**Is it time for vaccination to “go viral”?**

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**Contributors:**

All authors contributed as experts to the multidisciplinary panel discussion (anthropologist, public health policy advisor, vaccine industry expert, healthcare journalist, and practicing physicians) presented at a satellite symposium held at the 33rd annual meeting of the European Society of Paediatric Infectious Disease (ESPID) conference in Leipzig, Germany, in May 2015. The corresponding author conceived the concept of a manuscript based on the conference proceedings, collated consensus of the co-authors, and developed the first draft and the abstract. All authors made individual scientific contributions, offered critical revisions to the manuscript, and read and approved the final version.

**Abstract**

To promote and sustain excellent vaccination coverage, while preserving the key core values of ethics, truth, transparency, and trust, the vaccine community should adopt modern digital communication strategies. This article summarises our views – as experts in multidisciplinary field of vaccinology (consisting of an anthropologist, a public health policy advisor, a vaccine industry expert, a healthcare journalist, and a practicing physician) – which were presented at a satellite symposium held at the 33rd European Society of Paediatric Infectious Disease (ESPID) conference in Leipzig, Germany, in May 2015. This article aims to suggest and recommend strategies to promote vaccination awareness, and highlight proactive measures for building, maintaining, and enhancing trust in vaccination through innovative communication and evidence-based interaction with the end-user. We believe that converting the results of vaccine research into a successful vaccination programme, and replacing misinformation with evidence-based communication, will require a multidisciplinary approach that embraces modern digital and tailored applications to reach out to all populations.

**Introduction**

Although vaccines are recognized as one of the greatest public health achievements of the last century and save millions of lives each year, vaccination programmes are fighting to maintain public confidence. Public confidence in vaccines is decreasing for various reasons and anti-vaccine movements are becoming stronger.1-3 Individual decision-making regarding vaccination is not based only on knowledge-deficit of vaccine-hesitant individuals but on more complex determinants that may involve emotional, cultural, and social factors.4 “The days when health officials could issue advice, based on the very best medical and scientific data, and expect populations to comply, may be fading” (Margaret Chan, World Health Organization Director-General, 2010).5 Use of technologies such as smartphones, social networks, and the internet has changed the way we communicated and provides innovative ways to monitor trends that concern people. Together, these advancements are leading to a convergence of people, information, technology, and communities to improve health outcomes in a modern hyper-connected world.

On May 13th, 2015 in Leipzig, Germany, the Global Medical Affairs team of GSK Vaccines organised a satellite symposium at the European Society of Paediatric Infectious Disease (ESPID) conference and we were invited as experts to discuss how to maintain and increase vaccine acceptance and coverage for all age groups in the digital era. The symposium was structured around a series of presentations by ourselves as members of a multidisciplinary panel (consisting of an anthropologist, a public health policy advisor, a vaccine industry expert, a healthcare journalist, and a practicing physician), and was followed by discussions with delegates at the symposium and a live global webinar audience. Transcripts of the symposium, including video recordings of public perceptions captured by interviews conducted in London, Paris, and Berlin in April 2015 formed the basis of the needs-analysis for vaccination “to go viral”.

The purpose of this article is to delineate the presentations and findings that emerged from the meeting with the goal of highlighting proactive measures for building, maintaining, and enhancing trust in vaccination through innovative communication and evidence-based interaction with the end-user.

**Out of sight, out of mind**

Vaccination has become a victim of its own success with the resultant significant decrease in vaccine preventable-infections contributing to vaccine complacency. 6 The current low global incidence of diseases such as tetanus, diphtheria, and polio has led to the misperception by some that vaccination is no longer necessary and that vaccine-associated risk may outweighs that of the disease itself.. These people may thus prefer to avoid vaccination. One of the prevalent concerns about vaccines is safety. 7 Vaccines, like all medicines, can have adverse events however, but because vaccines are given to healthy people, notably most infants and children, people expect and demand higher safety standard then for drugs. Most vaccines related adverse events are mild or moderate, such as reactions at the site of injection (pain, redness, and swelling) or fever, but sometimes, severe adverse events can occur, such as anaphylactic reactions or febrile seizures.8 All vaccines are tested in clinical trials during the development phase and their safety and benefit-risk profiles are continuously monitored and re-evaluated by the manufacturers and health authorities, after licensure for their entire duration of use.2 However, most healthcare professionals (HCPs) and the public are not aware of this rigorous and continuous safety assessment of vaccines. Therefore, the general public needs to be made aware of the robust safety systems, and that they themselves can report concerns as well as HCP giving immunizations. If potential concerns arise, a transparent approach is essential to enhance and maintain public trust.

