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Understanding COVID-19 vaccination intention among healthcare workers in N'Djamena, Chad: insights for enhanced immunization strategies in Africa

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Abstract

Although COVID-19 cases and mortality are declining, vaccination remains essential for the World Health Organization (WHO) as it shifts from managing a global emergency to implementing long-term disease control strategies. Sub-Saharan Africa requires particular attention due to low vaccination coverage and the risk of variants. Chad ranks among the countries with the lowest vaccination rates globally. Healthcare workers' (HCWs) vaccine hesitancy may influence patient uptake, making it essential to understand their intentions and underlying reasons to inform context-specific public health strategies. A cross-sectional survey, adapted from the WHO Strategic Advisory Group of Experts (SAGE) vaccine hesitancy tool, was conducted among 632 HCWs in N'Djamena, Chad, between April 30 and May 14, 2021, before the national COVID-19 vaccination rollout. Approximately 60% of HCWs expressed willingness to be vaccinated. Positive attitudes were associated with older age, presence of chronic conditions, and greater fear of the disease. Vaccine refusal was linked to beliefs that vaccines are dangerous, prior rejection of all vaccines, or perception of COVID-19 vaccines as a strategy to benefit Western pharmaceutical companies. These findings can support the adaptation of global vaccination initiatives to local contexts in Sub-Saharan Africa by addressing HCWs' concerns to improve vaccine uptake.

Introduction

Since late 2020, the availability of a COVID-19 vaccine has significantly altered the pandemic's trajectory, leading to a gradual decrease in disease severity in highly vaccinated countries. [1] However, to successfully control the pandemic, vaccination must be global. [2] The World Health Organization (WHO) has transitioned from considering COVID-19 a global emergency to managing it as a long-term disease. To achieve this, it emphasizes the importance of vaccination in low-income countries. [3]

To date, 13.64 billion COVID-19 vaccine doses have been administered worldwide. However, significant regional disparities exist: while 81% of the population in the Americas has received at least one dose, this figure drops to 39% in Africa. Moreover, 32% of the global population has received a booster or additional dose, compared to only 6% in Africa. In Chad, 9.15 million COVID-19 vaccine doses have been administered, with approximately 31% of the total population having completed the primary vaccine series. [4] Far from achieving herd immunity, African countries have also become critical in the global fight against SARS-CoV-2 as they may become a reservoir for the virus and a focus for new variants. [5] However, experts highlight specific vaccination challenges in Africa, such as limited funding, vaccine safety

concerns and uncertainties, storage requirements and short vaccine shelf life, regulatory hurdles, difficulties in accessing vulnerable communities, and ongoing wars and conflicts. [6]

In June 2021, Chad received approximately 200,000 doses of the Sinopharm BBIBP-CorV vaccine (Beijing Institute of Biological Products Co., Ltd., Beijing, China) and 100,620 doses of the Pfizer-BioNTech mRNA vaccine (Pfizer Inc., New York City, USA; BioNTech SE, Mainz, Germany). The vaccination campaign began on 4 June 2021, led by the Minister of Public Health and National Solidarity. Initially, the focus was on healthcare workers (HCWs), individuals at health risk, and pilgrims, later expanding to include all adults over the age of 18. [7]

While overall vaccination coverage in the Republic of Chad has increased over the past few decades, the country faces significant challenges in extending COVID-19 vaccination to the entire population due to its geographical, socio-cultural, and economic peculiarities. Beyond the limited number of available doses, one crucial factor for the success of an immunization strategy is the population’s attitude towards vaccines. [8] The rapid development of new-generation COVID-19 vaccines and large-scale vaccination efforts have revived these concerns, particularly among HCWs who faced significant challenges during the pandemic.

This study examines COVID-19 vaccination intentions among healthcare workers (HCWs), who are at high risk of exposure, [9] highly likely to contract and transmit the disease, [10] and serve an important educational role for the general population. [11] In fact, there is a positive correlation between vaccination rates of HCWs and their willingness to recommend COVID-19 vaccination to patients. [12] According to the WHO, vaccine hesitancy is defined as the "delay in acceptance or refusal of vaccines despite availability of vaccine services", which is "complex and context specific, varying across time, place and vaccines". [13] From an exploratory cross-sectional study, we aimed to analyze the intention of HCWs to accept COVID-19 vaccination in the Republic of Chad, with the purpose of identifying some variables that could be affecting attitudes toward the vaccine.

