



**HAL**  
open science

**Nudging health care workers towards a flu shot:  
reminders are accepted but not necessarily effective. A  
randomized controlled study among residents in general  
practice in France**

Adriaan Barbaroux, Laurie Benoit, Romain A Raymondie, Isabelle Milhabet

► **To cite this version:**

Adriaan Barbaroux, Laurie Benoit, Romain A Raymondie, Isabelle Milhabet. Nudging health care workers towards a flu shot: reminders are accepted but not necessarily effective. A randomized controlled study among residents in general practice in France. *Family Practice*, 2021, 10.1093/fampra/cmab001 . hal-03185585

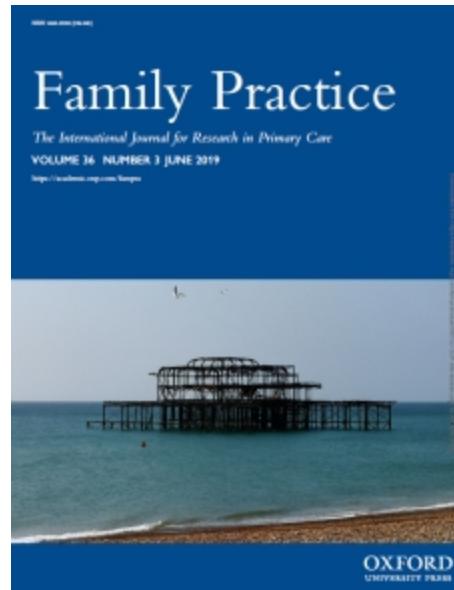
**HAL Id: hal-03185585**

**<https://hal.science/hal-03185585>**

Submitted on 28 Aug 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Reviewers should submit their review online via the journal

**Nudging healthcare workers toward a flu shot: reminders are accepted but not necessarily effective. A randomized controlled study among residents in general practice in France.**

Journal:	<i>Family Practice</i>
Manuscript ID	FAMPR-256-20.R1
Manuscript Type:	Health Service research
Date Submitted by the Author:	04-Dec-2020
Complete List of Authors:	BARBAROUX, Adriaan; Université Côte d'Azur, Département d'enseignement et de recherche en médecine générale, RETINES, LAPCOS, HEALTHY Benoit, Laurie; Université Côte d'Azur, RETINES, DERMG Raymondie, Romain; Université Côte d'Azur, LAPCOS Milhabet, Isabelle; Université Côte d'Azur, LAPCOS
Keywords:	Lifestyle Modification/ Health Behavior Change, Behavioral Medicine, population health, Upper Respiratory Infections / Common Cold / Bronchitis, Primary Care
Methods:	interdisciplinary research, Adaptive Clinical Trials

SCHOLARONE™  
Manuscripts

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 1 **Nudging healthcare workers toward a flu shot: reminders are accepted but not necessarily**  
4 **effective.** A randomized controlled study among residents **in general practice in France.**

5 2  
6 3 Running head: REMINDER NUDGE: EFFECTIVENESS AND ACCEPTABILITY

7 4  
8 5 Article Category: Health Service Research  
9 6

10 7 Adriaan BARBAROUX.<sup>a, b</sup>, Laurie BENOIT.<sup>a</sup>, Romain A. RAYMONDIE.<sup>b</sup>, Isabelle  
11 8 MILHABET.<sup>b</sup>

12 9  
13 10 <sup>a</sup> Université Cote d'Azur, Département d'enseignement et de recherche en médecine générale,  
14 11 RETINES, HEALTHY, France

15 12  
16 13 <sup>b</sup> Université Cote d'Azur, LAPCOS, France.  
17 14

18 15 Corresponding author:

19 16 Dr A. Barbaroux, Université Cote d'Azur, Département d'enseignement et de recherche en  
20 17 médecine générale, RETINES, LAPCOS, HEALTHY, France, 28 Avenue De Vallombrose,  
21 18 06107 Nice, France, [abarbaroux@unice.fr](mailto:abarbaroux@unice.fr) - +33630852190  
22 19

23 20 Key messages

24 21 Nudging is considered as one of the most efficient techniques for changing behavior.

25 22 **Changing the choice architecture may improve influenza vaccination coverage.**

26 23 To be effective, a nudge has to match **healthcare workers'** needs.

27 24 Reminders are accepted but not necessarily effective **in promoting vaccination.**

28 25 Prior exposure to a nudge increases its acceptability.  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 27 **ABSTRACT**

4  
5 28 *Background:* A nudge corresponds to any procedure that influences choice architecture, without  
6  
7 29 using persuasion or financial incentives. Nudges are effective in increasing vaccination with  
8  
9 30 heterogeneous levels of acceptability.

10 31 *Objective:* To evaluate the effectiveness and acceptability of a nudge promoting influenza  
11  
12 32 vaccination for general practice **trainees, also called residents.**

13 33 *Methods:* The hypothesis was that a reminder would be efficient and accepted and that prior  
14  
15 34 exposure to a nudge increases its acceptability. **Residents** were randomly divided into three  
16  
17 35 parallel experimental arms: a nudge group, a no-nudge group and a control group in order to  
18  
19 36 evaluate the hawthorne effect. The nudge consisted in providing a paper form for the free  
20  
21 37 delivery of the vaccine and contacts for occupational health services.

22 38 *Results:* The analysis included 161 **residents**. There was a strong consensus among the residents  
23  
24 39 that it is very acceptable to nudge their peers and patients. Acceptability was better with  
25  
26 40 residents exposed to the nudge and with residents included in step one (Hawthorne effect). The  
27  
28 41 nudge did not increase vaccination coverage.

29 42 *Conclusion:* The failure of this nudge highlights the importance of matching an intervention to  
30  
31 43 the population's needs. The experimental approach is innovative in this context and deserves  
32  
33 44 further attention.

34 45 ClinicalTrials.gov pre-registration: NCT03768596

35  
36 46  
37 47 *Keywords:* **Acceptability, Behavior change, Efficacy, Influenza, Nudge, Vaccination**  
38 48 **promotion.**  
39 49  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## 50 51 **Background**

52 Influenza affects two to eight million people every year in France and is responsible for  
53 8,000 to 20,000 deaths, with a total estimated annual cost between one hundred million and one  
54 billion euros<sup>1-4</sup>. Healthcare workers are a key vector for the transmission of the virus and are  
55 also in contact with those who are most at risk of severe influenza (the elderly or patients with  
56 multiple diseases)<sup>5</sup>. Vaccination of healthcare workers contributes to influenza prevention,  
57 limiting the use of care, and reducing pneumonia deaths in health facilities<sup>6-8</sup>. Despite extensive  
58 data on vaccination effectiveness and safety, recommendations, and promotion campaigns,  
59 vaccination coverage rates of European healthcare workers are between 6.4% and 30%<sup>9</sup>. These  
60 data led us to reflect: how can we encourage healthcare worker vaccination, both in their own  
61 interest and in the interest of the population?