Vaccine-hesitant individuals may refuse or delay vaccination for themselves or their children. This leads to pockets of unprotected population and increases the risk of disease outbreaks if vaccine coverage decreases locally below the herd immunity threshold. Herd immunity is especially important because it provides indirect protection for those who are not yet or cannot be vaccinated, such as newborns and immunocompromised individuals.9 Recent measles outbreaks in the United States and Europe, in which more than 31,000 cases were reported in 2013,10 notably resulted from insufficient vaccination rates.11-13

**Vaccine hesitancy**

As illustrated by the street interviews of people in three European capitals presented at the symposium (Figure 1), the continuum of public opinion ranges from pro- to anti-vaccine attitudes.4, 14 In a literature review, five categories of parents were identified.15 At one end are pro-vaccine people who do not question the value of vaccines (30–40% of the population) and those who have only minor concerns (25–35%). Then, there are hesitant people who have significant concerns but still vaccinate their children (20–30%), followed by those who question vaccines and may delay one or two recommended vaccines, or who may not vaccinate against certain diseases (2–27%). Finally, a few people refuse all vaccines (<2% of the population).15

Vaccine confidence implies trust in the concept of prevention through vaccination, the vaccine product, and manufacturers, the policy-makers responsible for national vaccine programmes, and the HCPs who administer the vaccines. The HCP play a critical role in the vaccine confidence landscape. On one hand, they exert the strongest influence on parents regarding vaccination decisions, yet, on the other hand, they are themselves increasingly reported to be vaccine hesitant about one or more vaccines.5

**Health in the digital era**

An increasing number of people use the internet to find information about health, including vaccination.16 A survey conducted in the United States in 2013 showed that 59% of the adults and 72% of the internet users had searched online for health information within the previous year.17 In the industrialised world, a third of mobile phone owners look at health information via their phones and a fifth of smartphone owners have downloaded a health application, mostly about exercise, diet, or weight.18 It was forecast that 500 million people would be using mobile health applications by the end of 2015.19 However, most applications that claim to deal with health are not evidence-based.20-22

As an example, in Canada in 2015, television was still the primary source of health information but the proportion of persons who rely on the internet for health information increased by 11% from 2007 to 2015 (from 32% to 43%) and was much higher in young adults (64% for 18–34 year-olds in 2015).23 In addition, approximately 80% of these persons changed at least one behaviour as a consequence of this health information.23 A survey of 5,648 persons in six European countries (Great Britain, Sweden, the Netherlands, Spain, Germany, and France)showed that, despite being considered a relatively untrustworthy resource, the internet was still the third most popular source of health information, after general practitioners and pharmacists.24 The rate may vary by country; however, it shows an overall trend that is worth consideration.

With the development of social media such as Facebook, Twitter, and personal blogs, communication has been made easier and border-free. Compared to traditional communication channels, information and misinformation can be shared between people without the intervention of educated professionals.16 Perceptions on vaccine risk can now travel globally and spread virally. This raises the possibility that any gaps in the information provided by vaccine manufacturers, HCPs, or health authorities may be filled by unverified sources. In addition, social media can act as an “echo chamber”, by which people find their own negative opinions confirmed in the rumours, misinformation, and personal opinions disseminated by others. This can reinforce individual beliefs whether or not the information is supported by scientific evidence.25

Larson and colleagues created an online information media surveillance system to detect emerging global public concerns about vaccines.26 They analysed data from 10,380 media reports obtained between May 2011 and April 2012 from 144 countries. Approximately 69% of these reports contained positive or neutral content about vaccines and 31% contained negative content. Of the latter, 24% were associated with impacts on vaccine programmes and disease outbreaks; 21% with beliefs, awareness, and perceptions about vaccines; and 16% each with vaccine safety and vaccine delivery programmes (Figure 2). These data show that the nature of public concerns about vaccines is complex and highly diverse and that, although concerns about vaccines vary geographically, global dissemination of some concerns has occurred and been enhanced by internet-based communication.27-29

