

Vaccine hesitancy, a public health problem

F. Petrelli¹, C.M. Contratti¹, E. Tanzi², I. Grappasonni¹

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Abstract

The phenomenon of “vaccine hesitancy” has only been studied for a few years, and this attitude is becoming a serious threat that can frustrate the efforts of recent years that have led to the achievement of relevant scientific advances to human health. The paper analyzes the possible causes, the scope of the phenomenon and its consequences, trying to identify the most effective actions to resolve this trend.

Introduction

Progress in modern society can be evaluated by measuring the “wellness” that every member of a particular society enjoys. Nevertheless thinking of health obsessively as if it were a personal asset, we could forget that at times our personal health depends on the state of an entire society. The recent theme of vaccine hesitancy (VH) represents one of the most relevant issues in public health, and *refers to delays in acceptance or refusal of vaccines despite availability of vaccination services. VH is complex and context specific, varying across time, place and vaccines* (1). Despite the fact that VH is a worldwide social phenomenon, it especially involves all countries that have reached high levels of immunization in the past years, but today they report a decrease of levels of vaccine acceptance despite available vaccination services and structures. This definition of

VH does not include those contexts in which vaccine uptake is low because of situations that contribute to a deficiency in vaccination services and stocks.

Even if we possess efficient tools to identify, address and solve the problem of VH, it is not yet possible to quantify exactly or in an approximate way the number of hesitant people both at national and global level. For this reason when speaking of hesitancy, we often need to employ data referred to immunization coverage, that are also proven to be reliable for small samples. We know that vaccinal decrease does not totally coincide with VH and it isn't the only parameter that has an impact on the issue. Nevertheless, the phenomenon of vaccinal decrease is complex and depends on multifactorial causes in the same way as hesitancy, thus, when possible, immunization coverage rates become a valid tool to appreciate the evolution of this social phenomenon.

¹School of Pharmacy, Center for Hygiene and Public Health, University of Camerino, Italy

²Department of Biomedical Sciences for Health, University of Milan, Milan, Italy

Different feelings on vaccines around the World and relative considerations

As already mentioned the problem is spreading, mostly in regions that still benefit from high health levels, also thanks to past vaccination initiatives. This last assertion refers mostly to a good part of European countries, North America and other settings around the world where the problem of hesitancy is obvious. The same situation emerges from an analysis of the data of a recent study revealing the global state of vaccine confidence. It's a large-scale data-driven study, the largest survey on confidence ever undertaken. In fact, the study involved about 66,000 individuals across 67 different countries. The sheer size of the sample allows a comparison between the results of a specific country with its own historical, political and economic situation, traditions and religion with similar results from other countries which possess different features and vice versa, provoking some interesting thoughts. Those interviewed were called to express their opinion on vaccine importance, safety, effectiveness and religious compatibility, by choosing one of 4 possible answers ranging from

“strongly agree” to “strongly disagree”. For the majority of respondents age, sex, income level, work status, religion and educational level was recorded, thus allowing the researchers to extract more data. First of all, the data analysis revealed that the European Region has a higher percentage of negative opinions on vaccine importance, safety and effectiveness, instead problems linked to religious compatibility are confined to the WPR area (Western Pacific Region) that includes Mongolia, Thailand and Vietnam; furthermore, 7 of 10 countries with the worst opinion on vaccine safety belong to the European Region (2) (Fig. 1).

This evidence further validates a famous sentence shared by many that portray vaccination as “a victim of its own success” (3, 4). Probably, the younger generations in high income countries have forgotten the real importance of vaccination and now they ignore the fear of terrible diseases which in the past caused an enormous number of victims. Today, the same fear has been replaced by excessive concerns linked to the side effects of vaccines. In fact, nowadays it is more common to be afraid of vaccination than the disease against which we are fighting. The accuracy of this theory

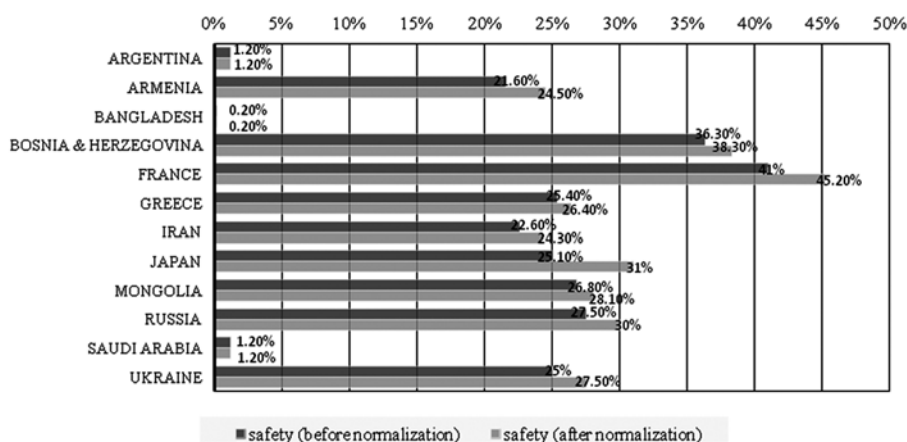


Fig. 1 - Percentage of negative answers to the survey question about vaccine safety (2). (light grey columns denote the value after renormalization of responses, from which responses like “do not know”, and interviewees who have given no response, have been removed).

is based on the evidence that the importance of immunization is still acknowledged in low and middle income countries, where the safety of a vaccine is secondary to the real risk of contracting infective diseases like polio, HBV, diphtheria, etc...: in the above-mentioned survey it is underlined that 0.2%, 1.2% and 1.3% of respondents from Bangladesh, Saudi Arabia and Argentina are skeptical about vaccine safety, whereas the same sentiment is expressed by 45.2%, 38.3% and 31.0% of French, Bosnian and Japanese respondents (2).

Furthermore, the data from the survey reveal that the subgroup composed of over 65s is more confident to express the efficacy of vaccines, probably because they well remember the awful diseases against which we defend ourselves nowadays. The current situation portrayed by this study unveils the massive presence of “complacency”, described by the World Health Organization (WHO) as one of the most influential determinants of vaccine hesitancy.

Otherwise it is necessary to provide some clarifications when we describe European countries as being the most skeptical about vaccines. Western and Northern European countries express less concern about vaccine safety than Southern and Eastern countries. But some remarkable exceptions are represented by France and Italy, which have the highest percentage of positive responses about safety-based vaccine skepticism. However, low levels of confidence are not exclusive to the European region, but are remarkable in Mexico, USA and Canada, in North America, Japan, China and Hong Kong, in Asia (2).

Diffusion of Hesitancy: chronological sequence, important factors behind, reaction and model

The question is the following: what has contributed to the evolution and spread of

the phenomenon? What are the reactions of the single States?

