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Rotavirus and the web: analysis of online conversations in Italy during 2020

Federico Marchetti ^a, Sara Verazza ^b, Margherita Brambilla ^c, and Vincenzo Restivo ^d

^aGSK, Verona, Italy; ^bFamily Pediatrician, Genova, Italy; ^cBlogmeter, Milan, Italy; ^dDepartment of Health Promotion, Maternal and Infant Care, Internal Medicine and Medical Specialties “G. D’Alessandro”, University of Palermo, Palermo, Italy

ABSTRACT

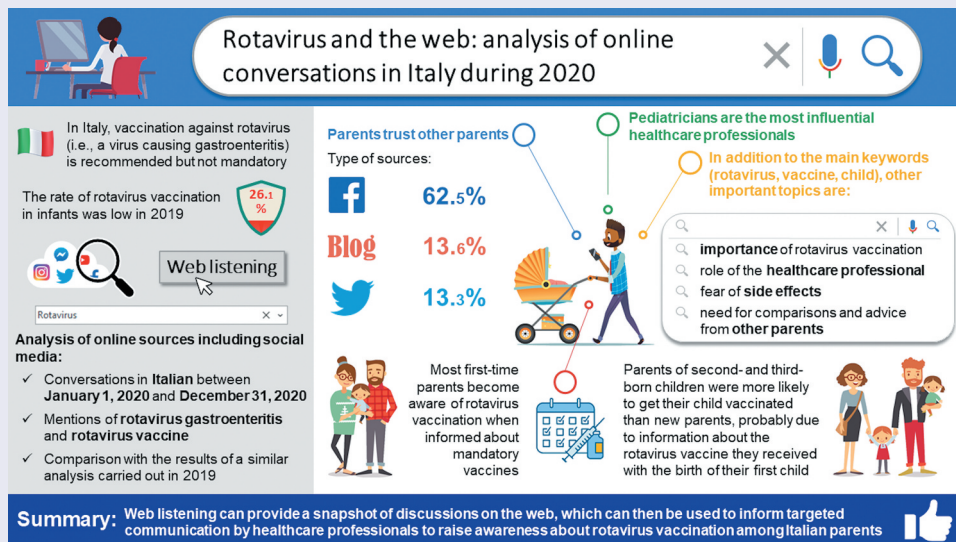
Rotavirus is the most common cause of severe diarrhea among children worldwide. In 2017, Italy included rotavirus vaccination in its National Immunization Program. The use of social media monitoring, an efficient tool to understand vaccine hesitancy, has increased in recent years; however, only a few examples of such monitoring are available for Italy. Present study analyzed content on online sources, including social media, to identify factors contributing to Italian parents’ decisions to vaccinate or not their children against rotavirus. Blogmeter Suite was used to search and analyze conversations related to rotavirus in Italian on online sources during 2020. These data were compared with data from 2019. There were 2250 mentions of “rotavirus” recorded; 1080 were related to the rotavirus vaccine. Terms and hashtags used were similar in both years. Facebook was the main source of influence, Instagram dominated the engagement (the sum of interactions related to a post), and Google Trends showed a 5-year upward trend in searches for rotavirus vaccine. Of 1270 sentiment opinions, 60.7% were negative. More parents were familiar with the disease and the vaccine in 2020 compared with 2019. Pediatricians were the most influential healthcare professionals (59.2% of mentions), followed by vaccination staff (33.4%). The most relevant factors for vaccine hesitancy were fear of adverse events, concerns about the vaccination schedule, and COVID-19. Present study represents the first web listening analysis of online discussions about rotavirus. The results can be used to inform targeted communication to counteract misinformation and raise awareness about rotavirus vaccination among parents.

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Introduction

Rotavirus is the most common cause of severe diarrhea worldwide among children <5 years of age and, until the introduction of the rotavirus vaccine in 2006, was the main cause of mortality in this age group.^{1,2} In 2009, the World Health Organization recommended the inclusion of rotavirus vaccination in the national immunization programs of all countries, especially those most affected by the disease (i.e., ≥10% of mortality in children aged <5 years).³

