

Responses to HPV Vaccination Campaigns in the Netherlands

An analysis of discussions on Twitter

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Abstract

Background: Even though the human papillomavirus vaccine is an effective and safe instrument to decrease HPV infections and cases of several types of cancer, the Dutch HPV vaccination rate has been suboptimal from the start and has even shown a decline in the last two years. This study sought to assess the determinants of HPV vaccination uptake in the Netherlands and how the vaccine and RIVM and GGDTwente messages were discussed on Twitter from 2011 till 2016.

Method: All Dutch language tweets mentioning HPV from the years 2011 till 2016 were collected from a database, amounting to a total of 17319. A content analysis of all tweets was carried out manually. The content of the GGDTwente and RIVM tweets was examined as well as responses to these tweets. Furthermore, the tweets were analyzed for specific determinants of HPV vaccination uptake and general sentiments.

Results: The GGDTwente and RIVM only became truly active on Twitter regarding the HPV vaccination program in 2015. The RIVM tweets received significantly more response, though this response mostly consisted of retweets. Nearly all GGDTwente tweets concerned vaccination schedules. By far the most common determinant of low vaccination uptake in tweets from the public was the fear of side-effects, with scare stories going viral in 2015 and 2016 especially. On the other hand, publications on the high number of HPV infections among women received a lot of attention as well. Overall, the general sentiment towards the HPV vaccine on Twitter was more positive than negative in the first years, but due to stories about side-effects turned more negative in 2015.

Conclusions: The results show that the fear of side-effects is something that needs to be addressed by public health authorities. Additionally, more practical measures such as a school-based vaccination program may be a great way to help increase the vaccination rate.

Preface

This thesis was written as part of the master Public Administration with a specialization in health care. When I heard it was an option to write my thesis on the HPV vaccine I was really excited, because it is a new vaccine and is the first to protect against several types of cancer. Now that the project has come to an end, I am more interested in vaccines than ever! I have also enjoyed diving into the world of Twitter, which can be a confusing but fascinating place.

I would like to thank my supervisors for their time, extensive feedback, and support. First of all, I would like to thank Pieter-Jan Klok, who was always willing to help me out when I needed advice or had a question no matter how often I knocked on his office door. Secondly, I would like to thank Djoerd Hiemstra, without whom I would have never been able to collect my tweets and who offered a fresh perspective on my research and gave useful advice on how to use the internet to my advantage. Finally, I want to thank Ariana Need for introducing me to the topic of vaccines, her enthusiasm for my research, and her amazing support at a time when I was struggling.

Table of Contents

1. INTRODUCTION	6
2. THEORY	9
2.1 FROM LOYAL TO CRITICAL CITIZENS	9
2.2 TO VACCINATE OR NOT TO VACCINATE	10
2.3 DETERMINANTS OF HPV VACCINATION UPTAKE IN THE NETHERLANDS	11
3. METHODOLOGY	16
3.1 DATA COLLECTION	16
3.2 DATA ANALYSIS	17
3.3 ETHICAL CONSIDERATION	18
4. RESULTS	19
4.1 MESSAGE OF THE GGDTWENTE AND RIVM HPV VACCINATION CAMPAIGNS ON TWITTER	19
4.2 RESPONSE TO GGDTWENTE AND RIVM HPV VACCINATION CAMPAIGN MESSAGES	20
4.3 HOW THE GGDTWENTE AND RIVM ADDRESS TWITTER RESPONSES	21
4.4 DETERMINANTS OF HPV VACCINATION UPTAKE ON TWITTER	22
4.5 SENTIMENTS TOWARDS THE HPV VACCINE ON TWITTER	28
5. CONCLUSIONS	31
6. DISCUSSION	32
6.1 THE HPV VACCINATION DEBATE IN THE NETHERLANDS	32
6.2 THE STUDIES ON DETERMINANTS OF HPV UPTAKE	33
6.3 LIMITATIONS	34
6.4 RECOMMENDATIONS	35
REFERENCES	37
APPENDIX 1 SEARCH STRATEGY	41
APPENDIX 2 DETERMINANTS EXPLAINED	42
APPENDIX 3 OVERVIEW OF THE ARTICLES' STUDY DESIGN	44
APPENDIX 4 PYTHON SCRIPT FOR COLLECTING THE TWEETS	48
APPENDIX 5 SELECTION OF TWEETS	49
APPENDIX 6 CODING LIST	50
APPENDIX 7 OVERVIEW OF DETERMINANTS WITHOUT OUTLIERS	52
APPENDIX 8 SANITY CHECK ON THE TWITTER FEED	54

1. Introduction

Every year, approximately 600 to 850 women are diagnosed with cervical cancer in the Netherlands and 200 women die because of the disease (Schurink & Melker, 2017). The human papillomavirus (HPV), mostly genotypes 16 and 18, is widely recognized as the causative agent in cervical cancer and is predominantly transmitted through sexual intercourse (Perez et al., 2018). Besides cervical cancer, the oncogenic HPV genotypes are associated with other types of cancer such as pharynx, anal, and vaginal cancer (Schurink & Melker, 2017). Moreover, genotypes 6 and 11 of HPV are responsible for about 85% of cases of genital warts (Perez et al., 2018). Currently, three vaccines against HPV are on the market: Gardasil 4vHPV¹, Gardasil 9vHPV and Cervarix 2vHPV (Perez et al., 2018). The latter is used in the Netherlands (Gezondheidsraad, 2008)².

In 2009, an HPV vaccination catch-up campaign was launched in the Netherlands and the vaccine was added to the National Immunization Program (NIP)³ for 12-year-olds in 2010 (Pot et al., 2017). Despite an active recruitment campaign, the participation rate of the first dose for girls aged 13 to 16 was 41 percent while 70 percent was expected (Keulen et al., 2013). In 2012, the vaccination rate in the Netherlands was still below 60% (Schurink & Melker, 2017). Even though the Dutch vaccination rate went up in the first few years, the latest data of 2017 show that uptake has decreased to 45.5% (Lier et al., 2018). This percentage is low, especially considering that with a coverage of nearly 100%, the HPV vaccination program could lead to a 76% reduction in cervical cancer-related deaths (Kohli et al., 2007).

In the last decade, much research has been carried out on the determinants of HPV vaccination uptake. Many articles focus on the socio-psychological determinants (Hofman et al., 2013a; Keulen et al., 2013b; among others), while some only examine socio-demographic and organizational factors (Rondy et al., 2010; Mollers et al., 2014). Others examine both (Alberts et al., 2017, among others). Two of the most important determinants are general attitude towards the vaccine and concerns about the safety of the vaccine (Keulen et al., 2013a; Pot et al., 2017). While fear of side-effects has a negative impact on HPV vaccination uptake, positive opinions of family members and friends and a recommendation from a General Practitioner increase the chance of parents opting for the HPV vaccine for their daughter (Keulen et al., 2013a).

¹ Gardasil 4vHPV protects against genotypes 6,11,16 and 18. Gardasil 9vHPV also protects against genotypes 31, 33, 35, 52, and 58 which means it can prevent 80-90% of cervical cancers. Cervarix, the vaccine used in the Netherlands, only protects against genotypes 16 and 18 (Perez et al., 2018).

² The Health Council of the Netherlands (Gezondheidsraad) advised the Dutch government in 2008 to choose the Cervarix vaccine. The most important reasons for this choice were the balance between cost and effectiveness (genotypes 16 and 18 account for most of the cases of cervical cancer) and the fact that genital warts were not considered a very serious condition (Gezondheidsraad, 2008).

³ The National Immunization Program (Rijksvaccinatieprogramma), was founded in 1953 with the introduction of its first vaccine: diphtheria. The NIP is put together by the Secretary of Health Welfare and Sport based on advice from the Gezondheidsraad. Today, the NIP includes vaccines that protect against 12 dangerous infectious diseases, including HPV. (www.rijksvaccinatieprogramma.nl/over-het-programma)

The research that has been carried out on determinants of vaccination uptake in the Netherlands has shown a large number of factors that play a role. However, something that has not gained as much attention is why some of these factors affect HPV vaccination uptake. Why, for example, do some people believe the HPV vaccine was only included in the NIP so the pharmaceutical companies can increase their revenue? Why does the fear of serious side-effects have a much greater impact on the HPV vaccination uptake than other vaccines of the NIP (Lier et al., 2017)? Besides the fact that the HPV vaccine is new and has not yet been proven to work to the extent as older vaccines, a phenomenon that may partly explain the difficulties that have been encountered while introducing the HPV vaccine is the cultural shift from allegiant to assertive citizens (Dalton and Welzel, 2014). For decades, respect for authority has decreased and citizens have become more critical of political institutions (Inglehart, 1999). While parents may have vaccinated their children without giving it much thought in the first decades of the NIP, nowadays parents look for other sources of information in addition to the information that is provided by the responsible authorities such as the National Institute for Public Health and the Environment (RIVM)⁴.

One example of a new source of information is social media, a place where information about vaccines is shared and discussed (Kaptein et al., 2014). In fact, Dunn et al. (2015) show the importance of social media platforms such as Facebook and Twitter as sources of information in the HPV vaccination debate. Their research demonstrates that Twitter users are influenced by exposure to negative opinions in tweets. While organizations such as the Public Health Service of Dutch municipalities (GGD)⁵ post messages on social media platforms, it is unclear how and to what degree their campaign messages are received.

Several studies have been carried out on the expression of HPV vaccine concerns on Twitter (Shapiro et al., 2017; Keim-Malpass et al., 2017) and the correlation between exposure to negative messages on social media and vaccination coverage (Dunn et al., 2017). However, these studies mainly focus on the United States and other English-speaking countries. While Keim-Malpass et al. (2017) acknowledge the importance of public health officials understanding the impact of social media and suggest adapting their communication strategy to this new age of social interaction, little research has been carried out on how social media messages of public health organizations actually impact public perception of the HPV vaccine. This study is a first step to create a better understanding of the discussion of the HPV vaccine on Twitter in the Netherlands and the role the GGD and RIVM play in this debate. Due to time constraints and limited resources, the decision was made to only examine one section of the GGD, the GGDTwente. A descriptive, qualitative approach is used to answer the following

⁴ The RIVM (Rijksinstituut voor Volksgezondheid en Milieu) is an institution that aims to improve public health and create a healthy environment by organizing, for example, the NIP and cancer-screening programs. (rivm.nl/rivm)

⁵ The GGD (Gemeentelijke Gezondheidsdienst) consists of local departments that aim as the RIVM but carry out the more practical tasks to achieve their aims. Examples are giving advice on upbringing, sexual behavior, and providing vaccinations (ggdtwente.nl/over-de-ggd/wat-we-doen)

research question: *How do Dutch Twitter users discuss and respond to the HPV vaccine and GGDTwente and RIVM campaign messages on Twitter from 2011 to 2016?* These discussions and responses will be examined within the context of the theory of a societal transition from loyal to critical citizens as people nowadays often turn to social media for information and advice on issues such as the HPV vaccine instead of contacting and listening to public health organizations such as the GGD. Furthermore, an overview is provided of the determinants of HPV vaccination uptake in the Netherlands that have been discussed in the literature so far. Examining the discussions on Twitter, the reception of campaign messages of the GGDTwente and RIVM and the underlying processes can help us understand why the campaigns have been less successful than is necessary for the population's protection against the virus and how these campaigns could perhaps be improved.

The next chapter will discuss the theory of loyal to critical citizens, the growing importance of social media, developments in the Dutch HPV vaccination rate, and the determinants of HPV vaccination uptake in the Netherlands. In chapter 3, the methodology used for this study is described in detail. The results of the study, with answers to the sub questions, are provided in chapter 4, followed by the conclusion and discussion in chapters 5 and 6 respectively.

2. Theory

2.1 From loyal to critical citizens

From as early as the 1960s, a shift started taking place within Western democracies. While citizens used to be allegiant people who trusted political institutions, nowadays governments struggle with critical, assertive citizens who question the government's decisions (Dalton and Welzel, 2014). Respect for authority has eroded and trust in governmental institutions has declined (Inglehart, 1999). Even though the Netherlands used to be a positive outlier with respect to trust in the political system in comparison to other western democracies, many scholars argue that this country has also seen a decline in the 21st century. Opinions differ, however, on whether the drop in political trust in the Netherlands is a result of structural factors (Hendriks, 2009) and/or political or economic contingencies (Bovens and Wille, 2008). However, Van Ham et al. (2015) argue that claims of a legitimacy crisis in the Netherlands have existed for decades and that actual evidence of a significant decline in trust in the democratic system is thin. Their research does show that trust in political institutions is clearly lower than trust in, for example, the judiciary and the police, but this difference has been stable for many years. Nevertheless, a lack of trust in political institutions combined with increasingly critical citizens can potentially threaten very successful governmental programs such as the NIP. Even the older vaccines of the NIP have shown a decline in uptake, be it not as drastic as the HPV vaccine (Lier et al., 2017).

As Verwij and Houwelingen (2014) argue, the government has a responsibility to protect the basic conditions for public health. This includes organizing vaccination campaigns to protect its citizens against serious diseases such as cervical cancer. However, as is mentioned above, a lack of trust in governmental institutions may impact the public's trust in the vaccines that are part of the NIP. Moreover, as critical citizens, people no longer automatically accept the information that is provided by responsible authorities, but also go online to find out whether there are sources that make claims about the HPV vaccine that contradict the government's message. Over the last decade, social media platforms such as Facebook and Twitter have come to play an important role in the vaccination debate (Shapiro et al., 2017). These platforms function both as sources of information and places where people discuss HPV vaccines (Dunn et al., 2015). One of the important characteristics of these platforms is that there are few restrictions on what can be posted. This means that parents are exposed to sources that offer alternative information than what is provided by the government, information that is often founded in conspiracy theories, stems from dubious sources⁶ and is

⁶ There are numerous websites and social media groups that share (often anecdotal) information on HPV vaccines, mostly about serious side-effects, without providing sources let alone scientific evidence. One example is the Dutch website wijwordenwakker.org that publishes lists of girls suffering from serious side-effects or even dying without being able to prove these claims. <http://wijwordenwakker.org/en/p1876>

in stark contrast with scientific evidence and the side-effects that are published by Lareb⁷ (Dunn et al., 2017). Moreover, Surian et al. (2016) found that people tweeting about harms and conspiracies are more active on Twitter than other users, “suggesting that some users are actively seeking to introduce concerns about HPV vaccines into the public domain (Shapiro et al., 2017, p5). Governmental institutions now face the challenge to not only convince parents to vaccinate their daughters, but to counter alternative information shared on social media as well. On top of that and in stark contrast to other vaccines from the NIP, the government does not only have to deal with critical parents, but the girls being vaccinated as well. These girls are active on social media too and can be just as critical of the HPV vaccine as their parents.

With increasingly critical and assertive citizens and the growing importance of social media in the vaccination debate, it is important to examine how the main responsible authorities for the NIP, the GGD and the RIVM, acknowledge these changes and incorporate them in their use of social media to reach the public. A first step is to look at the messages of these authorities on Twitter and the responses to these messages by the public. Therefore, the following sub questions are formulated:

Sub question 1: What is the message of the HPV vaccination campaign of the GGDTwente and the RIVM on Twitter from 2011 to 2016?

Sub question 2a: How do Twitter users respond to GGDTwente and RIVM Twitter campaign messages from 2011 to 2016?

2b: How do the GGDTwente and RIVM address the responses of Twitter users?

2.2 To vaccinate or not to vaccinate

The introduction of the HPV vaccine to the NIP in the Netherlands has been relatively unsuccessful. The participation rate of the first dose for girls aged 13 to 16 in the catch-up campaign was 41 percent despite an active recruitment campaign (Keulen et al., 2013). This percentage was low in comparison to other European countries (Hopkins and Wood, 2013). In 2011, the first HPV-vaccination year provided by the RIVM⁸, the vaccination rate for 12-year old girls was 56%. Though the vaccination rate slightly increased in the first years, it showed a significant decline in 2016 and decreased to 45.5% in 2017 (Figure 1), far below the aimed 70% (Lier et al., 2017). A decline in vaccination rates for other vaccines of the NIP can be observed as well, but not nearly as significant as the drop in HPV vaccination coverage. One major difference, as was mentioned above, is that the children receiving the HPV vaccine are

⁷ Lareb is the Dutch center for side-effects which publishes all registered side-effects of medications and vaccines on its website. This information can be accessed by the public (lareb.nl).

