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Attitudes of hospital physicians toward childhood mandatory vaccines in France: A cross-sectional survey

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ABSTRACT

Background: Due to a decades-long crisis of confidence in vaccination, in 2017 France extended the number of mandatory early childhood vaccines from 3 to 11.

Aims: To describe the opinions of hospital staff physicians (HSPs) regarding this measure, quantify the proportion who would have preferred measures based on education, and study the factors associated with the latter opinion.

Methods: Cross-sectional nationwide survey with a standardized questionnaire in 2018–2019 among HSPs in 14 French public hospitals. The factors associated with HSPs' preference for education and persuasion over mandatory vaccination were analyzed with simple and multiple Poisson regressions.

Results: The analyses included 1,795 HSPs (participation rate of 86%). Among them, 84% considered the extension of mandatory childhood vaccination essential given the epidemiological context at the time; in a later question, 40% would have preferred education and persuasion. Multiple regressions showed that the latter tended to be younger and less trustful of sources of information about vaccination. They were more likely to think that information on the rationale behind the national vaccination policy lacked clarity and that the extension of mandatory vaccines was not essential, even in the current epidemiologic situation.

Conclusion: Although most HSPs agreed that the extension of mandatory childhood vaccines was essential, some were ambivalent about its coercive philosophy. Further research is necessary to better understand the reasons of this ambivalence. A fraction did not understand the French vaccination strategy well. Efforts to explain its details to HSPs and an overhaul of their initial training on vaccination are still needed.

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Introduction

France has been traversing a crisis of confidence in vaccination for more than two decades.¹ It began with claims by some patients that hepatitis B vaccination was involved in the occurrence of multiple sclerosis in young adults vaccinated during a mass hepatitis B vaccination campaign in the mid-1990s;² the ensuing controversy, widely reported in the mass media, led the Ministry of Health to halt the campaign. Twenty years later, despite extensive epidemiological data indicating the safety of this vaccine, significant proportions of both the public and health professionals continue to fear it has serious side effects.^{3,4} The decline in public confidence in immunization accelerated during the 2009 A/H1N1 pandemic, when the portion of the general population unfavorable to immunization quadrupled, reaching 40% in 2010.⁵ It has fallen since but now fluctuates around a level of 20%, still twice that in the first decade of this century. This crisis of confidence affects many other Western countries, but appears most marked in France, with the proportion of the population lacking confidence in vaccine safety (exceeding 40%) much higher than elsewhere.⁶

This persistent dearth of confidence, the multiplication of vaccine controversies about different vaccines or vaccine components (e.g., aluminum adjuvants),¹ low vaccine coverage for certain diseases (e.g., measles and meningitis),⁷ and the resurgence of measles epidemics (24,000 cases in France between 2008 and 2016)⁸ led the French Ministry of Health to organize a national debate on vaccination in 2016, involving citizens, health professionals, and experts.⁹ The Ministry subsequently decided, in July 2017, to introduce a law to extend the compulsory early childhood vaccines from 3 diseases (diphtheria, tetanus, and polio) to 8 other diseases (pertussis, *Haemophilus influenzae* type b, hepatitis B, pneumococcus, meningococcus C, measles, mumps, and rubella).⁹ Passed by Parliament, this law went into effect in January 2018 for infants born from this date. Its enactment was accompanied by intense debate about whether such a measure could restore confidence in immunization, as the Ministry of Health argued that it would, and the risks of polarizing public opinion.¹⁰ The medical profession itself was caught up in this debate, in which a medical elite comprising renowned university hospital physicians supporting the new law¹¹ opposed general practitioners, the cornerstone of vaccination in France,

who were more divided about its relevance and risks.¹² Several other countries, facing similar, albeit less marked epidemiological and sociological situations, have also taken the step of adopting new vaccination obligations for early childhood. These include Italy (for 12 vaccines, in 2017) and, more recently, Germany (obligation to vaccinate children against measles, since March 2020) as well as several Eastern European countries.¹³

Given their important role in vaccination in France in explaining not only the vaccination schedule, but also the reasons for the extension of mandatory vaccination and its implications, it is essential to know and understand doctors' opinions about this measure.¹⁴ Surveys on this subject have been conducted among general practitioners and pediatricians in France.¹⁵ We considered it important to do the same with hospital staff physicians (HSPs), in the context of the national debate on vaccination, because they not only treat many children, often those with chronic diseases, but they also discuss vaccination with adult patients (often parents of young children) and with colleagues and other health professionals who vaccinate children. Finally, of course, like all the medical professionals also studied, these doctors are citizens, members of the public, and parents of small children. As part of a national survey from September 2018 to October 2019 to study HSPs' attitudes and practices regarding vaccination, we also collected information with the following objectives: 1) to describe the opinions of HSPs about the extension of mandatory early childhood vaccines, 2) to quantify the proportion of those who would have preferred measures based on education and persuasion, and 3) to study the factors associated with the latter opinion.

