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What impact does the attitude toward COVID-19 vaccination have on physicians as vaccine providers? A cross sectional study from the German outpatient sector

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A R T I C L E   I N F O

Article history:
Received 21 September 2022
Received in revised form 17 November 2022
Accepted 18 November 2022
Available online 25 November 2022

Keywords:
Outpatients
Vaccination
Persuasive communication
Health education
COVID-19
COVID-19 vaccines
Cross-sectional studies

A B S T R A C T

Background: COVID-19 vaccination is recognized as a key component in addressing the COVID-19 pandemic. Physicians’ attitudes toward vaccination are known to play a defining role in the management and dissemination of medical advice to patients. In Germany, outpatient practitioners are predominantly responsible for the dissemination of vaccines.

Method: Using a cross-sectional online survey, 932 outpatient general practitioners, gynecologists, and pediatricians in Germany were asked in fall, 2021, about their attitude toward COVID-19 vaccination and — among others — their communication in vaccine discussions, their assessment of vaccine safety, and reporting of suspected adverse events. Physicians were divided into two groups along their attitudes toward COVID-19 vaccination. In addition, multivariate linear regression models were constructed to assess differences in communication strategies.

Results: 92% of physicians had a positive or very positive attitude toward COVID-19 vaccination. Own vaccination status, practice-based vaccination delivery, and estimated vaccination coverage among patients were significantly associated with the attitude toward vaccination. Confidence in vaccine safety was significantly lower among physicians with negative attitudes. There were no differences between the two groups in self-assessment of the ability to detect suspected adverse events, but there were differences in the observing and reporting of adverse events. For the linear regression models, we found that a more negative attitude toward COVID-19 vaccination was significantly associated with increased acceptance of patient refusal of COVID-19 vaccination and empathic behavior for patient concerns. In contrast, willingness to engage in a detailed persuasion consultation was significantly lower. Pediatricians showed significantly higher empathy for patient-side concerns compared to general practitioners, whereas gynecologists showed less empathy than general practitioners.

Discussion: The physician’s attitude toward COVID-19 vaccination influences the physician’s practices as a vaccine provider. However, when providing medical advice and healthcare, the physician should focus on the actual needs of the patient.

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1. Background

The SARS-COV-2 pandemic has been marked by the most rapid development and approval of vaccines and the roll-out of the largest vaccination programs in the history of modern medicine. In this regard, vaccines have been widely credited with making a significant contribution to addressing the pandemic by preventing severe disease progression and COVID-19-related deaths.

COVID-19 vaccines have been met with a wide range of attitudes, from supportive to hesitant or openly dismissive [1]. Hesitant attitudes toward vaccines have a long history and exist for many vaccines [2,3]. Additionally, these hesitant attitudes are not limited to patients and parents [4–6] but are found among medical personnel in general [7,8] and physicians in particular [9,10].

In Germany, the outpatient sector has played an important role in the COVID-19 vaccination campaign. Indeed, outside of high-risk groups, the nationwide vaccination campaign was largely conducted by the outpatient sector. This sector was likewise an important pillar in the booster vaccination campaign.
Physicians play multiple roles in vaccination. They are the main vaccine providers in Germany – and they are vaccine recipients themselves, of course. From research on other vaccinations, it is well-known that hesitant vaccine attitudes among healthcare workers (HCW) negatively affect vaccination recommendations to patients [13,14], and that the physician’s attitude toward a vaccination can affect their professional behavior [15]. This phenomenon is especially relevant for physicians, as medical and physician staff play a significant role in communicating the benefits and risks of vaccinations to patients [1,16–18]. For example, studies have shown that physicians are the most important source of information for patients [19] and that medical advice from this professional group is one of the most important contributors to patients’ vaccination decisions [20,21].

While some empirical research has focused on HCWs’ attitudes toward COVID-19 vaccination and willingness to be vaccinated [22–26], the outpatient sector has been less frequently examined [22,27]. Moreover, there has been little empirical research in Germany and worldwide on the impact of the attitudes toward COVID-19 vaccination on physicians’ performance as vaccine providers in the outpatient sector [27].

In principle, the patient’s interests should be at the center of the provision of medical information regarding medical interventions. Indeed, in Germany, physicians have a legal duty to inform patients about a medical intervention in a neutral and evidence-based manner. A greater understanding of physicians’ attitudes toward COVID-19 vaccination and the impact on physician behavior toward patients may contribute to successfully address the challenges of the COVID-19 pandemic. Therefore, this study aims to

(i) assess attitudes toward COVID-19 vaccination among main vaccine providers in Germany, and
(ii) examine how physicians with negative attitudes toward COVID-19 vaccines differed from those with positive attitudes concerning their vaccination status, performing of vaccination services in their practice, confidence in detecting adverse events and reporting such events, and handling of vaccine discussions – both their communication self-efficacy when talking with patients about vaccinations and communication strategies used in those discussions.

