Frames of the vaccination hesitant and impact on the propensity to vaccinate girls against the Human Papilloma Virus (HPV): A survey experiment study

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Vaccination hesitancy, i.e. the refusal or delay in being vaccinated, is a complex phenomenon influenced by numerous factors including the communicative messages to which individuals are exposed. Little is known about the impact that framing vaccination hesitancy as a problem and the vaccination hesitant as the responsible for such problem has on the propensity to vaccinate.
In the study we report the results of a survey experiment in which respondents were randomly exposed to three different frames of the vaccination hesitant (as misinformed, anti-scientific and socially dangerous) and the impact of these frames on the intention to vaccinate girls against the human papilloma virus (HPV). The frames were derived from the press statements of the Italian Minister of Health between 2015 and 2017, and contained, besides different characterizations of the vaccination hesitant, the correspondent policy solutions to counteract such vaccination hesitancy.
Findings show how framing the vaccination hesitant as anti-scientific or socially dangerous that, in turn, supports policies mandating vaccination and sanctioning the vaccination hesitant, tends to discourage vaccination. These findings alert us to the importance of designing with great care the communication about vaccinations and vaccination hesitancy and avoid counterproductive effects.

Keywords: framing, vaccination hesitancy, communication, public health.

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S O M M A R I O

1. Introduction

Acceptance of vaccination is a behaviour resulting from a complex decision-making process influenced by a wide range of factors (Smith, 2017). While, in the past, immunization was deemed a fundamental prevention measure by most (Streefland, 2001), in the last two decades public distrust in vaccinations has spurred heated debates about the safety of vaccines (Streefland, 2001; Lane *et al.*,

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2018) and the legitimacy of compulsory immunization programs (Larson *et al.*, 2016). This has been accompanied by a drop in vaccination coverage in several countries and the resurgence of some preventable infectious diseases such as measles and mumps (Omer *et al.*, 2009).

Recently, much attention has been dedicated to the analysis and understanding of the issue of vaccination (or vaccine) hesitancy (Larson *et al.*, 2014; MacDonald *et al.*, 2015). In particular, the Covid-19 pandemic and the development of vaccines against the disease have put the topic back at the forefront of the international debate (Dror *et al.*, 2020). Vaccination hesitancy "refers to delay in acceptance or refusal of vaccines despite availability of vaccination services" (MacDonald *et al.*, 2015, p. 4161). The phenomenon of vaccination hesitancy has been shown to be influenced by a variety of contextual, social and individual factors (Larson *et al.*, 2014), with lack of or low trust in the medical profession as one of the most relevant determinants with respect to children immunization (Benin *et al.*, 2006; Yaqub *et al.*, 2014). In addition, vaccination hesitancy is known for not being a static state of mind and can change over time based on external (e.g., an epidemics) or personal (e.g., a change in risk attitude) considerations (Larson, 2022).

Attempts to counteract the phenomenon of vaccination hesitancy and stimulate immunization have been various across countries. Some national governments have intervened by making vaccination mandatory, imposing financial fines on non-compliant parents and making school attendance conditional on immunization (Haverkate *et al.*, 2012). Others have adopted softer measures, through either national information campaigns or reminder programs with the aim of persuading parents to vaccinate their children (Jarrett *et al.*, 2015; Jacobson Vann *et al.*, 2018).

Among the interventions to counteract vaccination hesitancy, those based on communication have shown to have some positive impact (Goldstein *et al.*, 2015; Jarrett *et al.*, 2015; Olson, Berry & Kumar, 2020), suggesting that the messages to which individuals are exposed might be particularly influential in shaping their views on vaccines and vaccinations. Some evidence, for instance, has accumulated on the capacity of face-to-face communication with parents to increase vaccination uptake (Kaufman *et al.*, 2018). A recent systematic review shows that the most effective strategies were multi-component, used a variety of media, and were personalised and tailored (Olson *et al.*, 2020). Less strong is, instead, the evidence of the effectiveness of interventions aimed at entire communities, with differences that depend on the vaccination under consideration, the context and the target group (Saeterdal *et al.*, 2014). Despite some positive results, impact of communicative messages on propensity to vaccinate or on vaccination hesitancy shown in the literature has not always been consistent and produced even counterproductive effects (Nyhan & Reifler, 2010; Isler *et al.*, 2020). For instance, a study considering messages to encourage measles-mumps-rubella (MMR) vaccination showed that communicating to parents the potential benefits for society of vaccinating their children (i.e., the "herd immunity" argu-

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

ment) did not have any impact on their propensity to vaccinate (Hendrix *et al.*, 2014). In a randomized trial, Nyhan and colleagues (2014) found out that pro-vaccination messages had no effect on vaccination hesitant parents who appeared even reinforced in their negative perceptions of vaccinations and their risks.

