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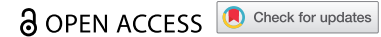


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RESEARCH ARTICLE



## Sexual and preventive behaviors associated with HAV, HBV, and HPV vaccine hesitancy among men who have sex with men in France

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### ABSTRACT

Vaccination coverage against hepatitis A virus (HAV), hepatitis B virus (HBV), and human papillomaviruses (HPV) is insufficient among men who have sex with men (MSM), partly because of their high prevalence of vaccine hesitancy (VH) specific to these vaccines. This study aimed to investigate determinants of specific VH in MSM, focusing on characteristics of their sexual activity, propensity to use prevention tools and medical care, disclosure of sexual orientation to health care professionals (HCPs), and perceived stigmatization. A cross-sectional electronic survey (February – August 2022) collected perceptions of HBV, HAV, and HPV, and of their respective vaccines among 3,730 French MSM and enabled the construction of a specific VH variable. Using agglomerative hierarchical cluster analysis, we constructed a typology of MSM sexual and prevention practices. We identified three MSM clusters (low- (C1, 24%), moderate- (C2, 41%), and high- (C3, 35%) “sexual activity/medical engagement”) that showed an increasing gradient in the use of medical prevention with regular medical care and exposure to high-risk sexual practices. A multiple ordinal logistic regression showed that overall specific VH was higher in the C1 cluster and in men who had not informed their physician of their sexual orientation. This typology could usefully help to adapt vaccination communication strategies for MSM prevention program according to patients' profiles. HCPs should be encouraged and trained to ask men about their sexual practices and to provide appropriate vaccination recommendations nonjudgmentally.

### ARTICLE HISTORY

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MSM; hepatitis B; hepatitis A; human papillomavirus; vaccine hesitancy; sexual activity; medical engagement; sexual orientation disclosure

## Introduction


### Background

Because of the risks of viral transmission to which men who have sex with men (MSM) are exposed, specific vaccination recommendations exist for them, in particular, against the hepatitis A virus (HAV), hepatitis B virus (HBV), and human papillomaviruses (HPV).<sup>1</sup> In France, MSM-specific recommendations concern all three, albeit only up to age 26 for HPV.<sup>2</sup> Official public health websites (institutional sites, prevention sites for the general public or for target populations or themes<sup>3–7</sup>) relay these recommendations. In France, many places offer free vaccinations. The hepatitis vaccines are affordable (largely covered by the National Health Insurance Fund and supplementary health insurance, or with an out-of-pocket cost of less than €20 for a full vaccination for each vaccine), while the HPV vaccine is more expensive (covered partially and only for teenagers and for MSM aged 26 or under, who pay an out-of-pocket cost of around €120 for a full vaccination). Vaccine coverage rates against these three viruses are insufficient among MSM in France (estimated around 75% for HAV,<sup>8–11</sup> 60% for HBV,<sup>12,13</sup> and 15% for HPV<sup>14,15</sup>), as in

several other Western countries.<sup>16</sup> Previous studies have shown that uptake and/or acceptance of HAV, HBV, and HPV vaccines are positively associated with high levels of education, income, and employment, as well as with sexual behaviors at high risk of exposure to these diseases (e.g., higher number of sexual partners, drug use before/during sex, condomless anal intercourse, previous sexually transmitted infections (STIs), HIV positive status), adoption of prevention behaviors (e.g., use of sexual health services, notably STI/HIV screening and pre-exposure prophylaxis (PrEP)), disclosure of sexual orientation to health care professionals (HCPs), and low rates of perceived stigmatization or embarrassment regarding one's homosexuality.<sup>16</sup>

The insufficient vaccine coverage of MSM is explained in part by vaccine hesitancy (VH), i.e., a “delay in acceptance or refusal of vaccination despite availability of vaccination services.”<sup>17</sup> In a previous publication about MSM in France, we reported that they have high levels of specific VH for at least one of these three vaccines (87%), strongly associated with low uptake of them.<sup>18</sup> Nonetheless, as other factors specifically related to MSM sexual and preventive behaviors are associated with uptake of these specific

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vaccines, their association with specific VH requires further investigation. Studies of VH among MSM are sparse, especially for the HAV, HBV, and HPV vaccines,<sup>18–20</sup> and deeper knowledge of the determinants of specific VH related to them is necessary to guide public health actions in identifying the groups to be targeted as a priority and the key factors to focus on.

### Objectives

The main objective of this article is to examine the factors that are associated with VH specific for HAV, HBV, and HPV vaccines among MSM. We aimed to focus on the characteristics of their sexual activity, their propensity to use the prevention tools available to them or to seek medical care, their disclosure of their sexual orientation to their HCPs, and their feelings of stigmatization. We hypothesized that the level of specific VH would be lower among MSM more inclined to use prevention tools, and/or whose sexual activity puts them at greater risk of acquiring STIs (since they may feel more concerned by the risk of contracting these), and who receive care in a medical environment where they feel comfortable disclosing their sexual orientation to the physician caring for them.

