Who follows the doctors’ advice and why? Social cognitive predictors of effectiveness of a brief intervention promoting influenza vaccination among elderly people

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Research Article

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Who follows the doctors’ advice and why? Social cognitive predictors of effectiveness of a brief intervention promoting influenza vaccination among elderly people

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Abstract:

Improving the public adherence to medical recommendations is critical to address the suboptimal influenza vaccination coverage among high-risk groups. This study sought to identify the social cognitive predictors of influenza vaccination uptake among elderly people, and the moderators of a brief multifaceted intervention at hospital, including a vaccination promotion interview, letters, and automatic reminders (SMS), through a parallel group randomized trial conducted in 18 Hospital Emergency departments in France and Monaco (N=1,475). The potential predictors of influenza vaccination were measured through a self-administrated questionnaire based on the leading social cognitive models of health behaviors. Follow-up phone interviews were conducted 6 month later to evaluate the effect of these variables on influenza vaccination among the participants. Controlling for clustering effects, we found that the influenza vaccine uptake varied principally as a function of the patients’ past behaviors and, to a lesser extent, to the perceived barriers to vaccination. In addition, providing recommendations through doctors interviews and letters, then sending SMS-based reminders significantly increased the overall influenza vaccine coverage among participants (AOR = 2.56, [95% CI = 1.05-6.24]). However, this brief intervention had only a significant effect on those who had a repeated history of influenza vaccination (AOR = 3.86 [95% CI = 1.59-9.41]). Our results suggest that the overall positive effects of such brief interventions on vaccination behaviors are mostly due to their capacity to prevent the risk of relapse in the least hesitant patients.

Keywords: Brief intervention, vaccination promotion, social cognitive predictors, seasonal influenza
1. Introduction

Since the fiasco of the H1N1 influenza vaccination campaign in 2009, and the subsequent diffusion of vaccine hesitancy in many western societies, convincing people to get vaccinated in order to prevent or control the spread of transmissible respiratory diseases has been increasingly recognized as one of the most important challenges for public health (ECDC, 2012; WHO, 2016). In this context, the study of interventions promoting vaccination have received widespread attention over the past decade from both scientists and public health officers. In the recent literature, numerous reviews of interventions to increase vaccination coverage have been published, evaluating a large range of behavioral change strategies from structural interventions enhancing the vaccination access to more brief and frugal interventions based on cues to action, such as doctors’ advices, letters or text message reminders (Dubé et al., 2015; Jarrett et al., 2015; MacDonald et al., 2013). Although seasonal influenza vaccination is generally considered as a cost-effective pharmaceutical instrument to reduce the likelihood and severity of the infection, the coverage rates are still largely under the WHO’s objective to immunize at least 75% of the high-risk populations in a large majority of the high-income countries (WHO, 2020). In France, national guidelines recommend influenza vaccination for those older than 64 years of age, and the cost of the vaccine is entirely covered by the national health insurance. Yet, only about 50% of the French elderly persons are vaccinated each year (Santé Publique France, 2023). This enduring suboptimal vaccine coverage has made critical the development of brief, inexpensive and scalable interventions to promote influenza vaccination in this population at high-risk for respiratory diseases. Prior to the COVID-19 pandemic, more than 60 interventional studies sought to rigorously evaluate the effectiveness of a variety of interventions to increase influenza vaccination uptake among elderly people (Thomas & Lorenzetti, 2018).

