A profile of vaccination sentiments on online news, forums, Twitter, and other microblogs in South Africa

A mini-dissertation submitted by

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2018
DECLARATION

I declare that the mini-dissertation hereby submitted to the Sefako Makgatho Health Sciences University, for the degree of Master of Pharmacy, in the School of Pharmacy has not previously been submitted by me for a degree at this or any other university; that it is my work in design and execution, and that all material contained herein has been duly acknowledged.

____________________  20 April 2019  
Matsangaise MM (Ms)  Date
DEDICATION

This dissertation is dedicated to my family who have been my pillar of strength throughout my studies.
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<tr>
<td>CDC</td>
<td>Centres for Disease Control</td>
</tr>
<tr>
<td>EPI</td>
<td>Expanded Programme on Immunisation</td>
</tr>
<tr>
<td>HepB</td>
<td>Hepatitis B vaccine</td>
</tr>
<tr>
<td>HPV</td>
<td>Human papillomavirus</td>
</tr>
<tr>
<td>MMR</td>
<td>Measles, mumps rubella vaccine</td>
</tr>
<tr>
<td>MPharm</td>
<td>Master of Pharmacy</td>
</tr>
<tr>
<td>NDoH</td>
<td>National Department of Health</td>
</tr>
<tr>
<td>NICD</td>
<td>National Institute for Communicable Diseases</td>
</tr>
<tr>
<td>NRF</td>
<td>National Research Foundation</td>
</tr>
<tr>
<td>SAMA</td>
<td>South African Medical Association</td>
</tr>
<tr>
<td>SAVIC</td>
<td>South African Vaccination and Immunisation Centre</td>
</tr>
<tr>
<td>SMUREC</td>
<td>Sefako Makgatho University Research Ethics Committee</td>
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<td>WHO</td>
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ABSTRACT

Introduction: Although vaccination is recognised as one of the most cost-effective public health interventions, outbreaks of vaccine preventable diseases in South Africa have made it apparent that vaccines are not reaching all. Evidence of anti-vaccination lobbying on the South African internet in a previous study further raised concerns and a probe to determine anti-vaccination sentiments on South African social media became necessary. This was especially necessitated and motivated by global studies which have demonstrated the correlation between vaccine sentiments on social media and a decline or rise in vaccine uptake. As a result, the South African Vaccination and Immunisation Centre began a social media tracking project in June 2016, to analyse sentiment on vaccination-related posts. Baseline results of the first 6 months of tracking found that 18% of posts were anti-vaccination. This study reports on the second 6 months of the project.

Objectives: The objectives of the study were to i) identify and classify sentiments towards human vaccination generated from online news, forums, Twitter and other microblog platforms in South Africa over a period of 6 months as positive, negative or neutral; ii) determine the frequency of the three vaccination sentiments over a period of 6 months; iii) identify and classify the main influencers of vaccine content; and iv) identify and describe anti-vaccination themes.

Method: A descriptive qualitative study, using content analysis of online vaccination conversations on Twitter, microblogs, forums and online news platforms was conducted. The study also incorporated a quantitative approach to determine the frequency of the classified sentiments. Vaccination-related social media posts were identified by Pulsar® software for the period December 2016 to May 2017. Data were coded into positive, neutral or negative sentiments and quantified by Pulsar® software. Conversations classified as negative were then imported into NVivo®12 software and open-coding was used to develop a framework of categories and themes. Ethical clearance for the study was obtained from Sefako Makgatho University Research Ethics Committee.

Results: A total of 11 111 conversations were identified, of which 16.5% were anti-vaccination. Twitter emerged as the biggest source of vaccine-related posts, with tweets making up 83% of all posts. After determining the top 10 influencers of negative vaccine content by visibility score as well as by impression score, a permaculture expert recorded the highest visibility score, while a news agent emerged with the largest impression score. Common anti-vaccination themes included the following: the conspiracy theory that Big
Pharma develops vaccines for financial gain; the theory linking vaccines to autism; issues surrounding safety of vaccines and vaccine ingredients; and concerns about the effectiveness of vaccines.

