COVID-19 vaccination attitudes in nurses and nursing students – a scoping review

Chrdle A.[1, 2, 3], Bártlová S.[1], Chloubová I.[1]

[1]University of South Bohemia in České Budějovice, Faculty of Health and Social Sciences, Institute of Nursing, Midwifery and Emergency Care, České Budějovice, Czechia
[2]Infectious Disease Department, České Budějovice Hospital, České Budějovice, Czechia
[3]Tropical and Infectious Diseases Unit, Royal Liverpool University Hospital, Liverpool, UK

ABSTRACT

Aim: There is a discussion about COVID-19 vaccination rates among healthcare workers (HCW), especially nurses. The primary question for this review was: "What are the attitudes of nurses, compared to other HCW, towards COVID-19 vaccination?" The secondary questions included the proportion of nurses with intention to get vaccinated, what prevents the nurses from accepting the vaccine and what enables them to accept the vaccine.

Methods: The PRISMA-ScR format for scoping reviews was chosen to respect the novelty of COVID-19 vaccines. Database search (PubMed/MEDLINE, PROquest and EBSCO) was performed for original studies in English language, from all geographies, with most recent search on March 20, 2022.

Vaccination acceptance rates were charted for nurses and nursing students in one category, and HCW other than nurses in the other category. The evolution in time of the nurses attitude to vaccine acceptance relative to that of HCW other than nurses was charted post hoc.

The factors associated with COVID-19 vaccination intention according to the WHO categories (contextual influences, individual/group influences, and vaccine/vaccination specific issues) were reviewed as narrative summary.

Results: Total 58 eligible studies were selected, all with cross-sectional study design, including 95418 healthcare workers of whom 33130 were nurses and 7391 were nursing students, from 44 countries in Europe, Americas, Africa and Asia.

Trust in science, in doctors, in experts and in governments were the main contextual factors increasing vaccination acceptance mentioned in the studies, while altruism and collective protection, or protecting a person at risk at home was mentioned only few times.

The nurses were less likely to accept vaccination compared to doctors and other HCWs at the onset, eg. before vaccine rollout, and this difference decreased with time ($p = 0.022$). Being older (n = 25 studies), being male (n = 23), having higher degree of education (n = 7), and having more years of clinical practice (n = 4) were associated with higher vaccination acceptance. Percieved individual risk of having severe COVID-19 (n = 14) or working in a COVID-19 dedicated units (n = 5) was mentioned in a minority of studies.

The main vaccine-releated factors associated with higher vaccination intention were trust in the vaccine and its efficacy and safety, general vaccinatoin acceptance and specifically having had influenza vaccination in previous years (n = 21 studies). A significant factor associated with higher vaccine acceptance was high "vaccine knowledge", "vaccine literacy", „understanding the vaccine" or "understanding benefits and barriers of vaccination" (n = 17 studies).

Conclusions: Nurses have been more hesitant to accept COVID-19 vaccination than other healthcare professions at the beginning, but with time this difference disappeared. This general nurse attitude of wait-and-see reported in the studies corresponds with real-life data from practicing healthcare workers as reported by the Czech Institute of Health Information and Statistics on vaccination against COVID-19.

Trust in scientific structures and vaccine makers increases the vaccine acceptance. The acceptance increases also with higher age, increasing level of education, longer clinical experience, and also with being a male. Vaccine literacy and having participated in previous vaccination programmes, especially influenza vaccine, were identified as independent modifiable factors increasing vaccination acceptance.

KEYWORDS

vaccination – acceptance – attitude – hesitancy – refusal – nurses – healthcare workers – COVID-19

SOUHRN

Chrdle A., Bártlová S., Chloubová I.: Postoje sester a studentů ošetřovatelství k očkování proti covid-19 – přehled

Cíl: Téma očkování zdravotníků proti covid-19 je předmětem diskusí především v případě zdravotních sester. Primární otázkou pro tento literární přehled bylo: "Jaké jsou postoje sester vůči očkování proti covid-19 ve srovnání s ostatními typy zdravotnických profesí?" Druhou otázkou bylo, jaký je podíl sester, které se chystají nechat se očkovat a dále co sestrám v očkování brání, a naopak co jim pomůže při rozhodování nechat se očkovat.

Metody: Pro přehledovou práci byl použit formát PRISMA-ScR pro přehledy typu scoping review s ohledem na novou oblast vakcín proti covid-19. V databázích (PubMed/MEDLINE, PROquest and EBSCO) byly vyhledány původní studie ze všech zemí světa, publikované v anglickém jazyce před 20. březnem 2022.

Ochota nechat se očkovat byla hodnocena v jedné kategorii společně pro zdravotní sestry a studenty ošetřovatelství, zatímco ve druhé kategorii byli ostatní zdravotničtí pracovníci. Vývoj postojů sester k očkování v čase ve vztahu k postoji ostatních zdravotníků byl vyhodnocen post hoc.
Faktory spojené s ochotou nechat se očkovat proti covid-19 byly rozděleny podle kategorií WHO (kontextuální vlivy, individuální/skupinové vlivy a otázky specifické pro očkování/danou vakcínu) a jsou shrnuty v narativním přehledu.
Výsledky: Celkem bylo do přehledu zařazeno 58 studií, které všechny měly průřezové dotazníkové uspořádání, a kterých se zúčastnilo 95 418 zdravotníků (včetně 33 130 sester a 7 391 studentů ošetřovatelství) v 44 zemích Evropy, Ameriky, Afriky a Asie.
Hlavní kontextuální faktory, které v hodnocených studiích zvyšovaly ochotu nechat se očkovat, byly důvěra ve vědu, důvěra v lékaře, v odborníky a ve vládní instituce, zatímco altruismus a kolektivní ochrana nebo ochrana ohrožených osob v domácnosti dotazovaných zdravotníků byly zmíněny pouze v malém počtu studií.
V počátečních obdobích očkování, tedy před uvedením vakcín do praxe, uváděly sestry nižší ochotu nechat se očkovat než lékaři a ostatní zdravotníci a tento rozdíl mezi zdravotnickými profesemi v čase klesal (p = 0,022). Ochota nechat se očkovat se zvyšovala s rostoucím věkem (n = 25 studií), vyšším stupněm dosaženého vzdělání (n = 7), vyšším počtem let v klinické praxi (n = 4) a byla vyšší u mužů než u žen (n = 23). Pouze v malém poštu studií uváděli zdravotníci jako důvod pro očkování pociťované vysoké osobní riziko těžkého průběhu infekce covid-19 (n = 14) nebo práci na covidových jednotkách (n = 5).
Mezi hlavní faktory spojené s vakcinací či vakcínou, které zvyšovaly ochotu nechat se očkovat, patřily důvěra ve vakcínu a v její účinnost a bezpečnost, celkový pozitivní vztah k očkování a především absolvované očkování proti chřipce v předchozích letech (n = 21 studií). Významným faktorem spojeným s vyšší ochotou nechat se očkovat patřila "vakcinační gramotnost", "pochopení vakcinace", "znalosti o vakcinaci" případně "pochopení výhod a nevýhod očkování" (n = 17 studií).
Závěry: Zdravotní sestry byly zpočátku méně ochotné nechat se očkovat proti covid-19 než ostatní zdravotníci, ale tento rozdíl postupem času vymizel. Podobně váhavý vyčkávací postoj sester k očkování se projevuje i v údajích realizovaného očkování zdravotníků proti covid-19, které registruje Ústav zdravotnických informací a statistiky ČR.
Důvěra ve vědecké instituce a výrobce vakcín zvyšuje ochotu nechat se očkovat. Tato ochota také roste s rostoucím věkem, vyšším stupněm vzdělání, delší dobou klinické praxe a také je vyšší u mužů. Mezi nezávislé, zevní intervencí potenciálně ovlivnitelné faktory spojené s vyšší ochotou nechat se očkovat patří vakcinační gramotnost a účast v jiném očkovacím programu, především v případě očkování proti sezonní chřipce.