Methodology

Population

In this cross-sectional, nationwide, questionnaire-based survey, interviewers collected opinions from HSPs in 14 French public hospitals, all members of a French national clinical research network. The hospitals were distributed across France, with at least one in each of the five great regions (Île-de-France, Northeast, Northwest, Southeast, Southwest); most ($n = 9$) had at least 250 full-time HSPs. We excluded hard-to-reach HSPs (physicians working in emergency departments, who rotate frequently) and specialties that do not address vaccination with patients at all (e.g., clinical biologists and radiologists). HSPs were stratified into specialties likely to deal with vaccination in their daily practice (e.g., pediatricians) or not (e.g., surgeons), referred to hereafter as likely "vaccinators" and "non-vaccinators".

The Ethics Committee of Aix-Marseille University approved this survey (2017-14-12-006).

Procedure and questionnaire

Clinical research associates established lists of eligible HSPs in each hospital, contacted them by e-mail or telephone, and, if they agreed to participate, conducted face to face interviews with computer-assisted personal interview software from September 2018 to October 2019.

The standardized questionnaire was adapted from a previous questionnaire developed and used to study vaccination practices

and perceptions among French GPs.¹⁴ The adaptation followed qualitative interviews with 18 HSPs of various specialties in several hospitals in Marseille (France) and involved a multidisciplinary panel of experts including epidemiologists, HSPs, and infectious disease specialists. We pilot-tested it for clarity, length, and face validity among 50 HSPs in 3 hospitals. To test for face validity, we analyzed how subjects understood the items and then corrected the wording of misunderstood or ambiguous terms.

The questionnaire asked participants for their opinions about the mandatory vaccination using three independent questions, each to be answered as Yes, No, or Don't Know, in this order: "Regarding the extension of mandatory vaccination from 3 to 11 diseases among children: It was essential in the current epidemiological context. It was essential, but mandatory vaccination should have been extended to other vaccines as well. Education and persuasion would have been preferable" (Table 2). Yes/no answers were chosen to optimize the time needed to answer the questionnaire, after the pilot test showed that the questionnaire was acceptable to HSPs.

Other questions before and after this topic asked participants for their opinions about the mandatory vaccination of health professionals against seasonal influenza (which has been discussed but not yet adopted in France) and various other aspects related to French vaccination policy: the clarity of the vaccination strategy, their confidence in the experts who establish vaccination recommendations, and their attitudes toward vaccination recommendations. HSPs were also asked about their confidence in the different sources of information (Ministry of Health, health and safety agencies, scientific sources, medical colleagues), their perceptions of the influence of the pharmaceutical industry on health authorities, and their personal vaccination against seasonal influenza. Finally, they were also asked about their exposure to multiple vaccine-preventable diseases (VPDs): measles, acute hepatitis B or newly diagnosed chronic hepatitis B, bacterial meningitis, cervical cancer, and complicated seasonal influenza requiring hospitalization.

The appendix presents the method used to calculate the number of participants required.

Statistical analysis

We weighted data for age and sex, according to the Ministry of Health's Shared Directory of Health Professionals, to match the HSP population in France. In a sensitivity analysis, we separately weighted data for the number of regional HSPs and hospital size (in addition to age and sex) and found no significant differences in the distribution of HSPs' responses compared to that after weighting only for age and sex. The following results are thus presented with the latter weighting only.

We calculated a score to assess HSPs' confidence in various sources of information about vaccines' benefits and risks (6 items, range [0–18], Cronbach's $\alpha = 0.70$) by adding their responses on a 4-point Likert scale. The items covered HSPs' confidence in the ministry of health, health and safety agencies, scientific sources and scientific colleagues, the group of experts who establish vaccine recommendations in France, and their perception of the influence of the pharmaceutical industry on health authorities. We also created a count variable (range [0–5]) of HSP' exposure to VPDs.

