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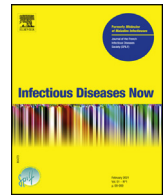


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Original article

# Evolution between 2008 and 2018 of mothers' perception regarding vaccination and infant vaccine coverage in France



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## ABSTRACT

**Objective.** – Monitoring of vaccination coverage rates (VCRs) is essential to assess the implementation of a country's vaccine policy and its effectiveness. Through the French Vaccinology study, we measured the evolution of VCRs as well as mothers' opinion towards vaccination between 2008 and 2018, before and after implementation of infant mandatory vaccination extension.

**Methods.** – This is a study based on an internet-standardised questionnaire. In 2018, a representative sample of 3000 mothers of infants 0 to 35 months of age answered on their opinion on vaccination and reported all vaccinations recorded in their child's health record.

**Results.** – On the period considered, infant VCRs were stable and high for diphtheria, tetanus, poliomyelitis, pertussis and pneumococcus components and progressed for measles, mumps rubella, 2 doses at 24 months of age from 45.3% in 2008 to 81.0% in 2018, hepatitis B (HepB) complete primovaccination at 6 months of age from 45.9% in 2008 to 86.3% in 2017 and 95.5% in 2018, and meningococcus C (MenC) 1 dose at 6 months of age from 43.0% in 2017 to 74.2% in 2018. In 2018, 69.0% of mothers were in favour of vaccination while this rate dropped from 80.2% in 2012 to 64.0% in 2017, and 80.8 to 89.6% perceived HepB, MenC measles and pertussis vaccinations as useful/essential, percentages in progress versus 2017.

**Conclusion.** – Following the implementation of infant mandatory vaccination in 2018, proportion of mothers in favour of vaccination increased significantly. HepB and MenC VCRs significantly progressed between 2017 and 2018.

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## 1. Introduction

It is essential to monitor vaccine coverage rates (VCRs) to measure the extent to which the vaccine policy of a country is being applied, to assess its effectiveness and to possibly make any corrections required to reach the desired VCRs. In 2014, the objectives put forward by the French High council for public health (HCSP) at the age of 24 months were to attain a full VCR schedule of at least 95% for measles, rubella, diphtheria (D), tetanus (T), polio-

myelitis (IPV), (acellular) pertussis (Pa), *Haemophilus influenzae* serotype b (Hib), hepatitis B (HepB), conjugated pneumococcal vaccine (Pn), and a VCR of at least 90% for conjugated meningococcus C (MenC) [1]. The aim of such high VCRs is to ensure individual and herd protection against these diseases, thereby limiting the risks of epidemics, such as those of measles and serogroup C invasive meningococcal disease (IMD C) that occurred in recent years in France.

It is difficult to reach these objectives mainly because of the increasing hesitancy of people towards vaccinations, which is particularly high in France, caused in particular by a fear of vaccine adverse effects [2,3]. For infants, the decision to vaccinate is very much affected by the opinion of mothers [4,5].

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Started up in 2008 by IDM families (IDM) for GSK, the *Vaccinologie* study is one of the largest studies on vaccination carried out in France. Thanks to this study, it is possible to follow, year on year, the VCR, as well as the attitude of mothers towards vaccinating their child. This article presents the data gathered from the mothers of infants aged 0 to 35 months from 2008 to 2018, before and almost one year after the implementation of compulsory vaccination in France for 11 diseases for infants born from 1 January 2018 [6]. Up to this date, vaccines against three diseases (D, T and IPV) were compulsory and the vaccines against eight diseases were recommended: Ca, Hib, Pn, HepB, measles–mumps–rubella (MMR) and MenC.

