

Awareness of vaccine-preventable diseases and self-reported immune status of Swiss dental healthcare workers

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Summary

INTRODUCTION: Dental healthcare workers are exposed to various infectious agents that may present an occupational risk. Although vaccinations rank among the most cost-effective health measures, vaccine hesitancy is present among healthcare workers.

METHODS: A structured anonymous questionnaire was completed by 1111 dental healthcare workers – dentists, dental hygienists, prophylaxis assistants, dental assistants, dental technicians, and dental students. Demographic data and immunisation status, either by vaccination or by immunity after disease, were collected. Additionally, employers and employees were asked about their current workplace vaccination policy, including questions about information provided on the risk of hepatitis B (HBV) infection, whether HBV vaccination was compulsory and who paid for compulsory vaccinations.

RESULTS: The overall response rate was 55.7%. Approximately half of the participants were dentists; only 17 technicians completed the questionnaire. The most common immunisation was for HBV (94.7% of participants). Only 19.2% of participants reported immunisation against human papillomavirus. Uncertainty over immunisation status was highest for *Haemophilus influenzae* type B (46.7%). Only a minority of participants (17.4%) received a yearly vaccination against seasonal influenza, whereas two-thirds never get vaccinated. The participants' level of awareness related to the seven general vaccinations (HBV, influenza, measles, mumps, rubella, varicella, and tetanus) was medium to high, whereas their level of awareness related to vaccinations against HBV and influenza was medium. Half of the employees stated that they were informed about the risk of HBV at their current workplace and over three-quarters of employers indicated that they provided such information to their employees. Compulsory HBV vaccination was implemented at approximately half of the dental practices.

CONCLUSION: The Swiss dental healthcare workers participating in this study had a medium level of awareness towards vaccinations. Almost all participants were vaccinated against HBV, but they were particularly hesitant about the seasonal influenza vaccination. As a considerable number of participants was unaware of their immunisation status, more comprehensive information on infectious diseases, vaccination and prevention is essential.

Introduction

Exposure to infectious agents is a well-known occupational risk for medical and dental healthcare workers. Routes of transmission may involve percutaneous injuries (a sharp object that cuts or penetrates the skin), or the contamination of mucous membranes of nose, eyes, or mouth, or of non-intact skin, with blood or body fluids of infectious patients. Dental healthcare workers are particularly at risk of pathogen transfer because of their close proximity to their patients and use of dental procedures involving aerosol production. Airborne pathogens include respiratory viruses such as influenza virus and bacterial species such as *Mycobacterium tuberculosis* or *Legionella pneumophila* [1, 2].

Exposure to blood-borne pathogens such as hepatitis C virus (HCV) or human immunodeficiency virus (HIV) may pose a particular risk to healthcare workers as they can lead to chronic diseases and incapacity for work [3]. Hepatitis B virus (HBV) infection used to present a considerable occupational risk to healthcare workers, particularly those routinely exposed to blood such as surgeons or pathologists [4, 5]. A study conducted in the 1980s at the Dental Institute of the University of Zurich, Switzerland, demonstrated that maxillofacial surgeons and nurses had increased rates of infection with HBV compared with the general population [6]. With the development of a vaccine against HBV, and the implementation of infection prevention and control programmes in dental settings, occupational infections with HBV among healthcare personnel have declined since the 1980s [7].

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To protect healthcare workers, medical and professional associations have implemented guidelines and recommendations for infection prevention. Such programmes usually include strategies for surface decontamination, sterilisation processes, hand disinfection, the use of personal protective equipment such as masks or gloves, and recommendations for vaccinations. Vaccinations are one of the most cost-effective of health measures. Vaccination protects not only the vaccinated individual but also indirectly protects people who cannot be vaccinated [8]. Healthcare personnel, including dental healthcare workers, have frequent and close contact with patients and are particularly at risk of exposure to potential infectious agents.

