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RESEARCH PAPER

How often people google for vaccination: Qualitative and quantitative insights from a systematic search of the web-based activities using Google Trends

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ABSTRACT

Nowadays, more and more people surf the Internet seeking health-related information. Information and communication technologies (ICTs) can represent an important opportunities in the field of Public Health and vaccinology.

The aim of our current research was to investigate a) how often people search the Internet for vaccination-related information, b) if this search is spontaneous or induced by media, and c) which kind of information is in particular searched. We used Google Trends (GT) for monitoring the interest for preventable infections and related vaccines.

When looking for vaccine preventable infectious diseases, vaccine was not a popular topic, with some valuable exceptions, including the vaccine against Human Papillomavirus (HPV). Vaccines-related queries represented approximately one third of the volumes regarding preventable infections, greatly differing among the vaccines. However, the interest for vaccines is increasing throughout time: in particular, users seek information about possible vaccine-related side-effects. The five most searched vaccines are those against 1) influenza; 2) meningitis; 3) diphtheria, pertussis (whooping cough), and tetanus; 4) yellow fever; and 5) chickenpox.

ICTs can have a positive influence on parental vaccine-related knowledge, attitudes, beliefs and vaccination willingness. GT can be used for monitoring the interest for vaccinations and the main information searched.

KEYWORDS
Google Trends; vaccination; Web 2.0

Introduction

Vaccination represents an important, effective tool for preventing infectious diseases or, at least, reducing their burden. Therefore, ensuring a high acceptance and coverage rate during vaccination campaigns is crucial.[1] However, phenomena such as anti-vaccination[2] and vaccine hesitancy,[3,4] vaccine resistance or vaccine refusal[5] could jeopardize what has been achieved so far thanks to herd immunity, leading to re-emerging infectious diseases and outbreaks.

Clinicians still represent a fundamental source of health-related information,[1] even though in the last years the Internet has rapidly become a widely used source of information, thanks to the rise of interactive content and social networking (e.g., Facebook, Twitter and YouTube, among others). This "new" Internet, termed as "Web 2.0," is characterized by the blurring of the difference between the user and the webmaster: the user is, at the same time, both consumer and producer (the so-called prosumer model).[6] The Web, and in particular the Web 2.0, has deeply changed the way that people can use the Internet to seek information on vaccines.[7-9] In Holland, 45.8% of parents do not judge sufficient the information received by the Dutch National Immunization Program and actively search for extra information.[7] According to a cross-sectional study performed by Bianco and colleagues, 29.6% of Italian parents search for vaccination.[8] Searching the web for vaccination-related information can have a positive impact on vaccination willingness. McRee and collaborators investigated the Internet-related behaviors of North Carolina parents of daughters and found that mining the Web looking for information about HPV vaccine was a predictor of higher level of HPV knowledge, disease perception and vaccination willingness and a predictor of lower level of vaccination hesitancy and worriness for vaccination-related side effects.[9] In a study performed by Barak-Corren and Reis in Israel, Internet-related activities were a proxy of vaccination compliance.[10]

On one hand, the widespread use of rapidly updated, interactive content has not only increased the potential audience base for Internet based information, but has made impossible to regulate and discipline from a normative point of view

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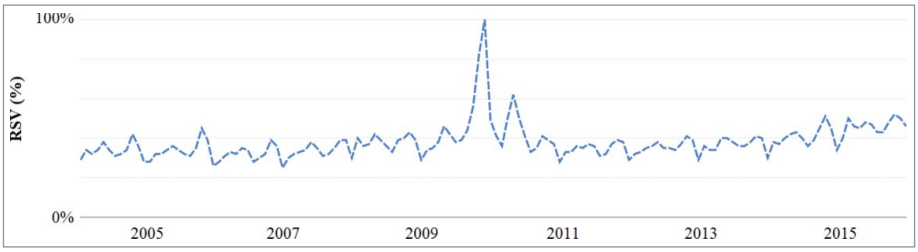

Figure 1. Interest toward vaccines in the study period 2004–2015 as captured by Google Trends.