**The “umbrella approach” to protection**

Our collective view is that the vaccination paradigm needs to shift from vaccination with a childhood connotation to an “umbrella approach” of protection for the whole family, with the goal of improving health and reducing morbidity in all age groups.30 Indeed, vaccination programmes are not limited to young children but also include all other age categories, such as adolescents (e.g., human papillomavirus, meningitis), adults and older adults (e.g., influenza, diphtheria, tetanus, pertussis, *Streptococcus pneumoniae*), and travellers (e.g., hepatitis A, yellow fever).31 At all ages, every consultation with a HCP could thus be used as an opportunity to raise the issue of disease prevention, including vaccination, which should have a central role in healthy living, along with other measures such as a healthy diet and exercise. An important aspect is that physicians’ attitudes and the language they use heavily influence whether parents decide to vaccinate their children or not.32 Opel and colleagues found that parents in the United States were more likely to accept vaccination for their child if the vaccine provider used a presumptive (e.g., “Well, we have to do some shots”) rather than a participatory (e.g., “What do you want to do about shots?”) format to initiate the vaccine recommendation (74% vs. 4% accepted).32

**How can trust be enhanced?**

It has been stated that “trust takes years to build, seconds to break, and forever to rebuild”. This may also apply to vaccines. One of the most famous vaccination controversies started with an article from Andrew Wakefield et al. in *The Lancet* in 1998suggesting an association between the mumps, measles, and rubella (MMR) vaccine and autism in children. 33 This concern was greatly amplified by the media.34 This article was eventually retracted after being deemed fraudulent 35, 36 but, more than 15 years later and despite the numerous studies that have failed to show a link between the MMR vaccine and autism,37 some parents continue to harbour scepticism about this vaccine and coverage remains suboptimal in some regions or counties in several countries, including the United Kingdom, France, and the United States.38-41 The amplification of concern by the media illustrates its pervasive impact on public perceptions of risk and that “strong beliefs about risk, once formed, change very slowly and are extraordinarily persistent in the face of contrary evidence”.42 We recommend that HCPs listen to their patients, take time to answer their questions and understand their concerns, and adapt their communication to each individual and follow-up on the decision at a later stage.

We are aware that the lack of trust in the vaccine manufacturers, and in the pharmaceutical industry in general, is linked to the fact that they make profits from selling vaccines. People may perceive that vaccine industry employees, including the scientists who develop the vaccines, have a vested interest in highlighting the benefits of vaccines and hiding their risks.2 Similarly, people may consider that, for financial reasons, vaccine manufacturers inappropriately influence health authorities to recommend and physicians to administer vaccines. For these reasons, all industry and vaccination stakeholders should examine their own behaviour according to an approved Code of Conduct/Ethics. However, words captured in such codes can only come to life through actions and behaviours.2, 43 Authorities and pharmaceutical companies thus decided to disclose payments to HCPs who provide consultancy to the companies.44-48 In addition, one of the major vaccine manufacturers, GSK Vaccines, announced in 2013 major changes in the way they will engage with HCPs as from 2016 (e.g., end direct payments to HCPs for speaking about their products and transfer decisions about sponsorship for attendance at medical conferences to independent third parties).49

We consider transparency to be crucial at every stage of research and communication: in assessing the burdens of disease, in determining the efficacy and safety of vaccines, in the decision-making processes for vaccination policies, and in safety surveillance after licensure.2 To facilitate transparency, several pharmaceutical companies, including major vaccine manufacturers, have established a platform for external scientists (https://ClinicalStudyDataRequest.com) to access clinical trial data and provide opportunities to conduct further research that may help advance science or improve patient care. We believe that a multi-stakeholder approach that includes public-private partnerships to build trust in vaccines is highly relevant. Informed, accurate, understandable, appropriate, and trusted communication is also needed, but communicating such knowledge alone is not the panacea for behavioural change.50 The process is a complex one that entails cultural factors, attitudes, motivations, experiences, information needs, social norms, and structural barriers. It is therefore important that health communication research identify effective communication interventions and tailored approaches.50