KLÍČOVÁ SLOVA
očkování – ochota nechat se očkovat – postoje – váhavost k očkování – odmítání očkování – zdravotní sestry – zdravotníci – covid-19

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INTRODUCTION

Nursing profession has a high moral position in the community and public when it comes to acceptance or endorsement of health interventions including vaccination [1]. The nurses are the highest in numbers amongst healthcare workforce, and therefore their informal influence is far reaching. Apart from that, nurses are most frequently of the healthcare professions in extended close contacts with patients and therefore, are inherently the largest population that can be associated with spread of airborne diseases in healthcare settings (in both directions, they can get infected as well as they can spread the infection) [2]. Historically, acceptance of influenza vaccine, including pandemic influenza vaccine, varied amongst nurses [3]. In covid-19 scenario, there are new factors compared to previous viral respiratory outbreaks. These include the novelty of the virus and its behaviour (variably virulent and far more contagious compared to the 2003 SARS-CoV-1 or 2012 MERS coronaviruses) [4], rapid development and rollout of innovative vaccines [5], and major change in interhuman communication patterns [6, 7].

More than one year after COVID-19 vaccination rollout across the healthcare systems, the vaccine coverage in healthcare workers appeared suboptimal [8].

We have reviewed the attitudes of nurses to covid vaccination and the driving forces behind covid-19 vaccine acceptance or hesitancy across geographical areas and cultures compared to other categories of HCW. The format of scoping review was chosen as this is a new disease and a novel situation and therefore we perceived the need to map the literature on this topic to identify key concepts, gaps in the research, and types and sources of evidence to refine the future research question and objectives. We have followed the PRISMA-ScR scoping review format [9].

The main research foreground question was "What are the attitudes of nurses, compared to other HCW, towards COVID-19 vaccination?" The secondary questions were what are the proportion of nurses with intention to get vaccinated, what prevents the nurses from accepting the vaccine and what enables them to accept the vaccine. As the literature mostly includes nurses within the category of healthcare workers, we have formulated the question to what are the differences in vaccine acceptance or hesitancy in nurses

compared to other healthcare professionals. Vaccine acceptance was selected as one category, while vaccine indifference, hesitancy or refusal were combined into the other category as the practical outcome is same, ie. non-vaccinated HCW.

METHODS

The eligibility criteria included peer-reviewed original research studies in English language. The aim was to include all geographies.

The lower time limit for the review was set at 2020 as COVID-19 is a disease emerging in late 2019. The search was performed in three healthcare research databases, including PubMed/MEDLINE, PROquest and EBSCO, with most recent search on March 20, 2022.

First, the records were independently screened by two peers based on title and abstract. Fulltext of prescreened articles were assessed prior to inclusion. Duplicities were removed in the process of screening.

Data extraction was made into a predefined Microsoft Excel spreadsheet (Excel, Microsoft Inc. USA), which included name of the main author, name of the study, doi, publication year, timing of study, date of study relative to local roll-out of vaccines (pre- vs. post-rollout), study design and methodology, geography/location of the study, characteristics of study population, size of study population, proportion of nurses relative to other healthcare professions, rate of vaccine acceptance vs. combined category of waiting, hesitance, and refusal for the nurses and for the other healthcare professions, and categorized main factors and determinants contributing to vaccine acceptance. Handsearch was performed in the references of excluded reviews.

This scoping review focused on identifying any factors that may have influenced the nurses attitudes toward COVID-19 vaccination to form a basis for future studies.

The characteristics of the included studies were summarized by descriptive statistics. Vaccination acceptance rate and vaccination non-acceptance (undetermined, hesitant or refusing) were computed to add to 100 %, if not explicitly stated in the original paper. Rate of vaccination acceptance in HCW other than nurses were calculated from data provided for nurses and all HCW (Excel, Microsoft Inc., USA). Nurses and nursing students were combined in one category since there is a variety of overlapping work and study patterns for nurses in training in different healthcare systems (such as combined type of study and part-time work).

Other variables included geography, type of population, time of study relative to vaccine roll-out. Charts and tables are used to present the results.

The factors associated with COVID-19 vaccination acceptance as opposed to indifference, refusal or hesitancy are reviewed as narrative summary. The identified factors were divided into the three main categories of vaccine hesitancy as specified by the WHO Strategic Advisory Group of Experts on immunization [10], including contextual influences, individual and group influences, and vaccine and vaccination specific issues.

The time evolution of the nurses attitude to vaccine acceptance relative to that of HCW other than nurses was charted post hoc and the significance of the slope parameter of the linear regression model was determined by ANOVA with alpha level 0.05 (SPSS Statistics 24.0, IBM Corp., USA).

Data and graph on real-life Czech HCW COVID-19 vaccination rates were obtained from the Institute of Health Information and Statistics of the Czech Republic (IHIS).

Results

The search in three databases and subsequent selection process provided 58 eligible studies [11–68], all with cross-sectional study design. The process of source search and study selection is depicted in flowchart in Figure 1.

Identification	Records identified from databases	
	N=4284 Pubmed n=975 Proquest n=1497 EBSCO n= 1812	Records removed before screening: duplicates removed (n=2397)
Screening	Records screened for eligibility	
	N= 1887	Records excluded (n= 1596) – based on irrelevant title/abstract (not related to healthcare workers, not about covid-19 vaccines, not original research)
Eligibility	Full-text articles assessed for eligibility	
	N=216	Full-texts excluded (n=158) – did not include nurse participants or, no data on vaccine acceptance rate
Included	Studies included in the review	
	N=58	

Figure 1. PRISMA flowchart: Scoping review of nurses acceptance of covid-19 vaccine

Total 44 studies were organized before the vaccine was available in the given location, 12 after the vaccine roll out, and two studies determined attitude to a booster dose. The time of study, location, numbers of participants (and the proportion of nurses amongst HCW) are shown in Table 1.

