Vaccination willingness for COVID-19 among healthcare workers: a cross-sectional survey in a Swiss canton

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AIMS OF THE STUDY: Vaccination is regarded as the most promising response to the COVID-19 pandemic. We assessed opinions about COVID-19 vaccination, willingness to be vaccinated, and reasons for vaccination hesitancy among healthcare workers.

METHODS: We conducted a cross-sectional, web-based survey among 3,793 healthcare workers in December 2020 in the Canton of Solothurn, Switzerland, before the start of the national COVID-19 vaccination campaign.

RESULTS: Median age was 43 years (interquartile range [IQR] 31–53), 2,841 were female (74.9%). A total of 1,511 healthcare workers (39.8%) reported willingness to accept vaccination, whereas 1,114 (29.4%) were unsure and 1,168 (30.8%) would decline vaccination. Among medical doctors, 76.1% were willing, whereas only 27.8% of nurses expressed willingness. Among the 1,168 healthcare workers who would decline vaccination, 1,073 (91.9%) expressed concerns about vaccine safety and side effects. The willingness of healthcare workers to be vaccinated was associated with older age (adjusted odds ratio [aOR] 1.97, 95% confidence interval [CI] 1.71–2.27) and having been vaccinated for influenza this year (aOR 2.70, 95% CI 2.20–3.31). Healthcare workers who reported a lack of confidence in government were less likely to be willing to be vaccinated (aOR 0.58, 95% CI 0.40–0.84), and women were less willing to be vaccinated than men (OR 0.33, 95% CI 0.28–0.38).

CONCLUSION: Less than half of healthcare workers reported willingness to be vaccinated before the campaign start, but proportions varied greatly depending on profession and workplace. Strategies with clear and objective messages that particularly address the concerns of healthcare workers are needed if their willingness to be vaccinated against COVID-19 is to be further increased.

Introduction

The worldwide spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections and coronavirus disease 2019 (COVID-19) is a major public health threat [1]. Globally, SARS-CoV-2 infection has been confirmed in over 131,837,512 people and as of 7 April 2021 2,862,664 have died from COVID-19 [2]. In Switzerland, the pandemic has stretched the healthcare system to its limits and burdened the economy with temporary closures of restaurants, stores and large public and private venues [4]. In the absence of effective treatments and a safe and effective vaccine, nonpharmaceutical interventions were implemented to mitigate the pandemic. Measures taken include using personal protective equipment (PPE) such as face masks in public spaces, keeping distance between individuals, and rigorous hand hygiene. Many pharmaceutical companies and research laboratories have been working on vaccines [5–7]. Effective vaccination is key to controlling the COVID-19 pandemic, but global vaccine distribution is challenging [8]. By the end of 2020, several vaccines had demonstrated efficacy in phase III trials [7], and by the beginning of January 2021, two messenger RNA (mRNA) vaccines had been approved by the Swiss Agency for Therapeutic Products (Swissmedic) [9, 10].

The delivery of the COVID-19 vaccines started on 4 January 2021, making it essential to identify and address widespread vaccine uptake barriers. Six months after the start of the national campaign, almost 50% of the total Swiss population have received at least one dose of an mRNA COVID-19 vaccine and about 30% are completely vaccinated. Scepticism about these new vaccines against COVID-19 presents one such challenge to vaccine uptake. Healthcare workers who face an increased risk of infection...
with SARS-CoV-2 and can transmit the virus among themselves and to highly vulnerable patients [11–15] are an important target group for vaccination. Previous studies have shown that vaccine uptake for vaccine-preventable diseases such as influenza is low among healthcare workers [16, 17]. Given the central role they play in treating COVID-19 and administering vaccinations, healthcare workers are uniquely positioned to influence vaccine uptake. Therefore, understanding the willingness of healthcare workers to be vaccinated against COVID-19, mainly if they are themselves hesitant, will be important in promoting vaccine uptake in the population.

We therefore assessed the willingness of healthcare workers in the Canton of Solothurn, Switzerland, to be vaccinated against influenza and COVID-19, and inquired about reasons for vaccine hesitancy among them.

Methods

Study design

We conducted a cross-sectional web-based survey among healthcare workers in the Canton of Solothurn, Switzerland. We included adults aged 16 years or older who work in the healthcare system in hospitals, medical practices, retirement and nursing homes, home care, pharmacies and long-term care facilities.

Data collection

We developed and pilot tested a standardised questionnaire based on the study of Larson et al. [18] and the Vaccine Confidence Project at the London School of Hygiene and Tropical Medicine (www.vaccineconfidence.org/). The electronic questionnaire collected information of three types: (i) demographic details such as sex, age, and profession; (ii) intention to be vaccinated against COVID-19 and reasons for being vaccinated / not being vaccinated or for being unsure, confidence in government, recommendation of the employer, and additional information needed to take a vaccination decision; (iii) history of influenza vaccination for the influenza season 2020/21. We collected the data in mid-December 2020 before the first approval of a COVID-19 vaccine and associated campaigning, using a web-based tool (www.findmind.ch). All fields were mandatory. Free-text fields were restricted to the questions on reasons for not vaccinating, vaccinating or being unsure to vaccinate (“other reasons”; the questionnaire is in the supplementary table S1 in the appendix).

All employees of the cantonal hospital in the Canton of Solothurn were invited to participate. The survey was also sent to the cantonal professional associations of physicians, nursing homes, long-term care facilities and residential care, which invited their members to participate. The survey was distributed via the commonly used channels of communication, such as emails, newsletters and weblinks on the internal hospital website.

Definitions

The Swiss Federal Office of Public Health (FPOH) defined the following COVID-19 risk groups: persons over the age of 50; those with comorbidities including hypertension, chronic respiratory diseases, diabetes, being immunocompromised, cardiovascular disease, cancer, or obesity (body mass index >30 kg/m²); persons who live in a nursing home or long-term care facility; and those who are pregnant.