62 Most public health policies use education programs to change healthcare workers'  
63 knowledges and attitudes towards vaccination<sup>10,11</sup>. These programs showed limited impact,  
64 suggesting that approaches based exclusively on the provision of information are not enough.  
65 Thaler and Sunstein proposed an effective and inexpensive method to increase people's  
66 adoption of healthy behavior without persuasion or financial incentive: nudges. A "nudge"  
67 refers to any change in choice architecture that aims at influencing people's behavior in a  
68 predictable way without denying them any options or changing their motivations<sup>12</sup>. It consists  
69 of a gentle incentive whereas respecting freedom of choice. Nudging is considered as one of  
70 the most efficient techniques for changing simple behavior without the need to change one's  
71 opinion toward the behavior<sup>12</sup>. This process has been studied for years in social psychology and  
72 has received renewed attention since Richard Thaler was awarded the Nobel Prize in Economics  
73 in 2017 for his work on the application of nudges to the economy. In the health field, several  
74 studies have shown the effectiveness of a nudge in increasing vaccination coverage<sup>13-19</sup>.

75 A nudge relates to people's well-being and must be transparent and publicly defensible<sup>12</sup>.  
76 However, the operationalization of nudges varies and is based on cognitive bias. They can be

1  
2  
3 77 implicit or unclear to varying degrees<sup>20</sup> and can even be regarded as manipulation attempts<sup>21,22</sup>  
4  
5 78 because persons exposed to a nudge do not have access to the intentions and operations  
6  
7 79 underlying the nudge. Previous studies described a generally positive but variable acceptability:  
8  
9 80 nudges were judged acceptable by 40 to 87% of participants<sup>23</sup>. Previous research showed that  
10  
11 81 effective nudges tend to be quite well accepted if the nudge is transparent and can be controlled:  
12  
13 82 people more easily accept a nudge involving reflection than one involving unconscious  
14  
15 83 processes (e.g., a nudge consisting of the display of nutritional content on food will be more  
16  
17 84 accepted than another one that places unhealthy food in an inconvenient location)<sup>24</sup>. However,  
18  
19 85 to our knowledge, no experimental studies focused on the acceptability of nudges.  
20  
21  
22  
23

24 86 The present experiment has a dual objective: to test the effectiveness of a nudge to  
25  
26 87 promote vaccination to general practice trainees (i.e., general practice residents or GP residents)  
27  
28 88 and to examine their acceptance of this approach, especially after having been confronted with  
29  
30 89 a nudge. Residents were approached because of their relevance to the context studied and their  
31  
32 90 representativeness of other healthcare workers, particularly regarding the inadequacy of their  
33  
34 91 vaccination coverage<sup>25</sup>.  
35  
36

37 92 It was hypothesized that the vaccination rate would be higher in the condition exposed  
38  
39 93 to the nudge than in the unexposed condition (H1a), and that inclusion in the study would  
40  
41 94 increase the vaccination coverage because of the Hawthorne effect (H1b)<sup>26</sup>. The second  
42  
43 95 hypothesis was that the acceptability of the nudge would be higher in the condition exposed to  
44  
45 96 the nudge than in the unexposed condition (H2a), and that inclusion in the study would increase  
46  
47 97 the nudge's acceptability (H2b) (Hawthorne effect)<sup>26</sup>.  
48  
49  
50

51 98

## 53 99 **Methods**

### 54 100 *Setting, participants, design and procedure*

55 101 This unicentric, three arm parallel trial was designed to control for the Hawthorne effect.  
56  
57 102 A simple and equal randomization (1:1:1 for three groups) was used. The criteria for inclusion  
58  
59 103 were to be a GP resident at a university from the south of France and to have attended courses  
60

1  
2  
3 104 given in November and December 2018. The exclusion criteria were the absence of a response  
4  
5 105 to one questionnaire or the presence of obvious inconsistencies in the responses.  
6

7 106 The study was conducted in two steps that were spaced one month apart in order to  
8  
9 107 control for the Hawthorne effect. In step 1, residents assigned to the nudge group received a  
10  
11 108 questionnaire about their opinions on vaccination and their professional experience. The  
12  
13 109 questionnaire was distributed by the main investigator (LB) and self-administrated by residents  
14  
15 110 during mandatory courses at the university. It was accompanied by a nudge formulated as  
16  
17 111 follows: "If you have not been vaccinated against influenza, please remove the form attached  
18  
19 112 to this questionnaire; it will allow you to obtain the vaccine at the pharmacy. On the back, you  
20  
21 113 will also find practical information about vaccination services at your internship site". The  
22  
23 114 residents in the no-nudge group received the same questionnaire, without the form or practical  
24  
25 115 information. The control group was not solicited at that time and was included directly in step  
26  
27 116 2 in order to control for the Hawthorne effect. In Step 2, the three groups received an  
28  
29 117 explanation of the nudge procedure and completed a questionnaire about participants'  
30  
31 118 vaccination status and the nudge's acceptability.  
32  
33  
34  
35  
36

37 119 Acceptability was assessed for the residents and for the patients. The acceptability was  
38  
39 120 assessed via a series of seven-point Likert scales, formulated as follows: "What do you think  
40  
41 121 about the use of this type of method on patients?" on a scale from 1 (not at all) to 7 (absolutely)  
42  
43 122 and applied to the following eight adjectives: relevant, legitimate, unfair, immoral, ethical,  
44  
45 123 inappropriate, acceptable, abusive. For this second set of Likert scales, the adjectives were  
46  
47 124 presented in reverse order to prevent participants from copying the answers from the previous  
48  
49 125 questionnaire. Half of the participants received a questionnaire starting with the residents and  
50  
51 126 the other half starting with the patients.  
52  
53  
54

55 127 The questionnaires specified the legal context for collecting data (anonymous,  
56  
57 128 computerized processing, no obligation to reply, possibility of leaving the study at any time).  
58  
59  
60



1  
2  
3 129 In order to obtain a statistical power of 90% with a tolerated alpha risk of 5%, 46  
4  
5 130 residents per group were required for the effectiveness study, assuming 60% vaccinated  
6  
7 131 residents in the nudge group against 30% in the no-nudge group. To obtain the same power for  
8  
9 132 the acceptability study, 22 people were needed per group by providing an acceptability of 5  
10  
11 133 points on a Likert scale of 7 in the nudge group versus 4 in the unexposed group.  
12  
13  
14  
15  
16

134

### 17 135 *Data analysis*

18  
19 136 The effectiveness of the nudge and the Hawthorne effect on vaccination rates were  
20  
21 137 evaluated by Chi<sup>2</sup> tests. The consistencies of the nudge acceptability scales were tested using  
22  
23 138 Cronbach's alpha.