Table 1. Geography, size and type of population, timing of the study and relation to the vaccination roll-out (pre vs. post roll-out) and acceptance rates of COVID-19 vaccine by nurses vs. other healthcare workers

Main author [reference]	Identifier: doi	Date of study	Study timing relative to roll out of vaccines (pre- vs. post-rollout)	Location	Study population (nurses – NURS, nursing students – students, healthcare workers – HCW)	Size of study population (n)	Proportion of nurses (%)	Rate of vaccine acceptance (%) by the nurses	Rate of vaccine acceptance (%) by all HCW other than nurses
Wang [11]	10.1016/j.vaccine.2020.09.021	3/20	pre	China	NURS	806	100	40	
Gagneux-Brunon [12]	10.1016/j.jhin.2020.11.020	7/20	pre	France	HCW	2047	28.7	62.9	82.5
Rosental [13]	10.3390/vaccines9070783	9/20	pre	Israel	students	308	100	76.2	
Wang [14]	10.1080/21645515.2021.1909328	9/20	pre	China	HCW	3634	50.6	76	82
Manning [15]	10.1016/j.outlook.2021.01.019	9/20	pre	USA	students	1029	100	45.3	
Cuschieri [16]	10.1007/s10389-021-01585-z	10/20	pre	Malta	HCW	1802	17.6	42.3	59.1
Grochowska [17]	10.3390/vaccines9050475	11/20	pre	Poland	HCW	419	4.2	22.2	70.6
Di Gennaro [18]	10.3390/v13030371	11/20	pre	Italy	HCW	1723	22	43	73.7
Dubov [19]	10.3390/vaccines9121428	12/20	post	USA	HCW	2491	35	78.6	86.9
Fontenot [20]	10.1371/journal.pone.0261669	12/20	pre	USA	students	772	100	83.6	
Aldosary [21]	10.26355/eurrev_202110_27012	12/20	pre	Saudi Arabia	NURS	334	100	70.7	
Alshehry [22]	10.1111/jan.15002	12/20	pre	Saudi Arabia	students	1170	100	55.9	
Fakonti [23]	10.3389/fpubh.2021.656138	12/20	pre	Cyprus	NURS	437	100	30	
Pataka [24]	10.3390/medicina57060611	12/20	pre	Greece	HCW	656	17.5	48.3	75.8
Trabucco Aurilio [25]	10.3390/vaccines9050500	12/20	pre	Italy	NURS	531	100	91.5	
Yigit [26]	10.1080/21645515.2021.1918523	12/20	pre	Turkey	HCW	343	49.9	32.2	72
Bauernfeind [27]	10.1007/s15010-021-01622-9	12/20	pre	Germany	HCW	2454	25.6	53.3	61.6
Dzieciolowska [28]	10.1016/j.ajic.2021.04.079	12/20	post	Canada	HCW	2761	23.1	73.7	83
Kaplan [29]	10.1111/ijcp.14226	12/20	pre	Turkey	HCW	1574	17.5	66.5	88.4
Shaw [30]	10.1093/cid/ciab054	12/20	pre	USA	HCW	5287	22.7	41.2	62.2
Zürcher [31]	10.4414/smw.2021.w30061	12/20	pre	Switzerland	HCW	3793	45.2	27.8	49.6
Browne [32]	10.1017/ice.2021.410	12/20	pre	USA	HCW	5929	49.5	52.7	82.5
Adeniyi [33]	10.3390/vaccines9060666	12/20	pre	South Africa	HCW	1308	45.2	89.2	90.8
Mena [34]	10.1371/journal.pone.0257002	12/20	pre	Spain	HCW	906	25.I	57.7	62.5

continuation of Table 1

Main author [reference]	Identifier: doi	Date of study	Study timing relative to roll out of vaccines (pre- vs. post-rollout)	Location	Study population (nurses – NURS, nursing students – students, healthcare workers – HCW)	Size of study population (n)	Proportion of nurses (%)	Rate of vaccine acceptance (%) by the nurses	Rate of vaccine acceptance (%) by all HCW other than nurses
Patelarou [35]	10.1016/j.nedt.2021.105010	12/20	pre	7 countries - Greece, Albania, Cyprus, Spain, Italy, Czech Republic, and Kosovo	students	2249	100	43.8	
Fontenot [36]	10.1080/21645515.2021.1947097	12/20	pre	USA - Hawaii	NURS	423	100	80.2	
Ahmed [37]	10.3390/nursrep11010018	1/21	pre	Saudi Arabia	HCW	236	62	47.2	68.9
Zaitoon [38]	10.1111/phn.12987	1/21	pre	Israel	HCW	714	32	78.1	77
Zhou [39]	10.1016/j.nedt.2021.105152	1/21	pre	China	students	1070	100	51.9	
Sun [40]	10.3389/fpubh.2021.664905	1/21	pre	China	HCW	505	53.3	75.01	78.4
Rabi [41]	10.1111/phn.12907	1/21	pre	Palestine	NURS	639	100	40	
Nohl [42]	10.3390/healthcare9121616	1/21	pre	Germany	HCW	285	31.6	71.4	80.1
Xu [43]	10.1080/21645515.2021.2004837	1/21	pre	China	HCW	5247	54.7	75.4	78.2
Saddik [44]	10.1080/21645515.2021.1994300	1/21	pre	United Arab Emirates	HCW	517	9.7	56.9	58.1
Patelarou [45]	10.1111/jocn.15980	1/21	pre	Spain	NURS	482	100	71.6	
Patelarou [45]	10.1111/jocn.15980	1/21	pre	Greece	NURS	259	100	79.2	
Patelarou [45]	10.1111/jocn.15980	1/21	pre	Albania	NURS	216	100	46.3	
Patelarou [45]	10.1111/jocn.15980	1/21	pre	Cyprus	NURS	113	100	54	
Patelarou [45]	10.1111/jocn.15980	1/21	pre	Kosovo	NURS	65	100	46.2	
Oliver [46]	10.1136/bmjopen-2021-053641	2/21	post	USA	HCW	1933	13.7	72	94
Khamis [47]	10.1007/s44197-021-00018-0	2/21	post	Oman	HCW	433	41.5		
Luma [48]	10.1016/j.puhip.2021.100222	2/21	pre	Iraq	HCW	1704	22.1	63.2	74.6
Kumar [49]	10.4082/kjfm.21.0071	2/21	pre	India	HCW	599	64.9	78.4	63
Paris [50]	10.1016/j.idnow.2021.04.001	2/21	pre	France	HCW	1965	28.6	76.2	71.8
Holzmann-Littig [51]	10.3390/vaccines9070777	2/21	pre	Germany	HCW	4500	10.4	91	91.7
Li [52]	10.1080/21645515.2021.1957415	2/21	post	China	HCW	1779	74	93	96.4
Krishnamurthy [53]	10.2147/JMDH.S336952	2/21	pre	Barbados	HCW	343	42	50.7	58.2
Vignier [54]	10.3390/vaccines9060682	3/21	post	French Guiana	HCW	579	34.5	49.3	74.1
Wiysonge [55]	10.1080/14760584.2022.2023355	3/21	pre	South Africa	HCW	395	49	50.8	66.8
Amuzie [56]	10.11604/pamj.2021.40.10.29816	3/21	pre	Nigeria	HCW	422	31.3	50	49.2
Nasir [57]	10.2147/IDR.S326531	3/21	pre	Bangladesh	HCW	524	27.8	84.9	88.3
Al-Sanafi [58]	10.3390/vaccines9070701	3/21	pre	Kuwait	HCW	1019	12.5	70.1	85.1