the information that reaches parents searching for vaccine information. Even though vast and abundant,[11] information available in the Internet is not always reliable. Further, much of the Internet-based vaccine information that reaches parents contains content that overly discourages vaccination practices.[12-14] This content is displayed in pages which are frequently returned from search engines and are high-ranked.[15] Further, this content is reported adopting a language that mimics scientific standards, trying to legitimate itself and claiming scientific veracity.[12] The information in the Web regarding MMR [16] is generally consistent and reliable, but websites do not report accurate, complete and consistent information about influenza,[17] and HPV,[18] among others. Some information, for example concerning antenatal vaccinations, is even lacking in

Table 1. List of preventable infectious diseases mined in the present study, together with the used keyword(s) both for the infectious disease and the corresponding vaccine. The period of time in which the query was performed is also indicated.

Preventable infectious diseases	Used keyword(s) for the infectious disease	Used keyword for the vaccine	Period time
Anthrax	Anthrax [Disease] + Anthrax bacterium [Bacteria] + 2001 Anthrax attack [Event]	Search topic option not available	From inception
Cervical Cancer (Human Papillomavirus)	Cervical cancer [Disease or medical condition]	HPV vaccines [Vaccine]	From 2006 on
Diphtheria	Diphtheria [Disease or medical condition]	Diphtheria vaccine [Drug] + DTP vaccine [Vaccine]	From inception
Hepatitis A	Hepatitis A [Infectious disease]	Hepatitis A vaccine [Vaccine]	From inception
Hepatitis B	Hepatitis B [Infectious disease]	Hepatitis B vaccine [Vaccine]	From inception
Haemophilus influenzae type b (Hib)	Haemophilus influenzae [Bacteria]	Hib vaccine [Vaccine]	From inception
Human Papillomavirus (HPV)	HPV*	HPV vaccines [Vaccine]	From 2006 on
Influenza (Flu)	Influenza [Infectious disease]+ Influenza A virus [Virus] + Influenza A virus subtype H1N1 [Cause of death] + 1918 flu pandemic [Disaster]	Influenza vaccine [Vaccine]	From inception
Japanese encephalitis (JE)	Japanese encephalitis	Japanese encephalitis vaccine [Drug]	From inception
Measles	Measles [Contagious disease]	Measles vaccine [Condition prevention factors] + MMR vaccine [Vaccine]	From inception
Meningococcal infection	Meningitis [Medical condition] + Meningococcus [Bacteria]	Meningococcal vaccine [Vaccine]	From inception
Mumps	Mumps [Viral disease] + Mumps virus [Virus]	MMR vaccine [Vaccine]	From inception
Pertussis	Pertussis [Contagious disease] + Bordetella Pertussis [Bacteria]	Pertussis vaccine [Drug]	From inception
Pneumococcal infection	Streptococcus pneumoniae [Bacteria] + Pneumococcal pneumonia [Disease or medical condition]	Pneumococcal vaccine [Medical treatment]	From inception
Polio	Poliomyelitis [Infectious disease] + Poliovirus [Disease cause]	Polio vaccine [Vaccine] + DTP vaccine [Vaccine]	From inception
Rabies	Rabies [Viral disease] + Rabies virus [Virus]	Rabies vaccine [Vaccine]	From inception
Rotavirus	Rotavirus [Virus]	Rotavirus vaccine [Topic]	From inception
Rubella	Rubella [Disease] + Rubella virus [Disease cause]	Rubella vaccine [Drug] + MMR vaccine [Vaccine]	From inception
Shingles (Herpes Zoster)	Shingles [Viral disease]	Zoster vaccine [Vaccine]	From 2006 on
Smallpox	Smallpox [Infectious disease]	Vaccination against smallpox [Topic]	From inception
Tetanus	Tetanus [Disease or medical condition	DTP vaccine [Vaccine]	From inception
Typhoid fever	Typhoid fever [Disease]	Search topic option not available	From inception
Typhus	Typhus [Disease] + Epidemic typhus [Disease]	Search topic option not available	From inception
Tuberculosis (TB)	Tuberculosis [Infectious disease] + Latent tuberculosis [Disease]	BCG vaccine [Vaccine]	From inception
Varicella (Chickenpox)	Chickenpox [Contagious disease]	Varicella vaccine [Vaccine]	From inception
Yellow Fever	Yellow fever [Viral disease] + Yellow fever mosquito [Insect]	Yellow fever vaccine [Drug]	From inception