## Material and methods

### Study design

We conducted a cross-sectional online questionnaire survey among volunteer MSM residing in France from February 15 to August 31, 2022.

### Participants

This study's methods have previously been described.<sup>18</sup> Briefly, the eligibility criteria were as follows: (1) adults aged 18 or older; (2) of male sex assigned at birth and self-identifying as a man, or genderqueer, or other than a woman; or of female sex assigned at birth and self-identifying as a man or trans man; and <sup>3</sup> who have had sex with men (exclusively or not); or have never had sex but do not self-identify as heterosexual.

### Procedure

A website ([www.vaccigay.fr](http://www.vaccigay.fr)) was created to present the project and host the questionnaire. The questionnaire was promoted on gay social networks and in the gay press, on posters in premises used by three national associations involved in health promotion and prevention among MSM (about 800 festival venues or health centers across France), and on flyers distributed to visitors. Finally, we placed advertising banners on Grindr, a gay dating application.

### Sample size

To determine sample size, we considered two criteria: 1) the minimum size of 500 participants recommended for computing multiple logistic regressions<sup>21</sup> and 2) the socioeconomic

diversity of the sample. We decided to stop data collection after 6 months when the sample size of fully completed questionnaires was well above the first criterion, and the inclusion of new participants did not modify the sociodemographic characteristics of the sample.

### Data collection

The questionnaire was based on a literature review and on 12 qualitative semi-structured telephone interviews of MSM that had demonstrated a lack of knowledge about the risks associated with their sexual practices and with vaccine-preventable diseases, particularly HPV. Its completion took about 20 minutes.

### Sociodemographic and health characteristics

The questionnaire collected information about participants' sociodemographic characteristics: age, gender, education level, employment status, perceived financial situation, and complementary health insurance. MSM were also asked about their gender identity and sexual orientation and about their health: HIV status, long-term illness status (i.e., certified by a physician as having an illness serious and/or chronic enough to require prolonged treatment, for which they receive full reimbursement of costs by the National Health Insurance Fund).

### Questions related to vaccination and specific vaccine hesitancy

We used a recently published methodology<sup>18</sup> to assess specific VH related to HAV, HBV, and HPV vaccines: 12 scale items (4 items per vaccine) asked participants about their perceptions of these three vaccines (their effectiveness and concerns about severe side effects) and of the diseases they prevent (fear of being infected with it, and its severity) (*scale answers from 0=“Not at all” to 10=“Absolutely”, with a “don't know” option*). We will refer to these items hereafter as benefit-risk balance (BRB) items. They are based on two theoretical models that share some dimensions: the Health Belief Model<sup>22–24</sup> (perceived risk and perceived vulnerability to disease, perceived risks and benefits of the vaccine) and the 3C model<sup>17</sup> (dimensions of confidence in vaccine safety; and complacency, i.e., the feeling that vaccination is not useful linked to the perception that the risk associated with the disease is low).

### Sexual practices and preventive attitudes toward risks of infection with HIV and other sexually transmitted infections

The questionnaire collected information about: (1) participants' general sexual practices: e.g. number of sexual partners in the previous 6 months, intentional risk avoidance in 5 defined at-risk situations (details of situations are listed in the legend to Table 3 and in the Supplementary Material A); (2) characteristics of their most recent episode of sexual intercourse: its type, partner or partners involved (number, stable and/or casual), any receptive anal sex, chemsex practice (i.e., recreational drug use); HIV-prevention practices, including condom use, PrEP use, and Treatment as Prevention (TasP) practice, as well as postexposure prophylaxis (PEP); and (3) their STI screening practices during the previous 12 months and lifetime HIV screening practices, and their use of

a CeGIDD center (sexual health center) during the previous 12 months; more than 300 CeGIDD in France, funded by the National health insurance found provide free information, screening, and diagnosis for HIV infections, viral hepatitis, and STIs.<sup>25</sup>

### HCP relationships and feeling of stigmatization/negative judgments

Finally, participants were asked whether or not they regularly (i.e., at least once a year) saw a general practitioner (GP) or another physician. For those who answered yes, we asked them whether or not they had disclosed their sexual orientation to the physician. The following item assessed their feeling of stigmatization in access to health care: “Have you ever had the feeling of being judged [negatively] by a health care professional (doctor, nurse, pharmacist, etc.) because of your sexual orientation?”

### Measures

#### Specific VH related to HAV, HBV, and HPV vaccines

For each vaccine, we used its four BRB items (see the previously published algorithm in Table 1<sup>18</sup>) to construct a variable capturing grades of specific (moderate or high) VH toward these vaccines. We then combined the three variables obtained (corresponding to the three vaccines of interest) into one outcome variable “specific VH grade” for at least one of the three vaccines, with three categories<sup>18</sup>: 1) “high VH” (complacency and lack of confidence for at least one vaccine); 2) “moderate VH” (complacency or lack of confidence in vaccine – but not both – for at least one vaccine); or 3) ‘no VH’ (no VH for any of the three vaccines).