## 2. Methods

*Vaccinologie* is a study carried out on the Internet using a questionnaire filled in by the mothers of infants in various age ranges. Each year, between September and December, 4500 to 10,000 mothers, recruited via a panel of IDM Families and its partners, are asked to answer a series of questions about their opinion/attitude towards vaccination and to record all vaccines from the child's health record. In 2018, the study took place from 6 September to 12 November and was based on 4500 mothers, of whom 3000 were mothers of infants aged between 0 and 35 months (1000 mothers of infants from 0 to 11 months, 1000 from 12 to 23 months and 1000 from 24 to 35 months). The same methodology, described in greater detail in previous publications, has been used since 2008 [5,7,8]. Only the size of the samples and the age ranges may have varied from one year to another, depending on the specifics of the required analyses. An adjustment was made to ensure sample representativeness by year of age. This involved additional processing of the most recent data from the INSEE census on criteria relating to the socio-professional category (SPC+/SPC–) of the reference person in the household, the number of children (first-time mothers/mothers with multiple offspring), and geographic areas, based on the DREES division (Department for research, studies, evaluation and statistics): Paris region (Île-de-France), Paris Basin, North, East, West, South-West, Centre-East and Mediterranean. Quality procedures for the data gathered are set up to ensure the best possible quality of the results: checks to ensure data consistency, exclusion of mothers who have lived abroad (to avoid the bias of different vaccination recommendations), reclassification of data. A source data check is added by comparing between 100 and 200 questionnaires selected at random with the photocopy of the vaccination pages of the children's health records.

We give the results of the VCRs of full primary vaccination at the age of six months among 6–8-month-old infants and the full schedule at the age of 24 months among 24–35-month-old infants.

The French infant vaccine calendar has been changing regularly since 2008 for various reasons. In 2008, the calendar included 10 components: Pn, D, T, IPV, Pa and Hib at the age of two, three, four and 16–18 months, HepB at two, four and 16–18 months and MMR at 12 months of age with a third dose between 13 and 24 months [9]. In 2009, the Pn vaccination was simplified to shots at two, four and 12–15 months of age [10]. In 2010, the MenC vaccination was introduced for all infants aged between one and two years with a catch-up vaccination up to the age of 24 years [11]. In 2013, the vaccine calendar was simplified as follows: valences D, T, IPV, Pa, Hib, HepB and Pn at the age of two, four and 11 months, MenC and MMR at the age of 12 months and a second dose of MMR at the age of 16–18 months [12]. Finally, in 2017, since the MenC vaccine strategy did not have a significant impact on the incidence of IMD C, especially in infants under one year old because of the lack of herd immunity, a dose of MenC vaccine was added at the age of five months [13]. The non-optimum VCRs for

several recommended vaccines in the infant vaccine calendar led the government to extend the mandatory vaccination – which until then only concerned three components (D, T and IPV) – to 11 components (8 additional components: Pa, Hib, HepB, Pn, MMR and MenC) for all infants born from January 1, 2018 [6].

In the analyses, the schedule was considered full according to the recommendations of the French vaccine calendar (i.e. at least four doses for D, T, IPV and Pa until 2012 then at least three doses from 2013, at least three doses for HepB and Pn, at least two doses for MMR and at least one dose for MenC). Furthermore, for the D, T, IPV, Pa, HepB and Pn components, an additional requirement was considered for the analysis of VCRs: compliance with the vaccine schedule. The schedule was considered compliant if the period between dose two and three was at least 5 months for infants that received 3 doses or between dose three and four for infants that received more than 3 doses.

With regard to the evaluation of the opinion/attitude of mothers towards vaccination, mothers were asked to answer the following question: “What do you think of vaccines?” (choice between: “I am rather in favour of vaccinating against all dangerous or serious diseases if vaccines exist” (mothers considered to be “favourable”), “I would rather like to minimize the number of vaccines” (mothers considered to be “cautious”), “I am opposed to all vaccines of any kind” or “I don't have an opinion”). Since 2011, the mothers have been asked their opinion on each of the vaccines: “For each of these diseases, assuming a vaccine exists, do you think vaccinating your child is: essential, useful, not very useful, useless, don't know”. Mothers considering the said vaccinations to be “not very useful” or “useless” had to give the reasons from a list of responses arranged randomly (multiple choice). The following question was asked about their vaccination decision: “What are your sources of information for deciding whether to vaccinate your child?” (multiple choice using the following method, presented at random: my physician, a pharmacist, Internet, friends and relatives, other, I have never been in this situation). Mothers who checked Internet as method had to specify which websites they visited (multiple choice: “mainstream media sites, scientific media sites, health authority sites, social media/forums/blogs, news/current affairs sites, other websites”). Finally, with regard to medical advice, mothers had to answer the following question: “did your doctor advise you to have your child vaccinated against...?”.