Among the interventions that do not require important change in health systems, the face-to-face provision of recommendations by health professionals (e.g., nurses, pharmacists, physicians) have been long identified as one of the most effective way to promote the vaccination uptake in the communities. Indeed, since the early stage of the social psychological research devoted to vaccination behaviors (Cummings et al., 1979), dozens of observational studies suggested that doctors’ advices represented a
simple and effective tool to promote vaccination uptake in the communities (Kan & Zhang, 2018; Kohlhammer et al., 2007; Wheelock et al., 2013). These empirical findings have progressively stimulated the development of various sophisticated methods to address vaccine hesitancy, such as structured interviewing method based on a motivational (Gabarda & Butterworth, 2021; Gagneur et al., 2018; Lemaitre et al., 2019) or a presumptive approach (Brewer, Chapman, et al., 2017; Brewer, 2021; Malo et al., 2018). Although there exist some notable differences between them, these methods of behavioral change fundamentally consist of short advising session with a trained health professional to motivate vaccine uptake among patients. In the recent literature, most interventions based on these interviewing techniques promoting influenza vaccination among the elderly – and tested through rigorous randomized controlled trials (RCT) – were proved to have significant and positive effects on their vaccine status. Beside these interpersonal communication strategies to increase influenza vaccination coverage, numerous interventions use impersonal communication tools such as letters, emails and/or text messages to provide information or instructions about the vaccine preventable diseases (Milkman et al., 2021; Stockwell et al., 2012; Yokum et al., 2018). However, although these interventions offer low-cost and scalable tools to increase influenza vaccination coverage among elderly, evidence from reviews of literature and meta-analyses showed that they have a somewhat limited effectiveness on individual behaviors (Thomas & Lorenzetti, 2018).

In the perspective to increase the influenza vaccination coverage among elderly, it seems particularly important to determine what social cognitive variables predict the vaccination uptake following a brief intervention, including low-cost cues to action such as reminders based on text-message. Most previously published randomized trials promoting influenza vaccination among elderly people are purely descriptive, commonly ignoring which cognitive or social variables are associated with the success of the intervention. Moreover, to the best of our knowledge, only a few randomized trials on influenza vaccination investigated the moderators of the intervention-behavior relationship, i.e., the variables that impede the effect of an intervention on the behavior that the researchers attempted to change. Yet, there are growing evidence that the effectiveness of pro-vaccine interventions depend – to a large extent – on preexisting attitudes toward vaccines (Nyhan et al., 2014). The present investigation
took advantage of the IMPROVED study, a multicomponent parallel-group randomized trial conducted in Hospital Emergency healthcare services in France and Monaco, to determine who among elderly people follows the doctors’ advices about vaccination against seasonal influenza and why. More specifically, the main objectives of our study were to identify from a variety of social cognitive models of health behavior (1) the variables predicting vaccination uptake among elderly people who consulted at Hospital emergency departments, and (2) the variables moderating the effectiveness of a brief intervention promoting influenza vaccination based on interviews and reminders through text-message (SMS). By achieving these objectives, we believe that our study may help to improve the effectiveness of programs and services promoting influenza vaccination in this high-risk population.

2. Methods

2.1 Study design

The IMPROVED study is a multicomponent parallel-group randomized trial to promote influenza and pneumococcal vaccination uptakes among patients 65 years and older. It was conducted between November 2015 and July 2017 in 18 Hospital Emergency healthcare services in France and Monaco (trial registration at ClinicalTrials.gov under the identifier NCT01899365). The study protocol was approved by an institutional review board (Comité de Protection des Personnes d’Ile de France 1, IRB 00008522, 2014-janvier-13467) and the French National Data Protection Authority (Commission Nationale Informatique et Libertés, DR-2015-108), and executed in compliance with the Helsinki Declaration for research involving human participants. The trial inclusion criteria were acceptance to participate to the study, mastery of the French language, ability to receive text-messaging intervention through mobile phone, absence of dementia or other mental disorders, and absence of medical contraindication to vaccination. All the participants provided written informed consent. A detailed description of the design, methods, intervention, demographic and health characteristics of the participants and the intervention effect on various outcome measures have been reported elsewhere (Tubiana et al., 2021).

2.2 Sample size and randomization
At the individual level, assuming a 0.05 intra-cluster correlation coefficient, it was estimated 1800 patients (900 patients per study group) were necessary to obtain 80% statistical power for detecting an absolute difference of 15 percentage points in the vaccination rate between the intervention and control group in the intention-to-treat analysis (with a two-sided alpha level set at 0.05). At the group level, anticipating an average number of 100 patients per department, it was estimated that 18 study sites were required. However, as the members of the 18 participating Emergency Departments were not able to comply with the recruitment plan, it was decided 18 months after the initiation of the IMPROVED study to stop the recruitment process, with a total sample size of 1475 participants (780 in the intervention group, and 695 in the control group). To prevent potent unintentional spillover effects of the intervention from one study arm to another, a computer-generated procedure was performed at the hospital level to randomly allocate the Emergency Departments, with a 1:1 ratio, to either the intervention group or the control group. Hospitals were matched according to their university affiliation status, annual number of ED admissions (<40,000 versus ≥40,000), and areas (Paris versus other regions) in order to balance the participants’ recruitment between study arms.