This study provides a better understanding of vaccination efforts in the outpatient sector and the contribution of physicians during the COVID-19 pandemic.

**German vaccination campaign**

In Germany, the first COVID-19 vaccine (Comirnaty) was deployed in high-risk groups and medical professionals in December 2020; over time, other vaccines were subsequently added. By the beginning of the survey period of the present study (September 2021), four vaccines with conditional approval from the European Medicines Agency and a recommendation by the German Standing Committee on Vaccination (Ständige Impfkommission) were available for use in Germany. The first vaccine (Comirnaty) for adolescents (12–17 years) was licensed at the end of May 2021, and the license was extended at the end of November 2021 to a low-dose (pediatric vaccine) for children between 6 and 11 years of age. In Germany, the COVID-19 vaccination program was initially not delivered via the outpatient sector as is usually the case (e.g. for flu vaccination), but a nationwide structure of vaccination centers was established to enable the fastest possible distribution of vaccines. It was not until April 2021 – four months into the vaccination campaign – that physicians in private practice were integrated into the vaccination campaign on a nationwide basis. Over the course of 2021, vaccination recommendations on individual vaccines, their use in different age groups, intervals between two vaccinations, and cross-vaccinations were continuously changed, meaning that, by the end of 2021, a heterogeneous vaccination schedule had emerged (see Supplementary data 1).

**2. Methods**

**2.1. Design**

The data analyzed for this study were collected in the third and final wave of a series of cross-sectional online surveys from the COVID-GAMS study (The COVID-19 Crisis and its impact on the German ambulatory sector—the physicians’ view; German Federal Ministry of Education and Research (BMBF 01KI2099, https://www.bmbf.de/bmbf/en/)). The third wave was conducted from mid-September until the end of November 2021. In this study, we focused on general practitioners (GPs), gynecologists, and pediatricians (PEDs), since these physicians are the main vaccine providers in Germany. Indeed, these physician groups are an important research target in terms of informational discussions about vaccination with patients as well as the occurrence of unexpected reactions to medical treatment.

**2.2. Participants and recruitment**

A total of 18,000 outpatient physicians were invited to participate in the online survey: GPs (6,500), dentists (4,000), gynecologists (2,000), PEDs (2,000), otolaryngologists (2,000), cardiologists (1,000), and gastroenterologists (500). This broader survey population from which we derived our study population was selected to examine outpatient care during the COVID-19 pandemic from the perspective of different medical disciplines. The address data for the random study sample were selected in collaboration with the National Association of Statutory Health Insurance Physicians. Personalized invitations were sent by fax and e-mail, followed by three reminders at 2-week intervals. In addition, physicians were invited to participate in the survey via the project homepage (www.covid-gams.de) and various specialist and medical associations were contacted which in turn informed about the survey via newsletters and homepages. Therefore, the study sample comprises of two groups regarding access to the survey: a group with personalized invitation and group who participated via an open survey link. The survey (including invitation letter, study and privacy information) was approved by the Ethics Committee of the University of Cologne (20–1169_1). The online survey was conducted anonymously, so in accordance with the ethics vote, only implicit consent had to be obtained. Participation in the survey was voluntary and could be terminated at any time. No expense allowance or payment was given for participation.

**3. Measures**

**3.1. Survey instrument**

Two series of questions were adopted from other vaccination surveys, modified for examining COVID-19 vaccination, and supplemented with questions about COVID-19 vaccination developed by the COVID-GAMS team and informed by representatives of the target groups. The questionnaire was checked for comprehensibility by scientists and ambulatory physicians not involved in the study development. All relevant survey questions and an English translation can be found in the supplementary file (Supplementary data 2).
3.2. Attitude toward COVID-19 vaccination

Attitudes toward vaccination in general and COVID-19 vaccination, in particular, was measured using a self-developed item “What is your attitude toward vaccinations in general/COVID-19 vaccination?”. Respondents indicated their attitude on a 4-point Likert scale (1 = very positive – 4 = very negative).

3.3. Vaccination status and providing

Own vaccination status could be stated as a binary response of either “fully vaccinated” or “not fully vaccinated”. Whether COVID-19 vaccination services were offered in the physicians’ practice was assessed using three self-developed categories: “yes”, “no vaccination in own practice but referral of patients to other practices or vaccination centers”, or “no”. Furthermore, physicians were asked to provide estimates of the vaccination rate among their patients as a percentage.