⁸ These data concern the percentage of girls targeted that year who received the complete HPV vaccine.

much more capable of expressing their own opinion due to their older age and might therefore not receive the vaccine even if their parents are more supportive.

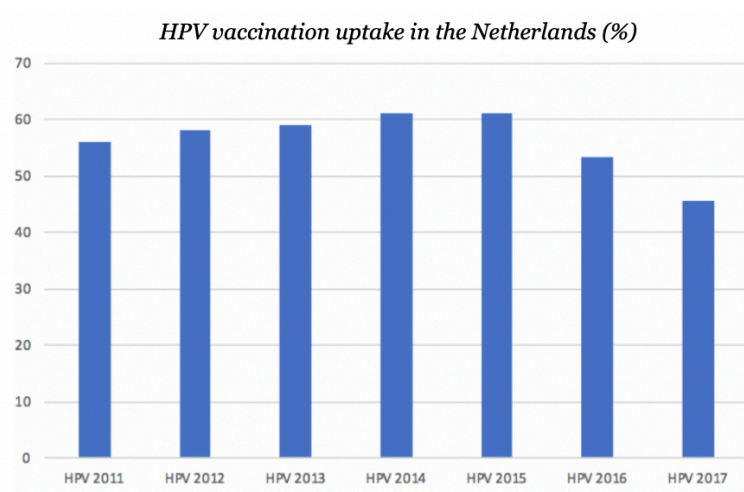


Figure 1

In order to obtain a comprehensive overview of the determinants for the HPV vaccination uptake in the Netherlands, a systematic literature review was carried out. For this review, the databases UT Library, Scopus, Web of Science, and PubMed were used. The following search terms were used⁹: “HPV” and “uptake” or “coverage” and “Dutch” or “Netherlands.” Articles written before 2008 were excluded, as well as medical articles about the virus or the vaccine. Only articles about determinants of HPV vaccination uptake in the Netherlands that were published in journals that use peer review were included. The complete search strategy is shown in appendix 1. The results of the review are described below.

2.3 Determinants of HPV vaccination uptake in the Netherlands

A full overview of the determinants found in articles about the HPV vaccination uptake in the Netherlands is provided in table 1. Determinants are divided into three categories: socio-psychological (related to the attitudes, beliefs and perceptions of people), socio-demographic (related to the background and residence), and organization/practical (how and where was the vaccination program organized). What becomes clear is that most articles have focused on socio-psychological determinants of vaccination uptake. Only Rondy et al. (2010) and Mollers et al. (2014) have focused specifically on socio-demographic and/or organizational determinants¹⁰. The socio-psychological determinants that are found most often are general attitude towards the vaccine, beliefs about the virus and vaccine, subjective norms, and risk perception when not vaccinating. According to most studies, general attitude, beliefs, and

⁹ The search terms did not include “vaccine” or “vaccination” as many variations exist (shot, vaccinate etc.) and there was a risk some relevant articles would thereby be excluded.

¹⁰ Even though the terminology of socio-psychological/socio-demographic is not ideal and categorizing “religious convictions” as a socio-demographic determinant is debatable, the decision was made to use these terms as they most reflect the terminology used by the articles. Constructing a whole new terminology would only create more confusion and does not serve the purpose of this paper.

subjective norms also have the strongest effect on vaccination uptake, with the exception of the study of Genefaite et al. (2012) which showed a more important role for lack of trust in responsible authorities. Among the socio-demographic determinants, religious convictions was found most often. Of determinants related to the organization of the HPV vaccination program, lack of information provided by the government was found most often to have a significant effect on vaccination uptake. What is important here is that most studies simply did not examine determinants related to the organization of the vaccination program. Considering the results of the study carried out by Rondy et al. (2010), these determinants may play a bigger role than how it appears in table 1.

Table 1 Determinants of HPV vaccination uptake¹¹

	Korfage et al 2008	Rondy et al 2010	Genefaite et al 2012	Hofman et al 2013a	Hofman et al 2013b	Keulen et al 2013a	Keulen et al 2013b	Mollers et al 2014	Alberts et al 2017	Patty et al 2017	Pot et al 2017
Socio-psychological											
attitude towards the vaccine					X	X	X		X		X
beliefs about the virus and vaccine (table 2)	X		X	X	X	X	X		X	X	X
subjective norms					X		X		X	X	X
descriptive norms							X		X		
habit strength						X	X		X		X
risk perception when not vaccinating						X	X		X	X	X
confidence/trust in responsible authorities			X			X	X			X	
perceived relative effectiveness				X		X	X				X
cancer in social environment				X	X				X		
anticipated regret when not vaccinating					X	X	X				X
(perceived) lack of information/knowledge				X		X				X	X
parental responsibility for daughter's health				X	X						
Socio-demographic											
religious convictions		X	X		X	X		X	X		X
socio-economic status (level of education)		X			X				X		X
country of birth parents		X				X			X		X
level of urbanization								X			
Organization/practical											
distance to vaccination location		X									
lack of information provided by org.			X		X					X	
GGD cooperating with schools		X									
info meetings with gynecologists		X									
use of local media by GGD		X									
use of incentives		X									

x=a significant relationship was found

¹¹ Table 1 only shows when a significant correlation was found. Whether the correlation is positive or negative is described in the text.

The determinants are described in more detail below. Furthermore, a description of the meaning of the determinants is provided in appendix 2. Moreover, an overview of the methodology used in the articles is provided in appendix 3.

Socio-psychological determinants

This category contains the most determinants that were found in the articles, of which attitude, beliefs, and subjective norms seem to be the strongest predictors of vaccination uptake (Pot et al., (2017); Keulen et al., (2013a) and others). Beliefs about the HPV vaccine and virus is by far the most common determinant that was studied. It contains a number of beliefs (table 2) with perceived safety of the vaccine found as a significant determinant in all studies, which refers to the fear of serious side-effects. Furthermore, general attitude towards the HPV vaccine is an important determinant as well. A positive attitude is related to a higher chance of vaccination (Keulen et al., 2013b). Moreover, the opinion of friends/family and doctors plays an important role too (subjective norms). On top of that, the higher the perceived risk of HPV/cervical cancer, the more likely parents will be to vaccinate their daughter (Patty et al., 2017). This is somewhat related to anticipated regret, as it refers to the level of regret parents/girls will experience when the girl does contract HPV.

Table 2 Beliefs about HPV and the HPV vaccine

	Korfage et al 2008	Genefaite et al 2012	Hofman et al 2013a	Hofman et al 2013b	Keulen et al 2013a	Keulen et al 2013b	Patty et al 2017	Pot et al 2017
Perceived safety of the vaccine (fear of side effects)	X	X	X	X	X	X	X	X
Perceived effectiveness of the vaccine	X		X		X	X	X	X
Lack of knowledge of the vaccine (too new)	X	X			X			
If the government offers the vaccine it will be safe				X	X		X	X
"Big Pharma"		X			X		X	X
Daughter too young/ not yet sexually active					X	X		X
Perceived severity of HPV and/or related diseases		X	X				X	
Prevention is better than cure	X						X	

x=a significant relationship was found

Habit strength, i.e. how much thought is put into the decision, also plays a role as well as trust in responsible authorities: a high level of trust is related to a higher vaccination intention. Interestingly, parents show a higher vaccination intent the less they put thought into the decision (Pot et al., 2017). Perceived relative effectiveness is an interesting determinant as it shows whether parents/girls think there are other ways to prevent contracting HPV than a vaccine. For example, Pot et al. (2017) found that some parents considered the HPV vaccine to be less effective than practicing safe sex and leading a healthy life. Another interesting

determinant is the (perceived) lack of information/knowledge about the vaccine. Not only is an actually measured lack of knowledge related to a lower vaccination rate, people have also expressed that they feel like they do not have enough information/knowledge or are simply unable to make an educated decision (Keulen et al., 2013a; Patty et al., 2017).

Socio-demographic determinants

The literature mentions four socio-demographic determinants of vaccination uptake. The first and most commonly found determinant is religious convictions. An (Orthodox) Protestant background is associated with a lower HPV vaccination rate in comparison to atheists and other Christian movements (Genefaite et al., 2012). Moreover, parents with another (non-Christian) religious background are less likely to vaccinate their daughters than atheists and non-Protestant Christians as well (Alberts et al., 2017). One theory for the lower vaccination uptake is that, besides the argument that vaccinating is interfering with God's plan, the HPV vaccine is considered more problematic than other vaccines as it protects against a sexually transmitted disease and no sex before marriage is a bigger issue in these communities (Hofman et al., 2013a).

Socio-economic status (SES) is a more complicated determinant compared to religious convictions as the articles have shown different results. Rondy et al. (2010) examined SES as one determinant and found a positive relation between higher SES and a higher vaccination uptake. Moreover, Pot et al. (2017) found a higher vaccination uptake for parents with a high level of education in comparison to low education, but a lower level of vaccination for parents with a middle level of education. On the other hand, the research of Hofman et al. (2013b) shows that a higher level of education is related to a lower level uptake. The third determinant in this category is the country of birth of the parents. When one or two parents of a girl were born in another country than the Netherlands, a lower vaccination rate was found (Keulen et al., 2013a). Lastly, Mollers et al. (2014) discovered that highly urbanized areas showed a lower HPV vaccination rate than lower urbanized areas.

Organizational/ practical reasons

This category has received less attention than the other two, but its determinants have been shown to affect vaccination uptake nonetheless. Rondy et al. (2010) looked at the first-year vaccination rate in different areas in the Netherlands and compared it to the way the GGD had organized the HPV vaccination campaign. They found that when the GGD had organized information meetings for parents at schools and when there were meetings with a gynecologist, the vaccination rate was higher. On the other hand, when the GGD had actively

used local media and used incentives¹², vaccination uptake was lower. Furthermore, the farther the vaccination location was from a residence, the lower the vaccination uptake was as well. Another organization determinant that was found is a lack of information provided by the government. Parents complained about receiving too little information about the vaccine and the virus from governmental institutions (Genefaite et al., 2012; Hofman et al., 2013b; Patty et al., 2017).

Considering the long list of determinants of HPV vaccination uptake that can be found in the literature and the growing importance of social media as a source of information and a medium to express opinions on the vaccine, the following sub questions are formulated:

Sub question 3a: Which determinants of HPV vaccination uptake can be found in Dutch tweets from 2011 to 2016?

Sub question 3b: Which sentiment (i.e. negative, positive, neutral) towards the HPV vaccine is most prevalent in the Dutch tweets from 2011 to 2016?

In this chapter, the societal reasons behind the low HPV vaccination rate were discussed as well as the specific determinants. The increasing importance of social media in an age where citizens have already become more critical of governmental institutions poses great challenges for the RIVM and GGD in their effort to protect young women against the human papillomavirus. In the next chapter, the methodology used for this study is laid out. At first, the way the data were collected is described, followed by the method of analysis.

¹² Some GGD departments organized a lottery where girls could win an iPod if they received all three HPV vaccines. Contrary to what was expected, this negatively impacted the vaccination rate as it increased distrust in the safety of the vaccine (Rondy et al., 2010)

3. Methodology

3.1 Data collection

All tweets for this study come from a large database collected by Tjong Kim Sang and Van den Bosch (2013). The Twitter messages were collected with “the filter part of Twitter’s streaming API [application programming interface],” a software that “allows a continuous search of new tweets based on the keywords present in the messages or based on the names of the users that sent the messages” (Tjong Kim Sang and Van den Bosch, 2013, p. 122). In order to find Dutch tweets, a list of 229 Dutch words and hashtags was drafted. Furthermore, the tweets of the 5000 users that post Dutch messages most frequently were collected. To eliminate tweets in other languages, the authors used the language checker libTextCat and the interface language information, which shows what language Twitter users have specified for their Twitter accounts¹³.

For this research, the tweets were collected from the database mentioned above using a Python script¹⁴ (appendix 4). All Dutch tweets mentioning HPV from the years 2011 till 2016 were included, which totaled to 17319. These included the tweets from the GGDTwente and the RIVM¹⁵. However, when inspecting the tweets manually it became clear many were irrelevant. First of all, despite the language check, many tweets in other languages came through. Secondly, there is an e-bike with hpv in its name. Thirdly, many of the tweets that did mention HPV only included a link to another website. The problem here was that many pages were so old that they had been deleted. Using the Internet Archive (archive.org) could have been a solution to this problem, but would have been too time-consuming. Lastly, there were tweets that mentioned HPV in a way that was irrelevant for this study, such as someone mentioning working on a project for school or a nurse giving the vaccinations. Therefore, the decision was made to exclude all tweets that were either in a different language, did not concern the Human Papillomavirus at all, were unusable due to lack of content in the tweet itself, or that were irrelevant in any other way.

Another issue with the collected tweets was the location from which they were sent. Unfortunately, there is only a small proportion of the tweets that contain coordinates in the metadata of the tweet referred to as geo-tags (Dunn et al., 2017). As all Dutch language tweets were collected for this research, tweets sent from Flanders were also included. Even though the Dutch population is much bigger than the Flemish, considering the Flemish HPV vaccination rate is considerably higher, the inclusion of Flemish tweets could have influenced the results (Vandermeulen et al., 2017). Consequently, extra attention was paid to links included in tweets and specific language used to look for signs that the Twitter user was

¹³ For more information on how the tweets were collected see the work of Erik Tjong Kim Sang and Antel van den Bosch (2013).

¹⁴ The tweets used in this research were selected by Djoerd Hiemstra.

¹⁵ The tweets from the GGDTwente and the RIVM were located in the collected data by searching for their Twitter IDs. These were found via gettwitterid.com.

Flemish. For example, if a link included in a tweet ended with “.be”, this tweet was excluded. Furthermore, if a tweet contained words such as “kei” or “allez,” the tweet status was used to find the Twitter user via [`twitter.com/statuses/\(number\)`](https://twitter.com/statuses/(number)) to uncover additional information to establish whether the user was Flemish or Dutch. In case there was evidence the user was Flemish, the tweet was excluded.

After excluding all irrelevant tweets according to the criteria described above, 6615¹⁶ tweets remained that were considered suitable for this study. The way in which these tweets were analyzed is described below.

3.2 Data analysis

A content analysis of all the tweets was carried out manually. Despite the time-consuming work, in this way the tweets could be analyzed in much more detail and more accurately than a computer program may have done. Furthermore, designing a computer program that could analyze the tweets for the specific determinants of HPV vaccination uptake and find all the responses to the tweets of the GGDTwente and the RIVM would have taken even more time and resources. Although studies exist that used computer programs, such as Surian et al. (2016) who used a program for topic modelling and community detection, their methods proved to be problematic for the aim of this study. First of all, some of the studies on Twitter and the HPV vaccine concerns did use a computer program but first analyzed a large number of tweets manually to validate their program (Shapiro et al., 2017). Secondly, in the studies in which a computer program was used, the topics that the tweets were analyzed for were much broader than the specific determinants that this study tried to find in the tweets. In the one study that examined the content of the tweets, the webpages that were linked and the responses to the tweets altogether, the tweets were analyzed manually and collected over a period of two weeks by searching Twitter every hour (Keim-Malpass et al., 2017). Taking everything into consideration, analyzing the tweets manually was the most effective way to obtain a detailed and accurate overview of the data. The method of analysis for each sub question is provided below.

1: What is the message of the vaccination campaign of the GGDTwente and the RIVM on Twitter from 2011 to 2016?

To answer this question, the tweets were examined for four specific messages: a. a call to vaccinate, b. a vaccination schedule (including links to the vaccination schedule), c. more information about the vaccine/HPV, d. a link to more information about the vaccine/HPV. While analyzing the tweets, it became clear a fifth category needed to be added, namely information about the vaccination rate.

¹⁶ An overview of the total number of tweets and tweets excluded is provided in appendix 5.

2a: How do Twitter users respond to GGDTwente and RIVM Twitter campaign messages from 2011 to 2016?

The tweets were analyzed for several potential responses: a. positive response (either a like, a positive comment or a retweet), b. negative response (a negative comment), c. neutral response (a neutral comment), d. a question.

