25	9.9	5	10.4	0.916
13. I always wear a facemask when working with respiratory infection patients (agree)	159	53.0	138	54.8	21	43.8	0.161

**DISCUSSION**

Despite VPDs being a real risk to HCWs, the knowledge, attitudes and uptake of the WHO-recommended vaccines by participants was suboptimal. Overall KAP scores were higher among clinical than non-clinical HCWs, with medical doctors having the highest knowledge and attitude scores, overall. Similarly a Sudanese study on hepatitis B virus vaccination showed that doctors had higher average KAP scores than staff in other job categories.<sup>18</sup>

The total knowledge score (57.1%) may be a reflection of non-clinical HCWs having little or no training on VPDs and vaccines during their undergraduate studies, compared to clinical HCWs. Limited clinical experience with VPD exposures may also have contributed to knowledge. Most participants were young (18–40 years), and younger

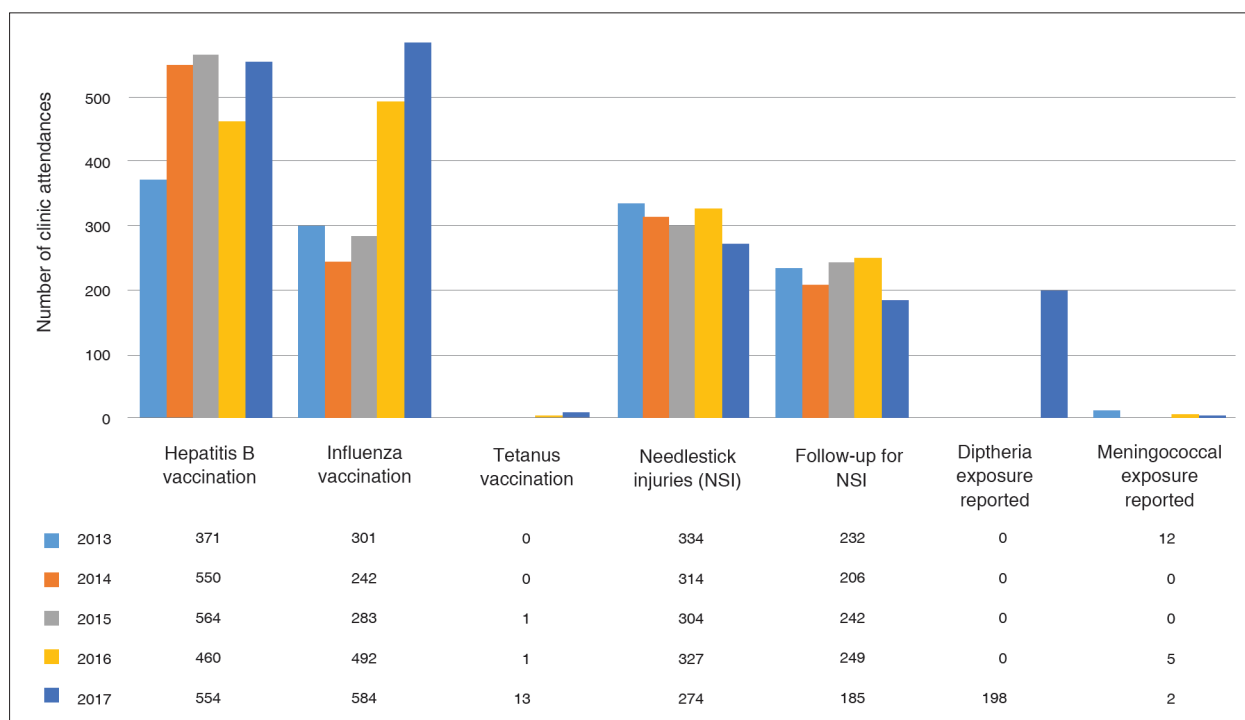
HCWs may have less acquired knowledge and experience due to fewer years of work. This was reflected in a Nigerian study where older age was associated with better hepatitis B virus vaccine knowledge and practices.<sup>17</sup> This may also explain why older HCWs ( $\geq 41$  years) in our study were more likely than younger HCWs to attend the occupational health clinic.