Negative opinions relating to vaccines and anti-vaccine movements have existed ever since vaccines were discovered; in time, some theories have been debunked, some have evolved, and yet others are still in vogue (3). This lack of faith in vaccination has been reinforced by several high-profile cases, the most well-known probably being the article written by A. Wakefield, who postulated a correlation between rising rates of autism and the administration of the MMR vaccine. This case had repercussions on the compliance to this vaccine for several years, so much so in fact that since 2000 numerous epidemics of measles have been noted (2005-06 in England and Wales, 2011 in France, 2012 in Wales and 2014 in the USA) (3, 5-7). In the meantime, the scientific community realised the drop in vaccine adherence was also due to a social phenomenon (VH). Therefore, the WHO’s “SAGE on immunization”, in existence since 1999, was given the task of defining studying this phenomenon, defining its characteristics and causes and deciding how to deal with it. In the space of a few years, the first results came to light, consisting in the elaboration of a Matrix (2013) (7, 8), TIP (Tailoring Immunization Programmes) (9), useful for identifying the phenomenon (2013), and the publication of the “Report Of The Sage Working Group On Vaccine Hesitancy” (2014) (1).

After its emergence as a topic of great interest and importance in the field of public health, thanks also to the numerous scientific papers published on the subject, national and international health policies started to focus on containing the problem and solving it, starting from the establishment of “Council conclusions on vaccinations as an effective tool in public health”, a crucial step that reinforces the EU’s actions to support member states through policies and effective vaccination programmes (10). On the basis of these principles, the Erice

Declaration, showing the path to follow in the fight against VH and how to improve vaccine adherence, was drafted in Italy (10). Over the past two years, many countries have adopted measures such as the Californian Senate Bill 277 (SB277), No Jab No Pay in Australia, successes in the fight against misinformation on the web through official sites (11), and the introduction of mandatory vaccinations in some Italian regions together with the extension of available vaccines in Italy (12-14), all subjects we will go into in the pages that follow.

Role of the Web

One major event that has transformed modern society radically was the growth of the World Wide Web and its widespread diffusion in our everyday life, changing even the way of acquiring knowledge. Just think of the transfer of whole fields of knowledge on the Net or simply a little information on any subject, that was previously contained exclusively in books: this know-how that was once “property of few” is now available to all. This revolution was very positive until the coming of Web 2.0, a new kind of web, democratic, where users could publish and comment all content without filters, but also without having any knowledge of the subject. In the field of culture and especially in the field of vaccinations, the Net has seen a loss of credibility of content (some reliable knowledge is difficult to find), of authors (in this situation everyone is his own editor) (15) and consequently Healthcare Workers have lost credibility because their authority and knowledge are an object of discussion for many who might have only just read up some theories on the Internet. For these reasons, someone defined the Web as a “modern Pandora’s box” (16): in fact today many countries are paying for the loss of the instructive role played by Internet, that at the moment can be portrayed as an ocean of information where it is easier to get lost than find your way. Disinformation in the

field of vaccines is often well planned by a clique of people who want to persuade many common people to believe in ridiculous anti-vax theories or become hesitant after having read a lot of web pages and articles full of retoric expedients (technical language is not employed, the title is always accentuated, the text can be read quickly and includes dramatic anecdotes which are nevertheless fake - not true -, often the article does not include references or when they are, they are unreliable). Usually this exclusive group of people is composed by doctors or lawyers that create a business (17) through selling “therapeutic (medical) procedures”, private consultations, lawsuits against the state government or they simply earn money thanks to visits to their own webpages or forums (click baiting). Taking advantage of social networks, they carry disinformation to ever higher levels in the field of vaccination, because of the speed with which content (in the form of articles, posts or pictures) reaches a wide range of people (18). Furthermore, the way in which news or theories are reported is very hasty and summary, a practice which goes against the principles underlying all scientific studies. The danger in perceiving such misleading arguments is still probably underrated: someone is ignoring the fact that, in 2016, about 3.5 billion people have access to the Internet (19, 20), and in this group, despite the fact that they could be a minority, there are people who live in low income or developing countries. Such a factor could fail to take into account differences between developing countries and high income countries. But in this case it is a negative change, because Internet could pass on a set of problems characteristic of developed countries to countries which didn’t have them before. In fact, vaccines can’t be “victims of their own success” in areas which see thousands of children and adults still die because of preventable diseases.

As regards the Internet and its massive use we should follow the model of Iceland,

a little country with a low population density, where Internet represents a basic necessity to reduce the distance between people who live in the same country or to connect Iceland to the rest of the European continent. In our humble opinion, Icelanders use this powerful tool in the right way. The recent outbreaks of measles and pertussis in Europe and North America has raised important questions in Iceland about the decrease of adhesion to childhood vaccination programs. During the winter of 2013-14 an Internet-based survey (21) was conducted in Iceland to gauge public opinion on childhood vaccinations. The survey was administered to a large group of people aged over 18, and participants were analyzed for age distribution, gender, residency (urban or rural), employment and income. The results of the study show the interesting approach and habits of Icelanders to immunization schedules, demonstrating that:

a) 95% of respondents expressed a “positive” or “very positive” opinion towards childhood vaccinations in the first and second years of life; instead, only 1.1% of those interviewed were “negative” or “very negative” about it;

b) replies to the statement “I fear that vaccinations can cause severe adverse effects” are more various, because 9.3% of participants agreed with the statement, 17.5% was undecided and a total of 66.9% disagreed or strongly disagreed with it. In substance, there wasn't an absolute majority of judgement as with the previous question, however compared with data from other countries it is a good result. Moreover, it is important to underline that more highly educated individuals are more likely to disagree with the statement, proving that education in Iceland can still be a positive factor for vaccine acceptance, on the contrary of the impressions we receive through studies from other regions and contexts;

c) 95.3% of individuals would have their child immunized according to the

Icelandic childhood vaccination schedule, thus the percentage corresponds to the first answers of the survey. A similar result (92% of positive responses) reveals the deep trust individuals place in Icelandic Health Authorities (21).

With big astonishment, in a country where the Internet is considered as a basic necessary, used by almost everyone (100% of people aged 16-24 and 95% of people aged 24-74 – data updated to 2014) (22), we appreciate how paradoxically its use doesn't represent a dangerous determinant for the vaccinal acceptance and VH. We should see it as an example for a use of digital platforms that is more correct and aware, that is, at the same time, monitored and reviewed by those in charge, especially when fundamental rights like public health and vaccines are at stake. In this way, it will be possible to transform a real enemy into an efficient tool to address disinformation and problems. (18) Furthermore, the trust demonstrated by Icelanders in their Health Authorities proves the need for patients to gladly accept the recommendations of health-care workers, considered by all to be the best source of information (21, 23).

In Italy, Internet represents a great non-institutional source of information consulted by parents for deciding not to vaccinate their child, and many vaccine-related websites have an anti-vaccination approach. For this reason, the Italian Society of Hygiene (SItI) endorsed, in 2013, the VaccinarSì project. VaccinarSì is a portal that aims to provide scientific information, verifiable, and easily understandable, with the aim to promote good and science-based communication around vaccines, counteract the misinformation, and combat the phenomenon of VH (11).

Relationships and trust in Health Authorities

Trust in national Policy and Health Authorities appears to be a characteristic quality of Northern European countries in

general, as the instance of Sweden confirms. From the study called “*Future pandemics and vaccination: Public opinion and attitudes across three European countries*” (24), it emerges that Swedes consider their national Authorities to be entirely reliable, and accept in full the guidelines suggested by their Health Authorities, contrary to what happens in Poland. The study describes Swedes as respectful and very obedient citizens, even though they do not always agree with all decisions taken by their politicians, but they feel guilty if they don’t follow the directives recommended. In addition they consider itself to be aware of personal and other people’s risks due to insufficient vaccination. These remarks underline the “human progress” reached by the Swedish people, who trust in democratically elected Politicians and reaffirm that, on the whole, adhesions to vaccine programs depend on the credibility of the State.