In the communication and health communication literatures, many studies have focused on the role of framing (Chong & Druckman, 2007a, 2007b; Guenther, Gaertner & Zeitz, 2021) in influencing intention to vaccinate (Pența & Băban, 2018). Framing entails selecting "some aspects of perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described" (Entman, 1993, p. 52). In particular, numerous studies have explored framing according to the psychological tradition proposed by prospect theory (Guenther *et al.*, 2021) and assessed the relevance of gain and loss frames on the decision of individuals to vaccinate themselves or their children (e.g., Nan, Xie & Madden, 2012; Hendrix *et al.*, 2014; Kim, Pjesivac & Jin, 2019). Less attention has been given to framing effects according to the sociological and political science traditions in which framing implies choosing certain aspects of a phenomenon to characterize it as a problem, attributing responsibility for that problem and suggesting solutions, for example through public policies, consistent with the proposed interpretation of that problem (Entman, 1993; Guenther *et al.*, 2021). For instance, we know very little about how framing vaccination hesitancy as a problem and the vaccination hesitant as the responsible for such problem may impact the attitudes of individuals towards vaccinations and the support of public policies mandating mass vaccination and sanctioning whoever does not comply to the mandate. Yet, the literature shows that in debates about public health issues such as obesity, alcohol consumption, or HIV (e.g., Kübler, 2001; Kim & Willis, 2007; Barry *et al.*, 2009) frames that attribute responsibility for these "problems" are frequent. More often these frames are communicated by policy makers and politicians that, in this way, attempt to shape public opinion about these issues (Chong & Druckman, 2007a; Druckman, 2001) and, by constructing the social groups responsible for creating or solving such problems (Schneider & Ingram, 1993; Ingram, Schneider & DeLeon, 2007), gain support for specific public policies addressing these issues. Despite still limited, some recent evidence (e.g., Zhang *et al.*, 2019; Hornsey *et al.*, 2020) shows how, also in the vaccination debate, the communication by leading policy makers and politicians may greatly impact the propensity to vaccinate and the attitude of vaccination hesitant parents towards immunization.

In this work, through a survey experiment, we attempt to address this gap in the literature by assessing the impact that different frames of the vaccination hesitant – as "misinformed", "antiscientific" or "socially dangerous" –, have on the propensity to vaccinate. We consider the case of vaccination for the human papilloma virus (HPV) to prevent cervical can-

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

cer in girls, a case that has raised heated debates in most countries (Colgrove *et al.*, 2010). We do this in the context of Italy that in 2017 introduced a mandatory vaccination policy for children with respect to ten different vaccines and sanctions for parents not complying to the mandate. We expose participants in the survey experiment to frames of the vaccination hesitant derived from the analysis of the press statements released by the Italian Minister of Health during the debate preceding the passing of this compulsory vaccination policy. We couple the different frames with the consistent public policy solutions proposed progressively by the Minister over the same period.

Based on the literature on framing effects and vaccine hesitancy, and the observation that the most negative frames used by the Minister of Health to describe vaccination-hesitant parents as antiscientific and socially dangerous were strongly supported by the scientific community but polarized political positions and triggered vocal reactions from a minority of the population, we formulated the following two hypotheses:

H1: Describing as antiscientific those who do not vaccinate their daughters and stating that everything must be done to force parents to vaccinate their daughters against HPV reduce respondents' intention to vaccinate their daughters.

H2: Describing as socially dangerous those who do not vaccinate their daughters and stating that every effort must be made to force parents to vaccinate their daughters against HPV, including sanctioning them if they do not comply, reduce respondents' intention to vaccinate their daughters.

2. Materials and methods

2.1. Empirical setting

In Italy, similarly to other countries, the history of compulsory vaccination has been marked by controversies (Signorelli, 2019). While in the 1970s and 1980s the population accepted without much opposition compulsory vaccination for several relevant diseases such as smallpox, diphtheria, polio, tetanus and hepatitis B, starting from the 1990s signs of intolerance for the obligation to be vaccinated to attend school started to emerge. In 1999, after a long political and judicial controversy, the possibility to vaccinate coercively children was abolished and soon, the policy of school attendance conditional on vaccination was tempered (Signorelli, 2019), maintaining only four compulsory children vaccination (i.e., diphtheria, polio, tetanus and hepatitis B) and a relaxed posture towards controls. This policy change, though, did not affect vaccination coverages that remained high indicating that the population had internalized the principles of mass immunization (Signorelli, 2019).

In 2015, the debate about vaccinations reemerged when data showed that the target of 95 per cent in vaccination coverage was not reached for any of the four compulsory children vaccinations (Bonanni *et al.*, 2015). The then Minister of Health took immediately the issue on board (Signorelli *et al.*, 2017) and, in 2017, with the occurrence of some measles outbreaks, proposed the reintroduction of a strict vaccination mandate for a set of children vaccinations well beyond the four already mandated in the country. The debate culminated with the Minister of Health's proposal

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

of a government decree proposing to increase the number of compulsory vaccinations from four to 12 and a series of sanctions on vaccination hesitant parents. This led to the progressive mobilization of parents and parents' associations who took the streets in different parts of the country asking for freedom of choice on vaccinations. In general, this period was characterized by increasing public distrust in scientific and institutional authorities, which likely exacerbated polarization around vaccination issues. After a long parliamentary debate and tense exchanges with civil society and what was, by then, labelled the "no-vax movement", the Parliament transformed the decree into law but reduced the compulsory vaccinations to ten and among the sanctions maintained the ban of unvaccinated children from schools. With the introduction of new legislation, vaccination coverage increased but remained inconsistent. For example, in 2021 for eight years old children it ranged from 41.3% for chickenpox to approximately 86% for polio, measles, mumps, rubella, diphtheria, tetanus, and pertussis (Ministero della Salute, 2022).