We used simple and multiple modified Poisson regressions¹⁶ to analyze the factors associated with HSPs' preference for education and persuasion over mandatory vaccination (YES/NO; dependent variable). We tested the following explanatory variables: demographic and professional characteristics (age, sex, and specialty), experience with VPDs, confidence in health authorities, opinion about mandatory seasonal influenza vaccination for healthcare workers (HCWs), personal vaccination against seasonal influenza, and opinion that the extension of mandatory vaccination from 3 to 11 diseases among infants was essential under the current epidemiological circumstances. We used the variance inflation factor (VIF) to test for multicollinearity and interpreted VIF values <5 as not presenting any multicollinearity issues. All analyses were based on two-sided *p* values, with statistical significance defined as $p \leq 0.05$; they were performed with Stata 14 (StataCorp, College Station, TX, USA) and R 3.6.3 (R Foundation, Vienna, Austria).

Results

Of the 4,327 eligible HSPs, 2,154 (50%) could be contacted: among them, 1,851 (86%) participated in the survey; 45 of these were excluded because their specialty was considered beyond the scope of the study (e.g., biologists, and radiologists), and 11 (0.6%) because they did not provide their age or sex, variables required to weight the data. The analyses thus included 1,795 (83%) HSPs. Slight majorities of the participants were women (53%) and aged 45 years or older (51%) (Table 1).

The respondents overwhelmingly reported that they were generally favorable to vaccination (94% very favorable, 6% somewhat favorable), and 80% favored mandatory vaccination against seasonal influenza for HCWs (Table 2). Given the epidemiological context at the time, 1502/1795 HSPs (84%) considered the extension of mandatory vaccination from 3 to 11 vaccines among infants to be essential; 320/1795 (18%) responded that it should have included other vaccines as well. Nonetheless, 722/1795 (40%) said they would have preferred education and persuasion, including 72% who had stated that the extension of mandatory vaccination was essential, and 18% who did not find it essential (10% did not know/refused to answer). The prevalence of opinions in favor of education and persuasion over mandatory vaccination did not differ significantly between infectious disease specialists (35%), pediatricians (39%), other vaccinators (41%), non-vaccinators (37%), and the remaining specialties (42%; $p = .82$, Table A1).

Overall, 63% found the official information about the rationale for the French vaccination policy to be sufficiently clear, and 98% trusted the group of experts who make the recommendations for vaccines in France (68% strongly, 30% somewhat).

In simple and multiple regressions (Table 3), HSPs reporting a preference for education and persuasion tended to be younger and less trustful of sources of information about vaccination. They were more likely to rely on their own judgment over official recommendations, to think that information about the rationale behind the vaccination policy lacked clarity, and to consider that the extension of mandatory vaccinations for infants was not essential, even in the current epidemiologic situation. The preference for education and persuasion was also associated with a lower probability of supporting mandatory vaccination of

Table 1. Characteristics of hospital staff physicians, weighted data, France, September 2018 to October 2019 (N = 1,795).

Characteristics	No.	
	(N = 1,795)	%
Sex		
Female	962	53.58
Male	833	46.42
Age (years)		
< 35	407	22.67
35–44	475	26.47
45–54	357	19.87
55–64	488	27.18
> 64	68	3.81
Specialty		
Anaesthesiologist	62	3.46
Cardiologist	119	6.61
Dermatologist	68	3.78
Endocrinologist	88	4.91
General practitioner	32	1.81
Geriatrician	118	6.56
Gynecologist-obstetrician	95	5.32
Hepato-gastroenterologist	122	6.81
Infectious diseases physician	102	5.70
Internist	100	5.56
Nephrologist	93	5.20
Neurologist	104	5.78
Onco-hematologist	115	6.42
Ophthalmologist, otolaryngologist	30	1.65
Pediatrician	186	10.35
Physiatrist	12	0.70
Psychiatrist	32	1.77
Public health, social medicine and Occupational health	52	2.89
Pulmonologist	117	6.52
Rheumatologist	60	3.33
Surgeon	87	4.87
Vaccination opinions		
Favorable to vaccination in general		
Strongly agree	1682	94.31
Somewhat agree	99	5.53
Strongly/somewhat disagree	3	0.16
Don't know/No response	12	

HCWs against seasonal influenza, in the simple regression only. The test for multicollinearity was negative (VIF < 5).