continuation of Table 1

Main author [reference]	Identifier: doi	Date of study	Study timing relative to roll out of vaccines (pre- vs. post-rollout)	Location	Study population (nurses – NURS, nursing students – students, healthcare workers – HCW)	Size of study population (n)	Proportion of nurses (%)	Rate of vaccine acceptance (%) by the nurses	Rate of vaccine acceptance (%) by all HCW other than nurses
Abiy [59]	10.1371/journal.pone.0257109	3/21	pre	Ethiopia	HCW	405	59.8	44.6	54
Pal [60]	10.3390/vaccines9111358	3/21	booster	USA	HCW	1354	37.8	87.5	94.8
Green-McKenzie [61]	10.1001/jamanetworkopen.2021.36582	4/21	post	USA	HCW	12610	24.8	86.3	72.6
Gotlib [62]	10.3390/vaccines9091029	4/21	post	Poland	students	793	100		
Fotiadis [63]	10.3390/ijerph181910558	5/21	post	Greece	HCW	1456	49.2	69.1	86
Puertas [64]	10.1016/j.lana.2022.100193	5/21	pre	14 Caribbean countries	HCW	1197	27.5	66	81.1
Mohammed [65]	10.1371/journal.pone.0261125	7/21	post	Ethiopia	HCW	614	41.9	38.9	40.2
Ibrahim [66]	10.1016/j.sjbs.2021.11.058	9/21	post	Saudi Arabia	HCW	529	42.2	100	100
Ulbrichtová [67]	10.3390/ijerph182312695	9/21	post	Slovakia	HCW	1277	42.4	76.9	89.7
Klugar [68]	10.3390/vaccines9121437	11/21	booster	Czechia	HCW	3454	69.7	68.3	78.1

All studies had cross-sectional survey design.

The total number of participants included in the review was 95,418 healthcare workers of whom 33,130 were nurses and 7,391 were nursing students. Nine studies took part in the USA, six in China, four in Greece and Saudi Arabia, three in Cyprus, France, Germany, and Italy, two in Albania, Czechia, Ethiopia, Israel, Kosovo, Poland, South Africa and Turkyie, one in Bangladesh, Barbados, Canada, India, Iraq, Kuwait, Malta, Nigeria, Oman, Palestine, Slovakia, South Africa, Switzerland, and United Arab Emirates. One study was organized across 14 Carribean countries.

Factors associated with higher rate of vaccine acceptance in the three WHO domains are listed in Table 2 and summarized below.

Table 2. Factors influencing the willingness or intention to receive COVID-19 vaccine in cross-sectional surveys of COVID-19 vaccination acceptance among nurses and other healthcare workers (HCW) in three domains affecting vaccination acceptance
(Adapted from 2014 WHO model of vaccine hesitancy [10]).

Main author	Date of study	Country/ location	*Domains of vaccination acceptance*		
			Contextual influences	Individual and/ or group influences	Vaccine and vaccination specific issues
Wang [11]	3/20	China	perceived necessity	Risk1, C+ unit	Flu-Vax, trust in efficacy/ safety
Gagneux-Brunon [12]	7/20	France	fear about covid	Age+, M+, Risk1, Dr+ vs. nurse	Flu-Vax
Rosental [13]	9/20	Israel		Risk1, M+, nurse+ vs. other HCW	Edu-Vax, trust in vaccine safety and quality
Wang [14]	9/20	China		Dr+ vs. nurse, Age-, Edu-, Risk1	Willingness to pay to get vaccinated
Manning [15]	9/20	USA	Risk2, protecting patients	Risk1	Edu-Vax, low concern about vaccine safety and speed of the vaccine development

continuation of Table 2

Main author	Date of study	Country/ location	*Domains of vaccination acceptance*		
			Contextual influences	Individual and/ or group influences	Vaccine and vaccination specific issues
Cuschieri [16]	10/20	Malta		HCW+ vs. nurse	Flu-Vax, Edu-Vax, no worries about long term AE
Grochowska [17]	11/20	Poland			Trust in safety and efficacy, Flu-Vax
Di Gennaro [18]	11/20	Italy	Risk2, info from social media, conflicting information	Dr+ vs. nurse, Age-	Flu-Vax, Pro-Vax, low fear of side effects
Dubov [19]	12/20	USA		political affiliation, Asian origin, Edu+, Dr+ vs. nurses,	Flu-Vax, trust in vaccine safety
Fontenot [20]	12/20	USA	consulting social media information	political affiliation - liberal, regional (North-East)	Pro-Vax, trust in vaccine safety
Aldosary [21]	12/20	Saudi Arabia			Edu-Vax, no concerns about long-term and short-term effects, trust in vaccine efficacy
Alshehry [22]	12/20	Saudi Arabia		Risk1	trust in vaccine, Pro-Vax, Edu-Vax
Fakonti [23]	12/20	Cyprus		Work+, F+	Flu-Vax, low concerns about rapid development, no fear of side effects
Pataka [24]	12/20	Greece		Dr+ vs. nurse, M+, Age+, C+unit	
Trabucco Aurilio [25]	12/20	Italy		F+	confidence in vaccine efficacy, Pro-Vax
Yigit [26]	12/20	Turkey		M+, Age+, Dr+ vs. nurse, Work+	country of vaccine origin - better domestic
Bauernfeind [27]	12/20	Germany		M+, Age+, Dr+ vs. nurse, Risk1	trust in vaccine development
Dzieciolowska [28]	12/20	Canada	trusting pharma and experts	M+, Age+, Dr+ vs. nurse, C+unit	trust despite vaccine novelty, sufficient time to decide
Kaplan [29]	12/20	Turkey	fear of covid	M+, Age+, Dr+ vs. nurse, Risk1, having a child, not having had covid	Pro-Vax
Shaw [30]	12/20	USA	vaccine free of charge, concerns about mandate, influenced by research, family and experts	M+, Age+, Dr+ vs. nurse, white or Asian, C-unit	trust in vaccine despite rapid development, trust in vaccine safety, no fear of side effects
Zürcher [31]	12/20	Switzerland	confidence in government, personal protection, ending the pandemic	M+, Age+	Flu-Vax, trust in vaccine safety, no fear of side effects
Browne [32]	12/20	USA		M+, white	Edu-Vax, no fear of side effects, no fear about vaccine novelty
Adeniyi [33]	12/20	South Africa	ending the pandemic	Edu+	Flu-Vax, trust in vaccine safety
Mena [34]	12/20	Spain		M+, Age+, Dr+ vs. nurse	Flu- Vax