2.2. Analysis of press statements and identification of frames of the vaccination hesitant

The first step of the study implied constructing frames of the vaccination hesitant. We considered the debate described above, that occurred between 2015 and 2017 in Italy, and especially the communication elaborated by the then Ministry of Health about vaccination hesitant parents as potentially exemplary of the communication elaborated around vaccination hesitancy in many countries. As such, in 2019, using the word "vaccini" (vaccines in Italian), we searched the Factiva database and retrieved 120 press statements released, between January 1st 2015 and 31st December 2017, by the Minister of Health to ANSA, the most important press agency in the country. Several times a day ANSA reports verbatim the statements of policy makers, experts or citizens about a variety of issues, statements that are then used by the main media channels to draft news articles and TV programs.

To analyze the statements, we employed the linguistic software Sketchengine and identified combination of words that could be considered "key" (hereafter, key multi-words) to the corpus of retrieved statements with respect to a reference corpus in the Italian language. More details about the software and the calculation of keyness can be found at https://www.sketchengine.eu/. We inductively grouped the retrieved key multi-words based on their linguistic similarity (i.e., synonyms, e.g., "compulsory vaccination" and "obligation to vaccinate") or convergence on a similar conceptual category (e.g., multi-words all related to vaccination hesitancy or to the vaccination hesitant). In particular, we identified in the Minister's statements three frames that paired a characterization of the vaccination hesitant as the responsible for the problem of decreased vaccination coverage in Italy to an appropriate policy measure to counteract the problem. Based on this analysis, we generated the messages to be administered in the survey experiment.

2.3. Survey Experiment: Design

Despite the fact that the Minister of Health had talked indistinctly about

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

many different vaccines, we structured the survey experiment around the HPV vaccination. The reason for this choice was two-fold. First, to be sure that respondents felt free to participate and answer to our survey experiment with candor, the experiment needed to deal with a case for which choice of vaccinating was still possible in 2019 and declaring vaccination hesitancy was not to be considered an unlawful behavior. Given that the 2017 decree declared the HPV vaccine highly recommended but not compulsory, this specific vaccine appeared well suited for the experiment. Second, despite the HPV vaccine being provided free of charge to 12 years old girls since 2008 and to boys since 2015, vaccination hesitancy in 2019 about the HPV vaccine was quite high in Italy and vaccination coverage remained significantly below the 95% goal for both genders (Gabutti *et al.*, 2021). Understanding the impact of the framing of the vaccination hesitant in a case with such high levels of vaccination hesitancy could be especially useful and informative to answer the research questions motivating the study.

The cross-sectional survey experiment was organized in one control and two treatment groups. The control and treatment questionnaires were designed by the authors and tested with 15 women selected from the network of friends, relatives and other acquittances of the authors. The three versions (two treatments and one control) were structured in the same way (see Appendix 1 and 2 for the text of the three questionnaires in Italian and English) with the only difference of core messages. For what concerns the differential core messages, we employed as: a) *control*: the "misinformed" framing of the vaccination hesitant plus the "better information" policy solution; b) *treatment 1*: the "antiscientific" framing of the vaccination hesitant plus the "compulsory vaccination" policy solution; c) *treatment 2*: the "socially dangerous" framing of the vaccination hesitant plus the "compulsory vaccination and sanctions" policy solution.

After the core messages, respondents were asked about their intention to get their underage daughter(s) vaccinated against HPV. Besides those close-ended questions, respondents were asked also to provide qualitative explanations for their answers. Finally, the respondent was asked some demographic information (i.e. age, level of education, job, status of parent of underage daughter), some of which have been shown to be correlated with vaccination hesitancy (Larson *et al.*, 2014). The versions of the questionnaire were randomly allocated to those who accepted to participate in the study by shuffling the three versions of the questionnaire. The interviewer was blind to the version of the administered questionnaire.

2.4. Survey experiment: Respondents

The survey experiment was conducted in December 2019 in a public maternal health facility in the province of Salerno in the Campania region with a target sample size of 150 respondents. To calculate sample size, it was assumed that each treatment group had a probability of vaccine hesitancy 20 percent points higher than the control group. With a power equal to 0.8 and a confidence level at 0.95% this assumption requires 48 subjects per group (rounded to 50).

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

The setting was selected as Campania displayed below average vaccination rates for HPV ranging for girls from 23% in the 2009 cohort to about 50% in the oldest cohorts (1997-1999; Ministero della Salute, 2022).

The sample consisted of women attending the public health facility for ambulatory visits. The access to the facility was granted by the head of the facility, after approval that the text of the questionnaire did not contain ethically sensitive or potentially distressing questions, and that the informed consent respected all the privacy rules active in the country. In addition, all respondents were explained both verbally and in written form that participation in the study was voluntary, that the study had only research purposes and that answers were anonymous. One of the authors approached the women, asked for willingness to participate in the research project and, when positive, for signing the informed consent. Questionnaires and signed informed consents were kept separate. The data were entered into Excel by one of the authors and a research assistant verified the correspondence between the paper-based responses and their electronic version.