Discussion

This study, conducted during the first two years after the implementation of the new French law on mandatory vaccination, shows that 84% of the HSPs considered that extending immunization requirements in early childhood was essential under the circumstances at the time. Very few studies have described the opinions of healthcare professionals about the extension of vaccination requirements in the countries that have recently ordered such extensions. During the European Vaccination Week in 2019, Santé Publique France (the national public health agency) released results suggesting broad support for it from pediatricians (96%) and, slightly less unanimously, from general practitioners (75%).¹⁵ These results, however, were based on online surveys, and their unreported methodology may well include significant selection bias. A study conducted in 2015 among a representative sample of 440 GPs in Southeastern France (one of the French regions most affected by the measles epidemic) indicated that only 25% were then favorable to the extension of vaccination obligations:¹⁷ at the time, only diphtheria, tetanus, and polio vaccines were

Table 2. Acceptance of official vaccination policies, hospital staff physicians, weighted data, France, September 2018 to October 2019.

	No.	
	(N = 1795)	%
Acceptance of official vaccination policies		
In favor of mandatory vaccination against seasonal influenza for healthcare workers		
Yes	1431	79.74
No	325	18.10
Doesn't know/NR ^a	39	2.16
Regarding the extension of mandatory vaccination from 3 to 11 diseases among children:		
It was essential in the current epidemiological context		
Yes	1502	83.68
No	169	9.43
Doesn't know/NR	124	6.89
It was essential, but mandatory vaccination should have been extended to other vaccines as well		
Yes	320	17.85
No	1161	64.68
Doesn't know/NR	313	17.46
Education and persuasion would have been preferable		
Yes	722	40.22
No	1000	55.70
Doesn't know/NR	73	4.08
Information transmitted by French health authorities to physicians about the rationale behind the vaccination policy is clear enough		
Strongly disagree	129	7.17
Somewhat disagree	473	26.36
Somewhat agree	740	41.24
Strongly agree	390	21.72
Doesn't know	63	3.51
You trust the group of experts who establish vaccine recommendations in France		
Strongly/somewhat disagree	36	2.02
Somewhat agree	544	30.39
Strongly agree	1209	67.58
Do not know/NR	6	
Experience related to vaccination		
Has had any patients with at least one vaccine-preventable disease in the past 5 years		
Yes	1603	89.30
No/Doesn't know/NR	192	10.70
Personal vaccination against influenza		
Against 2017/18 seasonal influenza		
Yes	1468	81.92
No	324	18.08
Doesn't know/NR	4	
Trust in health authorities		
Score of trust in official sources of information about vaccination		
Low	617	34.36
Moderate	570	31.76
High	608	33.88
You trust your own judgment over official vaccination recommendations		
Strongly disagree	1239	69.30
Somewhat disagree	429	23.97
Somewhat agree	91	5.08
Strongly agree	30	1.65
Doesn't know/NR	6	

^aNo response.

compulsory in early childhood. On the other hand, if the obligation to be vaccinated against these three diseases were to be lifted, 83% of GPs considered that there was a fairly or very high risk that vaccination coverage against these diseases would decline; this finding suggests their attachment to the “historical” vaccination obligations.

Simultaneously, we found that 40% of the participants would have preferred educational or persuasive measures over mandatory vaccination. This apparently contradictory result suggests ambivalence among a significant portion of HSPs about the extension of mandatory vaccines. This ambivalence might be explained by the context of the announcement of the decision, marked by intense controversy and even

polarization between those favorable to it and those opposed. The medical elite practicing in university hospitals strongly supported the new law. In this situation, which continued past the law's effective date, the opinions of the survey participants – practicing at hospital – might have been influenced by a social desirability bias in favor of the law. At the same time, asking them whether they found education and persuasion preferable (after asking about mandatory vaccination extension) may have offered HSPs an opportunity to reveal their preferences about what they felt the best way to intervene would have been. Another hypothesis is that these HSPs believed that health authorities had no other choice than to extend childhood vaccine mandates, in view of the

Table 3. Regarding the extension of mandatory vaccination from 3 to 11 diseases among young children, factors associated with favoring education and persuasion over mandatory vaccination, simple and multiple modified Poisson regressions, hospital staff physicians, France, September 2018 to October 2019.