continuation of Table 2

Main author	Date of study	Country/ location	*Domains of vaccination acceptance*		
			Contextual influences	Individual and/ or group influences	Vaccine and vaccination specific issues
Patelarou [35]	12/20	7 countries - Greece, Albania, Cyprus, Spain, Italy, Czechia, and Kosovo	trust in doctors, trust in governments, trust in experts, fear of covid	M+	Flu-Vax, Edu-Vax
Fontenot [36]	12/20	USA - Hawaii			Pro-Vax, lower safety concerns
Ahmed [37]	1/21	Saudi Arabia	trust in authorities, trust in manufacturing country, trust in manufacturing company	M+, Age+, Dr+ vs. nurse, Risk1	trust in vaccine safety, Edu-Vax
Zaitoon [38]	1/21	Israel		Age+, Dr+ vs. nurse	Flu-Vax
Zhou [39]	1/21	China	impact of COVID-19 on daily live	Work+	Pro-Vax, Edu-Vax, low fear of side effects, no questioned efficacy
Sun [40]	1/21	China	Risk2	Risk1	Trust in vaccine safety and effectiveness, less fear of rapid mutation of the virus, Edu-Vax, Flu-Vax
Rabi [41]	1/21	Palestine	Immune to media misrepresentation, not believing in natural immunity	Age+	Edu-Vax, no fear of getting covid from the vaccine, no fear of injection, no concern of long side effects,
Nohl [42]	1/21	Germany	collective responsibility	Age+, M+, Dr+ vs. nurse	trust in vaccine
Xu [43]	1/21	China	positive example of department lead, supportive social network to communicate vaccination	no chronic disease, tertiary hospital	previous vaccinations, Pro-Vax
Saddik [44]	1/21	United Arab Emirates	Risk2, social responsibility, trust in pharma/ country of origin	M+, Dr+ vs. nurse	trust in vaccine safety, Flu-Vax
Patelarou [45]	1/21	Spain, Greece, Albania, Cyprus, Kosovo	trusting the government, trusting the doctors, high covid mortality in country	M+, Risk1, no previous covid infection	Flu-Vax, Edu-Vax
Oliver [46]	2/21	USA	trust in vaccine development, altruism - protecting others	M+, Age+, Dr+ vs. nurse, non-black	Flu-Vax, trust in vaccine safety
Khamis [47]	2/21	Oman	Altruism, ending the pandemic	M+, Dr+ vs. nurse	trust in vaccine efficacy and safety
Luma [48]	2/21	Iraq	vaccine efficacy (vs. fake), trust lower after consulting social media	M+, higher degree of education, not having chronic illness	trust in vaccine efficacy and safety
Kumar [49]	2/21	India	Trust in country of vaccine manufacture	M+, Age+, Dr+ nurse+ vs. other HCW, Risk1, C+unit	
Paris [50]	2/21	France		Age+, Dr+ vs. nurse vs. other HCW	Flu-Vax, trust in vaccine safety
Holzmann-Littig [51]	2/21	Germany	trust in authorities and pharma	Age-	Flu-Vax, trust in speed of vaccine development

continuation of Table 2

Main author	Date of study	Country/ location	*Domains of vaccination acceptance*		
			Contextual influences	Individual and/ or group influences	Vaccine and vaccination specific issues
Li [52]	2/21	China	free of charge vaccination, cover for side effects	M+, Dr+ vs. nurse, Edu+	Edu-Vax
Krishnamurthy [53]	2/21	Barbados		Age+, Dr+ vs. nurse	Flu-Vax, Edu-Vax
Vignier [54]	3/21	French Guiana	trust in government, trust in science	Age+, Dr+ vs. nurse, Risk1	trust in vaccine safety, Pro-Vax
Wiysonge [55]	3/21	South Africa	protecting others, collective action, trust in authorities	Age+, Dr+ vs. nurse	trust in vaccine safety, Edu-Vax
Amuzie [56]	3/21	Nigeria		Age+, Edu+, non-single	Edu-Vax
Nasir [57]	3/21	Bangladesh	free of charge vaccination	Dr+nurse+ vs. other HCW	trust in vaccine efficacy and safety
Al-Sanafi [58]	3/21	Kuwait	non-belief in conspiracy, collective responsibility	M+, Edu+, public sector	
Abiy [59]	3/21	Ethiopia	good preventive practices	Dr+ vs. nurse, Risk1	Pro-Vax
Pal [60]	3/21	USA	trust in authorities, government and pharma	Age+, Edu+, Asian origin	Pro-Vax
Green-McKenzie [61]	4/21	USA	gradual roll-out over 4-12 weeks	Dr+nurse vs. other HCW (non-black nurses, doctors irrespective of race), C+unit	Hospital outreach and educational efforts
Gotlib [62]	4/21	Poland	Risk2	Risk1	vaccination on uni campus, education among students
Fotiadis [63]	5/21	Greece	sufficient information, general knowledge	Edu+, Work+, Dr+ vs. nurse	Flu-Vax, Edu-Vax, trust in vaccine safety
Puertas [64]	5/21	14 Caribbean countries	Positive effect of social media, friends if vaccinated, trust in country of manufacturing	Age+, Dr+ vs. nurse	trust in vaccine efficacy and safety, general attitude - wait and see
Mohammed [65]	7/21	Ethiopia	Societal vaccine benefit, trust in government, trust in science	Age-, Dr+nurse+ vs. other HCW	trust in vaccine safety, personal vaccine benefit vs. natural immunity
Ibrahim [66]	9/21	Saudi Arabia	convenient access to vaccine, voluntary vaccination	number of vaccinated friends, F+	
Ulbrichtová [67]	9/21	Slovakia	belief in compulsory vaccination	Age+, Dr+ vs. nurse, personal history of covid	Flu-Vax, trust in vaccine safety and efficacy
Klugar [68]	11/21	Czechia	altruism - protecting self, family, and community	M+, Age+, Dr+ vs. nurse	