2.3 Intervention

Patients who met the inclusion criteria were offered to participate to the study at the end of their consultation at the Emergency Department. After the collection of the informed consent, all the participants from the intervention groups immediately received a multifaceted intervention promoting vaccination among elderly people, which included: (1) a short interview with the ED physician based on the presumptive approach during which the patients were informed about the burden of pneumococcal and influenza diseases, as well as the benefits of both vaccinations, (2) an educational letter summarizing the information communicated by the physician during the interview, and (3) a letter dedicated to the general practitioner stating that the patient was at high-risk for respiratory infection and could benefit from influenza and pneumococcal vaccination. Among the vaccination promotion techniques available to healthcare providers, the presumptive approach consists essentially to deliver presumptive “announcements”, i.e., brief statements that explicitly recommend vaccine uptake and assume that patients are ready to get vaccinated (Brewer, Hall, et al., 2017). In addition to this brief
intervention delivered by the ED physicians, the patients randomized in the intervention groups received
a series of 3 text messages over a period of 6 weeks reminding them to talk about vaccination against
respiratory infectious diseases with their general practitioners.

2.4 Measures

The questionnaire was administrated at the Hospital Emergency Department included a wide range of
items aimed at collecting health and demographic information of the participants such as age, gender,
level of education, past and current occupational status, household income, size of household, housing
conditions, motives for consultation at the ED, antecedents of chronic diseases, perceived health, and
history of influenza vaccination. In addition, participants were asked about some past cues to action
related to influenza vaccination they may have received prior to the study such as GPs’
recommendations or vouchers from the National Health Insurance (response options: “Yes, every year”,
“Yes, at least once”, “Uncertain” or “No, never”). Finally, 6 months after their inclusion, the participants
were asked in a follow-up survey whether they were vaccinated against seasonal influenza and
pneumococcal virus since their consultation at the ED (response options: “Yes”, “No”, or “I don’t
know”). Self-reported influenza vaccine uptake 6 months after the intervention is the dependent variable
of the present study.

To identify the cognitive variables that predicts the vaccination behavior among elderly who received
the brief intervention, we used a wide range of constructs and variables drawn from the leading social
cognitive models of health behavior (such as the Health Belief Model, the Protection Motivation Theory,
the Self-Regulation Model or the Planned Behavior Theory). This includes perceived susceptibility
(“How susceptible do you feel to respiratory infectious diseases?”) to and severity (“How severe do you
think the respiratory infectious diseases are?”) of these infections, worry (“How worried are you about
getting a respiratory infectious diseases?”), perceived behavioral control (“How effective do you think
protective behaviors are to prevent respiratory infectious diseases?”), and perceived efficacy of
treatments (“How effective do you think drugs are to treat the respiratory infectious diseases?”). These
cognitive factors were assessed with single items based on the format and phrasing of questions
commonly used in the behavioral medicine literature (Brewer et al., 2007; Ferrer et al., 2016). For each
of them, the participants were asked to rate on an 11-point Likert scale ranging from 0 to 10 in which the meaning of the end-point values was explicitly indicated.

The questionnaire also included a range of statements to investigate the beliefs about vaccination, which were perceived barriers ("It is difficult to get vaccinated against respiratory infectious diseases, such as influenza and pneumonia"), perceived effectiveness ("Vaccines are effective to prevent the respiratory infectious diseases, such as influenza and pneumonia"), perceived safety of vaccination ("Vaccines against the respiratory infectious diseases, such as influenza and pneumonia are unsafe"), subjective norms ("My friends and relatives support that elderly people get vaccinated against the respiratory infectious diseases, such as influenza and pneumonia"), and intention ("I intend to get vaccinated against respiratory infectious diseases, such as influenza and pneumonia"). For these items, participants were asked to select one of four response options in a agreement scale (strongly disagree, disagree, agree, strongly agree), and responses were dichotomized to facilitate the statistical treatment of the collected data.