2.5. Analysis

The analysis was conducted comparing the three groups for their intention to vaccinate girls, according to a Likert scale from 1 (minimum) to 6 (maximum). The Likert scale was converted into a binomial variable, hereafter pro-vaccination attitude and vaccination hesitant attitude, respectively. The pro-vaccination attitude corresponded to answers "absolutely yes", "yes", "probably yes" on the Likert scale and indicated a high propensity to vaccinate, while the vaccination hesitant corresponded to answers "probably not", "absolutely not", "I don't know" on the Likert scale, and indicated different positions of vaccination hesitancy, from full rejection to doubt, as contemplated in the definition of vaccination hesitancy proposed by MacDonald and colleagues (2015).

The data were analyzed through the packaged software R, and the analysis proceeded as follows: i) randomization check; ii) significance tests and iii) multiple logistic regression. To check for randomization, we ran chi-squared tests for the collected set of demographic variables to detect whether differences among control and treatments groups were significant. Then, significance tests assessed whether the impact of each treatment frame (vs. control frame) on the propensity to vaccinate was statistically significant. Significance tests were conducted using both the 6-point Likert scale (i.e., continuous variable) and its conversion into the binomial variable, i.e. pro-vaccination vs vaccination hesitant. In both cases, we transform the original outcome variable. While the binary transformation reduces the amount of information in the data – by disregarding varying degrees of certainty in the intention to vaccinate (e.g., treating "surely" as equal to "probably") –, assigning numerical values to the Likert scale preserves the different intensities of intention but relies on the strong assumption of equal distance between each point on the scale. Using both transformations provides a robustness check of results. Finally, multiple logistic regression tested whether being subjected to different frames

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

could explain the propensity to vaccinate of respondents, once a set of socio-economic control variables were included. This also allowed us to detect their impact on the outcome variables.

Open answers were, instead, analyzed inductively to extract the main explanations for pro- or vaccination hesitant attitudes and aggregated based on their similarity.

3. Results

3.1. Frames of the vaccination hesitant and possible counteractive measures

From the analysis of the Italian Minister of Health's press statements three main frames of the vaccination hesitant parents emerged: 1) the vaccination hesitant as misinformed, holding irrational beliefs and victim of misinformation campaigns and false myths; 2) the vaccination hesitant as anti-scientific, belonging to a subculture with positions against science and scientific progress, and suffering from scientific illiteracy; 3) the vaccination hesitant as socially dangerous, proactive in spreading fake news, persevering in selfish and improvident behaviours, and contributing to fuel dangerous no-vax movements (Table 1).

The three frames could be arranged in a continuum with an increasing degree of negative moral judgment of the vaccination hesitant. These frames, in fact, appeared in temporal sequence, starting from 2015 to the months preceding the decree proposal, while the controversy about compulsory vaccination ignited and the social mobilization of parents and parents' associations intensified. It is not surprising, therefore, that the three frames were paired with three different policy solutions starting with: 1) information campaigns to counteract the "misinformed", through 2) compulsory vaccination to oblige the "anti-scientific"-minded to vaccinate their children, to 3) compulsory vaccination and sanctioning to restrain the "socially dangerous".

3.2. Impact of frames on propensity to vaccinate and vaccination hesitancy

Out of the 178 women contacted, 150 accepted to participate in the study (acceptance rate = 84.2%). The chi-squared tests, shown in Table 2, indicated how randomization had succeeded in creating similar control and treatment groups with respect to age, level of education, job status, and sta-

Table 1 – Key multi-words in the Italian Minister of Health's press statements (2015-2017)

	Frame 1 "Misinformed"	Frame 2 "Antiscientific"	Frame 3 "Socially dangerous"
Problem: Vaccination hesitancy and vaccination hesitant	• Misinformation campaigns • [holding] Absurd beliefs • Rumours without scientific support • False myths	• Antiscientific behaviours • Antiscientific positions • Scientific illiteracy • Antiscientific subculture • Antiscientific prejudices • Subculture	• [circulating] Fake news • Great egoism • Improvident attitude • Dangerous no-vax movements • Sectarian positions
Solution: Policy intervention	• Information campaigns • Correct information • Communication campaigns	• Compulsory vaccination • Obligation to vaccinate • Cultural battle • National law	• Compulsory vaccination • Sanctions • Judicial authorities • Stringent measures

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

Table 2 – Descriptive characteristics of control and treatment groups and randomization check (n = 50 for each group)

	Control frame "Misinformed"	Treatment frame 1 "Anti-scientific"	Treatment frame 2 "Socially dangerous"	X-squared	*p*-value
Age				3.8089	0.7025
20-30	6	10	6		
31-40	22	16	22		
41-50	10	14	13		
over 50	12	10	9		
Education				1.0094	0.9084
Middle school diploma	7	4	5		
High school diploma	28	30	30		
University degree	15	16	15		
Job				1.6162	0.9514
Employed	33	34	33		
Self-employed professional	6	6	7		
Housewife	5	6	3		
Unemployed	6	4	6		
Underage daughter				2.9408	0.2298
Yes	25	20	26		
No	25	30	24		

tus of parent of an underage daughter. This result gave us assurance of the possibility of comparing the different respondent groups for their expressed propensity to vaccinate with no risk of confounding.