Abbreviations: Age+ - vaccination intention increases with age, Age- - vaccination intention decreases with age, M+ - Males have higher vaccination intention compared to females, F+ - females have higher vaccination intention compared to males, Risk1 – perceived individual risk of severe COVID-19, fear of getting COVID-19, Risk2 – perceived risk of COVID-19 for other people, living with people at risk of severe disease, Dr+ vs. nurse – doctors higher intention to vaccination than nurses, HCW+ vs. nurse - all HCW other than nurses had in the study higher intention to vaccination than the subgroup of nurses, Dr+nurse+ vs. other HCW – doctors and nurses had higher vaccination intention than other healthcare professions, Flu-Vax – having previous influenza vaccine, Pro-Vax – positive vaccination attitude, general vaccination acceptance and acceptance of previous vaccination programmes, Edu+ - vaccination acceptance increases with increasing level of education, Edu- - vaccination acceptance decreases with increasing level of education, Work+ - vaccination acceptance increases with longer time in clinical practice, Edu-Vax – high vaccination and/or vaccine knowledge, "vaccine literacy", „understanding the vaccine" or understanding benefits and barriers of vaccination, C+unit – providing direct care for COVID-19 patients, working in a COVID-19 dedicated unit, C-unit – providing care outside of a covid-unit

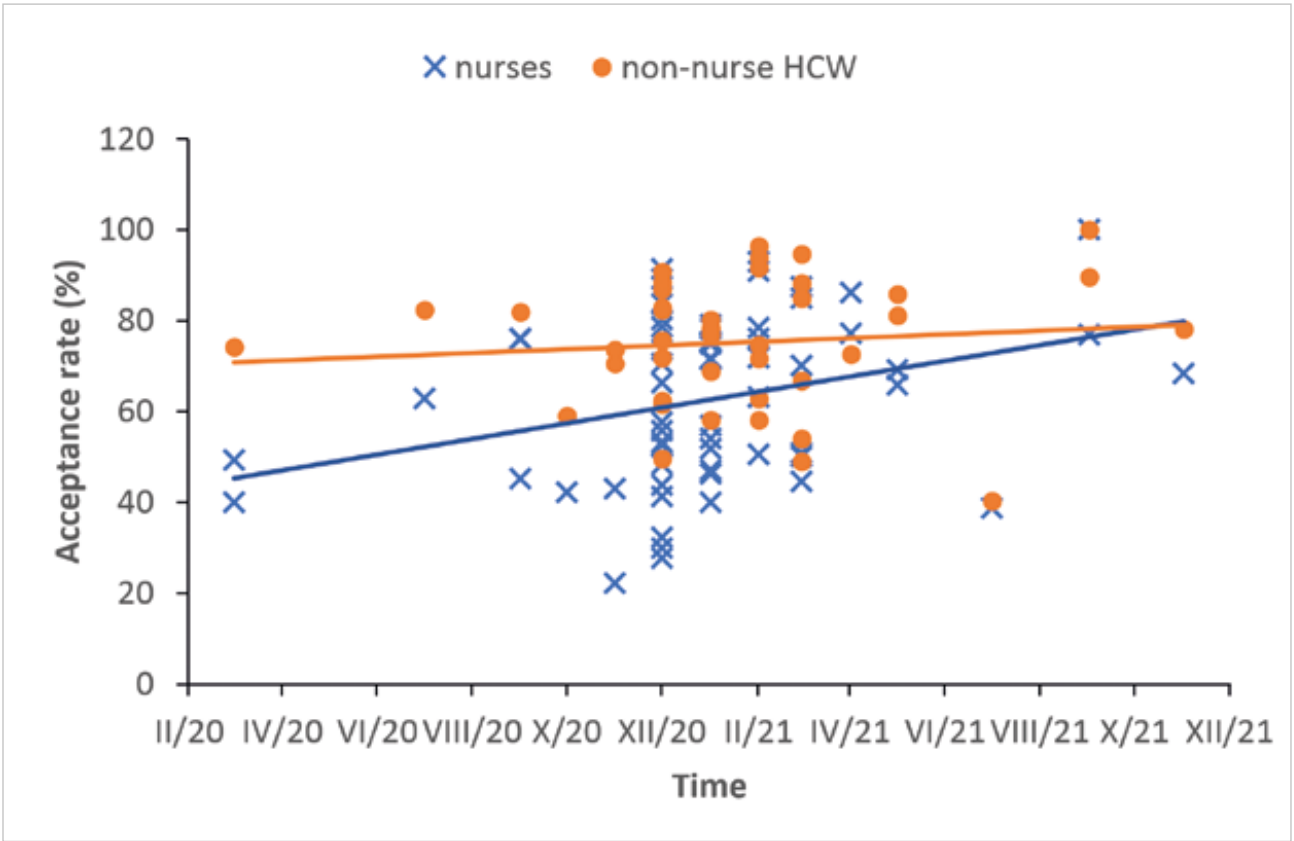

Figure 2. COVID-19 vaccination acceptance by nurses and healthcare workers (HCW) other than nurses
The rate of vaccine acceptance by nurses (blue crosses) is increasing in time (p = 0.015), while the rate of vaccine acceptance by non-nurse HCW (orange dots) does not change significantly (p = 0.521).