The survey participants fell into three groups: persons willing to be vaccinated, those who were not willing to be vaccinated, and those who were hesitant or unsure about being vaccinated. Among those willing to be vaccinated against COVID-19, the reasons for deciding to do so could be characterised as self-protection, individual vaccination as a contribution to pandemic control, and belonging to a risk group for severe COVID-19 disease. Reasons for vaccine hesitancy included opposition to vaccines in general, the perception that COVID-19 is harmless or that PPE is sufficient, concerns about the effectiveness of the vaccine, its safety and side effects, bad experiences with previous vaccinations, fear of needles, and other reasons. People who were unsure about being vaccinated against COVID-19 were hesitant because of perceived inconsistent information, doubt about vaccine effectiveness, doubt about vaccine safety and fear of side effects, doubt about individual vaccination for pandemic control, and uncertainty among colleagues, and lack of information provided by the employer. Supplementary table S1 provides further details.

Statistical analyses

We used descriptive statistics to characterise the study population by profession and intention to be vaccinated against COVID-19. Differences between groups were assessed using chi-square, t-test or Wilcoxon rank-sum tests as appropriate. We calculated the proportions of people intending to be vaccinated against COVID-19 with the corresponding 95% confidence intervals (95% CIs).

We examined factors associated with the healthcare workers’ intention to be vaccinated against COVID-19 in univariate and multivariate logistic regression. Logistic models were adjusted for age group and profession, confidence in government reports, the employer’s recommendation, and influenza vaccine uptake 2020/21. We grouped uncertainty about vaccination and having no intention of being vaccinated against COVID-19. We also performed a sensitivity analysis that combined those who were willing to be vaccinated and those who were not sure about vaccination. Finally, we compared the vaccine refusers and those who were unsure about COVID-19 vaccination. All analyses were performed in Stata (version 15.1, College Station, TX, USA).

Ethics statement

Data collection was anonymous. No ethical approval was needed, in line with the Swiss Human Research Act.

Results

A total of 4,244 healthcare workers participated in the survey. Response rates were as follows: ~64% (2,679/~4,200) among hospital staff, ~38% (338/~900) among medical practice staff, ~11% (440/~4,000) among nursing home staff, and ~29% (470/~1,600) among long-term care facility staff.

We excluded participants who did not fully complete the survey (n = 421) and those for whom data on sex, age or profession were missing (n = 12). We further excluded participants younger than 16 years (n = 18). The analyses thus
included 3,793 healthcare workers (see supplementary fig. S1 in the appendix).

Characteristics of the healthcare workers

The median age of participating healthcare workers was 43 years (interquartile range [IQR] 31–53), 2,841 were female (74.9%). Among all healthcare workers, 2,445 (64.5%) worked in hospitals, 398 (10.5%) worked in long-term care facilities, 373 (9.8%) in retirement and nursing homes, 311 (8.2%) in medical practices, 232 (6.1%) in residential care and 34 (0.9%) at pharmacies (table 1 and supplementary table S2 in the appendix). Asked about COVID-19 vaccination, 1,511 healthcare workers (39.8%) reported they planned to have the COVID-19 vaccine, 1,114 (29.4%) said they were unsure and 1,168 (30.8%) said they would not accept vaccination. Willingness to be vaccinated was highest among medical doctors, among whom 467 of 617 (76.1%) were willing to be vaccinated, and it was lowest among nurses at 470 of 1,690 (27.8%) (fig.1A and B shows willingness to be vaccinated by profession and workplace).

The self-reported uptake for seasonal influenza 2020/2021 vaccination was 38.1% (1,446 of 3,793), 118 (3.1%) were unsure whether they had been vaccinated and 2,229 (58.8%) reported they were not vaccinated. The influenza vaccination rate was highest among medical doctors (75.6%) and pharmacists (58.8%). Among the other professions, the vaccination rate ranged from 11.6% to 44.4% (table 1).

Determinants of willingness to be vaccinated

The willingness among healthcare workers to be vaccinated against COVID-19 was lower among females than male participants (odds ratio [OR] 0.33, 95% CI 0.28–0.38) and increased with age. Willingness was highest among the age group ≥60 years (OR 4.56, 95% CI 3.50–5.94) compared with the age group <30 years. Healthcare workers reporting having been vaccinated against seasonal influenza 2020/21 were more willing to be vaccinated against COVID-19 (OR 6.30, 95% CI 5.45–7.23) than the unvaccinated group. Confidence in government reports and employers’ vaccination recommendation were associated with willingness to be immunised against COVID-19: OR 4.12 (95% CI 3.37–5.03) and OR 14.19 (95% CI 11.53–17.47), respectively. In contrast, lack of such confidence was negatively associated with willingness to get vaccinated as compared with the group with no opinion (table 2). The willingness to be vaccinated against COVID-19 was higher among pharmacists (OR 6.22, 95% CI 2.96–13.13) and medical doctors (OR 8.24, 95% CI 6.66–12.21) than nurses.

In the multivariate analysis, willingness to be vaccinated was positively associated with confidence in government reports on the COVID-19 pandemic (adjusted OR [aOR] 1.41, 95% CI 1.07–1.85) and negatively with lack of confidence in government (aOR 11.40, 95% CI 8.87–14.65). Similarly, confidence in employer recommendations was positively associated, whereas lack of confidence was negatively associated. The analysis confirmed that healthcare workers who reported vaccination against seasonal influenza 2020/21 were more likely to be willing to be vaccinated against COVID-19 than those who were not vaccinated (aOR 2.70, 95% CI 2.20–3.31, table 2). When an interaction term with influenza vaccination and age group was included in the multivariate model, influenza vaccination and age group were interrelated (p-value from the test for an interaction p = 0.03).

In the sensitivity analysis grouping the willing and unsure together (rather than the refusers and unsure), results were similar to the primary analysis (supplementary table S3).