In Switzerland, the Federal Vaccination Commission and the Federal Office of Public Health decide whether a vaccination is recommended and for whom, and if the respective vaccination should be included in the Swiss vaccination schedule. In addition to the basic vaccinations for the general population, special recommendations are made for healthcare workers who have close contact with patients, including the recommendation for the yearly vaccination against seasonal influenza [9]. Despite these recommendations, healthcare workers remain hesitant towards vaccination [10, 11]. There are limited published data on the immunisation status of dental healthcare workers and their attitude towards vaccination. One study involving 379 Italian dentists reported that the participants expressed only a low-to-moderate awareness of vaccine-preventable diseases [12].

The present questionnaire-based study assessed the immunisation rates of Swiss dental healthcare workers including dentists, dental hygienists and prophylaxis assistants, dental assistants, dental technicians, and dental students. In addition, the awareness of these groups of vaccinations and vaccination policies at their workplaces were analysed.

Materials and methods

Questionnaire

A structured anonymous questionnaire, available both in German and in French, was given to participants at the annual meeting of the Swiss Dental Association SSO, the professional organisation of Swiss dentists, in May 2018. At this meeting, both dentists and dental hygienists were asked to fill in the paper questionnaires, which were later collected again on site. In order to also include dental students and other dental professions such as dental assistants or dental technicians, the questionnaires were also distributed through their cantonal dental societies and by the four Swiss universities from May 2018 to May 2019. The respective dental societies and the universities were first contacted by phone, then the appropriate number of questionnaires was sent by post and completed questionnaires were returned for analysis.

All dental healthcare workers, namely, dentists, dental hygienists, prophylaxis assistants, dental assistants, dental technicians, and dental students were included. A jurisdictional inquiry was submitted to the Ethics Committee for Northwest- and Central Switzerland, which approved the study and concluded that participants gave informed consent by completing the questionnaire.

The questionnaire was divided into three parts. In the first part, demographic information, such as age, gender, and main focus of their practical work, was obtained from the participants. In the second part, participants were asked about their immunisation status, either by vaccination or by immunity after disease. In particular, immunisation against diseases covered by basic vaccinations as recommended by the Swiss vaccination schedule, was investigated [9]. Positive and negative answers were recorded; the answers "I do not know" and questions left blanks were combined to "uncertain". Additionally, participants were asked if they knew their post-vaccination hepatitis B antibody titre and if they regularly received the seasonal influenza vaccination. The immunisation status against hepatitis C (HCV) was included in the list to verify the reliability of responses. As there is currently no vaccine available for HCV, a positive response to this question would indicate that the participant may not truly know their vaccination status. In the third part, employees and employers were asked if they were provided with (or provided) information about the risk of HBV infection at their workplace, if HBV vaccination was compulsory at their workplace, and if so, who paid for the compulsory vaccination.

Level of vaccination awareness among dental healthcare workers

The level of awareness was assessed using the method described by Petti et al., who distinguished between dentists' specific awareness and their general awareness towards vaccine-preventable infectious diseases (VPID) [12]. The VPID awareness included seven vaccinations against HBV, influenza, measles, mumps, rubella, varicella, and tetanus. For each positive response, a score of 1 was given. After adding up the individual scores, the participants' VPID awareness level was classified into high (score of 6–7), medium (score of 3–5), and low (score of 0–2). The specific awareness addressed affirmative responses to HBV and influenza vaccination, the two main diseases likely to be transmitted in a dental practice, and participants were classified as high (if they had both vaccinations), medium (if they had one of these vaccinations) or low (if they had none of these two vaccinations).

Statistical analysis

Data were summarised using descriptive statistics with counts and frequencies for categorical data, and median (interquartile range) for metric variables. The Kruskal-Wallis test (for median) and chi-square or exact Fisher test was applied when the expected frequencies was less than 5 in some cell.

The level of significance was set at $\alpha = 0.05$. All evaluations were done using the statistical software R (R Foundation for Statistical Computing, Vienna, Austria, R version 4.0.2.).

Results

Participation rate

A total of 1114 questionnaires were completed, three of which had to be excluded for being incomplete or making contradictory statements. Of the resulting 1111 questionnaires, 331 were completed directly at the dental congress

Table 1:
Characteristics of participants by profession.

