

# Original Research Article

## **Covid-19 vaccine uptake and its determinants among health care workers in Somali region of Ethiopia**

### **ABSTRACT**

**Aims:** Healthcare workers are known to be at higher risk of COVID-19 infection and have a role in transmitting to others in the work environment and communities. Public health measures and vaccination are the major strategies being implemented to prevent and control the infection. The study assessed COVID -19 vaccine uptake and its determinants among health care workers in Somali region of Ethiopia

**Study design:** This was a cross-sectional analytical study

**Place and Duration of Study:** Somali Region in October 2021

**Methodology:** A structured self-administered questionnaire adapted from the WHO Strategic Advisory Group of Experts on Immunization vaccine hesitancy survey question was used and administered to 427 healthcare workers in eight selected sites. Bivariate analysis and multiple logistic regression were used to assess association between vaccine uptake and some selected determinants. The level of significance was set at a p-value<5%.

**Results:** About 71% of the health workers have been vaccinated at least once and vaccination was significantly higher among those with perceived risk of being infected ( $\chi^2 = 12.19$ ,  $p < 0.05$ ), perceived benefit of the vaccine ( $\chi^2 = 47.30$ ,  $p < 0.05$ ) and perceived protection of the vaccine for their communities ( $\chi^2 = 22.13$ ,  $p < 0.05$ ). About 45% of the respondents believed the vaccine is very safe and vaccination is significantly higher among those who believed the safety of the vaccine ( $\chi^2 = 23.06$ ,  $p < 0.05$ ). Vaccine uptake is higher among medical doctors than other health professionals, (AOR = 2.32, 95% CI: 1.09–5.48),  $p < 0.05$ . The study shows significant relationship between inclination towards vaccination and actual vaccination where about 78% of those who had desired to be vaccinated actually got vaccinated. Other factors associated with vaccination uptake were colleagues getting vaccinated and support by community and religious leaders to vaccination

**Conclusion:** The study identified key determinants to vaccine uptake among the health workers which included perceived risk of being infected, perceived benefit, safety of the vaccines and perceived protection of the vaccine for their communities. These require targeted Social and behavioural change communication strategies to address.

**Keywords:** COVID 19, Vaccine, health workers, uptake, determinants

# 1. INTRODUCTION

The coronavirus disease 2019 (COVID-19) have resulted in loss of lives and significant social and economic impacts since the first case was detected in China in 2019, and its subsequent declaration as a pandemic on 11<sup>th</sup> March 2020 .<sup>1</sup> Ethiopia recorded its first confirmed case of COVID 19 on 13<sup>th</sup> March 2020 and Somali region reported its first case on 30<sup>th</sup> April 2020. Public health measures and vaccination are the major strategies being implemented to prevent and control the infection.

Vaccines have been one of the most successful public health interventions in the prevention and control of diseases, however vaccine hesitancy has been as global problem. WHO in 2019 listed vaccine hesitancy among the top threat to health.<sup>2</sup> The World Health Organization defines vaccine hesitancy as a “delay in acceptance or refusal of safe vaccines despite availability of vaccine services”.<sup>3</sup> Healthcare workers are at least three times higher risk of COVID-19 infection with the risk of transmitting to others in the work environment and communities.<sup>4,5</sup> As part of the preventive measure, COVID vaccination was rolled out in the Somali region of Ethiopia on 23<sup>rd</sup> March 2021 and health care workers were prioritized in line with global prioritization recommendation .<sup>6</sup> However, this prioritization has been reported not to be associated with optimal uptake among the health workers .<sup>7</sup> Vaccine hesitancy among healthcare workers is an area of concern because of their roles as trusted sources of health information to the community and their high risk of exposure to infections acquired in a healthcare setting and potential spread to the community.

In view of the possible impact of vaccine hesitancy among health workers on the control of the pandemic, this study aimed at assessing COVID-19 vaccine uptake and its determinants among health care workers in Somali region of Ethiopia.