Reasons for vaccine hesitancy

The main reasons for willingness to be vaccinated were personal protection, controlling the pandemic and belonging to a risk group (fig. 2A, table 1). These reasons differed according to profession (p <0.05). The most frequent reasons for vaccine hesitancy among healthcare workers included concerns about vaccine safety and side effects (1,073/1,168, 91.9%), the perception that PPE is sufficient (328/1,168, 28.1%), and that COVID-19 is harmless (231/1,168, 19.8%, fig. 2B and table 1). All reasons for vaccine hesitancy were similar in the different healthcare professions, except for vaccine safety and side effects, which were mentioned more frequently as a reason for vaccine hesitancy by nurses (p = 0.01)

Among the 1,114 healthcare workers who were unsure about a vaccination decision, 1,055 (94.7%) wanted more
| Table 1: Characteristics of healthcare workers participating in the survey, overall and by profession. |
|---------------------------------------------------------------|
| **Sex** | All HCW (n = 3793) | Nurses (n = 1690) | Medical doctors (n = 614) | Medical assistants (n = 63) | Pharmacist and assistants (n = 34) | Other medical staff* (n = 380) | Private care-givers (n = 224) | Staff without patient contact (n = 788) |
|---------|-------------------|------------------|--------------------------|---------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------------|
| **Sex** |                   |                  |                          |                           |                               |                               |                            |                                   |
| Male    | 952 (25.1)        | 202 (12.0)       | 358 (58.3)               | 1 (1.6)                   | 10 (29.4)                     | 57 (15.0)                     | 77 (34.4)                   | 247 (31.4)                        |
| Female  | 2,841 (74.9)      | 1,488 (88.0)     | 256 (41.7)               | 62 (98.4)                 | 24 (70.6)                     | 323 (85.0)                    | 147 (65.6)                  | 541 (68.7)                        |
| **Age in years, median (IQR)** | 43 (31–53) | 39 (27–52) | 46 (36–55) | 39 (25–52) | 49 (32–59) | 43 (30–53) | 41 (30–55) | 48 (36–55) |
| **Workplace** |          |                  |                          |                           |                               |                               |                            |                                   |
| Hospital | 2,445 (64.5)      | 1,122 (66.4)     | 372 (60.8)               | 0                         | 380 (100)                     | 0                             | 571 (72.5)                  |                                   |
| Medical practice | 311 (8.2) | 6 (0.4) | 240 (39.1) | 58 (92.1) | 0 | 0 | 0 | 7 (0.9) |
| Retirement and nursing home | 373 (9.8) | 287 (17.0) | 0 | 2 (3.2) | 0 | 0 | 0 | 84 (10.7) |
| Residential care | 323 (6.1) | 193 (11.4) | 0 | 2 (3.2) | 0 | 0 | 0 | 37 (4.7) |
| Pharmacy | 34 (0.9) | 0 | 0 | 0 | 34 (100) | 0 | 0 | 0 |
| Long-term care facilities | 398 (10.5) | 62 (4.9) | 2 (0.3) | 1 (1.6) | 0 | 0 | 224 (100) | 89 (11.3) |
| **Willingness to get COVID-19 vaccine** |          |                  |                          |                           |                               |                               |                            |                                   |
| Yes     | 1,511 (39.8)      | 470 (27.8)       | 467 (76.1)               | 24 (38.1)                 | 74 (20.6)                     | 161 (42.4)                    | 68 (30.4)                   | 297 (37.7)                        |
| No      | 1,168 (30.8)      | 642 (38.0)       | 55 (9.0)                 | 19 (30.2)                 | 6 (17.6)                      | 93 (24.5)                     | 106 (47.3)                  | 247 (31.3)                        |
| Unsure  | 1,114 (29.4)      | 578 (34.2)       | 92 (15.0)                | 20 (31.4)                 | 4 (11.8)                      | 126 (33.2)                    | 50 (22.3)                   | 244 (31.0)                        |
| **Opinion on employer’s recommendation** |          |                  |                          |                           |                               |                               |                            |                                   |
| No opinion | 893 (23.5) | 452 (26.8) | 107 (17.4) | 16 (25.4) | 8 (23.5) | 80 (21.1) | 40 (17.9) | 190 (24.1) |
| Completely and somewhat disagree | 1,066 (28.1) | 598 (35.4) | 75 (12.2) | 17 (27.0) | 3 (8.8) | 86 (22.6) | 95 (42.4) | 192 (24.4) |
| Completely and somewhat agree | 1,834 (48.4) | 640 (37.9) | 432 (79.4) | 30 (47.6) | 23 (67.7) | 214 (56.3) | 89 (39.7) | 406 (51.5) |
| **Opinion on government reports** |          |                  |                          |                           |                               |                               |                            |                                   |
| No opinion | 645 (17.0) | 337 (19.9) | 47 (7.7) | 12 (19.1) | 5 (14.7) | 55 (14.5) | 45 (20.1) | 144 (18.3) |
| Completely and somewhat disagree | 868 (22.9) | 489 (28.9) | 48 (7.8) | 18 (28.6) | 6 (17.7) | 57 (15.0) | 71 (31.7) | 179 (22.7) |
| Completely and somewhat agree | 2,280 (60.1) | 864 (51.1) | 519 (84.5) | 33 (52.4) | 23 (67.7) | 268 (70.5) | 108 (48.2) | 465 (59.0) |
| **Reasons for vaccine hesitancy against COVID-19** |          |                  |                          |                           |                               |                               |                            |                                   |
| Protection | 1,511 (100) | 470 (100) | 467 (100) | 24 (100) | 24 (100) | 161 (100) | 68 (100) | 297 (100) |
| Vaccine for pandemic control | 1,328 (87.9) | 395 (84.0) | 434 (92.9) | 24 (100) | 21 (87.5) | 143 (88.8) | 55 (80.9) | 256 (86.2) |
| Risk group | 266 (17.6) | 76 (16.2) | 96 (20.6) | 0 | 7 (29.2) | 20 (12.4) | 14 (20.6) | 53 (17.8) |
| **Reasons for vaccine hesitancy against COVID-19** |          |                  |                          |                           |                               |                               |                            |                                   |
| Protection | 1,168 (100) | 642 (100) | 55 (100) | 19 (100) | 6 (100) | 93 (100) | 106 (100) | 247 (100) |
| Vaccine safety and side effects | 1,073 (91.9) | 603 (93.9) | 51 (92.7) | 17 (89.5) | 4 (66.7) | 87 (93.5) | 90 (84.9) | 221 (89.5) |
| PPE is sufficient | 328 (28.1) | 193 (30.1) | 13 (23.6) | 4 (21.1) | 1 (16.7) | 26 (28.0) | 32 (30.2) | 59 (23.9) |
| COVID-19 hazard | 229 (19.6) | 118 (18.4) | 20 (36.4) | 3 (58.8) | 0 | 18 (17.2) | 25 (23.6) | 47 (19.0) |
| Bad experiences | 201 (17.2) | 111 (17.3) | 12 (18.2) | 2 (10.5) | 0 | 11 (11.8) | 20 (18.9) | 45 (18.2) |
| Effectiveness of the vaccine | 128 (11.0) | 85 (13.2) | 6 (10.9) | 1 (5.3) | 0 | 8 (8.6) | 12 (11.3) | 16 (6.5) |
| Opponents of vaccines in general | 39 (3.3) | 20 (3.1) | 0 | 1 (5.3) | 0 | 1 (1.1) | 5 (4.7) | 12 (4.9) |
| Fear of needles | 40 (3.4) | 20 (3.1) | 1 (1.8) | 0 | 1 (16.7) | 4 (4.3) | 4 (3.8) | 10 (4.0) |
| Others | 379 (32.4) | 194 (30.2) | 24 (43.6) | 4 (21.1) | 1 (16.7) | 33 (35.5) | 46 (43.4) | 77 (31.2) |
| **Reasons for being unsure of vaccination against COVID-19** |          |                  |                          |                           |                               |                               |                            |                                   |
| 1,114 (100) | 578 (100) | 92 (100) | 20 (100) | 4 (100) | 126 (100) | 50 (100) | 244 (100) |                                   |
Vaccine safety and side effects | 1,058 (95.0) | 538 (93.1) | 88 (95.7) | 18 (90.0) | 4 (100) | 124 (94.4) | 50 (100) | 236 (96.7)
Inconsistent information | 329 (29.5) | 192 (33.2) | 29 (31.5) | 1 (5.0) | 1 (25.0) | 40 (31.7) | 17 (34.0) | 51 (20.9)
Effectiveness of the vaccine | 316 (28.4) | 177 (30.6) | 16 (17.4) | 5 (25.0) | 1 (25.0) | 33 (26.2) | 15 (30.0) | 69 (28.3)
No education by my employer | 210 (18.9) | 126 (21.8) | 14 (15.2) | 5 (25.0) | 0 | 29 (23.0) | 4 (8.0) | 32 (13.1)
Uncertainty by my colleagues | 251 (22.5) | 147 (25.4) | 18 (19.6) | 6 (30.0) | 0 | 31 (24.6) | 10 (20.0) | 39 (16.0)
Vaccine for pandemic control | 174 (15.6) | 93 (16.1) | 14 (15.2) | 2 (10.0) | 0 | 17 (13.5) | 10 (20.0) | 38 (15.6)
Information needs among unsure HCW | 1,114 (100) | 578 (100) | 92 (100) | 20 (100) | 4 (100) | 126 (100) | 50 (100) | 244 (100)
Information about COVID-19 | 116 (10.4) | 68 (11.8) | 8 (8.7) | 1 (5.0) | 0 | 14 (11.1) | 5 (10.0) | 20 (8.2)
Information about the vaccine | 1,055 (94.7) | 550 (95.2) | 81 (88.0) | 19 (95.0) | 4 (100) | 121 (86.0) | 47 (94.0) | 233 (95.5)
Reports from vaccinated people | 778 (69.8) | 412 (71.3) | 45 (48.9) | 17 (85.0) | 2 (50.0) | 74 (58.7) | 41 (82.0) | 187 (76.6)
Opinion of experts | 404 (36.3) | 220 (38.1) | 32 (34.8) | 9 (45.0) | 0 | 56 (44.4) | 15 (30.0) | 72 (29.5)