Far from this cheerful reality, national Authorities are not always considered as a guarantors of Public Health, probably because of a precarious political situation and/or because of some negative circumstances occurred in the health sector that have reduced the credibility of the healthcare system. Often assumptions like that breed theories, strongly debated on the Web, about supposed civil liberties which have been abolished by the Government, such as the right not to vaccinate their own children in countries where mandatory vaccination is in force. This seems, for example, to have become a very current “ethical” topic in Italy, as shown by both the growing number of children who have not received mandatory vaccines and data, referring to January 2016, on the percentage of adhesion to MPR vaccination, which are so low as to compromise herd immunity (25). Unfortunately it is not clear that parents’ choices do not only effect their own child, but these effects are extended to other

children who, due to their health condition or age, are unable to directly benefit from vaccination: in short, the parents’ “freedom” could put a large part of the community at risk of infection, and overall it could damage the right of the rest of the population to living safely while enjoying the highest possible level of wellness. This is the reason why we must make some points clear: even before taking into consideration the parents’ freedom of choice to vaccinate their children, in countries who have underwritten the UN Convention on the Rights of the Child, the right of child to “*the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health*” is in force and besides, “*States Parties shall strive to ensure that no child is deprived of his or her right of access to such health care services*” (Art. 24 of UN Convention on the Rights of the Child) (25, 26). According to UNICEF, the right of every child to be vaccinated to prevent infectious diseases with high frequency, penetrance and risk of any negative effects in the correct way for his health condition is out of the question (25, 27). Children are not able to decide what is in their best interests, so they are under the tutelage of their parents, who are their legal representatives. As such, they should respect their offsprings’ rights to benefit from the highest standard of health and to be vaccinated, without applying personal judgements and opinions which could undermine their children’s freedom (25, 28).

Strategies of intervention

Now the ways forward to solve the problem are well defined and can be divided into: easy measures and less “democratic” measures. Among the first measures there are some which have already been employed for a long time, and which now need to be improved, and others that are yet to

be taken. This second group is composed by regulations which have only just been suggested or recently introduced in diverse contexts and we are waiting to obtain the first results. The distinction between the two different groups of measures must not be seen as an ultimatum but it merely shows the existence of two different approaches, that in our opinion could be applied in the same context, working in synergy with very positive results.

Continuous monitoring of the problem

Before proceeding with the application of strategies to address and solve VH, it is necessary to identify the hesitancy within a restricted geographical area or social context with a susceptible population. For this purpose the tools we possess, such as TIP (9) and surveys, are highly suitable. The TIP (Tailoring Immunization Programmes) is a guide developed by WHO/Europe to identify hesitant people after a targeted division of the population in sub-groups at sub-national level, then barriers to vaccination can be determined and evidence-based tools for tailored interventions can be implemented. The success of the application of TIP in the UK, Sweden and Bulgaria shows its effectiveness but reflects its limited usage in European countries. This limitation could encourage the researchers to improve the tool and extend its application to the rest of the world (1). Surveys submitted in the last years to the immunization managers of many countries to report the breadth and factors behind the growth and spread of VH are still necessary, because a periodical use can help to appreciate the evolution of this phenomenon in time, social contexts and territories.

An additional measure to facilitate the recognition of possible signals of VH is the realization of a national vaccination registry, computerized and integrated, to permit a helpful and rapid sharing of data held, that can be analyzed when necessary (29).

Democratic measures to rescue hesitant people and to perform a cultural change in the field of vaccines

Addressing VH, the WHO recommends that identification of hesitant individuals must be followed by their interception and salvage through multi-component strategies, which appear more effective than a single component strategy, especially for maintaining and improving vaccine uptake. Many experts affirm that communication is the most effective tool at our disposal to increase knowledge and awareness about vaccines and fight all the prejudices due to current widespread misinformation (30, 31).

The rescue of people who refuse or delay vaccinations is based on a face-to-face dialogue between healthcare workers and patients or people involved, that in most cases are parents. Contrary to what might be thought, parents don't just have to learn about concepts, but they also have to establish a real, interactive dialogue, in which first of all their natural concerns and fears must be listened to and understood. Subsequently, they can be reassured about the safety of vaccines and warned against the risks of vaccine-preventable diseases (25, 32, 33). Do better topics to use in this kind of dialogue exist? According to a study published by the British Medical Journal, using pictures and short stories about sick children to inform parents on risks related to vaccine-preventable diseases, is far more effective than attempts to correct mistaken beliefs on the risks linked to vaccines (34). In fact, attempting to change mistaken beliefs without any form of demonstration is the worst way to start a dialogue. Besides this form of communication, operating methods can also be improved (35), because parents often only come into contact with pediatricians or healthcare workers in the period preceding their child's first vaccination. These meetings seldom take place before the child's birth or during birthing classes.

In our opinion, communication between a doctor and parents during the pre-birth period could be successful for a number of reasons: a) future parents have more time to take part in one or more meetings with healthcare workers or experts in the field; b) well-timed interception of uncertain or hesitant parents; c) the opportunity to reach an informed or right choice before the birth of the child; d) awareness of lack of proven risks of immunization during pregnancy, as many studies show (36).

There is another form of communication to address VH, even if it does not have the same impact of a face-to-face dialogue. We are referring to communication through Mass and Social Media that should be used in a better way (18, 37). The implementation of information about vaccines in terms of quality and reliability on most recent media channels, such as the Web and Social Networks, could play a double role: an educational role could be given to the internet once more and thus challenge misleading information, which can be seen in first place in the results given by most search engines (18).

And don't forget about "classic" Mass Media channels like television and newspapers, which are still able to provide reliable information on the topic because it comes from authoritative sources. They play a critical role in awareness campaigns through: a) public service announcements, promoted by Health Authorities; b) television news and articles; c) cultural broadcasts and magazines; d) the support of vaccination services by celebrities or influential people (35).

Progress in cultural change in the field of vaccines should not occur exclusively with regard to hesitant parents, but it must also affect healthcare workers such as doctors, pediatricians and nurses. It is essential to involve professionals like that first, because they must face doubtful or hesitant individuals. That is why they must develop

some skills like: a) extensive knowledge of the topic; b) ability to enter into a dialogue with any person showing uncertainty, employing the best techniques, c) sensitivity in the individuation of hesitancy in any particular person, understanding the reasons of this hesitancy to help him/her and increase their knowledge about the problem. Improvement is possible by attending refresher courses for medical degrees, including several hours of a teaching programme spent on the knowledge of vaccinations and a study of VH, or with constant participation in refresher courses for healthcare workers on the subject (10, 29, 35) and employable techniques. The teaching of a correct procedure for the reduction of pain due to injections, the use of psychological expedients or simply proceeding with the distraction of a child, might make a difference and bring many benefits (1). These are first of all economical, because procedures can be learnt during training courses, and good techniques subsequently help to fix a lot of biases: just think that "pain" is included in "Working Group Determinants of Vaccine Hesitancy Matrix", among all the other real adverse reactions of vaccination that people experienced directly or indirectly (1). Children crying can worry and distress parents in such a way as to exaggerate the possibility that the child has experienced an adverse effect after the injection. Another reason for which it is better to start making changes in the process of education of healthcare workers comes from the very alarming news referring to the growing number of vaccine-hesitant doctors or doctors contrary to vaccines in many European countries (38). If the very people who should be at the forefront in the battle against VH, considered the most trusted source of vaccine-related information, are in truth the first working against the vaccines, it becomes clear that some countries in which vaccinations are mandatory are preparing measures to discourage and solve this emergency. In particular, in the new Italian

vaccination protocol (Piano Nazionale Prevenzione Vaccinale 2016-18) the adoption of new disciplinary and contractual sanctions was proposed (from a simple ticket up to being struck off from their professional body) for doctors against vaccination (39). This task might be carried out by the Board of their professional body, thus allowing it to monitor members, so concretely contributing to fight vaccine hesitancy, and restoring credibility to the figure of a physician, undermined after someone questioned his knowledge with arguments with no scientific-foundation. This can be seen as a decisive action, different from all the others previously explained in which the choice was left to the person involved, but at the same time the need of this measure could mean it frequently becomes the first change that is made.