## 2. MATERIAL AND METHODS

### 2.1 DESIGN.

This was a descriptive cross-sectional study conducted in October 2021

### 2.1 STUDY POPULATION AND SETTING.

The study was conducted among 427 healthcare workers who completed the questionnaires in eight selected sites of Somali region of Ethiopia which were Jigjiga, Wajale, Shinile, Degahbour, Kebridahar, Gode and Dolo-ado woredas. A sample size of 440 was used, determined by using the single population proportion formula taking the proportion of uptake of the COVID-19 vaccine at 22.5%,<sup>8</sup> at 95% confidence interval (CI) and 5% marginal error .<sup>9</sup>

Purposive method was used to select four hospitals and four health centers among the health facilities where COVID 19 vaccination has been successfully rolled out and have very high number of health workers. The four hospitals, namely Karamara, Degahbour, Kabridahar and Gode Hospitals, and predetermined sample size was allocated to each hospital. The total number of health care professionals in the four hospitals was 1260. The 4 health centers are Kebribayah, Togwajaale, Shinile and Dolo-ado. The total number of health care

professionals in the four selected health centers was 191. To obtain representative samples from the selected hospitals and health centers, proportional allocation was performed. A simple random sampling method was used to select participants from the health facilities using the staff registers and individuals who volunteered and consented to participate were recruited into the study.

## 2.3 DATA COLLECTION AND STATISTICAL ANALYSIS

A structured self-administered questionnaire adapted from the WHO SAGE (Strategic Advisory Group of Experts on Immunisation) vaccine hesitancy survey sample question was used to collect the data.<sup>10</sup> The survey consisted of questions that assessed socio-demographic characteristics, vaccination history and determinant specific questions.

Data were coded and entered into Epi Info software (version 3.5.1; CDC) and exported into Stata software (version 14.1; StataCorp LP) for analysis. Descriptive statistics were used to describe the sociodemographic characteristics of health workers and Pearson's chi-square was used to analyse the association between vaccination and the determinants. The association between vaccine uptake as the outcome variable and the socio-demographic factors as the predictor variables was done using multiple logistic regression and presented as adjusted odds ratios (AORs). The level of significance was set at a p-value of less than 0.05 with a 95% confidence interval. Table 1 shows the generic description of the determinants of COVID 19 vaccination.

**Table 1: The Generic description of the determinants of COVID-19 vaccination**

Determinants	Generic description	Contextualization for the study.
Perceived self-access	An individual's belief that he/she can do a particular behavior given his/her current knowledge, resources and skills.	We asked the respondents what might make it easier and what might make it difficult for them to get a COVID-19 vaccine.
Perceived social Norms	The perception that other people are important to an individual and think that he/she should do the behavior (injunctive norms), and plan to do the behavior (descriptive norms).	We asked respondents: <ul style="list-style-type: none"> <li>• if their close family and friends would want them to get COVID-19 vaccine.</li> <li>• if their community and religious leaders would want them to get COVID-19 vaccine.</li> <li>• who would approve of them getting COVID-19 vaccine.</li> <li>• who would disapprove of COVID-19 vaccination.</li> </ul>
Perceived safety	A person's perception on how safe the vaccine is .	We asked respondents how much safe the COVID -19 vaccine

Perceived susceptibility/risk	A person's perception of how vulnerable or at risk they feel vis-à-vis the problem or disease.	Respondents were asked what proportion of people in their community have had COVID-19, how likely they thought it was that someone in their household would contract COVID-19, and how concerned they were about getting COVID-19.
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### 3.1 RESULTS AND DISCUSSION

#### ***Socio-demographic characteristics***

Table 2 shows the socio-demographic profile of the 427 health workers who completed the questionnaire, response rate of 97% with 285(66.7%) male and 208(48.7%) of them were married. The mean participants' age is 29.05±8.03 and 382(89.5%) were urban residents with 369(86.4%) being muslims. Most of the participants were nurses, 273(63.9%) and only 22(5.1%) has pre-existing co-morbidity with Diabetes mellitus being the commonest chronic disease, 17(77.3%). Social media is the main source of information on COVID 19 with 264(61.8%) of the respondents.

**Table 2: Socio-demographics characteristics of the study sample**

Variables	Healthcare workers, N (%) N=427
Mean age(years)±SD	29.05±8.03
Sex	
Male	285(66.7)
Female	142(33.3)
Residence	
Urban	382(89.5)
Rural	45(10.5)
Ethnicity	
Somali	349(81.7)
Oromo	12(2.8)
Gurage	7(1.6)
Amhara	43(10.1)
Others	16(3.8)
Marital status	
Married	208(48.7)
Single	208(48.7)
Religion	
Muslim	369(86.4)

Christian	58(13.6)
Profession	
Doctors	58(13.6)
Nurses	273(63.9)
Other Health workers	44(10.3)
Support staffs(non-clinical )	52(12.2)
Co-morbidity status	
Yes	22(5.1)
No	405(94.9)
Type of comorbidities	
DM	17(77.3)
Hypertension	4(18.2)
Heart disease	1(4.5)
Primary source of information for Covid-19	
TV	151(35.4)
Radio	12(2.8)
Social media	264(61.8)

### ***Perceived access to vaccination and risk of getting infection***

Table 3 shows the respondents perceived access to COVID 19 vaccination and risks to COVID 19 infection.