The differences in the pro and vaccination hesitant attitudes between the control and treatments (Table 3) were statistically significant at less than 0.05 per cent. Similar results were obtained using the continuous variable (Table 3a) or the binomial variable (Table 3b). Results showed a steady increase in vaccination hesitancy when comparing the treatment frames (i.e., anti-scientific and socially dangerous) to the control frame (i.e., misinformed). In particular, respondents displayed vaccination hesitancy with an increase of 38 per cent between the treatment frame 1 (i.e., the anti-scientific) and the control frame (i.e., misinformed) and of around 45 per cent between the treatment frame 2 (i.e., socially dangerous) and the control. The difference between the two treatment frames, instead, was not statistically significant, even if with the expected sign.

This finding was confirmed by the multiple logistic regression analysis (Table 4) that evidenced a negative correlation between the treatment frames and propensity to vaccinate. This means that respondents belonging to the two treatment groups were much more inclined to vaccination hesitancy than those belonging to the control group, and that their behavior

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

Table 3 – Significance tests: Control versus treatment groups (n = 50 for each group)

	Vaccination-hesitancy	*t*-test (unequal variances) or X-squared	*p*-value
a) Likert scale (1-6)			
Control vs. treatment 1	3.56 vs 4.65	3.264	0.0015
Control vs. treatment 2	3.34 vs 4.65	3.874	0.0002
Treatment frame 2 vs. treatment frame 1	3.34 vs 3.56	0.581	0.5267
b) Binomial variable			
Control vs. treatment 1	16% vs. 48%	8.000	0.00468
Control vs. treatment 2	16% vs. 54%	10.314	0.00132
Treatment 2 vs. treatment 1	48% vs. 54%	0.174	0.67444

Table 4 – Propensity to vaccinate: Multiple logistic regression (n = 150)

	Estimate	Std Error	*z*-value	*Pr*(>|*z*|)	Odds ratio
(Intercept)	2.9677	0.7405	4.008	6.13e-05***	19.45
Treatment 1 (Antiscientific)	–1.7636	0.5220	–3.379	0.000728***	0.17
Treatment 2 (Socially dangerous)	–1.9482	0.5152	–3.782	0.000156***	0.14
Age: 31-40	–0.1745	0.5797	–0.301	0.763378	0.840
41-50	–0.7819	0.6165	–1.268	0.204656	0.457
over 50	0.6471	0.648	0.999	0.318023	1.909
Education: High school	–1.1802	0.4524	–2.609	0.009090**	0.307
Middle school	–1.9132	0.7146	–2.677	0.007426**	0.148
Job: Unemployed	–0.2502	0.4875	–0.513	0.607828	0.779
Underage daughter	–0.1322	0.4093	–0.323	0.746762	0.877

Significance: $p < 0.0001$***; $p < 0.001$**

could be explained by the fact that they had been exposed to the treatment frames. Moreover, results showed also a negative correlation between the level of education and propensity to vaccinate. In line with the literature (Larson *et al.*, 2014), respondents with lower education exhibited higher vaccination hesitancy than those with a university degree. Overall, we can conclude that framing the vaccination hesitant as anti-scientific or socially dangerous and proposing compulsory vaccination/sanctions as the policy solution to the issue of vaccination hesitancy as portrayed through the two frames can have a counterproductive effect and encourage vaccination hesitancy.

3.3. Motivations for pro- and vaccination hesitant attitudes

As summarized in Table 5, the justifications for pro and vaccination hesi-

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

Table 5 – Explanations provided by pro- and vaccination hesitant respondents

Explanations	Frequency	Examples
Pro-vaccination		
Prevention is fundamental	60.00%	• Vaccines are one of the many prevention tools available to the public. They protect us from serious diseases. • Prevention is important in a civilized society.
The vaccine is safe	12.73%	• HPV is the most frequent sexually transmissible infection. • The most effective way to prevent HPV is the vaccination, which has a very high safe profile.
I do not support anti-vaccination movements	9.09%	• Those parents that decide not to vaccinate their kids represent a danger for other children, and they foster the spread of fake news.
I suffered from cervical cancer	7.27%	• I suffered from cervical cancer, and I don't want my daughters and those of others to get it too.
I trust in and support scientific progress	5.45%	• Because I want my family and my daughters to live better. And I believe that medical research has made great progress.
Non-vaccinating has implications for society and especially for more vulnerable children	3.64%	• Because I want my children to live well, as I wish the same for those children who have little immune defences.
Obliging to vaccinate and sanctioning parents who do not vaccinate is fair	1.82%	• My daughters are already vaccinated, and I think mothers who do not trust science must be educated, or even obliged to vaccinate their daughters. • Prevention is necessary, and those parents who do not understand its importance, should be punished! I protect my daughter and I hope others do the same.
Vaccination hesitant		
Too little information about the vaccine	36.59%	• Institutions should be much more transparent about vaccines and their side-effects (treatment 1). • There is little information about the vaccine, and consequently the decision to punish people is never the right solution (treatment 2).
Self-determination should be respected	19.51%	• I think prevention is a personal choice that institutions should not interfere with (treatment 1). • I don't want to be forced to do something. I must be free to choose, maybe through the advice of the physician and medical professionals (treatment 2).
I do not trust the scientific community nor some institutions suggesting vaccines	14.63%	• I don't trust medical research. Many studies, indeed, confirmed the risks correlated with vaccinations. What should I do? Who should I trust? (treatment 1). • I did not vaccinate my kids, and parents can have valid reasons to decide not to vaccinate theirs. Fake news exists, but what institutions should be trusted? (treatment 2).
The vaccine is not one hundred per cent safe or efficacious	12.20%	• I don't believe in the efficacy of vaccinations (treatment 1). • I don't trust vaccinations! A girl became paraplegic. I don't want to risk disastrous consequences for a disease that my daughter might never get in her life (treatment 2).

