



# The Vaccine Training Barometer: Assessing healthcare providers' confidence to answer vaccine-related questions and their training needs

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## ABSTRACT

Healthcare providers (HCP) are seen by the public as the most trustworthy source of information about vaccination. While HCPs could be a valuable partner to increase vaccine confidence in general, it is not clear whether they feel confident themselves to address questions concerning vaccination. In the context of the EU Joint Action on Vaccination (EU-JAV), the Vaccine Training Barometer, an online survey tool, was developed to assess how frequently HCPs receive questions about vaccination, how confident they feel to answer these questions, and to what extent they are willing to follow extra training. After a pilot test in Flanders, Belgium, the Barometer was launched and completed by 833 HCPs in Flanders and 291 HCPs in the Spanish regions of Catalonia, Navarre and Valencian Community from November 2020 until January 2021, during the COVID-19 pandemic, just before and during the start of the first COVID-19 vaccination campaigns. In both countries, HCPs frequently received questions about vaccination (mostly on a daily or weekly basis), and about two thirds of them indicated that the frequency of questions had increased during the three months prior to completing the survey. Most questions were about the side effects and safety of vaccines. In both countries, a considerable proportion of HCPs did not feel confident to answer vaccine-related questions (31.5% felt confident in Flanders, 21.6% in Spain). A large proportion of HCPs received questions in the last three months before the survey that they could not answer (52.4% of respondents in Flemish sample, 41.5% in Spanish sample). Only 11.4% (Flanders) and 11.3% (Spain) of the respondents felt they gained sufficient knowledge through their standard education to be able to answer questions about vaccination. Almost all respondents were willing to follow extra training on vaccination (Flanders: 95.4%, Spain: 96.6%). The Vaccine Training Barometer is thus a useful tool to monitor HCPs' confidence to answer questions about vaccination and to capture their training needs.

## 1. Introduction

### 1.1. Vaccine confidence

Vaccination is seen as one of the most successful public health interventions in history [1,2]. It is estimated that it saves 2 to 3 million lives worldwide every year [3]. However, misinformation, hoaxes,

public crises with regard to vaccines, and skepticism towards science are a few current factors that can erode trust in vaccines and vaccination programmes [4–7]. Therefore, the monitoring of trust in vaccination worldwide has become an important focus in research, showing that the public is losing confidence in vaccines, also in Europe [2,4,8–14]. This decreasing level of vaccine confidence gives rise to increasing vaccine hesitancy [15], defined as “the delay in acceptance or refusal of

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vaccination despite availability of vaccination services” [16]. Indeed, vaccination uptake is decreasing in several countries worldwide due to a lack of trust in the importance, safety, and effectiveness of vaccines [4,8]. Vaccine hesitancy was already identified by WHO in 2019 as one of ten main global health threats [17] and remains an important issue to tackle [7,18]. Evidence suggests that the COVID-19 pandemic might have had a negative impact on global vaccine confidence, among others due to the uncertainty that comes with the novelty of the disease and the vaccines, misinformation, and COVID-19 response measures that might have triggered backlash [19]. It is suggested that this might have had a negative impact not only on vaccine confidence, but on public trust in public health authorities, science, and medicine as well [20].

### 1.2. The role of the healthcare provider

To maintain or increase vaccine uptake, research has focused on how vaccine confidence can be increased or maintained. An important line of research in this context is aimed at identifying the most trusted sources of vaccine information for the general public. Trust in these sources might well be as important as the content of information provided to vaccine hesitant individuals [21]. Across several studies, healthcare providers (HCPs)<sup>1</sup> are seen by the public as the most important and trustworthy source for receiving information concerning vaccination [9,10,22–26]. There is strong evidence of a relationship between HCP–patient<sup>2</sup> communication and patients’ vaccination attitudes and behaviors [27]. Similarly, there is a strong correlation between HCPs’ levels of vaccine confidence and vaccine confidence levels in the general public [11,12]. Studies have shown that receiving information, reassurance or encouragement from a HCP is an important factor influencing the decision of parents who were planning to postpone or refuse vaccination for their child [28–30]. Moreover, it was observed that people who receive information concerning vaccination from a HCP show less vaccine hesitancy than people who receive information via friends, family or books [31]. Receiving a recommendation to vaccinate from a HCP is the most frequently reported reason for the decision to vaccinate among the general public [32]. Furthermore, both the provision of information about vaccination by HCPs and the quality of that information are essential for vaccination decisions [33]. Therefore, HCPs are seen as a crucial partner to increase vaccine confidence [4,34].