In Italy, from 2005 through 2012, the annual hospitalization rate due to rotavirus among children <6 years of age was 296/100,000 children; most of these hospitalizations (80.79%) occurred in children <3 years of age.⁴ The distribution of children hospitalizations revealed a typical seasonal peak in March.^{4,5} Fifteen years after rotavirus vaccines were made available in Italy, more than one million babies have been protected with the two-dose human live-attenuated rotavirus vaccine.⁶ Vaccination against rotavirus is included in the

vaccination calendar of the National Vaccine Prevention Plan 2017–2019; it is offered free of charge to all newborns in their first year of life (two or three doses, depending on which of the two available vaccines is used).^{7,8} Rotavirus vaccination is strongly recommended (as is vaccination against *Neisseria meningitidis* serogroup B and C and pneumococcal disease) but not mandatory.⁸ The most recent national data available for rotavirus vaccine uptake in Italy, although referring only to children born in 2017, show rates of vaccinated children significantly lower than the targets initially set by the Ministry of Health: in 2018, national vaccination coverage was 19.4% (ranging between 0.1% and 75.5% in different regions), while the target was >75%; in 2019, coverage was 26.1% (range between regions 1.0% to 72.4%), whereas the target was >95%.^{7,9,10}

The European Centre for Disease Prevention and Control (ECDC) proposed social media monitoring as a new research tool to identify factors that influence the perception of vaccination among a population (e.g., vaccine hesitancy).¹¹ By listening to, monitoring, and analyzing conversations in social media, it is possible to identify what kind of information is being shared in a rapid, real-time manner and subsequently to provide information that counteracts the rumors or misinformation.

Social listening includes the monitoring of social media conversations to identify the topics being discussed and gain an understanding of the mood of individuals posting on social media (i.e., qualitative analysis), while social monitoring focuses on data collection and metrics, such as engagement rates or numbers of mentions (i.e., quantitative analysis).¹² Web listening platforms incorporate softwares capable of performing in-depth semantic network analyses of words, concepts, or sentiments to understand and register the discussions as a person would do. The social media data obtained are organized into conceptual cognitive maps and are prepared for structural, lexical, and semantic analyses. The results of these analyses are organized and stored in databases and reports that are easy to read by users; they can be visualized using visual analytics platforms (such as *Tableau Software*).^{11,13}

The number of studies reporting social media as a source of information about public perception of vaccines has increased in recent years. Various social media platforms were used for these research purposes. For instance, Google Trends was used to monitor interest in preventable infections (e.g., influenza, meningitis, and human papillomavirus) and related vaccines between 2004 and 2016;¹⁴ the search engine Google.fr was used in 2013 to evaluate the strategies and arguments used by vaccine opponents on French-speaking websites;¹⁵ in Poland, posts on the online forum “Nie szczepimy” (“We Don’t Vaccinate”) were examined to study attitudes toward vaccine hesitancy and vaccine refusal among the population;¹⁶ Twitter was used to investigate the proportion of vaccine-related posts linked to webpages of low credibility;¹⁷ Facebook posts were analyzed to investigate trends in perception around influenza vaccines from 2015 to 2018;¹⁸ WhatsApp and Telegram were used to analyze content related to coronavirus disease 2019 (COVID-19) outbreak in Iran;¹⁹ and Sina Weibo, China’s largest social media platform, was used to examine concerns related to the COVID-19 pandemic that were raised and discussed.²⁰

While content related to vaccines is widely present across all social media platforms, only a few examples of web listening in relation to vaccines and vaccination have been carried out in Italy. A set of such studies explored vaccine hesitancy and the perception around maternal immunization among pregnant women.^{21–23} To date, no social listening study relating to rotavirus vaccination has yet been published.

The aim of the present study was to interrogate social media for factors that contribute to the decision of Italian parents to vaccinate or not their child against rotavirus. In addition to identifying the general sentiments, other factors investigated were (1) the influence hubs, or which online actors most influence parents, what is their level of involvement, and in which social media they intervene; (2) the “moment of truth,” or how people become aware of the need to vaccinate their children; (3) the role of healthcare professionals (e.g., nurses, midwives, pediatricians) in the uptake of rotavirus vaccines; (4) the presence and involvement of fathers in online discussions on rotavirus vaccination; (5) the reasons for vaccine hesitancy, such as parental fears of adverse events, and how they influence online conversations (e.g., vaccination plans). These factors were all analyzed a posteriori (i.e., after the extraction of the subsets of data from the corpus obtained through web listening); a description of this framework can be found applied in Andreotta et al.²⁴

Methods

Study design

This was an observational study that involved searching for and analyzing all conversations in Italian on social media related to rotavirus gastroenteritis and rotavirus vaccine, from January to December 2020.