**Conclusions:** Anti-vaccination sentiments on South African social media platforms present a serious cause for concern. Themes identified provide further valuable information that can be used by the South Africa National Department of Health to develop targeted messages about vaccine safety. The data from global studies showing correlation between negative sentiments possibly influencing the decision not to vaccinate make it especially important to address this growing phenomenon. Targeted interventions addressing a social media audience are therefore paramount. The viral nature of the internet makes these interventions especially urgent.

**Recommendations:** Ongoing surveillance of the South African social media landscape is encouraged, and studies investigating the impact of anti-vaccination conversations in the South African context are recommended. A large social media presence and visibility of public health groups debunking vaccination myths and answering public concerns is therefore necessary.
Chapter 1: Introduction

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

This chapter outlines the background and motivation for the study and briefly gives the rationale for the study. A description of the problem statement is provided, which is followed by the aims and objectives of the study. The importance of the study is given and the chapter is concluded with an outline of how the dissertation is presented.

1.2 BACKGROUND AND RATIONALE FOR THE STUDY

Vaccination is recognised as a key intervention for preventing infectious diseases, thereby reducing the need for antibiotics which in turn reduces antimicrobial resistance. Each year vaccination saves millions of lives and has successfully eradicated smallpox, which in the past claimed over 5 million lives annually (Henderson, 2011). In addition, vaccination remains the most cost-effective way of preventing vaccine-preventable diseases (Ozawa, Clark, Portnoy et al., 2017). South Africa has achieved significant successes through its Expanded Programme on Immunisation (EPI-SA), including being declared free of wild poliovirus transmission by the Africa Region Certification Commission in 2006 (World Health Organization [WHO], 2015). The EPI-SA currently provides free universal infant vaccination against disseminated tuberculosis, polio, diphtheria, pertussis, tetanus, Haemophilus influenzae type b (Hib) disease, hepatitis B, rotavirus diarrhoea, pneumococcal disease and measles (Dlamini & Maja, 2017). In addition, the human papillomavirus (HPV) vaccine against cervical cancer is provided to public sector girls from the age of nine (Dlamini & Maja, 2016; Bruni, Barrionuevo-Rosas, Albero et al., 2017).

Although EPI-SA has gone to great lengths to improve access to adequate infant immunisation (Dlamini & Maja, 2016), outbreaks of vaccine-preventable diseases continue to occur. For example, cases of measles and diphtheria have been reported in South Africa in the past number of years (Siegfried, Wiysonge & Pienaar, 2010; Mahomed, Archary, Mutevedzi et al., 2017; National Institute for Communicable Diseases [NICD], 2017a; NICD, 2017b). Measles cases were reported in eight provinces of the country in 2017 and as a result it has become increasingly obvious that infant vaccines are not reaching all intended areas and people (NICD, 2017). This supposition is supported by South Africa’s 2016 Demographic and Health Survey, which reported that only 53% of children aged 12 to 23 months had received all their
age appropriate vaccines in their first year of life (National Department of Health [NDoH], Statistics South Africa, South African Medical Research Council & ICF, 2017).

Although significant strides in HPV vaccination coverage have been made since its introduction in 2014 (NDoH, 2014), limited access and uptake has been observed (Bruni et al., 2017). The 2015/2016 NDoH annual report showed a low uptake of the 2\textsuperscript{nd} dose of the HPV vaccine (63\%), which was below the targeted 80\% coverage (NDoH, 2017). Also noteworthy, is the sub-optimal coverage of the hepatitis B vaccine (HepB) amongst healthcare workers (Makwakwa, Fernandes, Francois et al., 2014; Sondlane, Mawela, Razwiendani et al., 2016). For example, only 15.4\% of healthcare workers were reported to have received all three doses of HepB in a study done at Chris Hani Baragwanath Hospital in Johannesburg (Makwakwa et al., 2014).