### 1.3. Healthcare providers’ confidence to communicate about vaccination

The success of HCPs in increasing vaccine confidence, however, depends on their knowledge about vaccines and vaccination, their confidence to communicate about vaccination and their confidence to answer questions from patients. Studies suggest that HCPs do not always feel confident to recommend vaccination, address questions about vaccination or address vaccine hesitancy [35]. A study among general practitioners (GPs) in France showed that many GPs do not feel confident to explain certain aspects of vaccination. In this study, more than half of the GPs surveyed did not feel confident to explain the role of adjuvants in vaccines [36]. A study in Serbia showed that HCPs needed additional communication skills especially for conversations with parents delaying or refusing vaccines [37]. For communication with pregnant women, the confidence seems to be even lower. In a study in the UK, only 25 % of midwives felt prepared to advise pregnant women on vaccination [38]. This aligns with findings that HCPs’ likelihood of recommending vaccines is generally lower for pregnant women than for the general population [12]. For healthcare students, who are the future HCPs, knowledge about vaccination and confidence to answer questions

about vaccination is rather low as well. A survey among European healthcare students showed that almost half of the students indicated that too little attention is spent on vaccination in their curriculum and more than one third does not feel confident to answer questions about vaccines [39]. However, their acceptance of vaccines is encouraging, as has been observed in recent studies on vaccination against COVID-19 [40,41].

Knowledge about vaccination seems to be an important factor for increasing HCPs’ confidence to communicate about vaccination. Several studies have shown that HCPs are more likely to recommend vaccination to patients when they have sufficient knowledge about vaccines and vaccination [42–46]. When HCPs do not have sufficient knowledge, they do not feel confident to discuss specific issues concerning vaccination (e.g., the role of adjuvants, explaining risks and benefits) and are less likely to recommend vaccination [36]. Different studies thus indicate that improving knowledge about vaccination among HCPs and future HCPs is necessary. Even when HCPs rate their own knowledge about vaccines to be sufficient, they still emphasize the need for additional training about communication, and especially support for managing difficult conversations with vaccine hesitant patients [35,47,48].

Taking this background into consideration, the goal of our study was to develop a tool that allows to monitor the confidence of HCPs to answer questions concerning vaccination, and to identify their specific needs for training.

## 2. Material and methods

To investigate the confidence and the need for additional training of HCPs, the online survey “Vaccine Training Barometer” was developed, during the period from August until November 2019, within the sustainability work package of the framework of the EU Joint Action on Vaccination [39]. This Barometer was developed after a literature review and discussions with different profiles of HCPs and experts (nurses, general practitioners, physicians of well-baby clinics and vaccinologists). The dimensions of the survey include: 1) frequency and nature of received questions about vaccination, 2) confidence to answer questions about vaccination, 3) own knowledge/education about vaccination, 4) willingness to follow extra training on vaccination and format of these trainings, 5) sources of information about vaccination and preferred types of support. Moreover, the survey offers the possibility to capture questions about vaccines and vaccination that HCPs have received but could not answer, and common misconceptions among patients that HCPs are confronted with. The survey was calculated to be around 8 min in length. An overview of the Barometer questions can be found as supplementary information. The goal was to develop a sustainable tool to be able to monitor in-service HCPs’ confidence to communicate about vaccination and their need for training over time (by means of repeated sampling).

### 2.1. Pilot test in Flanders

The Barometer was pilot-tested in Flanders, Belgium, to check for ease of use and potential issues before implementing the full survey on a wider scale. The pilot test was conducted through the online software platform Qualtrics [49]. The data were collected between February 7, 2020 and March 31, 2020. This was at the start of the COVID-19 pandemic in Belgium, when restrictions increased and COVID-19 vaccines were not available yet. The pilot was launched at the annual Valentijn Vaccinatiesymposium 2020 in Flanders (Belgium), by sharing a leaflet with the link to the survey among the participants of the symposium. The Valentijn Vaccinatiesymposium is organized annually since 2003 by the Centre for the Evaluation of Vaccination (University of Antwerp, Belgium) and the Agency for Care and Health in Flanders (VAZG) and aims to inform vaccinators in Flanders about specific issues, new knowledge and developments concerning vaccines and vaccination programs. The participants of the symposium are HCPs involved in

<sup>1</sup> HCP = healthcare provider.

<sup>2</sup> Vaccination is a preventive health measure, which means that, in this paper, “patients” are typically healthy citizens and HCPs’ communication concerns preventive and not curative measures.

vaccination, such as school doctors, well-baby clinic nurses and physicians, general practitioners, pediatricians, pharmacists, occupational health physicians and nursing home physicians.