2b: How do the GGDTwente and RIVM address the responses of Twitter users?

The research for this sub question was of an exploratory nature to find out whether these organizations keep track of responses to their messages and how they handle them. There are two types of responses: comments to actual tweets of the GGDTwente and RIVM and responses in a broader sense where one of the organizations is tagged in a tweet. The reactions of the GGDTwente and RIVM to these responses were analyzed through open coding.

3a: Which determinants of HPV vaccination uptake can be found in Dutch tweets from 2011 to 2016?

For this sub question, all the tweets were analyzed for the presence of the determinants provided in tables 1 and 2 with the exception of attitude as this determinant is part of the sentiments examined under sub question 3b. A coding list of all the categories is provided in appendix 5.

3b: Which sentiment towards the HPV vaccine is most prevalent in the Dutch tweets from 2011 to 2016.

The aim of this question is to research which is the predominant sentiment towards the HPV vaccine on Twitter. All (useful) tweets were categorized as either positive, negative, neutral, or doubt. Some tweets were quite clear, for others it was more difficult to decide whether a tweet is positive or negative. For example, one tweet states: “getting the HPV vaccine this afternoon bleh☹”. Despite the tweet containing negative expressions, the fact that the Twitter user does plan to get the vaccine is considered a positive sentiment towards the vaccine. An example of a neutral tweet is when information is provided without an expression of support or opposition: “more girls infected with HPV than expected.”

3.3 Ethical consideration

This study was approved by the Ethical Committee of the Faculty of Behavioural, Management, and Social Sciences of the University of Twente (reference number: 18746).

This chapter discussed the methodology used for this study. All tweets were analyzed manually via an either open or closed coding system depending on the sub question. Below, the results of the research are described.

4. Results

4.1 Message of the GGDTwente and RIVM HPV vaccination campaigns on Twitter

In order to answer sub question 1:

What is the message of the vaccination campaign of the GGDTwente and the RIVM on Twitter from 2011 to 2016?, the tweets of the GGDTwente and RIVM were analyzed for specific messages: call to vaccinate, vaccination schedule, providing information, a link to information, and vaccination uptake. The total number of original¹⁷

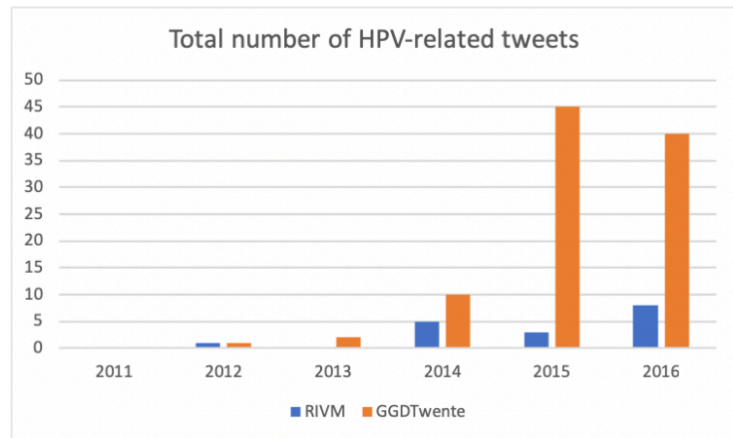


Figure 2

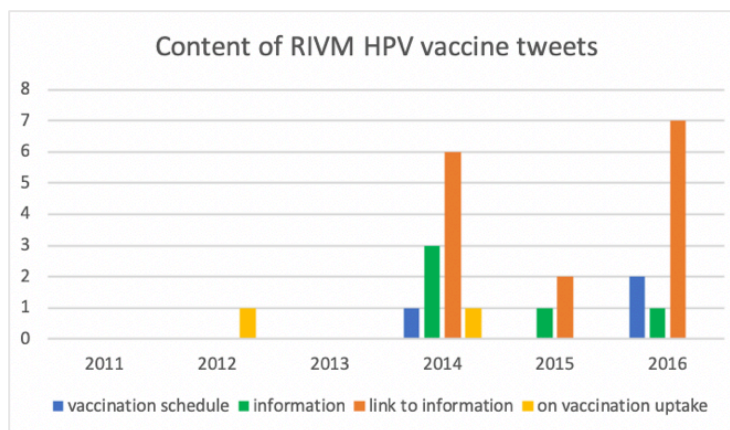


Figure 3

in 2016, the number of tweets from the GGDTwente drastically increased in 2015 and was still relatively high in 2016. The content of the tweets also differs between the two organizations. While the RIVM mostly provided links to pages on its website with more information about the HPV vaccine (figure 3)¹⁸, the majority of the tweets created by the GGDTwente

the RIVM and GGDTwente were very quiet about the HPV vaccination programs from 2011 till 2013. In 2011, neither the RIVM nor the GGDTwente sent out any tweets on the HPV vaccine. Only in 2014 did both organizations increase the use of Twitter.

While the RIVM became a bit more active with a maximum of 8 tweets

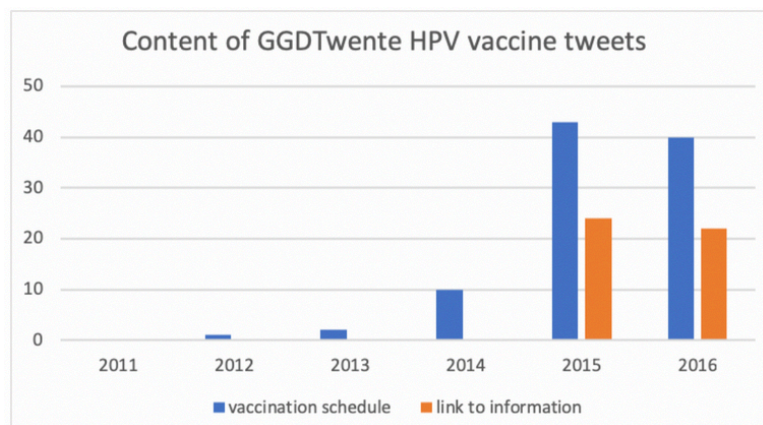


Figure 4

¹⁷ The decision was made to exclude retweets from other organizations because these cannot be analyzed for likes, comments etcetera. There were only three retweets for the GGDTwente and RIVM combined and these contained messages similar to original tweets from the GGDTwente and RIVM.

¹⁸ One tweet may fall into multiple categories (in figures 3 and 4).



Image 1

concerned information about when and where a new round of HPV vaccinations would take place and links to vaccination schedules (figure 4). Almost all GGDTwente tweets were aimed at a specific council where the HPV vaccine would soon be given. However, this changed somewhat in 2015. Contrary to earlier years, some of the

tweets from 2015 and 2016 included sentences such as: “Do you know if you are going? Talk about it and go to [website].” An example of such a tweet is shown in image 1. Despite the slow rise of the vaccination rate and the significant increase of activity on Twitter from the GGDTwente and the RIVM, hardly any of the RIVM tweets and none of the GGDTwente tweets included a call to vaccinate or actual information about the human papillomavirus or the HPV vaccine. However, some of the links included in the GGDTwente tweets may have been to website pages with more information, but unfortunately these links did not exist anymore at the time the tweets were accessed for this study and could not be found via archive.org. The RIVM did twice tweet about the increase in vaccination uptake (2012 and 2014).

4.2 Response to GGDTwente and RIVM HPV vaccination campaign messages

To answer sub question 2a: *How do Twitter users respond to GGDTwente and RIVM Twitter campaign messages from 2011 to 2016?*, all the responses to the RIVM and GGDTwente tweets were examined. The main difference between the response of Twitter users to the RIVM tweets and the GGDTwente tweets is the amount of response that was generated. Though the content of the responses is very similar as tweets of both organizations are mostly only retweeted, the tweets of the RIVM (figure 5) were retweeted far more often than those of the GGDTwente (figure 6). While a single tweet of the RIVM in 2016 was retweeted circa 11

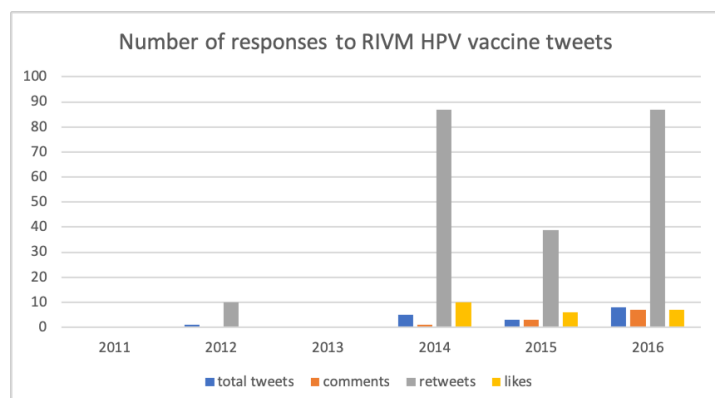


Figure 5

times on average, the 40 tweets of the GGDTwente were only retweeted 15 times in total. It is important to note here that the RIVM has considerably more followers than the GGDTwente (around 36.000 and 2.000 respectively on January 8th 2019). This naturally affects the amount of response that is generated. The number of likes and comments are both lower for the GGDTwente, but low for the RIVM as well. The few comments that were made were a question about the use of a specific type of needles and why boys are not vaccinated too, one remark about a link to the website not working and twice did someone write that they did not

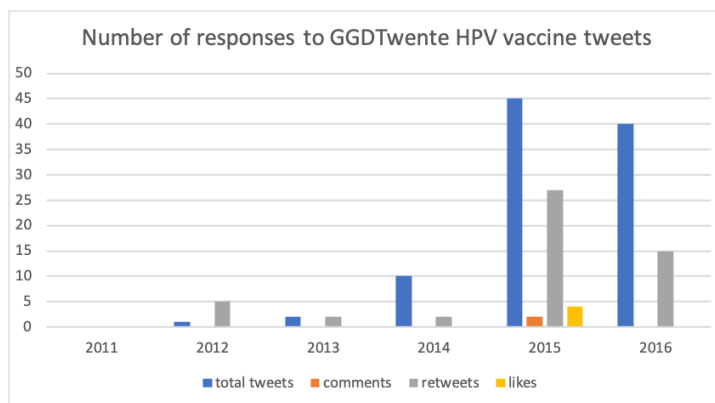


Figure 6

positive. However, the low response to especially the GGDTwente tweets and the lack of comments in general makes it also difficult to argue that the overall response was definitively positive.

4.3 How the GGDTwente and RIVM address Twitter responses

Since there was a lack of comments on the tweets from both the RIVM and the GGDTwente, not much can be written about the way the GGDTwente and RIVM address responses.

However, when a question was asked, both organizations responded and once the RIVM suggested a Twitter user who proclaimed mistrust in the vaccine to visit a doctor to talk about her concerns and ask question. Furthermore, a few times in the data of this study a Twitter user asked a question to the RIVM and tagged the organization (these tweets were not comments on tweets of the RIVM) and the RIVM responded (image 2). It could be that this happens more often and that the RIVM actively searches for questions on the HPV vaccine on Twitter, but because of the absence of “HPV” in the RIVM response these responses were not found in the data of this study. In conclusion, the answer to sub question



Image 2

2b *How do the GGDTwente and RIVM address the responses of Twitter users* is that the organizations answer questions that are asked and in one case the RIVM suggested to a Twitter user to seek advice from a doctor. However, there were very few responses for the organizations to address.

4.4 Determinants of HPV vaccination uptake on Twitter

To answer sub question 3a *Which determinants of HPV vaccination uptake can be found in Dutch tweets from 2011 to 2016?*, the determinants of HPV uptake are first described per year.¹⁹ In addition, an overview is provided of the most common determinants of not vaccinating against HPV. For some determinants, a distinction is made between a positive opinion (+) and negative opinion (-). For example, when a tweet included the expression that the HPV vaccine is effective, it was categorized as “perceived effectiveness (+).” If someone wrote that the HPV vaccine is *not* effective, the tweet was categorized as “perceived effectiveness (-)”. The same method of categorization was used for perceived severity of HPV and related illnesses, subjective norms, confidence in authorities and perceived relative effectiveness of the HPV vaccine. An overview of the prevalent sentiment towards the HPV vaccine, including the data from this chapter, is provided in chapter 4.5²⁰. Furthermore, general attitude towards the vaccine is not examined as a separate determinant as it is practically the same as overall sentiment towards the HPV vaccine and thus part of chapter 4.5.

2011

The most common determinant of HPV vaccine uptake in 2011 is the newness of the vaccine (figure 7). Other determinants that negatively affect HPV vaccination uptake are a lack of confidence in authorities responsible for providing the vaccine, fear of side-effects and “Big Pharma”

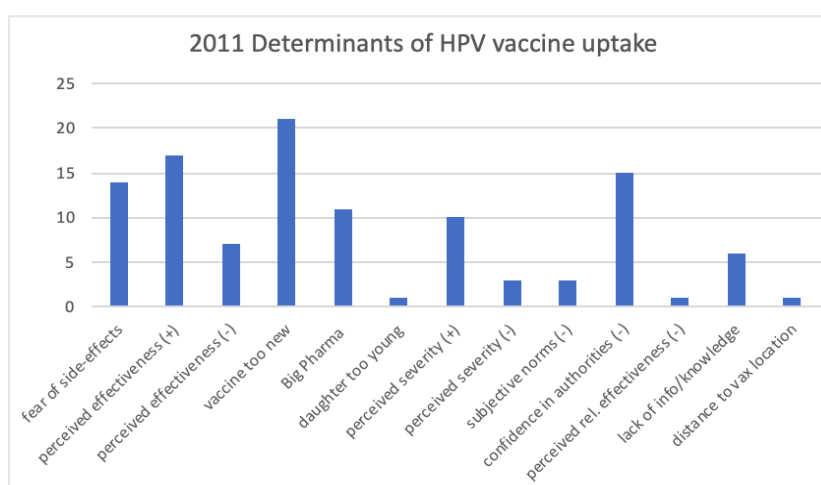


Figure 7

or the belief that the vaccine was only introduced so the pharmaceutical companies can increase their revenue. The determinants that positively affect the uptake are perceived effectiveness (+) of the vaccine and perceived severity (+) of the human papillomavirus. In both cases, more Twitter users expressed confidence in the effectiveness of the HPV vaccine (17) and conviction of the seriousness of the virus (10) than those who believed the vaccine is not effective (7) and the virus is not dangerous (3).

¹⁹ The tweets of the GGD Twente and RIVM are not included in these analyses.

²⁰ The decision was made not to create graphs showing the overall presence of determinants as either positively or negatively affecting HPV vaccination uptake because it would only provide a partial and skewed image of the actual overall perception of the public. First of all, some tweets include several determinants. Secondly, some tweets simply stated girls should get the HPV vaccine without providing a reason and are therefore not included in this chapter. A complete overview is provided in chapter 4.5.

2012

The results for this year are very different compared to 2011. While there were many different determinants that were important in 2011, fear of side-effects is clearly the single most important determinant in 2012 (figure 8)²¹. Other determinants for not vaccinating are only

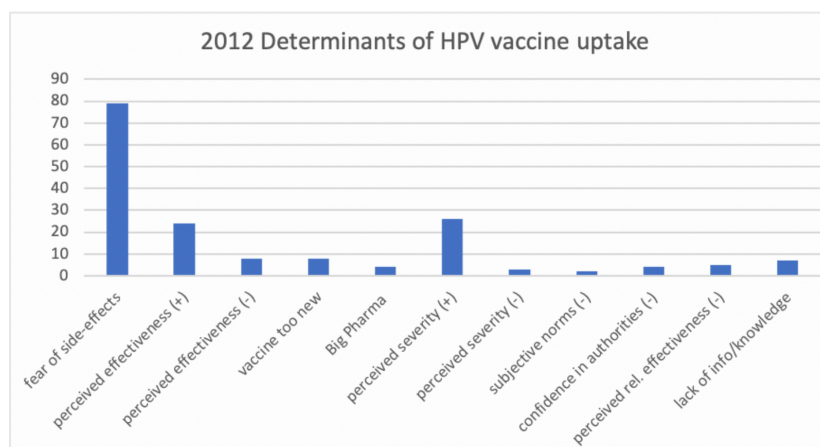


Figure 8

mentioned a few times. A belief in the effectiveness of the vaccine and perceived severity of the virus and related illnesses positively affect vaccination uptake and are the second and third most common determinants this year.