Reasons for low vaccination coverage range from a lack of confidence in vaccines to limited access to basic health-care in some communities (Salmon, Dudley, Glanz & Omer, 2015). Factors related to vaccination coverage include amongst others, socio-economic status and religion (Larson, Jarrett, Eckersberger et al., 2014). In middle and high income countries, there is better internet access than in lower income countries, which therefore plays a significant role in dissemination of vaccine information and misinformation, shaping sentiment and ultimately the decision on whether or not to vaccinate. Vaccination hesitancy fuelled by the emergence of anti-vaccination lobbying, is a growing phenomenon on social media platforms in high income countries (Dubé, Gagnon, Ouakki et al., 2016; Ward & Peretti-Watel, 2016). Vaccination hesitancy is defined as a lack of willingness to vaccinate despite vaccination services being available and may include a partial willingness to vaccinate versus complete refusal or acceptance of some vaccines and refusal of others (WHO, 2014). Vaccine hesitancy focuses mainly on the indecision to accept or deny vaccines and many factors such as context, time and specific vaccine influencing the decision (WHO, 2014). Evidence from recent studies in South Africa shows the increasing presence of anti-vaccination lobbying on the South African internet (Baker, 2015; Burnett, von Gogh, Moloi et al., 2015). However, there is a paucity of scientific literature about the influence that social media-based anti-vaccination lobbying has on vaccination uptake in South Africa.

Because of internet-based anti-vaccination lobbying on South African webpages, in 2016, the South African Vaccination and Immunisation Centre (SAVIC) started a project using software that tracks vaccination conversations on social media networks including online news, forums, Twitter and other microblog platforms. The search algorithm and sentiment allocation
methodology were piloted from June to November 2016, rendering the software ready to be used for tracking South African vaccination conversations on social media.

1.3 PROBLEM STATEMENT

Infant vaccination coverage in South Africa has been shown to be far below the targets set by the WHO and the NDoH, resulting in outbreaks of vaccine-preventable diseases which are targeted by EPI-SA. The contribution of internet-based anti-vaccination lobbying to the low vaccination coverage has not been established. Vaccination sentiments on social media may contribute to shaping the extent of vaccine uptake by members of the public who use social media. However, there are no published data from South Africa on the perceptions of social media users towards vaccination.

1.4 RESEARCH QUESTION

What is the profile of sentiments towards human vaccination expressed on South African online news, forums, Twitter and other microblogs?

1.5 AIM OF THE STUDY

To profile sentiments on human vaccination expressed on online news, forums, Twitter and other microblogs in South Africa.

1.6 OBJECTIVES OF THE STUDY

The objectives of the study were as follows:

- To identify and classify sentiments towards human vaccination generated from online news, forums, Twitter and other microblog platforms in South Africa over a period of 6 months as positive, negative or neutral.
- To determine the frequency of the three vaccination sentiments over a period of 6 months.
- To identify and classify the main influencers of vaccine content on online news, forums, Twitter and other microblogs.
- To identify and describe anti-vaccination themes mentioned on online news, forums, Twitter and other microblogs.
Chapter 1: Introduction

1.7 IMPORTANCE OF THE STUDY

This study provides data that are essential for understanding public sentiment towards human vaccination in South Africa. Being confined to that sector of the South African public utilising social media, it provides invaluable insights into how information or misinformation on the internet shapes online conversations about vaccination. Evidence of the impact of anti-vaccination lobbying on vaccine uptake in high income countries makes it imperative that South African researchers embark on studies to investigate the trends in human vaccination-related online conversations. The already evident infiltration of anti-vaccination lobbying on the South African internet makes this a matter of urgency as the statistics have demonstrated a large and growing social media use and a reliance on social media for information.

The results of the study will assist in designing interventions aimed at increasing awareness of the benefits of vaccination in the social media sphere with the aim of improving vaccination uptake.

1.8 OUTLINE OF THE DISSERTATION

Chapter 1 provides an overview of the dissertation and covers the background and rationale of the study, as well as the problem statement, aim and objectives.