3.4. Confidence in detecting suspected adverse events

Physicians’ confidence in vaccine safety was assessed using a self-developed item (“Based on your experience in your daily practice, how safe do you consider the COVID-19 vaccines currently licensed in Germany regarding adverse events?”). For each of the four COVID-19 vaccines, respondents stated their confidence in vaccine safety on a 4-point Likert scale (1 = very unsafe – 4 = very safe). In addition, the participants could indicate that they were unable to assess vaccine safety. These answers were handled as missing data points. Pediatricians were asked exclusively about Comirnaty (BioNTech/Pfizer), as this was the only vaccine licensed in Germany for adolescents aged 12 years and older at the time. Physicians were asked to indicate on a 5-point Likert scale how easy or difficult it is for them to recognize possible adverse events of vaccines among their patients (1 = very easy – 5 = very difficult). Physicians could answer that they could not judge the ease of detecting such adverse events. In addition, four self-developed categories of responses were provided to assess the extent to which physicians were reporting suspected adverse events to the German authorities: “yes, all reported”; “yes, some reported”; “no, none reported”; “no, none seen”.

3.5. Communication self-efficacy and communication strategies

A set of questions on physicians’ confidence in communicating with patients about vaccines (communication self-efficacy) was based on the self-efficacy questionnaire used by Henrikson et al. (2015) [21] with slight COVID-19-specific adaptations. Three aspects were examined, including confidence in talking about the risks of vaccines, in providing vaccine information resources, and in answering difficult questions about vaccines, and supplemented by an extension question from Neufeind et al. (2021) [15]: confidence in talking to patients or their legal representatives about vaccines. Answers were given on a 5-point Likert scale (1 = not at all confident – 5 = very confident). In addition, physicians were asked on a 5-point Likert scale how vaccine discussions with patients about COVID-19 vaccination differ from discussions about other vaccines (1 = much easier – 5 = much more difficult). To examine how physicians communicate with vaccine-hesitant patients about the COVID-19 vaccination, six behavioral strategies were asked separately in the questionnaire (communication strategies): acceptance of the patient’s decision not to be vaccinated without further discussion; recommendation to switch physicians; conducting a detailed persuasion consultation; expressing empathy for concerns; education about the individual risks of vaccination omission; and educating about the impact of non-vaccination on community protection. Answers were provided on a 5-point Likert scale (1 = does not apply at all – 5 = fully applies). We based our questions on the questionnaire used by Neufeind et al. (2021) [15] in their study examining physicians’ attitudes toward the measles vaccine mandate in Germany with slight COVID-19-specific adaptations.

3.6. Socio-demographic characteristics

Finally, socio-demographic factors were surveyed, including age (10-year groups), years of work experience, specialist group, gender, and employment status (self-employed, employed).

3.7. Statistical analysis

To examine the differences between physicians with positive attitudes toward COVID-19 vaccination and those with negative attitudes toward COVID-19 vaccination, we formed two groups according to their stated attitudes (very positive/positive vs. negative/very negative). For the communication strategies used in vaccine discussions with vaccine-hesitant patients, we built linear regression models with robust estimators. Data preparation (tidyverse package [1.3.1]) and analysis (stats package [4.1.3], car package [4.1.3], car package [4.1.3], car package [4.1.3]) were performed in R (version 4.1.3) and R Studio (version 2022.02.3 + 492).

4. Results

4.1. Sociodemographic characteristics

A total of 1,122 physicians participated in the survey, with 552 GPs, 205 gynecologists, 175 pediatricians (n = 932). In all three specialist groups, the majority of participants were self-employed (GPs and gynecologists: 92.4 %, PEDs: 87.4 %). In terms of gender distribution, among GPs and PEDs, both genders were approximately equally represented (GPs: 53.8 % male, PEDs: 48.3 % male); however, nearly three-quarters of the surveyed gynecologists were female (73.9 %). In all three groups, the largest age group was those between 51 and 60 years (GPs: 41.9 %, gynecologists: 53.2 %, PEDs: 44.8 %). On average, GPs had 19.3 years of work experience, and PEDs and gynecologists had 16.7 years each. Among the PEDs and gynecologists, about 16 % of each group came from the five eastern German states, while, among the general practitioners, this proportion was 12.8 %. Altogether, 42.8 % of GPs, 29.8 % of PEDs, and 52 % of gynecologists participated via the open survey (Table 1).