24  
25  
26 139 The hypotheses addressing the acceptability of the nudge were tested by linear  
27  
28 140 regressions and contrast calculations. Since the independent variable group had three levels, it  
29  
30 141 was broken down into two orthogonal contrasts<sup>27</sup>.

31  
32  
33 142 All statistical analyses were performed using JASP® software<sup>28</sup>.

### 34 35 143 *Regulatory and ethical aspects*

36  
37 144 The study was classified out of scope of the Jardé law by the CPP Ile De France IV (ID-  
38  
39 145 RCB: 2018-A02939-46, Ref. 2018/101). A favorable opinion was issued by the Ethics  
40  
41 146 Committee of the French National College of Generalist Teachers (n°-17011961B). This work  
42  
43 147 has been the subject of a declaration of compliance with the MR004 to the National  
44  
45 148 Commission of Liberty and Computing "CNIL" n° 2211449v0. Protocol was pre-registered on  
46  
47 149 ClinicalTrials.gov (NCT03768596).  
48  
49  
50

51 150

## 52 53 151 **Results**

### 54 55 152 *Descriptive statistics*

56  
57  
58 153 Step 1 (inclusion) took place between November 7 and 29, 2018 and step 2 (data  
59  
60 154 collection) between December 5 and 20, 2018. Of the 218 residents enrolled at the university,

1  
2  
3 155 20 did not attend the relevant class and 22 were absent in step 2. Of the participants in both  
4  
5 156 steps, 15 were excluded as outliers because they pretended to be younger in step two than they  
6  
7 157 pretended in step one or because they pretended to be vaccinated in step one but not in step two.  
8  
9  
10 158 Flow chart is available in Figure 1. The final analysis included 161 participants distributed as  
11  
12 159 follows: 59 participants in the nudged group, 36 in the non-nudged group and 66 in the control  
13  
14 160 group. Participants' age ranged from 23 to 35 years ( $M = 26.33$ ,  $SD = 1.75$ ); 102 were women  
15  
16 161 (67.5%), 58 were men (36.5%), and two did not report age and sex.

17  
18  
19 162 **INSERT Figure 1**

20  
21 163 Of the 95 participants included in step 1, 56 (59%) were already vaccinated at the time  
22  
23 164 of inclusion. In step 2, 117 participants reported being vaccinated (72.7%). **Table 1 presents the**  
24  
25 165 **number of vaccinated (or not) participants per group and percentages among 161 residents.**

26  
27  
28 166 **INSERT Table 1**

### 29 167 *Nudge effectiveness*

30  
31 168 The first hypothesis (H1a: residents exposed to the nudge were more likely to be  
32  
33 169 vaccinated than unexposed residents) was not verified,  $\chi^2(1, N = 39) = 0.21$ , *ns*. Similarly, the  
34  
35 170 Hawthorne effect (H1b), which assumed a higher vaccination rate in step 1 groups than in the  
36  
37 171 control group included in step 2, was not demonstrated,  $\chi^2(1, N = 161) = 0.50$ , *ns*.

### 38 39 40 172 41 42 173 *Nudge acceptability*

43  
44 174 We observed a high level of acceptability for the nudge regardless of the experimental  
45  
46 175 condition the residents were included in (see Table 2). Participants rated the nudging procedure  
47  
48 176 acceptable for both patients ( $M = 6.31$ ;  $SD = .73$ ) and residents ( $M = 6.34$ ;  $SD = .81$ ). Only two  
49  
50 177 residents considered the nudge procedure to be rather unacceptable when applied to residents  
51  
52 178 (acceptability below the seven-point Likert-scale midpoint). Acceptability for residents and  
53  
54 179 patients did not differ,  $t(142) = 1.47$ ,  $p = .15$ .

55  
56  
57 180 **INSERT Table 2**

1  
2  
3 181  
4  
5 182 *Impact of nudge exposure on nudge acceptability for the residents (H2a)*. Residents were more  
6  
7 183 accepting of the nudge as applied to themselves after previous exposure to the same nudge ( $p$   
8  
9  $< .05$ ). See figure 2 for a visual representation of these data and Table 3.

10 184  
11  
12 185 **INSERT Figure 2**

13  
14 186 **INSERT Table 3**

15  
16  
17 187 **Regarding the use of the nudge with patients as targets**, regression analyses did not  
18  
19 188 support the hypothesis that residents accept the nudge for patients to a greater extent after being  
20  
21 189 exposed to **the nudge** ( $p = .08$ ). However, the omnibus effect was significant ( $p < .05$ ),  
22  
23 190 suggesting a difference in acceptability between the 3 groups (nudge, no-nudge and control) as  
24  
25 191 described below (H2b-patients: Hawthorne effect).

26 192  
27  
28 193 *Impact of the Hawthorne effect on nudge acceptability (H2b)*. **Compared to residents in the**  
29  
30 194 **control group**, residents **rated the nudge as more acceptable** for themselves **when** they were  
31  
32 195 included in the study **in** step 1 ( $p < .05$ ), regardless of whether they were nudged or not.  
33  
34 196 **Likewise**, residents were more likely to **rate the nudge as acceptable to target patients when**  
35  
36 197 they were included in the study **in** step 1 ( $p < .01$ ), regardless of whether they were nudged or  
37  
38 198 not.