2.5 Statistical analysis

In this study, we solely conducted complete-case analyses, i.e. analyses considering all study participants with available follow-up data. To test for baseline equivalence of intervention and control participants, we performed chi-square tests for categorical variables and t-tests for continuous variables (the detailed results are presented in Tubiana et al, 2021). For the attrition analysis (study participants lost to follow-up), we also used chi-square tests for categorical variables and t-tests for continuous variables. A p-value lower than .05 was considered statistically significant. To identify the social and cognitive predictors of influenza vaccine uptake and the moderators of the intervention-behavior relationship, we performed a series of multilevel binary logistic regressions using generalized estimating equations (GEE). This modeling approach is an extension of standard logistic regression, which adjusts for the effect of clustering, and does not require parametric assumptions (Sommet & Morselli, 2017). Moreover, as there were not a large number of clusters (K < 50), the Satterwaite’s approach to degrees of freedom were used to estimate fixed effects (Heck et al., 2014). We examined the effects on the social-cognitive factors on self-reported uptake of influenza vaccination at 6 months after the patients’
inclusion by entering these factors into models one at a time then simultaneously in a final model when their statistical association with the outcome variable was significant at p<.05. To account for the moderating effect of past vaccination behaviors on the intervention, we also entered the brief intervention-past behavior interaction term in the models. The data were analyzed using SPSS software, version 21.

3. Results

Respondents and non-respondents at the follow-up survey did not differ in terms of gender, level of formal education, motive for consultation, past and current occupation, size of household, housing condition, and perceived wealth. Nevertheless, significant differences between the two groups of participants were found regarding age (M= 76.3 for non-respondents vs 75.3 for respondents, \( t = -2.10, p = .035 \)), past influenza vaccination (56.8% of the non-respondents were vaccinated during the last campaign vs 48.1% of the respondents, \( \chi^2 = 8.49, df = 2, p = .014 \)), perceived health (34.0% of the non-respondents reported poor health vs 24.3% of the respondents \( \chi^2 = 20.90, df = 3, p < .001 \)), location (53.0% of the non-respondents were living in big cities vs 43.8% of the respondents, \( \chi^2 = 15.21, df = 6, p = .019 \)), household income (\( \chi^2 = 14.60, df = 4, p = .006 \)), and health conditions (\( p < .05 \) for history of cancer, infectious pneumonia, chronic respiratory failure, heart failure, and liver cirrhosis). Overall, these results indicate that the non-respondents to the follow-up interview were suffering from poorer health conditions than the respondents. Therefore, a higher rate of hospitalization or death may partly explain why the investigators could not reach these participants 6 months later.

Of the 873 patients who responded to the follow-up survey, 387 (44.3%) got vaccinated against seasonal influenza within 6 months after their inclusion in the study. This average rate was slightly below the estimated national coverage of 51% among the elderly people during the same period (Santé Publique France, 2023). Consistent with our expectation, the rate of vaccination was significantly higher in the intervention group than in the control group (50.4% vs 37.1%, respectively, \( \chi^2 (1, 873) = 15.59, p < .001 \)), indicating that the intervention was effective to promote influenza vaccination. The variance in vaccination behaviors across groups was estimated at .327 (\( Z = 2.22, p = .026 \)), which indicates non-negligible clustering effects and validates the utilization of multilevel binary logistic regression models.
to analyze the data. To further assess for clustering effects, we calculated the intraclass correlation coefficient (ICC), which was estimated at .087 (SD = .560). This estimate confirms the existence of some clustering effects in the vaccination behaviors as a value of .05 is generally viewed as a standard statistical threshold from which there are substantial evidence of clustering (Heck et al., 2014).