tant answers allowed some interesting trends to emerge. For pro-vaccination respondents the most important explanation for the propensity to vaccinate (60 per cent) was that prevention was fundamental for people's

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

health (e.g. "Vaccines are one of the many prevention tools available to the public. They protect us from serious diseases"). To a much lesser extent, pro-vaccination respondents indicated trust in the safety of vaccines and in the scientific progress associated with them (e.g. "I believe that medical research has made great progress"). A part of them also expressed a sense of contraposition to anti-vaccination activists and, more in general, to vaccination hesitant parents to the point of considering fair obliging them to vaccinate their children or sanctioning them if they did not comply (e.g., "Prevention is necessary, and those parents who do not understand its importance, should be punished!").

For vaccination hesitant respondents, instead, explanations were more diverse. Besides a 37 per cent of the respondents claiming not to have enough knowledge about vaccines to decide (e.g., "There is little information about the vaccine"), others indicated that their preference was for not vaccinating, both based on their rational assessment of pros and cons and on the distrust of institutional information sources about vaccines (e.g. "Parents can have valid reasons to decide not to vaccinate theirs. Fake news exists, but what institutions should be trusted?). Finally, a good proportion of respondents appeared to consider not vaccinating as a way to exercise a right to self-determination and to express disagreement with mandatory policies (e.g., "I don't want to be forced to do something. I must be free to choose").

4. Discussion

The study employs a survey experiment conducted in Italy on 150 women and uses the case of the HPV vaccination to uncover how frames of the vaccination hesitant as anti-scientific or socially dangerous, that in turn support coercive and sanctioning policies, tend to discourage vaccination. The frames used in the survey experiment were derived from the analysis of the press statements of the Italian Minister of Health during the heated debate around vaccination hesitancy and compulsory vaccination that occurred in Italy between 2015 and 2017. These messages combine moral judgments with policy initiatives. Although concise, they reflect three distinct perspectives on vaccine hesitancy. Each statement contains at least two components and, thus, two mechanisms that can explain respondent's behaviour. As such our study was not designed to measure the impact of all these mechanisms. Doing so would have required a much larger sample size, which was beyond our available resources. In addition, given the complexity and interaction of the factors shaping respondents' attitudes, evaluating the effect of the composite messaging strategies currently employed by the Minister remains informative and offers relevant policy insights.

Two elements of the frames to which respondents were exposed might have induced this effect. On the one hand, the stereotypical characterization of the vaccination hesitant might have polarized respondents. Stereotypes are known to induce both ideological as well affective polarization on issues and to magnify inter-group conflicts (Allport, 1954). This means that vaccination-hesitant respondents might have reacted to the categorization as anti-scientific or socially dangerous by becoming even more confident in

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

their skepticism about vaccinations. This is partly consistent with results that show how vaccination-hesitant individuals exposed to messages that portray vaccination as a pro-social and altruistic behavior are not more willing to undergo vaccination (Nyhan *et al.*, 2014; Isler *et al.*, 2020). At the same time, pro-vaccination respondents might have been stimulated by the moral categorization of vaccination hesitant parents in the two treatment frames to blame and hold accountable them for their choices (Power, Murphy & Coover, 1996). The qualitative explanations provided by the respondents to their answers support, at least partially, this interpretation of the results.

On the other hand, the proposal of coercive and sanctioning policies contained in the two treatment frames might have distanced part of the respondents. The refusal of coercive policies is known to be influenced by numerous factors, including the perception of infringement of freedom and the degree of trust in government (Ejelöv & Nilsson, 2020). As evident in the qualitative explanations provided by the respondents, the language of the frames might have elicited a strong perception of freedom infringement and unfairness. Indeed, the literature documents the state of anger that vaccination-hesitant individuals experience once exposed to ideas of compulsory vaccination even for only some vaccinations (Betsch & Böhm, 2016). Alternatively, a good percentage of respondents distrusting institutions and government in the first place might have been prompted to express their disagreement with compulsory vaccination policies and sanctions. This explanation is consistent with social identity theory and ingroup/outgroup bias (Henkel *et al.*, 2023). Framing vaccine-hesitant individuals as morally deviant may have activated social identity mechanisms, with respondents identifying with or against such groups.