39  
40  
41 199 A post hoc analysis was done in order to compare nudged residents' acceptability to  
42  
43 200 control residents' acceptability (included in step 2). This difference was significant ( $p < .01$ )  
44  
45 201 showing that residents in the nudge group **rated the nudge as more acceptable** than residents in  
46  
47 202 the control group, suggesting a ceiling effect. In other words, since the Hawthorne effect led to  
48  
49 203 a high degree of acceptability (close to the top of the scale), **nudged** residents **could not rate the**  
50  
51 204 **nudge as more acceptable, which might explain the lack of support for hypothesis H2a-patients.**

52  
53  
54  
55 205

56  
57 206 *Additional analyses*

1  
2  
3 207 Results of the multinomial linear regression are available online (table 4 and 5).  
4  
5 208 Residents were more accepting of nudges targeting other residents when they approved  
6  
7 209 vaccination recommendations. Residents were more accepting of the nudges targeting patients  
8  
9 210 when they approved vaccination recommendations and when they were women or older.  
10  
11  
12 211

## 13 212 **Discussion**

14  
15  
16  
17 213 The objective of this experiment was to evaluate the effectiveness and acceptability of  
18  
19 214 a nudge on residents' vaccination coverage. These data show that prior exposure to a nudge  
20  
21 215 increases its acceptability, and that a reminder nudge promoting a desirable and valued behavior  
22  
23 216 will be perceived as a soft and acceptable incentive to target both residents and patients.  
24  
25

### 26 217 *Effectiveness*

27  
28 218 In this controlled, randomized experimental study, a nudge based on a reminder did not  
29  
30 219 increase influenza vaccination coverage among residents. Whereas it is perhaps disappointing  
31  
32 220 that this nudge was ineffective, we can ascribe this finding -or lack thereof- to the very high  
33  
34 221 initial rate of vaccination in our sample, which may explain the ineffectiveness of the nudge.  
35  
36 222 Previous studies showed that vaccination coverage is typically lower<sup>9,25</sup> among residents and  
37  
38 223 that reminders can be effective<sup>19</sup>. Another explanation for the lack of effect of this nudge could  
39  
40 224 be the mismatch between the type of nudge (a reminder) and the needs of the residents at the  
41  
42 225 time of data collection. That is, residents' high vaccination rates can be ascribed to an ongoing  
43  
44 226 vaccination campaigns implemented by the hospital during data collection. Indeed, residents  
45  
46 227 informed us that the hospital had set up booths offering free vaccination. This intervention can  
47  
48 228 explain why the vaccination rates were higher than expected. Thus, our reminder-based nudge  
49  
50 229 might have been redundant for our sample of residents. Nevertheless, these data highlight the  
51  
52 230 importance for policymakers to choose the right nudge for the right population. Further, despite  
53  
54 231 Nobel prizes and meta-analyses extolling nudges<sup>10,11</sup>, the latter are not necessarily effective. It  
55  
56  
57  
58  
59  
60

1  
2  
3 232 is therefore crucial to publish null findings to avoid publication bias and contribute to current  
4  
5 233 cumulative efforts for an open science<sup>29</sup>.

6  
7  
8 234 *Acceptability*

9  
10 235 According to our second hypothesis, this experiment revealed interesting results  
11  
12 236 concerning the acceptability of such a nudge. First, the nudge was broadly accepted, to a greater  
13  
14 237 extent than previous literature suggested<sup>23,30</sup>. Second, it is relevant to note that participants  
15  
16 238 regarded the nudge as acceptable to target both residents and patients. Third, we found nudge  
17  
18 239 exposure to have a positive impact on residents' acceptability of the nudge. Further, nudge  
19  
20 240 acceptability was improved even for participants included in the control condition, thus  
21  
22 241 supporting the presence of a Hawthorne effect.

23  
24  
25 242 Overall, we observed very little variability in participants' ratings of nudge  
26  
27 243 acceptability, with the vast majority of residents accepting the nudge despite the embedded  
28  
29 244 deception in the experimental design. Indeed, the intervention was originally presented as a  
30  
31 245 simple questionnaire, and participants were subsequently informed of the presence of a nudge  
32  
33 246 intended at modifying their vaccination behavior. This shift in the communication contract  
34  
35 247 could have been perceived as a manipulation attempt<sup>31</sup> but was not interpreted as such by  
36  
37 248 participants. The strong homogeneity in residents' responses suggests a broad consensus  
38  
39 249 supporting vaccination and interventions to promote it. This massive acceptability was not  
40  
41 250 found by Felsen et al.<sup>24</sup> whose participants judged the acceptability of various nudges to be 6  
42  
43 251 on a 9-point Likert scale, whereas our participants judged the nudge's acceptability to be 6.3  
44  
45 252 on a 7-point Likert scale. Hagman et al<sup>23</sup> also found a lower nudge acceptability: 20 to 60% of  
46  
47 253 their participants declared nudges as unacceptable (i.e., scored below the scale's midpoint),  
48  
49 254 whereas this was the case for only two of our 161 participants. This discrepancy can be  
50  
51 255 explained by the sample and the behaviors studied. Indeed, despite vaccine hesitancy among  
52  
53 256 healthcare workers<sup>32</sup>, vaccination is widely acknowledged in the medical community as the  
54  
55 257 most rational and best behavior for the health of people and society<sup>33</sup>. Residents may be more

1  
2  
3 258 inclined to accept a nudge than Felsen and Hagman's samples (general, non-medical  
4  
5 259 population), especially for a nudge about vaccination.

### 260 *Strengths and limitations*

9 261 One limitation concerns the already high rate of vaccination in our sample before the  
11 262 study, which may have contributed to the nudge's ineffectiveness. However, this type of nudge  
13 263 (i.e., reminders) may be relevant for other populations who have not been exposed to ongoing  
15 264 vaccination campaigns<sup>34</sup> such as the one we described. Patel et al. showed that nudging by  
17 265 automatically setting up a vaccination appointment unless individuals explicitly opt out can be  
19 266 more effective than reminders<sup>35</sup>. Therefore, it could be interesting to evaluate effectiveness and  
21 267 acceptability of a stronger nudge (i.e., opt-out) in a comparable sample.

25 268 In addition, the groups were not equal in size because of 20 individuals absent in step  
27 269 one that were not equally distributed among the groups. Attrition between step 1 and 2 also  
29 270 contributed to group imbalance with less individuals excluded in the control group. This size  
31 271 difference may have reduced the statistical power but is probably not a source of bias.