Characteristics	Education and persuasion would have been preferable to mandatory vaccination (ref. No ^a) N = 1,795			
	RR ^b	95% CI	aRR	95% CI
Characteristics				
Sex (ref. Female)				
Male	0.98	[0.88,1.10]	1.00	[0.89,1.11]
Age (ref. < 35)				
35 to 54	0.95	[0.84,1.07]	0.91	[0.81,1.02]
> 54	0.82*	[0.69,0.97]	0.77**	[0.65,0.91]
Experience and practices related to vaccination				
Exposure to vaccine-preventable diseases [0–5]	0.99	[0.95,1.03]	0.99	[0.95,1.04]
Discusses vaccination with patients (ref. No ^a)				
Yes	0.90	[0.74,1.09]	0.95	[0.78,1.15]
Trust in health authorities				
Score of trust in official sources of information about vaccination (ref. Low [8–20])				
Moderate [20.5–22]	0.82**	[0.72,0.93]	0.93	[0.82,1.05]
High [22.5–24]	0.63***	[0.55,0.72]	0.75***	[0.65,0.86]
You trust your own judgment over official vaccination recommendations (ref. No)				
Yes ^a	1.42***	[1.20,1.69]	1.26**	[1.06,1.49]
The information transmitted by authorities on the rationale behind the vaccination policy is sufficiently clear (ref. No ^a)				
Yes	0.78***	[0.70,0.87]	0.85**	[0.76,0.94]
Opinion about seasonal influenza vaccination among healthcare workers and personal vaccination against influenza				
In favor of mandatory vaccination against seasonal influenza for healthcare workers (ref. No ^a)				
Yes	0.80***	[0.71,0.91]	0.90	[0.79,1.02]
Vaccinated against 2017–2018 seasonal influenza (ref. No ^a)				
Yes	0.93	[0.81,1.06]	1.11	[0.97,1.28]
Opinion on the extension of mandatory vaccination from 3 to 11 diseases among infants				
It was essential given the current epidemiological context (ref. Yes)				
No ^a	1.85***	[1.67,2.06]	1.70***	[1.52,1.91]

^aIncludes “Doesn’t know” and non-response.

^bRR: relative risks; aRR: adjusted relative risks; CI: confidence interval; ***: $p < 0.001$, **: $p < 0.001$, *: $p < 0.05$; VIF < 5, no proof of multicollinearity.

epidemiologic situation, but also thought that they should also have resorted simultaneously (or earlier) to education and persuasion measures. A recent study in Italy, where a statute introducing vaccination obligations was passed in 2017, found that public health interns considered this law to be the only way to control the public health risks induced by vaccination hesitation.¹⁸ Laws imposing vaccination requirements in the United States have proven effective in achieving high vaccination rates.¹⁹ In France, one year after these new vaccination obligations came into effect, preliminary evaluations suggest vaccination coverage in early childhood improved with, for example, gains of 6 percentage points in vaccination coverage for the first dose of the hepatitis B vaccine and 36% for the meningococcal C vaccine in the cohort of children concerned by the new law.²⁰ Vaccination obligations can therefore provide a safety net that can be put in place in worrisome epidemiological situations. They do not, however, address the root causes of the loss of confidence in vaccination:²¹ persuasive measures are necessary to build public understanding of the value of immunization. Various approaches might facilitate the required persuasion, including, for example, motivational

interviews, and presumptive communication. The difficulty in implementing them is reinforced by the lack of adequate evidence about effective methods and strategies of persuasion,²² although some are promising and have been applied successfully elsewhere, such as motivational interviewing in Quebec.²³ At the same time that the new law went into effect, the French Public Health agency overhauled and strengthened the information system on vaccination for the public and professionals (“Vaccination Info-Service” site of the French Public Health Agency).²⁴ However, the provision of information to the public is not enough to restore public confidence in vaccination on a long-term basis.^{25,26} More personalized interventions are needed to respond appropriately to individual expectations and demands.²³ Healthcare professionals play an essential role in this respect, both for the general population and for patients treated in hospitals, as inpatients and outpatients. But these professionals are not trained²⁷ in this type of approach, and some may themselves be uncertain about the risks or even benefits of certain vaccines.¹⁴

The lack of any significant difference in the proportion of HSPs who expressed a preference for educational

measures by specialty or intensity of immunization activity suggests that this preference is probably more a matter of personal conviction and values (about how to motivate people to be vaccinated) than of type of practice or specialty (Table 3). However, the profile of HSPs expressing a preference for educational measures was very different from that of those who did not agree with this (Table 3). The former found more often than the latter that the rationale of the French vaccination strategy was unclear (Table 3) – an opinion held by a nontrivial proportion of HSPs (Table 2). Qualitative studies are needed to better understand the reasons for this opinion. The decision to extend vaccination obligations might have raised or caused the resurfacing of questions about the French vaccination strategy; such questioning existed among GPs before 2017.²⁸ The opinion that the vaccination strategy is unclear mirrors observations in the general population: a year after the implementation of the new law, almost half of parents surveyed reported that they did not yet know precisely what it covered, and one third felt poorly informed about it.¹⁵ These results suggest that major efforts to clarify this law and the vaccination strategy should continue and improve among both the public and physicians.