Regarding access to the vaccination services, all the respondents reported easy access to vaccination. In terms of perceived risk to getting the infection, 380 (89%) of the respondent reported any level of perceived risk. The levels of perceived risk are a little, moderate and very concerned. Similarly, for patients' concern, the perceived risk was 383(89.7%) among the respondents.

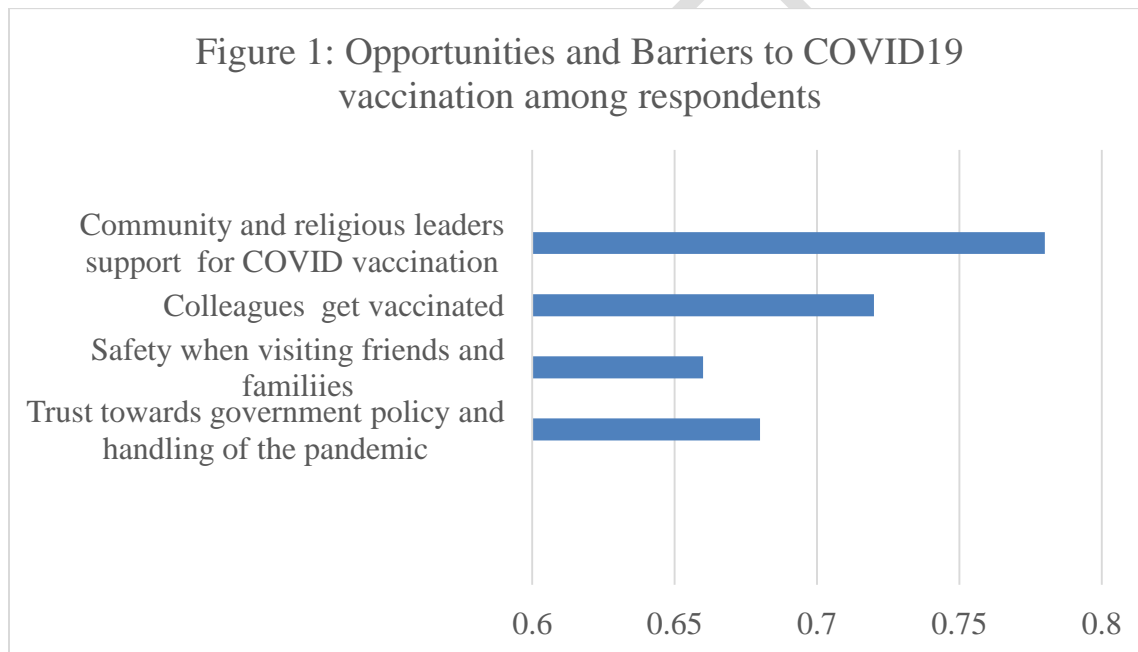
**Table 3: Perceived access to COVID vaccination and Perceived Risk to COVID infection among respondents**

Perceived access to COVID vaccination	Healthcare workers, N (%)
How easy to get vaccination services	
Very easy	427(100)
Perceived Risk to COVID infection	
How concerned are you about getting COVID -19?	
Not at all concerned	47(11.0)
A little concerned	64(15.0)
Moderately concerned	106(24.8)

Very concerned	210(49.2)
How concerned are you about your patients getting COVID -19 from you?	
Not at all concerned	44(10.3)
A little concerned	67(15.7)
Moderately concerned	110(25.8)
Very concerned	206(48.2)

### **Barriers and opportunities (perceived social norms)**

Figure 1 shows some opportunities and barriers associated with COVID19 vaccination among the respondents. Opportunities (perceived social norms) such as safety when visiting friends and families (66%), colleagues getting vaccinated (72%) and support by community and religious leaders (78%) and trust towards government policy and handling of the pandemic (68%) to vaccination are some of the factors identified to improve vaccination.