HCW = healthcare workers; IQR = interquartile range; PPE = personal protective equipment
Data are n (%) unless otherwise stated.
* "Other medical staff" includes physical therapists, occupational therapists, speech therapists and midwives.

Information on vaccine safety and side effects, 778 (69.6%) awaited reports from already vaccinated people and 404 (36.3%) wanted an opinion from experts. The main reasons can be found in figure 2C and table 1. The reasons for being unsure were similar across the healthcare professions, but pharmacists more frequently wanted information on the vaccine than medical doctors (100% vs 88%, p = 0.01).

**Discussion**

Less than half of participating healthcare workers reported willingness to be vaccinated against COVID-19. The most frequently given reason for vaccine hesitancy was concern about vaccine safety and side effects. Nurses were less likely to be willing to be vaccinated against COVID-19 than medical doctors or pharmacists.

Vaccines are an effective control measure to reduce the burden of infectious disease. Poliomyelitis was eradicated, and we are close to eliminating measles, mumps, and rubella with vaccines [19]. Vaccination will play an important role in the control of the COVID-19 pandemic. Even transient herd immunity in Switzerland will require more than 60% of the population having achieved immunity to SARS-CoV-2 either through infection and recovery or through vaccination, particularly when considering the potential impacts of SARS-CoV-2 variants of concern. However, this proportion varies depending on model assumptions [20].

Willingness to get vaccinated is central to achieving herd immunity. Several cross-sectional studies have assessed the willingness to get vaccinated. In seven countries, a European general population survey found that the willingness to be vaccinated against COVID-19 ranged from 62% to 80% [21]. Similar results were found in the United Kingdom and Ireland, with 69% and 65% acceptance, respectively [22]. In the USA, 37% of healthcare workers reported being willing to get vaccinated against COVID-19 [23]. These results are in line with our results (40%) in the Canton of Solothurn in Switzerland. These numbers cause concern because healthcare workers play an important role in vaccine uptake among the general population. A review on vaccine hesitancy has shown that vaccinated healthcare workers are more likely to recommend vaccination than unvaccinated healthcare workers [24]. Furthermore, a vaccination recommendation given by a healthcare worker is frequently cited as the reason for vaccination acceptance [25]. In contrast, the lack of such a recommendation was the most common reason for not being vaccinated [24, 26].

Some healthcare workers have expressed reservations about the safety and side effects of COVID-19 vaccines. One contributor to such reservations is the perception of undue haste in the development of COVID-19 vaccines compared with previous vaccines. In the twentieth century, it took a decade or longer to get vaccines to the market, for example, in the case of poliomyelitis [27]. Many factors contributed to the comparatively short time it took for COVID-19 vaccines to be granted emergency use authorizations in many countries, with definitive licensing granted on a rolling basis. Researchers have been developing mRNA and viral vector-based vaccines for other diseases for more than a decade [28]. As the pandemic spread, public willingness and even demand led to rapid enrolment in phase I to phase III clinical trials with historically unprecedented speed. Simultaneously, the rapid spread of SARS-CoV-2 allowed endpoint-driven phase III trials to demonstrate vaccine efficacy sooner than was expected at their outset.