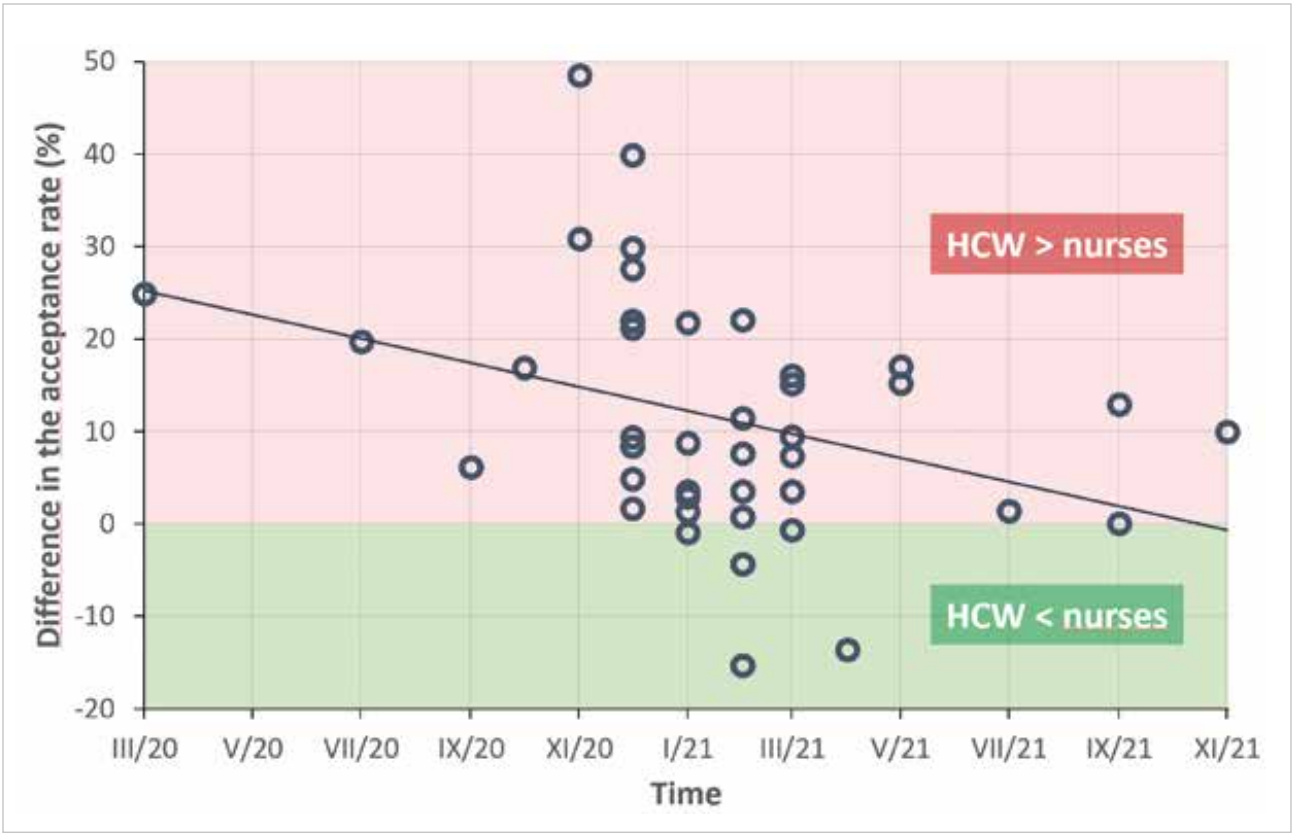

Figure 3. Time change in the difference in COVID-19 vaccination acceptance in nurses versus healthcare workers other than nurses
The difference in the rate of vaccine acceptance between nurses and other HCW is decreasing in time (p = 0.022).

Context-related factors

Trust in science, in doctors, in experts and in governments were the main contextual factors increasing vaccine acceptance mentioned in the surveys. Access to vaccine and vaccine provision free of charge were significant factors in USA, Bangladesh and China. Trust in official channels of communication as opposed to social media influence was noted. Nurses who declared more trust in pharma industry, vaccine manufacturers or country, where the vaccine was manufactured, were more likely to accept the vaccine. Only few times altruism and collective protection or need to terminate the pandemic was mentioned. Few studies indentified higher acceptance rate in those having in their home someone at risk (n = 5 studies).

Individual and group characteristics

The demographic comparisons have shown that nurses were less likely to accept vaccination compared to doctors and other healthcare professionals especially at the onset of pandemic and before vaccine rollout. This difference decreased with time (Figure 2 and 3) (p = 0.022). The main factors independently associated with higher levels of vaccination acceptance in majority of studies were being male (n = 23 studies), increasing age (n = 25 studies), increasing level of education (n = 7 studies) and increasing number of years in clinical practice (n = 4 studies). Nursing students and nurses attitudes to covid vaccination were similar.

Percieved individual risk of having severe COVID-19 was significant factor in a minority of studies (n = 14).

Differing vaccination intention based on an experience of working in COVID-19 dedicated units was rarely mentioned (chance of vaccine acceptance increased in 5 studies, decreased in one study).

Vaccine and vaccination specific factors

In majority of studies, the main factors associated with higher vaccination intention were trust (or lack of fear) in the vaccine (n = 5 studies), trust in vaccine efficacy and safety (n = 21), or absence of fear of long-term side effects (n = 13). Lack of concerns about the rapid vaccine development was mentioned in some studies (n = 3). Other frequently mentioned factors increasing the intention to vaccinate against COVID-19 were "general positive attitude to vaccination", "general vaccine acceptance" and "having been vaccinated within previous vaccination programmes" (n = 11 studies), specifically "having had influenza vaccination in previous years" (n = 21 studies). A significant, potentially modifiable cognitive factor, associated with higher vaccine acceptance was "high knowledge of vaccination agenda", "vaccine literacy", „understanding the vaccine" or "understanding the benefits and barriers of vaccination" (n = 17 studies).

DISCUSSION

Vaccine hesitancy is one of the top ten threats to global health [69]. The nurses were reported to be more hesitant for COVID-19 vaccine uptake if compared to other healthcare professions. We have found that this was true at the pandemic onset, and during the time period before vaccine roll-out. As time progressed, this difference significantly decreased (see Figure 2 and 3), and this fact was especially apparent in studies done post vaccine roll-out. The data are therefore suggesting that nurses choose a wait-and-see approach toward COVID-19 vaccines (and vaccination in general). The real vaccine uptake by the nurses was higher than their previously declared intention to be vaccinated. In some of the studies nurses initially indicated secondary intention or indifferent attitude, rather than simple vaccine refusal [34, 36, 46]. In one study that was part of an extensive educational programme, all HCW including nurses achieved higher vaccination uptake than what they originally intended [27].

Major contextual factors for vaccination acceptance included trust in official structures and channels of communication as opposed to trusting social media and alternative sources of information. Trust in the country of vaccine manufacture, in the manufacturer and in pharma industry in general was noted in those more willing to be vaccinated. Higher vaccination acceptance was also associated with increasing age, education level and longer work experience, which is all in keeping with this context and we may assume that with more experience and deeper understanding how the healthcare system works (and does not work), one is less prone to look for sources of alternative or conspirational content.

With further pandemic waves and implementation of vaccine mandates by governments or by employers, the real vaccination rate reflected not only the intention or willingness to be vaccinated, but also motivation by being able to work or travel [61]. Higher nurse vaccination intention was noted in regions with higher vaccination intention in general public [63]. On the other side, a certain level of vaccine hesitancy was still persisting even in vaccinated HCWs [66].

When it comes to booster dose acceptance, concerns other than mere questions whether a booster it is needed are the main drivers of reluctance, and may be an important consideration in the planning of messages about booster doses [60].

Previous influenza vaccine uptake as well as participation in other vaccination programmes were indicated as factors increasing vaccine acceptance. This may indicate who may be the "vaccine champions" – people promoting vaccination – in the future: those, who accept vaccine also very likely advocate the vaccine [37]. This is in keeping with the potential of developing nurses' capacity to be leaders in delivering effective vaccine recommendations to the communities they serve [36].