**Predictors of Influenza vaccination**

To identify the predictors of influenza vaccination, we conducted first a series of analysis using multilevel binary logistic regression models and testing individually each variable. Controlling for clustering effects, we found that most of the ‘conventional’ variables drawn from the main social cognitive theories of health behaviors predicted the vaccine uptake against influenza at the follow-up study. As shown in Table 1, only the perceived severity, worry, perceived control and perceived efficacy of treatment did not predict the vaccination behavior reported by the participants during the 6 months following their inclusion in the study. Moreover, with the notable exception of gender, none of the sociodemographic and health characteristics of the participants was found to predict their vaccination status at the follow-up survey. Then, we conducted a multivariate analysis using multilevel binary logistic regression models and testing simultaneously the significant variables identified in the previous analyses. Controlling again for clustering effects, we found that the vaccination behaviors varied principally as a function of the patients’ past behaviors (AOR = 40.66, [95% CI = 20.79-79.52]) and perceived barriers to vaccination (AOR = .51, [95% CI = .35-.72]). Furthermore, as shown in Table 2, we found after controlling for these sociodemographic and cognitive confounders that providing recommendations through doctors interviews and letters, then sending SMS-based reminders significantly increased the influenza vaccine coverage among participants (AOR = 2.56, [95% CI = 1.05-6.24]). Based on the receiver-operating characteristic (ROC) curve, a parsimonious model including these 3 constructs enables to correctly classify about 82% of the participants to the trial, and explained about 50% of the marginal variance in influenza vaccine uptake.

**Moderator of the Intervention-Behavior relationship**
To better understand who followed the doctors’ advices and why, we tested whether past vaccination behavior and perceived barriers moderated the intervention-future behavior relationship by introducing an interaction term in the multilevel binary logistic regression model. Tested individually, we did not find on the basis of these subsequent analyses that perceived barriers was a moderator of the intervention-behavior relationship. However, consistent with our expectations based on previous health behavior prediction studies (Hagger et al., 2018; Ouellette & Wood, 1998; Sutton, 1994), these analyses revealed that the intervention-behavior relationship was strongly moderated by the participants’ past behavior (see Table 3). In other words, our brief multifaceted intervention was substantially more effective on participants who had a repeated history of influenza vaccination, compared to those who never got the influenza vaccine (AOR = 3.86 [95% CI = 1.59-9.41]). As shown in Figure 1, this result suggests that the effectiveness of interventions based on various cues to action vary depending on the past behaviors of the patients and therefore, on their preexisting beliefs and attitudes towards influenza vaccine.

4. Discussion

Over the last decades, many rigorous observational and interventional studies have demonstrated that provision of high-quality recommendation by health professionals may represent an unique way of motivating people to get vaccinated (Kohlhammer et al., 2007). Indeed, there is today a growing body of empirical evidence showing that some simple and frugal interventions have significant effects on vaccination behaviors in various populations and settings. These effects are particularly well-documented for the influenza vaccination among the elderly people. For instance, in a systematic review of the determinants of this vaccination, Kan and Zhang (2018) found 14 cross-sectional studies showing that advices or reminders from health providers were strongly associated with influenza vaccine uptake among elderly people. Similarly, in a review of interventions aiming to increase influenza vaccination coverage in people aged 60 years or older (randomised controlled trials (RCTs) and cluster-RCTs), Thomas and Lorenzetti (2018) found a clear and positive effect of a variety of simple interventions based on cues to action on the subsequent vaccination behaviors. However, the review also pointed out that the effectiveness of interventions varied significantly as a function of the type of media used by the
health professionals. Overall, interventions that rely on interpersonal communication tools (e.g., face-to-face interviews) seem to outperform those based on impersonal communication tools (e.g., text messaging reminders). In a context of increasing vaccine hesitancy, these findings have recently stimulated the development of more sophisticated interviewing methods to help and train health providers to better promote vaccination, such as the motivational interviewing techniques or the presumptive announcement approach (Brewer, Chapman, et al., 2017). Based on these empirical evidence, we designed and implemented in 18 Hospital emergency departments a brief intervention combining these two types of interventions. The results of our study confirm that these kinds of intervention represent a simple, low-cost and scalable strategy to effectively increase the influenza vaccination rate among high-risk groups. To the best of our knowledge, our study is one of the first to use social cognitive models of health behavior and a prospective research design to investigate the effects of an intervention on influenza vaccination among elderly people.