34 272 The originality and strength of this work resides in its interventional, controlled and  
36 273 randomized nature. Indeed, systematic reviews showed that, despite the numerous publications  
38 274 on nudges, only a few authors used the consort reporting guidelines and the public  
40 275 preregistration systems as we did<sup>29,36,37</sup>. Moreover, experimental studies conducted on the  
42 276 effectiveness and acceptability of a nudge are scarce. To our knowledge, this is the first attempt  
44 277 at studying the impact of exposure to a nudge on its acceptability, showing that prior exposure  
46 278 to a nudge plays a role in its acceptability of a nudge beyond conscious and rational choices.

50 279

### 53 280 **Conclusion**

55 281 These data highlight the importance of choosing the right nudge for the right population.  
57 282 Despite nudges' growing popularity, they are not necessarily effective, which stress the  
59 283 importance for policymakers to match an intervention to the population's needs. The social

1  
2  
3 284 acceptability of a nudge can be increased by prior exposure to the same nudge. Nudge-based  
4  
5 285 health promotion campaigns can be widely accepted but policymakers should use pilot studies  
6  
7  
8 286 to test the adequacy of planned nudges prior to large scale implementation.  
9

10 287 This experimental approach is innovative in this context and deserves to be further  
11  
12 288 considered because the potential benefits are a major political issue in terms of public health.  
13

14 289

15  
16  
17 290 *Data availability.* The data underlying this article will be shared upon request to the  
18  
19 291 corresponding author.

20  
21 292 *Ethical approval.* As an interventional study in the human and social sciences applied to the  
22  
23 293 field of health, the study was classified out of scope of the Jardé law by the CPP Ile De France  
24  
25 294 IV (ID-RCB: 2018-A02939-46, Ref. du CPP: 2018/101). A favorable opinion was issued by  
26  
27 295 the Ethics Committee of the French National College of Generalist Teachers (n°-17011961B).  
28  
29

30 296 *Funding.* This study has no funding.

31  
32  
33 297 *Conflicts of interest.* The authors declare that they have no conflict of interest in relation to this  
34  
35 298 work.

36  
37 299 *Acknowledgements.* We would like to thank the residents who  
38  
39 300 participated, Pr David Darmon, Pr Dirk Steiner and Mrs Jennifer  
40  
41 301 Bastart for their precious advices and Abby Cuttriss (Office of  
42  
43 302 International Scientific Visibility, Côte d'Azur University) for  
44  
45 303 proofreading.  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**BIBLIOGRAPHY**

1. GEIG - La Grippe - Impact économique. Accessed December 27, 2018. <http://www.grippe-geig.com/impact-economique.html>
2. Ecogrippe 2006 : combien coûte la grippe ? Jean Marie Cohen, Anne Mosnier, Isabelle Daviaud, Isidore Grog. Open Rome, Paris. Accessed December 27, 2018. [http://www.grog.org/documents/jour\\_2007/Ecogrippe.pdf](http://www.grog.org/documents/jour_2007/Ecogrippe.pdf)
3. Cohen JM, Mosnier A, Grog I. La surveillance de la grippe en France. *Med Sci (Paris)*. 2003;19(2):239-242. doi:10.1051/medsci/2003192239
4. Thompson WW, Shay DK, Weintraub E, et al. Mortality Associated With Influenza and Respiratory Syncytial Virus in the United States. *JAMA*. 2003;289(2):179-186. doi:10.1001/jama.289.2.179
5. Salgado CD, Farr BM, Hall KK, Hayden FG. Influenza in the acute hospital setting. *The Lancet Infectious Diseases*. 2002;2(3):145-155. doi:10.1016/S1473-3099(02)00221-9
6. Carman WF, Elder AG, Wallace LA, et al. Effects of influenza vaccination of health-care workers on mortality of elderly people in long-term care: a randomised controlled trial. *The Lancet*. 2000;355(9198):93-97. doi:10.1016/S0140-6736(99)05190-9
7. Hayward AC, Harling R, Wetten S, et al. Effectiveness of an influenza vaccine programme for care home staff to prevent death, morbidity, and health service use among residents: cluster randomised controlled trial. *BMJ*. 2006;333(7581):1241. doi:10.1136/bmj.39010.581354.55
8. Vaux S, Noël D, Fonteneau L, Guthmann J-P, Lévy-Bruhl D. Influenza vaccination coverage of healthcare workers and residents and their determinants in nursing homes for elderly people in France: a cross-sectional survey. *BMC Public Health*. 2010;10(1):159. doi:10.1186/1471-2458-10-159
9. Blank PR, Schwenkglens M, Szucs TD. Vaccination coverage rates in eleven European countries during two consecutive influenza seasons. *Journal of Infection*. 2009;58(6):446-458. doi:10.1016/j.jinf.2009.04.001
10. Looijmans-van den Akker I, Hulscher ME, Verheij TJ, Riphagen-Dalhuisen J, van Delden JJ, Hak E. How to develop a program to increase influenza vaccine uptake among workers in health care settings? *Implement Sci*. 2011;6:47. doi:10.1186/1748-5908-6-47
11. Lluçà A, García-Basteiro AL, Olivé V, et al. New interventions to increase influenza vaccination rates in health care workers. *American Journal of Infection Control*. 2010;38(6):476-481. doi:10.1016/j.ajic.2010.01.013
12. Thaler RH, Sunstein CR. *Nudge: Improving Decisions about Health, Wealth, and Happiness*. Yale University Press; 2008.
13. Milkman KL, Beshears J, Choi JJ, Laibson D, Madrian BC. Using implementation intentions prompts to enhance influenza vaccination rates. *PNAS*. 2011;108(26):10415-10420. doi:10.1073/pnas.1103170108
14. Korn L, Betsch C, Böhm R, Meier NW. Social nudging: The effect of social feedback interventions on vaccine uptake. *Health Psychol*. 2018;37(11):1045-1054. doi:10.1037/hea0000668
15. Corace KM, Srigley JA, Hargadon DP, et al. Using behavior change frameworks to improve healthcare worker influenza vaccination rates: A systematic review. *Vaccine*. 2016;34(28):3235-3242. doi:10.1016/j.vaccine.2016.04.071
16. Lehmann BA, Chapman GB, Franssen FM, Kok G, Ruitter RA. Changing the default to promote influenza vaccination among health care workers. *Vaccine*. 2016;34(11):1389-1392. doi:10.1016/j.vaccine.2016.01.046
17. Chapman GB, Li M, Colby H, Yoon H. Opting In vs Opting Out of Influenza Vaccination. *JAMA*. 2010;304(1):43. doi:10.1001/jama.2010.892
18. Jacobson Vann JC, Jacobson RM, Coyne-Beasley T, Asafu-Adjei JK, Szilagyi PG. Patient reminder and recall interventions to improve immunization rates. *Cochrane Effective*