*search term option

Table 2. Top and rising queries and top and rising topics related to preventable infectious diseases and vaccination in the study period 2004–2015 as captured by Google Trends. Abbreviations: RSV (Relative Search Volume).

Preventable infectious diseases	Related top query	Related rising query	Related top argument	Related rising argument	Ratio RSV preventable disease/RSV related vaccine (%)
Anthrax	Not among the first 10	Not among the first 10	Not among the first 10	Not among the first 10	—
Cervical Cancer (Human Papillomavirus)	Not among the first 10	1	1	1	17.31
Diphtheria	Not among the first 10	3	4	2	3.85
Hepatitis A	10	8	4	4	15.68
Hepatitis B	Not among the first 10	Not among the first 10	4	2	10.67
Haemophilus influenzae type b (Hib)	Not among the first 10	1	3	Not among the first 10	164.86
Human Papillomavirus (HPV)	3	2	1	1	11.11
Influenza (Flu)	Not among the first 10	Not among the first 10	3	Not among the first 10	16.67
Japanese encephalitis (JE)	Not among the first 10	Not among the first 10	Not among the first 10	Not among the first 10	—
Measles	Not among the first 10	4	3	1	34.78
Meningococcal infection	9	Not among the first 10	2	1	37.29
Mumps	Not among the first 10	Not among the first 10	4	Not among the first 10	62.96
Pertussis	6	3	1	1	1.72
Pneumococcal infection	10	Not among the first 10	Not among the first 10	Not among the first 10	230.00
Polio	6	1	1	1	26.42
Rabies	9	7	1	1	6.85
Rotavirus	9	2	1	2	13.51
Rubella	Not among the first 10	Not among the first 10	2	1	2.50
Shingles (Herpes Zoster)	Not among the first 10	1	5	1	3.75
Smallpox	Not among the first 10	Not among the first 10	Not among the first 10	Not among the first 10	2.04
Tetanus	2	1	2	1	7.41
Typhoid fever	Not among the first 10	Not among the first 10	Not among the first 10	Not among the first 10	—
Typhus	Not among the first 10	Not among the first 10	Not among the first 10	Not among the first 10	—
Tuberculosis (TB)	Not among the first 10	Not among the first 10	Not among the first 10	Not among the first 10	5.13
Varicella (Chickenpox)	Not among the first 10	Not among the first 10	3	1	4.23
Yellow Fever	6	2	1	1	5.56

the Web.[19] This can have a negative impact on parental decision, even among educated parents.[20] A study performed in the USA found that first-time expectant mothers searching for vaccine-related information in the Internet were more likely to delay one or more recommended vaccinations.[21]

On the other hand, workers in the field of the Public Health can exploit the new technologies[22] in order to provide lay-people with updated, neutral and credible information, increase vaccine confidence.[23] For example, the State Health Departments in the USA exploit Facebook to post vaccine-related information (7% of the totally posted content).[22] In particular, considering that a decisional process is computationally complex and taking into account the interactive, multidimensional, multi-tasking nature of the Web 2.0, the Internet can represent the proper platform to support and facilitate the decision whether to vaccinate or not.[24,25] Information alone, indeed, is not enough: it can create awareness and facilitate acceptance, but results more effective when actively supported.[26,27] Some examples of Internet-based platforms are: GoHealthyGirls.org,[28,29] VaccinarSi[30] and the project "Hermes," which is trying to promote Internet αbetization among pediatricians in the Region Tuscany (Italy). These aids appear to be effective and also cost-effective.[31]

The Internet can be exploited also for promoting vaccination-related advocacy[32] and for increasing education among health-care workers,[33] especially in low- and middle-income countries (LMICs).[34] In an investigation performed in Melbourne, Australia, the Internet proved to be an effective mean for increasing participation and coverage rate during the influenza vaccination campaign.[35]

The aim of our current research was to investigate a) how often people search the Internet for vaccination-related information, b) if this search is spontaneous or induced by media, and c) which kind of information is in particular searched.