Chapter 2 contains the literature review on the topic investigated.

Chapter 3 provides a detailed account of the methodology of the study.

Chapter 4 contains the two manuscripts that will be submitted for publication in peer reviewed journals. As a requirement for the MPharm degree, MPharm dissertations do not have separate chapters dedicated to results and discussion. The results of the study and the discussion thereof are presented within the two manuscripts.

Chapter 5 includes the limitations of the study, recommendations and a brief conclusion.
CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

This chapter explores the literature that was used to support the objectives of the study, outlined as sections and subsections. Section 2.2 gives details about vaccination uptake, sentiments and the media. Section 2.3 gives an extensive description of social media as a data source for vaccine conversations. Subsection 2.3.1 is a review of social media for research purposes and 2.3.2 describes the ethical implications in social media research. Subsection 2.3.3 investigates literature on the role that influencers have in promoting health-related information in general as well as vaccine content. The chapter is concluded with Section 2.4, in which anti-vaccination myths and themes are discussed.

2.2 VACCINATION UPTAKE, VACCINE SENTIMENTS AND THE MEDIA

Vaccine sentiments reaching the general public through mass media have been observed to have an impact on the uptake of vaccines. Previous studies have shown a correlation between a surge in vaccine conversations in the media and a decline/increase in uptake (Smith, Ellenberg, Bell et al., 2008; Salathé & Khandelwal, 2011). For example, in a study to determine the impact of media coverage of the measles mumps and rubella vaccine (MMR)-autism controversy, a decrease in MMR coverage was observed following the media publications (Smith et al., 2008). Similarly, a strong correlation was observed between sentiments expressed on Twitter towards a newly introduced influenza vaccine and Centre for Disease Control (CDC)-estimated vaccination rates in the United States (Salathé & Khandelwal, 2011). The impact of the media on vaccination was also demonstrated when Japan suspended its HPV vaccine recommendation following online media outcry about the perceived HPV vaccine adverse effects (Larson, Wilson, Hanley et al., 2014).

Vaccine sentiments may be categorised as positive, neutral or negative based on the tone or nuance gathered from the posts (Salathe et al., 2011; Larson, Smith, Paterson et al., 2013). Conversations or posts expressing concerns about adverse effects following immunisation or any form of vaccination hesitancy towards the immunisation programme, would be classified as negative sentiment (Larson et al., 2013). Positive or neutral sentiments are those conversations which lack an indication of concern about vaccines or the vaccination programme (Becker, Larson, Bonhoeffer et al., 2016; Keim-Malpass,
Mitchell, Sun et al., 2017). Some studies have classified conversations as either pro-vaccination, anti-vaccination or neutral (Guidry, Carlyle, Messner et al., 2015). Understanding the different sentiments that the public share about vaccines will help shape interventions tailor-made for a social media audience.

### 2.3 SOCIAL MEDIA AS A DATA SOURCE FOR VACCINE CONVERSATIONS

#### 2.3.1 Social media: Key definitions

Social media is defined as websites or applications where people can communicate and exchange information (Oxford, 2017). Examples of such applications include Facebook, Twitter, Instagram, Pinterest and YouTube amongst a wide array of sites. Twitter is one of the fastest growing social media platforms. In 2019, it was recognised as the second largest influential social network in South Africa (ORNICO, 2019). Conversations on Twitter are known as tweets. Tweets may further be classified into ‘posts’ and ‘engagements’. ‘Posts’ refer to the user’s own opinions, whereas ‘engagements’ refer to the user’s reaction to another post in the form of a ‘like’ or a ‘retweet’ (Twitter, 2018). For the purposes of this study the term ‘posts’ will be used to refer to tweets, posts and engagements from the social media platforms investigated in this study.

Microblogs are social media sites that allow the user to post very short entries or content in the form of a picture or text (Merriam-Webster, 2017). Examples of microblogs include Twitter, Tumblr and Friendfeed. Other social networks such as Facebook have a microblogging feature which is referred to as a ‘status update’. Conversations on microblogs are known as ‘posts’.