2013

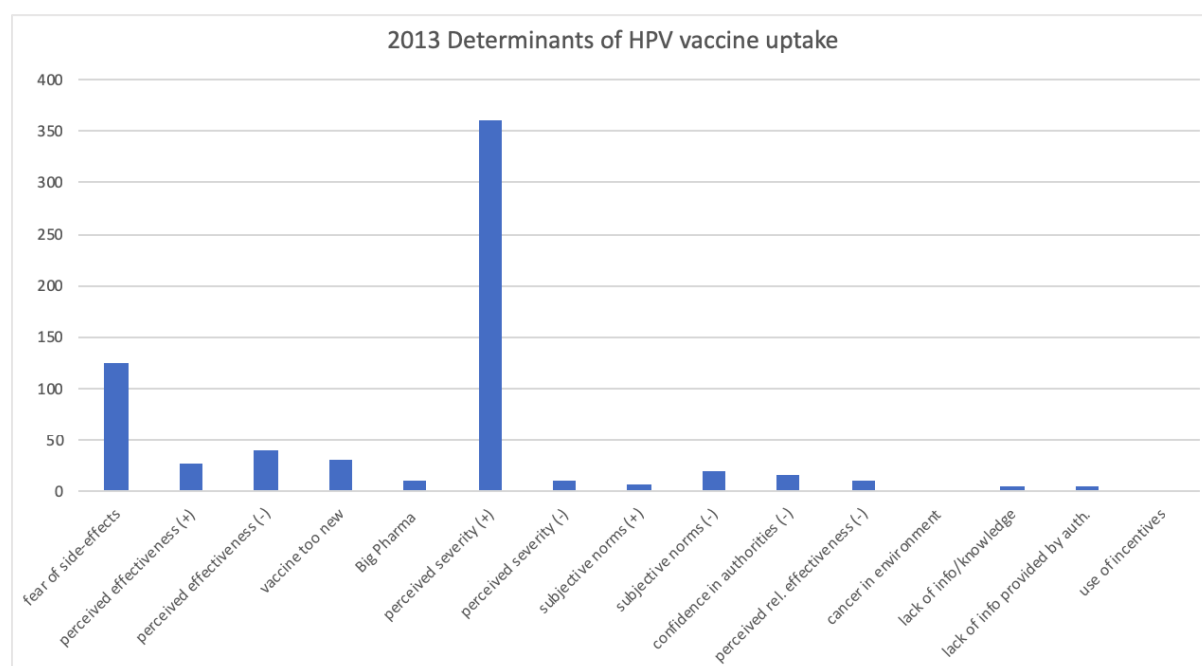


Figure 9

At first glance, the graph with the results for 2013 shows something remarkable (figure 9)²². Perceived severity (+) is by far the most common determinant. However, of the 360 tweets, 261 were about one report on the increasing number of HPV infections among girls in the Netherlands. The other important determinant this year is clearly fear of side-effects and without the report about HPV infections among girls, it would again have been the most

²¹ An overview of the determinants of 2012 without the outlier (fear of side-effects) is provided in appendix 6.

²² An overview of the determinants of 2013 without the outlier (perceived severity (+)) is provided in appendix 6.

common determinant. Furthermore, for the first time since 2011, a negative perception of the effectiveness of the vaccine surpassed a positively perceived effectiveness (40 vs 27). Moreover, tweets about the fear of side-effects sometimes also mentioned the newness of the vaccine, claiming not enough research has been carried out to rule out potential serious long-term side-effects.

2014

The two most common determinants in 2014 that negatively affect vaccination uptake are a fear of side-effects and a belief that the HPV vaccine is not effective (figure 10). However, more people express trust in the effectiveness of the vaccine (112 versus 69). Furthermore, perceived severity (+) is high as well and stated far more often than that the human papillomavirus and related illnesses are not serious (100 versus 12). Though the newness of the vaccine, the role and intentions of the pharmaceutical industry and the relative effectiveness of the vaccine are mentioned several times, they are not nearly as common as the other determinants mentioned above.

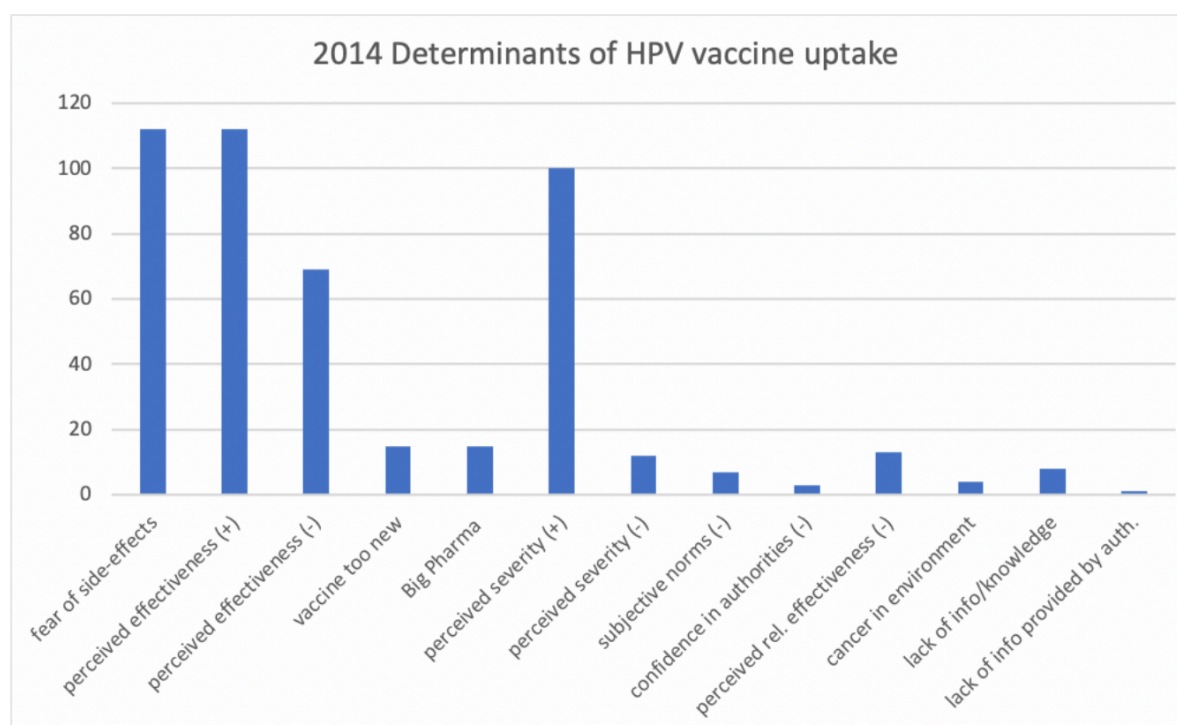


Figure 10

2015

In 2015, the number of tweets about horrifying side-effects of the HPV vaccine exploded (figure 11)²³. Several “news reports” from dubious websites went viral, resulting in the high number of tweets displaying a fear of side-effects as is shown in figure 11. Most reports were

²³ An overview of the determinants of 2015 without the outlier (fear of side-effects) is provided in appendix 6.

on girls in foreign countries falling severely ill after receiving the HPV vaccine and ending up in the ER (image 3). Another article went viral that had the heading “HPV vaccine Gardasil will be the biggest medical scandal of all times” and claimed that the vaccine was neither safe nor effective. Remarkably enough, none of the Twitter users sharing the Gardasil story seemed to realize (or care) that the



Image 3

Netherlands does not even use Gardasil, but the vaccine from its competitor, Cervarix. On top of the posts claiming side-effects were genuinely occurring, other tweets shared articles about more research that would be carried out on potential side-effects and that it was unclear whether the health issues that were being reported were actually caused by the HPV vaccine. While these tweets often did not show a negative attitude towards the vaccine per se, they may have increased fear in Twitter users reading about the research.

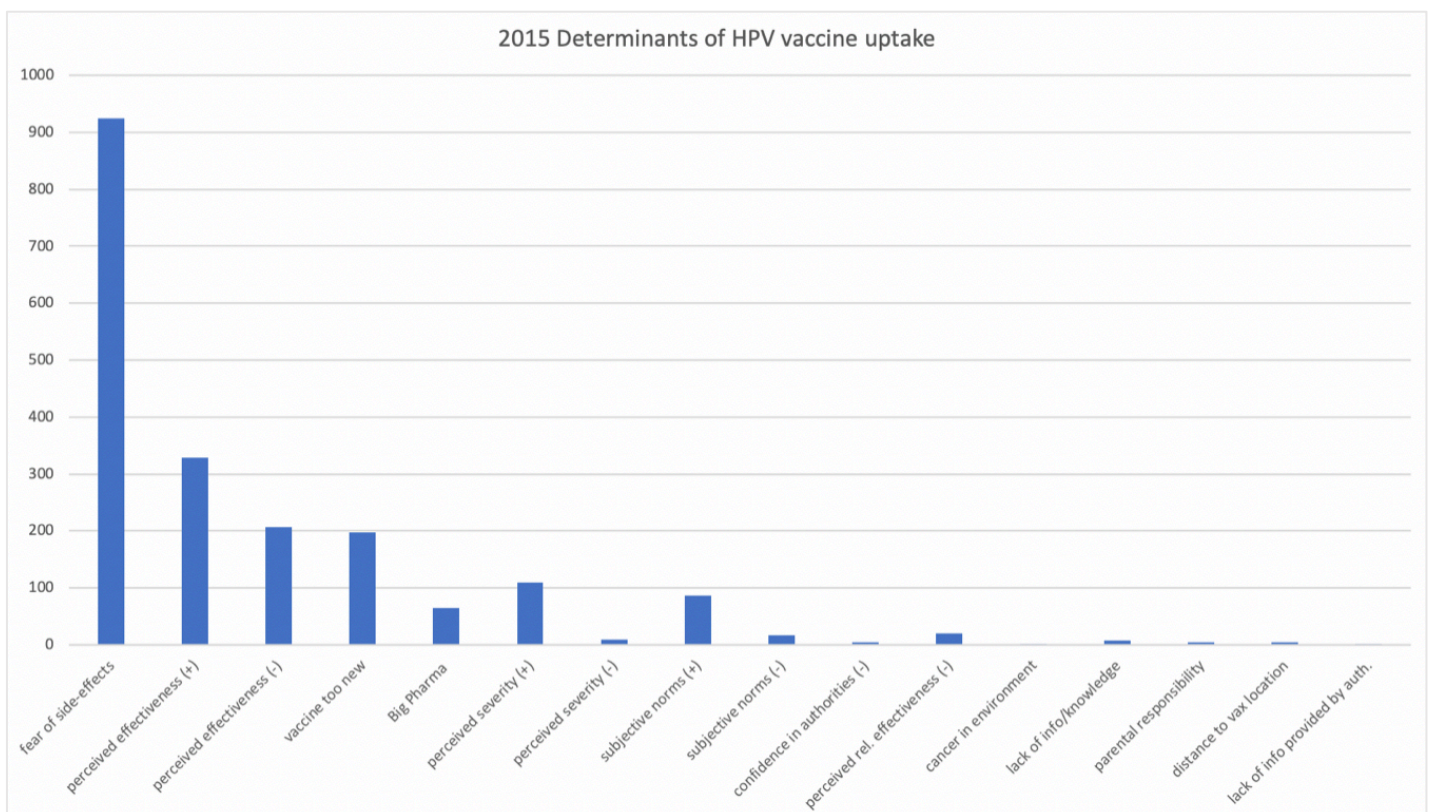


Figure 11

Besides the fear of side-effects, both the belief and disbelief in the effectiveness of the vaccine and the newness of the vaccine were the most common determinants. The most interesting determinant among the less common determinants is subjective norms (+). These

tweets mostly consist of a doctor/scientist recommending the HPV vaccine. Contrary to earlier years, perceived severity of HPV does not play an important role in 2015.

2016

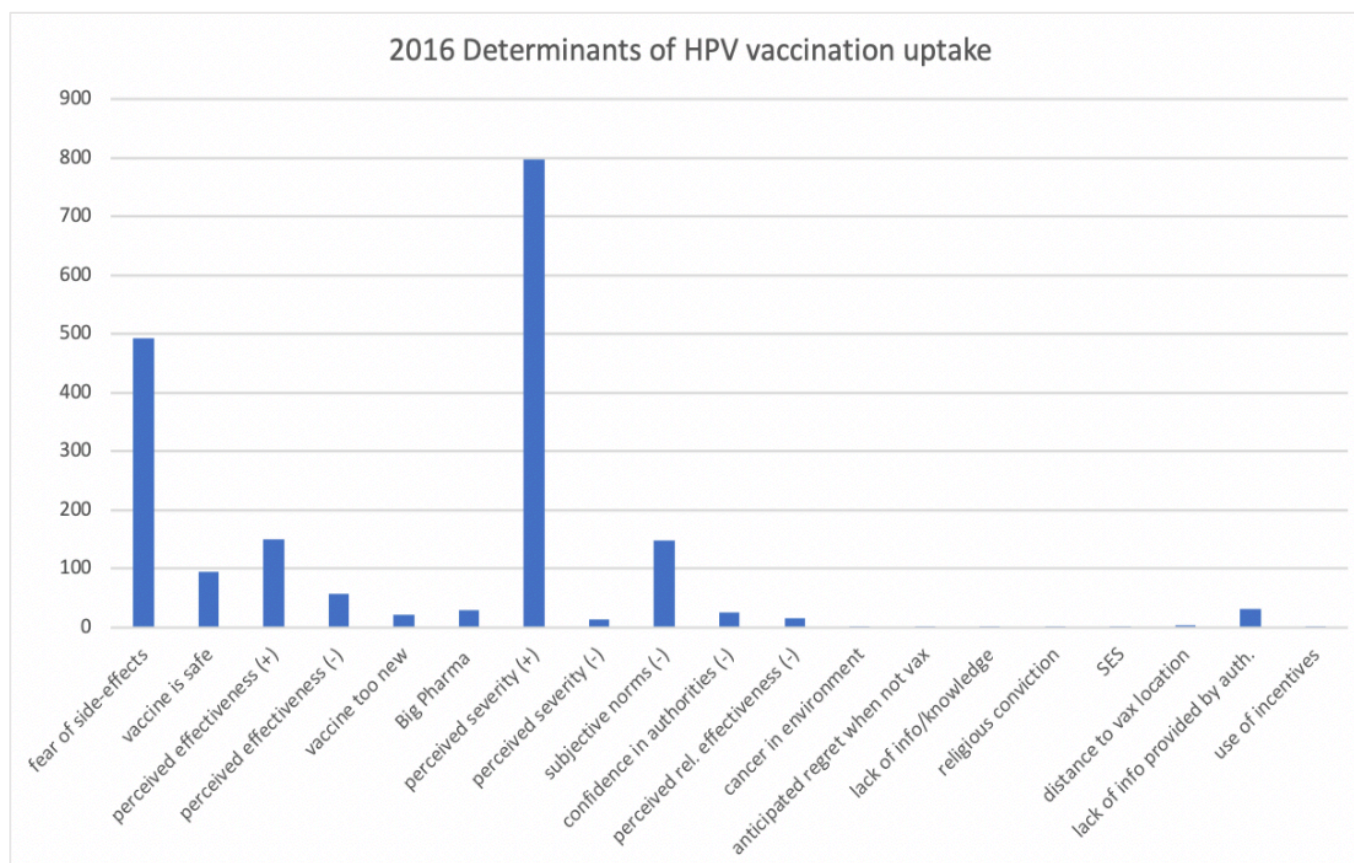


Figure 12

The most striking determinant regarding numbers in 2016 is perceived severity (+) (figure 12). However, similar to 2013, most of these tweets refer to a news article about a study that showed that a far higher number of Dutch women were infected with the human papillomavirus than was expected and that meant the costs for the national screening program would consequently be much more expensive than what was budgeted. Furthermore, fear of side-effects was again by far the most important determinant for not vaccinating, partly due to a new article that went viral about a former employee (a physician)²⁴ of the pharmaceutical company that developed Gardasil (Merck) claiming the vaccine is unsafe and ineffective. Just as in 2015, no one mentioned that Gardasil is not actually used in the Netherlands. This article also increased the number of the determinant subjective norms (-) as these tweets included the advice of the former Merck employee for women to not get the HPV vaccine.