After excluding responses of respondents who completed less than 50 % of the survey, who were working outside of Flanders, or who were not healthcare providers, 117 respondents were included in the analyses. With 407 participants at the symposium, the response rate was 28.75 %. All respondents were working as HCPs in Flanders: 57.6 % of them were physicians, 38.1 % nurses, 0.8 % midwives, 0.8 % pharmacists, and 2.5 % other (e.g., medical advisor).

The analysis of the pilot test showed that there were no major issues (i.e. no issues with survey flow, survey length was acceptable, good response rate). Only small adjustments were made to the survey based on the responses and experiences of the participants of the pilot test (e.g., adding a question about participants' gender, formulating questions more clearly to avoid misinterpretation, adjusting the formulation of questions to match the Spanish translation).

## 2.2. Data collection in Flanders and Spanish regions

After implementing the small changes based on the pilot test, the Vaccine Training Barometer was launched as a cross-sectional survey in Flanders and in the Spanish regions of Catalonia, Navarre and Valencian Community. The survey was conducted through the online software platform Qualtrics [49]. Data were collected from November 16, 2020 until January 31, 2021. This was just before and during the start of the first COVID-19 vaccination campaigns, as the vaccination campaign started on December 27, 2020 in Spain and on December 28, 2020 in Belgium. A campaign was set up to invite healthcare providers to be a respondent of the survey. The inclusion criteria were HCPs working in Flanders or Spain. For Flanders, the channels used were the mailing lists of the VAZG, the professional network of the study team, and general email addresses of local associations of healthcare providers (identified through a web search). For the Spanish regions, an invitation letter to participate in the study was sent by email through the mailing lists of the related professional associations (physicians, nurses, midwives and pharmacists). Although full representativeness of the total group of HCPs cannot be guaranteed, there were measures taken to reduce bias as much as possible: we recruited a large sample with great diversity in types of HCPs, and the survey was distributed at different points in time via different channels.

After excluding responses of respondents who completed less than 50 % of the survey, who were working outside of Flanders or Spain, and who were not HCPs, 833 respondents were included in the Flemish sample, and 291 in the Spanish sample.

## 3. Results

### 3.1. Description of sample

For the Flemish sample, 44.5 % were nurses (e.g., nurses in school health system, well-baby clinic nurses, hospital nurses), 22.4 % were pharmacists, 16.7 % were physicians (e.g., school health physicians, general practitioners, pediatricians, well-baby clinic doctors, occupational health physicians), 12.6 % were dentists, 0.4 % were midwives, and 3.1 % other (e.g., well-baby clinic employees, physiotherapist, psychologist). There were 16.2 % men and 83.8 % women in the sample.

For the Spanish sample, 50.9 % were midwives, 25.1 % were pharmacists, 14.1 % were physicians (e.g., general practitioners, pediatricians), and 10 % were nurses (e.g., hospital nurses, well-baby clinic nurses, company nurses). The sample consisted of 17.2 % men and 82.8 % women.

### 3.2. Frequency and nature of received questions about vaccination

#### 3.2.1. Flemish sample

When asked about how often they receive questions about vaccination from patients, the majority of HCPs indicated that this happened on a daily or a weekly basis (Fig. 1). A majority of 63 % indicated that the frequency of questions had increased over the past 3 months, while 36.4 % reported that the frequency of questions had remained stable over the past 3 months and 0.6 % reported a decrease. Table 1 shows the topics of questions they received, showing that most questions were about side effects and safety of vaccines.

#### 3.2.2. Spanish sample

The majority of the HCPs indicated that they received questions about vaccines and vaccination daily or weekly (Fig. 1). Additionally, 68.4 % reported an increase in questions over the past 3 months, while 30.6 % reported that the frequency of questions had remained stable over the past 3 months and 1 % reported a decrease. Table 1 shows the topics of questions HCPs received, highlighting that most questions were about side effects and safety of vaccines.

### 3.3. Confidence to answer questions about vaccination

#### 3.3.1. Flemish sample

Only 31.5 % of the respondents indicated that they feel confident to answer questions about vaccination and 53.2 % of the respondents indicated that they feel confident most of the time, while 11.3 % felt confident only sometimes, and 4 % did not feel confident at all (Fig. 2). Moreover, 52.4 % of the respondents indicated that in the last 3 months, they had received questions about vaccination from patients that they could not answer.

#### 3.3.2. Spanish sample

Only 21.6 % of the respondents felt confident to answer questions about vaccination and 55.3 % felt confident most of the time, while 19.2 % felt confident only sometimes, and 3.8 % did not feel confident at all (Fig. 2). Moreover, 41.5 % of the respondents received questions about vaccination in the last 3 months that they could not answer.