#### Disclosure of sexual orientation to physician

Participants who were not regularly seen by a physician were coded as not having disclosed their sexual orientation.

### Statistical analyses

#### Typology of sexual and prevention practices

Using agglomerative hierarchical cluster analysis (AHCA),<sup>26,27</sup> we constructed a typology of MSM sexual and prevention practices based on variables related to general sexual practices, characteristics of the most recent episode of sexual intercourse, and STI screening practices. We used the Ward method based on minimum inertia lost (i.e., minimal total within-cluster variance and maximal between-cluster variance) to identify the optimal number of clusters.<sup>27</sup>

#### Characterization of clusters

Bivariate analyses based on Chi<sup>2</sup> tests then studied the characteristics of MSM associated with these clusters: sociodemographic characteristics,<sup>28–30</sup> clinical characteristics, and disclosure of sexual orientation to the physician,<sup>31–36</sup> personal experience of stigmatization by an HCP,<sup>37,38</sup> and specific VH grade.

#### Association between overall specific VH and the typology of sexual and prevention practices

We computed a multiple ordinal logistic regression adjusted for sociodemographic and clinical characteristics to study the relations between overall specific VH (dependent variable) and the MSM typology obtained in the cluster analysis, disclosure of sexual orientation to the HCP, and feelings of HCP stigmatization (explanatory variables). The model also included an interaction term “cluster\*disclosure to HCP” to analyze if the association between disclosure of sexual orientation and specific VH varied between clusters.

The score test was used to ensure that the proportional odds assumption was not rejected.<sup>39</sup> We also computed the variance inflation factor (VIF) to test for multicollinearity in equivalent linear models.

All analyses were based on two-sided *P*-values, with *p* ≤ .05 indicating statistical significance. They were conducted with SAS 9.4 software (SAS Institute, Cary, NC).

**Table 1.** Threshold scores of perceived disease severity of, fear of infection, vaccine effectiveness, and vaccine risk used to construct the specific VH for each vaccine.

VH grade for each vaccine	BRB items			
	Perceived disease severity	Perceived fear of infection	Perceived vaccine effectiveness	Perceived vaccine risk
<b>No VH</b> Disease perceived as serious OR concerning, AND vaccine perceived as effective AND safe	Score > 5/10	Score > 5/10	Score > 5/10	Score < 5/10
<b>Moderate VH (complacency OR lack of confidence, but not both)</b>				
Complacency Disease perceived as not serious AND not concerning, AND vaccine perceived as safe – whatever its effectiveness	Score ≤ 5/10	Score ≤ 5/10	–	Score < 5/10
Lack of confidence in vaccine Disease perceived as serious OR concerning, AND vaccine perceived as ineffective OR unsafe	Score > 5/10	Score > 5/10	Score ≤ 5/10	Score ≥ 5/10
<b>High VH (complacency AND lack of confidence)</b> Disease perceived as not serious AND not concerning, AND vaccine perceived as unsafe – whatever its effectiveness	Score ≤ 5/10	Score ≤ 5/10	–	Score ≥ 5/10

This methodology has already been published.<sup>13</sup>

As the “don’t know” options had not been included in the 0–10 scales, they had to be recoded. For each type of question, we first performed multiple correspondence analyses of the corresponding items to assess the correlations between “don’t know” answers and the other response categories. We then recoded the “don’t know” answers between 0 and 10, according to the results of these multiple correspondence analyses: they were recoded at 5 for fear of infection, at 0 for perceived disease severity, at 1 for perceived vaccine effectiveness, and at 4 for the perceived vaccine risk.

## Results

### Participants' characteristics

Overall, 3,730 MSM fully completed the questionnaire. Table 2 summarizes the participants' characteristics. Almost all (98%) considered themselves men and 78% had sexual relationships with men exclusively. Half were younger than 39 years. A fairly high proportion had a high level of education: 41% reported 2–4 years of postsecondary schooling, and 37% had at least a master's degree. Most (78%) were employed, with 17% not in the labor force

(retired, student, or other). Thirty percent reported financial difficulties, and 6% did not have complementary health insurance, which reimburses health care costs not covered by the National Health Insurance Fund. Four in 10 MSM (41%) reported personal experience of a negative judgment by an HCP because of their sexual orientation. Nine percent were HIV+; 31% had long-term illness status, 90% regularly saw a GP or another physician and 71% had disclosed their sexual orientation to their physician. In all, 87% reported specific VH (74% moderate, 13% high) for at least one of the HAV, HBV, and HPV vaccines.