The process of cultural change in the field of vaccines involves not only adults, (parents, healthcare workers or graduate students), but must also begin from a young age, starting from the education imparted to adolescents and also to younger children (29).

On this subject, a study on health literacy in young adults has found that higher levels of understanding of medical terms was related to education and parental occupation. This study underlined that adherence to health care recommendations and preventive strategies is more likely to be influenced by a patient's literacy level, and concluded that preventive medicine strategies should also be focused on younger age groups, as this formative period is appropriate for introducing health care education. Issues related to health literacy should be included in schooling (40).

Indeed, reaching this aim, beyond family education, will depend on schooling, which is the tool to bring about such a change. The aim of school is not only to train future professionals, but also to nurture good citizens for tomorrow. Young people are in a moment of their life in which personal

beliefs are forming and learning about the advantages of immunization can influence future decision-making (41). Teaching about and making clear the advantages of vaccines in children, adolescents and young adults could first represent an efficient tool to assure increased vaccinal adhesion when they become adults and parents. Then, society will be composed of informed citizens, conscious of the value of vaccines and full of civic duty towards their community and Authorities, like the Northern European people previously mentioned.

One of the main causes of VH is caused by a lack of trust in Government and Health Authorities, as already mentioned. Strategies that we have proposed for restoring this situation are driven by reconciliation between citizens and Government, which must be recognised as the defender of Public Health. The first step to take consists in the increase of financial and human resources released for Research. This step will demonstrate the Government's attention to achieving high levels of health to all citizens and patients. Especially in the field of immunization, money invested in Research leads to an improvement in the quality of health services and at the same time a significant money-saver for health care expenditure due to the treatment and therapy of vaccine-preventable diseases (42).

We consider the free offer of new vaccines not already included in previous programmes to be a successful approach, as was the case of the Meningitis B vaccination in England and Scotland. Undoubtedly the success of this programme lies in the extension of vaccinal services offered, but it was fully demonstrated by positive feedback from the British. Indeed, the English requested this vaccine be extended to all children under the age of 11 through a petition, even though the same vaccine has been given free to all newborn babies since 2015. During a period marked by a strong decrease in vaccinal adhesion,

hesitancy and the challenge to the abolition of mandatory vaccines, the 820,000 odd signatures obtained on the petition, called “Give the Meningitis B vaccine to ALL children, not just newborn babies”, can’t go unnoticed, because the petition became the most popular ever for number of signatures in the specific site of the English Parliament (43, 44). Also from this data emerges the “craving for protection” of a population who has already paid the consequences of VH in the past. Economic sustainability could represent a real barrier for the last two measures: that it could give contrary results if the measures are not undertaken, as demonstrated by people’s discontent after the English petition was refused (43). In Italy a strong signal of improvement in health conditions came from updating “LEA” (essential level of assistance), which does not ignore the improvement of vaccinal services (45). The Italian Health Authorities have also submitted the new vaccinal programme (PNPV 2017-19), that has been in force since 18 February 2017 (12), consisting in introduction of new formulations and extension of vaccinations currently in use, to new target (13, 14). The programme is considered by the President of ISS, Walter Ricciardi, as the most advanced in the world, underlining its wide offer and innovation (46). It includes the introduction of: the vaccine against Men B in 3 doses and against Rotavirus infections during the first year of child’s life, the vaccine against varicella (chicken pox) for children, the vaccine against IPV and Meningococcal ACYW₁₃₅ vaccines for adolescents, the HPV vaccine also for male adolescents, anti-pneumococcal and anti-zoster vaccines for people over 65 years of age (47). The cost of the measure, added to current costs, was quantified by the “Ministero della Salute” (Ministry of Health) as being equivalent to about 303 million Euros (48) and it shows how the battle against VH might not be economically viable for all countries.

The development of campaigns to raise awareness about the advantages of vaccines and their safety through a targeted strategy of advocacy is surely more feasible using marketing strategies with easy understandable communication format (35, 49). We can use the adjective “tailored” to describe the strategy because it must be different according to the individual towards it is directed and the way in which it is conducted (1). In this sense, Italy is still doing well on the Web platform (35), through the creation and promotion of the “Italian Card for the promotion of vaccination” (29). This is a tool sponsored by both the Italian Health Ministry and the Italian Society of Hygiene, and everyone can join after registering on its Web site. It represents a real call to action to start spreading correct information and to initiate a positive dialogue on the subject of vaccines with other people both on the Internet and in real life (50). Advocacy can be realized with many means of expression, including photography. In the same way the Australian photographer Anne Geddes, often engaged in humanitarian campaigns, stood for the value of vaccination, publishing 2 photo spreads, called “Win For Meningitis” and “Protecting Our Tomorrow”, that portray the consequences of meningitis on the bodies of paralympic athletes and children and show some of the devastating effects of the virus on humans. The figurative language probably has the most powerful impact to influence our beliefs about vaccines. This is probably the first time that a marketing strategy was adapted to promote any such form of prevention.

If adopted appropriately, these measures, being focused, non-aggressive and “democratic” in nature, should succeed without creating significant discontent and disputes with anti-vaccination movements. Both an improvement in healthcare services in terms of staff quality, and a process of growth and awareness of citizens thanks to information learned, would be the result.

Obviously, the process will only give noticeable results (for example the increase of vaccinal adhesion) after many years, but they will be long-lasting, almost everlasting (because of social change) and suitable for defeating VH, not just the decrease in vaccination rates.

Undemocratic measures

Unfortunately, circumstances of recent times have not always permitted Health Authorities to wait for results, due to the application of these “progressive” measures. For this reason, other intervention strategies, more severe than the ones previously mentioned, were studied and proposed, and have already been applied in particular contexts because of the urgent need for them. The almost undemocratic nature of this kind of intervention has proved necessary in particular moments of crisis and emergency, like when a sudden drop in vaccinal coverage is taking place, something which is difficult to tackle in a short space of time. In fact, the advantage of these measures, contrary to the previous measures mentioned, consists in the rapid achievement of results, due to taking action in contrast with people connected to anti-vaccination movements and others who are hesitant or dubious.