The strong association between a high level of confidence by HSPs in official sources of information on immunization and the belief that educational and persuasive measures would not have been preferable suggests that the physicians with the most trust fully supported the extension of childhood vaccine mandates. They may well have considered that because the epidemiological situation required it, the Health Minister's decision to extend vaccine mandates was needed without delay rather than relying solely on education and persuasion, which would likely take years to show results.

The lack of association in the adjusted analyses between HSPs' support for a requirement for that HCWs be vaccinated against seasonal influenza and the view that the extension of early childhood immunization requirements was essential (Table 3) is counterintuitive. Admittedly, these two questions do not measure exactly the same thing: the first measures adherence to a measure that has been debated but not decided upon; the second measures rather the perceived necessity of a measure already in effect. But in both cases, these measures target epidemiological situations of concern and aim to promote collective protection for the population as a whole. One possible hypothesis is that HSPs differentiate between what they would recommend for their patients and what they would accept for themselves, as we previously found among GPs.²⁹

These results should be interpreted bearing in mind the study's strengths and limitations. The participation rate was high (86%). Selection bias cannot be ruled out, however, as not all eligible HSPs could be contacted, and participation was voluntary: physicians who agreed to participate may have been more aware of vaccination issues than non-participants. Nonetheless, this rate of hospital specialists favorable to vaccination in general is fairly close to that observed among GPs in France,³⁰ even though some social desirability bias cannot be excluded. In addition, recall bias cannot be ruled out for certain questions, in particular, past exposure to vaccine-preventable diseases.”

Because the 14 participating hospitals (among 93 of similar size in mainland France) were not randomly selected, the resulting sample may not be representative of all HSPs in France. Nonetheless, weighting the data according to hospital region and size did not change the distributions observed of responses to questionnaire items. Moreover, most HSPs' specialties (and all of those participating in vaccination tasks) were represented in the sample.

The cross-sectional design prevents drawing any conclusions about causality in the associations found in this study, as is the case for most studies in this field.

Conclusion

Our study is the first to our knowledge that explores the opinions of a large sample of HSPs about the recent revision of the French vaccination strategy and the substantial increase in compulsory childhood vaccinations. Although most of these doctors agreed that it was essential in the current epidemiological context, some indicated ambivalence about its coercive philosophy. Further research, especially qualitative, is necessary to better understand these findings. Our results suggest, more generally, that communication and training efforts are still essential for HSPs, so that they can better understand the French vaccination strategy and share it with their patients. Similarly, the initial training of health professionals in France remains to be redesigned to give the place to vaccination that it deserves and requires.²⁷ This is especially important given the number of studies in several countries showing that in the era of Covid-19 significant fractions of the general population would refuse a future vaccine against this disease.³¹ HSPs, who care for the patients most vulnerable to severe Covid-19, will have an essential role in motivating reticent patients to accept this future vaccine, which, once available, is likely to play a central role in the strategy to mitigate the pandemic.