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Materials and Methods

Study design

A cross-sectional survey was carried out involving 632 participants from April 30 to May 14, 2021, notably prior to the rollout of COVID-19 vaccination campaigns in Chad, aimed at collecting data regarding healthcare workers' willingness to receive the COVID-19 vaccine. Participants completed a 43-question, 20-minute survey on demographic, social, and clinical variables related to COVID-19, as well as an adapted WHO Strategic Advisory Group of Experts (SAGE) vaccine hesitancy questionnaire on COVID-19 vaccination. [13]

Sample recruitment and data collection

HCWs working in health services and in any inpatient, outpatient, or outreach service in a community setting were eligible to participate in this study. Thus, in line with the WHO definition, HCWs in this specific context included anyone who worked in a health facility, including hygienists, wardens, or those in administrative positions. [14] A group of trained research assistants administered the questionnaire.

Measurements and variables

The initial questionnaire was pilot-tested with 18 individuals and subsequently refined based on feedback from a local advisory board. Data from the pilot tests were not included in the main study.

The intention to be vaccinated against COVID-19 was measured with the question: "Do you intend to be vaccinated against COVID-19 if the vaccine is available in Chad and free?" Response options were: 1 = yes; 2 = I will observe for a while before deciding; 3 = it will depend on the type of vaccine; 4 = no, I will not get vaccinated; 5 = I don't know. In addition to this question, the questionnaire included socio-economic variables, medical aspects and experiences with vaccination, beliefs, attitudes, environmental context, and the intention to accept or reject the COVID-19 vaccine, with explanatory reasons for each choice.

The questionnaire consisted of closed-ended questions in both single-and multiple-response formats, including binary yes/no scales, nominal and ordinal scales, and Likert-type questions. An open-ended question was incorporated at the end, asking HCWs how they believed

the general population would react to vaccination, considering that the questionnaire was administered prior to the arrival of the vaccine in Chad.

Statistical analysis

Data on demographic variables are presented using mean and standard deviation (SD). Associations between variables were analyzed with t-tests. STATA v.13 (StataCorp, 4905 Lakeway Dr., College Station, TX, USA) was used to carry out the statistical analysis. To examine COVID-19 vaccination acceptance intentions, linear regression models were used to explore the associations between these intentions, work-related factors, and perceived likelihood of infection. The single open-ended question was analyzed using a thematic approach to establish content patterns.

Results

Among the 632 participants, the mean age was 29.6 years (SD=8.93). Men accounted for 60.4% of the sample. Only 4.3% of participants had no formal education, while the majority (74.7%) had higher or technical education. Most participants reported not having been affected by COVID-19 (80.9%) and had never been tested for the virus (82%). Demographic data is presented in Table 1.

Regarding attitudes toward and past experiences with vaccines, most participants believed that vaccines always or frequently protect against diseases (87.4%). We found that 54.5% of the participants indicated that vaccines are never dangerous. Most healthcare workers did not believe that vaccination could cause infertility (81.8%). However, fewer participants believed that vaccines do not introduce diseases into Africa (73.8%), and trust in the pharmaceutical industry was lower, with 25.9% considering vaccination to be a strategy driven by pharmaceutical companies. Supplementary Table 1 presents additional insights into the attitudes, prior experiences, and beliefs of healthcare professionals. Furthermore, Figure 1 illustrates the distribution of participants' responses in stacked histograms corresponding to the Likert questions from Supplementary Table 1.

Finally, 62% of HCWs reported willingness to be vaccinated, whereas 10.6% were opposed to vaccination. The remaining participants expressed hesitancy: 15.5% stated that they would "wait before deciding", 10.6% indicated that their decision would depend on the type of vaccine, and 5.9% remained undecided. Furthermore, 57.2% of participants reported they would have their child vaccinated as soon as possible, while 16.6% said they would not. Ultimately, based on the WHO vaccine hesitancy criteria, we observed a COVID-19 vaccine hesitancy rate of 38% among respondents for themselves and 42.8% for their children (Table 2).

Intention to be vaccinated was recategorized into three outcomes (yes, no, and doubtful). Ordered logistic regression analyses were then performed to identify variables associated with differences in final vaccination intention. The best-fitting model included age, presence of chronic diseases, fear of COVID-19, perception of vaccines as dangerous, prior refusal of vaccination, and the belief that COVID-19 vaccines represent a strategy to enrich the Western pharmaceutical sector. Regression coefficients and p-values are reported in Table 3.