## 3. Results

### 3.1. Infant vaccine coverage rates

Between 2008 and 2018, VCRs at the age of 6 months (full primary vaccination) were very high and stable for DT-IPV, Pa and Pn components (respectively 96.6% for DTPa-IPV and 91.6% for Pn in 2018). Since 2008, the year the first hexavalent vaccine was reimbursed by the state health scheme, HepB VCR has progressively increased, with a rate of 95.5% in 2018 (Fig. 1).

At the age of 24 months, the VCRs (full and compliant schemes) varied more or less, depending on the components (Fig. 2). Between 2011 and 2018, the DT-IPV and Pa VCRs were stable (respectively 93.0% and 92.8% in 2018). The VCR for Pn, HepB, MMR and MenC components has been increasing gradually since 2008 with a VCR in 2018 of respectively 88.2%, 83.6%, 81.0% and 77.3% (Fig. 2). If just full schedule is considered, without considering whether the vaccine schedule was compliant, the VCRs in 2018 were respectively 96.5%, 96.1%, 91.8% and 86.4% for DT-IPV, Pa, Pn and HepB.

Finally, following the addition in the 2017 calendar of the first dose of MenC vaccine at the age of five months, the VCR increased quickly: in 2018, 74.2% of infants aged 6 months had been vaccinated (Fig. 1).

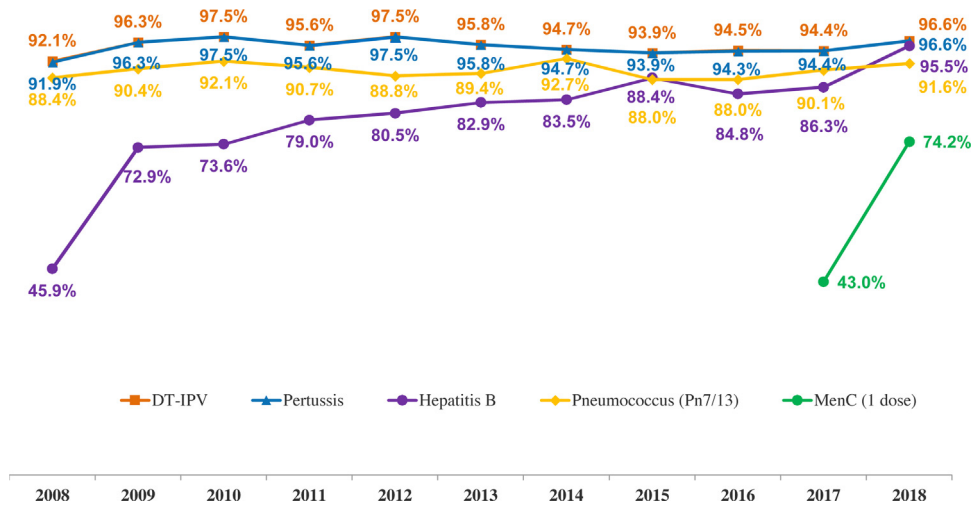


Fig. 1. Evolution of vaccine coverages complete primo vaccination at 6 months of age. Studied population: 250 infants of 6–8 months in 2009, 2011, 2013 to 2018 / 563 infants of 6–8 months in 2012 / 562 infants of 6–8 months in 2010 / 496 infants of 6–8 months in 2008. DT-IPV: diphtheria, tetanus, poliomyelitis.