**Table 2.** Characteristics of study participants, overall and within clusters ( $n = 3,730$ ).

	All ( $n = 3,730$ )		Low sexual activity (C1) low medical engagement	Moderate sexual activity (C2) moderate medical engagement	High sexual activity (C3) high medical engagement	<i>P</i> <sup>†</sup>
	N	%	( $n = 907$ , 24%)	( $n = 1,533$ , 41%)	( $n = 1,290$ , 35%)	
<b>Current gender</b>						0.79
Man	3,652	97.9	<b>98.0</b>	<b>98.0</b>	97.8	
Trans man	14	0.4	<b>0.6</b>	0.3	<b>0.4</b>	
Genderqueer/nonbinary	55	1.5	1.3	<b>1.6</b>	1.5	
Other	9	0.2	0.1	0.2	<b>0.4</b>	
<b>Has sexual relationships with</b>						<.0001
Men exclusively	2,898	77.7	73.4	<b>78.2</b>	<b>80.2</b>	
Men and women	816	21.9	<b>24.9</b>	21.8	19.8	
Not concerned (never had any sexual relationship)	16	0.4	<b>1.7</b>	0.1	0.0	
<b>Sociodemographic characteristics</b>						
Age (quartiles)						<.0001
18–29	953	25.6	<b>30.5</b>	<b>27.1</b>	20.2	
30–38	873	23.4	21.6	<b>24.9</b>	22.9	
39–49	992	26.6	24.0	24.0	<b>31.5</b>	
50–84	912	24.5	23.8	24.0	<b>25.4</b>	
Education level						0.001
Lower than high school	403	10.8	<b>13.5</b>	9.1	<b>10.9</b>	
High school	454	12.2	<b>14.0</b>	11.0	<b>12.3</b>	
2–4 years of higher education	1,512	40.5	<b>41.1</b>	<b>41.6</b>	38.8	
Master's degree or higher	1,361	36.5	31.4	<b>38.3</b>	<b>37.9</b>	
Employment status						0.06
Employed	2,907	77.9	75.6	77.9	<b>79.6</b>	
Unemployed	178	4.8	<b>5.0</b>	4.2	<b>5.3</b>	
Inactive	645	17.3	<b>19.4</b>	<b>17.9</b>	15.1	
Financially comfortable	2,612	70.0	67.1	<b>71.4</b>	<b>70.4</b>	0.08
Complementary health insurance <sup>a</sup>	3,495	93.7	92.0	<b>94.7</b>	<b>93.7</b>	<b>0.03</b>
<b>Personal experience of stigmatization with an HCP</b>						
Have you ever felt judged by an HCP because of your sexual orientation	1,535	41.2	33.9	40.5	<b>47.1</b>	<.0001
<b>Health characteristics</b>						
HIV status						<.0001
Unknown	195	5.2	<b>17.3</b>	0.8	2.0	
Negative	3,214	86.2	78.9	<b>96.0</b>	79.5	
Positive	321	8.6	3.8	3.2	<b>18.5</b>	
Long-term illness status <sup>b</sup>	1,148	30.8	27.9	25.6	<b>38.9</b>	<.0001
Regularly sees a general practitioner <sup>c</sup>	2,620	70.2	<b>70.6</b>	<b>73.6</b>	66.1	<.0001
Regularly sees another physician	1,306	35.0	15.8	32.6	<b>51.5</b>	<.0001
Does not see any physician regularly	380	10.2	<b>21.1</b>	8.7	4.3	
<b>Sexual orientation disclosed</b>						
Sexual orientation disclosed to the physician	2,632	70.6	46.2	<b>72.5</b>	<b>85.4</b>	<.0001
<b>Specific grade of VH for HAV, HBV or HPV vaccines<sup>d</sup></b>						<b>0.0003</b>
No VH	493	13.2	9.8	<b>13.4</b>	<b>15.4</b>	
Moderate	2,767	74.2	<b>75.1</b>	<b>75.5</b>	72.0	
High	470	12.6	<b>15.1</b>	11.2	12.6	

<sup>a</sup>Complementary health insurance: not-for-profit companies that reimburse their members' health care costs in addition to the compulsory scheme.

<sup>b</sup>Long-term illness status: certified by a physician as having an illness serious and/or chronic enough to require prolonged treatment, for which they receive full reimbursement of costs by the National Health Insurance Fund.

<sup>c</sup>Participants were asked whether or not they regularly (i.e. at least once a year) saw a general practitioner or another physician.

<sup>d</sup>Combination of the three VHs relating to the three vaccines separately, each obtained from their four BRB items (see Materials and methods section).

### Clusters of sexual and prevention practices and associated characteristics

The cluster analysis identified three groups of MSM varying according to their sexual activity and use of prevention tools (Table 3).