It is notable that most HCWs believed vaccines to be effective and safe with few side effects, and that there was widespread support for compulsory HCW vaccination. However, few HCWs supported punitive action against staff refusing vaccination. In many SA healthcare facilities, an institutional culture of HCW and patient safety is still in development. It is also unlikely, given the limited resources for occupational health in South Africa, that

**Table 5. Factors influencing healthcare workers’ vaccination knowledge, attitudes and practices**

Factor	predictor	regression co-efficient	odds ratio	95% CI	p value
Knowledge	Healthcare role (clinical)	6.58		1.85–11.31	0.007
	Job type (medical doctor)	15.76		11.84–19.68	< 0.001
Attitudes	Healthcare role (clinical)	9.62		5.08–14.16	< 0.001
	Job type (medical doctor)	4.99		1.22–8.75	0.010
Practices	Attended occupational health clinic	Age ( $\geq 41$ years)	3.07	1.87–5.06	< 0.001
		Job type (medical doctor)	0.65	0.37–1.15	0.136
	Completed 3-series HBV immunisations	Age ( $\geq 41$ years)	0.45	0.27–0.74	0.002
		Healthcare role (clinical)	7.82	3.58–17.05	< 0.001
	Had HBV serological testing post-HBV immunisation series	Sex (female)	1.96	0.98–3.93	0.057
		Job type (medical doctor)	7.63	4.03–14.46	< 0.001
	Received influenza vaccine	Age ( $\geq 41$ years)	1.66	0.94–2.94	0.082
		Healthcare role (clinical)	0.43	0.21–0.89	0.024
	Received measles vaccine	Sex (female)	1.88	1.00–3.52	0.048
		Job type (medical doctor)	3.07	1.61–5.84	0.001

HBV: hepatitis B virus. Potential predictors included in a linear regression model evaluating their association with knowledge and attitude scores (reporting adjusted co-efficients): age ( $\leq 40$  vs  $\geq 41$  years), sex, job category (clinical vs non-clinical), job type (medical doctor vs other HCW). Potential predictors included in a logistic regression model evaluating their association with self-reported practices (reporting adjusted odds ratios): age ( $\leq 40$  vs  $\geq 41$  years), sex, job category (clinical vs non-clinical), job type (medical doctor vs other HCW).



**Figure 1. Occupational health clinic vaccination and disease prophylaxis (2013–2017)**

mandatory vaccination of HCWs with WHO-recommended vaccines could be enforced.

Overall, participants fared badly on the practice questions. However, hepatitis B virus vaccine uptake was high, and superior to that of the other vaccines, at 82.3%, and far exceeded that previously reported in two HCW cohorts in Gauteng province (55.7% and 67.9%) in 2012 and 2009, respectively.<sup>15-16</sup> Similarly, many more participants reported hepatitis B virus vaccination series completion (56.7%) than did HCWs in the two Gauteng province studies (15.4% and 19.9%). Most HCWs in our study believed that their work placed them at an increased risk of hepatitis B virus infection, which could be the reason for high hepatitis B virus vaccine uptake, and for vaccine practices of clinical HCWs being better than those of non-clinical HCWs, given the daily work exposures of clinical HCWs.

Although most nurses and doctors claimed that they recommended the influenza vaccination to their patients, influenza vaccine uptake by the HCWs themselves was poor, at 22.7%. This poor uptake has been reported in a previous SA study where only 34.0% of HCWs were vaccinated in 2013/2014.<sup>19</sup> Influenza vaccine uptake was lower among clinical HCWs in our study, most likely due to increased workloads and less time available to attend the occupational clinic. Participants' reasons for not receiving the influenza vaccine were similar to those given by Saudi Arabian HCWs,<sup>20</sup> namely fear of influenza vaccine side effects and poor vaccine access. The practice of presenteeism was prevalent (69.0%), in keeping with an Ethiopian study where 52.6% of HCWs presented to work while ill.<sup>24</sup>

Potential interventions to overcome the barriers to HCW vaccine uptake reported by participants could be directed at increasing awareness regarding recommended vaccinations, improving access to vaccinations, and stricter vaccination enforcement. In particular, walk-in services and ward-based vaccination were requested by participants.