- 1  
2  
3 356 Practice and Organisation of Care Group, ed. *Cochrane Database of Systematic Reviews*.  
4 357 Published online January 18, 2018. doi:10.1002/14651858.CD003941.pub3  
5 358 19. Ellingson MK, Dudley MZ, Limaye RJ, Salmon DA, O’Leary ST, Omer SB.  
6 359 Enhancing uptake of influenza maternal vaccine. *Expert Review of Vaccines*. Published online  
7 360 December 27, 2018:1-14. doi:10.1080/14760584.2019.1562907  
8 361 20. Bruns H, Kantorowicz-Reznichenko E, Klement K, Luistro Jonsson M, Rahali B. *Can*  
9 362 *Nudges Be Transparent and Yet Effective?* Social Science Research Network; 2018. Accessed  
10 363 December 12, 2019. <https://papers.ssrn.com/abstract=2816227>  
11 364 21. Hansen PG, Jespersen AM. Nudge and the Manipulation of Choice. *European Journal*  
12 365 *of Risk Regulation*. 2013;4(01):3-28. doi:10.1017/S1867299X00002762  
13 366 22. Bonell C, McKee M, Fletcher A, Haines A, Wilkinson P. Nudge smudge: UK  
14 367 Government misrepresents “nudge.” *The Lancet*. 2011;377(9784):2158-2159.  
15 368 doi:10.1016/S0140-6736(11)60063-9  
16 369 23. Hagman W, Andersson D, Västfjäll D, Tinghög G. Public Views on Policies Involving  
17 370 Nudges. *Review of Philosophy and Psychology*. 2015;6(3):439-453. doi:10.1007/s13164-015-  
18 371 0263-2  
19 372 24. Felsen G, Castelo N, Reiner PB. Decisional enhancement and autonomy: public  
20 373 attitudes towards overt and covert nudges. *Judgment and Decision Making*. 2013;8(3):12.  
21 374 25. Mir O, Adam J, Gaillard R, et al. Vaccination coverage among medical residents in  
22 375 Paris, France. *Clinical Microbiology and Infection*. 2012;18(5):E137-E139.  
23 376 doi:10.1111/j.1469-0691.2012.03788.x  
24 377 26. Systematic review of the Hawthorne effect: New concepts are needed to study  
25 378 research participation effects - ScienceDirect. Accessed April 22, 2019.  
26 379 <https://www.sciencedirect.com/science/article/pii/S0895435613003545>  
27 380 27. Brauer M, McClelland G. L’utilisation des contrastes dans l’analyse des données :  
28 381 Comment tester les hypothèses spécifiques dans la recherche en psychologie ? *L’Année*  
29 382 *psychologique*. 2005;105(2):273-305. doi:10.3406/psy.2005.29696  
30 383 28. *JASP Team (2019). JASP (Version 0.11.1)[Computer Software]*. Accessed July 27,  
31 384 2019. <https://jasp-stats.org/>  
32 385 29. Nagtegaal R, Tummers L, Noordegraaf M, Bekkers V. Nudging healthcare  
33 386 professionals towards evidence-based medicine: A systematic scoping review. *Journal of*  
34 387 *Behavioral Public Administration*. 2019;2(2). doi:10.30636/jbpa.22.71  
35 388 30. Reisch LA, Sunstein CR. Do Europeans Like Nudges? *SSRN Electronic Journal*.  
36 389 Published online 2016. doi:10.2139/ssrn.2739118  
37 390 31. Beauvois J-L. *Les Influences Sournoises: Précis Des Manipulations Ordinaires*.  
38 391 François Bourin; 2011.  
39 392 32. Verger P, Fressard L, Collange F, et al. Vaccine Hesitancy Among General  
40 393 Practitioners and Its Determinants During Controversies: A National Cross-sectional Survey  
41 394 in France. *EBioMedicine*. 2015;2(8):891-897. doi:10.1016/j.ebiom.2015.06.018  
42 395 33. Ehreth J. The global value of vaccination. *Vaccine*. 2003;21(7-8):596-600.  
43 396 doi:10.1016/s0264-410x(02)00623-0  
44 397 34. Pantoja T, Grimshaw JM, Colomer N, Castañon C, Leniz Martelli J. Manually-  
45 398 generated reminders delivered on paper: effects on professional practice and patient  
46 399 outcomes. *Cochrane Database of Systematic Reviews* 2019, Issue 12. Art. No.: CD001174.  
47 400 DOI: 10.1002/14651858.CD001174.pub4.  
48 401 35. Patel MS. Nudges for influenza vaccination. *Nat Hum Behav*. 2018;2(10):720-721.  
49 402 doi:10.1038/s41562-018-0445-x  
50 403 36. Szaszi B, Palinkas A, Palfi B, Szollosi A, Aczel B. A Systematic Scoping Review of  
51 404 the Choice Architecture Movement: Toward Understanding When and Why Nudges Work.  
52 405 *Journal of Behavioral Decision Making*. 2018;31(3):355-366. doi:10.1002/bdm.2035  
53 406 37. Lamprell K, Tran Y, Arnolda G, Braithwaite J. Nudging clinicians: A systematic  
54 407 scoping review of the literature. *J Eval Clin Pract*. Published online April 27, 2020.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

408    doi:10.1111/jep.13401  
409  
410

For Peer Review

411 **Tables**

412

413 Table 1

414 *Number of vaccinated (or not) participants per group and percentages for GP resident at the*  
 415 *university from a city in the south of France in 2018 (N = 161)*

	Nudge Group	No-Nudge Group	Control Group	Total
	(n = 59)	(n = 36)	(n = 66)	
<b>Vaccinated at stage 1 (%)</b>	36 (61%)	20 (56%)	----	56/95 (59%)
<b>Vaccinated at stage 2 (%)</b>	44 (75%)	27 (75%)	46 (70%)	117/161 (73%)
Not vaccinated at stage 2	15 (25%)	9 (25%)	20 (30%)	44/161 (27%)

416

417

For Peer Review

418 Table 2

419 *Mean acceptability of the nudge when applied to residents or patients per group according to*  
 420 *vaccination status for GP resident at the university from a city in the south of France in 2018*  
 421 *(N = 161)*