### **Association between perceived risks, benefits, safety and inclination towards vaccination and being vaccinated**

Table 4 shows the bivariate analysis of the association between perceived risk and benefit and vaccination among respondents using Pearson chi-squared test. A total of 303(71%) of the respondents have received at least one dose of AstraZeneca vaccine which was the only vaccine available at the time of conducting the

study. It shows that vaccination of health workers was significantly higher among those with perceived risk of being infected ( $\chi^2 = 12.19$ ,  $p < 0.05$ ). Likewise, vaccination of health workers was significantly higher among those who perceived COVID-19 vaccine as very important ( $\chi^2 = 47.30$ ,  $p < 0.05$ ). Similarly, vaccination among health workers was significantly higher among those who believed being vaccinated will protect the community they served ( $\chi^2 = 22.13$ ,  $p < 0.05$ ). In terms of vaccine safety, 45.4% of the respondents believed the vaccine is safe and the vaccination is significantly higher among those who believed the safety of the vaccine ( $\chi^2 = 23.05$ ,  $p < 0.05$ ). A total of 337(78.9%) of the 427 health workers said they were willing to be vaccinated, however only 272(80.7%) of them actually got vaccinated. The analysis found that vaccination was significantly higher among those who had desired to be vaccinated, ( $\chi^2 67.776$ ,  $p < 0.05$ ).

**Table 4: Association between perceived risks, benefits, safety, inclination toward vaccination and actual Vaccination**

Variable	Vaccination status		chi-square ( $\chi^2$ ) statistic (P-value)
	Yes (n, %) 303(71)	No (n, %) 124(29)	
<b>How concerned are you about getting Covid-19</b>			
Not all concerned	27(61.4)	17(38.6)	12.19(0.0067)
A little concerned	36(56.3)	28(43.7)	
Moderately concerned	70(66)	36(34)	
Very concerned	170(79.8)	43(20.2)	
<b>How important do you think getting a Covid-19 vaccine will be for your health?</b>			
Not at all important	16(47.3)	10(52.7)	47.30(0.0001)
A little important	19(36)	34(64)	
Moderately important	68(66)	35(34)	
Very important	207(83.1)	42(16.9)	
<b>How much do you think getting a Covid-19 vaccine for yourself will protect other people in your community from Covid-19?</b>			
Not at all important	16(50)	16(50)	22.13(0.0001)
A little important	18(47.3)	20(52.7)	
Moderately important	85(64)	48(36)	
Very important	184(82.1)	40(17.9)	
<b>How safe do you think a Covid-19 vaccine will be for you?</b>			
Not at all safe	18(51.4)	17(48.6)	23.05(0.00039)
A little safe	24(47)	27(53)	
Moderately safe	108(73.5)	39(26.5)	
Very safe	153(78.9)	41(21.1)	

<b>Inclination towards COVID-19 vaccination</b>			
If a COVID19 vaccine were recommended and available for you, would you get it?			
Yes	272(80.7)	65(19.3)	67.78(0.0001)
No	17(28.8)	42(71.2)	
Not sure	14(45.2)	17(54.8)	

### ***Socio demographic factors associated with the COVID-19 vaccination***

Table 5 shows multivariate logistic regression analysis of sociodemographic factors and vaccination. The study found higher vaccine uptake among medical doctors than other health professionals (AOR = 2.32, 95% CI: 1.09–5.48) , $p < 0.05$ , but no association between the participants' age, gender, co-morbidity and vaccine uptake.

**Table 5: Socio-demographic profile and association with the COVID-19 vaccination**

<b>Variables</b>	<b>Vaccinated Health workers n= 303 AOR 95% CI</b>	<b>P value</b>
Age		
<40	0.69(0.31-1.53)	0.36
≥40	Ref	
Sex		
Male	Ref	
Female	0.72(0.45-1.13)	0.15
Residence		
Urban	1.01(0.50-2.01)	0.99
Rural	Ref	
Education/profession		
Doctor	2.32(1.09–5.48)	0.045
Nurse	1.67(0.89-3.15)	0.11
Other Health workers	1.03(0.44-2.39)	0.95
Support staffs (non-clinical)	Ref	
Marital status		
Married	Ref	
Single	0.86(0.56-1.34)	0.56



Religion		
Muslim	Ref	
Christian	0.88(0.47-1.65)	0.70
Comorbidities		
Yes	Ref	
No	2.10(0.85-5.21)	0.11

### 3.2 DISCUSSION

The study identified the vaccine uptake and the associated determinants among health workers in the selected study sites.