		Dentist (n = 561)	DH/DA/PA (n = 377)	Student (n = 156)	Technician (n = 17)	Total (n = 1111)	p-value (overall)
Mean age in years (min–max)		48.0 (24.0–80.0)	31.0 (15.0–64.0)	24.0 (20.0–33.0)	45.0 (16.0–66.0)	36.0 (15.0–80.0)	<0.001
Gender, n (%)	Female	242 (43.1%)	369 (97.9%)	107 (68.6%)	7 (41.2%)	725 (65.2%)	<0.001
	Male	318 (56.7%)	7 (1.9%)	49 (31.4%)	10 (58.8%)	384 (34.6%)	
Position, n (%)	Employer	344 (61.3%)	0 (0.0%)	0 (0.0%)	4 (23.5%)	348 (31.3%)	<0.001
	Employee	217 (38.7%)	377 (100.0%)	156 (100.0%)	13 (76.5%)	763 (68.7%)	

DA: dental assistants; DH: dental hygienists, PA: prophylaxis assistants.

Gender: 1109 responses and 2 missing values.

and 780 questionnaires were obtained through the dental societies and the four Swiss universities, resulting in a response rate of 55.7% (fig. 1). There are around 5000 dentists who are members of the Swiss Dental Association SSO. With 561 participants who were dentists, around 10% of Swiss dentists participated in this survey.

Most of the questionnaires (933; 84.0%) were completed in German and 178 (16.0%) in French. The characteristics of the participants are summarised in table 1.

Dentists accounted for approximately half of the participants whereas only 17 technicians handed in a complete questionnaire. The majority of participants were female (65.4%). Almost two thirds of the participating dentists worked in their own practice, whereas 217 (38.7%) of them were employees (table 1). Most dentists focused on general dentistry (76%) and work in specialised areas was less frequently stated (table 2).

Figure 1: Flowchart of included questionnaires.

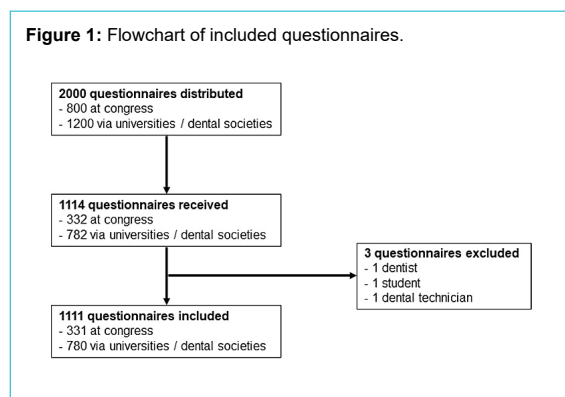


Table 2:
Focus of practice of the participating dentists with several answers possible, with the number (and percentage) of dentists working in the respective field of specialisation.

Focus of practice	Number of dentists, n (%) (n = 561)
General dentistry	426 (75.9%)
Preventive and restorative dentistry	153 (27.3%)
Reconstructive dentistry	153 (27.3%)
Cariology	133 (23.7%)
Endodontology	117 (20.9%)
Paediatric dentistry	110 (19.6%)
Implantology	97 (17.3%)
Surgery	97 (17.3%)
Periodontology	82 (14.6%)
Orthodontics	70 (12.5%)

Basic immunisations

The immunisation status of the participants for basic vaccinations as recommended by the Swiss vaccination schedule is shown in table 3. The most commonly reported immunisation among all professions was HBV, with 1052 (94.7%) participants answering affirmatively. Only 213 (19.2%) participants reported immunization against human papillomavirus (HPV). Uncertainty over the immunisation status was highest for the *H. influenzae* type B (n = 519, 46.7%).

Although no vaccine is currently available for HCV, 246 participants (22.1%) gave positive responses to this reliability question. The two groups, participants who responded positively (n = 246) and participants who responded negatively or other (n = 865) were analysed for differences in their answers about basic vaccinations. There were statistically significant differences between the two groups in their immunisation status against diphtheria (p = 0.002), pertussis (p < 0.001), *H. influenzae* type B (p = 0.002), hepatitis A (p < 0.001), HBV (p = 0.039), HPV (p = 0.014) and varicella (p = 0.013). Additionally, statistically significant differences were noted in the answers regarding the HBV antibody titre (p = 0.002) and the annual vaccination against seasonal influenza (p = 0.016). No tendency towards affirmative or negative trends between the two groups was observed.