²⁴ This story refers to several remarks made by Bernard Dalbergue, in a French magazine (Principes de Santé) in April 2014 about the alleged dangers and ineffectiveness of Gardasil4 (<https://www.principes-de-sante.com/coups-de-gueule/interview-du-dr-bernard-dalbergue-le-gardasil-sera-le-plus-grand-scandale-sanitaire-de-tous-les-temps>)

For 2016, another category was added, namely the HPV vaccine is safe, as these types of tweets increasingly showed up in the data. Compared to the nearly 500 tweets about side-effects the close to 100 tweets claiming the vaccine is safe are plainly in the minority. However, it seems that people and organizations started to realize that all the messages about serious side-effects and the vaccine's ineffectiveness needed to be countered. Moreover, the first studies were published showing the HPV vaccine is safe and actually works. The fact that these types of tweets were often created shortly after each other creates an interesting image (image 4). However, had someone searched for HPV

HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/vjbiFeRJTR	good read	
RT @VaccinatieRaad: WantToKnow.nl ,! HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/vjbiFeRJTR	good read	
RT @VaccinatieRaad: WantToKnow.nl ,! HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/IVPzHFai1		
Prik tegen baarmoederhalskanker lijkt succes	http://t.co/EnHl9rU8ys	#hpv	
HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/qp43qgED2v		
WantToKnow.nl ,! HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/rbZlAib6H2	via @wanttoknownl	
WantToKnow.nl ,! HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/4fP4YfoRHh	via @wanttoknownl	
RT @Wanttoknownl: HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/HafTd8MHCB		
Promotieonderzoek: eerste resultaten HPV vaccin veelbelovend	http://t.co/V0730Ax9mP	#jgz	
Steeds meer bewijs voor HPV vaccinatie, nu ook van eigen bodem.	http://t.co/BZSWsCSTMx		
RT @VaccinatieRaad: Promotieonderzoek: eerste resultaten HPV vaccin veelbelovend	http://t.co/V0730Ax9mP	#jgz	
RT @Wanttoknownl: HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/HafTd8MHCB		
RT @VaccinatieRaad: Promotieonderzoek: eerste resultaten HPV vaccin veelbelovend	http://t.co/V0730Ax9mP	#jgz	
RT @VaccinatieRaad: Promotieonderzoek: eerste resultaten HPV vaccin veelbelovend	http://t.co/V0730Ax9mP	#jgz	
HPV-vaccin: het grootste medische schandaal ooit..!	http://t.co/FZ0jCp5Dm1	via http://t.co/kb2ygUG0EO	
AD: Prik tegen baarmoederhalskanker lijkt succes	http://t.co/gVpsWX44O1	Niet verrassend, wel goed om te zien #H	

Image 4 An excerpt from the tweets of 2016 in chronological order

on Twitter and looked at the tweets in chronological order as portrayed in image 4, it would also have been very confusing as tweets about the HPV vaccine as a success and major scandal alternate almost every other tweet.

Most common determinants of not vaccinating against HPV 2011-2016

As can be seen in figure 13, the most important determinant of not vaccinating against HPV is fear of side-effects. Only in 2011 was another determinant mentioned more often on Twitter, namely the newness of the vaccine. The number of tweets and retweets with stories about girls

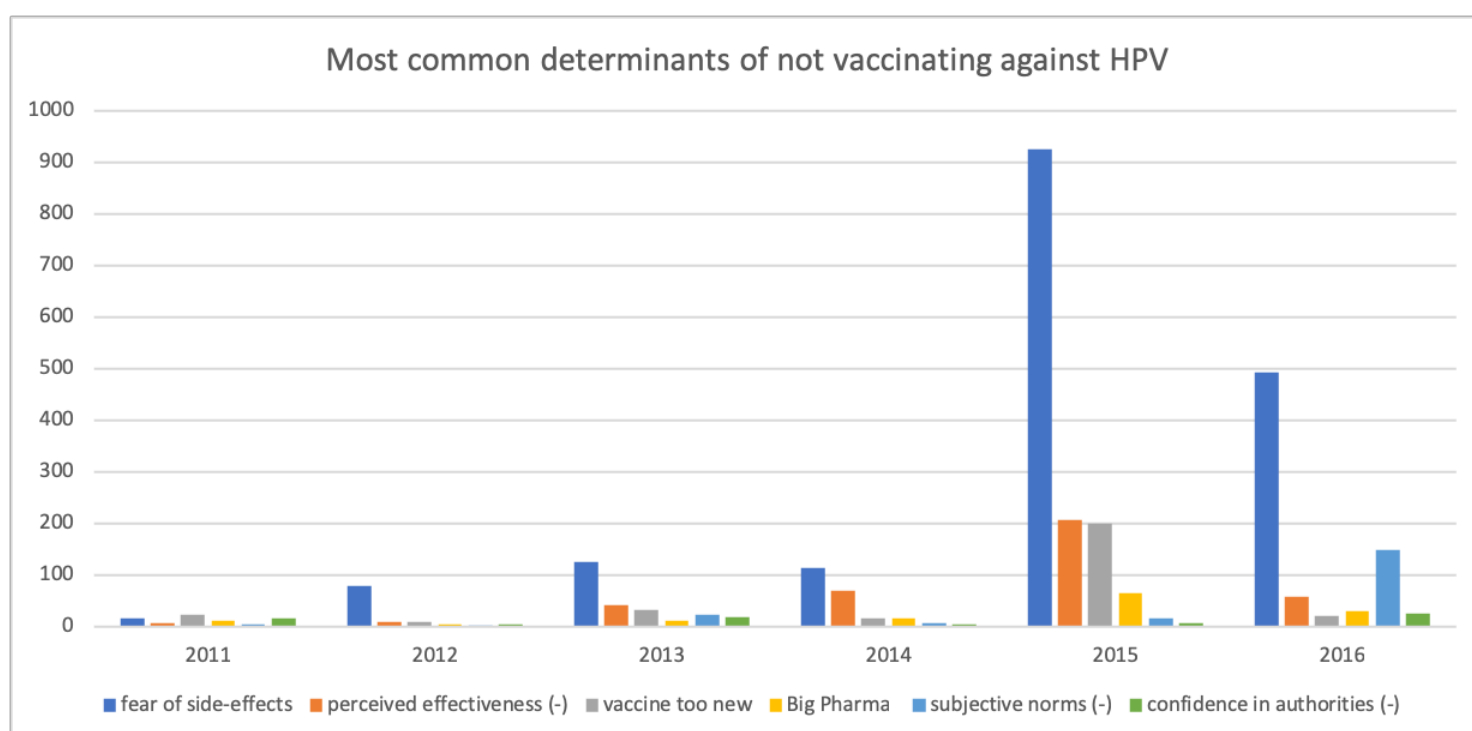


Figure 13

suffering from chronic fatigue and more serious side-effects including death increased dramatically in 2015. Though 2016 saw less of these stories that went viral, fear of side-effects was still significantly higher than the other determinants negatively affecting the HPV vaccination rate. Doubts about the effectiveness are the second most common determinant, with the newness of the vaccine playing an important role in the Twitter debate in 2015 and subjective norms showing a sharp increase in 2016 due to a published news report about a former employee of Merck advising against the use of Gardasil.

Overall, the fear of side-effects is the most common determinant for not vaccinating, while the perception of HPV and related diseases as serious is the most common determinant that can positively affect HPV vaccination uptake. Below, a complete overview of overall sentiments towards the HPV vaccine is provided.

4.5 Sentiments towards the HPV vaccine on Twitter

Besides for the specific determinants, the tweets were also analyzed for their overall sentiment towards the vaccine in order to answer sub question 3b: *Which sentiment towards the HPV vaccine is most prevalent in the Dutch tweets from 2011 to 2016?* All tweets (except those from the GGDTwente and RIVM)²⁵ were categorized as either positive, negative, neutral, or doubt. An important difference between these categories and those of the determinants is that, for example, a tweet mentioning the seriousness of cervical cancer is only categorized as positive towards the HPV vaccine if support for the vaccine is overtly stated. Moreover, a tweet can only fall into one of the sentiment categories, opposed to several determinants.

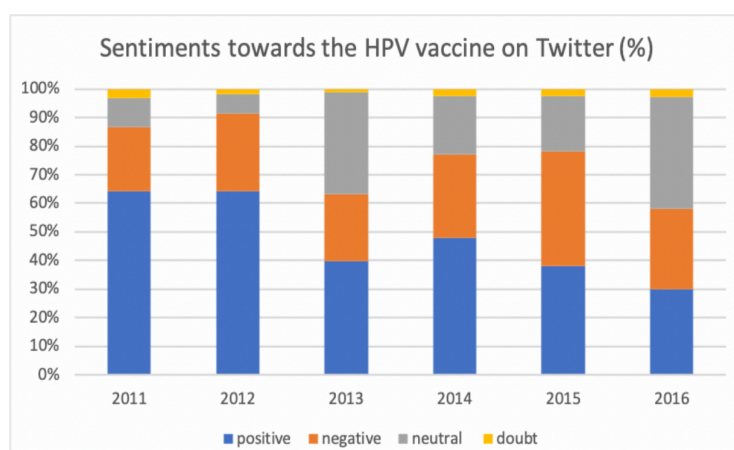
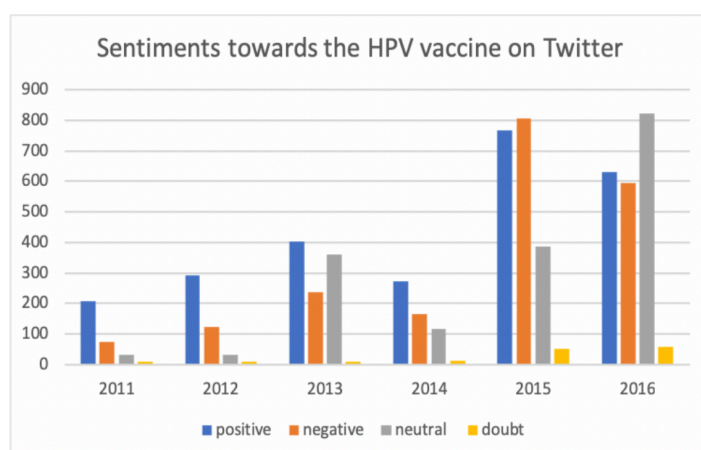


Figure 14

Figure 15

²⁵ The tweets from the GGDTwente and the RIVM were left out as the purpose of this study is to examine the sentiment of the public towards the HPV vaccine and how they respond to the messages of the institutions organizing the HPV vaccination campaign.

Figure 14 shows that the total number of tweets from 2011 till 2014 was quite low and increased in 2015. This may partly be explained by the increase in attention to the HPV vaccine in the media, with television shows such as Zorg.nu dedicating an episode to (claimed) side-effects of the vaccine (zorg.nu, 2016). Moreover, in 2015 a study was published about the effectiveness of the HPV vaccine and the Volkskrant published an article in 2016 on the high number of HPV infections that generated much attention on Twitter (Mollers et al., 2015; Visser, 2016). Furthermore, 2015 saw a sharp increase in horror stories about the HPV vaccine, increasing the fear of side-effects as shown in the overview of most important determinants (figure 13).

In 2011 till 2014, significantly more tweets were positive about the HPV vaccine than negative. Though 2015 was the only year where more negative tweets were created than positive tweets, the difference is small. While the positive tweets exceeded the negative tweets in most years, figure 15 shows that the proportion of positive tweets overall per year dropped from over 60 percent in 2011 to 30 percent in 2016. This can be partly explained by the increase in neutral tweets. Tweets categorized as neutral contain, among other things, information about the virus and number of infections among Dutch women. These tweets have been put into the neutral category because they do not express an opinion on the HPV vaccine specifically. However, most of the tweets from this category



Image 5

will, for the majority of the population, increase understanding of the need for a vaccine so they lead more towards a positive opinion on the HPV vaccine than a negative sentiment. This is different for 2015, as many of the tweets in the neutral category mentioned the additional research that was going to be carried out on alleged side-effects. Despite these tweets leaning towards a more negative attitude towards the HPV vaccine, the tweets were categorized as neutral since the outcome of the research was not yet known and a causal relation between the adverse events and the vaccine had not yet been found. Moreover, there are plenty of tweets in which people acknowledge that the virus is dangerous but argue that there are many other preventative measures that can be taken instead of the vaccine. Thus, the decision was made to create a separate neutral category.

The percentage of tweets expressing doubt about receiving/giving the vaccine or not stays relatively stable over the years. Most of these tweets were from parents who were hesitant to give their daughters the HPV vaccine due to stories about serious side-effects they had heard of (image 5). Sometimes the hashtag #dtv (durf te vragen (dare to ask)) was used as well.

The tweets mentioning decisions that were made about actually vaccinating against HPV or not were also examined separately. The results, shown in figure 16, are striking. First of all, the number of times a Twitter user mentions the (not) received vaccination is much higher from 2011 till 2013 than in the last three years even though the number of total tweets was

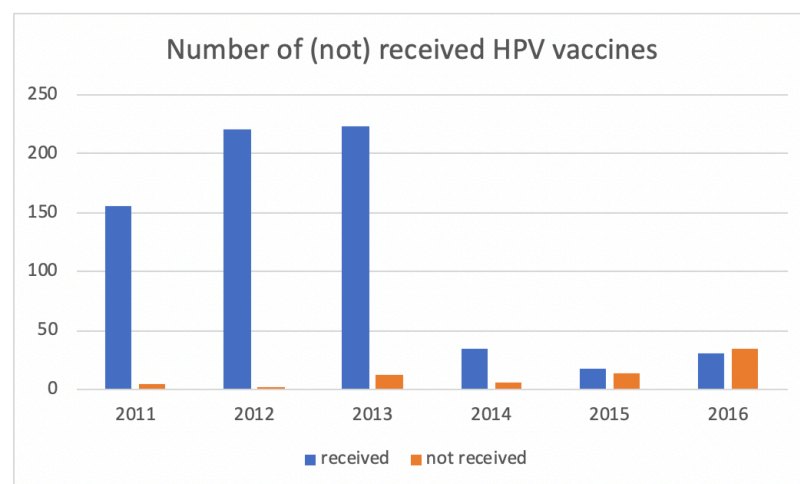


Figure 16

considerably higher in 2015 and 2016. It is difficult to explain this sudden drop, but one theory is that the debate on social media became so fierce and saw such an increase in messages about serious side-effects that people felt less comfortable sharing that they received the

vaccine.²⁶ Secondly, 2016 was the first year that contained more tweets in which someone said they were not receiving the HPV vaccine than those who did receive it. This result coincides with the first drop in the actual vaccination rate, which was 2016, and is therefore something that is more along the lines of what could be expected.

Overall, a positive sentiment was prevalent in 2011 and 2012, but declined in later years. However, only in 2015 were there actually more tweets expressing a negative sentiment towards the HPV vaccine than positive tweets.

Chapter 4 laid out the results of the research. HPV and the vaccine became a significantly more popular topic on Twitter in 2015. While the RIVM and especially the GGDTwente increased their social media activity by posting tweets with information about the vaccination schedule and providing links to websites for more information, the general public seemed mostly concerned about potential side-effects linked to the vaccine in stories that went viral. On the other hand, news reports about the seriousness of HPV and its contagiousness were also shared and discussed often. The next chapter provides a short overall conclusion. In the following discussion, some of the results will be examined in more detail. Furthermore, the studies that formed the foundation for the theory on determinants of HPV uptake in the Netherlands will be shortly reviewed. Finally, the limitations of this study will be examined and recommendations are made for the HPV vaccination program.

²⁶ It is also possible that there were more tweets, but that they were not included in the data for this study. This is discussed in more detail in chapter 6.