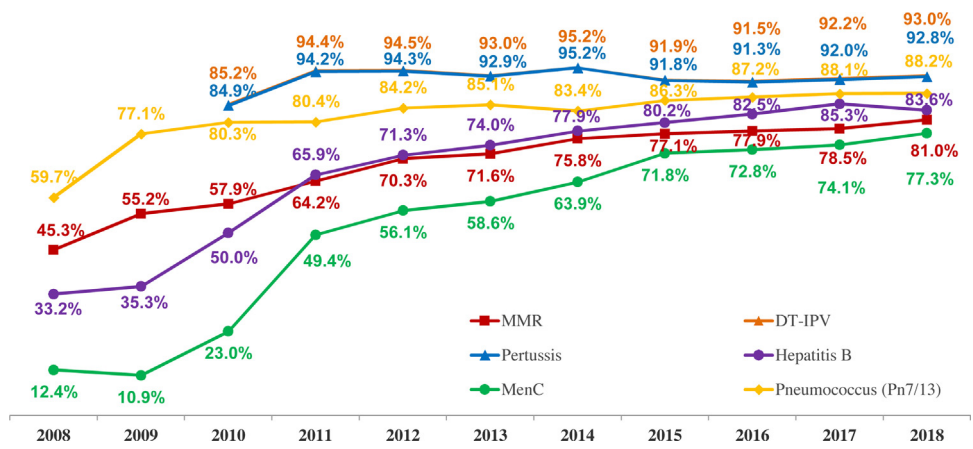


Fig. 2. Evolution of vaccine coverages (complete schedule) at 24 months of age. Studied population: 1000 infants of 24–35 months in 2009, 2011, 2013 to 2018 / 2250 infants of 24–35 months in 2010 and 2012 / 1667 infants of 24–35 months in 2008. DT-IPV: diphtheria, tetanus, poliomyelitis. MMR: measles, mumps, rubella.

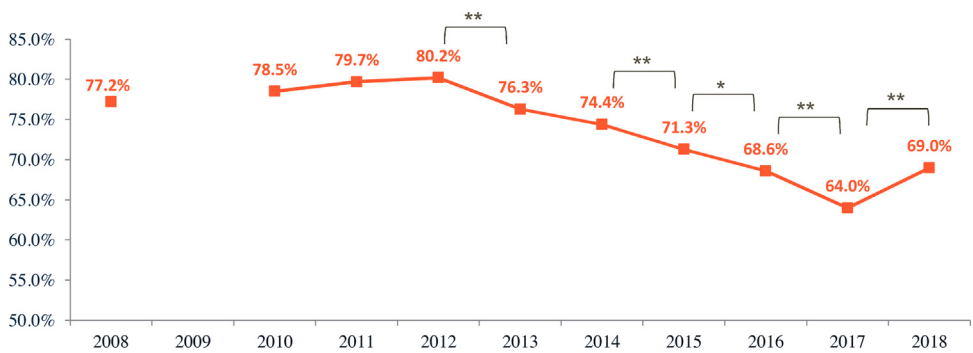


Fig. 3. Evolution of proportion of mothers “rather in favour of vaccinating against all dangerous or serious diseases if vaccines exist” (favourable mothers) ( $P < 0.05^*$ ;  $P < 0.01^{**}$ ). Studied population: 3000 mothers of 0–35 month-old infants in 2009, 2011, 2013 to 2018 / 7750 mothers of 0–35 month-old infants in 2010 and 2012 / 5001 mothers of 0–35 month-old infants in 2008. 2009: not realized.

3.2. Mothers' opinions towards vaccination

In 2018, the 3000 mothers of infants aged between 0 and 35 months were on average 32.5 years of age ( $\pm 4.7$ ).

That year, 69.0% of mothers said they were “rather to vaccinate against all dangerous or serious diseases if vaccines exist” (“favourable” mothers) and 28.4% “rather to minimise the number of vaccines” (“cautious” mothers). Opposition to all vaccines

concerned a very small minority (0.7%). Between 2013 and 2017, the proportion of “favourable” mothers gradually fell, then increased significantly between 2017 and 2018 (plus 5 points,  $P < 0.01$ ) (Fig. 3).

The proportion of “cautious” mothers (28.4% in 2018) varied according to sociodemographic profile: type of childcare (crèche, no: 29.4% versus yes: 25.3%,  $P < 0.05$ ), level of education (below baccalaureate: 35.4% versus above baccalaureate +2 years of education:

**Table 1**

Vaccine coverages (VCRs), complete schedule at 24 months of age for pertussis, hepatitis B, MMR and MenC, depending on whether the mothers declare having received or not vaccine advice from their physician.

Vaccinations		VCR without medical advice (%)	VCR with medical advice (%)	P value
Pertussis	3 doses at 24 months of age	94.8	96.3	0.393
HepB	3 doses at 24 months of age	67.8	87.4	<0.001
MMR	2 doses at 24 months of age	68.2	81.6	0.056
MenC	1 dose at 24 months of age	71.9	77.2	0.195

Studied population in 2018: 1000 mothers of 24–35 month-old infants. MMR: measles, mumps, rubella. MenC: meningococcal C.

22.8%,  $P < 0.01$ ), household income (less than €1700 net per month: 35.4% versus over €2700 per month: 23.4%,  $P < 0.01$ ) and profession (unemployed: 33.4% versus SPC+: 18.8%,  $P < 0.01$ ).