The first cluster (C1), “low sexual activity/low medical engagement” included 24% of participants: they reported fewer sexual partners, and avoided at-risk situations more often or were less concerned about them (in particular, going to saunas, backrooms, adult video shops and/or outdoor gay venues (Supplementary Material A)), than the other MSM. Their most recent sexual intercourse involved fewer risky

sexual practices, and they sought medical treatment to prevent HIV transmission/acquisition less frequently; they also reported less frequent recent HIV/STI screening (Table 3). They were also more likely to have had relationships with both men and women than with men only and were less likely to report seeing a physician regularly; only 46% had disclosed their sexual orientation to their physician, compared with a mean of 71% for the entire sample (Table 2). Of the three clusters, they reported the highest rate of high specific VH related to the HAV, HBV, and HPV vaccines: 15%, versus 11% in cluster 2 and 13% in cluster 3. Moreover, only 10% had no VH, versus 13% in cluster 2 and 15% in cluster 3 ( $p = .0003$ ,

**Table 3.** Typology of participants according to sexual practices and prevention behaviors, agglomerative hierarchical cluster analysis,  $n = 3,730$ .

	Low sexual activity low medical engagement ( $n = 907$ , 24%)	Moderate sexual activity moderate medical engagement ( $n = 1,533$ , 41%)	High sexual activity high medical engagement ( $n = 1,290$ , 35%)	All ( $n = 3,730$ )	$p$ †
	col. %				
<i>General practices and risk avoidance strategies</i>					
Number of sexual partners during the previous 6 months					<.0001
0–1	<b>39.7</b>	4.4	2.7	12.4	
2–10	52.2	<b>65.6</b>	41.4	53.9	
> 10	8.2	30.1	<b>55.9</b>	33.7	
Avoidance of anal intercourse with HIV positive partners, or partners whose HIV status is uncertain <sup>a</sup>					<.0001
Not applicable	<b>26.7</b>	10.6	10.8	14.6	
Never	15.7	15.7	<b>47.2</b>	26.6	
Rarely	11.3	<b>18.4</b>	<b>18.5</b>	16.7	
Quite often	8.5	<b>21.5</b>	8.0	13.7	
Very often	<b>37.9</b>	<b>33.8</b>	15.5	28.5	
<i>Characteristics of most recent sexual intercourse</i>					
Number of partners					<.0001
Single partner	<b>90.6</b>	<b>85.5</b>	54.9	76.1	
Multiple partners	9.4	14.6	<b>45.1</b>	23.9	
Type of partner					<.0001
One or multiple casual partners	60.9	<b>72.9</b>	64.7	67.2	
Stable and casual partners	0.7	0.3	<b>23.0</b>	8.2	
One or multiple stable partners	<b>38.5</b>	<b>26.8</b>	12.3	24.6	
Chemsex practice: recreational drug use (cocaine, GHB/GBL, amphetamines, MDPV, 3-MMC, 4–4-MMC...)	1.1	1.7	<b>22.7</b>	8.8	<.0001
Receptive anal sex	43.1	43.5	<b>60.5</b>	49.3	<.0001
Means of protection against the risk of HIV transmission used					
Condom	<b>34.2</b>	<b>36.5</b>	27.7	32.9	<.0001
PrEP	7.8	<b>34.1</b>	<b>52.1</b>	33.9	<.0001
TasP with an HIV+ partner	0.0	0.0	<b>4.2</b>	1.5	<.0001
TasP as HIV+	0.0	0.3	<b>15.4</b>	5.5	<.0001
None	<b>58.9</b>	<b>37.1</b>	16.5	35.3	<.0001
Postexposure treatment after this sexual intercourse	0.0	0.0	<b>5.4</b>	1.9	<.0001
<i>Screening practices</i>					
At least one STI screening in the last 12 months					<.0001
No or don't know	<b>63.2</b>	11.9	6.1	22.3	
Yes, negative	28.5	<b>59.7</b>	<b>52.3</b>	49.5	
Yes, at least one test positive or don't know	8.4	28.4	<b>41.6</b>	28.1	
At least one HIV screening during lifetime					<.0001
No	<b>16.2</b>	0.0	0.3	4.1	
Yes, more than a year ago	<b>44.8</b>	10.3	11.4	19.1	
Yes, in the last 12 months	39.0	<b>89.7</b>	<b>88.3</b>	76.9	
Use of an anonymous and free screening center or consultation (CeGIDD <sup>b</sup> ) in the last 12 months					<.0001
No	<b>82.4</b>	44.6	50.3	55.8	
Yes, just one	8.6	<b>20.1</b>	7.1	12.8	
Yes, several times	9.0	<b>35.3</b>	<b>42.6</b>	31.4	

†Chi<sup>2</sup> test, or Fisher's exact test when sample size was too small.

<sup>a</sup>The distributions in each cluster for all other avoidance items were similar to this distribution (appendix): “I avoid one-night stands;” “I try to restrict the number of partners with whom I have anal intercourse;” “In a sauna, a backroom or in an outdoor gay venue, I restrict the number of partners with whom I have sexual contact;” “I avoid attending saunas, backrooms, adult video shops and/or outdoor gay venues.”