5. Conclusions

Citizens have become more critical of and vocal about the actions of public organizations. Social media are platforms where citizens can express their critique and look for alternative sources of information. One of the topics discussed on these social media is the HPV vaccine. This study answered the question *How do Dutch Twitter users discuss and respond to the HPV vaccine and GGDTwente and RIVM campaign messages on Twitter from 2011 to 2016?* At first the tweets of the GGDTwente and RIVM were analyzed. Especially the GGDTwente seems to have a clear Twitter policy. Almost every tweet concerns the vaccination schedule for a specific geographical area. The RIVM tweets are more diverse, though less in numbers. Secondly, the responses to these tweets were examined. Retweeting occurred most often, while comments were scarce. However, in case there was a comment, the GGDTwente and the RIVM did respond. Thirdly, all tweets from 2011 till 2016 were analyzed for the presence of determinants of HPV vaccination uptake. The results show that fear of side-effects was most common on Twitter these years. The determinant positively affecting the vaccination uptake found most often is perceived severity of the virus and related illnesses. However, in most cases these tweets were about the number of HPV infections and not the potential medical consequences of an infection. Lastly, the overall sentiment towards the HPV vaccine was examined. Perhaps surprisingly considering the vaccination rate, all years showed a higher number of positive than negative tweets with the exception of 2015.

Though the overall sentiment towards the HPV vaccine is more positive than negative and responses to RIVM and GGDTwente tweets are mostly positive too, there is a strong anti-HPV vaccine movement on Twitter spreading misinformation about serious side-effects. The implications of these results are discussed below.

6. Discussion

6.1 The HPV vaccination debate in the Netherlands

As far as what is shown in the literature review, this study is a first step to provide an overview of the HPV vaccination debate on a social media platform in the Netherlands. Since citizens have become increasingly critical of their government and do not simply accept what they are told, the internet and social media specifically have become important platforms where people discuss and share information about vaccines. While scholars disagree on whether there is an actual decline in trust in political institutions, critical citizens do pose a threat to governmental programs such as the NIP as is shown by the low HPV vaccination rate. Therefore, examining the discussion of HPV on Twitter can provide a valuable insight into the public's perception of the HPV vaccine, the reception of the messages of the health institutions responsible for the vaccination program, and the challenges that these institutions face.

Both the public and the GGDTwente and RIVM took some years to become active on Twitter regarding HPV and the vaccine. While the GGDTwente mostly tweets about vaccination schedules and the RIVM sometimes provides links to information on its website, neither organization is actively trying to convince the public the HPV vaccine is a great way for girls to protect themselves against the virus and that it really is safe. Unfortunately, the safety of the HPV vaccine is exactly that what the public is most concerned about. Even though positive tweets about the HPV vaccine outweigh the negative tweets most of the years, certain websites and Twitter users have been very successful in spreading fear of serious side-effects. Posts on websites such as wanttoknow.nl and nvpk.nl, the Dutch Association Critical of Vaccines (Nederlandse Vereniging voor Kritisch Prikken), went viral in 2015 and 2016. Another website active on Twitter is the Vaccination Board (Vaccinatieraad), which sounds very official but definitely is not and it is understandable that its stories about terrible side-effects scares and confuses people. Considering the fact that these posts gain much attention on Twitter, it could be wise for the RIVM and GGDTwente to adopt a more proactive approach in countering these stories.

Regarding the approach used by the RIVM and GGDTwente it is important to take into account the types of people the organizations have to deal with. The tweets analyzed for this study show there are not just convinced supporters and strong opponents of the HPV vaccine, but also people who are somewhere in between. Increasing the HPV vaccination rate in these groups may require different tactics. Based on the content of the tweets and the sentiments that were expressed four groups were identified. First of all, there are those who simply vaccinate and have a positive sentiment towards the HPV vaccine. This is the easiest group for authorities as it requires little attention. Secondly, there is a group called on-the-fencers, or fence-sitters. People in this group are unsure about vaccines, or a certain vaccine specifically, as they have been influenced by scare stories (Leask, 2011). They have become afraid, but have

not made their minds up about whether to trust these stories or the health authorities. People expressing doubt on Twitter and using the “dare to ask” hashtag would fall into this category. As several scholars have argued, this group is the one that should receive the most attention as they are still open to more information and willing to change their mind (Leask, 2011; Betsch et al., 2015). Furthermore, convincing this group will require less resources than the next two groups. The third group is not against vaccines per se, but feels uncomfortable with the HPV vaccine as it is relatively new and long-term effects are still unknown. This group also seems more susceptible to the horror stories that go viral on social media than on-the-fencers. Despite its negative sentiment towards the vaccine, targeting this group is still worthwhile as their opinion might be changed if sufficient evidence for the safety and effectiveness of the HPV vaccine is published and spread. The fourth and last group is the most difficult to reach, as people of this group are strongly against vaccines in general. This group is colloquially referred to as the anti-vaxxers. These people strongly oppose vaccines because of religious reasons, a preference for homeopathic alternatives, or believe in such extreme conspiracy theories that any attempt by public health authorities to change their mind would be completely futile. One example from the data is a twitter user claiming the HPV vaccine was only introduced to decrease the world’s population. In case the authorities have to work with limited resources, the anti-vaxxers would be the last group that should be focused on.

As was mentioned before, citizens have become more critical of governmental institutions and this affects how they make their decisions. All four groups discussed above could be considered critical citizens, as the decision to vaccinate can also be made after thorough consideration. However, the stronger the opposition towards the HPV vaccine is, the more critical citizens seem to be about the public health institutions responsible for the NIP. Nevertheless, only anti-vaxxers sometimes expressed a strong distrust in these institutions on Twitter. This shows that being a critical citizen does not necessarily coincide with distrusting the government and is more in line with the theory that the Netherlands does not see a decline in trust in governmental institutions per se, but more of a cultural shift from allegiant to critical citizens.

6.2 The studies on determinants of HPV uptake

One of the main issues with the studies used for the theory of this thesis is the lack of attention that is paid to determinants of HPV vaccination uptake other than psycho-sociological factors. Many studies used questionnaires that did not include questions about any possible practical issues people had encountered in their decision-making process regarding getting the HPV vaccine. Even though most of these studies intentionally focused on psycho-sociological determinants, they run the risk of creating an image of the problems with the vaccination program that is incomplete. A great example of a study that proves practical factors sometimes play a bigger role than researchers expect is a study by Letley et al. (2018) about the main

determinants of the low MMR (Mumps Measles and Rubella) vaccination uptake amongst the Charedi community in London. The researchers expected to find reasons related to religion, believes the vaccine causes autism, and lack of trust in national health authorities, but found that inconvenient opening hours, long waiting times, and unfriendly waiting rooms were the primary determinants of low vaccination uptake. Even though the vaccination location was not mentioned very often in the tweets analyzed for this study, it could be that practical factors play a more important role than the results initially suggest.

The tweets examined for this study also showed two determinants that were not mentioned in the literature. One example is the fear of needles. Though mentioned only a few times, girls posted tweets asking friends whether receiving the shot actually hurt. One girl even asked why there was no other way of receiving the vaccine other than having to get a needle stuck into her arm. The age of the girls receiving the vaccine becomes relevant here, as they have a far stronger opinion on whether or not they should receive the HPV vaccine than, for example, a one-year old receiving the MMR vaccine. A possible determinant that could have a positive influence on HPV vaccination uptake that was mentioned in several tweets was the fact girls receive the vaccine on schooldays, therefore missing one or more classes. Some expressed delight about this side issue, considering it a bonus.

Another issue with the studies from the literature is that those that did examine the impact of socio-economic status, or education specifically, on vaccination uptake showed different results. While Rondy et al. (2010) and Pot et al. (2017) found that a high level of education is related to a higher level of vaccination, the results of Hofman et al. (2013b) showed a lower vaccination rate among daughters from highly educated parents. As a difference in the years the data were collected cannot explain these discrepancies, the most probable explanation is that the studies differed significantly in the databases or population that they examined. However, since it is very important for organizations responsible for the HPV vaccination program to know which communities to focus on in their campaigns, more research is needed to investigate which of the prior studies was actually correct.

6.3 Limitations

Four limitations of this study need to be discussed, especially regarding the coding of the tweets. First of all, as was described in chapter 3 (methods), all tweets were analyzed and coded manually. While this method has the advantage that less information is lost, having only one person coding the tweets increases the risk of subjectivity and errors. Ideally at least two people should go through the data, but due to the nature of this study this was not possible. In order to overcome part of this problem a detailed coding list was created. Secondly, the tweets that were analyzed for this study were collected from an existing database. This means that if tweets about HPV were not part of the database, they were also not included in this study. A

quick sanity check on the current Twitter feed²⁷ showed 6 tweets that were about HPV, but not included in this study. Since very few tweets showed up on Twitter at all, it is difficult to say how many tweets were actually left out. As the missing tweets were from 2011, 2012 (3), 2013, and 2014 there is no direct indication that tweets from one particular year are missing more than from other years. However, it is advisable, in case of further research, to create a way to include the missing tweets as well.

A third limitation of this study concerns the source of the data, namely Twitter. While social media have become important sources of information and places where public debates occur, it should be noted that Twitter's users do not accurately represent the Dutch population. Around 50 percent of Dutch Twitter users are highly educated, while lower educated people make up only 13 percent of Twitter users (Veer et al., 2016). Furthermore, less than 10 percent of Twitter users are younger than 20 years with even fewer users of the age at which girls receive their HPV vaccines. Therefore, even though the scope of the data can provide a good image of the discussion about the HPV vaccine on Twitter, an analysis of the same discussion on a social media platform with a more accurate representation of the Dutch population could show different results. It would be interesting to compare the results of this study with, for example, the HPV vaccination debate on Facebook.

Finally, even though this study provides great insight in the HPV vaccination debate on Twitter, due to the nature of the tweets not all determinants of HPV vaccination uptake could be considered. Socio-economic status, for example, cannot be measured. Considering that the studies discussed in this paper pay little attention to determinants other than psychosociological factors too, more research is needed to examine the impact of socio-economic and practical determinants.

6.4 Recommendations

There are four important things that need to be considered if the RIVM and GGDTwente want to increase the HPV vaccination uptake. First of all, the fear of side-effects has to be addressed as this is clearly the most common determinant discussed on Twitter. Secondly, additional research is needed to determine whether practical factors play a more significant role than the results of this research suggest. Thirdly, the age of the girls is important. Contrary to most other vaccines, the HPV vaccine is provided at an age where girls have a much stronger opinion about what is put into their body. Therefore, improvement measures should be aimed at the girls as well as their parents. Lastly, something that was briefly touched upon in this thesis is that there are other countries that are doing considerably better regarding the HPV vaccination rate. Flanders, for example, has achieved a vaccination rate of around 90 percent even though its citizens have access to the same social media and scare stories as citizens of

²⁷ An overview of the sanity check is provided in appendix 8

the Netherlands (Vandermeulen et al., 2017). It would be very interesting to investigate why our southern neighbors have gained much better results.

Three improvement measures that have been suggested in the literature are school-based vaccination programs, quick responses of public health authorities in case of negative media attention and a broad alliance of involved organizations stressing the importance of the vaccine (Hopkins & Wood, 2013; Donken, 2018). Vaccination uptake may also benefit from an increase in the cooperation between the GGD and schools, as girls may be more easily convinced of the benefits of the HPV vaccine if local health officials provide classes or at least provide the opportunity for girls to ask questions. While it has also been suggested that framing the HPV vaccine as a cancer vaccine instead of one protecting against a sexually transmitted disease might increase support, a randomized controlled trial carried out by Porter et al. (2018) showed little improvement. Still, educating the public about all the other types of cancer the HPV vaccine prevents may increase support as it is not just a vaccine against cervical cancer. More research on this topic is necessary. However, with the knowledge that is available at this moment, it is clear that most attention of the public health institutions should be directed towards the fence-sitters. Convincing them of the safety and effectiveness of the HPV vaccine would be a great first step.

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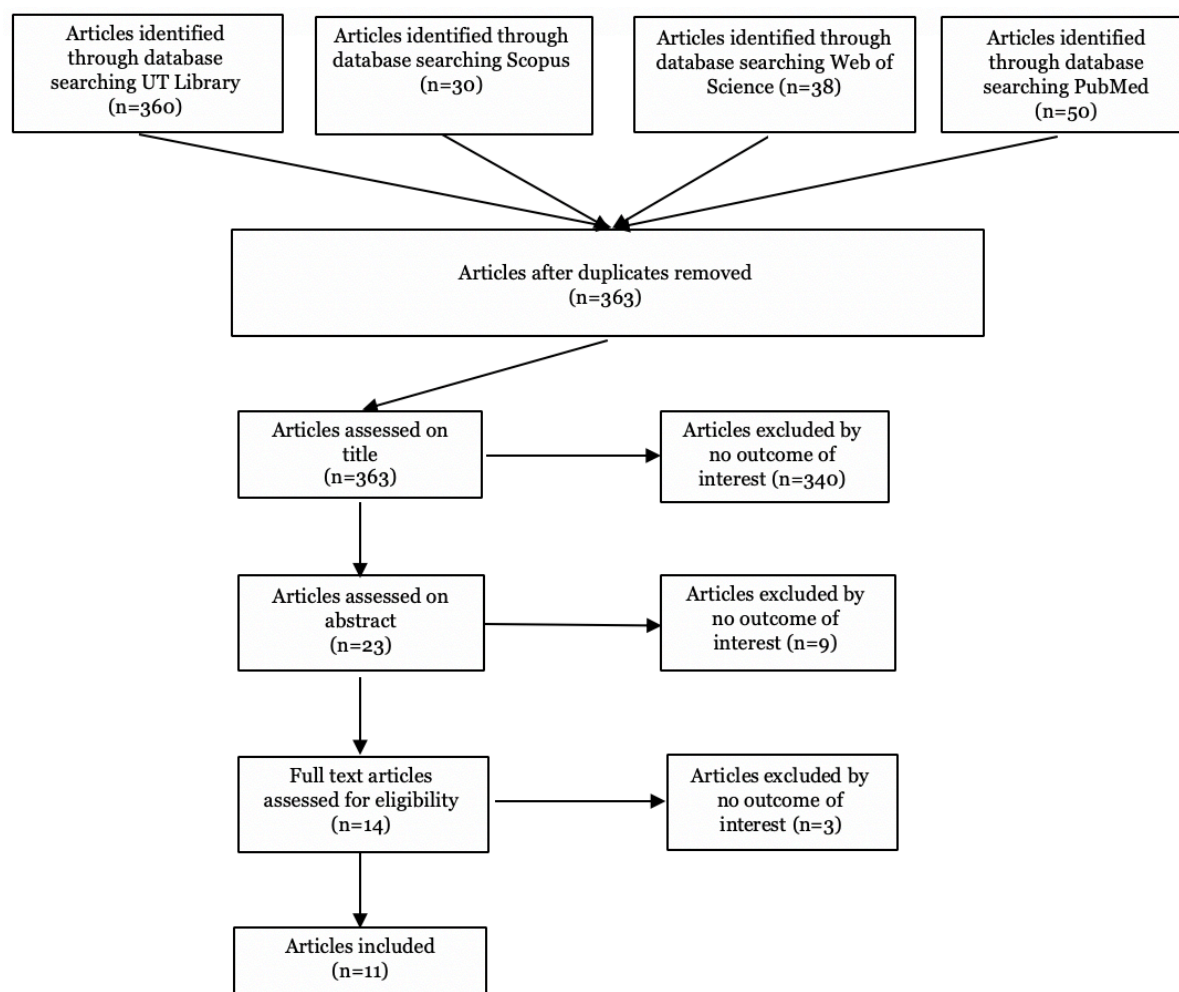
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Appendix 1 Search Strategy