4.2. Attitudes toward COVID-19 vaccination

Overall, 883 physicians stated both their attitudes toward vaccination in general and toward COVID-19 vaccines in particular (GPs: 521, gynecologists: 198, PEDs: 164). A large majority of physicians had a positive or very positive view of vaccinations in general (98.6 %), as well as toward COVID-19 vaccines in particular (91.9 %). However, while only 1.3 % reported a negative or very negative attitude toward vaccines in general, 8.1 % expressed negative or very negative attitudes toward COVID-19 vaccines (Fig. 1). Therefore, there was a shift toward a more negative attitude toward COVID-19 vaccines. Gynecologists stated more positive attitudes toward COVID-19 vaccination than GPs and PEDs, but the difference was not significant (Kruskal-Wallis rank sum test, p = .192).
4.3. Associations between attitude toward COVID-19 vaccination and own vaccination status

Overall, 93.7 % of physicians reported being fully vaccinated against COVID-19 in September-November 2021 (Table 2). Attitudes toward COVID-19 vaccination were significantly associated with the individual practitioner’s vaccination status (Fisher’s Exact Test, p <.001). Specifically, 99.1 % of the group with positive attitudes toward COVID-19 vaccination (n = 816) reported being fully vaccinated. 30 % of the group with negative attitudes toward COVID-19 vaccination (n = 70) reported being fully vaccinated.

### Table 2
Cross table of vaccination status by attitude toward COVID-19 vaccination.

| Attitude         | Fully vaccinated | Not fully vaccinated | N   |
|------------------|------------------|----------------------|-----|
| Positive/very positive | 809 (99.14 %)    | 7 (0.86 %)           | 816 |
| Negative/very negative | 21 (30 %)        | 49 (70 %)            | 70  |
|                  | 830 (93.68 %)    | 56 (6.32 %)          | 886 |

Fig. 1. Attitudes toward vaccination in general and COVID-19 vaccination (Cross-specialty and specialty-specific) (n = 883).

4.4. Associations between attitude toward COVID-19 vaccination and vaccination services provided

Overall, 88 % of physicians reported providing COVID-19 vaccination services in their practice. Out of the 12 % who did not perform vaccination, 57.8 % referred patients to another practice or...
a vaccination center. There were significant differences (Fisher’s Exact Test, \( p < .001 \)) between the two groups in terms of the extent to which physicians offered COVID-19 vaccines at their private practice (Table 3). While 97.1 % of the physicians with positive attitudes toward COVID-19 vaccination provided COVID-19 vaccines at their practice or referred patients to a colleague or a vaccination center, 68.3 % of the physicians with negative attitudes did so.

4.5. Associations between attitude toward COVID-19 vaccination and physician-estimated vaccination rate among patients

GPs (70.7 %) and gynecologists (72.4 %) both reported a similar mean for the estimated vaccination rate among their patients, while PEDs had a mean rate of 29 %. The estimated vaccination rate among adult patients differed significantly between the groups with positive and negative COVID-19 vaccination attitudes (Welch test, \( p < .001 \)) for GPs (72 % vs. 55.1 % for the positive and negative attitude groups, respectively) but not for gynecologists (72.5 % vs. 70.8 % for the positive and negative attitude groups, respectively, \( t \)-test, \( p = .633 \)). A significant difference was again found for PEDs (Mann-Whitney \( U \) test, \( p = .040 \)), showing that those with negative attitudes estimated 15.3 % of adolescents 12–17 years of age to be vaccinated, whereas those with positive attitudes estimated 29.6 % to be vaccinated (Fig. 2).

4.6. Associations between attitude toward COVID-19 vaccination and confidence in vaccine safety

There were significant differences in safety assessments for all four vaccines between the two groups (Mann-Whitney \( U \) test, \( p < .001 \)), with those physicians with positive attitudes reporting more confidence in vaccine safety than those with negative attitudes (Fig. 3). Physicians with positive attitudes toward COVID-19 vaccination (\( n = 481 \)) had significantly more confidence in the safety of mRNA vaccines (SD = 0.5) than the vector vaccines (SD = 0.7) (Mann-Whitney \( U \) test, \( p < .001 \)). Physicians with negative attitudes (\( n = 35 \)) showed no differences (Mann-Whitney \( U \) test, \( p = .975 \)) in their safety assessment between the two vaccine

| Cross table of vaccination services provided by attitude toward COVID-19 vaccination. |
|---------------------------------|----------------|----------------|----------------|
|                                 | Yes            | No, but referred patients to a vaccination center or another practice | No, referred patients to a vaccination center | N |
| Positive/very positive          | 716 (91.09 %)  | 47 (5.98 %)     | 23 (2.93 %)    | 786 |
| Negative/very negative          | 31 (49.21 %)   | 12 (19.05 %)    | 20 (31.75 %)   | 63  |
| GPs (n=499)                     |                |                |                |     |
| Estimated vaccination rate among patients |                |                |                |     |
| GPs (n=499)                     |                |                |                |     |
| Gynecologists (n=187)           |                |                |                |     |
| PEDs (n=146)                    |                |                |                |     |

Fig. 3. Confidence in COVID-19 vaccine safety by attitude toward COVID-19 vaccination (binary) (\( n = 721 \)).
groups (mRNA SD = 0.46; vector SD = 0.63). In this group, all vaccines were considered unsafe on average.