The open question explored the perception of HCWs on what the Chadian population may think about the COVID-19 vaccine. While many of the answers from HCWs alluded to the fact that the population is not optimistic about the vaccine or that they are waiting to see how the vaccination process will work, some considered that the population would reject vaccination for different reasons. According to their answers, part of the population denies the existence of the virus. Others refer to the fact that part of the community would associate this vaccine with health risks ("[the vaccine] is a way to spread the virus"). Some refer to specific damage that would be done to the black population ("[the vaccine] is a poison to kill blacks", "[the vaccine] aims to sterilize blacks"). There are also allusions to some forms of domination through health devices ("[the vaccine] is another form of domination", "[the vaccine] is a means of control"). A smaller group of HCWs reported a positive attitude among the general population toward vaccination, viewing it as a means "to protect against COVID-19" or as an important component of the "fight against COVID-19".

Discussion

Our study found that approximately 62% of HCWs in N'Djamena expressed willingness to be vaccinated. These data can be compared with another cross-sectional study conducted among the general population during the same period [15] and a similar study carried out in N'Djamena 5 months later, after the implementation of the vaccination campaign. [16]

Regarding the former, vaccine acceptance among HCWs in N'Djamena was higher than that observed in the general population during the same period (approximately 48%). The comparison between HCWs' and the general population's attitudes varies significantly across

countries. [17, 18, 19] Some differences may be attributed to HCWs' higher education level, which makes them less susceptible to misinformation and fake news. [17, 18, 19] Other studies suggest that their increased exposure to vaccine-related adverse events leads to greater suspicion compared with the general population. [18]

With regard to temporal trends, our study shows a higher level of intention than that reported by Rice et al. (53%), whose survey was conducted between August and October 2021, after the vaccination campaign had already been implemented. [16] This disparity could be attributed to well-described evolving attitudes and knowledge about vaccines over time, influenced by various factors such as demographics, ideology, and misinformation. [20] Also in Nigeria, the proportion of the general population who refused to receive the COVID-19 vaccine increased over time. This result, in line with our own, could mean that information about the COVID-19 vaccine, including misinformation aimed at discrediting its efficacy, seems to spread over time. [21]

Based on a systematic review that included 24 studies and recruited 50,940 HCWs from around the world, the authors found that the overall proportion of HCWs who intend to accept vaccination against COVID-19 was 63.5%. Focusing on the African context, there was great variability between data collected in different countries, probably due to differences in study designs and populations. Thus, studies measuring the intention of African health workers to get vaccinated against COVID-19 ranged from 27.7% in the Democratic Republic of the Congo, 46.6% in Zambia, and 90.1% in the Eastern Cape, South Africa. [22] As our study suggests, the differences may also be attributed to the timing of the study, whether it was conducted before or after the vaccination campaign in each country.

Our study also reports that one of the most significant variables regarding the positive intention to be vaccinated is the fear related to COVID-19, even among HCWs. A qualitative study suggests that this fear may stem from anxiety and ambivalence experienced by HCWs in real-life settings. [23] Therefore, those who show greater fear of the disease manifest a more favorable behavioral intention to be vaccinated. This finding is consistent with studies that suggest that fear is one of the main factors that impact individual decisions on vaccination. [24] Accordingly, we found that older people and those with chronic conditions have a more positive intention to be vaccinated, as age and chronic diseases are known risk factors for COVID-19. [25] These variables have also been positively reported in other studies on the intention to be vaccinated. [22]

Regarding the group that expresses a negative intention toward vaccination, the two most influential variables are the belief that vaccines are dangerous and the belief that vaccines benefit the pharmaceutical industry. With regard to the first belief, studies have shown that distrust in vaccines and concerns about their potential harm have had a significant impact on entire populations. In Tanzania, for example, the whole country refused to be vaccinated against COVID-19 for this very reason. [25] Regarding the second belief, several studies on HCWs also highlight this variable as influential in shaping behavioral intentions toward vaccination. [26, 27] In our study, some participants' responses reflected beliefs that the vaccine is a means to spread the virus, a form of domination and racial control, as they allude to distrust towards the pharmaceutical industry.

Ultimately, positive behavioral intention was motivated by the perception that the benefits of the vaccine outweigh its potential risks. This aligns with the behavioral intention model, which suggests that the primary determinant of behavioral intention is an individual's positive or negative attitude toward a behavior, shaped by their evaluation of the associated benefits and drawbacks. [28] Accordingly, whenever elements, such as fear about possible harm caused by vaccines or distrust of the pharmaceutical industry, prevail, the cognitive conclusion is that it is better to abstain from vaccination behavior.