Beyond the question to know whether brief interventions based on cues to action are effective, it seems equally important to better understand why some people or groups are more sensitive to them than others. As suggested by some previous studies (Nyhan et al., 2014), it is highly plausible that the effects of these interventions on vaccination behaviors vary across and within populations. Yet most of the intervention studies tend to focus on the assessment of the average effect size, and ignore the potential difference in the responsiveness to these interventions. Thus, the current discussions are still dominated by the simplistic question to know what kinds of intervention work best, and therefore the published studies remain essentially descriptive and less informative than expected. In other words, there is a heterogeneity challenge that has not yet been seriously addressed by the scientific community (Stanley et al., 2018). By conducting this study, we sought to improve the understanding of the social and individual heterogeneity in the responsiveness to these cues-to-action based interventions. Our results showed that most constructs drawn from the leading social cognitive models of health behavior predicted fairly well the vaccination behavior that we attempted to alter through the intervention. As shown in Table 1, there were significant bivariate associations between the psychological variables derived from these models and influenza vaccination (except for perceived severity, worry, perceived control and
perceived efficacy of treatment). However, after controlling for numerous potential socio-demographic and cognitive confounders, it was found that history of influenza vaccination and perceived barriers to vaccine uptake most strongly predicted influenza vaccination. It should be also underlined that former variable greatly overweighed the former as predictor of the vaccination behavior reported at the follow-up survey. This result is not completely surprising as the past vaccination behaviors has been consistently observed to predict – to a large extent – the future vaccination behaviors of both members and the general public and health providers (Bocquier et al., 2019; Caille-Brillet et al., 2013). In sum, a vast majority of people seem to have stable vaccination behaviors over time.

More interestingly, we found that past behavior was an important moderator of the intervention-future vaccination behavior relationship. As shown in Figure 1, our study reveals that such a brief intervention only works on the participants who have already been vaccinated against seasonal influenza in the past years. In addition, it seems that the more people have been vaccinated against influenza prior to the study, the more the intervention was effective. Overall, these results suggest that the positive effects of such brief interventions on vaccination behaviors are mostly due to their capacity to prevent the risk of relapse in the populations who are not reluctant to inoculation. How to explain this main finding? There are actually several social-psychological theories that may convincingly account for such a differentiated effect between the vaccinated and the non-vaccinated participants, such as the theory of cognitive dissonance (Harmon-Jones & Mills, 2019), the balance theory (Crandall et al., 2007), or the confirmation bias (Nickerson, 1998). According to these various theoretical frameworks, once formed, prior attitudes and beliefs (e.g., “vaccine are not safe”) guide the interpretation of subsequent information. People trust inputs that confirm their initial beliefs and reject those that would invalidate them as being questionable, erroneous, or unreliable. Therefore, it can be assumed that the contradiction of a recommendation provided by the health professionals to people reluctant to vaccination causes cognitive dissonance that is resolved by neutralizing the discomfiting advices, instead of effecting behavioral change. From this theoretical perspective, the maintenance or restoration of some cognitive consonance induced by the release of health recommendation may require among patients the misperception, neglect, or refutation of the vaccination promoting message. It may also require a search
of moral support from certain people – including some health providers – who do not share the dissonant message about influenza vaccination, or active attempts to persuade other people that the provided recommendation is not sufficiently sounded.