PEDs (n = 165) were surveyed separately only for the then-approved vaccine for adolescents, Comirnaty (BioNTech/Pfizer). Nine PEDs were excluded as they indicated that they could not provide any information on safety. PEDs with a positive attitude (n = 147) had an average attitude score of 3.48 on the 4-point scale from very unsafe to very safe, whereas pediatricians with a negative attitude (n = 9) had an average attitude score of 1.44. This difference was significant (Mann-Whitney U test, p < .001).

### 4.7. Associations between attitude toward COVID-19 vaccination and reporting on suspected adverse events

Regarding the ease with which physicians indicated to identify possible adverse events (vaccination complications) of COVID-19 vaccination among their patients, no differences between both attitude groups could be established on a 5-point Likert scale (mean for positive attitude group = 3.06; mean for negative attitude group = 3.09; Mann-Whitney U test, p = .98). Overall, 51.4% of physicians observed possible adverse events of COVID-19 vaccination (Table 4). The extent to which suspected adverse events were reported, differed significantly between the two groups (Pearson’s Chi-squared test, p < .001). Overall, 95.2% of all physicians with negative attitudes toward COVID-19 vaccination observed some or more adverse events in their patients. This was in contrast to 48% of physicians with positive attitudes toward vaccination. Reporting of possible vaccine adverse events (all/some/none) differed between the two groups, but not significantly (Pearson’s Chi-squared test, p = .159). While physicians with positive attitudes toward COVID-19 vaccination reported more frequently all adverse events observed (31.3% vs. 20.3% of physicians with negative attitudes), physicians with negative attitudes toward COVID-19 vaccination more often reported some but not all adverse events (33.9% vs. 24.9% of physicians with positive attitudes). In both groups, nearly half of physicians stated not reporting suspected adverse events (43.9% vs. 45.8% for the positive attitude group and negative attitude group, respectively).

### 4.8. Associations between attitude toward COVID-19 vaccination and communication self-efficacy

Both groups felt mostly confident in their ability to speak with patients about COVID-19 vaccines (Fig. 4). However, physicians with negative attitudes toward COVID-19 vaccination stated significantly higher confidence in their abilities to talk about vaccination (Mann-Whitney U test, p = .027), provide information (Mann-Whitney U test, p = .016), and answer difficult questions (Mann-Whitney U test, p < .001). Only the assessment of their ability to talk about the risks of vaccinations did not differ significantly between the two groups (Mann-Whitney U test, p = .063). Furthermore, on average, physicians indicated that vaccine discussions about COVID-19 were more difficult than those about other vaccines (3.59 on a 5-point Likert scale). There was no significant difference between the two groups in this regard (Mann-Whitney U test, p = .255).

### 4.9. Associations between attitude toward COVID-19 vaccination and communication strategies utilized

We queried six physicians’ communication strategies in COVID-19 vaccine discussions with declining patients (Fig. 5). There were significant differences between the groups in five of the strategies. Physicians with positive attitudes reported more often conducting detailed, persuasive discussions with the patient (Mann-Whitney U test, p < .001) and informing patients about the consequences of non-vaccination for community protection (Mann-Whitney U test, p < .001). Physicians with negative attitudes reported more often accepting the patient’s decision against vaccination without further discussions (Mann-Whitney U test, p < .001) and showing empathy for concerns (Mann-Whitney U test, p < .001). Both groups recommended a physician change only very rarely, and those with negative attitudes significantly less often (Mann-Whitney U test, p = .004). Finally, both groups, for the most part, stated to provide neutral explanations of the individual risks of omitting vaccination when confronted with a patient who declined the COVID-19 vaccine (Mann-Whitney U test, p = .186).

### 4.10. Multivariable linear regression models on communication strategies

We developed four regression models to control for the effect of possible confounders on the results regarding physician communication strategies in vaccine discussions. We omitted two behaviors in these models. First, we refrained from further investigating the item on providing neutral information since we found no significant differences. Second, we refrained from constructing a model for the recommendation to switch physician as the distribution of the values was skewed, and the assumption of normal distribution of the residual term was violated. The models assessed attitudes toward COVID-19 vaccination was on a 4-point Likert scale. Individuals with missing information on either of the variables and groups with three or fewer individuals (n = 4) were excluded from further investigation for statistical reasons. Ultimately, 744 individuals were included in the four multivariable linear regression models.

When examining attitudes toward COVID-19 vaccination alone (Table 5) and its association with the strategies in the information consultation, vaccination attitude was found to be significantly associated with all four strategies. Specifically, vaccination refusal was significantly more likely to be accepted without further discussion when the physician had more negative attitudes toward COVID-19 vaccination (0.714, p < .001). The same applies to expressing empathy toward concerns which is positively associated with negative vaccination attitudes (0.506, p < .001). In contrast, willingness to engage in extensive persuasion (–0.579, p < .001) and educating about community protection (–0.526, p < .001) decreased when physicians had more negative attitudes.