Online news platforms are electronic news blogs which replace or often supplement the traditional paper-based newspapers. A survey done in August 2017 in the United States showed that 68% of adults obtained their news from social media (Horrigan, 2018). Although South Africans primarily rely on television as a news source, the rate of online news uptake is double that of print and radio (Effective Measure, 2017).

#### 2.3.2 Social media for research

Researchers have started utilising social media as a data source for exploring public awareness about health matters (Gough, Hunter, Ajao et al., 2017). Electronic media gives real time access to public opinions on issues surrounding their beliefs and opinions (Dredze, Broniatowski, Smith et al., 2016). Online research cuts across demographics and allows the
Chapter 2: Literature Review

perspectives of different social groups to be explored (Dredze et al., 2016). There is growing evidence of a reliance by the public on the internet for health information (Hesse, Moser & Rutten, 2010; Lehmann, Ruiter & Kok, 2013) and a tendency to express their perceptions on social networks. An internet survey conducted on American adults showed that the internet was the second most trusted source of health information and the first point of enquiry for health-related information (Hesse et al., 2010).

Together with selected microblogs, Twitter presents a large pool of information from which researchers can gather trends and sentiments from the public about a specific subject. Twitter has in the past been used to understand the public’s perception of the HPV vaccine (Keim-Malpass et al., 2017). A previous study has utilised social media to track the geographical spread of vaccine conversations by developing a ‘rumour surveillance’ for early detection of vaccine content (Larson et al., 2013). In a similar fashion, Twitter has been used as a surveillance system during an influenza outbreak to track and investigate the correlation between Twitter mentions and influenza prevalence (Broniatowski, Paul, Dredze et al., 2013). Other social media platforms such as Pinterest, have also been used to gain an understanding of how vaccines are portrayed on the platform (Guidry et al., 2015).

2.3.3 Ethical implications of social media research

Social media is a relatively new source of research data and hence comes with its own challenges. The legal environment surrounding internet research is still ambiguous. Posts that are publicly available on social media are deemed exempt from requiring consent (Rivers & Lewis, 2014; Wenner, 2014; Twitter, 2018). Conflicting information exits on social media ethics and it is difficult to strike a balance between conventional research ethics and the relatively less stringent internet ethics (Buchanan & Zimmer, 2018). Twitter’s privacy policy puts no restriction of access to usernames, known as Twitter handles, and this permits the use of the usernames by third parties for marketing or research (Twitter, 2018). Provision is made for those who would like to maintain their privacy or do not want their information collected to ‘lock’ their accounts or use pseudonyms instead of their real names (Twitter, 2018). On the other hand, Facebook updated its privacy policy to add restriction of open access to user information for unauthorised parties and therefore posts are not in the public domain, hampering research on the site (Facebook, 2018).

Although these ethical dynamics exist across social media platforms, ethical bodies seem to agree that some basic research ethics need also be applied to social media as with conventional research methods (South African Medical Association [SAMA], 2015;
Chapter 2: Literature Review

Buchanan & Zimmer, 2018). In the United States, research ethics stipulate that there should not be ‘linkability’ of research data and that any personal identifiable information should be removed or have its access restricted (Buchanan & Zimmer, 2018). Similarly, the South African Medical Association in its social media ethics guideline recommends that patient confidentiality should be maintained in all medical practitioners’ social media interactions (SAMA, 2015).

2.3.4 Bias in social media research

A limitation of social media, for the purpose of research, is that conclusions for a larger population cannot be drawn just from electronic platforms, as they exclude the portion of the population who are not sufficiently comfortable with technology as well as those who do not have access to an internet infrastructure (Gustafson & Woodworth, 2014). The information gathered does however give an idea of the general trends in conversations in the social media sphere and will enable interventions to be made specifically for those who may be influenced by anti-vaccination content shared on social media.