In addition to the adoption of contractual or disciplinary sanctioning systems against doctors opposed to vaccines, there are other very interesting initiatives to speak of. The first that can be mentioned is the reintroduction of mandatory vaccine requirements for admission to public or private first and secondary schools, including day-care centers, in some North American States. We chose this one primarily because it has been in place for months, and the first results are noteworthy. Interesting results are coming from California, the third American State (the earliest were West Virginia and Mississippi) to reject vaccination exemption based on both religious and philosophical beliefs for school entry. Obviously medical

exemptions remain. It is strange that the reform SB 277 and deeply wanted by Californian Governor Jerry Brown, was introduced in one of the most liberal States in the USA. However, there are some reasons not to be surprised by the decision. First, since the first of January 2014, in accordance with the Assembly Bill 2109 (AB 2109), to obtain vaccination exemption for their children, parents had to provide a document certifying that they had received information about vaccine-preventable diseases and the benefits and risks of immunization (51).

Furthermore, the measles outbreak, which occurred precisely in California in 2014 and was linked to the Disneyland amusement park, attracted the attention of the press and media. In this way, public opinion became aware of problems linked to low vaccinal coverage and understood the seriousness of the situation, after insufficient vaccine-adhesion compromised the “herd immunity” (7). The results of measures now in force must be evaluated taking into account a “social fabric” that is varied and rich, the high number of private schools and the high socio-economic status common to most of the State.

Different studies have shown that parental socio-economic status and income favored vaccine hesitancy (1, 52-54). One of these studies, in particular, actually correlated nonmedical vaccine exemption in California kindergartens from 2005 to 2015 to the type of school (public or private) and income levels (calculated according to school fees).

First, the study analysed shows that religious affiliation is not directly connected to vaccine exemption; secondly, it is evident that a sharp increase of nonmedical exemptions both in public and private kindergartens has occurred since 2000 (Tab. 1); in closing, the researchers have underlined a strong association between kindergarten tuition and exemptions for personal beliefs (52).

The latest news from California, on the subject of vaccine adherence and exemptions, confirms the effectiveness of such measures during moments of crisis and show how an optimal immunization rate can be regained in a short space of time. Let us analyze the data of the last kindergarten immunization assessment (56).

The document, issued by the “California Department of Public Health”, is well-structured and in substance reports 3 incredible results: the increase of students who have received all required vaccines for entry at kindergarten level, the drop in percentages of Personal Belief Exemption (PBE) during the last year and a widespread increase of Personal Medical Exemption (PME). First of all, the percentage of children with all the required immunizations has reached 95.6%, with an increase of 2.8 percentage points from 2015-16, 5.2 percentage points from the last 2 school years (in 2014-2015 the percentage was equal to 90.4) and unconditionally the highest value in kindergartens for many years. Even if the data refer only to children who are enrolled in kindergarten and there are some limitations linked to the lack of immunization data from a few schools, the results are very positive for the restoration of “herd immunity” and they underline the big goal that both the AB 2109 and SB 277 have helped to achieve in a few years. The second incredible result relates to the astonishing fall in PBE to a value of 0.6% from 2.37% during 2015-2016 (Fig. 2). But the percentage does not show the real dimension of success: although the number of kids enrolled in

kindergarten is higher every school year, the number of PBE has decreased from 13.086 units in 2015-16 to 3.133 units in 2016-17. There are about 10.000 fewer exemptions for personal beliefs, and most of them could represent hesitant or doubtful people. The third piece of data reveals an unusual rise in personal medical exemptions (PME) that are equal to 0.5% (Fig. 2).

Figure 2 shows the trend in the last 13 school years of vaccination exemption for both medical (PME) and personal (PBE) reasons. At first sight, it is possible to note how the curve of PBE has 2 different directions: the percentage of exemptions has grown every year (like the study first mentioned had described), but in 2014 the curve started to decrease; probably because of the introduction of the AB 2109, In the last year it has fallen definitively, thanks to SB 277. Also, PME values are fundamentally constant during the period taken into account until the introduction of SB 277.

Though it seems a small part of the whole sample, the result is very different from all previous reports. In addition, the comparison between the values obtained for public and private schools is interesting: public schools reported 0.4% of medical exemption, whereas private kindergartens show medical exemptions for 1.4% of the total sample. The number of students enrolled in private institutes is always the same, but the rise of the PME rate must be examined in depth. Can this increase in PME be normal? Are all of these cases verifiable? What are the reasons for these PME and what role do doctors play in the final decision, especially

Table 1 - Comparison of Personal Belief Exemption (PBE) percentages in Californian kindergarten throughout the last 4 school years. The trend is similar for both kind of schools but the values are always higher in private institutes (55).

Kindergarten school year	Public (%)	Private (%)	All (%)
2012-2013	2.55%	5.20%	2.79%
2013-2014	2.92%	5.88%	3.15%
2014-2015	2.31%	5.33%	2.54%
2015-2016	2.16%	4.93%	2.37%

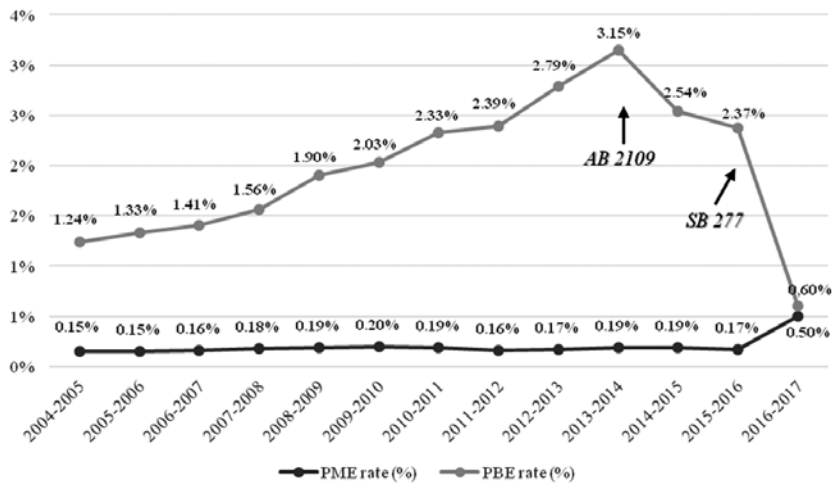


Fig. 2 - Trend of vaccination exemptions in Californian kindergartens (57). With “Assembly Bill (AB) 2109” children could reach the vaccinal exemption only if their parents own a certificate which prove that they have received information about vaccine-preventable diseases and the benefits and risks of immunization. SB 277 consists in rejection of vaccinal exemptions for non-medical reasons.

in private schools with higher tuition? We hope all these questions are answered quickly to and all misunderstandings are solved after a thorough analysis is carried out in the next months.

The example offered by the report introduces one of the most relevant challenges that SB 277 must face: will required immunization also be respected in private structures or will ways to bypass or nullify the measure be found? The additional challenges concern the strength of the law when faced with imaginable pressures from protesters and having to monitor children who will choose home schooling to avoid the application of measures (57, 58), or independent study and IEP services, which are quite insignificant for the moment but are probably set to increase. Only time can give us an answer, but meanwhile California and another two American States have showed the way for a number of proposals that contain the opinion of the people, overcoming possible contradictions represented by the respect of individual liberties as stated in the First Amendment and the Right to

education in the name of the fulfillment of Public Health (59, 60). The example given by the American States will be followed by Emilia Romagna, the first Italian Region to approve and apply, from 2017, a regional bill to stress the already mandatory vaccinations (tetanus-diphtheria-HBV-polio) for entry in day care centers (61). Emilia Romagna has shown the way to other Italian Regions, first of all Tuscany and Sicily, that are studying the best solution to apply the bill, but the sentiment is very different in other Regions like Veneto and Lombardy, which are more inclined to choosing a solution based on improving communication allowing their inhabitants to make choices which are more aware. The national agreement of regional health policy in the field of immunization is not excluded after the excitement following Emilia Romagna’s choice. And moreover: who knows if tomorrow this measure, now limited to entry in day care centers, will be extended to primary school at national level?