We found that confidence in the governmental authorities is associated with willingness to get vaccinated against COVID-19. During a health crisis or a pandemic, trust in the government and risk perception play a key role in vaccine acceptance [29, 30]. A French survey among general practitioners showed they were more likely to recommend vaccines to patients when they trusted official sources of information [31]. A global survey also reported an association between vaccine acceptance and participants’ trust in
government [32]. High levels of trust in government was associated with willingness to follow governmental recommendations on preventative behaviours to contain swine flu [33] or compliance with social distancing measures during the Ebola outbreak [34]. In contrast, mistrust and misinformation reduced compliance with social and behavioural measures [35]. A cross-sectional study during the COVID-19 pandemic among UK residents showed that residents who trusted the government to control the pandemic were more likely to follow government recommendations during the lockdown [36]. Strategies to increase vaccine coverage among healthcare workers should draw upon guidance from authorities or persons conceived as such by a target audience (in this case healthcare workers) and specific information about vaccine safety and efficacy. Thus, it is not surprising that many undecided healthcare workers want to have reports from fellow healthcare workers who have been vaccinated before they make up their minds. Peers provide important information that influences decision making, but this source of information is often overlooked. Healthcare workers may be the most effective promoters of vaccination for their fellows.

We observed that healthcare workers who were vaccinated against seasonal influenza are also more likely to willing to be vaccinated against COVID-19. Both diseases are contagious respiratory diseases caused by viruses, and they share some of the same symptoms (fever, cough) and approaches for prevention (hand hygiene, physical distancing, and masks). However, there are important differences.

Table 2: Characteristics of healthcare workers’ willingness to be vaccinated against COVID-19, vaccine hesitancy and uncertainty about vaccination, and factors associated with willingness to be vaccinated.

| Variables                      | Total | Willingness to be vaccinated against COVID-19 n (%) | Comparison of persons willing to be vaccinated against COVID-19 with persons with hesitancy/unsure | p-value | Adjusted OR (95% CI)* | p-value |
|--------------------------------|-------|---------------------------------------------------|------------------------------------------------------------------------------------------------|---------|-----------------------|---------|
|                                | Number of participants | Yes | No | Unsure | Unadjusted OR (95% CI) | p-value | Adjusted OR (95% CI)* | p-value |
| Total                          | 3,793 | 1,511 | 1,168 | 1,114 |                     |         |                      |         |
| **Sex**                        |       |       |       |       |                     |         |                      |         |
| Male                           | 952   | 561 (56.9) | 196 (20.6) | 195 (20.5) | 1 | <0.001 |                      |         |
| Female                         | 2,841 | 950 (33.4) | 972 (34.2) | 919 (32.4) | 0.33 (0.28–0.38) |         |                      |         |
| **Age groups**                 |       |       |       |       |                     |         |                      |         |
| 29 and younger                 | 829   | 207 (24.9) | 381 (46.0) | 241 (29.1) | 1 | <0.001 | <0.001 |         |
| 30 to 39                       | 807   | 285 (35.3) | 257 (31.9) | 265 (32.8) | 1.64 (1.33–2.03) | 0.93 (0.68–1.25) |         |
| 40 to 49                       | 790   | 335 (42.4) | 215 (27.2) | 240 (30.4) | 2.21 (1.79–2.73) | 1.29 (0.96–1.76) |         |
| 50 to 59                       | 1,012 | 470 (46.4) | 254 (25.1) | 288 (28.5) | 2.61 (2.13–3.18) | 1.78 (1.34–2.36) |         |
| 60 and older                   | 355   | 214 (60.3) | 61 (17.2) | 80 (22.5) | 4.56 (3.50–5.94) | 2.45 (1.68–3.57) |         |
| **Profession**                 |       |       |       |       |                     |         |                      |         |
| Medical doctor                 | 614   | 467 (76.0) | 55 (9.0) | 92 (15.0) | 8.24 (6.66–12.21) | 4.88 (3.58–6.65) |         |
| Nurse                          | 1,690 | 470 (27.6) | 642 (38.0) | 578 (34.2) | 1 | 1 |                     |         |
| Medical assistant              | 63    | 24 (70.6) | 6 (17.7) | 4 (11.8) | 1.60 (0.95–2.69) | 1.45 (0.68–3.10) |         |
| Pharmacist and pharmacist assist- | 24    | 16 (66.7) | 5 (20.8) | 3 (12.5) | 6.22 (2.96–13.13) | 4.20 (1.53–11.52) |         |
| Other medical staff**          | 380   | 161 (42.4) | 93 (24.5) | 126 (33.2) | 1.91 (1.52–2.40) | 1.22 (0.89–1.68) |         |
| Not close patient contact      | 788   | 297 (37.7) | 247 (31.3) | 244 (31.9) | 1.57 (1.31–1.88) | 1.15 (0.89–1.48) |         |
| Private caregiver              | 224   | 88 (30.4) | 106 (47.3) | 50 (22.3) | 1.13 (0.83–1.53) | 1.51 (0.98–2.33) |         |

Confidence in the government reports

| No opinion                     | 645   | 150 (23.3) | 238 (36.9) | 257 (39.8) | 1 | <0.001 | <0.001 |         |
| Completely and somewhat disagree | 868   | 95 (10.9) | 533 (61.4) | 240 (27.7) | 0.41 (0.31–0.54) | 0.58 (0.40–0.84) |         |
| Completely and somewhat agree   | 2,290 | 1,266 (55.5) | 397 (17.4) | 617 (27.1) | 4.12 (3.37–5.03) | 1.41 (1.07–1.85) |         |

Follow employer’s recommendation

| No opinion                     | 893   | 140 (15.7) | 283 (31.7) | 470 (52.6) | 1 | <0.001 | <0.001 |         |
| Completely and somewhat disagree | 1,066 | 41 (3.9) | 801 (75.1) | 224 (21.0) | 0.22 (0.15–0.31) | 0.30 (0.20–0.44) |         |
| Completely and somewhat agree   | 1,834 | 1,330 (72.5) | 84 (4.6) | 420 (22.9) | 14.19 (11.53–17.47) | 11.40 (8.87–14.65) |         |

Influenza vaccination 20/21

| No                            | 2,347 | 555 (23.7) | 1019 (43.4) | 773 (32.9) | 1 | <0.001 | <0.001 |         |
| Yes                           | 1,556 | 956 (66.1) | 149 (10.3) | 341 (23.8) | 6.30 (5.45–7.23) | 2.70 (2.20–3.31) |         |

CI = confidence interval; HCW = healthcare worker; OR = odds ratio* Model adjusted for age groups, profession, confidence in the government reports, following employer’s recommendation, and influenza vaccination 20/21. † “Other medical staff” includes physical therapists, occupational therapists, speech therapists, and midwives

CI = confidence interval; HCW = healthcare worker; OR = odds ratio
* Model adjusted for age groups, profession, confidence in the government reports, following employer’s recommendation, and influenza vaccination 20/21.