Appendix 2 Determinants explained

Determinant	Meaning
Attitude towards the HPV vaccine	General attitude towards the HPV vaccine. Measured by questions such as “Vaccinating my daughter against HPV is good-bad / desirable-not desirable” (Pot et al., 2017)
Beliefs	
-perceived safety of vaccine/fear of side-effects	-This mostly refers to concerns about severe side-effects- e.g. “I am very worried about the side-effects of the HPV vaccination.” (Genefaite et al., 2012)
-perceived effectiveness	-This refers to concerns about the effectiveness of the vaccine. Also related to the newness of the vaccine- e.g. “We know way too little about the effects of the vaccine.” (Genefaite et al., 2012)
-lack of knowledge of the vaccine /vaccine too new	-This is about the newness of the vaccine. Statements include that there is too little known about the effectiveness and safety of the vaccine. (Keulen et al., 2013a)
-If the government offers the vaccine it will be safe.	-This statement was part of the survey of a few studies: “If the government offers the vaccination, I assume it will be safe.” (Keulen et al., 2013a)
- “Big Pharma”	-Big Pharma refers to concerns about the influence of the pharmaceutical industry on the government and its financial objectives. “The HPV vaccine was only introduced so the pharmaceutical industry will earn a lot of money from it.” (Pot et al., 2017)
-daughter too young	-The age of the daughter is sometimes a concern and relates to beliefs about the daughter’s sexual behavior and sometimes the misconception that the vaccine is only necessary once she becomes sexually active -e.g. “My daughter does not need the vaccination because she is not yet sexually active.” (Pot et al., 2017)
-perceived severity of HPV and related diseases	-This refers to people believing HPV and cervical cancer are serious health issues and those believing HPV is not that dangerous as the chance of it causing cancer is perceived as small. The higher the perceived severity the higher the uptake- e.g. “Lack of conviction that HPV can be extremely harmful.” (Genefaite et al., 2012)
-prevention is better than cure	-Preventing the contraction of HPV is better than trying to cure cervical cancer. “If you can prevent diseases by getting vaccinated this is a good idea.” (Patty et al., 2017)
Subjective norms	Subjective norms refer to the opinions of family members and friends but sometimes also the opinions of General Practitioners and physicians of the GGD -e.g. “To what degree do you expect to comply with the opinion of family members/ friends on vaccinating your daughter?” (Keulen et al., 2013b)
Descriptive norms	These are about the actions of others, mostly family members and friends and to what extent these actions influence someone’s decision making. (Alberts et al., 2017)
Habit strength	Habit strength refers to the amount of thought that is put into a decision- e.g. “Vaccinating my daughter is something I do.” (Pot et al., 2017)
Risk perception when not vaccinating	The perceived risk of contracting HPV/cervical cancer when daughter is not vaccinated-i.e. perceived susceptibility to HPV/cervical cancer (Alberts et al., 2017)
Confidence/trust in authorities	Mostly refers to (lack of) trust in the government but can also include the level of trust in other responsible authorities such as the GGD and the RIVM-e.g. “I don’t believe/ trust that the government would stop vaccinations if there was evidence of serious side-effects” (Genefaite et al., 2012)
Perceived relative effectiveness	This refers how people rate the effectiveness of the HPV vaccine in comparison to other measures such as a healthy lifestyle, use of condoms etc. (Keulen et al., 2013)
Cancer in social environment	The influence of having a friend/family member with cancer on someone’s willingness to vaccinate their daughter against HPV -e.g. “Past experience of someone close or him/herself with cervical cancer.” (Alberts et al., 2017)
Anticipated regret	The expected regret when daughter is not vaccinated and then contracts the virus-e.g. “Imagine your daughter has not received the HPV vaccination and she gets cervical cancer in the future. How much would you regret your decision to let her receive no vaccination?” (Pot et al., 2017)
(Perceived) lack of information/knowledge	Here, someone feels they do not have or actually do not have sufficient knowledge or access to information to make a well-informed decision about vaccination- e.g. “I have enough information to decide on vaccination yes or no” (Patty et al., 2017)
Parental responsibility for daughter’s health	This refers to how a parent’s feeling of responsibility for their daughter’s health influences the decision-making process. (Hofman et al., 2013a)
Religious convictions	Mostly refers to Protestants or Orthodox-Protestant groups specifically believing vaccinating goes against their religious beliefs (Keulen et al., 2013a)
Socio-economic status	Mostly refers to level of education. However, some articles examine more SES factors or simply do not distinguish between the different factors. (Alberts et al., 2017)
Country of birth parents	Whether one or both parents were born in the Netherlands or another country. (Pot et al., 2017)
Level of urbanization	Refers to the level of urbanization of the residence of the parents/daughter. (Mollers et al., 2014)
Distance to vaccination location	Distance from the residence of parents to the vaccination location. (Rondy et al., 2010)

Lack of information provided	This refers to parents specifically mentioning the government or other authorities not providing enough (objective) information about the vaccination program- e.g. "I think the information provided by the government was very limited/biased" (Genefaite et al., 2012)
GGD cooperating with schools	Refers to the impact of the GGD cooperation with schools on the vaccination uptake. (Rondy et al., 2010)
Info meetings with gynecologists	Refers to information meetings organized by gynecologists for parents. (Rondy et al., 2010)
Use of local media by GGD	Refers to the GGD using local media in the vaccination campaign. (Rondy et al., 2010)
Use of incentives	This refers specifically to a lottery where girls who received all the doses could win an iPod (Rondy et al., 2010).

Appendix 3 Overview of the articles' study design

Author	Title	Publication date, Journal	Study design	Significant determinants
Korfage, I. J., Essink-Bot, M. L., Daamen, R., Mols, F., & van Ballegooijen, M.	Women show mixed intentions regarding the uptake of HPV vaccinations in pre-adolescents: A questionnaire study.	June 2008, European Journal of Cancer	A cross-sectional study: Four groups were compared (2 groups of randomly selected women, a group with abnormal pap smears, and cervical cancer survivors. Determinants were obtained through questionnaires and analyzed through logistic regression.	Perceived safety and effectiveness of the vaccine, newness of the vaccine, the belief that prevention is better than cure
Rondy, M., Alies van Lier, Jan van de Kassteele, Laura Rust, and Hester de Melker	Determinants for HPV vaccine uptake in the Netherlands: A multilevel study	25 February 2010, Vaccine	A retrospective observational study: Data on individuals were gathered from Praeventis. Statistics on background information was collected from the SCP and CBS. Additionally, a cross-sectional regional observational study: coordinators of the HPV vaccination program were asked to complete a questionnaire.	Religion, SES, country of birth parents, distance to vax location, GGD cooperating with schools, info meetings with gynecologists, use of local media, use of incentives
Gefenaite G., Marieke Smit, Hans W Nijman, et al.	Comparatively low attendance during Human Papillomavirus catch-up vaccination among teenage girls in the Netherlands: Insights from a behavioral survey among parents.	2 July 2012, BMC Public Health	Paper questionnaire: A sample of parents (randomly selected from Praeventis) were invited to fill in a questionnaire at home. One group's daughters were vaccinated, the other groups were not. Social-demographic, behavioral, and knowledge determinants were examined.	Perceived safety, perceived effectiveness of the vaccine, "Big Pharma," perceived severity of HPV, trust in authorities, religion, lack of info provided by the government

Keulen, H. M. van, Otten, W., Ruiter, R. A. C., Steenbergen, J. V., Fekkes, M., & Paulussen, T. W	Redenen om zich te laten vaccineren tegen HPV: implicaties voor toekomstige informatievoorziening	1 January 2013, Nederlands Tijdschrift voor Geneeskunde	Questionnaire: A random sample of girls who received an invite for the HPV vaccine in 2009/2010 and their mothers were asked to complete an online survey. Determinants of vaccination uptake were identified via a univariate logistic regression analysis.	Attitude, beliefs, subjective and descriptive norms, habit strength, risk perception when not vaccinating, trust in authorities, perceived relative effectiveness, anticipated regret when not vaccinating
Keulen H.M. van, Wilma Otten, Robert AC Ruiter, Minne Fekkes, Jim van Steenbergen, Elise Dusseldorp and Theo WGM Paulussen	Determinants of HPV vaccination intentions among Dutch girls and their mothers: a cross-sectional study.	6 February 2013, BMC Public Health	Cross-sectional study: A random sample of girls and mothers was selected from the vaccination register as well as a random sample recruited via an online panel by a marketing research company. The survey contained questions about socio-demographic characteristics, socio-psychological factors, and vaccination intention. The association between the last two was examined via backward linear regression analyses.	Attitude, perceived safety, effectiveness, and newness of vaccine, "Big Pharma", daughter too young, risk perception, trust in authorities, perceived relative effectiveness, anticipated regret when not vaccinating, lack of info, religion, country of birth parents
Hofman, R., Van Empelen, P., Vogel, I., Raat, H., Van Ballegooijen, M., & Korfage, I. J.	Parental decisional strategies regarding HPV vaccination before media debates: a focus group study	22 March 2013, Journal of Health Communication	Focus groups: 4 semi-structured focus group discussions with 36 parents of children aged 8 to 15 (3 primarily Dutch, 1 with only Turkish parents).	Perceived safety and effectiveness of the vaccine, perceived severity of HPV, perceived relative effectiveness, cancer in environment, lack of knowledge, parental responsibility

Hofman, R., van Empelen, P., Richardus, J. H., de Kok, I. M., De Koning, H. J., van Ballegooijen, M., & Korfage, I. J	Predictors of HPV vaccination uptake: a longitudinal study among parents	16 September 2013, Health Education Research	Questionnaire: A sample of parents was randomly identified via municipal health services. Parents were asked to complete a baseline and follow-up questionnaire. Hierarchical logistic regression analyses were used to predict vaccination uptake.	Attitude, beliefs, subjective norms, cancer in social environment, anticipated regret when not vaccinating, parental responsibility, religion, SES, lack of info provided by authorities
Mollers, Madelief, Karin Lubbers, Symen K Spoelstra, Willibrord CM Weijmar-Schultz, Toos Daemen, et al.	Equity in human papilloma virus vaccination uptake?: sexual behaviour, knowledge and demographics in a cross-sectional study in (un)vaccinated girls in the Netherlands	28 March 2014, BMC Public Health	Online questionnaire: A random sample of Dutch girls aged 16-17 was invited to fill in an online survey. Variables associated with vaccination status were classified via a knowledge scale score and multivariable analyses.	Religious convictions, level of urbanization
Alberts, Catharina J., Maarten F van der Loeff, Yvonne Hazeveld, et al.	A longitudinal study on determinants of HPV vaccination uptake in parents/guardians from different ethnic backgrounds in Amsterdam, the Netherlands.	21 February 2017, BMC Public Health	Questionnaire: All parents and guardians living in Amsterdam were invited to complete a questionnaire about their vaccination intent one month before the first scheduled vaccination round. Linear and logistic regression analyses were used to assess the impact of several determinants on intention and uptake.	Attitude, beliefs, subjective and descriptive norms, habit strength, risk perception when not vaccinating, cancer in social environment, religion, SES, country of birth parents

Pot, Miriam, Theo GWM Paulussen, Robert AC Ruiters, Iris Eekhout, et al.	Motivational and contextual determinants of HPV-vaccination uptake: A longitudinal study among mothers of girls invited for the HPV-vaccination	July 2017, Preventive Medicine	Questionnaire: A random sample of mothers and girls drawn from Praeventis and 3 online panels was invited to complete a questionnaire. Data on uptake were collected from Praeventis. Backward linear and logistic regression analyses were conducted to examine the most important determinants of vaccination intention and uptake.	Attitude, beliefs, subjective norms, habit strength, risk perception when not vaccinating, perceived relative effectiveness, anticipated regret when not vaccinating, lack of info, religion, SES, country of birth parents
Patty, Nathalie J. S., Hanna Maria van Dijk, Iris Wallenburg, Roland Bal, et al.	To vaccinate or not to vaccinate? Perspectives on HPV vaccination among girls, boys, and parents in the Netherlands: a Q-methodological study	7 November 2017, BMC Public Health	Q-methodology: Participants of the study were asked to rate a set of statements, a by-person factor analysis was used to identify common patterns. Additional information was gathered through interviews and open-ended questions.	Beliefs, subjective norms, risk perception when not vaccinating, trust in authorities, lack of knowledge, lack of information provided by the government

Appendix 4 Python Script for collecting the tweets

Script to select tweets with "hpv".

Run me on ctithead1 with:

```
spark-submit --master yarn --deploy-mode cluster --num-executors 50 --conf  
spark.yarn.executor.memoryOverhead=2048 tweet_hpv.py
```

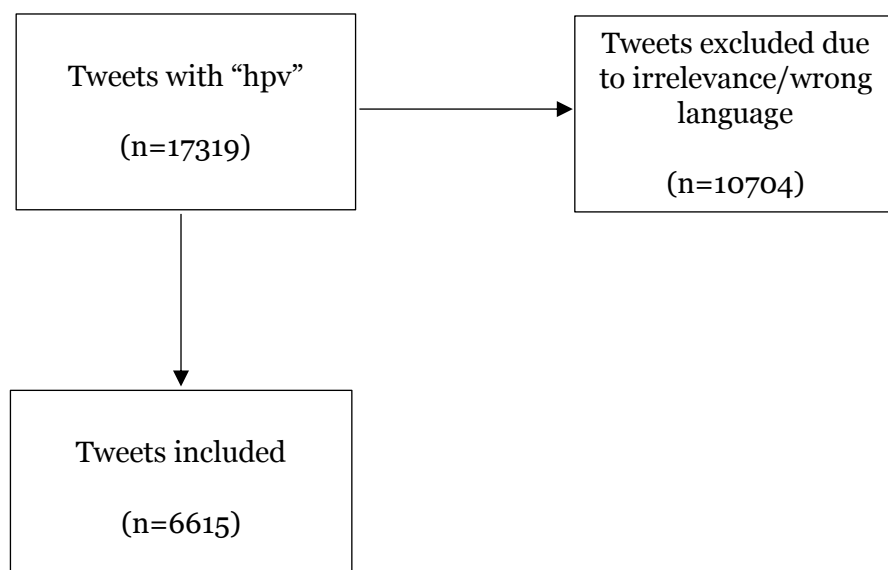
The Yarn logs are where you can understand any error:

```
yarn logs --applicationId application_1508921708233_0017
```

```
"""
```

```
import re  
from pyspark import SparkContext  
from pyspark.sql import SQLContext  
  
def toTSVLine(data):  
    return u"\t".join(re.sub(r"[\n\t]", " ", d) for d in data)  
  
sc = SparkContext(appName="Tweet selection")  
sqlc = SQLContext(sc)  
  
PATH = "/data/twitterNL/*/*.out.gz"  
KEYWORD = "hpv"  
  
df = sqlc.read.json(PATH)  
tweets = df.select("created_at", "id_str", df.user.id_str.alias("user"), "text")  
  
sample_tweets = tweets.rdd \  
    .filter(lambda x: x.text is not None and KEYWORD in re.split(r"^[a-z0-9]+",  
x.text.lower()))  
  
sample_tweets.map(toTSVLine) \  
    .saveAsTextFile("tweet_hpv-all")
```

Appendix 5 Selection of Tweets



Number of tweets per year	
2011	324
2012	458
2013	1018
2014	591
2015	2066
2016	2158
Total	6615

Appendix 6 Coding List²⁸

Tweets were put in these categories when:

Fear of side-effects

- a fear of side-effects is mentioned specifically
- concern is expressed about (long-term) unknown side-effects
- specific side-effects are mentioned that have (allegedly) been observed
- posts about research that will be carried out on alleged side-effects

Perceived effectiveness of the vaccine

- positive: it is stated that the HPV vaccine has been proven to be effective
- negative: concerns are raised about the effectiveness
- negative: it is specifically stated that the vaccine is not effective

Vaccine too new

- it is specifically stated the vaccine is too new
- it is stated that not enough research has been carried out
- it is stated that not enough is known about the vaccine
- it is stated that there are still too many uncertainties regarding the vaccine

Big Pharma

- the term “big pharma” is specifically mentioned
- it is said the introduction of the HPV vaccine is all about making money

Daughter too young/ not yet sexually active

- a parent mentions it was weird having to consider giving their young daughter a vaccine that protects against a virus that is sexually transmitted

Perceived severity of HPV and related illnesses

- severe: it is mentioned how dangerous the virus is
- severe: it is mentioned how dangerous/awful (cervical) cancer is
- severe: it is about an increase in infections or more infections discovered than initially assumed
- not severe: it is stated the virus is not that dangerous or bad
- not severe: it is argued the vaccine is redundant

Subjective norms

- positive: the advice of a doctor or scientist to vaccinate against HPV is mentioned
- negative: the advice of a doctor to not vaccinate is mentioned
- negative: the story of a former employee of Merck is mentioned claiming that the vaccine is unsafe and ineffective

Confidence in responsible authorities

- it is specifically claimed the authorities responsible for the introduction and distribution of the HPV vaccine cannot be trusted
- the government is accused of being in cahoots with “Big Pharma”
- conspiracy theories are shared showing a distrust in the authorities (e.g. the vaccine is used to sterilize women or to decimate the world’s population)

²⁸ This list only includes the options that have been found in the tweets, meaning the list does not exclude potential other options.