Halfway around the world, in Australia, since 1 January 2016, is in force a bill (the

so-called “No Jab No Pay”), which tries to discourage objections to vaccination, denying family assistance payments and child care rebate when the full immunization requirements are not respected. Families with children aged under 20 years need to have their children immunised (62). Although the aim is to increase the immunization level and protect Public Health, especially children’s health, some questions have arisen regarding consequences for migrant and refugee children living in Australia, who for a number of reasons are not eligible for child care payments and could discourage the real aim of increasing adherence to vaccination (63).

Further measures, like the extension of the number of mandatory vaccines in countries where compulsory vaccination is already provided, or the establishment of a new law on mandatory immunization in other countries, have not yet been considered. Nowadays, their introduction is conceivable only if VH will continue, in spite of numerous efforts and measures adopted. The real danger consists in the “undemocratic” nature of the decision which could increase people’s discontent because they are being deprived of their freedom of choice. The natural consequence is that people and healthcare workers alike could find ways of bypassing the law,

rendering the measures studied useless and doing little to solve the problem of VH. In addition, this kind of reform represents a defeat in the field of Public Health, because according to many experts “*vaccination must be considered a health opportunity to reach and not as an obligation to avoid*” (15).

Future prospects

In closing, talking once more about the USA, it will be interesting to see the development of the vaccination theme after the presidential election of Donald Trump. His position on vaccines was clear before the start of his electoral campaign, indeed the current American President’s tweets about the correlation between vaccines and autism are famous (Fig. 3) (64-67).

It is not surprising that Trump has asked Robert F. Kennedy jr, one of the most well-known supporters of the Wakefield thesis and a conspiracy theorist, to chair a “vaccine safety” commission (68). Time will give us the answer to many questions, but it was important to mention this event now because we must remember that the present and future of vaccines also depends on sea changes like a Presidential election and its consequences.



Fig. 3 - Two of the most famous tweets from the official account of the current American President. It underlines his vocation for the battle against autism and massive vaccinations (66, 67).

Conclusion

We would remind everyone that the measures described thus far do not represent an end point in the search for the best solutions to defeat VH. Their validity is always limited to the time and context of application, and for this reason research in the field of vaccines is still in need of significant investments, both in terms of economic and human resources. Streamlining resources through a continual process of study and sharing of results (and unsuccessful attempts) obtained is essential, and will contribute to creating a cooperative network, a shared process for the solution to the problem of vaccine hesitancy.

Riassunto

Vaccine hesitancy, un problema di sanità pubblica

Il fenomeno della “vaccine hesitancy” è oggetto di studio solo da pochi anni e tale atteggiamento sta diventando una seria minaccia che può vanificare gli innumerevoli sforzi che, negli ultimi anni, hanno portato al raggiungimento di rilevanti progressi scientifici per la salute umana. Vengono analizzate le possibili cause, le dimensioni del fenomeno e le sue conseguenze, cercando di individuare le azioni più efficaci per dirimere questa tendenza.

References

- World Health Organization (WHO). Report of the SAGE Working Group on Vaccine Hesitancy, 2014. Available on: http://www.who.int/immunization/sage/meetings/2014/october/SAGE_working_group_revised_report_vaccine_hesitancy.pdf [Last accessed: 2017, Mar 21].
- Larson H J, de Figueiredo A, Xiaohong Z, et al. The State of Vaccine Confidence 2016: Global Insights Through a 67-Country Survey. *EBio-Medicine* 2016; **12**: 295–301.
- Dubé E, Vivion M, MacDonald NE. Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: influence, impact and implications. *Expert Rev Vaccines* 2015; **14**(1): 99–117.
- Janko M. Vaccination: a victim of its own success. *Am Med Assoc J Ethics* 2012; **14**(1): 3–4. Available on: <http://journalofethics.ama-assn.org/2012/01/fred1-1201.html> [Last accessed: 2017 Mar 21].
- The Guardian. Misplaced autism worries fuel measles outbreak. <https://www.theguardian.com/uk/2006/jun/16/health.healthandwellbeing> [Last accessed 2017 Jun 15]
- NHS. Measles Outbreak: Data. <http://www.wales.nhs.uk/sitesplus/888/page/66389#e> [Last accessed 2017 Jun 15]
- Majumder MS, Cohn EL, Mekaru SR, Huston JE, Brownstein JS. Standardized Vaccination Compliance and the 2015 Measles Outbreak. *JAMA Pediatr* 2015; **169**(5): 494–5.
- World Health Organization (WHO). SAGE Working Group on Vaccine Hesitancy. Introduction and Session Overview http://www.who.int/immunization/sage/meetings/2014/october/1_Intro_Eskola_revised_final2.pdf?ua=1
- WHO Europe. The Guide to Tailoring Immunization Programmes (TIP). Available on http://www.euro.who.int/__data/assets/pdf_file/0003/187347/The-Guide-to-Tailoring-Immunization-Programmes-TIP.pdf
- Odone A, Fara GM, Giammaco G, Blangiardi F, Signorelli C. The future of immunization policies in Italy and in the European Union: the Declaration of Erice. *Hum Vaccin Immunother* 2015; **15**: 1268–1271. [dx.doi.org/10.1080/21645515.2015.1019980](https://doi.org/10.1080/21645515.2015.1019980)
- Ferro A, Odone A, Siddu A, et al. Monitoring the web to support vaccine coverage: results of two years of the portal vaccinarSi. *Epidemiol Prev* 2015; **39**(4 Suppl 1): 88–93.
- Gazzetta ufficiale. Piano nazionale prevenzione vaccinale 2017–2019. GU Serie Generale n. 41 del 18-02-2017. http://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2017-02-18&atto.codiceRedazionale=17A01195&elenco30giorni=false [Last accessed: 2017 Mar 21]
- Quotidiano Sanità. Nuovi Lea. La Corte dei conti registra il Dpcm. E ora manca solo la Gazzetta Ufficiale. Available on: http://www.quotidianosanita.it/governo-e-parlamento/articolo.php?articolo_id=47590 [Last accessed: 2017 Mar 21].
- Quotidiano Sanità. Il premier Gentiloni ha firmato il Dpcm sui nuovi Lea. L'annuncio di Lorenzin su twitter. Ecco cosa prevedono e quanto costano. Available on: <http://www.quotidianosanita.it/governo-e-parlamento/articolo>