### 3.4. Knowledge and education about vaccination

#### 3.4.1. Flemish sample

Almost 1 in 3 respondents indicated that they do not have enough knowledge to answer questions about vaccination (Fig. 3). When respondents did feel they had enough knowledge, it was mainly through extra courses and own experience, while only 11.4 % felt they had gained enough knowledge through their standard education (Fig. 3). A large share of the respondents followed extra education or training after their standard education, such as an information session (48.3 %), self-study (38.3 %) or an extra course (14.8 %) to close the knowledge gap.

#### 3.4.2. Spanish sample

About half of the respondents indicated that they do not have enough knowledge to answer questions about vaccination (Fig. 3). Most of the respondents indicating that they do have enough knowledge, had acquired this knowledge through an extra course, while only 11.3 % of them felt they had gained enough knowledge through their standard education (Fig. 3). A large share of the respondents had followed extra education about vaccination after their standard education, such as an information session (51.5 %), self-study (39.9 %) or an extra course (22 %).

### 3.5. Need for extra education on vaccination

#### 3.5.1. Flemish sample

Given the limited knowledge about vaccination acquired through

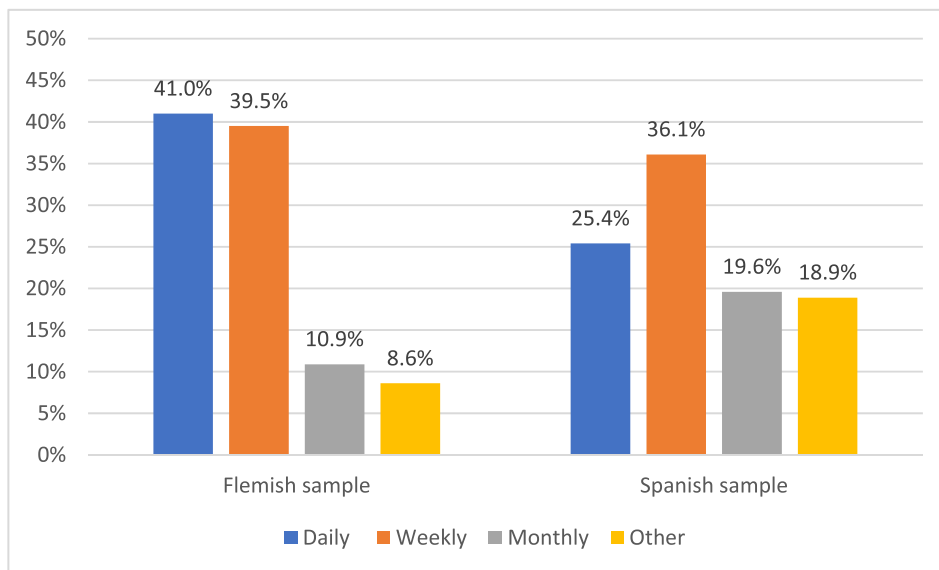


Fig. 1. Frequency of questions about vaccination.

**Table 1**  
Types of questions about vaccination.<sup>5</sup>

	Flemish sample Nov 2020 – Jan 2021 833 HCP	Spanish sample Nov 2020 – Jan 2021 291 HCP
Questions about basic vaccination schedule	42.9 %	23.7 %
Questions about vaccines not included in the basic schedule	38.4 %	24.4 %
Questions about side effects and safety of vaccines	70.3 %	74.9 %
Questions about the disease against which a vaccine protects	10.2 %	22 %
Questions about catch-up vaccinations	31.2 %	17.9 %
Other questions	12.1 %	8.9 %

<sup>5</sup> These results are based on a multiple-answer question where participants were invited to check all that applied.

standard education, it is not surprising that 95.4 % of the respondents indicated that they are willing to follow an extra course on vaccination, should they have the opportunity, with a preference for an online course (48 %), a one-day course (25.1 %) or an evening course (15.3 %), among other options.

### 3.5.2. Spanish sample

Almost all respondents (96.6 %) indicated that they are willing to follow an extra course on vaccination, with a preference for an online course (64.5 %) or an evening course (15.8 %), among other options.