Results

In general, the interest for vaccines as general topic is stable throughout the period 2004-present, apart from a peak in November 2009, associated with the 2009 pandemic influenza (Fig. 1). The used keywords for top and rising queries and top and rising topics related to preventable infectious diseases and vaccination, as well as the chosen time period, are shown in Table 1.

Generally speaking, when looking for vaccine preventable infectious diseases, vaccine was not a popular topic, with some valuable exceptions, including the vaccine against HPV (Table 2). Vaccines-related queries represented approximately a third of the queries generated by looking for infections, namely 31.10 $\pm$ 56.70% of the volumes regarding preventable infections (median 10.89%; range 1.72–230.00%).

Vaccine-related queries are generally influenced by media coverage (Table 3).

However, the interest for vaccines is increasing throughout time: in particular, users seek information about possible vaccine-related side-effects (Table 3). The five most searched vaccines are those against 1) influenza; 2) meningitis; 3) diphtheria, pertussis (whooping cough), and tetanus; 4) yellow fever; and 5) chickenpox.

Table 3. Vaccine-related queries in terms of interest and potential impact of the media coverage.

Preventable infectious diseases	Interest toward vaccine	Related queries	Media influence
Anthrax	Not enough volume	Not enough volume	Not enough volume
Cervical Cancer (Human Papillomavirus)	Stable	Side effects (breakout); use of vaccine in men (breakout)	10 peaks due to media coverage
Diphtheria	Rising	Use during pregnancy (breakout); side effects (breakout)	4 peaks due to media coverage
Hepatitis A	Stable	Vaccine schedule (breakout); general information	1 peak due to media coverage
Hepatitis B	Rising	Vaccine schedule (breakout); general information	2 peaks due to media coverage
Haemophilus influenzae type b (Hib)	Stable	General information	1 peak due to media coverage
Human Papillomavirus (HPV)	Stable	Side effects (breakout); use of vaccine in men (breakout)	10 peaks due to media coverage
Influenza (Flu)	Stable	Swine flu (breakout); side effects	6 peaks due to media coverage
Japanese encephalitis (JE)	Rising	General information (breakout)	4 peaks due to media coverage
Measles	Stable	Side effects (breakout); link with autism (breakout); vaccine schedule (breakout); general information	10 peaks due to media coverage
Meningococcal infection	Stable	General information	6 peaks due to media coverage
Mumps	Rising	Side effects (breakout); link with autism (breakout); vaccine schedule (breakout); general information	10 peaks due to media coverage
Pertussis	Rising	General information (breakout); use during the pregnancy (breakout)	4 peaks due to media coverage
Pneumococcal infection	Stable	Vaccine schedule (breakout)	4 peaks due to media coverage
Polio	Rising	Use during pregnancy (breakout); side effects (breakout)	1 peak due to media coverage
Rabies	Rising	Veterinary use (breakout)	1 peak due to media coverage
Rotavirus	Rising	General information (breakout); vaccine schedule (breakout)	6 peaks due to media coverage
Rubella	Stable	Side effects (breakout); link with autism (breakout); vaccine schedule (breakout); general information	10 peaks due to media coverage
Shingles (Herpes Zoster)	Rising	Age (breakout); cost (breakout)	6 peaks due to media coverage
Smallpox	Not enough volume	Not enough volume	
Tetanus	Rising	Use during pregnancy (breakout); side effects (breakout)	4 peaks due to media coverage
Typhoid fever	None	None	2 peaks due to media coverage
Typhus	None	None	2 peaks due to media coverage
Tuberculosis (TB)	Rising	Side effects (breakout)	3 peaks due to media coverage
Varicella (Chickenpox)	Rising	Disease symptoms (breakout); vaccine schedule (breakout)	3 peaks due to media coverage
Yellow Fever	Rising	General information (breakout)	Not enough volume

Discussion

Our finding that approximately one third of the health-related queries regards vaccines is in agreement with the result obtained by Bianco et al.[36] The query volumes considerably vary according to the searched vaccine.