Perceived relative effectiveness

- it is argued there are other ways to protect against HPV than the vaccine such as practicing safe sex and abstinence till marriage

Cancer in social environment

- someone mentions knowing someone who has/had (cervical) cancer

Anticipated regret

- someone writes that when a parent does not have their daughter vaccinated they will think: “I wish I had given her the vaccine. Then she would not have died” (tweet no 1865, November 16 2016)

Perceived lack of information/knowledge

- someone says he/she does not have enough information/knowledge to decide about vaccinating against HPV or not
- someone mentions they do not know what HPV is

Parental responsibility for daughter's health

- someone says that, as a parent, they want to protect their daughter's health and therefore give her the vaccine

Religious convictions

- it was mentioned someone did not get the vaccine because of religious convictions

Socio-economic status (SES)

- one person mentioned he/she lives in a council that is white and highly educated so the HPV vaccination rate is higher than in other places.

Distance to vaccination location

- someone complains about the distance between their house and the vaccination location
- it is argued a further distance to a vaccination location negatively affects the vaccination rate

Lack of information provided by the government/responsible authorities

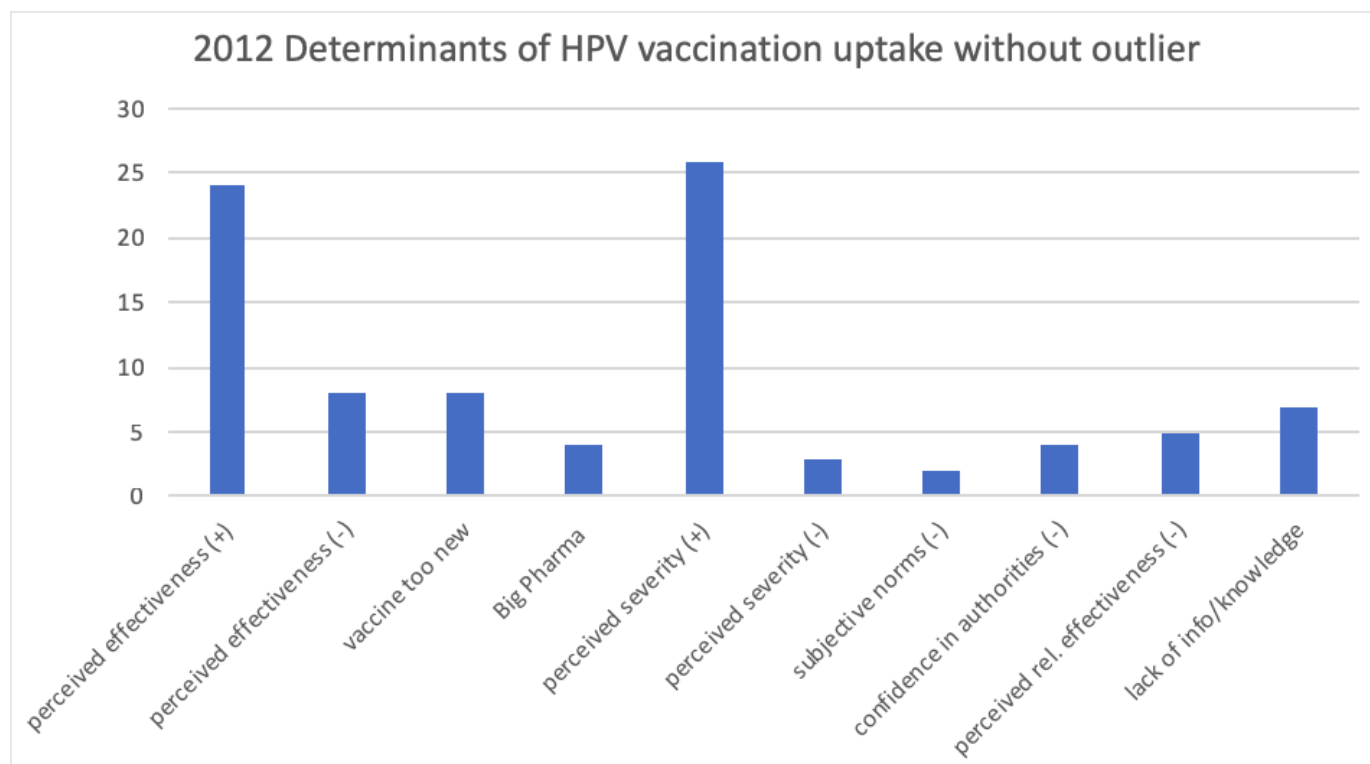
- it is mentioned not enough information about HPV and the vaccine is available
- someone argues authorities should provide more information about the safety of the vaccine and side-effects that are mentioned on social media and the news
- someone argues authorities should do more to counter (fake news) stories about side-effects
- someone says more education by responsible authorities on HPV is necessary

Use of incentives

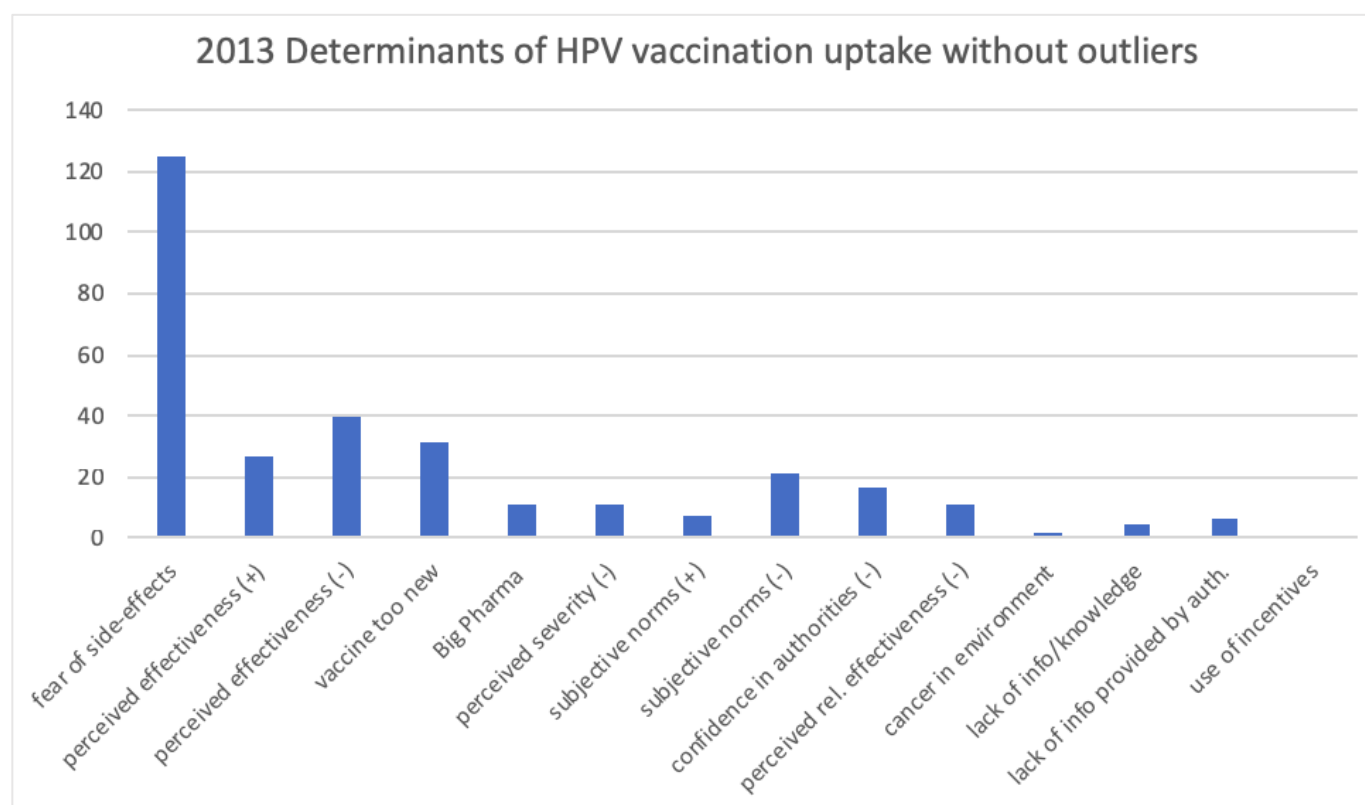
- someone refers to girls able to win an iPod if they receive the HPV vaccine

Appendix 7 Overview of determinants without outliers

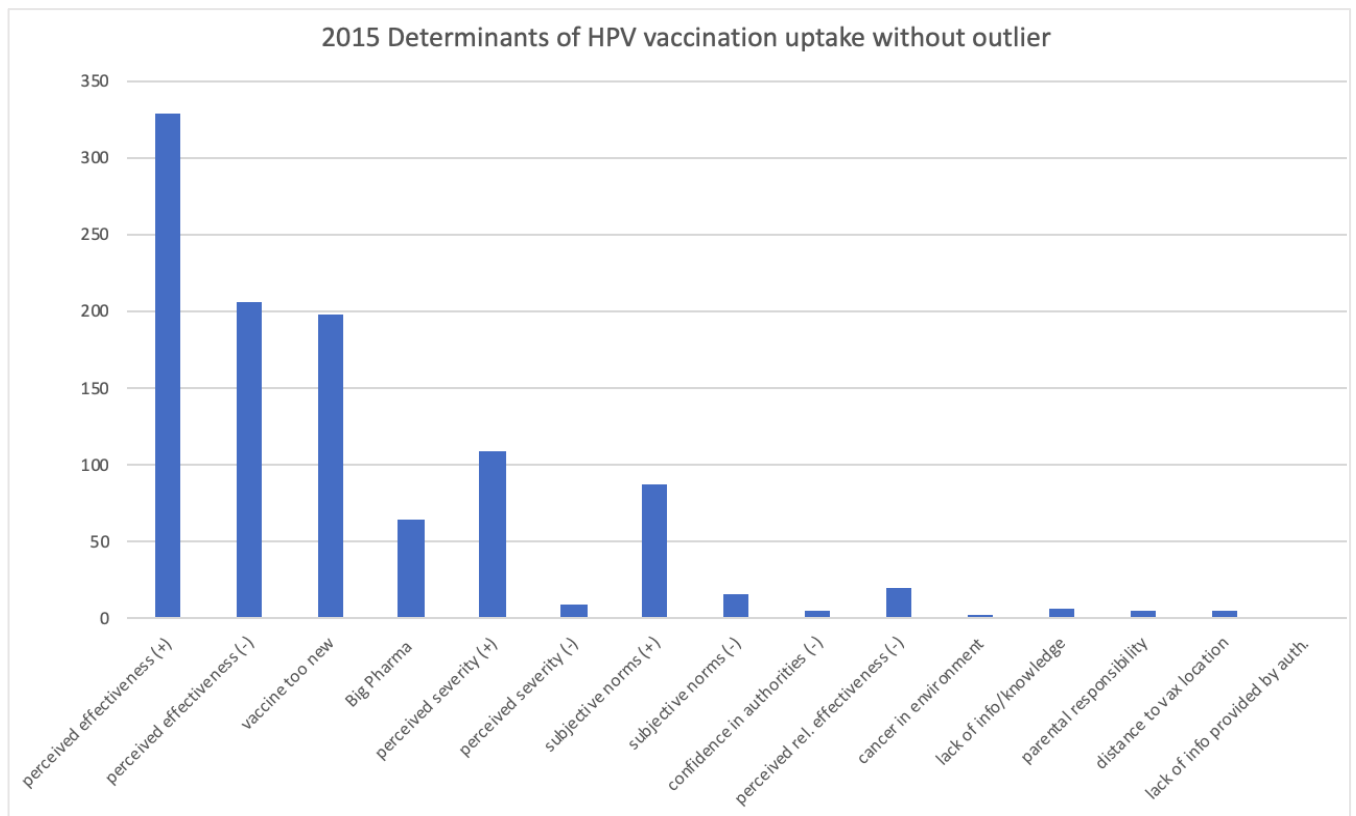
2012



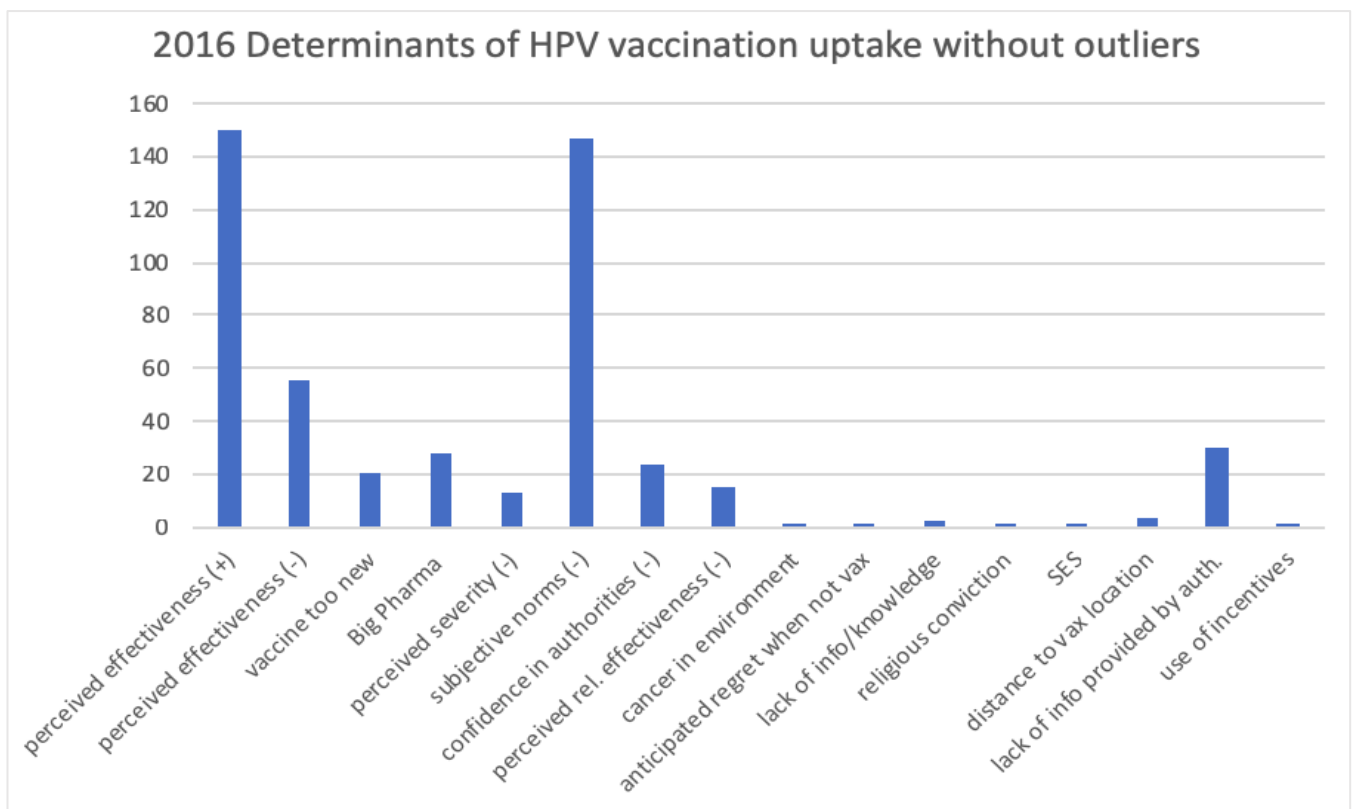
2013



2015



2016



Appendix 8 Sanity check on the Twitter feed

Tweets collected in Twitter with the search terms: “hpv gehad”, “hpv gehaald”, “hpv gekregen”, and “hpv prik”		
	Total tweets found	Tweets not in the data
2011	14	1
2012	15	3
2013	11	1
2014	5	1
2015	6	0
2016	14	0
total	65	6