2.3.5 Vaccine content influencers on social media

Several public health organisations such as the WHO, United Nations Children’s Fund and National Departments of Health are among influential entities harnessing the power of social media in disseminating important vaccination messages. These large organisations capitalise on their relatively extensive social media following and therefore are capable of increasing direct engagement with the public (Heldman, Weaver & Schindelar, 2013). Other influencers include independent social media users who may or may not be affiliated to a public health organisation, are healthcare workers or lay people with a large social media following (Househ, 2016; Gough et al., 2017). In addition, online news agents have been observed to make great impressions and are often the most shared or reposted and referenced source of vaccine information on social media (Becker et al., 2016). Influencers with an extensive following, pushing anti-vaccination content on social media platforms increase the likelihood of a reduction in vaccine confidence amongst the audiences in their virtual space (Heldman et al., 2013). Identifying health influencers on social media gives rise to potential partnerships between positive influencers and public health organisations, for the purposes of designing important health advocacy strategies, including interventions for increasing vaccination uptake (Heldman et al., 2013; Gough et al., 2017).
2.4 ANTI-VACCINATION THEMES ON SOCIAL MEDIA

The conversational landscape in other studies revealed the infiltration of anti-vaccination lobbying on electronic media platforms (Becker et al., 2016; Burnett et al., 2015; Hickler, Guirguis & Obregon, 2015). Several beliefs propagated by anti-vaccination lobbyists pertaining to vaccines and the vaccination programme, are shared on social media by anti-vaccination lobbyists and vaccine hesitant parents. Some of the common anti-vaccination themes encountered on the internet and social media include concerns about vaccine safety, vaccine effectiveness, human rights issues around consent, religious beliefs and conspiracy theories involving pharmaceutical companies and the government (Healy, 2014; Guidry et al., 2015).

2.4.1 Vaccine safety

Fears that vaccines are not safe have been around since the invention of the first vaccine against smallpox (Porter & Porter, 1988; Wolfe & Sharp, 2002). However, it was the 1998 report in The Lancet by Wakefield et al., suggesting a link between the MMR and autism that gave rise to modern anti-vaccination lobbying, which was primarily focused on the myth that vaccines are not safe (Wakefield, Murch, Anthony et al., 1998). Since the advent of social media, this myth has been a dominant and recurring theme, with studies reporting on varying safety related claims being made on social media, ranging from a lack of confidence in vaccine ingredients to concerns about vaccine adverse effects as well as a belief that vaccines have the potential to cause disease (Lehmann et al., 2013; Guidry et al., 2015). Recurring mentions of vaccine ‘additives’ such as mercury and aluminum are also common amongst anti-vaccination posts (Kang, Ewing-Nelson, Mackey et al., 2017). These are often linked to the emergence of autism and other idiopathic diseases in vaccinated children. Vaccine hesitant social media users also cite their fear of developing vaccine related adverse events to explain their lack of enthusiasm towards vaccines. A study of YouTube videos related to immunisations showed that vaccines were perceived to cause a range of serious adverse events including neurological injury and some form of permanent injury (Keelan, Pavri-Garcia, Tomlinson et al., 2007)

2.4.2 Vaccine effectiveness

Vaccine effectiveness has also been questioned by vaccine hesitant parents who have been exposed to anti-vaccination misinformation, with sentiments ranging from a complete lack of confidence to partial acceptance (Guidry et al., 2015). Some vaccine hesitant social media users were found to believe that vaccines increase susceptibility to the diseases
against which one is vaccinated (Guidry et al., 2015; Lehman et al., 2013). Others questioned why it was possible to still contract the disease against which one is vaccinated. This was demonstrated in a study that tracked the coverage of influenza vaccine, where people questioned why it was necessary to get the vaccine if one could still contract influenza regardless of one’s vaccination status (Lehmann et al., 2013). Furthermore, to support the vaccine ineffectiveness claim, anti-vaccination conversations often recommend alternative therapies such as vitamin C and D supplementation for influenza and lifestyle adjustments in place of vaccines, with these practices being credited for the decline in vaccine preventable diseases (Lehmann et al., 2013). Others are of the belief that vaccines are not ‘natural’ and that complementary medicines are more effective than vaccines for preventing disease (Shapiro, Surian, Dunn et al., 2017).