This research has shown great interest for vaccination against HPV. This is in agreement with data from the literature, that indicate that most users are female adolescents. Also searching if it safe or not to uptake vaccines during pregnancy confirms the previous finding.

Another interesting observation is that users often search for vaccines-related side-effects. This is in agreement with what found by a Dutch study[7] and, more generally, with other studies concerning drugs.[37,38] This underlines the importance of properly communicating the risks that may be related to a vaccination, even though rare. ICTs can play a role also regarding this aspect. Vaxtracker, for example, is a web-based platform for the adverse events.[39]

This study has some limitations. GT only captures the search behavior of a certain segment of the population – those with Internet access and those using Google rather than other search engines (although Google is the most common search engine). However, the major limitation of GT is the lack of detailed information on the method by which Google generates this search data and the algorithms it employs to analyze it.

Another limitation of the current study is that we cannot speculate about a putative relationship between mandatory vaccination policies and public interest for vaccines, in that these policies differ greatly among different countries.[45] This issue could be properly addressed only at single country level.

Finally, although some privacy issues exist in using Google Web search data, tracing individuals that conduct online searches when signed into their accounts and recording and analyzing data about users' characteristics, such as gender and age, intent of web search and "search outcomes" could improve the usefulness of this tool for public health and health education purposes.

Conclusion

ICTs can have a positive influence on parental vaccine-related knowledge, attitudes, beliefs and vaccination willingness, but can also lead to misinformation and vaccine concerns and problematization. As such, the web should be monitored and exploited by health-care workers working in the field of Public Health.

GT can be used for monitoring the public interest for vaccinations and explore the main information searched. This knowledge could help health-care workers in properly addressing people's concerns and doubts about vaccinations.

Material and methods

Google Trends (GT), an online tracking system of Internet hit-search volumes that recently merged with its sister project Google Insights for Search (Google Inc.), was used to explore Internet activity related to the currently preventable infectious diseases and respective, available vaccines.

GT has been extensively used in the field of infectious diseases, both for monitoring and surveillance purposes[40-43] and for investigating the public interest for epidemic outbreaks, especially in terms of reaction to media coverage.[44,45]

Searches can be performed using "search term" or "search topic" option. The first strategy enables to search exactly what entered by the user, while in the second search approach, GT enables to search all websites not only including that given keyword but related to the entered term. We focused our analysis on the "Related Searches" section, which shows queries (and not keywords) that are related to the entered terms (which are instead true keywords). In particular, GT distinguishes between top and rising queries. Top queries are the most popular or "evergreen" queries within the used search parameters, and, as such, tend to stay relatively consistent across time periods. On the contrary, rising queries tend to increase in term of relative interest. This rise in interest is expressed in percentage; with the term "breakout," GT indicates an increase above 5,000%.

The list of infectious diseases currently preventable with vaccines was downloaded from the US Centers for Disease Control and Prevention (CDC) and systematically searched on GT.

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

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References

[1] Omer SB, Salmon DA, Orenstein WA, deHart MP, Halsey N. Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases. N Engl J Med 2009 May 7; 360(19):1981-8; PMID:19420367; http://dx.doi.org/10.1056/NEJMsa0806477

[2] Davies P, Chapman S, Leask J. Antivaccination activists on the world wide web. Arch Dis Child 2002 Jul; 87(1):22-5; PMID:12089115; http://dx.doi.org/10.1136/adc.87.1.22

[3] Salmon DA, Dudley MZ, Glanz JM, Omer SB. Vaccine hesitancy: Causes, consequences, and a call to action. Vaccine 2015 Nov 27; 33 Suppl 4:D66-71.