The research design employed a mixed-methods approach that combined both quantitative and qualitative text analysis, according to the four-phased framework delineated by Andreotta et al.²⁴ The available corpus was assessed and divided into keyword-based batches, which were then reported quantitatively. The batches were then assessed to identify topics that were relevant to the research – vaccine hesitancy, factors of influence, key opinion people – from which subsets of data were extracted for more precise qualitative analysis.

When feasible, the results were compared with those from an analysis carried out in 2019 that used a similar methodology on posts searched from November 2018 to July 2019 (not published). Quantitative 2019 data were recalculated on comparable metrics in order to allow robust year-over-year comparison, whereas qualitative results were not always comparable as the timeframes of both analyses were different.

Social media and web analysis

The Blogmeter Suite platform is a proprietary integrated social listening platform that can be used for social media and web analysis. This platform extracts text data from a database of more than 2 billion indexed documents as of end of 2020, collected either from official social media network application programming interfaces (APIs) or proprietary Blogmeter

- (3) Difficulties encountered on the “vaccination journey” (posed by logistical obstacles to rotavirus vaccination, in the context of the COVID-19 pandemic, but also by the discordant or negative opinions of healthcare professionals)
- (4) Negativity around the issue of mandatory vaccination
- (5) Severity of rotavirus gastroenteritis.

Influence hubs

Facebook represented the main source of influence, with 62.5% of mentions of rotavirus, followed by blogs (13.6%), Twitter (13.3%), forums (4.6%), and the news (3.3%) (Figure 2).

The total engagement, i.e., the sum of interactions related to a post, accounted for 24,000. This engagement was dominated by Instagram (62.5%) and driven by influencers such as Ilaria di Vaio and Silvia Cattaneo. Facebook had the next highest level of engagement, at 33.6% (Figure 2).

Online communities dedicated to parenting were the main place where conversations about the rotavirus vaccine took place. The communities *Pancine*, *Mamme & Bimbi* (369 mentions), *Mamme.it* (123), *Mamme & Pancione* (122), *Just4Mom* (72), *Bebè* (68), *NostroFiglio* (52), and *Maternita.it* (51) gathered the highest number of mentions. Other hubs of information were the official page of Roberto Burioni (277), *la Repubblica* (72), and *Corriere della Sera* (31).

Apart from Roberto Burioni and Paolo Bellavite, there were no healthcare professionals animating the online discussions around rotavirus. A further analysis carried out in 2020 (data not shown) confirmed that, of about 1.3 million mentions dealing with various vaccinations (for poliomyelitis, hepatitis, diphtheria, tetanus, pertussis, pneumococcus, measles, mumps, rubella, varicella, influenza, meningitis, and rotavirus), there was no participation by healthcare professionals other than Roberto Burioni. Those animating these discussions were members of the lay media and the previously-mentioned, most active and followed mothers' blog.

Google Trends data

Data from Google Trends showed that the rotavirus vaccine was the subject of more searches and interest than the disease itself. Parents searched for information about rotavirus disease because of the vaccine; for many, this was the moment they became informed about the pathology of the disease.

An analysis of searches over the past five years revealed that the interest of parents in the rotavirus vaccine has grown, with a peak of information-seeking behavior in November 2018 (i.e., coinciding with the first time vaccination certificates were made mandatory for children to attend school). In 2020, interest remained high, but there were no peaks of interest higher than that seen in 2018.

Vaccination journey: the “moment of truth”

Most first-time parents learned about the rotavirus vaccine either from their pediatrician or from the invitation to vaccinate their baby sent to their home by the local health unit. At that point, parents started to seek information on the topic and to decide whether to have the optional (and recommended) vaccinations, such as the rotavirus vaccine, along with the mandatory ones⁸ (Figure 3).

The role of healthcare professionals

As shown in Figure 1, the relationship with and support from healthcare professionals were important in parents' decision-making processes. There were 954 mentions of healthcare professionals, most of which related to pediatricians (59.2%), followed by personnel encountered at the vaccination site, i.e., doctors/nurses (33.4%), and nurses (6.0%). These three groups were potentially able to influence parents to vaccinate their child. A few specific mentions of midwives and healthcare assistants were detected (1.4%).