Only a minority (17.4%) of participants indicated that they received a yearly vaccination against seasonal influenza, and two-thirds never received a vaccination. The stated reasons for refusing vaccination were: having a good immune system (45.2%), no interest (24.3%), fear of falling ill from the vaccination (18.2%), having no time (9.1%), or vaccine hesitancy (5.3%).

Workplace vaccination policy

Half of the employees stated that they were informed about the risk of HBV transmission at their current workplace, and approximately three quarters of the employers indicated that they provided such information to their employees. A compulsory HBV vaccination was implemented at approximately half of the dental practices; more employers (53.4%) than employees (45.1%) indicated that HBV vaccination was compulsory at their workplace. The costs for the HBV vaccination were mostly paid personally by the employees (table 4).

Level of vaccination awareness among dental health-care workers

The VPID awareness level included seven basic vaccinations (table 5). Statistically significant differences were detected among the different age categories (p = 0.03). More

than half of the students and the dentists had a high VPID awareness level, which means that they had six or seven of the respective vaccinations. By contrast, a medium VPID awareness level was most frequently noted for dental hygienists / dental assistants / prophylaxis assistants and technicians ($p < 0.001$). A small difference was found for the language in which the questionnaire was completed ($p = 0.01$), whereas no differences were detected between male and female participants ($p = 0.8$).

Most of the participants had either the vaccination against HBV or against influenza, resulting in a medium level of specific awareness, whereas only 17.1% reported having both vaccinations. Statistically significant differences

were again detected among the different age categories, which were more pronounced than for the VPID awareness ($p < 0.001$). This primarily resulted from younger persons below the age of 35, who were more likely to have a medium level of specific awareness whereas participants aged over 55 more frequently had none or both vaccinations. Age-related data for the different age categories on the immunisation status for influenza and HBV as well as knowledge of the anti-HBV titre are given in table 6.

Statistically significant differences were also noted for the different professions ($p < 0.001$), with dentists having the highest level of specific awareness, whereas only half of the technicians had at least one of the two vaccinations.

Table 3:
Immunisation status, by vaccination or by immunity after disease, of the participants.