The study is not spared from limitations. First, the outcome is hypothetical in the sense that we observed intentions rather than actual decisions and we did not ask respondents their actual behavior regarding other recommended vaccines. As stated, intentions to vaccinate may differ from actions, this warrants caution in extrapolating results. Nevertheless, overcoming this limitation would be difficult given the unfeasibility of following up respondents to observe their actual behaviors and the potential confounding effect of exposure to additional messages after the treatments. Second, the frames used in the survey experiment were inspired by the analysis of the Italian Minister of Health's statements, but they did not reproduce the statements verbatim. This choice, in our view, does not detract from the validity of the study experiment whose aim was not to evaluate the effectiveness of the communication of *one* policymaker nor to assess how the Minister's communication impacted the propensity to vaccinate at the time they were pronounced. Instead, we aimed at understanding the effect of certain political communication strategies on the propensity to vaccinate. Numerous studies show how the communication strategy utilized by the Italian Ministry of Health is rather common in the political world for a variety of issues, such as immigration, obesity, drug addiction (e.g., Kübler, 2001; Kim & Willis,

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

2007; Barry *et al.*, 2009; Merolla *et al.*, 2013) for which coercive policies are on the table for discussion. Third, our respondents were recruited from a single center and over a brief period of time, which notably restricts the generalizability of our findings. Fourth, like with most experimental design, we could isolate the effect on vaccination hesitancy of only one frame at a time. The literature examining how the debate around vaccinations unfolds on social media (e.g,, Schmidt *et al.*, 2018; Gargiulo *et al.*, 2020) has documented the variety of frame present at the same time in the debate and their complex relationships. For instance, Schmidt and colleagues (2018) showed how the layering of contrasting frame in social media was able to generate further polarization in anti-vaccination individuals. Further research needs, therefore, to be conducted to study the complex reality of debates around vaccinations. Additional limitations of the study include the risk of bias due to the setting in which the questionnaire was administered –being in a maternal health department may have induced a social desirability bias – and the fact that the survey was handled by only one person, who may have inadvertently influenced the respondents.

These and previously mentioned limitations highlight the value of future research with larger, more representative samples of parents with daughters in vaccination age. Further studies should also more precisely measure which components of the interventions impact the willingness to vaccinate. More sophisticated research designs, leveraging recent developments in digital survey methods, could test the interaction of the three frames, their dependence on psychological, social, cultural, and economic factors, the dynamics of vaccine hesitancy, and – by adopting a more normative approach – the effectiveness of targeted health communication. An additional area worth studying concerns the dynamics of social media in shaping and polarizing attitudes.

In conclusion, the study shows that acceptance of vaccination might be particularly sensitive to the framing to which parents are exposed when thinking about vaccinating their children. It contributes to understand better the effect of communication conveyed by policy makers and how parents react to negative or morally charged connotations of vaccination hesitant behaviours. The study alerts policy makers, especially those with authority over public health issues, to consider carefully what communication strategies they employ when addressing the population about vaccinations, even amidst a fierce controversy. Our work suggests that while some communication strategies centered on categorizing the vaccination hesitant might be conducive to gain support for compulsory vaccination policies, at the same time, they might generate counterproductive effects and distance part of the population. In particular, the study hints to the fact that this kind of framing might make salient deeper beliefs about the legitimacy of a moral judgment of deviant behaviors and of compulsory measures and elicit absolute values such as freedom and right to self-determination. The study also suggests recognizing the heterogeneity of beliefs and socio-psychological traits among population groups and, consequently, differentiating communication strategies

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

according to audience diversity. While some groups may respond positively to coercive messages, others – particularly those with low institutional trust – may become more resistant. Tailored messaging based on audience segmentation could offer a more effective approach.

5. Conclusions

In a survey experiment, we found that the frames used by the Ministry of Health to talk about vaccine-hesitant parents led to a decrease in the intention to vaccinate daughters against HPV. These counterintuitive results highlight the need for a deeper understanding of anti-vaccine behavior and more applied research on how to communicate complex health issues to populations with heterogeneous views on health and political institutions, whose behavior is shaped by multiple factors at both individual and social levels.

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7. Competing interests

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Appendix 1. Text of questionnaire (in Italian)

a) *Introductory part common to all messages:*
Di seguito le verranno proposte delle domande sul tema della vaccinazione contro il virus del papilloma (HPV), un virus che si trasmette per via sessuale e che può avere come conseguenza tumori e lesioni nell'area genitale come il tumore al collo dell'utero nelle donne.

b) *Common premise:*
In Italia, si registrano ogni anno 2.400 casi di tumori al collo dell'utero nella donna e l'infezione da virus HPV risulta essere la prima causa di tale tumore. Ogni anno le morti per questo tumore sono numerose e sono destinate a crescere.
Le vaccinazioni contro l'HPV sono disponibili in forma totalmente gratuita per le bambine di età compresa tra i 12 e i 18 anni. Inoltre, il vaccino è molto sicuro, e può provocare solo lievi disturbi nella zona di iniezione. Le statistiche dicono che, grazie ai vaccini e al pap-test, sarebbe possibile eliminare completamente i tumori nella donna dovuti al virus HPV.

c) *Differential core messages (frames of the vaccination hesitant and policy solution):*

Control: Chi non fa vaccinare la propria figlia/figlie è semplicemente disinformato. È necessario fare di tutto per informare meglio i genitori.