### Table 4

Cross table reporting of suspected side effects by attitude toward COVID-19 vaccination.

| Observed suspected adverse events | All reported | Some reported | None reported |
|-----------------------------------|--------------|---------------|---------------|
| Positive/very positive            | 117 (31.28%) | 93 (24.87%)   | 164 (43.85%)  |
|                                   | (36 2)       | (36 2)        | (36 2)        |
| Negative/very negative            | 12 (20.34%)  | 20 (33.90%)   | 27 (45.76%)   |
|                                   | (36 2)       | (36 2)        | (36 2)        |
|                                   | 129          | 113           | 191           |
|                                   | (36 2)       | (36 2)        | (36 2)        |

| N   | None observed | N   |
|-----|---------------|-----|
| 374 | (47.95%)      | 406 |
| 59  | (95.16%)      | 3   |
| 433 | (51.43%)      | 409 |
| 842 | (48.56%)      | 842 |

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toward COVID-19 vaccination. The goodness of fit of the four models varied, showing relevant explanatory power, especially for acceptance of the patient’s decision without discussion ($R^2 = 0.126$) and willingness to engage in extensive persuasion ($R^2 = 0.105$), whereas the predictive power values for willingness to engage in discussions about community protection ($R^2 = 0.080$) and empathy for concerns ($R^2 = 0.076$) were smaller.

When adding variables on the attitude toward vaccines in general, own vaccination status, and specialty, as well as control variables (age group, gender), the associations between attitudes toward COVID-19 vaccination and communication strategies remained significant for all models (Table 5). However, in all models the estimates decreased slightly.

In terms of the specific associations between certain confounding variables and communication strategies, not being fully vaccinated (n = 25) showed a significant positive association with empathy ($0.833$, $p <.001$). Additionally, PEDs showed significantly higher understanding and empathy for patient-side concerns than family physicians ($0.350$, $p <.001$). In contrast, gynecologists showed less willingness to engage in detailed, persuasive discussions ($-0.289$, $p <.01$) and were less willing to educate about the implication of non-vaccination on community protection ($-0.234$, $p <.05$). Explained variance improved slightly in all multivariate models compared to the univariate models, most notably for empathy for concerns (from $R^2$ of 0.076 to 0.142). All multivariate models and included variables were tested for multicollinearity with GVIF values below 2.

5. Discussion

This study examined how physicians in the outpatient sector thought about the COVID-19 vaccine and how their attitudes were associated with their performance as vaccine providers. Our results show that while physicians predominantly endorsed COVID-19 vaccines, there was a relevant fraction of hesitant physicians. This hesitancy translates to both vaccination status and communication strategies. Overall, physicians’ attitudes toward COVID-19 vaccination were markedly more negative than their attitudes toward other vaccines.
Table 5
Physician communication strategies in vaccine discussions (uni- and multivariate).

| Response Strategy | Univariate Model | Multivariate Model |
|-------------------|------------------|--------------------|
| | Attitude toward COVID-19 vaccination | |
| CI | 0.714*** | 0.708*** |
| SE | (0.055) | (0.091) |
| Attitude toward vaccination in general | | |
| CI | -0.227, 0.216 | -0.276, 0.138 |
| SE | (0.113) | (0.106) |
| Fully vaccinated (0 = yes/1 = no) | 0.579*** | 0.520*** |
| CI | -0.190, 0.413 | -0.091, 0.218 |
| SE | (0.299) | (0.334) |
| Specialty (0 = GP/1 = pediatrician) | 0.189 | 0.289*** |
| CI | -0.425, 0.180 | |
| SE | (0.132) | (0.108) |
| Specialty (0 = GP/1 = gynecologist) | 0.205+ | |
| CI | -0.015, 0.426 | |
| SE | (0.112) | |
| Gender (0 = male/1 = female) | 0.006 | 0.015 |
| CI | -0.245, 0.180 | |
| SE | (0.299) | (0.334) |
| Age (0 = 31–40 years/ 1 = 41–50 years) | 0.526*** | 0.506*** |
| CI | -0.728, -0.312 | -0.190, 0.413 |
| SE | (0.106) | (0.106) |
| Specialty (0 = GP/1 = pediatrician) | 0.346*** | 0.280*** |
| CI | -0.091, 0.218 | |
| SE | (0.334) | (0.334) |
| Specialty (0 = GP/1 = gynecologist) | 0.494*** | 0.438*** |
| CI | -0.245, 0.180 | |
| SE | (0.108) | (0.108) |
| Gender (0 = male/1 = female) | 0.200 | 0.100 |
| CI | -0.425, 0.180 | |
| SE | (0.299) | (0.334) |
| Age (0 = 31–40 years/ 1 = 41–50 years) | 0.269 | 0.250 |
| CI | -0.728, -0.312 | |
| SE | (0.106) | (0.106) |
| Specialty (0 = GP/1 = pediatrician) | 0.346*** | 0.280*** |
| CI | -0.091, 0.218 | |
| SE | (0.334) | (0.334) |
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| CI | -0.245, 0.180 | |
| SE | (0.108) | (0.108) |
| Gender (0 = male/1 = female) | 0.200 | 0.100 |
| CI | -0.425, 0.180 | |
| SE | (0.299) | (0.334) |
| Age (0 = 31–40 years/ 1 = 41–50 years) | 0.269 | 0.250 |
| CI | -0.728, -0.312 | |
| SE | (0.106) | (0.106) |
| Specialty (0 = GP/1 = pediatrician) | 0.346*** | 0.280*** |
| CI | -0.091, 0.218 | |
| SE | (0.334) | (0.334) |
| Specialty (0 = GP/1 = gynecologist) | 0.494*** | 0.438*** |
| CI | -0.245, 0.180 | |
| SE | (0.108) | (0.108) |