		Dentists (n = 561)	DH/DA/PA (n = 377)	Students (n = 156)	Technicians (n = 17)	Total (n = 1,111)	p-value (overall)
Diphtheria	Yes	430 (76.6%)	180 (47.7%)	122 (78.2%)	9 (52.9%)	741 (66.7%)	<0.001
	No	20 (3.6%)	32 (8.5%)	5 (3.2%)	3 (17.7%)	60 (5.4%)	
	Uncertain	111 (19.8%)	165 (43.8%)	29 (18.6%)	5 (29.4%)	310 (27.9%)	
Tetanus	Yes	525 (93.6%)	307 (81.4%)	145 (92.9%)	10 (58.8%)	987 (88.8%)	<0.001
	No	8 (1.4%)	18 (4.8%)	2 (1.3%)	2 (11.8%)	30 (2.7%)	
	Uncertain	28 (5.0%)	52 (13.8%)	9 (5.8%)	5 (29.4%)	94 (8.5%)	
Pertussis	Yes	407 (72.5%)	143 (37.9%)	96 (61.5%)	4 (23.5%)	650 (58.5%)	<0.001
	No	30 (5.4%)	44 (11.7%)	7 (4.5%)	5 (29.4%)	86 (7.7%)	
	Uncertain	124 (22.1%)	190 (50.4%)	53 (34.0%)	8 (47.1%)	375 (33.8%)	
Poliomyelitis	Yes	459 (81.8%)	179 (47.5%)	104 (66.7%)	8 (47.0%)	750 (67.5%)	<0.001
	No	19 (3.4%)	29 (7.7%)	8 (5.1%)	2 (11.8%)	58 (5.2%)	
	Uncertain	83 (14.8%)	169 (44.8%)	44 (28.2%)	7 (41.2%)	303 (27.3%)	
H. influenza type B	Yes	158 (28.2%)	48 (12.7%)	40 (25.6%)	0 (0.0%)	246 (22.1%)	<0.001
	No	177 (31.5%)	104 (27.6%)	58 (37.2%)	7 (41.2%)	346 (31.2%)	
	Uncertain	226 (40.3%)	225 (59.7%)	58 (37.2%)	10 (58.8%)	519 (46.7%)	
HAV	Yes	373 (66.5%)	238 (63.1%)	113 (72.4%)	8 (47.1%)	732 (65.9%)	0.108
	No	98 (17.5%)	67 (17.8%)	18 (11.6%)	6 (35.3%)	189 (17.0%)	
	Uncertain	90 (16.0%)	72 (19.1%)	25 (16.0%)	3 (17.6%)	190 (17.1%)	
HBV	Yes	535 (95.4%)	352 (93.4%)	156 (100%)	9 (52.9%)	1052 (94.7%)	<0.001
	No	8 (1.4%)	8 (2.1%)	0 (0%)	5 (29.4%)	21 (1.9%)	
	Uncertain	18 (3.2%)	17 (4.5%)	0 (0%)	3 (17.7%)	38 (3.4%)	
HCV	Yes	110 (19.6%)	110 (29.2%)	26 (16.7%)	0 (0.0%)	246 (22.2%)	<0.001
	No	277 (49.4%)	150 (39.8%)	91 (58.3%)	10 (58.8%)	528 (47.5%)	
	Uncertain	174 (31.0%)	117 (31.0%)	39 (25.0%)	7 (41.2%)	337 (30.3%)	
Measles	Yes	486 (86.6%)	277 (73.5%)	151 (96.8%)	10 (58.8%)	924 (83.2%)	<0.001
	No	30 (5.4%)	31 (8.2%)	2 (1.3%)	3 (17.7%)	66 (5.9%)	
	Uncertain	45 (8.0%)	69 (18.3%)	3 (1.9%)	4 (23.5%)	121 (10.9%)	
Mumps	Yes	478 (85.2%)	240 (63.6%)	151 (96.8%)	10 (58.8%)	879 (79.1%)	<0.001
	No	33 (5.9%)	47 (12.5%)	2 (1.3%)	3 (17.7%)	85 (7.7%)	
	Uncertain	50 (8.9%)	90 (23.9%)	3 (1.9%)	4 (23.5%)	147 (13.2%)	
Rubella	Yes	460 (82.0%)	269 (71.4%)	148 (94.9%)	10 (58.8%)	887 (79.8%)	<0.001
	No	39 (6.9%)	32 (8.4%)	3 (1.9%)	3 (17.7%)	77 (7.0%)	
	Uncertain	62 (11.1%)	76 (20.2%)	5 (3.2%)	4 (23.5%)	147 (13.2%)	
HPV	Yes	76 (13.5%)	56 (14.9%)	81 (51.9%)	0 (0.0%)	213 (19.2%)	<0.001
	No	318 (56.7%)	138 (36.6%)	55 (35.3%)	8 (47.1%)	519 (46.7%)	
	Uncertain	167 (29.8%)	183 (48.5%)	20 (12.8%)	9 (52.9%)	379 (34.1%)	
Varicella	Yes	275 (49.0%)	110 (29.2%)	87 (55.8%)	6 (35.3%)	478 (43.0%)	<0.001
	No	125 (22.3%)	95 (25.2%)	30 (19.2%)	4 (23.5%)	254 (22.9%)	
	Uncertain	161 (28.7%)	172 (45.6%)	39 (25.0%)	7 (41.2%)	379 (34.1%)	
Seasonal Influenza	Yes	148 (26.4%)	23 (6.1%)	22 (14.1%)	0 (0.0%)	193 (17.4%)	<0.001
	No	321 (57.2%)	310 (82.2%)	106 (67.9%)	15 (88.2%)	752 (67.7%)	
	Sporadic	90 (16.0%)	41 (10.9%)	28 (18.0%)	1 (5.9%)	160 (14.4%)	
	No answer	2 (0.4%)	3 (0.8%)	0 (0.0%)	1 (5.9%)	6 (0.5%)	
Known anti-HBV-titer	Yes	475 (84.7%)	225 (59.7%)	155 (99.4%)	4 (23.5%)	859 (77.3%)	<0.001
	No	56 (10.0%)	74 (19.6%)	0 (0.0%)	6 (35.3%)	136 (12.3%)	
	Uncertain	30 (5.3%)	78 (20.7%)	1 (0.6%)	7 (41.2%)	116 (10.4%)	

Data are n (%). DA: dental assistants; DH: dental hygienists, HAV/HBV/HCV: hepatitis A/B/C virus; HPV: human papillomavirus; PA: prophylaxis assistants.