Acceptability	Nudge Group		No-Nudge Group		Control Group	
	Vaccinated	Not	Vaccinated	Not	Vaccinated	Not
for residents	6.64 (0.41)	6.30 (0.85)	6.38 (0.89)	6.36 (1.03)	6.11 (0.96)	6.23 (0.72)
for patients	6.53 (0.50)	6.33 (0.83)	6.41 (0.70)	6.36 (1.02)	6.13 (0.80)	6.07 (0.74)

422 *Legend. Values in brackets correspond to the SD*

423

For Peer Review

424 Table 3

425 *Average acceptability of the nudge when applied to residents or patients per group and per step*426 *for GP resident at the university from a city in the south of France in 2018 (N = 161)*

	Nudge group	No-nudge group	Control group (not nudged and included in step2)	Included in step1 (nudge + no-nudge)	Nudge-free (no-nudge + control)
<b>Acceptability</b>					
for residents	6.55 (0.57) *	6.37 (0.91)	6.15 (0.89) †	6.48 (0.72) †	6.23 (0.90) *
for patients	6.47 (0.61)	6.40 (0.77)	6.11 (0.77) ††	6.44 (0.67) ††	6.21 (0.78)

427 *Note. Values in brackets correspond to the SD.* Results marked with a \* were significant ( $p <$   
 428  $.05$ ) and correspond to H2a **residents**, results marked with a † and with †† were significant ( $p <$   
 429  $.05$  and  $p < .01$ ) and correspond to H2b **residents** and **patients**, respectively.

1  
2  
3 430 **Figure captions**

4 431

5 432 *Figure 1. Flow chart*

7 433 *Figure 2. Mean acceptability of a nudge as applied to patients or to residents, among 161*

9 434 *residents from a city in the south of France in 2018 (error bars displays SE)*

10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For Peer Review

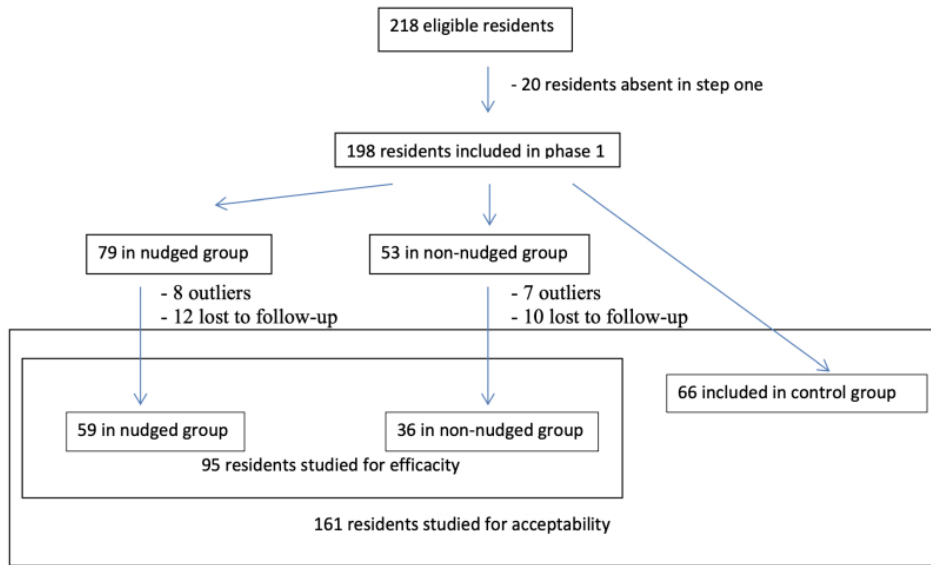


Figure 1. Flow chart

71x46mm (300 x 300 DPI)

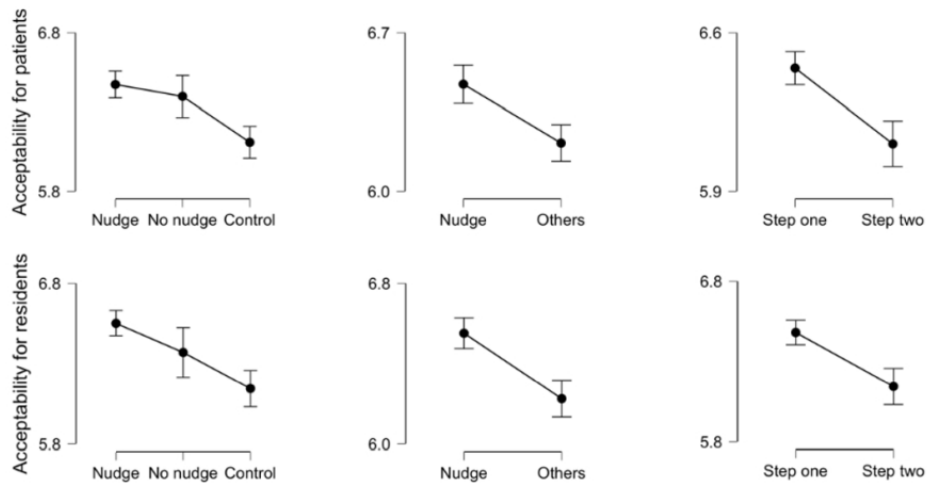


Figure 2. Mean acceptability of a nudge as applied to patients or to residents, among 161 residents from a city in the south of France in 2018 (error bars displays SE)

79x43mm (300 x 300 DPI)



## 1 Table 4 : supplementary material

2 *Results of multinomial linear regression estimating the association between acceptability of the*  
 3 *nudge as applied to patients and residents characteristics, among 161 residents from a city in*  
 4 *the south of France in 2018.*

Predictors	<i>r</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Age	0.1158	0.0411	2.817	0.006
Sex (Male = 1)	-0.3405	0.1169	-2.914	0.004
Have been vaccinated	0.0787	0.1231	0.639	0.524
Agreed with recommendations	0.2118	0.0598	3.539	< .001
Contrast Control Vs Rest	-0.1150	0.0411	-2.799	0.006
Contrast no-nudge Vs Nudge	-0.0199	0.0768	-0.259	0.796

5

6

## 7 Table 5 : supplementary material

8 *Results of multinomial linear regression estimating the association between acceptability of the*  
 9 *nudge as applied to other residents and residents characteristics, among 161 residents from a*  
 10 *city in the south of France in 2018.*