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001
Response options: 1= 'does not apply at all'; 2= 'rather does not apply'; 3= 'partly/partially'; 4= 'rather applies'; 5= 'fully applies'
5.1. Vaccination status

The vaccination rate (93.7% fully vaccinated) among surveyed physicians is comparable with the results from the German COVID-19 vaccination rate monitoring (COVIMO), where the vaccination rate (at least one vaccination) for HCWs was reported to be 90.2% [28], and the hospital-based online survey on COVID-19 vaccination (KROCO), where 95% of physicians working in hospitals reported being fully vaccinated [29] for the observation period. Compared to other healthcare professionals, physicians tend to show a higher willingness to opt for COVID-19 vaccination, although outpatient physicians may show lower willingness than hospital-based physicians [28–30]. The survey period included the first booster phase in Germany. It is possible that physicians with an infection had not yet received a third vaccination at this time and, thus, did not consider themselves fully vaccinated. Furthermore, a rare medical contraindication may not have permitted vaccination.

5.2. Vaccination attitude

While the majority of physicians viewed COVID-19 vaccination as positive or very positive, still, 8% expressed negative or very negative attitudes in the fall of 2021. This is in line with other findings, where a comparable percentage of COVID-19 vaccination hesitancy among physicians was internationally reported [27,31]. Multiple factors exit that influence the attitude on vaccination recommendations [27,29]. Reasons for a negative attitude toward COVID-19 vaccination may be the rapid development and approval, the number of issued safety warnings, increased observation of vaccine breakthroughs and adverse events, or general dissatisfaction with the COVID-19 protective measures taken [27]. Among the 70% of not fully vaccinated physicians with negative attitudes toward COVID-19 vaccination, it can be assumed that a fundamental distrust of COVID-19 vaccination has prevailed from the onset of the vaccination campaign. Since physicians were part of the prioritized first-line vaccination group, the decision not to get vaccinated could not stem from experiential knowledge with the newly developed vaccines. In contrast, among the 30% fully vaccinated physicians with negative attitudes toward COVID-19 vaccination, personal experiences and/or their patients' experiences with vaccination could serve as an explanation for their attitudes. These experiences with vaccinations could have led them to develop experience-driven negative attitudes. The link between physicians' vaccination status and their vaccination recommendations to patients [32], as well as the negative association between physician attitudes toward vaccination and recommendations to patients, are established from studies on other vaccinations [9]. Accordingly, physician's recommendations to vaccinate are strongly influenced by their beliefs regarding the efficacy and safety of a vaccine [8,33].

5.3. Vaccination safety

Physicians with negative attitudes appeared to have general safety concerns about all COVID-19 vaccines, whereas physicians with positive attitudes toward COVID-19 vaccine had high confidence in vaccine safety, but still differentiated between platforms: vector vaccines were rated lower in safety than mRNA vaccines. This is consistent with the greater number of safety warnings issued for this class of vaccines (8 out of 10) by the German authorities at that time [34].

The association between negative attitudes and a lack of confidence in safety of COVID-19 vaccination is in line with the results from multiplied countries [31] and other studies conducted among the German general population [28] and hospital personnel [29]. It seems that it is one of the major determinants of vaccination behavior in general [35,36]. Consequently, physicians with negative attitudes toward COVID-19 vaccines had significantly more safety concerns about all COVID-19 vaccines and had more frequently observed adverse events in their patients that they attributed to the COVID-19 vaccines. Causality cannot be provided in our study. It is unclear whether experiencing adverse events triggered a lack of confidence and in turn a negative attitude toward the vaccine or whether a negative attitude shaped the perception and experience of the vaccine.