2.4.3 Human rights issues

Anti-vaccination sentiments on social media have also been characterised by the questioning the perceived breech of human rights through ‘mandatory vaccination’ in countries were childhood vaccines are regarded as legally compulsory (Guidry et al., 2015). Parents expressed concern at the ‘lack of respect’ for their decision to have their children abstain from vaccines as they held the belief that they were the ‘experts’ of their own children (Kata, 2012). Others were of the view that mandatory vaccines were an expression of the government’s excessive control and felt that this was therefore a violation of civil liberties (Guidry et al., 2015; Shapiro et al., 2017). Concerns about the girls-only mandate of the HPV vaccine were also expressed and questions about who should be the decision maker when it comes to HPV vaccination were also observed (Shapiro et al., 2017).

2.4.4 Religious beliefs

While religion-based anti-vaccination sentiment expressed on the internet has been documented to have an influence on vaccine perceptions and may ultimately have an impact on vaccine uptake (Burnett et al., 2012; Grabenstein, 2013), very few social media studies have identified religious beliefs as a theme related to vaccine hesitancy. A study of parenting blogs observed a relationship between religious affiliation and vaccine exemptions, with parents relying on their faith teachings to inform their decision to vaccinate or not (Tangherlini, Roychowdhury, Glenn et al., 2016). Findings from a study on Twitter regarding the HPV vaccine showed conflicting sentiments towards the vaccine which was perceived to be contrary to some religious principles which advocated for abstinence as a way of preventing HPV infection (Shapiro et al., 2017).
2.4.5 **Conspiracy theories**

Negative sentiments around vaccination often stem from a lack of trust in health governing boards as well as the government (Lehmann *et al.*, 2013; Blankenship, Goff, Yin *et al.*, 2018; Kang, Ewing-Nelson & Mackey *et al.*, 2017). Anti-vaccination lobbyists also often make reference to the perceived financial benefit that Big Pharma and organisations such as the CDC stand to gain from the vaccination programme (Kang *et al.*, 2017).

2.5 **SUMMARY**

Vaccination sentiments shared across social media platforms have been classified as either positive, neutral or negative as well as either pro- or anti- vaccination. Evidence in literature has shown the ability of social media for quick dissemination of vaccine content and how the coverage of such has in the past resulted in reduced or increased vaccine uptake. Social media thus presents researchers with a large platform which cuts across demographics and from which different perspectives can be explored. However, the ethical environment for social media research is still unclear but basic research ethics aimed at protecting subjects are recommended.

Vaccine content influencers are individuals or organisations usually with a large following or reach who are key-drivers of vaccine content on social media. These include both positive and negative influencers and a study of both assists in developing targeted interventions towards vaccine advocacy.

Varying vaccine themes have been identified on social media from previous studies and these include: vaccine safety theme were the safety of vaccines and their ingredients is questioned; vaccine effectiveness where others doubt the efficacy of vaccines; human rights where others cite a lack of respect for civil liberties as far as mandatory vaccines are concerned and the religious beliefs theme which demonstrates how religion has in past studies influenced parents stance on vaccination.

The following chapter will provide details on the methodology of the study.
3.1 INTRODUCTION

This chapter describes the methodology for the study with details about the study design, population and sample selection discussed in Sections 3.2 and 3.3 respectively. A description of the data collection process and instruments is provided in Section 3.4. Section 3.5 explains the data analysis methods for the qualitative and quantitative data in detail. Methods used to ensure the trustworthiness of the study are discussed in Section 3.5.4. The chapter is concluded with Section 3.7, describing the ethical considerations for the study.

3.2 STUDY DESIGN

Firstly, this was a descriptive qualitative study, using content analysis of online vaccination conversations on Twitter, microblogs, forums and online news platforms.