<sup>b</sup>CeGIDDs are free information, screening and diagnostic centers for human immunodeficiency virus infections, viral hepatitis and sexually transmitted infections. There are more than 300 in France. They are funded by the National health insurance fund.

Table 2). MSM in this cluster were younger and less educated than in the other clusters.

The second cluster (C2), “*moderate sexual activity/moderate medical engagement*,” included 41% of the participants; they reported sexual and prevention practices intermediate between the other two clusters (Table 3). MSM identified in this cluster saw a physician regularly more often than in the other two groups, and 73% had disclosed their sexual orientation (Table 2). They showed moderate specific VH more often than average (76% versus 75% in cluster 1 and 72% in cluster 3:  $p=.0003$ , Table 2). They were more educated.

The third cluster (C3), “*high sexual activity/high medical engagement*,” included 35% of the participants, and their behaviors were the opposite of those in the first cluster. Its participants more often reported high numbers of sexual partners and avoided at-risk situations less often. Moreover, their most recent sexual intercourse involved a higher number of potentially high-risk sexual practices and was associated with more frequent use of PEP, PrEP, or TasP; they also reported more recent HIV/STI screening (Table 3). This cluster also included more participants who were HIV+ and/or who had a long-term illness (Table 2); they were more likely to see a specialist regularly and more

frequently reported feeling personal stigmatization by a health care professional; 85% had disclosed their sexual orientation to their physician. They were older than respondents in the other two clusters.

#### **Frequency and grade of specific VH was associated with clusters of sexual and prevention practices and with a feeling of stigmatization**

The proportional odds assumption was not rejected ( $p=.06$ ) by the score test<sup>39</sup> and we found no issue of multicollinearity (VIF values were all  $< 5$ <sup>40</sup>).

The multiple ordinal logistic regression model (Table 4) showed that the probability of overall specific VH was higher among MSM in the “*low sexual activity/low medical engagement*” cluster (C1) than among those in the “*high sexual activity*”/“*high medical engagement*” cluster (C3), but not among those in the intermediate cluster (C2). The probability of overall specific VH was also higher among MSM who had not disclosed their sexual orientation to their physician compared to those who had, without significant interaction with the cluster variable. Personal experience of stigmatization with a health professional

**Table 4.** Factors associated with specific VH frequency and grade: results from multiple ordered logistic regressions (ref. No VH),  $n = 3,728^a$ .

	Ordinal ( $p = .06$ ) aOR [95% CI]
<b>Clusters and HCP sexual orientation disclosure</b>	
Clusters (ref. C3 “High sexual activity/high medical engagement”)	
C1 “Low sexual activity/low medical engagement”	<b>1.37 [1.06;1.78]</b>
C2 “Moderate sexual activity/moderate medical engagement”	1.10 [0.91;1.34]
Sexual orientation disclosed to the physician (ref. Yes)	
No <sup>b</sup> – Don’t know	<b>1.53 [1.07;2.18]</b>
Interaction (ref. C3, revealed their sexual orientation)	
C1*No/Don’t know	0.84 [0.53;1.35]
C2*No/Don’t know	0.89 [0.57;1.37]
<b>Personal experience of stigmatization by an HCP</b>	
Have ever felt [negatively] judged by an HCP because of sexual orientation (ref. No never – Don’t know)	
Yes	1.10 [0.95;1.28]
<b>Sociodemographic characteristics<sup>c</sup></b>	
Age (quartiles) (ref. 18–29)	
30–38	<b>1.53 [1.22;1.91]</b>
39–49	<b>2.11 [1.68;2.64]</b>
50–84	<b>2.15 [1.72;2.69]</b>
Education level (ref. Did not pass “baccalaureate” <sup>d</sup> exam at end of high school or lower level)	
Passed “baccalaureate” at end of high school	0.91 [0.67;1.23]
2–4 years of higher education	<b>0.68 [0.53;0.87]</b>
Master’s degree or higher	<b>0.54 [0.42;0.71]</b>
Professional situation (ref. Employed)	
Unemployed	1.16 [0.82;1.65]
Not in the labor force <sup>e</sup>	0.83 [0.67;1.03]
Perceived financial situation (ref. Comfortable – Okay)	
Tight – Difficult – In debt	<b>1.26 [1.06;1.49]</b>
Complementary health insurance (ref. No – don’t know)	
Yes	0.86 [0.63;1.17]
<b>Health characteristics</b>	
Result of the last HIV test (ref. HIV-)	
Unknown	1.24 [0.86;1.78]
HIV+	0.92 [0.67;1.24]
Beneficiary of 100% health care coverage due to a long-term illness (ref. No – Don’t know)	
Yes	1.12 [0.93;1.34]

<sup>a</sup>2 missing values for area of residence.

<sup>b</sup>Including those who replied that they did not regularly see a physician.