## 3.6. Sources of information about vaccination

### 3.6.1. Flemish sample

Regarding sources of information about vaccination, the respondents mainly turned to online medical libraries and medical platforms (44.2 %), an online search engine (e.g., Google search) (43.8 %), emailing an expert (26.4 %), or a national public health institution (24.7 %) – among other options (Fig. 4). As extra support to feel more confident to answers

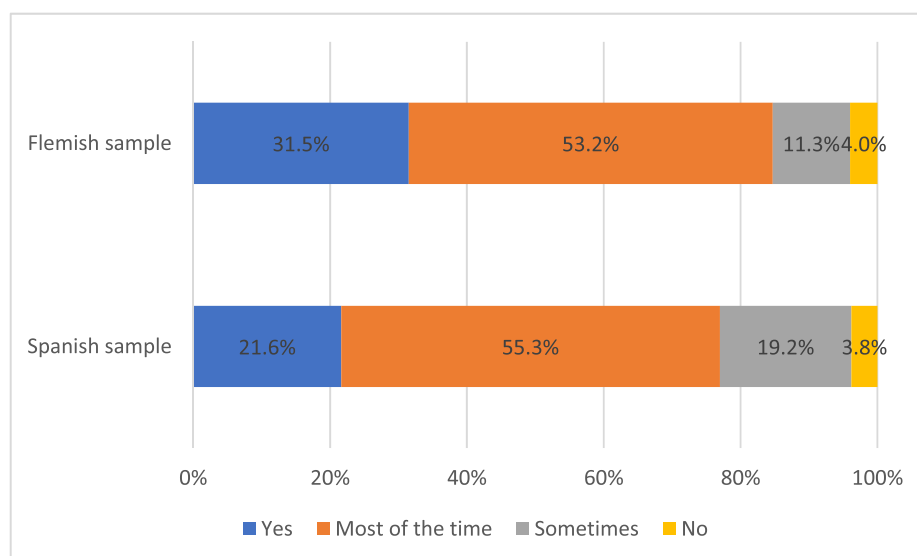


Fig. 2. Confidence to answer questions about vaccination.

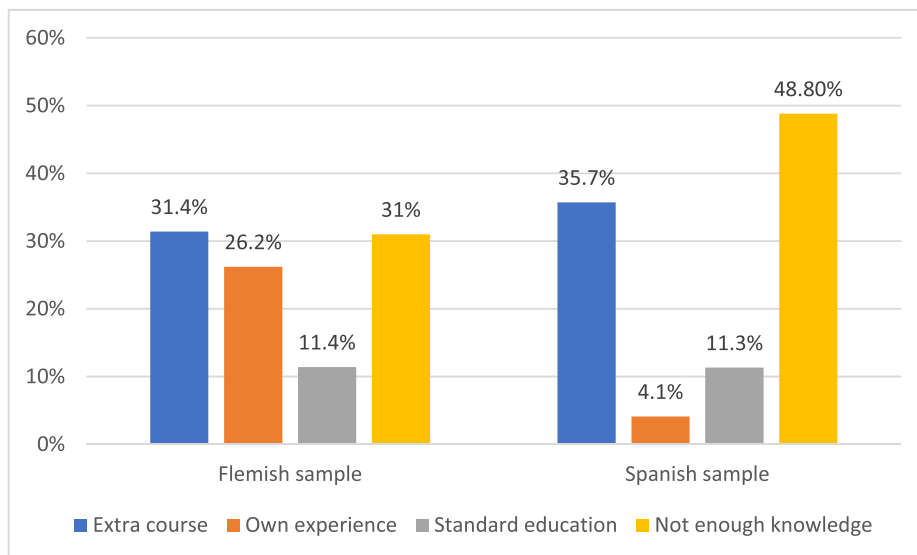


Fig. 3. How HCPs gained knowledge about vaccination.

questions about vaccination, HCPs would prefer an app with information (54.4 %), a website (52.8 %), a course or training (46.1 %), an FAQ database (45.7 %), or support and recommendations from the government (35.9 %), among other options (Fig. 5).

### 3.6.2. Spanish sample

The respondents mainly turned to online search engines (e.g., Google search) (51.2 %), online medical libraries and medical platforms (43 %), or a national public health institution (36.1 %) for information about vaccination – among other options (Fig. 4). Almost similar to Flanders, the Spanish sample would prefer as extra support an app with information (52.6 %), a website (49.8 %), a course or training (45.7 %), support and recommendations from the government (38.5 %), a FAQ database (35.4 %), or a leaflet (31.6 %) – among other options (Fig. 5).

## 4. Discussion

Since HCPs are the most trusted source of information about vaccination for the general public [9,10,22–26], their confidence to answer

questions about vaccination from patients is crucial for maintaining and/or increasing vaccine confidence. Therefore, it is important to monitor HCPs’ confidence to answer questions about vaccination and to monitor their needs for training. In this context, the Vaccine Training Barometer was developed. After a pilot test in Flanders, the Barometer was launched during the COVID-19 pandemic (November 2020 -January 2021) in Flanders (Belgium) and the Spanish regions of Catalonia, Navarre and Valencian Community.