** “Other medical staff” includes physical therapists, occupational therapists, speech therapists, and midwives
Superspreader events are more common for COVID-19 [37], and mortality rates are higher for COVID-19 than for influenza [38, 39]. A recent study showed that over time, the uptake of the seasonal influenza vaccine in Switzerland had dropped overall, and among older persons (≥65 years) and people with chronic disease [40]. This reduced coverage might be explained by variable and lower seasonal influenza vaccine effectiveness, which can range from 30–60% [41, 42].

The limitations of this study include different response rates among the healthcare professions and potential over-representation of hospital-based healthcare workers. We conducted a web-based cross-sectional online survey in which participation was voluntary but highly supported by the hospital-based personnel. Hospital-based healthcare workers may be over-represented. Healthcare workers interested in the topic are more likely to respond to the questionnaire. This might introduce a bias and lead to an over- or under-estimation of vaccine hesitancy or vaccine acceptance. The survey was conducted only in the Canton of Solothurn and the results cannot be necessarily generalised to the whole of Switzerland. Furthermore, some cantons were more heavily affected by the pandemic than others. This may result in different attitudes towards the COVID-19 vaccine among healthcare workers. Compared with other online surveys, this survey was distributed among specific groups of healthcare workers to cover better this heterogeneous population. Additionally, attitudes towards vaccination against COVID-19 and willingness to get vaccinated change over time. With more people being vaccinated, acceptance increases, and vaccine hesitancy might decrease. Finally, the survey was conducted before the approval of the two COVID-19 vaccines in Switzerland. Perceptions of the safety of the vaccine have changed since the approval of the vaccines and vaccine hesitancy might have decreased in the months after approval. This is true for COVID-19 vaccines, but maybe also be true for any new vaccine introduced in the healthcare sector.

This study’s strength is the inclusion of diverse healthcare institutions and healthcare workers who play quite different roles within them. We included healthcare workers working with varying populations of risk ranging from nursing home residents, hospitalised patients to people living in long-term care facilities. Furthermore, the survey covered the three largest healthcare providers in the canton of Solothurn.

**Conclusions**

At this early stage of the COVID-19 vaccine campaign, the overall willingness to get vaccinated among healthcare workers is low. Balanced and transparent information on...
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Appendix: Supplementary data

Figure S1: Study flow chart.

- Total number of responses \( n=4,244 \)
  - Exclusion: Incomplete questionnaire \( n=421 \)
  - Completed the questionnaire \( n=3,823 \)
    - Exclusions due to missing information \( n=30 \)
      - Sex \( n=11 \)
      - Profession \( n=1 \)
      - Age <16 \( n=18 \)
- Included in this study \( n=3,793 \)
Table S1: Grouping of the reasons for willingness or hesitancy to be vaccinated against COVID-19 or uncertainty about vaccination.

| Reasons for willingness to be vaccinated | Reasons for hesitancy to be vaccinated |
|-----------------------------------------|----------------------------------------|
| To protect myself from COVID-19 infection. | I think vaccinations are generally unnecessary. |
| Because I want to protect my colleagues at work and my patients. | Vaccination against COVID-19 is not necessary. |
| Because I want to protect my family members (parents, siblings, children, etc.). | I don't think COVID-19 is necessary. |
| Because my vaccination is a contribution to the fight against the pandemic. | I don't think COVID-19 is harmless. |
| Because this is the only way to stop the pandemic. | COVID-19 is no worse than the flu. |
| Because I belong to the risk groups. | I don't think the vaccine is effective. |
| Other reasons, please specify | I think the COVID-19 vaccine may not be safe. |
| Others | Other reasons, please specify |

| Reasons for hesitancy to be vaccinated | Reasons for being unsure about being vaccinated |
|----------------------------------------|-----------------------------------------------|
| I think vaccinations are generally unnecessary. | The information is inconsistent. |
| Vaccination against COVID-19 is not necessary. | The vaccines were too fast/quickly approved Swissmedic. |
| I don't think COVID-19 is harmless. | I fear possible side effects. |
| COVID-19 is no worse than the flu. | I don't know if the vaccination will provide protection for me and/or others. |
| I don't think the vaccine is effective. | I don't know if my vaccination will help contain the pandemic (herd immunity). |
| I think the COVID-19 vaccine may not be safe. | My colleagues are also unsure or against vaccination. |
| I am concerned that the vaccine was approved too quickly and has not been tested enough | I have not yet been educated by my employer. |
| I am afraid of possible side effects. | Education by employer |
| I have had a bad experience or reaction to a previous vaccination | Other |
| I had a bad experience with vaccinations at a previous physician or health clinic. | Other reasons, please specify |
| I am afraid of needles. | Others |
| I am already protected because I comply with protective measures (masks, hand hygiene). | Fear of needles. |
| I protect my environment because I follow the protective measures, therefore vaccination is unnecessary. | Personal protective equipment is sufficient. |
| Because some colleagues do not want to be vaccinated either. | Other reasons, please specify |
| Because the experts' opinions are inconsistent. | Other |
| The best way is to let nature take its course. | Inconsistent information. |
| Religious reasons. | The information is inconsistent. |
| Other reasons, please specify | The vaccines were too fast/quickly approved Swissmedic. |
| Others | I fear possible side effects. |
| Reasons for being unsure about being vaccinated | I don't know if the vaccination will provide protection for me and/or others. |
| The information is inconsistent | Information about COVID-19. |
| The vaccines were too fast/quickly approved Swissmedic | Information on the safety of the vaccination. |
| I fear possible side effects. | Information about possible side effects of the vaccination. |
| I don't know if the vaccination will provide protection for me and/or others. | Information about the effectiveness of the vaccination (does it protect me?). |
| Information about the effectiveness of the vaccination (does it protect me?) | Information about the vaccination procedure (e.g. how often vaccination is necessary). |
| Information on the vaccination. | Experiences and reports from people who have already been vaccinated. |
| Information about possible side effects of the vaccination. | Reported experiences from vaccinated people. |
| Information about the effectiveness of the vaccination (does it protect me?) | A statement from experts. |
| Information about the vaccination procedure (e.g. how often vaccination is necessary). | Opinion by experts. |
| Other | Other |