[4] Jacobson RM, St Sauver JL, Finney Rutten LJ. Vaccine Hesitancy. Mayo Clin Proc 2015 Nov; 90(11):1562-8; PMID:26541249; http://dx.doi.org/10.1016/j.mayocp.2015.09.006

[5] Justich PR. Refusal to have children vaccinated: A challenge to face. Arch Argent Pediatr 2015 Oct; 113(5):443-8; PMID:26294150

[6] Betsch C, Brewer NT, Brocard P, Davies P, Gaissmaier W, Haase N, Leask J, Renkewitz F, Renner B, Reyna VF, Rossmann C, Sachse K, Schachinger A, Siegrist M, Stryk M. Opportunities and challenges of Web 2.0 for vaccination decisions. Vaccine 2012 May 28; 30 (25):3727-33; PMID:22365840; http://dx.doi.org/10.1016/j.vaccine.2012.02.025

[7] Harmsen IA, Doorman GG, Mollema L, Ruiter RA, Kok G, de Melker HE. Parental information-seeking behaviour in childhood vaccinations. BMC Public Health 2013 Dec 21; 13:1219; PMID:24358990; http://dx.doi.org/10.1186/1471-2458-13-1219

[8] Bianco A, Zucco R, Nobile CG, Pileggi C, Pavia M. Parental information-seeking behaviour in childhood Parents seeking health-related information on the Internet: cross-sectional study. J Med Internet Res 2013 Sep 18; 15(9):e204; PMID:24047937; http://dx.doi.org/10.2196/jmir.2752

[9] McRee AL, Reiter PL, Brewer NT. Parents' Internet use for information about HPV vaccine. Vaccine 2012 May 28; 30(25):3757-62; PMID:22172505; http://dx.doi.org/10.1016/j.vaccine.2011.11.113

[10] Barak-Corren Y, Reis BY. Internet activity as a proxy for vaccination compliance. Vaccine 2015 May 15; 33(21):2395-8; PMID:25869888; http://dx.doi.org/10.1016/j.vaccine.2015.03.100

[11] Chatterjee A. Vaccine and immunization resources on the World Wide Web. Clin Infect Dis 2003 Feb 1; 36(3):355-62.

[12] Davies P, Chapman S, Leask J. Antivaccination activists on the world wide web. Arch Dis Child 2002 Jul; 87(1):22-5; PMID:12089115; http://dx.doi.org/10.1136/adc.87.1.22

[13] Tafuri S, Gallone MS, Gallone MF, Zorico I, Aiello V, Germinario C. Communication about vaccinations in Italian websites: a quantitative analysis. Hum Vaccin Immunother 2014; 10(5):1416-20; PMID:24607988; http://dx.doi.org/10.4161/hv.28268

[14] Guidry JP, Carlyle K, Messner M, Jin Y. On pins and needles: how vaccines are portrayed on Pinterest. Vaccine 2015 Sep 22; 33(39):5051-6; PMID:26319742; http://dx.doi.org/10.1016/j.vaccine.2015.08.064

[15] Fu LY, Zook K, Spoehr-Labutta Z, Hu P, Joseph JG. Search Engine Ranking, Quality, and Content of Web Pages That Are Critical Versus Noncritical of Human Papillomavirus Vaccine. J Adolesc Health 2015 Nov 7; 58(1):33-9; PMID:26559742.

[16] Miyasaki MR, Alejo RS, Yamamoto LG. MMR vaccine information on the Internet World Wide Web. Hawaii Med J 2003 Mar; 62(3):49-52; PMID:12703174

[17] Oncel S, Alvur M. How reliable is the Internet for caregivers on their decision to vaccinate their child against influenza? Results from googling in two languages. Eur J Pediatr 2013 Mar; 172 (3):401-4; PMID:23143529; http://dx.doi.org/10.1007/s00431-012-1889-z

[18] Bodemer N, Müller SM, Okan Y, Garcia-Retamero R, Neumeyer-Gromen A. Do the media provide transparent health information? A cross-cultural comparison of public information about the HPV vaccine. Vaccine 2012 May 28; 30(25):3747-56; PMID:22421558; http://dx.doi.org/10.1016/j.vaccine.2012.03.005

[19] Chamberlain AT, Koram AL, Whitney EA, Berkelman RL, Omer SB. Lack of Availability of Antenatal Vaccination Information on Obstetric Care Practice Web Sites. Obstet Gynecol 2016; 127(1):119-26.