The study found that 71% of the health workers have been vaccinated at least once which is higher than the finding in a study conducted earlier in Ethiopia which showed vaccine uptake of 62.1% among health professional<sup>11</sup>. This is however lower than 90% reported in a survey among health workers in hospitals in South Africa.<sup>12</sup> Similarly, a study in USA reported that 70% of the hospital based health workers had received full dose of the COVID19 vaccine<sup>13</sup> while studies in China and United Arab Emirates reported a coverage of 76.9% and 89.2% among healthcare workers respectively among health workers.<sup>14,15</sup> A report from WHO found that only 27% of health workers in Africa have been fully vaccinated against COVID-19 compared to 80% in high income countries.<sup>16</sup>

In the study, vaccination was significantly higher among health workers with perceived risk of being infected, this is similar to the findings in studies in Egypt, Ethiopia, Vietnam and Italy and a scoping review which reported that the willingness to take the COVID-19 vaccine was significantly positively correlated with the health workers perception of the severity of COVID and risk of getting infected.<sup>8,17-20</sup> A study in Saudi Arabia found that health workers who perceived themselves as being at a lower risk are not highly concerned about getting COVID infection and were not fully engaged in preventive measures for COVID-19, including vaccination.<sup>21</sup>

Vaccine uptake was significantly higher among those who perceived COVID -19 vaccine was beneficial for their protection and the communities they served. Similarly, other studies found that collective responsibility emerged as an important determinant, with participants wanting to be vaccinated in order to protect people with weaker immune systems and also because they regarded vaccination as a collective effort to control COVID-19 infection.<sup>22,23</sup>

Vaccination was significantly higher among those who believed the safety of the vaccine. This is similar to finding in studies in South Africa, Ethiopia, Egypt, and Democratic Republic of the Congo which reported that concerns regarding safety and effectiveness are important predictors of vaccine hesitancy among the health workers.<sup>18,23-25</sup>

Other factors associated with COVID-19 vaccination uptake in the study were colleagues getting vaccinated and support by community and religious leaders for vaccination. This is similar to finding from a previous study in Ethiopia which reported that health workers would delay accepting the vaccine and would prefer to wait and observe the effects of the vaccine on other people due to concerns of long-term side effects [26]. Similarly, the findings in some studies reported that advice from peers and belief that vaccines are compatible with religion are factors that determined the likelihood of accepting vaccination.<sup>23,27</sup>

In the study about 80.7% of those who had desired to be vaccinated actually got vaccinated, which is similar to a study in USA where about 70% of parents who were willing to vaccinate their children actually did but lower than a study in Poland where 96% of people who declared the willingness to vaccinate actually got vaccinated.<sup>28,29</sup>

The study found higher vaccine uptake among medical doctors than other health professionals. This is similar to finding from a systematic review which reported that vaccine confidence is higher among health workers with higher education levels (physicians) compared to nurses and attributed this to their better exposure to recent scientific research and sufficient knowledge about the new vaccines.<sup>26</sup> While other study reported that health workers with lower education may have lower awareness and risk perception, and more prone to follow community misconceptions.<sup>8</sup> However, a study in South Africa among hospital health workers found no association between vaccine acceptance and professional category of workers.<sup>12</sup>

The study found no association between the participants' age, gender, co-morbidity, and vaccine uptake. This is similar to a study in South Africa which reported that factors such as age, co-morbidity and were not associated with vaccine acceptance.<sup>12</sup> This is however in contrast to many studies that have reported higher vaccine acceptance with health workers who were male, of older age, with pre-existing co-morbid illnesses.<sup>30-</sup>

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### **Strength and Limitations**

This to our knowledge is the first study on vaccine uptake among health workers in the region. The limitations include social desirability and recall bias due to self-reported responses and limited generalizability to the population. The study was conducted in governmental health facilities and may not represent the views of health care workers private health facilities. Despite these limitations, the study highlighted the determinants of COVID vaccination uptake among health workers and will help in developing appropriate socio-behavioural change communication strategy to improve and sustain vaccine uptake among health workers. This will also contribute to improving vaccine uptake among the general population because of the influence of the health workers on the population being their major source of trusted information.