**Limitations**

This study may be prone to several methodological limitations, which are common in questionnaire survey, such as the discrepancy between actual and self-reported health behaviors which are caused by the social desirability bias in response to some questions even though the questionnaire is anonymous (King & Bruner, 2000). However, because of the high consistency between the national coverage and the vaccination rate in the present study, we think that it is unlikely that there was a strong social desirability bias in the self-reported vaccination behaviors. Furthermore, there is no reason why this methodological bias would be higher in the intervention group than in the control group, especially as there was no significant difference in terms of vaccine hesitancy between the two groups. There is nonetheless a possibility that the positive effect of the intervention on vaccination behaviors was underestimated as the non-respondents at the follow-up survey were substantially less hesitant than the respondents. Second, our study was conducted on a sample of patients recruited at Hospital, who might differ from other elderly people recruited at a GPs office. However, it should be noted here that about one third of the adult population makes at least one consultation at the ED annually in France, which represents a very large population (DREES, 2017). Finally, our intervention design do not allow distinguishing the effects of the structured interview from that of the text-based reminders. Consequently, in the absence of randomized trials combining these two types of interventions, it is unclear to date whether the provision of automatic reminders using text-messaging have an added-value to promote vaccination in addition to a brief intervention through an structured interview with a health professional.

**Conclusion**

Providing SMS-based reminders in combination with a brief intervention based on interviews with health professionals in healthcare centers may significantly improve the vaccine coverage among elderly
people. In our study conducted in a variety of French Hospital Emergency, we found that this kind of combined intervention increased vaccination rates among patients who exhibited a higher vaccine hesitancy than the national average by an average of 13.3 percentage points, over a 6-months follow-up period. However, its effectiveness seems to depend to a large extent on the preexisting beliefs and behaviors of the patients. Our results suggest that the overall positive effects of such brief interventions on vaccination behaviors are mostly due to their capacity of these multifaceted interventions to prevent the risk of relapse in the compliant population.

5. References


https://www.santepubliquefrance.fr/determinants-de-sante/vaccination/donnees-de-couverture-vaccinale-grippe-par-groupe-d-age


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Competing interests:
J.R. has received honoraria from MSD and Pfizer for training and scientific projects on vaccine hesitancy. Y.-E.C. has received honoraria from Biomérieux, Beckman Coulter, Roche Diagnostics and Sanofi. XD has received grants from Pfizer and Sanofi Pasteur for scientific projects. The other authors declare no conflicts of interest.
Table 1. Bivariate logistic regression analyses using generalized mixed model

<table>
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<td></td>
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<td>Upper</td>
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<td>0.998 - 1.071</td>
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<td>0.214</td>
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<td>1.066 - 3.373</td>
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<td>0.744</td>
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<td>Group*History</td>
<td>Intervention*Always-</td>
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<td>0.377</td>
<td>24.541</td>
<td>11.720 - 51.385</td>
<td>8.500</td>
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<td>Intervention*S</td>
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<td>18.643</td>
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<td>Control*Never</td>
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<td>4.669 - 23.587</td>
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<td>Intervention*Sometimes-</td>
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<td>0.586 - 3.219</td>
<td>0.820</td>
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Table 2. Multivariate logistic regression analyses using generalized mixed model

(A) Fixed Effects Parameter Estimates (without interaction)

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<th>Names</th>
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<th>Estimate</th>
<th>SE</th>
<th>exp(B)</th>
<th>95% Exp(B) CI</th>
<th>Lower</th>
<th>Upper</th>
<th>t</th>
<th>p-value</th>
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<tbody>
<tr>
<td>(Intercept)</td>
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<td>-3.532</td>
<td>0.584</td>
<td>0.029</td>
<td>0.009 - 0.093</td>
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<td>0.963 - 1.155</td>
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<td>0.417</td>
<td>1.470</td>
<td>0.649 - 3.333</td>
<td>0.925</td>
<td>0.355</td>
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<td></td>
<td>Effective - Ineffective</td>
<td>0.470</td>
<td>0.443</td>
<td>1.600</td>
<td>0.670 - 3.819</td>
<td>1.060</td>
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<td>Perceived barriers</td>
<td>Constraining - Non constraining</td>
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<td>0.506</td>
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<td>0.557 - 1.415</td>
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<tr>
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<td>Safe - Unsafe</td>
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<td>Always - Never</td>
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(B) Fixed Effects Parameter Estimates with interaction

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<th>95% Exp(B) CI</th>
<th>Lower</th>
<th>Upper</th>
<th>t</th>
<th>p-value</th>
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<td>0.956 - 1.040</td>
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<td>0.501</td>
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Fig. 1. Past behaviors as moderators of the intervention-future behaviors relationship