The 2 main barriers cited by “cautious” mothers in 2018 were their fear of vaccine adverse effects (66.0%) and the lack of hindsight for some vaccines (50.8%).

### 3.3. Opinion of mothers according to the type of vaccine

In 2018, the proportion of mothers considering vaccinations against pertussis, measles, meningococcus C and hepatitis B to be essential/useful was 89.6%, 87.2%, 83.9% and 80.8% respectively, with, for the first time, a statistically significant increase from 2.8 to 4.4 points according to the vaccination versus 2017 ( $P < 0.05$ ). The reasons cited by mothers who considered the vaccinations to be not very useful/useless varied according to the vaccine. For measles vaccination, the two main reasons were the view that the disease is harmless (35.4%) and the preference for the child to have the disease rather than be vaccinated (27.1%). For MenC vaccination, it was the lack of information (35.4%) and the fear of adverse effects (32.9%). For pertussis vaccination, it was the lack of 100% protection by the vaccination (25.2%) and a lack of information (24.3%). Finally, for HepB vaccination, it was the fear of adverse effects (49.9%) and the belief that the child is vaccinated too young (37.2%).

### 3.4. Decision to vaccinate

The main source of information for mothers when deciding whether to have their child vaccinated remained their physician (81.0% in the 2018 questionnaire), followed by the Internet (26.1%), friends and relatives (23.0%) and a pharmacist (15.4%). Between 2015 and 2017, we observed an increase in the proportion of mothers using Internet as a source of information with a plateau in 2018. There was a more widespread use of Internet by “cautious” mothers (from 20.8% in 2011 to 38.6% in 2018) than by “favourable” mothers (from 9.9% to 20.9% respectively). Mothers who cited Internet as source of information in 2018 said they first consulted health authority websites (67.7%) and mainstream media sites (65.6%), followed by scientific media sites (40.0%) and social media/forums/blogs (34.1%).

### 3.5. Impact of physician advice on vaccination coverage rates

The mothers were also asked whether their child’s doctor advised vaccinating against Pa, HepB, MMR and MenC. In 2018, of the 1000 mothers of children aged between 24 and 35 months, respectively 77.9%, 61.3%, 89.8% and 46.3% remembered receiving advice for the said vaccinations. VCRs were higher when mothers remembered receiving advice from their doctor. The difference in VCRs ranged from 1.5 points for pertussis to 19.6 points for HepB vaccination (Table 1).

## 4. Discussion

*Vaccinologie* is the only French study carried out annually in the general population which has been evaluating opinion and attitudes towards vaccination and VCRs in children for 11 years. The data confirmed an increase in a certain level of distrust from mothers towards vaccination, with an increase in the proportion of mothers wishing to minimise the number of vaccines: less than one mother in five in 2012 to one in three in 2017. The two main barriers were the fear of adverse effects and a lack of hindsight for some vaccines. This fear of vaccine adverse effects is particularly important in France. In an international survey on opinion towards vaccination carried out with 65,819 people in 67 countries in 2015, 41% of French people believed vaccines to be unsafe (the country with the highest score; overall average of 17%) [2]. More recently, in another international survey of Wellcome Global Monitor on opinions towards health of 140,000 people in 144 countries, France was also in top position with 33% of French people being skeptical about the safety of vaccines (overall average of 7%) [3]. However, the extension of the number of mandatory vaccinations for infants in France in 2018 combined with a massive information campaign by the health authorities appear to be having a positive impact on the opinion of mothers towards vaccination. For the first time, we observed an increase in the proportion of mothers favourable to vaccination and the perceived usefulness of the various vaccines.

During these years, trust towards doctors has remained high. Eight mothers in ten turn to their doctor to decide whether to have their child vaccinated. VCRs were also significantly higher when mothers remember receiving advice from their doctor on vaccination. The survey confirmed the role of doctors in the decision on whether to vaccinate, even if more mothers now seek information on vaccination on the Internet.