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References

1. Ward JK, Peretti-Watel P, Bocquier A, Seror V, Verger P. Vaccine hesitancy and coercion: all eyes on France. *Nat Immunol.* 2019;20(10):1257–59. doi:10.1038/s41590-019-0488-9.
2. Larson HJ, Cooper LZ, Eskola J, Katz SL, Ratzan S. Addressing the vaccine confidence gap. *Lancet.* 2011;378(9790):526–35. doi:10.1016/S0140-6736(11)60678-8.
3. Rey D, Fressard L, Cortaredona S, Bocquier A, Gautier A, Peretti-Watel P, Verger P. Vaccine hesitancy in the French population in 2016, and its association with vaccine uptake and perceived vaccine risk-benefit balance. *Eurosurveillance.* 2018;23(17):17–00816. doi:10.2807/1560-7917.es.2018.23.17.17-00816.
4. Wilson R, Zaytseva A, Bocquier A, Nokri A, Fressard L, Chamboredon P, Carbonaro C, Bernardi C, Dubé E, Verger P. Vaccine hesitancy and self-vaccination behaviors among nurses in southeastern France. *Vaccine.* 2020;38(5):1144–51. doi:10.1016/j.vaccine.2019.11.018.
5. Peretti-Watel P, Verger P, Raude J, Constant A, Gautier A, Jestin C, Beck F. Dramatic change in public attitudes towards vaccination during the 2009 influenza A(H1N1) pandemic in France. *Eurosurveillance.* 2013;18(44):20623. doi:10.2807/1560-7917.es2013.18.44.20623.
6. Larson HJ, de Figueiredo A, Xiaohong Z, Schulz WS, Verger P, Johnston IG, Cook AR, Jones NS. The state of vaccine confidence 2016: global insights through a 67-country survey. *EBioMedicine.* 2016;12:295–301. doi:10.1016/j.ebiom.2016.08.042.
7. Lévy-Bruhl D, Desenclos JC, Quelet S, Bourdillon F. Extension of French vaccination mandates: from the recommendation of the steering committee of the citizen consultation on vaccination to the law. *Eurosurveillance.* 2018;23(17):18–00048. doi:10.2807/1560-7917.ES.2018.23.17.18-00048.
8. Antona D, Lévy-Bruhl D, Dina J, Vabret A. Epidémiologie de la rougeole en France en 2017 [Internet]. Saint-Maurice (France): Santé publique France; 2018 [accessed 2020 Oct 1]. https://www.mesvaccins.net/textes/Bilan_epidemie_rougeole_fev_2018.pdf
9. Ward JK, Colgrove J, Verger P. Why France is making eight new vaccines mandatory. *Vaccine.* 2018;36(14):1801–03. doi:10.1016/j.vaccine.2018.02.095.
10. Ward JK, Colgrove J, Verger P. France's risky vaccine mandates. *Science.* 2017;358(6362):458–59. doi:10.1126/science.aag1682.
11. Association Française de Pédiatrie Ambulatoire (AFPA), Groupe de Pathologie Infectieuse Pédiatrique (GPIP), Société Française de Pédiatrie (SFP), Société de Pathologie Infectieuse de Langue Française (SPILF). Communiqué de presse 6/10/2017 [Internet]. AFPA, GPIP, SFP, SPILF; 2017 [accessed 2020 Oct 1]. <https://www.cefec.fr/Document/Communication/CommuniquePresse/2017/20171006CommuniquePresseObligation%20vaccinalesv111017.pdf>.
12. Collège National des Généralistes Enseignants (CNGE). L'obligation de vaccination risque d'être contre productive [Internet]. CNGE; 2017 [accessed 2020 Oct 1]. https://www.cnge.fr/conseil_scientifique/le_monde_du_130717_l'obligation_de_vaccination_risq/.
13. Bozzola E, Spina G, Russo R, Bozzola M, Corsello G, Villani A. Mandatory vaccinations in European countries, undocumented information, false news and the impact on vaccination uptake: the position of the Italian pediatric society. *Ital J Pediatr.* 2018;44(1):67. doi:10.1186/s13052-018-0504-y.
14. Verger P, Collange F, Fressard L, Bocquier A, Gautier A, Pulcini C, Raude J, Peretti-Watel P. Prevalence and correlates of vaccine hesitancy among general practitioners: a cross-sectional telephone survey in France, April to July 2014. *Eurosurveillance.* 2016;21(47). doi:10.2807/1560-7917.ES.2016.21.47.30406.
15. Santé publique France (SPF). Semaine européenne de la vaccination du 24 au 30 Avril 2019. Dossier de Presse [Internet]. Saint-Maurice (FRA): SPF; 2019 [accessed 2020 Oct 1]. https://solidarites-sante.gouv.fr/IMG/pdf/190418_-_dossier_de_presse_-_semaine_europeenne_vaccination.pdf.
16. Zou G, Modified Poisson A. Regression approach to prospective studies with binary data. *Am J Epidemiol.* 2004;159(7):702–06. doi:10.1093/aje/kwh090.
17. Collange F, Fressard L, Pulcini C, Launay O, Gautier A, Verger P. Opinions des médecins généralistes de la région Provence-Alpes-Côte d'Azur sur le régime obligatoire ou recommandé des vaccins en population générale. [Internet]. Saint-Maurice (France): Santé publique France. BEH 24–25:406–13; 2016; [accessed 2020 Oct 1]. <https://www.santepubliquefrance.fr/regions/provence-alpes-cote-d-azur-et-corse/documents/article/2016/opinions-des-medecins-generalistes-de-la-region-provence-alpes-cote-d-azur-sur-le-regime-obligatoire-ou-recommande-des-vaccins-en-population-generale>
18. Gentile L, Cuda A, Dallagiacoma G, Provenzano S, Santangelo OE, Navaro M, D'Aloisio F, Gianfredi V. Opinion, knowledge and attitude of public health residents towards the new mandatory vaccination law in Italy. *J Public Health.* 2020. doi:10.1007/s10389-019-01171-4.
19. Colgrove J. Vaccine refusal revisited — the limits of public health persuasion and coercion. *N Engl J Med.* 2016;375(14):1316–17. doi:10.1056/NEJMp1608967.
20. Lévy-Bruhl D, Fonteneau L, Vaux S, Barret A-S, Antona D, Bonmarin I, Che D, Quelet S, Coignard B. Assessment of the impact of the extension of vaccination mandates on vaccine coverage after 1 year, France, 2019. *Eurosurveillance.* 2019;24(26). doi:10.2807/1560-7917.ES.2019.24.26.1900301.
21. Drew L. The case for mandatory vaccination. *Nature.* 2019;575(7784):S58–60. doi:10.1038/d41586-019-03642-w.
22. Verger P, Dubé E. Restoring confidence in vaccines in the COVID-19 era. *Expert Rev Vaccines.* 2020. doi:10.1080/14760584.2020.1825945.
23. Gagneur A, Battista M-C, Boucher FD, Tapiero B, Quach C, De Wals P, Lemaitre T. Promoting vaccination in maternity wards — motivational interview technique reduces hesitancy and enhances intention to vaccinate, results from a multicentre non-controlled pre- and post-intervention RCT-nested study, Quebec, March 2014 to February 2015. *Eurosurveillance.* 2019;24(36):1800641. doi:10.2807/1560-7917.ES.2019.24.36.1800641.
24. vaccination-info-service.fr [Internet]. Saint-Maurice (France): Santé publique France; 2020 [accessed 2020 Oct 1]. <https://vaccination-info-service.fr/>
25. Vivion M, Hennequin C, Verger P, Dubé E. Supporting informed decision-making about vaccination: an analysis of two official websites. *Public Health.* 2020;178:112–19. doi:10.1016/j.puhe.2019.09.007.
26. Leask J. Target the fence-sitters. *Nature.* 2011;473(7348):443–45. doi:10.1038/473443a.