### 4.1. HCPs’ confidence to answer questions about vaccination and training needs in Flanders and Spanish regions

Not surprisingly, our study showed that during the period of November 2020 – January 2021, which was just before and during the start of the first COVID-19 vaccination campaigns, both in the Flemish and in the Spanish sample, HCPs received questions about vaccination frequently, and about two thirds of them indicated that the frequency of questions had increased over the past three months prior to the time of questioning. Most questions were about side effects and safety of

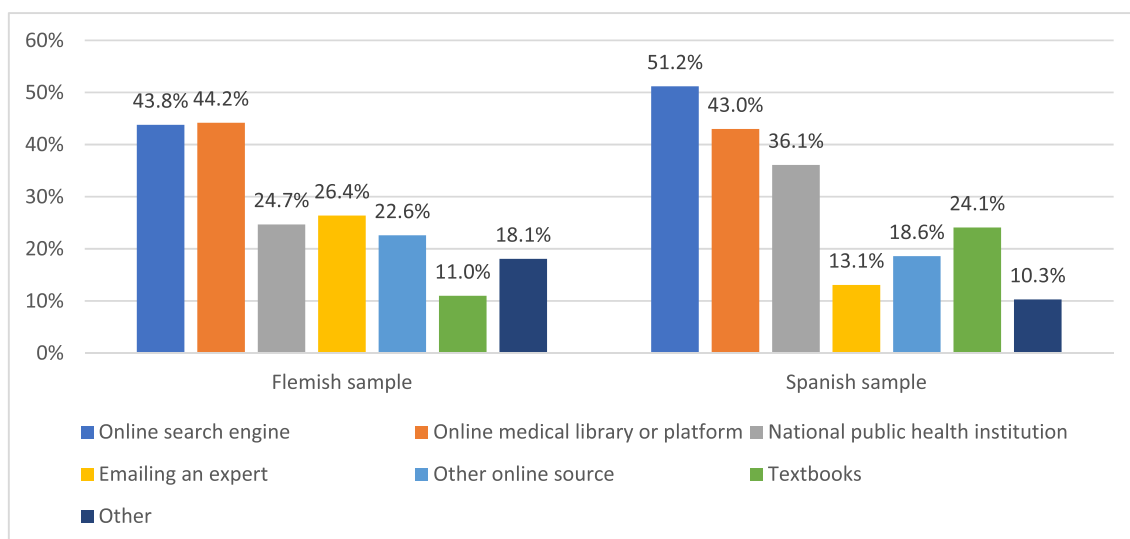


Fig. 4. Sources that HCPs consult for information about vaccination.(These results are based on a multiple-answer question where participants were invited to check all that applied.).



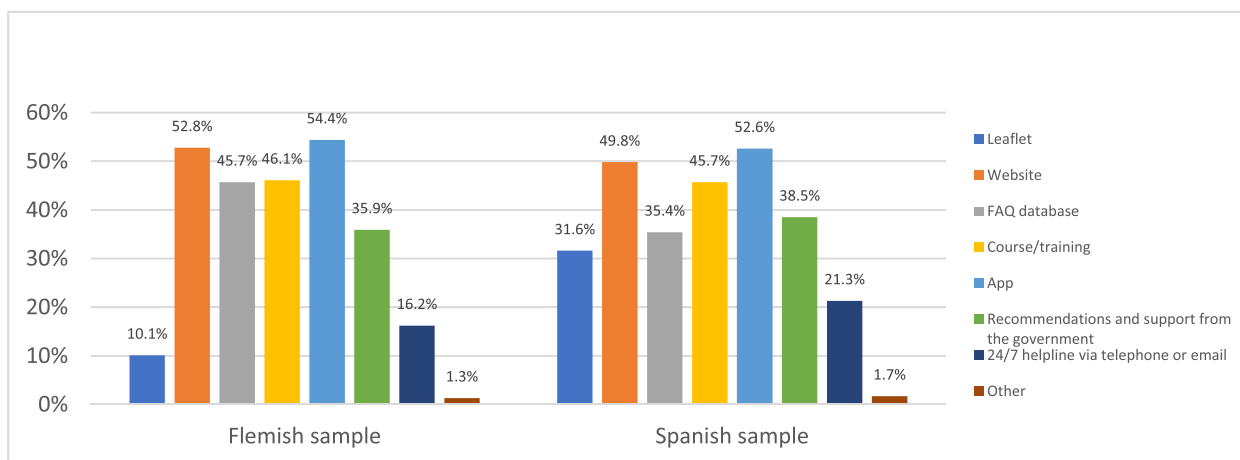


Fig. 5. Sources that HCPs would prefer for extra support.(These results are based on a multiple-answer question where participants were invited to check all that applied.).

vaccines. This finding suggests that the introduction of the COVID-19 vaccination campaign led to an increase in the number of questions about vaccination, leaving many HCPs feeling unsure about how to answer questions about the new vaccines. Additionally, these findings demonstrate that the Vaccine Training Barometer is indeed capable of detecting increases in the frequency and type of questions asked to HCPs.