<sup>c</sup>The region of residence was also taken into account as an adjustment variable (Overseas, Northwest, Northeast, Southwest, Southeast; ref. Paris region) but the aORs were not significant.

<sup>d</sup>School-leaving exam at the end of high school.

<sup>e</sup>Mostly students and retired people.

was not significantly associated with specific VH grade. Additional factors associated with a higher probability of specific VH included older age, a low education level, and a precarious financial situation.

## Discussion

### Main results

Our study identified three profiles of MSM in terms of their sexual and prevention practices: “*low sexual activity/low medical engagement*” (C1), “*moderate sexual activity/moderate medical engagement*” (C2), and “*high sexual activity/high medical engagement*” (C3). These profiles showed a gradient along which the uptake of medical prevention increased with both regular medical care and the extent of potentially high-risk sexual practices. Overall specific VH related to HAV, HBV, and HPV vaccines was higher in the C1 than the C3 cluster, but not the C2 cluster. Men who had not informed their physician of their sexual orientation were more likely to report higher VH grades than those who had, regardless of the cluster, while personal experience of stigmatization by providers was unrelated to VH grade.

### Specific VH is associated with less risky sexual practices and less engagement in prevention

Our results confirm our hypothesis that fewer at-risk sexual practices and less engagement in prevention practices are both associated with a higher grade of specific VH related to HAV, HBV, and HPV. These results are consistent with those of studies of acceptability and/or uptake of HAV, HBV, and HPV vaccines among MSM<sup>16</sup> and of their VH for other vaccines.<sup>41</sup> Having a stable partner or few partners and avoiding at-risk sexual behavior (corresponding to the C1 cluster) may reinforce the perception of being safe from the risk of STIs and the feeling that vaccination is not useful (*complacency*<sup>17</sup>). Compared to the other clusters, a smaller proportion of C1 cluster members (46%) disclosed their sexual orientation to a physician. Their relatively young age and low level of education may be additional barriers to seeking care.<sup>42</sup> In turn, poor medical follow-up means a loss of opportunity to be informed about sexual health specifically affecting MSM, particularly about STIs and vaccine recommendations and to discuss these topics with HCPs. This may explain their more frequent complacency and lack of confidence in the safety of vaccines, as a relationship of trust with an HCP is a central aspect of vaccine trust.<sup>43</sup> But even if MSM with these characteristics have less exposure than others to STIs, they are still exposed to them. They thus remain an important target for intervention, so that they can have regular medical care and be made aware of the need for vaccination.

The attitudes and behaviors of MSM in C3 (and to a lesser extent those in C2) were the opposite of those in C1: they reported both high levels of risky sexual activity and better self-protection, with half reporting PrEP uptake. They seemed to be more comfortable with their sexuality in that they were more likely to declare their sexual orientation to their doctor (Table 2). These MSM from C2 and C3 were more often treated by specialists than by GPs and thus were more likely to be made aware of the benefits of the vaccines recommended for MSM. Accordingly, they had lower grades of VH compared

with C1, although the difference was not marked. The situation of MSM in C2 is more worrisome than that in C3, for although frequently exposed to risky sexual practices, the proportion of C2 participants not seeing a doctor regularly was more than double that in C3 (Table 2).

### High prevalence of vaccine hesitancy in all clusters

Nonetheless, the high prevalence of moderate and/or high VH (> 85%) in all three clusters (Table 3) shows that the vast majority of MSM reported complacency and/or lack of confidence in vaccine safety for at least one of the three vaccines of interest. Doubts and fears were more common among older MSM, probably because they were more likely to have been exposed to specific vaccine controversies<sup>18</sup> (See Supplementary Material B for a discussion of the relations between age, VH, and clusters). Although national health strategies aim to increase vaccination coverage among MSM, they do not yet appear to have succeeded in answering their questions about vaccination<sup>44</sup>. This suggests that it would be valuable to develop and implement an ambitious program addressing VH and improving vaccine coverage for all MSM, as we recently advocated.<sup>18</sup> The typology presented in this article adds to previous publications and could be used to tailor the content of such a program to MSM profiles in terms of communication strategy and choice of vectors for this communication since the three profiles differ in terms of their levels of prevention, vaccination awareness, regular medical care, and types of HCPs who provide it. For example, for MSM with higher levels of affirmation of their sexual orientation, vectors such as party venues, specialized care networks and CeGIDD (sexual health centers) would be most appropriate to ensure vaccination education. The advantage of CeGIDD is that the subject of sexuality is generally discussed more freely and that of vaccination more systematically, as specialist physicians are better trained in these issues. However, geographical accessibility and opening hours limit the use of this resource, a problem that teleconsultation, initiated by the national sexual health strategy, could perhaps help to overcome.<sup>44</sup> For the MSM in the C1 cluster – who tended to be young, not see doctors regularly, and most often GPs when they do – it seems necessary to reach out more broadly to the general population. Previous experience in France has shown the value of a media prevention campaign targeting MSM in the public arena. Nonetheless it gave rise to opposition from groups, particularly in the political and media spheres, with a discourse that shifted the focus of attention and debate to issues of homophobia to the detriment of prevention issues.<sup>45</sup> It must therefore be accompanied by a strong mobilization of institutional and associative stakeholders to reduce the risks of stigmatization.