Despite the trust in healthcare professionals, there was some confusion among parents, principally because of conflicting advices from pediatricians (i.e., some did not recommend

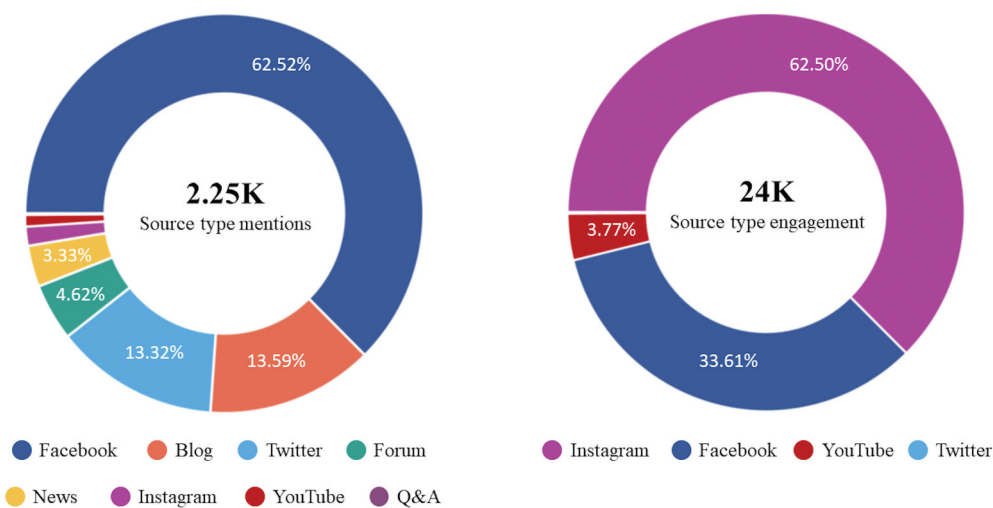


Figure 2. Web sources. Abbreviation: K, thousand.

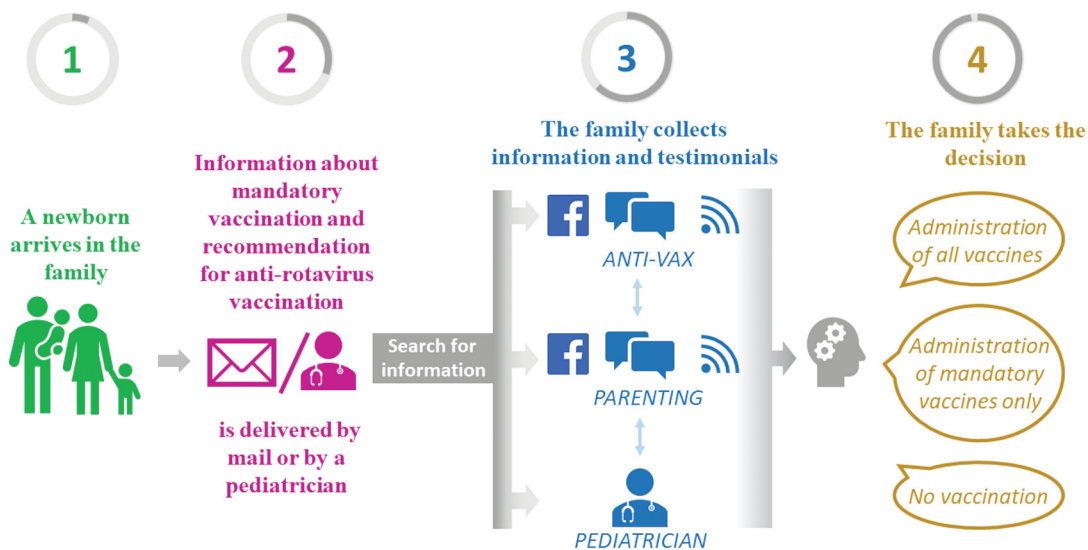


Figure 3. Parents' journey.

rotavirus vaccination for the babies and some even discouraged it). The reason why some pediatricians advised against the vaccine could not be identified.

The role of fathers

The data showed a lower presence of fathers in conversations compared with mothers, with 47 mentions on social media; 31 on Facebook (66.0%) and 12 on blogs (25.5%). Their presence on Instagram, Twitter, news, or forums accounted for just 8.5% of mentions (4 in total).