Strengths and limitations

Our study employed systematic and standardized procedures to collect health data in a region prioritized for the effective long-term management of the COVID-19 pandemic. The availability of other studies conducted in N'Djamena (Chad) has allowed for synchronous comparison with the general population and diachronic comparison to show the evolution of HCWs' attitudes toward COVID-19 vaccination over time. Our sample included 632 Chadian HCWs and was diverse in terms of age, gender, and socioeconomic composition. However, because the questionnaire was written in French and participation was voluntary, the cohort may be biased toward individuals particularly concerned about COVID-19.

Conclusions

As recently emphasized by the WHO, promoting global vaccination is essential for transitioning from a global emergency to long-term disease management and for sustaining the achievements of immunization plans worldwide. However, a major challenge to achieving these objectives is people's willingness to be vaccinated and their vaccine hesitancy. In this context, individuals' intentions to receive the COVID-19 vaccine are shaped by their beliefs and perceptions of associated risks.

This study unveils the general attitude of Chadian HCWs towards COVID-19 vaccination and explores the underpinning reasons for their behavior. This insight is particularly relevant for tailoring global public health strategies to a specific local context, such as Sub-Saharan Africa, given its frontline position against infectious risks. Reaching this often-overlooked population and providing culturally adapted health strategies are of crucial importance in the fight against COVID-19. Our research highlights the inadequacy of information provided by some HCWs. To address this, we recommend intensifying information campaigns targeting all HCWs regarding vaccination safety and health system trustworthiness. This emphasis becomes critical as new-generation vaccines, including mRNA and virus-derived vaccines, gain prominence in the African vaccine landscape.

Table 1. Demographic and descriptive data.

Variable	**n (%)**	
Age	29.56 (SD 8.93)	471
Gender	Male	360 (60.4)
	Female	236 (39.6)
Educational level	No instruction	25 (4.31)
	Primary education	19 (3.28)
	Secondary education	103 (17.76)
	Higher and technical education	433 (74.66)
Religion	Catholic	245 (40.16)
	Protestant	214 (35.08)
	Muslim	125 (20.49)
	Animist	7 (1.15)
	Atheist	10 (1.64)
	Other	9 (1.48)
Marital status	Married	236 (39.33)
	Single	277 (46.17)
	Divorced	11 (1.83)
	Widow	12 (2)
	Cohabitation	64 (10.67)
Chronic disease	Yes	68 (11.24)
	No	537 (88.76)
Health status	Excellent	158 (26.47)
	Very good	304 (50.92)
	Good	118 (19.77)
	Regular	13 (2.18)
	Bad	13 (2.18)
	Very bad	4 (0.67)
Travel abroad	Yes	79 (12.95)
	No	531 (87.05)
Suffer from COVID-19	Yes	115 (19.13)
	No	486 (80.87)
Tested for COVID-19	Yes	110 (18)
	No	501 (82)
Acquaintance with COVID-19	Yes	163 (26.72)
	No	447 (73.28)
Acquaintance died from COVID-19	Yes	103 (16.8)
	No	510 (83.2)
Fear of COVID-19	None at all	133 (22.43)
	Sometimes I am afraid	109 (18.38)

Variable	n (%)	
	I am quite afraid	146 (24.62)
	I am very much afraid	205 (34.57)

SD, standard deviation.

Figure 1. Distribution of participants' answers to the Likert questions with 5 (panel A) or 3 (panel B) choices corresponding to attitudes, past experiences, and beliefs about COVID-19 vaccination.