Regarding incomplete or non-reporting suspected adverse events, attitudes had no significant effect on reporting. Physicians with negative and positive attitudes toward the COVID-19 vaccine both indicated incomplete reporting. Nearly 50% of respondents, who have observed adverse events, indicated to not have reported them according to §6 para. 1, no. 3 Infektionsschutzgesetz [Infection Protection Act], where a "suspicion of health damage exceeding the usual extent of a vaccination reaction" must be reported to German medical regulatory bodies. Importantly, these are suspected adverse events. The study cannot provide information on the type of suspected cases nor the further course of the reports. We did not include any further questions on the severity and/or number of suspected adverse events. Studies on reporting of adverse events indicate that more serious events are more likely to be reported [37].

In a multinational qualitative study in several European countries, suspected adverse effects of vaccination were identified as the most important reason for a reluctance to vaccinate [33]. Fear of adverse events is also associated with vaccine hesitancy [9]. Similarly, the development of new vaccines may contribute to concerns that the vaccines have not been tested sufficiently or for long enough and, thus, that unknown adverse events may occur [33]. Finally, dealing with suspected adverse events of COVID-19 vaccination is partly seen as a taboo subject by physicians in Germany who are concerned that this may encourage hesitancy to vaccinate [38].

5.4. Vaccination communication

In our data, we found that physicians with positive versus negative attitudes toward the COVID-19 vaccine used different communication strategies when discussing the vaccine with declining patients. Those with negative attitudes expressed more empathy with concerns and tended to accept the decision without further discussion. This is in line with previous works which reported that HCWs with a negative attitude toward vaccines are less likely to try to convince vaccine-hesitant patients to vaccinate [8,14,39,40]. Therefore, compared to HCWs with a positive attitude toward vaccines, HCWs with a negative attitude may be engaged in supporting patient autonomy more regarding their health decisions [41]. Importantly, empathy toward patients is considered a foundational component for having a successful discussion on vaccines [42,43]. In addition, physicians with positive attitudes were more likely to try convincing declining patients in a detailed discussion and to educate them about the consequences of non-vaccination for community protection. This might imply that these physicians tend to use a directive style of communication - meaning to impose a vaccination on a patient rather than encouraging the patient to make an informed vaccination decision. This communication style is common in physicians but can spark reactance and alienate patients [44]. Patients with different attitudes toward vaccination have different needs [45–47]. Therefore, it is useful for physicians who interact with patients with a deviating opinion during a vaccine discussion to pay special attention to the way they address patients. Communication should be conducted in a way to avoid further reinforcing rejectionist attitudes. For those
who decline vaccination, showing empathy, letting patients express their concerns, and building a trusting relationship might be the first steps to evoke behavioral change [44].

5.5. Limitations

As this is a cross-sectional survey, causal relationships cannot be inferred. As a result, we cannot determine, e.g., whether negative attitudes toward COVID-19 vaccination arose from negative experiences (adverse events, vaccine breakthroughs) or whether negative attitudes influenced physicians’ views on vaccine safety. In addition, a unidimensional question on general attitudes toward COVID-19 vaccination may not be specific enough. For example, it is conceivable that attitudes toward COVID-19 vaccination would differ for heterogeneous patient populations (such as by age, pre-existing conditions, and infection status).

As participation in the survey was possible via an open online survey, there may have been a selection bias. However, the central outcome – attitude toward COVID-19 vaccination – does not significantly differ between the participants with the personalized invitation and those from the open survey (mean personalized: 1.41, mean open: 1.43; Mann-Whitney U test, p = .36).

The study population was not selected as representative of the German outpatient sector. However, key socio-demographic characteristics are, for the most part, in line with national averages for 2021 regarding age (54.2 years on average) [48], and gender distribution (average female GPs: 48.8 %, female gynecologists: 70.9 %, and female PEs: 57.9 %) [49]. In regard to employment status, we see an overrepresentation of about ten percentage points for self-employed physicians in our study compared to the nationwide data for 2021 [50]. Overall, a slight selection bias cannot be ruled out.

6. Conclusion

Physicians with negative attitudes toward the COVID-19 vaccine were less likely to be vaccinated themselves, less likely to provide COVID-19 vaccination services in their practice, and their estimate of their patients’ vaccination coverage was lower. This highlights that physicians’ attitudes toward the COVID-19 vaccine translate into various behaviors that impact their role as vaccine providers.

Acknowledgments

The authors express their gratitude to all participating physicians. Despite the fact that they remain anonymous, this study would not have been possible without their participation.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2022.11.054.

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