Fathers were more likely to report their own experience of the rotavirus vaccine on sites other than maternity communities. In these communities (*Pancine*, *Mamme e Bimbi*, *Mamme.it*, and *AlFemminile*), it was challenging to find comments from fathers at all. However, when a community was not gendered, a higher level of participation by fathers was observed.

Regarding the opinions of fathers in terms of rotavirus vaccination, there was no evidence of differences between mothers and fathers.

Factors linked with vaccine hesitancy

Adverse events

Mentions of adverse events represented 17.1% of the total mentions (385/2250 rotavirus mentions). Parents discussed the consequences of the vaccine to either reassure or discourage other parents, depending on their own experience.

Reassuring messages were reported by parents whose children had not experienced any adverse events or only experienced mild symptoms, such as mild fever, bad mood, or stomachache. These parents recommended getting the vaccine.

Discouraging messages were reported by parents whose children had experienced a serious adverse event, such as severe colic, bloody stool, intussusception (intestinal invagination), or conditions requiring hospitalization. These parents therefore strongly advised other parents against child

vaccination. Some families that reported major adverse events following a first dose of the vaccine became “ambassadors” and discouraged parents from having their children vaccinated, against the advice of their pediatrician.

Vaccination schedule

Vaccination schedules were identified as another factor at play in parental decision-making. The proximity of the timing of the recommended optional vaccines (rotavirus and meningococcal disease) was of particular concern.⁸ In some cases, this concern was simply reflected by a change in the vaccination schedule, spacing out the administrations. In other cases, parents decided to skip one or both optional vaccines.

COVID-19

The COVID-19 pandemic had an influence on rotavirus vaccination. The rotavirus vaccine was mentioned in discussions around COVID-19 to explain the mechanism of the new ribonucleic acid (RNA) vaccines against COVID-19, in some cases to reassure. Another consequence of the COVID-19 health emergency was the logistical obstacle for rotavirus vaccination plans, with long delays expected in those areas most affected by the pandemic.²⁵ Some parents and pediatricians were not concerned with the rotavirus vaccine delay, considering it less important than other childhood vaccines.

Comparison with a previous analysis

In a previous analysis, conducted in 2019, 54.6% of the total rotavirus mentions were related to the rotavirus vaccine, compared with 48.0% in 2020. The most reported terms and hashtags in the 2019 analysis were “rotavirus” (785), “child” (364), and “vaccine” (363).

Although a full comparison of the qualitative results of both analyses was not possible due to the different timeframes, the 2020 research roughly confirmed the qualitative findings of the 2019 edition: that parents often discover the vaccine when they receive an official recommendation – from the state or their

pediatrician –, that they look for information in online parenting communities and from their pediatricians, and that they express hesitancy, especially when speaking of adverse events and when discussing the perceived usefulness – or lack thereof – of the vaccine. Compared with 2019, many parents in 2020 reported that they were already aware of rotavirus disease and the need to have their child vaccinated. Parents of second- and third-born children were more likely to have their child vaccinated than new parents, probably due to information about the rotavirus vaccine they received with the birth of their first child.

Discussion

Although previous studies have analyzed social media conversations related to vaccination in Italy,^{26–29} the present study represents the first web listening analysis of the rotavirus vaccine. Posts in Italian on online sources, including social media, were investigated to understand the factors that contribute to Italian parents' decisions to vaccinate their children in 2020. Research in the past has unraveled a strong relationship between consumption of social media and vaccine hesitancy. It was specifically found that users on social media can “self-select content streams, contributing to ideological isolation” and thereby form their opinion on vaccination, as recently demonstrated for the COVID-19 vaccination.³⁰ The approach of identifying in the qualitative analysis content related to vaccination to assess the overall opinions and feelings of people regarding specific vaccines has previously been tested by Basch et al. to assess the safety of pediatric vaccines through analyses of YouTube videos.³¹

Rather than creating a direct link between specific metrics (such as positive or negative sentiment) and vaccine hesitancy, the quantitative data analysis helped us assessing the overall opinion of parents and extracting topic subsets (i.e., factors of influence) in the vaccination journey. Compared with 2019, more parents were aware of rotavirus and the need to have their children vaccinated against it. This increase was probably generated in part by rotavirus disease awareness campaigns specifically designed for parents³² and by campaigns promoting pediatric vaccination in Italy. The latter were carried out by institutions such as the Italian Ministry of Health and National Institute of Health^{33,34} or scientific societies such as the Italian Federation of Primary Care Pediatricians (Federazione Italiana Medici Pediatri; FIMP).³⁵ The personal experiences of other families and the guidance of pediatricians were also important, especially for first-time mothers.