Or

Treatment 1: Chi non fa vaccinare la propria figlia/figlie ha dei pregiudizi antiscientifici. Essere antiscientifico vuol dire ignorare l'evidenza, ma soprattutto dubitare della scienza. Non far vaccinare la propria figlia/figlie significa essere contrari alla scienza e al suo progresso, e ciò porta a prendere decisioni sbagliate per le proprie figlie che aumentano le probabilità di farle ammalare. È necessario fare di tutto per obbligare i genitori a vaccinare le proprie figlie contro il virus HPV.

Or

Treatment 2: Non far vaccinare la propria figlia/figlie è di cattivo esempio per altri genitori, alimenta campagne contro i vaccini prive di buon senso e la diffusione di falsità. Ciò porta a prendere decisioni sbagliate che aumentano le probabilità di far ammalare di tumore. È necessario fare di tutto per obbligare i genitori a vaccinare le proprie figlie contro il virus HPV fino ad arrivare a punirli nel caso non lo facessero.

d) *Common question on propensity to vaccinate:*
Lei fa o farebbe vaccinare sua figlia o le sue figlie?

☐ Assolutamente sì
☐ Forse sì
☐ Sì
☐ Probabilmente no
☐ Sicuramente no
☐ Non lo so

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

e) *Common open part:*
Ci spieghi brevemente il perché della sua risposta.

f) *Common section on respondent demographics (parent of an underage daughter, age, job status, education level):*

Ha una figlia o delle figlie minorenni (meno di 18 anni)?
☐ Sì
☐ No

Qual è la sua età?
☐ 20-30
☐ 31-40
☐ 41-50
☐ oltre i 50

Qual è il suo impiego?
☐ Lavoratore dipendente (operaio, insegnante ecc.)
☐ Libero professionista
☐ Casalinga
☐ Disoccupato/a
☐ Altro

Qual è il suo grado di istruzione?
☐ Scuola elementare
☐ Scuola media
☐ Scuola secondaria (Liceo/scuola tecnico-professionale ecc.)
☐ Laurea universitaria

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

Appendix 2. Text of the questionnaire with control and treatments (translated in English)

a) *Introductory part common to all messages:*
Below you will be asked questions on the topic of vaccination against the human papilloma virus (HPV), a virus that is sexually transmitted and which can result in tumours and lesions in the genital area, such as cervical cancer in women.

b) *Common premise:*
In Italy, there are 2,400 cases of cervical cancer in women every year and HPV infection appears to be the primary cause of these tumours. Every year the deaths from this cancer are numerous and are bound to grow. HPV vaccinations are available totally free of charge for girls between the ages of 12 and 18. Furthermore, the vaccine is very safe, and can cause only minor problems in the injection area. Statistics show that, thanks to this vaccination and pap smears, it would be possible to eliminate in women tumours due to the HPV virus.

c) *Differential core messages (frames of the vaccination hesitant and policy solution):*

CONTROL: Anyone who does not have their daughter(s) vaccinated is simply misinformed. Everything must be done to better inform parents.

Or

TREATMENT 1: Those who do not vaccinate their daughter(s) have anti-scientific prejudices. Being anti-scientific means ignoring the evidence, but, above all, doubting science. Not having your daughter(s) vaccinated means being against science and its progress, and this leads to making bad decisions for your daughters, which increase the chances of them being sick. Everything must be done to force parents to vaccinate their daughters against the HPV virus.

Or

TREATMENT 2: Not having one's daughter(s) vaccinated is a bad example for other parents; it fuels campaigns against vaccines without common sense and the spread of fake news. This leads to bad decisions, which increase the chances of getting cancer. Every effort must be made to force parents to vaccinate their daughters against the HPV virus and, if they do not, they should be sanctioned.

d) *Common question on propensity to vaccinate:*
Do you (or would you) have your daughter(s) vaccinated against HPV?

☐ Absolutely yes
☐ Maybe yes
☐ Yes
☐ Probably no
☐ For sure no
☐ I don't know

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522

e) Common open part:
Please explain briefly the motivations for your answer.

f) Common section on respondent demographics (parent of an underage daughter, age, job status, education level):

Do you have a daughter or daughters under the age of 18?
☐ Yes
☐ No

What is your age?
☐ 20–30
☐ 31–40
☐ 41–50
☐ Over 50

What is your employment status?
☐ Employee (e.g. factory worker, teacher, etc.)
☐ Self-employed/Freelancer
☐ Homemaker
☐ Unemployed
☐ Other

What is your level of education?
☐ Primary school
☐ Lower secondary school (middle school)
☐ Upper secondary school (high school / technical or vocational school, etc.)
☐ University degree

MECOSAN – ISSNe 2384-8804, 2025, 133 DOI: 10.3280/mesa2025-133oa21522