In both studied samples, a considerable proportion of HCPs did not feel very confident to answer questions about vaccination (31.5 % feels confident in the Flemish sample, 21.6 % in the Spanish sample) and a large proportion of HCPs received questions in the last three months that they could not answer (52.4 % of respondents in Flanders, 41.5 % in Spanish regions) (Table 2). These outcomes are important and concerning, keeping in mind that it is the HCPs who are considered the most trusted source of information about vaccination for the general public. These findings align with prior research indicating that HCPs often lack knowledge and confidence to communicate about vaccination with patients, especially when confronted with vaccine hesitant patients [35,37,48].

Our results also showed that both in the Flemish and the Spanish sample, only 11.4 % and 11.3 % of the respondents, respectively, felt that they gained enough knowledge through their standard education to be able to answer questions about vaccination (Table 2). This is an important finding, underlining that more attention is needed for vaccinology in the curriculum of healthcare students and that in-service HCPs indeed have a crucial need for training. Knowledge about vaccination among HCPs is crucial for increasing their confidence to communicate about vaccination and their intention to recommend vaccination to patients, which has been proposed as one of the main reasons for patients or parents to change their intention to get vaccinated [36,42–46]. The vast majority of HCPs in our study (95.4 % in the Flemish sample

Table 2 Key findings about HCPs’ confidence to answer questions about vaccination and training needs.

	Flemish sample Nov 2020 – Jan 2021 833 HCP	Spanish sample Nov 2020 – Jan 2021 291 HCP
Feels confident to answer questions about vaccination	31.5 %	21.6 %
Received questions in the last 3 months that they could not answer	52.4 %	41.5 %
Gained sufficient knowledge through their standard education	11.4 %	11.3 %
Is willing to follow extra training	95.4 %	96.6 %

and 96.6 % in the Spanish sample) is willing to follow extra training on vaccination (Table 2). The eagerness among HCPs for information on vaccines and vaccination might be due to the fact that the field of vaccinology is rapidly evolving with new vaccines and vaccine platforms being developed, of which the information has never been covered in the traditional educational programs. Given this willingness of HCPs to follow additional vaccination training, coupled with prior research linking a higher knowledge about vaccination to a higher likelihood to recommend vaccination and a higher confidence to communicate about vaccination [35], our findings in both countries can be considered a call to action to develop training initiatives about vaccination for in-service HCPs and to revise the curriculum for healthcare students.

4.2. Vaccine Training Barometer as a tool to monitor confidence and training needs of HCPs

Our findings also indicate that the Vaccine Training Barometer can be used as a tool to monitor the confidence of HCPs to answer questions about vaccination and their training needs over time. For this purpose, the Vaccine Training Barometer can be put forward for use in multiple countries and/or target audiences, as a longitudinal survey or as a repeat cross-sectional survey (e.g., annually), to be able to follow up the confidence of HCPs and their need for additional training. When used at regular intervals, fluctuations could be picked up in a timely fashion, and appropriate actions could be taken. The following strategy would be valuable to test and to implement if proven successful, in any target population of HCPs: (a) to question HCPs by using the Barometer, (b) to analyze the findings on questions asked by patients, HCPs’ confidence to answer questions, and their training needs and preferences, (c) to provide training tailored to the needs and preferences identified through the Barometer, (d) to evaluate by re-questioning HCPs using the Barometer, and (e) to do a long-term follow-up. For example, if the Barometer indicates in a certain target population that HCPs have been receiving more questions from patients over the past months, that their confidence in addressing these questions is low, but that their willingness to follow extra training is high, appropriate training initiatives for HCPs could be implemented, based on the preferences of HCPs indicated in the Barometer. When trainings have been implemented, a new implementation of the Barometer could evaluate whether the training initiatives have increased HCPs’ confidence to answer questions about vaccination.

Besides implementing the Barometer for specific target groups in order to tailor trainings to the needs and preferences of the HCP group of interest, the Barometer can also be used on a larger scale to assess HCPs’ confidence and training needs over different countries in order to raise

awareness on the issue. In that sense, the Barometer has already served as the basis for a European-wide survey run by the Coalition for Vaccination [50].