The considerable number of discussions on the web about rotavirus, particularly in Facebook communities, demonstrates the increase in interest, knowledge, and awareness about rotavirus disease and prevention among the population.

Parental journey toward accepting or not rotavirus vaccination for their children begins with advice from their family pediatrician. The journey continues with advice from healthcare personnel when parents attend a vaccination center, and parents are influenced throughout the process by opinions from other parents and suggestions that they read online.

This study showed that most first-time parents received information on the rotavirus vaccine from their family pediatricians and the invitation letter sent to their home by the local health unit. Personal experience is also important, with second- and third-time mothers being more confident and less anxious about vaccinating their children, while first-time mothers need more information and reassurance before having their children vaccinated. Similar behavior was reported by Danchin et al. in a survey of 975 women in Australia published in 2018. The authors found that first-time mothers were more hesitant about vaccinations for their newborns than mothers who already had children.³⁶

The present study highlights a certain level of participation by fathers in online conversations about rotavirus vaccination. Although fathers participate less than mothers, no differences between fathers and mothers could be detected with regard to the nature of their opinions or concerns with regards to rotavirus vaccination. We noted that fathers rarely participate in online maternity communities, which are mostly populated by mothers. The absence of online communities dedicated to paternity means that apparently the voices of fathers remain unexpressed. However, these voices exist, and can be found in publications of non-gendered online communities. This should be kept in mind when framing communication campaigns or counseling programs about childhood vaccination, to ensure a more gender-balanced communication.

The influence of healthcare professionals is crucial for maintaining parental confidence in vaccination,³⁷ as they are considered to exert the greatest influence on parental decision, even when their opinion is in conflict with national vaccination recommendations. However, our study highlighted a lack of participation in online discussions by healthcare professionals. Greater online participation by these professionals would certainly help those parents who are hesitant to make informed decisions with regards to childhood rotavirus vaccination.³⁰

In the present study, we identified several factors linked to vaccine hesitancy. Some of these were shared with the previous analysis, e.g., adverse events; others were new, e.g., the influence of the COVID-19 pandemic and vaccination schedules.

The safety profile of the rotavirus vaccine was not seen to create any alarm in the online discussions. Nevertheless, parents whose child experienced an adverse event following rotavirus vaccination became “ambassadors,” i.e., they discouraged other parents from accepting rotavirus vaccination for their children.

The vaccination schedule was also perceived as a concern for some parents, due to the proximity of timing of the rotavirus vaccine and other vaccinations, in particular the anti-meningococcal vaccine.⁸

The COVID-19 pandemic generated a discussion in which the rotavirus vaccine was used to explain the mechanism of the new RNA vaccines against COVID-19,³⁸ which is not scientifically sound but is of interest to parents. The COVID-19 pandemic also exerted a negative impact on vaccination against rotavirus. Vaccination plans were delayed in areas affected by the pandemic due to logistical obstacles, but also because of parents' fear of COVID-19 infection if they visited a health center. As a result, rotavirus vaccination coverage decreased notably in 2020.²⁵

The findings of this research identified some rotavirus vaccine hesitancy topics. To address those, some existing tools can be recalled, and new programs set up.

As the family pediatrician represent the first line of information for parents, some focused communication tools could be provided to have them help parents make informed decision about childhood rotavirus vaccination (i.e., based on a thorough understanding of risks-benefits). In this perspective, FIMP developed a specific educational program aimed at increasing the ability of family pediatrician to communicate the value of rotavirus vaccination to parents, which is based on video tutorials.^{39,40} Furthermore, FIMP collaborates to populate a web site, supported by GSK, which is dedicated to offer scientifically-validated information on rotavirus disease and prevention to parents.³²

Due to the important role played by peers in influencing hesitant parents, some actions could be postulated to support balanced communication. For example, an institutional web listening service could be set up, to promptly provide scientifically-validated information to individuals engaged in discussions that could lead them to refuse rotavirus vaccination for their children. Such information could include data showing intussusception is a condition that occurs naturally in Italy, independently from rotavirus vaccine implementation,^{41,42} and also that risk factors, such as previous consumption of antibiotics, can independently contribute to the condition.⁴³ Alternatively, if a child experiences an adverse event following rotavirus vaccination, a deeper dialogue with the parents could be started by the family pediatrician and/or public health personnel, to manage expectations in terms of their medical understanding.