Only small differences were found between gender ($p = 0.03$), or language groups in which the questionnaire was completed ($p = 0.05$).

More than 80% of the dentists knew their anti-HBV titre. Dentists with high exposure to patients' blood such as those specialising in oral surgery, periodontology, and/or implantology, were not more likely to know their HBV-antibody titre than dentists working in other dental fields ($p = 0.65$). Likewise, a specialisation in orthodontics and/or paediatric dentistry was not associated with a higher immunisation status against the childhood diseases pertussis, measles, mumps, rubella, and varicella than dentists specialising in other fields ($p = 0.87$).

Discussion

The present survey investigated the immunisation status and level of vaccination awareness amongst different groups of dental healthcare workers. The results demonstrated that whereas most of the participants were vaccinated against HBV, less than 20% regularly receive the seasonal influenza vaccination, resulting in a medium level of specific awareness. The participants' level of VPID awareness, which includes seven vaccinations, was medium to high. It has to be noted, however, that our sample might not be representative for all Swiss dental healthcare workers.

Our results indicate that Swiss dentists tend to be reluctant to be vaccinated, which is in accordance with a recent

Table 4:

Information about HBV risk, the HBV vaccination policy, and cost coverage of this vaccination provided by the employer or received by the employee at the respective workplace.

		Employer (n = 348)	Employee (n = 763)	p-value (overall)
Information on HBV risks given to / received by employees?	Yes	265 (76.1%)	380 (49.8%)	<0.001
	No	75 (21.6%)	274 (35.9%)	
	Uncertain	8 (2.3%)	109 (14.3%)	
HBV-vaccination compulsory?	Yes	186 (53.4%)	343 (45.0%)	<0.001
	No	127 (36.5%)	102 (13.3%)	
	Uncertain	35 (10.1%)	318 (41.6%)	
Cost coverage by employer?	Yes	84 (24.1%)	91 (11.9%)	<0.001
	No	155 (44.5%)	372 (48.8%)	
	Uncertain	109 (31.3%)	300 (39.3%)	

Data are n (%). HBV: hepatitis B virus.

Table 5:

Level of awareness related to vaccinations overall and for different age categories, profession, gender, and language.

		VPID awareness			p-value (overall)	Specific awareness			p-value (overall)
		Low	Medium	High		Low	Medium	High	
All participants (n = 1111)		138 (12.4%)	518 (46.6%)	455 (41.0%)		56 (5.0%)	865 (77.9%)	190 (17.1%)	
Age categories (n = 1,111)	<35 (n = 517)	60 (11.6%)	233 (45.1%)	224 (43.3%)	0.026	15 (2.9%)	447 (86.5%)	55 (10.6%)	<0.001
	35–44 (n = 172)	14 (8.1%)	88 (51.2%)	70 (40.7%)		5 (2.9%)	133 (77.3%)	34 (19.8%)	
	45–54 (n = 182)	22 (12.1%)	97 (53.3%)	63 (34.6%)		13 (7.2%)	140 (76.9%)	29 (15.9%)	
	≥55 (n = 240)	42 (17.5%)	100 (41.7%)	98 (40.8%)		23 (9.6%)	145 (60.4%)	72 (30.0%)	
Profession (n = 1111)	Dentist (n = 561)	48 (8.6%)	221 (39.4%)	292 (52.0%)	<0.001	23 (4.1%)	393 (70.1%)	145 (25.8%)	<0.001
	DH/DA/PA (n = 377)	81 (21.5%)	219 (58.1%)	77 (20.4%)		25 (6.6%)	329 (87.3%)	23 (6.1%)	
	Student (n = 156)	3 (2.0%)	69 (44.2%)	84 (53.8%)		0 (0.0%)	134 (85.9%)	22 (14.1%)	
	Technician (n = 17)	6 (35.3%)	9 (52.9%)	2 (11.8%)		8 (47.1%)	9 (52.9%)	0 (0.0%)	
Gender (n = 1109)	Male (n = 384)	45 (11.7%)	177 (46.1%)	162 (42.2%)	0.758	21 (5.5%)	283 (73.7%)	80 (20.8%)	0.033
	Female (n = 725)	93 (12.8%)	341 (47.0%)	291 (40.2%)		35 (4.8%)	582 (80.3%)	108 (14.9%)	
Language (n = 1111)	German (n = 933)	111 (11.9%)	453 (48.6%)	369 (39.5%)	0.013	41 (4.4%)	736 (78.9%)	156 (16.7%)	0.047
	French (n = 178)	27 (15.2%)	65 (36.5%)	86 (48.3%)		15 (8.4%)	129 (72.5%)	34 (19.1%)	