Predictors	<i>r</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Age	0.0549	0.0401	1.366	0.174
Sex (Male = 1)	-0.0660	0.1331	-0.496	0.621
Have been vaccinated	0.0643	0.1421	0.452	0.652
Agreed with recommendations	0.1566	0.0676	2.317	0.022
Contrast control Vs rest	-0.0937	0.0464	-2.019	0.045
Contrast no-nudge Vs nudge	-0.0945	0.0877	-1.078	0.283

11  
12  
13  
14

1  
2  
3 15 **Figure captions :**

4 16

5 17 *Figure 1. Flow chart*

6  
7  
8 18 *Figure 2. Acceptability of a nudge as applied to patients or to residents, among 161 residents*

9  
10 19 *from a city in the south of France in 2018 (error bars displays SE).*  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For Peer Review

1  
2  
3 CONSORT GUIDELINES :  
4

## 5 1a. Title

6 Identification as a randomised trial in the title.

7  
8 *OK*

## 9 1b. Abstract

10 Structured summary of trial design, methods, results, and conclusions

11  
12 *OK*

## 13 INTRODUCTION :

14 2a : Reffer to previous systematic review

15  
16 *OK*

17 2b: Provide adequate information about trial objectives and hypotheses

18  
19 *OK*

## 20 METHOD :

21 3a: Description of trial design (such as parallel, factorial) including allocation ratio :

22 *OK (multi-arm parallel trial, An equal randomization (1:1:1 for three groups) was used.)*23 3b : Important changes to methods after trial commencement (such as eligibility criteria), with  
24 reasons25 *we do not have any changes to method to declare.*26 4a : A comprehensive description of the eligibility criteria used to select the trial participants  
27 is needed to help readers interpret the study28  
29 *OK*30 4b : information on the settings and locations is crucial to judge the applicability and  
31 generalisability of a trial. Were participants recruited from primary, secondary, or tertiary  
32 health care or from the community.33  
34 *OK*35 5: The interventions for each group with sufficient details to allow replication, including how  
36 and when they were actually administered.37  
38 *OK*

## 39 6a. Outcomes

40 Completely defined pre-specified primary and secondary outcome measures, including how  
41 and when they were assessed.42  
43 *OK*

## 44 6b. Changes to outcomes

45 Any changes to trial outcomes after the trial commenced, with reasons.

46 *Authors do not have any changes to outcomes to declare.*

## 47 7a. Sample size

48 How sample size was determined.

49  
50 *OK*

## 51 7b. Interim analyses and stopping guidelines

52 When applicable, explanation of any interim analyses and stopping guidelines.

53 *Authors do not have any interim analyses and stopping guidelines to declare.*

## 54 8b. Randomisation: type

55 Type of randomisation; details of any restriction (such as blocking and block size).

56  
57 *OK, simple randomization was used.*

## 58 9. Randomisation: allocation concealment mechanism

59 Mechanism used to implement the random allocation sequence (such as sequentially  
60 numbered containers), describing any steps taken to conceal the sequence until interventions  
were assigned.

1  
2  
3 *The steps are well described. The allocation concealment was unnecessary since participants*  
4 *were not aware of the three-arm design of the study, the intervention was initially presented*  
5 *as "a questionnaire as part of a thesis in general practice".*

6  
7 10. Randomisation: implementation

8 Who generated the allocation sequence, who enrolled participants, and who assigned  
9 participants to interventions.

10 *Not applicable to this trial.*

11 11a. Blinding

12 If done, who was blinded after assignment to interventions (for example, participants, care  
13 providers, those assessing outcomes) and how.

14 *Not applicable to this trial.*

15 11b. Similarity of interventions

16 If relevant, description of the similarity of interventions.

17 *The residents in the no nudge group received the same questionnaire, without the form or*  
18 *practical information. The control group was not solicited at that time and was included*  
19 *directly in step 2. Step 2 consisted of the three groups receiving an explanation of the nudge*  
20 *procedure and the completion of a questionnaire collecting the vaccination status and the*  
21 *nudge's social acceptability.*

22 12a. Statistical methods

23 Statistical methods used to compare groups for primary and secondary outcomes.

24 *OK*

25 12b. Additional analyses

26 Methods for additional analyses, such as subgroup analyses and adjusted analyses

27 *OK*

28 13a. Participant Flow

29 For each group, the numbers of participants who were randomly assigned, received intended  
30 treatment, and were analysed for the primary outcome

31 *OK*

32 13b. Losses and exclusions

33 For each group, losses and exclusions after randomisation, together with reasons

34 *OK*

35 14a. Recruitment

36 Dates defining the periods of recruitment and follow-up

37 *OK*

38 14b. Reason for stopped trial

39 Why the trial ended or was stopped

40 *The trial was not truncated.*

41 15. Baseline Data

42 A table showing baseline demographic and clinical characteristics for each group

43 *Demographic and clinical characteristics were described in the text. Authors decided to*  
44 *provided these informations in full text rather than in a table.*

45 16. Numbers analysed

46 For each group, number of participants (denominator) included in each analysis and whether  
47 the analysis was by original assigned groups

48 *OK*

49 17a. Outcomes and estimation

50 For each primary and secondary outcome, results for each group, and the estimated effect size  
51 and its precision (such as 95% confidence interval)

52 *OK*

53 17b. Binary outcomes

1  
2  
3 For binary outcomes, presentation of both absolute and relative effect sizes is recommended

4 *Not applicable for this trial*

5 18. Ancillary analyses

6 Results of any other analyses performed, including subgroup analyses and adjusted analyses,  
7 distinguishing pre-specified from exploratory

8 *OK*

9 19. Harms

10 All important harms or unintended effects in each group

11 *Not applicable for this trial*

12 20. Limitations

13 Trial limitations, addressing sources of potential bias, imprecision, and, if relevant,  
14 multiplicity of analyses

15 *OK*

16 21. Generalisability

17 Generalisability (external validity, applicability) of the trial findings

18 *OK*

19 22. Interpretation

20 Interpretation consistent with results, balancing benefits and harms, and considering other  
21 relevant evidence

22 *OK*

23 23. Registration

24 Registration number and name of trial registry

25 *OK*

26 24. Protocol

27 Where the full trial protocol can be accessed, if available

28 *OK*

29 25. Funding

30 Sources of funding and other support (such as supply of drugs), role of funders

31 *OK*