- php?articolo_id=46823 [Last accessed: 2017 Mar 21]
15. Vitali Rosati G. Il Web e le Vaccinazioni. Available on: <http://www.vaccinarsi.org/controla-disinformazione/web-e-vaccinazioni.html> [Last accessed: 2017 Mar 21].
 16. Kata A. A postmodern Pandora's box: Anti-vaccination misinformation on the Internet. *Vaccine* 2010; **28**(7): 1709-16.
 17. Rete Informazione Vaccini (RIV). Parte 1. Il business degli anti-vax, fra avvocati, medici e consulenti della speranza. Available on: <http://www.riv.life/parte-1-il-business-degli-anti-vax-fra-avvocati-medici-e-consulenti-della-speranza/> [Last accessed: 2017 Mar 21].
 18. Odone A, Ferrari A, Spagnoli F, Visciarelli S, Shefer A, Pasquarella C, Signorelli C. Effectiveness of interventions that apply new media to improve vaccine uptake and vaccine coverage. *Hum Vaccin Immunother* 2015 Jan; **11**(1) 72-82. doi:10.4161/hv.34313. Epub 2014 Nov 1. PMID:25483518
 19. Statista. Number of internet users worldwide from 2005 to 2016 (in millions). Available on: <https://www.statista.com/statistics/273018/number-of-internet-users-worldwide/> [Last accessed: 2017 Mar 21].
 20. Internet live stats. Internet users in the world. Available on: <http://www.internetlivestats.com/internet-users/> Last accessed: 2017 Mar 21].
 21. Óskarsson Y, Guðnason Þ, Jónsdóttir G A, Kristinsson K G, Briem H, Haraldsson Á. Public opinion on childhood immunisations in Iceland. *Vaccine* 2015; **33**(51): 7211-6.
 22. Report ISTAT. Cittadini e nuove tecnologie. Available on: http://www.istat.it/it/files/2014/12/Cittadini_e_nuove_tecnologie_anno-2014.pdf?title=Cittadini+e+nuove+tecnologie++18%2Fdic%2F2014++Testo+integrale.pdf [Last accessed: 2017 Mar 21].
 23. Kennedy A, Basket M, Sheedy K. Vaccine attitudes, concerns, and information sources reported by parents of young children: results from the 2009 Health-Styles survey. *Pediatrics* 2011; **127**(Suppl 1): S92-9.
 24. Determann D, de Bekker-Grob E W, French J, et al. Future pandemics and vaccination: Public opinion and attitudes across three European countries. *Vaccine* 2016; **34**:803-8.
 25. Pinto L, Bona G, Di Mauro G. Vaccinazioni e interesse superiore del fanciullo. Available on: <http://www.epicentro.iss.it/temi/vaccinazioni/pdf/Sipps2016.pdf> [Last accessed: 2017 Mar 21].
 26. Commissione parlamentare per l'infanzia. Ratifica ed esecuzione della convenzione sui diritti del fanciullo, fatta a New York il 20 novembre 1989. Available on: http://www.camera.it/_bicamerale/infanzia/leggi/1176.htm, <http://www.ohchr.org/EN/ProfessionalInterest/Pages/CRC.aspx> [Last accessed: 2017 Mar 21].
 27. Unicef. Codice del diritto del minore alla salute e ai servizi sanitari. Available on: https://www.unicef.it/Allegati/Codice_diritto_minore_ospedale.pdf [Last accessed: 2017 Mar 21].
 28. Fadiga L. Trattamenti sanitari, vaccinazioni, diritto alla salute delle persone minori di età, 2013. Available on: http://www.assemblea.emr.it/biblioteca/attivita-e-servizi/documenti/dossier/introduzione_fadiga/at_download/file/intro%20dossier.pdf [Last accessed: 2017 Mar 21].
 29. Biasio L, Corsello G, Costantino C, et al. Communication about vaccination: a shared responsibility. *Hum Vaccin Immunother* 2016; **12**(11): 2984-7. doi: 10.1080/21645515.2016.1198456
 30. ECDC. Let's talk about protection. Enhancing childhood vaccination uptake. <http://ecdc.europa.eu/en/publications/Publications/lets-talk-about-protection-vaccination-guide.pdf> [Last accessed: 2017 Jun 15].
 31. AIFA. Area stampa. Cresce a livello globale l'opposizione ai vaccini: l'OMS analizza il fenomeno ed esplora le strategie per affrontarlo. <http://www.aifa.gov.it/content/cresce-livello-globale-l-opposizione-ai-vaccini-l-oms-analizza-il-fenomeno-ed-esplora-le-strat> [Last accessed: 2017 Jun 15] (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3906284/>)
 32. Rizzo C, Bonanni P, Carsetti R, et al. Dobbiamo cambiare per mantenere elevate le coperture vaccinali in Italia! Available on: http://www.riaponline.it/wp-content/uploads/2015/09/06_SIPS_Coperture_vacc1.pdf [Last accessed: 2017 Mar 21].
 33. Organizzazione Mondiale della Sanità (OMS). Parlare con i genitori dei vaccini in età pediatrica, 2012. Available on: http://www.salute.gov.it/imgs/C_17_opuscoliPoster_134_allegato.pdf [Last accessed: 2017 Mar 21].
 34. Horne Z, Powell D, Hummel JE, Holyoak KJ. Countering antivaccination attitudes. *Proc Natl Acad Sci U S A* 2015; **112**(33): 10321-4.
 35. Signorelli C, Odone A. Advocacy communication, vaccines and the role of scientific societ-