Data are n (%). DA: dental assistants; DH: dental hygienists; PA: prophylaxis assistants.

VPID awareness: level of awareness related to the seven vaccinations against HBV, influenza, measles, mumps, rubella, varicella and tetanus.

Specific awareness: level of awareness related to vaccinations against HBV and influenza.

Table 6:

Age-related immunisation status, by vaccination or by immunity against influenza, HBV and known anti-HBV titre for the different age categories.

		<35 (n = 517)	35–44 (n = 172)	45–54 (n = 182)	+55 (n = 240)	Total (n = 1111)	p-value (overall)
HBV	Yes	502 (97.1%)	167 (97.1%)	169 (92.9%)	214 (89.2%)	1052 (94.7%)	<0.001
	No	5 (1.0%)	0 (0.0%)	6 (3.3%)	10 (4.1%)	21 (1.9%)	
	Uncertain	10 (1.9%)	5 (2.9%)	7 (3.8%)	16 (6.7%)	38 (3.4%)	
Known anti-HBV-titer	Yes	400 (77.4%)	148 (86.0%)	143 (78.6%)	168 (70.0%)	859 (77.3%)	0.001
	No	54 (10.4%)	14 (8.2%)	22 (12.1%)	46 (19.2%)	136 (12.2%)	
	Uncertain	63 (12.2%)	10 (5.8%)	17 (9.3%)	26 (10.8%)	116 (10.5%)	
Seasonal influenza	Yes	55 (10.6%)	34 (19.8%)	29 (15.9%)	75 (31.2%)	193 (17.4%)	<0.001
	No	359 (69.5%)	119 (69.2%)	137 (75.3%)	137 (57.1%)	752 (67.7%)	
	Uncertain	103 (19.9%)	19 (11.0%)	16 (8.8%)	28 (11.7%)	166 (14.9%)	

"uncertain" includes the answers "I do not know" and questions left blank or, in the case of influenza, answers given as "irregular vaccination".

study in Italy, where the overall level of awareness toward vaccine-preventable diseases in a sample of 379 Italian dentists was described as moderate-to-low. In particular, one-third of the participating dentists stated they received the seasonal annual influenza vaccine and had checked their serum level of antibodies against HBV surface antigen (anti-HBs) during the prior 10 years. Additionally, more than half of the dentists reported having received none or only one out of seven different vaccinations [12].

With a prevalence of almost 95%, HBV immunisation was the most frequently reported immunisation in the present study. Dental healthcare workers such as oral surgeons, who have regular contact with blood and saliva, have an increased risk of being infected with HBV [13]. In a Swiss study in 1982, 11.2% of the dental healthcare workers were found to be seropositive for HBV antigens, a rate that was almost twice as high as in the general population at the Dental Institute of the University of Zurich. The risk was highest for dental surgeons, dental surgery nurses, and dentists treating risk-prone patients, for example drug users. Additionally, dental healthcare workers with more years of professional experience showed higher rates of infection with HBV [6]. Today, it is common practice in Switzerland to vaccinate adolescents and risk groups against HBV, resulting in a reduction in the number of cases of acute hepatitis B [14]. This was evident in the present study, as all students reported being vaccinated against HBV, with all but one knowing their individual serum level of anti-HBs. In contrast, only half of the participating dental technicians were vaccinated against HBV. This result may be biased owing to the small number of dental technicians included in the study, but it is conceivable that fewer direct patient contacts of technicians might result in a lower risk assessment and vaccination rate by this group. However, the actual risk might be higher than perceived for this professional group. In a study conducted among US Air Force personnel, the incidence of detecting anti-HBc was 2.7% for dental technicians compared with 0.76% for military members of equivalent age and rank working in non-medical fields [15].