Addressing myths and false contra-indications to vaccination is also an important element to include when educating HCWs regarding vaccination. Since HCWs and the occupational health clinic nurse in charge viewed self, family and patient protection as important reasons for vaccinating, directing awareness and education at this positive impact of vaccination may improve vaccine uptake. HCWs also regarded vaccination guidelines as facilitators of HCW vaccine uptake, and indicated a willingness to follow SA Department of Health vaccination recommendations. The development of provincial or national HCW vaccination guidelines (based on the WHO recommendations) would be valuable for education and enforcement of undergraduate, pre-employment, and in-service HCW vaccination in South Africa.

Addressing the barriers to, and facilitators of, HCW vaccine uptake, and implementing appropriate interventions, may ultimately alter HCW perceptions of recommended vaccinations and enable them to regard vaccinations as non-negotiable rather than simply 'nice-to-have'. Improving HCW perceptions towards vaccines is especially important given the current global pandemic of COVID-19, and the introduction and distribution of vaccines in South Africa and worldwide.<sup>25-26</sup> The few studies that have been conducted on HCW COVID-19 vaccine acceptance have reported a wide variation, from 27.7% to 78.1%.<sup>27</sup> HCW hesitancy regarding the COVID-19 vaccine may negatively affect efforts to control the spread of the virus.

### Strengths and limitations

Strengths of this study included the large sample size in absolute numbers, a diverse cadre of HCWs from a middle-income African country, and a unique set of data on HCWs' KAP, regarding vaccination against several different VPDs. The convenience sampling of HCWs was a limitation. This sampling method, and the fact that only about 8.0% of the

hospital HCWs were included in the survey, prevents us from being able to generalise the findings to all HCWs in the hospital, or in other hospitals. To validate our findings, a larger proportion of HCWs should be included in a future study, selected using probabilistic sampling. However, there are challenges in recruiting busy HCWs into studies. Clinical HCWs were better represented than non-clinical HCWs (nearly 85% of participants were clinical HCWs), possibly due to lower literacy levels and language barriers of non-clinical HCWs, which might have contributed to their reluctance to participate. Proportional sampling of these two groups could prevent this bias in future studies. Another limitation was that the questionnaire was not validated. However, various university lectures on vaccines, good vaccination practices, and similar HCW vaccination studies in other developing countries were used when compiling the questions. Finally, vaccination practices were self-reported rather than observed, which might have led to information bias.

### CONCLUSION

Clinical HCWs had better KAP than non-clinical HCWs, regarding vaccination. Vaccine uptake was highest for hepatitis B virus and poorest for influenza. Barriers to HCW vaccine uptake included fear of vaccine side effects and poor access to vaccinations. Facilitators to HCW vaccine uptake included WHO and SA Department of Health vaccination guidelines, and HCWs wanting to protect themselves, their families and their patients. Strategies to improve HCW vaccine uptake should focus on vaccination education and facilitation of workplace access to vaccination.

### KEY MESSAGES

1. Overall KAP scores were low; non-clinical staff had significantly lower scores than clinical staff and are an important target group for healthcare worker vaccination.
2. Reported practices for vaccination were very low for all staff.
3. There is a need for enhanced healthcare worker education regarding vaccination.
4. National guidelines on HCW vaccination should be developed as a priority to encourage vaccine uptake at undergraduate level, as a pre-employment pre-requisite, and during service.

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### DECLARATION

The authors declare that this is their own work; all the sources used in this paper have been duly acknowledged and there are no conflicts of interest.

### AUTHOR CONTRIBUTIONS

Conception and/or design of the study: KPL, AD

Data acquisition: KPL

Data analysis: KPL, AD

Interpretation of the data: KPL, AD

Drafting of the paper: KPL

Critical revisions of the paper: KPL, AD

Accountability for all aspects of the work: KPL, AD

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