27. Kernéis S, Jacquet C, Bannay A, May T, Launay O, Verger P, Pulcini C. Vaccine Education of Medical Students: A Nationwide Cross-sectional Survey. *Am J Prev Med.* 2017;53(3):e97–104. doi:10.1016/j.amepre.2017.01.014.
28. Wilson R, Vergélys C, Ward J, Peretti-Watel P, Verger P. Vaccine hesitancy among general practitioners in Southern France and their reluctant trust in the health authorities. *Int J Qual Stud Health Well-being.* 2020;15(1):1757336. doi:10.1080/17482631.2020.1757336.
29. Agrinier N, Le Maréchal M, Fressard L, Verger P, Pulcini C. Discrepancies between general practitioners' vaccination recommendations for their patients and practices for their children. *Clin Microbiol Infect.* 2017;23(5):311–17. doi:10.1016/j.cmi.2016.08.019.
30. Flicoteaux R, Pulcini C, Carrieri P, Schwarzinger M, Leport C, Verger P. Correlates of general practitioners' recommendations to patients regarding vaccination for the 2009–2010 pandemic influenza (A/H1N1) in France: implications for future vaccination campaigns. *Vaccine.* 2014;32(20):2281–87. doi:10.1016/j.vaccine.2014.02.074.
31. Peretti-Watel P, Seror V, Cortaredona S, Launay O, Raude J, Verger P, Fressard L, Beck F, Legleye S, L'Haridon O, et al. A future vaccination campaign against COVID-19 at risk of vaccine hesitancy and politicisation. *Lancet Infect Dis.* 2020;20(7):769–70. doi:10.1016/S1473-3099(20)30426-6.