**4. Conclusion:** Vaccine hesitancy among healthcare workers is an area of concern because of their roles as trusted sources of health information to the community and their high risk of exposure to infections acquired in a healthcare setting and potential spread to the community.

The study identified key determinants to vaccine uptake among the health workers which included perceived risk of being infected, perceived benefit, safety of the vaccines and perceived protection of the vaccine for

their communities. These require targeted social and behavioural change communication strategies to address. Improving vaccine uptake among the health workers will help in scaling up vaccine uptake among the population in view of the role health workers play as change agents in their communities.

## ETHICAL APPROVAL

Approval to conduct the study was obtained from the Somali Regional Health Bureau

## COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist.

## REFERENCES

1. Catrin Sohrabi, Zaid Alsafi, Riaz Agha (2020). World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19) *Int. J. Surg* 76: 71–76
2. WHO (2019). Ten threats to global health in 2019 <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>
3. World Health Organization (2013) SAGE working group on vaccine hesitancy-literature review :1-40. [https://www.who.int/immunization/sage/meetings/2014/october/1\\_Report\\_WORKING\\_GROUP\\_vaccine\\_hesitancy\\_final.pdf](https://www.who.int/immunization/sage/meetings/2014/october/1_Report_WORKING_GROUP_vaccine_hesitancy_final.pdf)
4. Stock AD, Bader ER, Cezayirli P, et al (2020). COVID-19 infection among healthcare workers: serological findings supporting routine testing. *Front Med* 7: 471.
5. Ilesanmi OS, Afolabi AA, Akande A et al (2021). Infection prevention and control during COVID-19 pandemic: realities from healthcare workers in a North Central State in Nigeria. *Epidemiol Infect.* 149: e15
6. WHO (2020). SAGE Road Map for Prioritizing use of COVID-19 Vaccine in the context of Limited supply. An approach to inform planning and subsequent recommendations based upon epidemiologic setting and vaccine supply scenarios Version 1.1 13 November . <https://www.who.int/docs/default-source/immunization/sage/covid/sage-prioritization-roadmap-covid19-vaccines.pdf>
7. Sallam M (2021). COVID-19 vaccine hesitancy worldwide: a concise systematic review of vaccine acceptance rates. *Vaccines (Basel)* 9(2): 160
8. Biswas N, Mustapha T, Khubchandani J, Price JH (2021) The Nature and Extent of COVID-19 Vaccination Hesitancy in Healthcare Workers. *J Community Health.* 46(6):1244-1251
9. Lwanga K.S; Lemeshow S (1991). Sample Size Determination in health studies. A Practical Manual. WHO [https://tbrieder.org/publications/books\\_english/lemeshow\\_samplesize.pdf](https://tbrieder.org/publications/books_english/lemeshow_samplesize.pdf)

10. SAGE Working Group on Vaccine Hesitancy:

[https://www.who.int/immunization/programmes\\_systems/Survey\\_Questions\\_Hesitancy.pdf](https://www.who.int/immunization/programmes_systems/Survey_Questions_Hesitancy.pdf)