**Health communication in the digital era**

In the age of the internet and mass communication, power has shifted from doctors to their patients.51 People have now become central actors of their own health and need to be recognized and informed as such. When individuals turn to the internet for vaccination advice, anti-vaccine websites can influence their decision to vaccinate. Most of these websites use narratives to increase the perceived risk of adverse events. Such narratives describing negative experiences with adverse events after vaccination are easy to understand and highly emotional.16, 52 By contrast, the current tools used by the medical community and public health authorities include evidence-based information such as statistics or research, which are more difficult to communicate and understand. Such approaches may not be sufficient to convince vaccine-hesitant people. Storytelling strategies, such as those used by the anti-vaccine movements (i.e., providing positive narratives about vaccination), combined with evidence-based information could allow a much stronger response against the anti-vaccine arguments.25 A recent Canadian initiative, supported by UNICEF, is an example of promoting positive vaccination conversation by HCPs through an interactive website by posting articles and stories on social media “to gain points” with the aim and motto of “act locally, vaccinate globally”.53

From our perspective, the medical community needs to seriously address concerns about the value of vaccination, both at the individual and societal levels, by introducing scientific evidence in the context of trustful parent-physician relationships. Policy-makers should invest more in proactive communication strategies to disseminate the results in an understandable way.24, 54 Investing in regular and continuous positive communication on the role and value of vaccines when infectious diseases are under control will combat vaccine complacency and avoid communicating about vaccines only when safety issues or outbreaks arise.2 The typical life cycle of vaccination programmes has been illustrated by the US Centers for Disease Control and Prevention (Figure 3).55, 56 Because coverage and vaccine efficacy are never 100%, some individuals will always remain susceptible to a disease. When the number of susceptible individuals reaches a critical point, for instance following the discovery of a safety issue or because of access issues, new outbreaks may arise many years after the disease had apparently disappeared.55, 56 Evidence-based information is thus needed before reaching this critical point. Since 2005, the European Immunization Week campaign, coordinated by the World Health Organization regional office for Europe, offers the perfect opportunity for countries and regions to attach proactive and reactive local initiatives and communication activities about vaccines and vaccination programmes.57

**Targeted communication**

In addition to universal communication, tailored communication (i.e., adapted to different populations) is needed. For instance, messages for adolescents and young adults are more beneficial if provided through the internet and social media, whereas messages for people older than 55 are more effective if they are televised or in newspapers.23 In 2013, the World Health Organization published a guide for tailoring immunisation programmes in the European region.58, 59 This guide provides tools to identify susceptible populations, determine demand- and supply-side barriers to vaccination, and implement evidence-based interventions. These strategies may be used at any time to maintain high coverage rates but may be particularly valuable for areas having low vaccination coverage or for populations who are highly susceptible to vaccine-preventable diseases. Tailored programmes have been successfully implemented in more than five countries so far and have resulted in improved healthcare access for migrants in Sweden and Roma populations in Bulgaria, and have identified barriers to vaccination among the ultra-orthodox Jewish communities in Greater London.59, 60

**Educational programmes**

Because all HCPs have a role in vaccination, courses on immunology and vaccinology should be incorporated (if not already) into the medical curriculum of physicians, pharmacists, midwives, and nurses. As an example, seasonal influenza vaccination is recommended for HCPs but vaccination uptake is often low.61 Various interventions, including education, have been explored to increase this uptake, although benefits of these interventions remains variable.62, 63 Similarly, efforts should be made to reinforce appropriate medical exposure and research orientation for journalists so that they can provide the public with accurate information.

Children could also be educated at school about vaccination and vaccines, so that future generations may better understand the benefits of vaccination for a healthy living for both themselves and the society in general. Besides educating people on the safety and efficacy of vaccines, it is also important to educate them about the severity of the diseases and the risks of not getting vaccinated, especially when such diseases are rare due to vaccination. This could be accomplished as it is currently for healthy diet, exercise, alcohol, drugs, or sexual behaviour education programmes.

Research in cognitive psychology has shown that people are more likely to remember “sticky myths” than their corrections, because revising pre-existing beliefs in light of new facts demands more cognitive efforts.64 Highlighting the degree of medical consensus increases perceived scientific agreement, which acts as a consequential gateway belief by promoting favorable public attitudes towards vaccination.65

**Recommendations for vaccination “to go viral”**

Whereas public confidence is a linchpin of successful vaccination programmes, we believe that a collective approach will be essential to help build and maintain confidence in vaccines and vaccination programmes and, therefore, to reach and sustain the vaccination coverage required to eliminate vaccine-preventable diseases. This approach should involve the pharmaceutical industry, policy-makers, and HCPs with the help of anthropological and social sciences and health media communication. We have listed the contributions of each stakeholder in Table 1, that we consider essential to increase confidence in vaccination in the digital age.