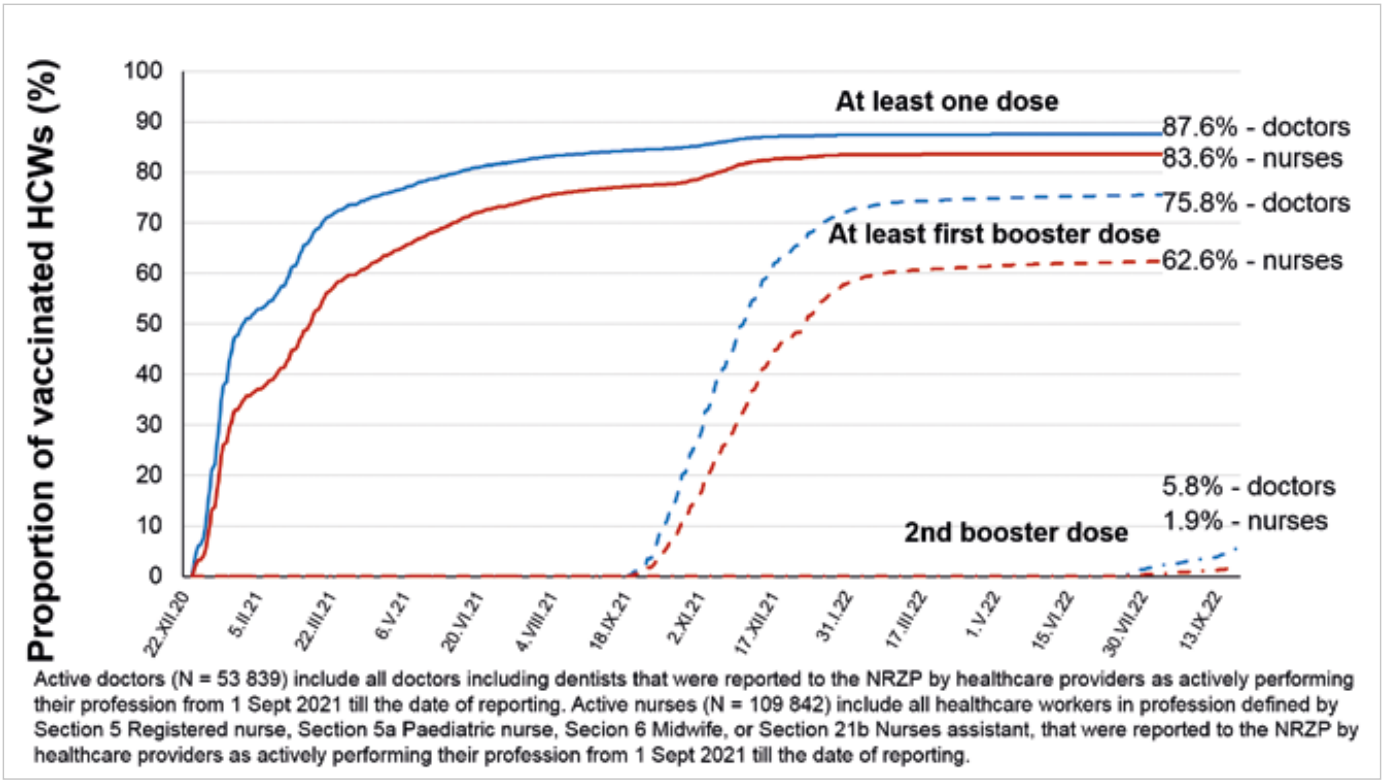

Figure 4. COVID-19 vaccination of active doctors and nurses in Czechia (doctors – blue lines, nurses – red lines)

Source: RNDr. Jan Mužík, PhD., Institute of Health Information and Statistics of the Czech Republic (IHIS CR), datasource: National Registry of Healthcare Workers (Národní registr zdravotnických pracovníků - NRZP); Information System for infectious Diseases (Informační systém infekční nemoci - ISIN), as of 27 Sept 2022

Another interesting aspect was noted in 17 studies, that identified "vaccine literacy", "vaccine knowledge" or plain "understanding the vaccine" as an independent factor increasing vaccination acceptance. Indeed, those with low intention to accept the vaccine could be identified as the misinformed, the undecided, the uninformed, or the unconcerned [19]. As the factor of vaccine literacy appears to be modifiable easier than gender, level of education, profession or trust in the government, and faster than age and years in clinical practice, further research into vaccine literacy interventions is warranted. In this review we have identified that it is young and middle aged female nurses including nursing students whose educational needs appear to be unmet and further research should address this, especially realizing how much reliable and culturally informed health communication is vital in influencing positive health behaviour [70].

The findings of occupation-related difference in vaccination acceptance are compatible with real-life data on COVID-19 vaccination in Czech HCWs as reported by IHIS. Figure 4 provided by the courtesy of IHIS shows that the proportions of vaccinated doctors and nurses diverge from the very beginning of vaccination and nurses reach similar vaccine coverage to that of doctors slower both for the basic vaccination and the booster dose. As of 27 September 2022, rates of completed basic COVID-19 vaccination reported by IHIS were in similar range, while booster dose rate was lower in nurses. Currently working Czech doctors completed vaccination in 87.8%, while 75.3% received a booster dose. Currently working Czech nurses completed vaccination in 83.4%, while 61.9% received booster dose. The very first data on 2nd booster bose show similar pattern of early curve divergence.

If nurses tend to wait-and-see at first, but arrive at the end, research then should focus on what needs to be shown so that they feel comfortable accepting the vaccine. As one of the reviewed studies has shown, an ongoing institutional education programme increased vaccine acceptance compared to what nurses claimed in the beginning of such programme [61]. Multicomponent and dialogue-based interventions indeed have been most effective in these settings and this is the way the researchers may turn their attention further on [71].

Limitations

The review included only studies published in English language and some studies published in other languages may have been missed. However, 15,739 out of total 40,521 nurses were surveyed in countries where English is an official language, and 24,782 nurses were in countries where English is not commonly used. Therefore, this linguistic and geographic distribution enables to draw our conslusions to non-English speaking countries as well.

Looking at longitudinal dimension using cross sectional data may have limitations, especially as the studies did not have uniform design and sets of questions, and were performed in various settings. For such variability, however, the findings have shown similar trends and patterns (eg. doctors vs. nurses, age, gender, vaccine literacy) across different countries, healthcare systems and cultures.

Although we have identified multiple factors independently associated with increased COVID-19 vaccine acceptance, we are unable to quantify the size of the effect of individual factors.

There have been other factors that may have influenced the vaccine acceptance, some of them mentioned in the reviewed studies. COVID-19 vaccination intention was influenced by non-medical factors, as COVID-19 has been the first pandemic in the era of widespread use of social media, with related infodemic and desinfodemic features exceeding those of any previous outbreak. Healthcare workers, including nurses, are not spared of this social aspect.

Another limitation of the included studies is the absence of follow-up and real data of vaccine uptake. Therefore, this review can only scope as to what are the declared intentions and which factors are perceived by the nurses and other HCWs to be significant in the process of decision making.

CONCLUSIONS

The vaccine intention is a spectrum, and real vaccine uptake may not correspond with the original intention. The nurses across geographies and healthcare systems are consistently more reluctant than other healthcare workers, especially doctors, to accept a new vaccine. This lower acceptance rate, however, diminishes over time and both declared and actual vaccine acceptance grow and approach that of the doctors and other HCWs. Future strategies to promote vaccination among nurses and other HCW in a pandemic setting should address this observation. Further research is warranted into the nurses vaccination attitudes related to COVID-19 vaccine, influenza vaccine and vaccination in general, as these appear intertwined.

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Adresa pro korespondenci:
MUDr. Aleš Chrdle
Nemocnice České Budějovice, a. s.
Boženy Němcové 54
370 01 České Budějovice
e-mail: chrdle@email.cz