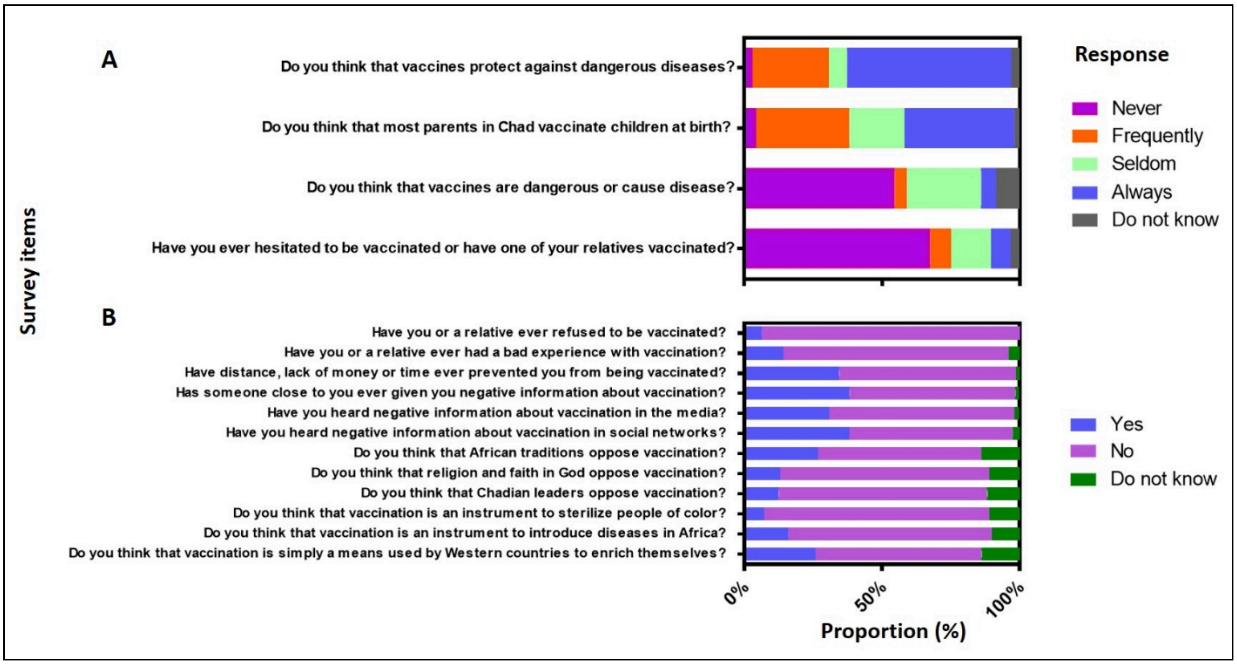

Table 2. Vaccination intention among Chadian HCWs.

Question	Answer	n (%)
Do you intend to get vaccinated against COVID-19 if the vaccine is available in Chad and free?	Yes, I will get vaccinated as soon as possible	375 (61.98)
	I will observe for a while before deciding	94 (15.54)
	It will depend on the type of vaccine	36 (5.95)
	No, I will not get vaccinated	64 (10.58)
	I don't know	36 (5.95)
If you have (or had) children, do you plan to have them vaccinated against COVID-19?	Yes, they will get vaccinated as soon as possible	346 (57.19)
	I will observe for a while before deciding	116 (19.17)
	It will depend on the type of vaccine	36 (5.95)
	No, they will not get vaccinated	100 (16.53)
	I don't know	7 (1.16)

Table 3. Ordered logistic regression explaining vaccination final intention.

Predictor	Coefficient	Standard Error	p-value	95% CI
Age	0.0424	0.0162	0.009	0.0105-0.0742
Chronic disease	1.1829	0.4730	0.012	0.2557-2.1100
Fear of COVID-19	0.5190	0.1000	0.000	0.3230-0.7151
Vaccines are dangerous	0.3018	0.1248	0.016	0.0571-0.5464
Refused a vaccine	−1.3918	0.4198	0.001	−2.2146-−0.5690
Enrich pharma industry and Western countries	−0.5147	0.1531	0.001	−0.8149-−0.2146

CI, confidence interval.

Online Supplementary Material:

Supplementary Table 1. HCWs' attitudes, past experiences, and beliefs regarding vaccination.

Author Contributions

GRTD, OD, ME, NSS, MM, FM, data acquisition and analysis; GRTD, OD, RL, statistical analysis; GRTD, CGV, RL, MB, FM, literature review; GRTD, MB, RL, FM, CGV, manuscript writing. All authors contributed to the conception and design of the project and critically revised successive drafts. All authors have read and approved the final manuscript.

Ethics Statement

Ethics approval and consent to participate: approval for this research was granted by the Institutional Review Board of the University Hospital Complex "Le Bon Samaritain" (IRB protocol number 016/CHU-BS/DG/2021-B). Participation in this survey was anonymous, voluntary, and informed, with all candidates providing their consent.

Data Availability

Availability of data and materials: due to ethical restrictions related to participant confidentiality, the anonymized survey datasets generated and analyzed during this study are not publicly available. They can, however, be obtained from the corresponding author upon reasonable request.

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