**Conclusion**

Converting the results of vaccine research into successful vaccination programmes, and replacing misinformation with evidence-based communication, will require a multidisciplinary, cohesive, targeted, and managed approach that embraces internet based applications and smartphone technology to reach out to all populations. The vaccine community needs to be aware that the current contextual dynamics of the internet and social media could impact the delivery and acceptance of vaccination programmes in the digital age. With the help of anthropological and social sciences and health media communication, we consider that it is time for the industry, policy-makers, and HCPs to embrace the digital age of communication and for vaccination “to go viral”.

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**References**

1. Larson HJ, Cooper LZ, Eskola J, Katz SL, Ratzan S. Addressing the vaccine confidence gap. Lancet. 2011;378:526-535.

2. Hardt K, Schmidt-Ott R, Glismann S, Adegbola RA, Meurice FP. Sustaining Vaccine Confidence in the 21st Century. Vaccines. 2013;1:204-224.

3. Dube E, Vivion M, MacDonald NE. Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: influence, impact and implications. Expert Rev Vaccines. 2015;14:99-117.

4. Dube E, Laberge C, Guay M, Bramadat P, Roy R, Bettinger J. Vaccine hesitancy: an overview. Hum Vaccin Immunother. 2013;9:1763-1773.

5. Larson H, Schulz W, Vaccine confidence project team, the SAGE working group on Vaccine Hesitancy. The state of vaccine confidence 2015 [The Vaccine Confidence Project web site]. 2015. Available at: http://www.vaccineconfidence.org/The-State-of-Vaccine-Confidence-2015.pdf. Accessed March 21, 2016.

6. MacDonald NE, Hesitancy SWGoV. Vaccine hesitancy: Definition, scope and determinants. Vaccine. 2015;33:4161-4164.

7. Ahmed SS, Plotkin SA, Black S, Coffman RL. Assessing the safety of adjuvanted vaccines. Sci Transl Med. 2011;3:93rv92.

8. Maglione MA, Das L, Raaen L, et al. Safety of vaccines used for routine immunization of U.S. children: a systematic review. Pediatrics. 2014;134:325-337.

9. Kim TH, Johnstone J, Loeb M. Vaccine herd effect. Scand J Infect Dis. 2011;43:683-689.

10. Muscat M, Shefer A, Ben Mamou M, et al. The state of measles and rubella in the WHO European Region, 2013. Clin Microbiol Infect. 2014;20 Suppl 5:12-18.

11. Sugerman DE, Barskey AE, Delea MG, et al. Measles outbreak in a highly vaccinated population, San Diego, 2008: role of the intentionally undervaccinated. Pediatrics. 2010;125:747-755.

12. Gahr P, DeVries AS, Wallace G, et al. An outbreak of measles in an undervaccinated community. Pediatrics. 2014;134:e220-228.

13. Clemmons NS, Gastanaduy PA, Fiebelkorn AP, et al. Measles - United States, January 4-April 2, 2015. MMWR Morb Mortal Wkly Rep. 2015;64:373-376.

14. Peretti-Watel P, Larson HJ, Ward JK, Schulz WS, Verger P. Vaccine hesitancy: clarifying a theoretical framework for an ambiguous notion. PLoS Curr. 2015;7.

15. Leask J, Kinnersley P, Jackson C, Cheater F, Bedford H, Rowles G. Communicating with parents about vaccination: a framework for health professionals. BMC Pediatr. 2012;12:154.

16. Betsch C, Brewer NT, Brocard P, et al. Opportunities and challenges of Web 2.0 for vaccination decisions. Vaccine. 2012;30:3727-3733.

17. Pew Internet. Mobile Health 2013. [Pew Research Center web site]. 2013. Available at: http://pewinternet.org/Reports/2013/Health-online.aspx. Accessed March 15, 2016.

18. Pew Internet. Mobile Health 2012. [Pew Research Center web site]. 2012. Available at: http://pewinternet.org/Reports/2012/Mobile-Health.aspx. Accessed September 15, 2015.