### Sexual-orientation disclosure to the physician is strongly associated with grade of specific VH

Our finding that failure to disclose one’s same-sex sexual behavior to one’s physician is associated with higher VH is in line with previous results about MSM sexual risk prevention behavior.<sup>31–36,46</sup> Unsurprisingly, MSM from C1 were less



inclined to disclose their sexual orientation to their health provider and reported the lowest perceived need for sex-related medical care. Disclosing one's sexual orientation to one's doctor may be influenced by a feeling of stigmatization by HCPs, either experienced or anticipated, especially for younger people.<sup>47</sup> Counter-intuitively, however, the MSM in C1 reported this kind of feeling less often than the other two groups (34% vs. >40%). However, the wording of our question captured personal experiences of stigmatization, not fear of it: MSM in C1 may have experienced stigmatization less often because they saw doctors regularly less often than the other MSM and because they were less likely to disclose their sexual orientation to their doctor (Table 2). On the other hand, studies in the USA have shown that HCPs ask relatively few men about their sexual orientation and rarely discuss HPV vaccination with them, mainly because of a lack of knowledge about the disease, and the vaccine, and because they underestimate the frequency of homosexuality.<sup>46,48</sup> Similarly, few doctors in France raise the question of sexual orientation with their patients, because these doctors lack knowledge of the health problems faced by MSM, are uncomfortable broaching the subject, and fear patients' judgment.<sup>49-52</sup> In 2017, the British National Health Service (NHS) requested that members of the English medical profession ask all patients aged 16 years or older about their sexual orientation at every face-to-face interview.<sup>53</sup> Discussion techniques based on motivational interviewing could be a good option for helping HCPs to broach the subject nonjudgmentally and then to discuss vaccination issues.<sup>54</sup> This technique has been shown to be effective in many areas of health and looks particularly promising for patients who are MSM and/or HIV+, usually to reduce their alcohol and drug consumption and condomless sex,<sup>55-60</sup> but also to encourage HPV vaccination.<sup>61</sup>

### Strengths

The measurement of specific VH used here is based on a previously published method<sup>18</sup> derived from two theoretical models, the 3C model of VH<sup>17</sup> and the Health Belief Model.<sup>24</sup> Constructing a typology of MSM according to their sexual and preventive practices, and linking it to specific HAV, HBV, and HPV VH is an original approach that offers a way to better adapt MSM vaccination strategies. Like previous studies on the subject, our results showed links between sexual practices, prevention, and some sociodemographic characteristics.<sup>28-30</sup>

### Limitations

Caution is required in generalizing our results to the entire French MSM population, because our sample was not random. Despite the open recruitment strategy and the multiplication of recruitment channels in our study, participating MSM were on average older, better educated, and better-off financially than those who participated in other recent surveys in France; these were, however, much larger than our sample.<sup>62,63</sup> As in other studies, we cannot rule out some self-selection, which may lead to the overrepresentation of MSM more assertive about their sexual identity and their exclusively homosexual practices, more motivated and interested in prevention issues, and less vaccine-hesitant.<sup>64</sup>

### Conclusion

This study suggests that VH specific to vaccines against HAV, HBV, and HPV is fairly widespread among the various MSM profiles, but slightly more marked in the “*low sexual activity/low medical engagement*” profile. We found that disclosing one's sexual orientation to one's HCP may be a crucial step in addressing specific HAV, HBV and HPV VH because it enables their provider to offer them health information and medical follow-up tailored to their sexual practices. Our results also suggest that the engagement of MSM with the health care system depends in part on their sexual practices, undoubtedly in conjunction with other factors such as the availability or accessibility of care facilities, ideally LGBT-friendly. This point should be considered in designing a tailored prevention and vaccination program, for the choice of its modes and/or vectors of information.

It also has implications for health professionals' preparation and training. HCPs should be encouraged and trained to ask men, particularly young men, if they have same-sex sexual relations. As the levels of specific VH were high in all the MSM clusters, i.e., even among those who had disclosed their orientation, providers should be equipped and trained to furnish appropriate information and recommendations in a nonjudgmental manner, and/or to refer them when appropriate to centers dedicated to sexual health (CeGIDD in France).

Further studies, especially qualitative, are needed to improve our understanding of MSM's vaccination behaviors and preferences according to their profiles, as well as of HCPs' attitudes, knowledge, and practices concerning vaccination of MSM. Intervention research projects are necessary to assess the effectiveness of communication strategies regarding vaccination for HCPs and MSM.

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