[20] Barbieri CL, Couto MT. Decision-making on childhood vaccination by highly educated parents. Rev Saude Publica 2015; 49:18; PMID:25830870; http://dx.doi.org/10.1590/S0034-8910.2015049005149

[21] Weiner JL, Fisher AM, Nowak GJ, Basket MM, Gellin BG. Childhood immunizations: First-time expectant mothers' knowledge, beliefs, intentions, and behaviors. Vaccine 2015 Nov 27; 33 Suppl 4:D92-8.

[22] Jha A, Lin L, Savoia E. The Use of Social Media by State Health Departments in the US: Analyzing Health Communication Through Facebook. J Community Health 2016; 41(1):174-9.

[23] Wilson K, Atkinson K, Deeks S. Opportunities for utilizing new technologies to increase vaccine confidence. Expert Rev Vaccines 2014 Aug; 13(8):969-77; PMID:24931799; http://dx.doi.org/10.1586/14760584.2014.928208

[24] Pineda D, Myers MG. Finding reliable information about vaccines. Pediatrics 2011 May; 127 Suppl 1:S134-7.

[25] Connolly T, Reb J. Toward interactive, Internet-based decision aid for vaccination decisions: better information alone is not enough. Vaccine 2012 May 28; 30(25):3813-8; PMID:22234264; http://dx.doi.org/10.1016/j.vaccine.2011.12.094