19. research2guidance. mHealth App Developer Economics 2014 [Research2guidance web site]. 2014. Available at: http://mhealtheconomics.com/mhealth-developer-economics-report/. Accessed July 13, 2015.

20. Breton ER, Fuemmeler BF, Abroms LC. Weight loss-there is an app for that! But does it adhere to evidence-informed practices? Transl Behav Med. 2011;1:523-529.

21. Bender JL, Yue RY, To MJ, Deacken L, Jadad AR. A lot of action, but not in the right direction: systematic review and content analysis of smartphone applications for the prevention, detection, and management of cancer. J Med Internet Res. 2013;15:e287.

22. Odone A, Ferrari A, Spagnoli F, et al. Effectiveness of interventions that apply new media to improve vaccine uptake and vaccine coverage. Hum Vaccin Immunother. 2015;11:72-82.

23. Research Canada. CanadaSpeaks 2015. A National Public Opinion Poll on Health and Medical Research [Research Canada web site]. 2015. Available at: http://www.rc-rc.ca/media-1. Accessed July 13, 2015.

24. Bouder F, Way D, Lofstedt R, Evensen D. Transparency in Europe: A Quantitative Study. Risk Anal. 2015.

25. Shelby A, Ernst K. Story and science: how providers and parents can utilize storytelling to combat anti-vaccine misinformation. Hum Vaccin Immunother. 2013;9:1795-1801.

26. Larson HJ, Smith DM, Paterson P, et al. Measuring vaccine confidence: analysis of data obtained by a media surveillance system used to analyse public concerns about vaccines. Lancet Infect Dis. 2013;13:606-613.

27. Larson H, Brocard Paterson P, Erondu N. The globalization of risk and risk perception: why we need a new model of risk communication for vaccines. Drug Saf. 2012;35:1053-1059.

28. Larson HJ, Wilson R, Hanley S, Parys A, Paterson P. Tracking the global spread of vaccine sentiments: the global response to Japan's suspension of its HPV vaccine recommendation. Hum Vaccin Immunother. 2014;10:2543-2550.

29. Milstien J, David Griffin P, Lee JW. Damage to immunisation programmes from misinformation on contraceptive vaccines. Reprod Health Matters. 1995;3:24-28.

30. Michel JP, Lang PO. Promoting life course vaccination. Rejuvenation Res. 2011;14:75-81.

31. Kanitz EE, Wu LA, Giambi C, et al. Variation in adult vaccination policies across Europe: an overview from VENICE network on vaccine recommendations, funding and coverage. Vaccine. 2012;30:5222-5228.

32. Opel DJ, Heritage J, Taylor JA, et al. The architecture of provider-parent vaccine discussions at health supervision visits. Pediatrics. 2013;132:1037-1046.

33. Wakefield AJ, Murch SH, Anthony A, et al. Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. Lancet. 1998;351:637-641.

34. Poland GA, Spier R. Fear, misinformation, and innumerates: how the Wakefield paper, the press, and advocacy groups damaged the public health. Vaccine. 2010;28:2361-2362.

35. The editors of The Lancet. Retraction--Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. Lancet. 2010;375:445.

36. Deer B. How the case against the MMR vaccine was fixed. BMJ. 2011;342:c5347.

37. Demicheli V, Rivetti A, Debalini MG, Di Pietrantonj C. Vaccines for measles, mumps and rubella in children. Cochrane Database Syst Rev. 2012;2:CD004407.

38. McHale P, Keenan A, Ghebrehewet S. Reasons for measles cases not being vaccinated with MMR: investigation into parents' and carers' views following a large measles outbreak. Epidemiol Infect. 2015:1-6.

39. Health and Social Care Information Centre. NHS Immunisation Statistics England 2013-14 [HSCIC web site]. 2014. Available at: http://www.hscic.gov.uk/catalogue/PUB14949. Accessed September 15, 2015.

40. Hill HA, Elam-Evans LD, Yankey D, Singleton JA, Kolasa M. National, State, and Selected Local Area Vaccination Coverage Among Children Aged 19-35 Months - United States, 2014. MMWR Morb Mortal Wkly Rep. 2015;64:889-896.