Information needed to take a decision

- General information about the disease COVID-19.
- Information on the safety of the vaccination.
- Information about possible side effects of the vaccination.
- Information about the effectiveness of the vaccination (does it protect me?).
- Information about the vaccination procedure (e.g. how often vaccination is necessary).
Table S2:
Participant characteristics by workplace.

|                          | Total | Hospital | Medical practice | Nursing home | Home care organisation | Pharmacy | Long-term care facilities |
|--------------------------|-------|----------|------------------|--------------|------------------------|----------|---------------------------|
|                          | 3,975 | 2,445    | 311              | 373          | 232                    | 34       | 398                       |
| Sex                      |       |          |                  |              |                        |          |                           |
| Male                     | 952 (25.1) | 576 (23.6) | 164 (52.7)      | 59 (15.8)    | 15 (6.5)               | 10 (29.4)| 128 (67.5)                |
| Female                   | 2,841 (74.9) | 1,869 (76.4) | 147 (47.3)      | 314 (84.2)   | 217 (93.5)             | 24 (70.6)| 270 (67.8)                |
| Age in years, median (IQR) | 43 (31–53) | 40 (30–52) | 52 (44–60)      | 46 (30–55)   | 49.5 (38.5–57)         | 49 (32–59)| 44 (31–55)                |
| Profession               |       |          |                  |              |                        |          |                           |
| Medical doctor           | 614 (16.2) | 372 (15.2) | 240 (77.2)      | 0            | 0                      | 0        | 2 (0.5)                   |
| Nurse                    | 1,690 (44.6) | 1,122 (45.9) | 6 (1.9)        | 287 (76.9)   | 193 (83.2)             | 0        | 82 (20.6)                 |
| Medical assistant        | 63 (1.7) | 0        | 56 (18.7)       | 2 (0.5)      | 2 (0.9)                | 0        | 1 (0.3)                   |
| Other medical staff      | 380 (10.0) | 380 (15.5) | 0                | 0            | 0                      | 0        | 0                         |
| Pharmacist               | 34 (0.9) | 0        | 0                | 0            | 0                      | 24 (70.6)| 0                         |
| Not close patient contact| 788 (20.8) | 571 (23.4) | 7 (2.3)         | 84 (22.5)    | 37 (16.0)              | 0        | 89 (22.4)                 |
| Willingness to get COVID-19 vaccine |        |          |                  |              |                        |          |                           |
| Yes                      | 1,511 (39.8) | 936 (38.3) | 226 (72.7)      | 126 (33.8)   | 79 (34.0)              | 24 (70.6)| 120 (30.2)                |
| No                       | 1,168 (30.8) | 726 (29.7) | 32 (10.3)       | 137 (36.7)   | 87 (37.5)              | 6 (17.6)| 180 (45.2)                |
| Unsure                   | 1,114 (29.4) | 783 (32.0) | 53 (17.0)       | 110 (29.5)   | 66 (26.5)              | 4 (11.8)| 96 (24.6)                 |
| Follow my employer’s recommendation |        |          |                  |              |                        |          |                           |
| Completely disagree      | 443 (11.7) | 237 (9.7) | 15 (4.8)        | 64 (17.2)    | 44 (19.0)              | 3 (8.8) | 80 (20.1)                 |
| Somewhat disagree        | 823 (16.4) | 403 (16.5) | 32 (10.3)       | 61 (16.4)    | 47 (20.3)              | 0        | 80 (20.1)                 |
| No opinion               | 893 (23.5) | 584 (23.9) | 74 (23.8)       | 101 (27.1)   | 49 (21.1)              | 8 (23.5)| 77 (19.4)                 |
| Somewhat agree           | 742 (19.6) | 528 (21.6) | 41 (13.2)       | 54 (14.5)    | 43 (18.5)              | 6 (17.7)| 70 (17.6)                 |
| Completely agree         | 1,092 (28.8) | 693 (28.3) | 149 (47.9)      | 93 (24.9)    | 49 (21.1)              | 17 (50.0)| 91 (22.9)                 |
| Confidence in the government reports |        |          |                  |              |                        |          |                           |
| Completely disagree      | 230 (6.1) | 129 (5.3) | 7 (2.3)         | 37 (9.9)     | 14 (6.0)               | 0        | 43 (10.8)                 |
| Somewhat disagree        | 638 (16.8) | 388 (15.9) | 33 (10.6)       | 74 (19.8)    | 48 (20.7)              | 6 (17.7)| 89 (22.4)                 |
| No opinion               | 645 (17.0) | 409 (16.7) | 31 (10.0)       | 76 (20.4)    | 47 (20.3)              | 5 (14.7)| 77 (19.4)                 |
| Somewhat agree           | 955 (25.2) | 645 (26.4) | 71 (22.8)       | 74 (19.8)    | 70 (30.2)              | 11 (32.4)| 84 (21.1)                 |
| Completely agree         | 1,325 (34.9) | 874 (35.8) | 169 (54.3)      | 112 (30.0)   | 53 (22.8)              | 12 (35.3)| 105 (26.4)                |
| Influenza vaccine 20/21   |        |          |                  |              |                        |          |                           |
| No                       | 2,229 (58.8) | 1364 (55.8) | 78 (25.1)       | 262 (70.2)   | 171 (73.7)             | 11 (32.4)| 343 (86.2)                |
| Yes                      | 1,446 (38.1) | 995 (40.7) | 222 (71.4)      | 102 (27.4)   | 58 (25.0)              | 20 (58.8)| 49 (12.3)                 |
| Unsure                   | 118 (3.1) | 86 (3.5) | 11 (3.5)       | 9 (2.4)      | 1 (0.6)               | 3 (2.4) | 6 (1.5)                   |