[26] Thomson A, Robinson K, Vallée-Tourangeau G. The 5As: A practical taxonomy for the determinants of vaccine uptake. Vaccine 2016; 34 (8):1018-24.
[27] Glanz JM, Kraus CR, Daley MF. Addressing Parental Vaccine Concerns: Engagement, Balance, and Timing. PLoS Biol 2015 Aug 7; 13 (8):e1002227; PMID:26252770; http://dx.doi.org/10.1371/journal.pbio.1002227
[28] Starling R, Nodulman JA, Kong AS, Wheeler CM, Buller DB, Woodall WG. Beta-test Results for an HPV Information Web site: GoHealthyGirls.org - Increasing HPV Vaccine Uptake in the United States. J Consum Health Internet 2014 Jan 1; 18(3):226-237; PMID:25221442; http://dx.doi.org/10.1080/15398285.2014.931771
[29] Starling R, Nodulman JA, Kong AS, Wheeler CM, Buller DB, Woodall WG. Usability Testing of an HPV Information Website for Parents and Adolescents. Online J Commun Media Technol 2015 Oct; 5(4):184-203; PMID:26594313
[30] Ferro A, Bonanni P, Castiglia P, Montante A, Colucci M, Miotto S, Siddu A, Murrone L, Baldo V. Improving vaccination social marketing by monitoring the web. Ann Ig 2014 May-Jun; 26(3 Suppl 1):54-64.
[31] Tubeuf S, Edlin R, Shourie S, Cheater FM, Bekker H, Jackson C. Cost effectiveness of a web-based decision aid for parents deciding about MMR vaccination: a three-arm cluster randomised controlled trial in primary care. Br J Gen Pract 2014 Aug; 64(625):e493-9; PMID:25071062; http://dx.doi.org/10.3399/bjgp14X680977
[32] Signorelli C, Odone A. Advocacy communication, vaccines and the role of scientific societies. Ann Ig 2015 Sep-Oct; 27(5):737-747; PMID:26661915
[33] Thielmann A, Viehmann A, Weltermann BM. Effectiveness of a web-based education program to improve vaccine storage conditions in primary care (Keep Cool): study protocol for a randomized controlled trial. Trials 2015 Jul 14; 16:301; PMID:26169675; http://dx.doi.org/10.1186/s13063-015-0824-9
[34] Company A, Montserrat M, Bosch FX, de Sanjosé S. Training in the prevention of cervical cancer: advantages of e-learning. Ecancermedicalscience 2015 Oct 8; 9:580; PMID:26557878
[35] McCarthy EA, Pollock WE, Tapper L, Sommerville M, McDonald S. Increasing uptake of influenza vaccine by pregnant women post H1N1 pandemic: a longitudinal study in Melbourne, Australia, 2010 to 2014. BMC Pregnancy Childbirth 2015 Mar 5; 15:53; PMID:25880530; http://dx.doi.org/10.1186/s12884-015-0486-3
[36] Mao JJ, Chung A, Benton A, Hill S, Ungar L, Leonard CE, Hennessy S, Holmes JH. Online discussion of drug side effects and discontinuation among breast cancer survivors. Pharmacoepidemiol Drug Saf 2013 Mar; 22(3):256-62; PMID:23322591; http://dx.doi.org/10.1002/pds.3365
[37] Kishimoto K, Fukushima N. Use of anonymous Web communities and websites by medical consumers in Japan to research drug information. Yakugaku Zasshi 2011; 131(5):685-95; PMID:21532265; http://dx.doi.org/10.1248/yakushi.131.685
[38] Cashman P, Moberley S, Dalton C, Stephenson J, Elvidge E, Butler M, Durrheim DN. Vaxtracker: Active on-line surveillance for adverse events following inactivated influenza vaccine in children. Vaccine 2014 Sep 22; 32(42):5503-8; PMID:25077424; http://dx.doi.org/10.1016/j.vaccine.2014.07.061
[39] Walkinshaw E. Mandatory vaccinations: The international landscape. CMAJ 2011 Nov 8; 183(16):E1167-8; PMID:21989473; http://dx.doi.org/10.1503/cmaj.109-3993
[40] Carneiro HA, Mylonakis E. Google trends: a web-based tool for real-time surveillance of disease outbreaks. Clin Infect Dis 2009 Nov 15; 49(10):1557-64; PMID:19845471; http://dx.doi.org/10.1086/630200
[41] Yang S, Santillana M, Kou SC. Accurate estimation of influenza epidemics using Google search data via ARGO. Proc Natl Acad Sci U S A 2015 Nov 24; 112(47):14473-8; PMID:26553980; http://dx.doi.org/10.1073/pnas.1515373112
[42] Zhou X, Coiera E, Tsafnat G, Arachi D, Ong MS, Dunn AG. Using social connection information to improve opinion mining: Identifying negative sentiment about HPV vaccines on Twitter. Stud Health Technol Inform 2015; 216:761-5; PMID:26262154
[43] Charles-Smith LE, Reynolds TL, Cameron MA, Conway M, Lau EH, Olsen JM, Pavlin JA, Shigematsu M, Streichert LC, Suda KJ, et al. Using Social Media for Actionable Disease Surveillance and Outbreak Management: A Systematic Literature Review. PLoS One 2015 Oct 5; 10(10):e0139701; PMID:26437454; http://dx.doi.org/10.1371/journal.pone.0139701
[44] Towers S, Afzal S, Bernal G, Bliss N, Brown S, Espinoza B, Jackson J, Judson-Garcia J, Khan M, Lin M, et al. Mass Media and the Contagion of Fear: The Case of Ebola in America. PLoS One 2015 Jun 11; 10(6):e0129179; PMID:26067433; http://dx.doi.org/10.1371/journal.pone.0129179
[45] Alicino C, Bragazzi NL, Faccio V, Amicizia D, Panatto D, Gasparini R, Icardi G, Orsi A. Assessing Ebola-related web search behaviour: insights and implications from an analytical study of Google Trends-based query volumes. Infect Dis Poverty 2015 Dec 10; 4:54; PMID:26654247; http://dx.doi.org/10.1186/s40249-015-0090-9