41. Institut de Veille Sanitaire. Couverture vaccinale rougeole, rubéole, oreillons (%) à 24 mois par région. [InVS web site]. 2015. Available at: http://www.invs.sante.fr/Dossiers-thematiques/Maladies-infectieuses/Maladies-a-prevention-vaccinale/Couverture-vaccinale/Donnees/Rougeole-rubeole-oreillons/Infra-nationales/Couverture-vaccinale-rougeole-rubeole-oreillons-a-24-mois. Accessed September 15, 2015.

42. Covello V, Sandman PM. Risk communication: Evolution and revolution. In: Wolbarst A, ed. Solutions to an Environment in Peril. Baltimore, MD: John Hopkins University Press; 2001:164-178.

43. Begg N. Trust in Vaccines: Why It Takes More than Good Faith. Vaccines. 2013;1:343.

44. GSK. Healthcare professionals [GSK web site]. 2015. Available at: http://uk.gsk.com/en-gb/healthcare-professionals/. Accessed October 13, 2015.

45. Pfizer. Payments to Health Care Professionals [Pfizer web site]. 2014. Available at: http://www.pfizer.com/responsibility/working\_with\_hcp/payments\_to\_hcp. Accessed October 13, 2015.

46. Sanofi. Public disclosure of payments [Sanofi web site]. 2015. Available at: http://www.sanofi.co.uk/l/gb/en/layout.jsp?scat=1F2EF5C5-8417-4F3F-BD31-D538277F0D70. Accessed October 13, 2015.

47. Roche. ABPI Code Reporting [Roche web site]. 2014. Available at: https://www.roche.co.uk/home/corporate-responsibility/abpi-code-reporting.html. Accessed October 13, 2015.

48. AstraZeneca. Physician engagement [AstraZeneca web site]. 2013. Available at: http://www.astrazeneca-us.com/responsibility/corporate-transparency/physician-engagement. Accessed October 13, 2015.

49. GSK. Press Release: GSK announces changes to its global sales and marketing practices to further ensure patient interests come first [GSK web site]. 17 Dec 2013 2013. Available at: https://www.gsk.com/en-gb/media/press-releases/2013/gsk-announces-changes-to-its-global-sales-and-marketing-practices-to-further-ensure-patient-interests-come-first/. Accessed October 13, 2015.

50. European Centre for Disease Prevention and Control. Communication on Immunisation - Building trust. ECDC Technical Document. 2012.

51. Kata A. Anti-vaccine activists, Web 2.0, and the postmodern paradigm--an overview of tactics and tropes used online by the anti-vaccination movement. Vaccine. 2012;30:3778-3789.

52. Betsch C, Renkewitz F, Betsch T, Ulshofer C. The influence of vaccine-critical websites on perceiving vaccination risks. J Health Psychol. 2010;15:446-455.

53. Public Health Association of British Columbia. I Boost Immunity [Public Health Association of BC web site]. 2015. Available at: http://www.iboostimmunity.ca/. Accessed March 21, 2016.

54. MacDonald N, Picard A. [A plea for clear language on vaccine safety]. CMAJ. 2009;180:E2-3, 697-698.

55. Centers for Disease Control and Prevention. Life-cycle of an Immunization Program [CDC web site]. 2014. Available at: http://www.cdc.gov/vaccines/vac-gen/life-cycle.htm. Accessed July 13, 2015.

56. Chen RT, Rastogi SC, Mullen JR, et al. The Vaccine Adverse Event Reporting System (VAERS). Vaccine. 1994;12:542-550.

57. World Health Organization Regional Office for Europe. European Immunization Week [WHO web site]. 2015. Available at: http://www.euro.who.int/en/health-topics/disease-prevention/vaccines-and-immunization/european-immunization-week. Accessed September 15, 2015.

58. World Health Organization - Regional Office for Europe. The Guide to Tailoring Immunization Programmes (TIP). [WHO web site]. 2013. Available at: http://www.euro.who.int/en/health-topics/communicable-diseases/poliomyelitis/publications/2013/guide-to-tailoring-immunization-programmes. Accessed September 15, 2015.

59. Van Damme P, Lindstrand A, Kulane A, Kunchev A. Commentary to: Guide to tailoring immunization programmes in the WHO European Region. Vaccine. 2015;33:4385-4386.