Another opportunity for future use of the Barometer is the ability to assess the most frequently asked questions about vaccination by patients, questions that HCPs could not answer and common misconceptions among patients that HCPs are confronted with. The Barometer contains questions to capture this information. The analysis of the HCPs' answers to these questions falls outside the methodology and scope of this study, but it has potential for future research and use of the Barometer. This information could be useful for trainers of HCPs and public health authorities to tailor trainings and vaccination campaigns.

To even better tailor training activities to the needs of HCPs, an interesting addition for future use of the Barometer could be the inclusion of questions assessing which knowledge HCPs lack and which topics they would like to receive training on.

#### 4.3. Limitations

This study has a few limitations. Based on the facts that our response rate was unknown, and that data collection was based on self-selection sampling, we cannot exclude that there might have been a nonresponse bias. Participating HCPs could have had a different profile than non-participating HCPs. For example, it is possible that HCPs who decided to participate in this survey already had a bigger interest or a higher confidence in vaccination, or that they had more experience with or more knowledge about vaccination than others and therefore chose to participate. However, if that was the case, it is striking that even in this group the confidence to answer questions was that low and the need for extra training that high.

Second, we measured self-rated confidence of HCPs to answer questions concerning vaccination, which might not reflect the true situation, because social desirability might have played a role. Moreover, confidence to answer questions about vaccination does not necessarily reflect true competence in doing so. Prior research shows that HCPs' self-rated knowledge about vaccination predicts the likeliness of recommending vaccines to patients, while true knowledge measured by factual questions does not [44]. This suggests that self-rated confidence to answer questions, as questioned in the Barometer, is a valuable indicator for future studies.

Third, although the survey was taken by a large and diverse sample of HCPs, the representativeness of the total population of HCPs cannot be guaranteed. The response rate of the survey was also unknown. Generalizing the findings should thus be done with care. However, the findings are an important signal that at least in our sample, which consists of an important part of the HCPs in the studied regions, there is a need for more training among HCPs, which should be followed up either way.

Fourth, the Barometer was conducted just before and during the start of the first COVID-19 vaccination campaigns. During that period, the public had a lot of questions about the new COVID-19 vaccines and even vaccines in general, and there still was a lot of uncertainty about the vaccines. HCPs' confidence to answer questions might have been lower and their need for training higher in this unique context of the pandemic than in an inter-pandemic "business as usual" context. Our findings can thus not be generalized to any context and period. However, the Barometer provides an excellent tool to remeasure the confidence to answer questions about vaccines and the training needs in inter-pandemic periods as well.

Fifth, because we did not force responses to the questions in the survey, a few missing values, that might not be random [51], were recorded. Responses of respondents who completed less than 50 % of the survey were deleted. For the remaining data, the percentage of missing values was less than 5 %, which can be considered negligible [51]. Therefore, we reported valid percentages, which are the percentages when missing data are excluded from the calculations.

Sixth, the age of the participants was not surveyed. This is a limitation to keep in mind when interpreting the findings regarding HCPs' knowledge on vaccination and the amount of attention for vaccination in HCPs' education, as these are factors that could be influenced by participants' age.

Finally, the Barometer was conducted in two European regions. It is possible that different results may be found in other regions in Europe or the world. However, the focus of this study was to describe the development and possibilities of the Vaccine Training Barometer as a tool to monitor HCPs' confidence to answer questions about vaccination and their needs for training. Future research could implement the Barometer in other regions to examine the differences between them.

## 5. Conclusions

The Vaccine Training Barometer was developed and implemented in some regions of Belgium and Spain. The results showed that HCPs in Flanders and the Spanish regions of Catalonia, Navarre and Valencian Community receive many questions about vaccination, with an increase during the COVID-19 vaccination campaign, but many HCPs do not feel confident to respond to these questions and most of them cannot rely on their prior education. The vast majority of HCPs is open to extra training. As such, the Barometer is a useful tool to monitor the confidence of HCPs to answer questions about vaccination and to capture their specific training needs.

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### CRediT authorship contribution statement

**Aurélie De Waele:** Data curation, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Greet Hendrickx:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – review & editing. **Sara Valckx:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – review & editing. **Àngela Domínguez:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Writing – review & editing. **Diana Toledo:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Writing – review & editing. **Jesús Castilla:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration. **José Tuells:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration. **Pierre Van Damme:** Funding acquisition, Methodology, Supervision, Writing – review & editing.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

Data will be made available on request.

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