VCRs for various components have been gradually increasing since 2008, the year of the first *Vaccinologie* survey. The highest and most stable VCRs are observed for D, T, IPV and Pa, administered in almost all cases in combination with the first 3 components. The high rate of more than 95% for a full schedule at 24 months (96.5% precisely for DT-IPV and 96.1% for pertussis, regardless of whether the schedule was compliant) can be explained by the fact that they are old vaccines and that D, T and IPV vaccines have been mandatory in France in the general population for decades, so they are vaccines that the mothers surveyed had received themselves. These VCR estimates are very similar to the analyses by Santé publique France (SPF) in 2017 on the health certificates of the 24th month, with a VCR estimated to be 96.3% and 96.0% for DT-IPV and Pa vaccinations respectively for a full schedule [14]. Vaccination against pneumococcus was introduced into the French vaccine calendar in 2006. It has benefited from the recommendation of co-administration with vaccines containing DT-IPV-Pa-Hib-HepB components. The VCR is, therefore, close to public health objectives (VCR estimated to be 91.8% for 3 doses at 24 months, regardless of compliance to the schedule) and similar to the SPF estimates on health certificates for the 24th month (VCR of 92.2% in 2017) [14]. VCRs for MMR, HepB and MenC have continually increased,

but are, however, insufficient. For MMR, VCR for two doses at 24 months was 81.0% in 2018, comparable with that estimated by SPF based on the health certificates of the 24th month (VCR two doses at 80.3% in 2017) [14]. Despite the progress of this VCR, the required objectives of 95% to ensure herd protection and to avoid recurring epidemics in France have not been reached. So, in 2019 alone, 2206 cases of measles were declared in France, of which there were 156 pneumopathies and 2 cases of encephalitis (one of which was fatal) (dated from 1 January to 24 July 2019) [15]. For hepatitis B, the increase in VCR has been marked in infants since the hexavalent vaccine was reimbursed in 2008, and especially in young infants following the extension of mandatory vaccination (plus 9 points of VCR at the age of 6 months between 2017 and 2018). In 2018, VCR of 95.5% at the age of 6 months for primary vaccination was comparable with that of SPF (98.6% for the first dose at the age of 7 months in 2018) [16]. So, given the stagnating level of HepB VCR in adolescents, with just a third of them correctly vaccinated [17], infant vaccination is currently the target to have a medium-term impact on the epidemiology of hepatitis B in France. For MenC, VCR at the age of 24 months has been increasing, but very slowly: 77.3% in 2018, eight years after the introduction of this vaccination in the French calendar, and this VCR is much lower in the older age ranges. SPF estimated VCR to be 78.6% at 24 months, 75.7% for 2 to 4 years old, 70.3% for 5 to 9 years old, 45.8% for 10 to 14 years old, 31.9% for 15 to 19 years old and 18.4% for 20 to 24 years old in 2018 [14]. These highly insufficient VCRs, in particular for adolescents, who are the greatest carriers of meningococcus, have not been able to provide herd immunity, which is essential for this strategy to be successful. SPF estimated that if MenC VCR had been high enough to produce herd immunity, a very significant part of the 838 cases of IMD C of which 108 were fatal from 2011 to 2017 in France could have been avoided [18]. Following the new dose of MenC vaccine introduced in the vaccine calendar in 2017 at the age of five months [13], VCR in infants aged 6 months increased very quickly (Vaccinoscopia: 74.2% in 2018), similar with that estimated by SPF of 75.7% at the age of 5 months in 2018 [14].

## 5. Conclusion

The extension of mandatory vaccination for all infant vaccines of the paediatric calendar for all children born from 1 January 2018, combined with the communication campaign of the health authorities aimed at both healthcare professionals and the general public, appear to have already a considerable impact on the opinion of mothers towards vaccination and on VCRs, which were less than optimum (hepB and MenC). It is important to carry on with these communication campaigns and to continue to analyse this data through the next waves of *Vaccinoscopia* study.

## Ethical Approval

All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments.

## Authors' contributions

A.M., B.L., R.C., J.-P.S., D.S., P.P. and J.G. reviewed and validated the methodology as well as the results from the study. H.L. and L.L. contributed to the methodology, the analysis and validation of the results. P.P. wrote the manuscript. All authors agreed to be compliant with the international criteria for author-

ship as defined by the International Committee of Medical Journal Editors.

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## Disclosure of interest

A.M., B.L., R.C., J.-P.S., D.S., P.P., H.L., L.L. and J.G. are members of Vaccinoscopia scientific committee. P.P. is employed by the GSK group of companies. H.L. is founder of IDM Families, which created and conducted the Vaccinoscopia surveys. L.L. is employed by IDM Families. J.-P.S. is editor-in-chief of the *Médecine et Maladies Infectieuses* journal but was not involved in the peer-review process of the manuscript.

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