60. Butler R, MacDonald NE, Sage Working Group on Vaccine Hesitancy. Diagnosing the determinants of vaccine hesitancy in specific subgroups: The Guide to Tailoring Immunization Programmes (TIP). Vaccine. 2015;33:4176-4179.

61. Mereckiene J, Cotter S, Nicoll A, et al. Seasonal influenza immunisation in Europe. Overview of recommendations and vaccination coverage for three seasons: pre-pandemic (2008/09), pandemic (2009/10) and post-pandemic (2010/11). Euro Surveill. 2014;19:20780.

62. Lytras T, Kopsachilis F, Mouratidou E, Papamichail D, Bonovas S. Interventions to increase seasonal influenza vaccine coverage in healthcare workers: a systematic review and meta-regression analysis. Hum Vaccin Immunother. 2015:0.

63. Macdonald L, Cairns G, Angus K, de Andrade M. Promotional communications for influenza vaccination: a systematic review. J Health Commun. 2013;18:1523-1549.

64. Lewandowsky S, Ecker UK, Seifert CM, Schwarz N, Cook J. Misinformation and Its Correction: Continued Influence and Successful Debiasing. Psychol Sci Public Interest. 2012;13:106-131.

65. van der Linden SL, Clarke CE, Maibach EW. Highlighting consensus among medical scientists increases public support for vaccines: evidence from a randomized experiment. BMC Public Health. 2015;15:1207.

**Figure AND TABLE Legends**

**Figure 1.** Public opinions about vaccines.

The street interviews were conducted in London, Paris, and Berlin in April 2015. The figure was presented at a satellite symposium at the 33rd European Society of Paediatric Infectious Disease (ESPID) conference in Leipzig, Germany, in May 2015. The figure was created by Drs. Pauline Paterson and Heidi Larson at The Vaccine Confidence Project at the London School of Hygiene & Tropical Medicine.

**Figure 2.** Typology of data categories in negative reports.

Analysis of the 8354 data categories associated with the 3209 negative reports obtained between May 2011 and April 2012 from 144 countries. Figure reproduced from Larson H.J. et al. Lancet Infect Dis 2013 with permission.26

**Figure 3.** Life cycle of a vaccination programme.

Potential stages in a vaccination programme, showing the interactions between vaccination coverage, disease incidence, and incidence of vaccine adverse events. Figure adapted from Chen R.T. et al. Vaccine 1994 with permission.56

**Table 1.** Stakeholder contributions essential to increase confidence in vaccination

**Figures AND TABLES**

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**Table 1.** Stakeholder contributions essential to increase confidence in vaccination

|  |  |
| --- | --- |
| **Stakeholders** | **Contributions** |
| Anthropologists | * Evaluate how and when beliefs about vaccines are formed and how they spread
* Evaluate how to identify communities at risk of vaccine-preventable disease outbreaks
* Help develop evidence-based strategies to guide HCPs on how best to communicate the importance of vaccination programmes to vaccine-hesitant patients and parents
 |
| The vaccine industry | * Produce evidence that vaccines are immunogenic, effective, and have an adequate safety profile
* Inform on how vaccines work, and on how they are developed, manufactured, and released
* Ensure that vaccine supplies are sufficient to meet the needs
* Public-private partnership initiatives should be encouraged to ensure the best use of existing vaccines and the development of vaccines needed for the future
 |
| Policy-makers | * Provide transparent, evidence-based vaccination recommendations. European Union-wide recommendations may be preferred to improve consistency among countries
* Invest in communication so that factual, honest, complete, and understandable information is transmitted to end-users
* Invest in universal and tailored programmes of communication adapted to different sub-populations
* Invest in vaccine education for schools, universities, and post-graduates
 |
| Healthcare professionals | * Be well-informed through continuous education programmes on vaccine-preventable infectious diseases and vaccines available for different age groups to deliver accurate information about vaccination to patients and parents
* Strive to bring whole families under the umbrella protection of vaccination in the context of global healthcare preventive measures. Immunisation should be considered as a social norm for healthy living and be regarded as a lifelong choice.
* Recognise that vaccine confidence and uptake have social and psychological elements attached and be aware of the contextual dynamics.
 |
| Journalists | * Know how to best identify, process, and report legitimate medical information to the general public
* Be vigilant and avoid headline news that is based on anecdotes rather than on evidence-based medicine, as media can provide a link between scientists, HCPs, and healthcare users
 |