- ies. *Ann Ig* 2015; **27**(6): 737-47. doi: 10.7416/ai.2015.2066
36. De Martino M. Dismantling the Taboo against Vaccines in Pregnancy. *Int J Mol Sci* 2016; **17**(6): 894.
 37. Odone A, Signorelli C. When vaccine hesitancy makes headlines. *Vaccine* 2017; **35**(9): 1209-10. doi.org/10.1016/j.vaccine.2015.11.051
 38. ECDC. Let's talk about hesitancy. Enhancing confidence in vaccination and uptake. <http://ecdc.europa.eu/en/publications/Publications/lets-talk-about-hesitancy-vaccination-guide.pdf> [Last accessed: 2017 Jun 15].
 39. Piano Nazionale Prevenzione Vaccinale 2016-18. Available on: <http://www.quotidianosanita.it/allegati/allegato1955037.pdf> [Last accessed: 2017 Mar 21].
 40. Grappasonni I, Petrelli F, Klusoňová H, Kračmarová L. Level of understanding of medical terms among italian students. *Ceska Slov Farm* 2016; **65**(6): 216-20.
 41. Bartolucci S, Distefano F A, Ricciardi W, et al. Il Role Play al servizio della promozione della Salute tra gli studenti delle scuole medie: il progetto pilota "Vacciniamo le scuole. Atti del 48° Congresso Nazionale SItI 2015, C13.4.
 42. Signorelli C. Vaccines: building on scientific excellence and dispelling false myths. *Epidemiol Prev* 2015; **39**(3): 189-201.
 43. The Lancet Infectious Diseases. Costs, compassion, and the case for vaccination. *Lancet Infect Dis* 2016; **16**(4): 385. [http://thelancet.com/journals/laninf/article/PIIS1473-3099\(16\)00139-0/fulltext](http://thelancet.com/journals/laninf/article/PIIS1473-3099(16)00139-0/fulltext) [Last accessed: 2017 Mar 21].
 44. UK Government e Parliament petitions. Give the Meningitis B vaccine to ALL children, not just newborn babies. Available on: <https://petition.parliament.uk/petitions/108072#debate-threshold> [Last accessed: 2017 Mar 21].
 45. Signorelli C, Guerra R, Siliquini R, Ricciardi W. Italy's response to vaccine hesitancy: An innovative and cost effective National Immunization Plan based on scientific evidence. *Vaccine*. 2017 Jun 23. pii: S0264-410X(17)30788-0. doi: 10.1016/j.vaccine.2017.06.011. [Epub ahead of print].
 46. Doctor 33. Nuovo Piano nazionale vaccini, in GU dal 18 febbraio e da subito in vigore. <http://www.doctor33.it/politica-e-sanita/nuovo-piano-nazionale-vaccini-in-gu-dal-febbraio-e-da-subito-in-vigore/> [Last accessed 2017 Mar 21].
 47. Italian Health Ministry. Piano Nazionale Prevenzione Vaccinale PNPV 2017-2019. Available on: http://www.salute.gov.it/imgs/C_17_pubblicazioni_2571_allegato.pdf [Last accessed: 2017 Mar 21].
 48. Ministero della Salute, Relazione tecnica (aggiornamento Lea). Quadro di riferimento per la valutazione dell'impatto dello schema di dPCM. Available on: <http://www.quotidianosanita.it/allegati/allegato3684201.pdf> [Last accessed: 2017 Mar 21].
 49. Odone A, Signorelli C. What are we told ? A news media monitoring model for public health and the case of vaccines. *Eur J Public Health* 2016; **26**(4): 533-4. doi:10.1093/eurpub/ckw002
 50. TeamVaxItalia. La carta italiana per la promozione delle vaccinazioni (La Carta). Available on: <http://www.teamvaxitalia.it/lacarta-per-le-vaccinazioni.html> [Last accessed: 2017 Mar 21].
 51. California Legislative Information. Bill Information - Assembly Bill No. 2109. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB2109 [Last accessed: 2017 Apr 10].
 52. McNutt L A, Desemone C, DeNicola E, et al. Affluence as a predictor of vaccine refusal and underimmunization in California private kindergartens. *Vaccine* 2016; **34**: 1733-8.
 53. Frasca G, Pascucci M G, Caranci N, Finarelli A C. Studio di valutazione d'impatto delle disuguaglianze sull'adesione alle vaccinazioni. Available on: http://www.epicentro.iss.it/temi/vaccinazioni/pdf/Report_Studiodisuguaglianze%20e%20vaccinazioni.pdf [Last accessed: 2017 Mar 21].
 54. MacDonald N. E. Vaccine hesitancy: Definition, scope and determinants. *Vaccine* 2015; **33**(34): 4161-4.
 55. Californian Department of Public Health (CDPH). Immunization Rates in Child Care and Schools. From "2015-16 CA Kindergarten Summary Report" to "2012-13 CA Kindergarten Summary Report". <https://archive.cdph.ca.gov/programs/immunize/Pages/ImmunizationLevels.aspx> [Last accessed: 2017 June 7].
 56. Californian Department of Public Health (CDPH). Immunization Rates in Child Care and Schools. 2016-2017 Kindergarten Immunization Assessment – Executive Summary California Department of Public Health, Immunization

- Branch. http://www.cdph.ca.gov/programs/immunize/Documents/2016-17_CA_KindergartenSummaryReport.pdf [Last accessed: 2017 Apr 20].
57. Californian Department of Public Health (CDPH). Immunization Rates in Child Care and Schools. From “2016-17 CA Kindergarten Summary Report” to “2004-05 CA Kindergarten Summary Report”. <http://www.cdph.ca.gov/programs/immunize/Pages/ImmunizationLevels.aspx> [Last accessed: 2017 Mar 21].
 58. The Mercury News. California’s vaccine law: Opponents moving, home schooling to avoid controversial mandate. Available on: <http://www.mercurynews.com/2016/06/30/californias-vaccine-law-opponents-moving-home-schooling-to-avoid-controversial-mandate/> [Last accessed: 2017 Mar 21].
 59. Mello MM, Studdert DM, Parmet WE. Shifting Vaccination Politics — The End of Personal-Belief Exemptions in California. *N Engl J Med* 2015; **373**: 785-7.
 60. Viemeister v. White, 179 N.Y. 235, (1904). “Public Schools: Condition of Attendance,” *Yale Law Journal* 1904; **13**: 261. <https://books.google.it/books?id=TS9yB3gTP8UC&pg=PA92&lpg=PA92&dq=Public+Schools:+Condition+of+Attendance,+Yale+Law+Journal&source=bl&ots=8icD0VTePi&sig=nedccasegI1KHBAHFw58hHwBaII&hl=it&sa=X&ved=0ahUKEwiwq-aSxtHMAhWMBBoKHWqzD-S8Q6AEIHDAAN#v=onepage&q=Public%20Schools%3A%20Condition%20of%20Attendance%2C%20Yale%20Law%20Journal&f=false> [Last accessed: 2017 Mar 21].
 61. E-R. Flessibili, di qualità e vaccini obbligatori: servizi educativi 0-3 anni, la riforma. Available on: <http://www.regione.emilia-romagna.it/consumatori/inchieste/2016/luglio/flessibili-di-qualita-e-vaccini-obbligatori-servizi-educativi-0-3-anni-la-riforma> [Last accessed: 2017 Mar 21].
 62. Parliament of Australia. Social Services Legislation Amendment (No Jab, No Pay) Bill 2015. Available on: http://parlinfo.aph.gov.au/parlInfo/download/legislation/ems/r5540_ems_78b7b14d-fa5d-469e-a038-2840207a8f3e/upload_pdf/503827.pdf;fileType=application%2Fpdf Last accessed: 2017 Mar 21].
 63. Paxton G A, Tyrrell L, Oldfield SB, Kiang K, Danchin MH. No Jab, No Pay — no planning for migrant children, 2016. *Med J Aust* 2016; **205**(7): 296-8.
 64. Callender D. Vaccine Hesitancy: More than a movement. *Hum Vaccin Immunother* 2016; **12**(9): 2464-8.
 65. Business Insider. Trump has suggested vaccines cause autism — an idea that couldn’t be more wrong. Available on: <http://www.businessinsider.com/trump-vaccines-autism-wrong-2017-1?IR=T> [Last accessed: 2017 Mar 21].
 66. Twitter. Donald J. Trump Official account @realDonaldTrump. Tweet of 28 March 2014. https://twitter.com/realDonaldTrump/status/449525268529815552?ref_src=twsrc%5Etfw&ref_url=http%3A%2F%2Fwww.businessinsider.com%2Ftrump-vaccines-autism-wrong-2017-1 [Last accessed: 2017 Apr 20].
 67. Twitter. Donald J. Trump Official account @realDonaldTrump. Tweet of 3 September 2014. https://twitter.com/realDonaldTrump/status/507158574670573568?ref_src=twsrc%5Etfw&ref_url=http%3A%2F%2Fwww.businessinsider.com%2Ftrump-vaccines-autism-wrong-2017-1 [Last accessed: 2017 Apr 20].
 68. The Washington Post. Vaccine skeptic Robert Kennedy Jr. says Trump asked him to lead commission on ‘vaccine safety. Available on: https://www.washingtonpost.com/politics/trump-to-meet-with-proponent-of-debunked-tie-between-vaccines-and-autism/2017/01/10/4a5d03c0-d752-11e6-9f9f-5cdb4b7f8dd7_story.html [Last accessed: 2017 Mar 21].