IQR = interquartile range
Data are n (%) unless otherwise stated.
* "Other medical staff" includes physical therapists, occupational therapists, speech therapists, and midwives.
Table S3: Sensitivity analysis: Determinants for the willingness to be vaccinated against COVID-19 (yes/unsure) among healthcare workers compared with healthcare workers with hesitancy.

| Variables | Total number of participants | Willingness to be vaccinated against COVID–19: n (%) | Comparison of willingness to be vaccinated against COVID–19 (yes/unsure) with persons with hesitancy |
|-----------|-------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------|
|           |                               | Yes | No |             | Unadjusted OR (95% CI) | p-value | Adjusted OR (95% CI)* | p-value |
| Total     | 3,793                         |     |    |             |                        |         |                       |         |
| Sex       |                               |     |    |             |                        |         |                       |         |
| Male      | 952                           | 756 (79.4) | 196 (20.6) | 1 | 0.050 (0.42–0.59) | <0.001 |                       |         |
| Female    | 2,841                         | 1869 (65.8) | 972 (34.2) | 1 | 0.50 (0.42–0.59) | <0.001 |                       |         |
| Age groups |                               |     |    |             |                        |         |                       |         |
| 29 and younger | 829                           | 448 (54.0) | 381 (46.0) | 1 | 1 | <0.001 | <0.001 |         |
| 30 to 39 | 807                           | 550 (68.2) | 257 (31.9) | 1.64 (1.33–2.03) 1.48 (1.12–1.97) | 1.48 (1.12–1.97) 1.70 (1.23–2.29) | <0.001 | <0.001 |         |
| 40 to 49 | 790                           | 575 (72.8) | 215 (27.2) | 2.21 (1.79–2.73) 1.70 (1.23–2.29) | 1.70 (1.23–2.29) 2.08 (1.58–2.73) | <0.001 | <0.001 |         |
| 50 to 59 | 1012                          | 758 (74.9) | 254 (25.1) | 2.61 (2.13–3.18) 2.08 (1.58–2.73) | 2.08 (1.58–2.73) 2.72 (1.79–4.13) | <0.001 | <0.001 |         |
| 60 and older | 355                            | 294 (82.8) | 61 (17.2) | 4.56 (3.50–5.94) 2.72 (1.79–4.13) | 2.72 (1.79–4.13) 2.72 (1.79–4.13) | <0.001 | <0.001 |         |
| Profession |                               |     |    |             |                        |         |                       |         |
| Medical doctor | 614                            | 559 (91.0) | 55 (9.0) | 6.22 (4.64–8.35) 1.93 (1.31–2.84) | 1.93 (1.31–2.84) 1.93 (1.31–2.84) | <0.001 | <0.001 |         |
| Nurse     | 1,690                         | 1,048 (62.0) | 642 (40.0) | 1 | 1 | <0.001 | <0.001 |         |
| Medical assistant | 63                            | 44 (69.4) | 19 (30.2) | 1.42 (0.82–2.45) 1.20 (0.56–2.57) | 1.20 (0.56–2.57) 1.20 (0.56–2.57) | <0.001 | <0.001 |         |
| Pharmacist and pharmacist assistant | 34                            | 28 (82.4) | 6 (17.6) | 2.68 (1.18–5.94) 0.85 (0.26–2.79) | 0.85 (0.26–2.79) 0.85 (0.26–2.79) | <0.001 | <0.001 |         |
| Other medical staff† | 380                           | 287 (75.5) | 93 (24.5) | 1.89 (1.47–2.44) 1.04 (0.73–1.47) | 1.04 (0.73–1.47) 1.04 (0.73–1.47) | <0.001 | <0.001 |         |
| No close patient contact | 788                           | 541 (68.6) | 246 (31.4) | 1.34 (1.12–1.61) 0.62 (0.41–0.94) | 0.62 (0.41–0.94) 0.62 (0.41–0.94) | <0.001 | <0.001 |         |
| Private caregiver | 224                           | 118 (52.7) | 106 (47.3) | 0.68 (0.52–0.90) 0.80 (0.62–1.04) | 0.80 (0.62–1.04) 0.80 (0.62–1.04) | <0.001 | <0.001 |         |
| Confidence in the government reports |                               |     |    |             |                        |         |                       |         |
| No opinion | 645                           | 407 (63.1) | 238 (36.9) | 1 | 1 | <0.001 | <0.001 |         |
| Completely and somewhat disagree | 868                           | 335 (38.6) | 533 (61.4) | 0.37 (0.30–0.45) 0.82 (0.62–1.09) | 0.82 (0.62–1.09) 0.82 (0.62–1.09) | <0.001 | <0.001 |         |
| Completely and somewhat agree | 2,280                          | 1,883 (82.6) | 397 (17.4) | 2.77 (2.29–3.36) 1.59 (1.23–2.06) | 1.59 (1.23–2.06) 1.59 (1.23–2.06) | <0.001 | <0.001 |         |
| Follow employer’s recommendation |                               |     |    |             |                        |         |                       |         |
| No opinion | 893                           | 610 (68.3) | 283 (31.7) | 1 | 1 | <0.001 | <0.001 |         |
| Completely and somewhat disagree | 1,066                          | 265 (24.9) | 801 (75.1) | 0.15 (0.13–0.19) 0.17 (0.13–0.21) | 0.17 (0.13–0.21) 0.17 (0.13–0.21) | <0.001 | <0.001 |         |
| Completely and somewhat agree | 1,834                          | 1,750 (95.4) | 84 (4.6) | 9.67 (7.45–12.54) 6.58 (4.94–8.76) | 6.58 (4.94–8.76) 6.58 (4.94–8.76) | <0.001 | <0.001 |         |
| Influenza vaccination 2020/21 |                               |     |    |             |                        |         |                       |         |
| No | 2,347                          | 1,328 (56.7) | 1,019 (43.4) | 1 | 1 | <0.001 | <0.001 |         |
| Yes | 1,556                          | 1,297 (89.7) | 149 (10.3) | 6.68 (5.53–8.06) 2.48 (1.94–3.17) | 2.48 (1.94–3.17) 2.48 (1.94–3.17) | <0.001 | <0.001 |         |

CI = confidence interval; OR = odds ratio
* Model adjusted for age groups, profession, confidence in the government reports, following employer’s recommendation, and influenza vaccination 2020/21.
† “Other medical staff” includes physical therapists, occupational therapists, speech therapists, and midwives.