Web listening is becoming more popular as a tool for measuring people's sentiments about vaccination. A recent example that highlighted its potential was a systematic scoping review commissioned by ECDC in 2020, which was conducted by researchers from the Vaccine Confidence Project.¹¹ The review concluded that social media monitoring is a plausible way of capturing the nature and direction of online discourses about vaccination and could be helpful in understanding how social media can influence public perceptions and therefore decisions about vaccination. Such information could then be used to restore public confidence in vaccines.¹¹

The European Joint Action on Vaccination project, co-funded by the Health Programme of the European Union (Work Package 8), is conducting a comprehensive analysis of the factors that influence perceptions around vaccines among the general population in different countries. The data generated from the monitoring of social media and web resources will be used to identify the most efficient practices to help overcome vaccine hesitancy.⁴⁴

In Italy, there are various reports of the use of web listening to monitor the insights of web users about vaccinations and to measure trends in hot topics. For instance, in 2017, 560 YouTube videos related to the unfounded link between vaccines and autism or other serious side effects in children were subjected to a quantitative analysis that revealed a negative tone in most of the videos. The authors urged greater engagement on the web by public institutions,

to provide reliable information about vaccination to the population.²⁶ The same platform was used in an observational study carried out from September 2015 to January 2016, in which the search keyword used was "vaccinations." In contrast to previous results, most of the videos were positive in tone, although the most shared and liked videos disapproved of immunization.²⁷

Other platforms have been used for the analysis of measles, mumps, and rubella vaccination coverage in Italy²⁸ and to study the impact of the "FLUAD case."²⁹ The FLUAD case highlighted the crucial need for adequate information campaigns. Following a cluster of deaths related to the administration of an influenza vaccine (FLUAD, Seqirus), two contaminated batches were withdrawn, but no link between the influenza vaccine and the deaths was ever confirmed. Nevertheless, this incident fostered huge media coverage that negatively impacted influenza vaccination coverage.²⁹ These examples highlight the role of new media and the importance of disseminating high-quality information to raise vaccination awareness.

The present study has some limitations. First, at the end of 2019, a technical transition within the Blogmeter Suite was implemented, and the single "post" metric was changed to two metrics, "total messages" and "mentions." In the drafting of the 2020 research, the quantitative data of 2019 were recalculated on the single "mentions" metric in order to allow for a true quantitative year-over-year comparison. However, qualitative results were not always comparable as the timeframe of the 2019 and 2020 analyses were different. Second, there is a lack of comparisons with other studies or research dealing with the same topic, as the use of social media and web listening to study vaccine hesitancy is still a relatively new technique. Some reports and studies have been published, especially in recent years, but the number of such reports in publicly available peer-reviewed journals is still limited.

Web listening analysis provides a snapshot of the content of online discussions. This work represents the first such study focused on parental opinions about rotavirus vaccination. The results can be useful for informing targeted communication by healthcare professionals to raise awareness about vaccination and protect children from rotavirus gastroenteritis.

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Disclosure statement

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ORCID

Federico Marchetti  <http://orcid.org/0000-0001-6435-8990>
 Sara Verazza  <http://orcid.org/0000-0002-6139-4280>
 Margherita Brambilla  <http://orcid.org/0000-0003-3652-4255>
 Vincenzo Restivo  <http://orcid.org/0000-0002-5406-884X>

Authors' contributions

FM and MB participated in the design of the study. FM, SV, and MB participated in the collection of the data; and all authors were involved in the analyses and interpretation of the study. All authors participated in the development of this manuscript and in its critical review, with important intellectual contributions. All authors had full access to the data and gave approval before submission. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The work described was carried out in accordance with the recommendations of the International Committee of Medical Journal Editors for conduct, reporting, editing, and publication of scholarly work in medical journals.

Trademarks

FLUAD is a trademark of Seqirus.

Abbreviations

API	Application programming interface
COVID-19	Coronavirus disease 2019
ECDC	European Centre for Disease Prevention and Control
FIMP	Federation of Primary Care Pediatricians
RNA	Ribonucleic acid

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