Influenza vaccination rates among healthcare workers worldwide are generally low [16]. As in other countries, Swiss healthcare workers are recommended to be vaccinated annually against seasonal influenza. However, in the present study only 17.4% of respondents reported that they were regularly vaccinated. Dentists were more likely to receive an annual influenza vaccination than the other dental professions. This is in accordance with a recent study, where medical doctors working in a Swiss gynaecological hospital had higher vaccination rates than nurses, midwives, and non-medical staff [17]. Healthcare workers reportedly get vaccinated against influenza mainly for their own benefit and not for their patients' benefit [16]. As the efficacy of influenza vaccine is lower in the elderly and immunocompromised persons [18], indirect protection by vaccinated younger persons and healthcare workers is valuable. Through information campaigns, lectures, and on-site vaccination programmes, a significant increase in vaccine acceptance and increases in influenza vaccination rates can be achieved [19, 20].

The immunisation status against HCV was included in the list to verify the reliability of responses. Although partic-

ipants were given the option to respond "do not know" if they were not aware of their immunisation status, more than one-fifth of all participants indicated that they were immunised against HCV. No vaccination is currently available for HCV and the prevalence of HCV infection is generally low among dental personnel [21, 22]. It is therefore unlikely that these participants had immunity to HCV due to a prior infection, but, more likely, a considerable number of participants was unaware of their immunisation status. This presents a major limitation of this study. Ideally, the participants report their immunisation status based on the data in their vaccination card or respond "do not know" if they have no access to their vaccination card. Therefore, the results depicted in table 3 should be interpreted with caution. The National Vaccination Strategy aims to identify and eliminate weak points such as access to vaccinations and to improve the health literacy regarding vaccinations of different stakeholder groups, as well as to implement a nationwide or even international Electronic Patient Record [23]. However, vaccinations are not mandatory in Switzerland.

In the present study, a discrepancy was observed between employers and employees regarding compulsory vaccination policy and cost coverage. This might be a true difference, as the employers and employees in this study were not matched to individual workplaces. Alternatively, it might be an indication that communication between employers and employees regarding the importance of vaccination for healthcare workers needs to be improved. Healthcare workers, including dental personnel, remain reluctant to be vaccinated. This might be of special importance in the light of the current COVID-19 pandemic [24]. Worldwide, healthcare workers' hesitancy about COVID-19 vaccination ranged from 4.3% to 72%, with an average of 22.5% [25]. In Switzerland, too, the willingness to be vaccinated against COVID-19 seems to be low among healthcare workers [26]. The current communication and education initiatives by health authorities may potentially change this vaccination hesitancy. In this context, it might be of interest to analyse possible changes in the attitudes of dental healthcare workers toward vaccination in general after the current COVID-19 pandemic.

As a considerable number of participants were unaware of their immunisation status, more comprehensive information on infectious diseases, vaccination and prevention is essential. This can be achieved by addressing this issue already during the dental curriculum and regularly at continuing education events. Additionally, it is recommendable for medical institutions to find effective ways to obtain sufficient vaccination coverage of their personnel to protect both personnel and patients. In the dental field, the Swiss Dental Association SSO plays an important role in educating and informing their members on vaccine-preventable diseases including COVID-19.

In conclusion, the Swiss dental healthcare workers participating in this study had a medium level of awareness towards vaccinations. Almost all were immunised against HBV, but they remained especially hesitant about the seasonal influenza vaccination. A considerable number of participants were unaware of their immunisation status. Therefore, increased attention should be paid to vaccine-preventable diseases in a dental practice with a stronger fo-

cus on the indirect protection of vulnerable persons by vaccinated healthcare personnel.

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