11. Terefa DR, Shama AT, Feyisa BR et al (2021) . COVID-19 Vaccine Uptake and Associated Factors Among Health Professionals in Ethiopia. *Infection and Drug Resistance* 14: 5531
12. Adeniyi OV, Stead D, Singata-Madliki M, Batting J(2021) Acceptance of COVID-19 Vaccine among the Healthcare Workers in the Eastern Cape, South Africa: A Cross Sectional Study. *Vaccines* 9: 666.
13. Hannah E, Emma S. Jones MS et al (2021). COVID-19 vaccination coverage among hospital-based healthcare personnel reported through the Department of Health and Human Services Unified Hospital Data Surveillance System, United States, January 20, 2021-September 15, 2021. *American Journal of Infection Control* 49: 1554–1557
14. Wang Ming-Wei, Wen Wen, Wang Nan et al (2021) COVID-19 Vaccination Acceptance Among Healthcare Workers and Non-healthcare Workers in China: A Survey. *Frontiers in Public Health* 9:1-8
15. Mohammad L, Baynouna A , Elharake JA , Al Memari S (2021) COVID-19 vaccine acceptance among healthcare workers in the United Arab Emirates. *IJID Regions* 1:20-26
16. WHO Africa(2021). Only 1 in 4 African health workers fully vaccinated against COVID-19. 25 November 2021. <https://www.afro.who.int/news/only-1-4-african-health-workers-fully-vaccinated-against-covid-19>
17. El-Sokkary RH, El Seifi OS, Hebatallah M, Mortada EM, Hashem MK(2021). Predictors of COVID-19 vaccine hesitancy among Egyptian healthcare workers: across-sectional study *BMC Infectious Diseases* 21:762-771
18. Aemro A, Amare NS, Shetie B, Chekol B, Wassie M (2021) Determinants of COVID-19 vaccine hesitancy among health care workers in Amhara region referral hospitals, Northwest Ethiopia: a cross-sectional study. *Epidemiology and Infection* 149, e225, 1–8.
19. Ledda C, Costantino C, Cuccia M, Maltezou HC, Rapisarda V (2021). Attitudes of Healthcare Personnel towards Vaccinations before and during the COVID-19 Pandemic. *Int J Environ Res Public Health* 18(5):2703.
20. Huynh G, Thien T, Nguyen N, Le An Pham (2021) COVID-19 vaccination intention among healthcare workers in Vietnam. *Asian Pacific Journal of Tropical Medicine* 14:159
21. Qattan A, Noor A, Omar A, Al Rahahleh N, Chirwa GC, Al-Hanawi MK(2021). Acceptability of a COVID-19 vaccine among healthcare workers in the Kingdom of Saudi Arabia. *Frontiers in Medicine* 8:83
22. Betsch C, Schmid P, Heinemeier D, et al (2018). Beyond confidence: development of a measure assessing the 5C psychological antecedents of vaccination. *PLoS One* 13(12):e0208601
23. Wiysonge CS, Alobwede SM, de Marie C et al (2022). COVID-19 vaccine acceptance and hesitancy among healthcare workers in South Africa. *Expert Rev Vaccines* 6:1-11
24. Fares S, Elmnyer MM, Mohamed SS, Elsayed R (2021) COVID-19 Vaccination Perception and Attitude among Healthcare Workers in Egypt. *J Prim Care Community Health*. 12:1-9

25. Nzaji MK, Ngombe LK, Mwamba GN et al(2020) "Acceptability of vaccination against COVID-19 among healthcare workers in the Democratic Republic of the Congo," *Pragmatic and Observational Research*.11: 103–109
26. Li M, Luo Y, Watson R, et al (2021). Healthcare workers' (HCWs) attitudes and related factors towards COVID-19 vaccination: a rapid systematic review. *Postgrad Med J* 2021;0:1–7.  
doi:10.1136/postgradmedj-2021-140195
27. Oduwole EO, Mahomed H, Laurenzi CA (2021) et al. Point-of-care vaccinators' perceptions of vaccine hesitancy drivers: a qualitative study from the cape metropolitan district, South Africa. *Vaccine* 39(39):5506–5512.
28. Rane MS, Robertson MM, Westmoreland DA, Teasdale CA, Grov C, Nash D (2022). Intention to Vaccinate Children Against COVID-19 Among Vaccinated and Unvaccinated US Parents. *JAMA Pediatr* 176(2):201–203.
29. Maciuszek J, Polak M, Stasiuk K (2022) Declared Intention (Not) to Be Vaccinated against COVID-19, and Actual Behavior—The Longitudinal Study in the Polish Sample. *Vaccines* 10: 147.
30. Gadoth A, Halbrook M, Martin-Blais R, Gray AN, Tobin NH (2021) Assessment of COVID-19 vaccine acceptance among healthcare workers in Los Angeles. *Ann. Intern. Med*: 1–3.
31. Amuzie CI, Oadini F, Kalu UK, Izuka M (2021) COVID-19 vaccine hesitancy among healthcare workers and its sociodemographic determinants in Abia State, South-eastern Nigeria: a cross-sectional study. *Pan African Medical Journal* 40(10);1-13.
32. Agyekum MW, Afrifa-Anane GF, Kyei-Arthur F, et al (2021) Acceptability of COVID-19 vaccination among health care workers in Ghana. *Hindawi*.:1-8.
33. Angelo AT, Alemayehu DS, Dachew AM (2021) Health care workers intention to accept COVID-19 vaccine and associated factors in southwestern Ethiopia, 2021. *PLoS ONE* 16(9): e0257109.