Secondly, the study also incorporated a quantitative approach to determine the frequency of the classified sentiments.

3.3 STUDY POPULATION AND SAMPLE

3.3.1 Target population

The study population included all publicly available South African posts on Twitter, microblogs, forums and online news platforms which contained at least one of the terms from the Boolean search (see Section 3.3.2) over a 6-month period. Only posts originating from publically available South African Internet Protocol addresses were utilised. Users with a Virtual Private Network were not included.

3.3.2 Sample selection

All posts from the selected electronic platforms, for the period December 2016 to May 2017 were selected for analysis.

The following inclusion criteria were applied:

- All posts from Twitter, forums, microblogs and online news platforms which made reference to human vaccination, that contained at least one of the following search terms:
Chapter 3: Methodology

Vaccination, vaccinate, vaccine, vaccinations, vaccinates, vaccines, vaccinated, #vaccination, #vaccinate, #vaccine, #vaccinations, #vaccinates, #vaccines, , #vaccinated, inenting, entstof, entstowwe, inentings, ingeënt, #ingeënt, #inenting, #entstof, #entstowwe, #inentings

The following exclusion criteria were applied:

- Posts that made reference to animal vaccination
- Posts outside South Africa

3.4 DATA COLLECTION PROCESS AND INSTRUMENT

Retrospective data were collected from online news sites, forums, Twitter and microblogs for a period of 6 months (December 2016 to May 2017) using Pulsar® software.

Pulsar® software is utilised in market and science research. Pulsar® uses an algorithm to collect and summarise data. This enables collection of vast quantities of data in an instant and increases access to information for research and/or marketing purposes. The software allows for the following data to be aggregated: Conversation volume over time; trending themes; top locations discussing topics; heat map depicting the story’s penetration around South Africa; top influencers and engagers.

The programme allows for retrospective and prospective tracking of conversations and therefore enables continuous follow-up of conversations. The impact of an intervention, for example, can continuously be traced for years after its inception. SAVIC secured a license for Pulsar® as part of a National Research Foundation (NRF) grant for the purposes of conducting online research.

In this study, an online Boolean search of vaccine related key words was generated and built into the programme. Search terms were limited to English and Afrikaans only, two of the eleven official languages in South Africa, since during piloting using the other languages yielded no results. Filter and keywords (see Section 3.3.2) were inserted into the search interface to extract only relevant conversation on human vaccination. Posts from the search results often contained hyperlinks to other websites in which some of the search terms were mentioned. These hyperlinks were then opened and the contents extracted to an Adobe® PDF document and reserved for analysis. Figure 3.1 shows screenshots of examples of anti-vaccination conversations extracted from Pulsar® software.
Figure 3.1: Screenshots from Pulsar® software showing negative vaccine conversations

3.5 DATA ANALYSIS

3.5.1 Classification of sentiments

Data were coded into positive, neutral or negative sentiments by Pulsar® software. A key word searching algorithm imbedded in the software retrieved information and filtered for words based on a predetermined but dynamic ‘dictionary’ that associates certain words or groups of words with a certain sentiment. Two researchers reviewed each post, and manually changed the software assigned sentiment if they both agreed that it was incorrect. Where there was disagreement on an assigned sentiment, the post was sent to the supervisor and a final decision on sentiment allocation was made. A negative sentiment was characterised by data showing concerns about vaccination or the vaccination programme, such as concerns about vaccine adverse effects, vaccine ingredients or any other concern that suggested a negative connotation about vaccines. Positive sentiments were those that promoted vaccination in any way. Neutral sentiments were posts where no clear tone could be detected. The proportion of
Chapter 3: Methodology

each sentiment in relation to the total number of posts, and the proportion of posts from each respective platform (Twitter/ online news/ forum/ microblog) was also calculated by the software.

3.5.2 Frequency of the three vaccination sentiments over a period of 6 months

Following classification into the three sentiments, Pulsar® was also used to quantify the sentiment. A total count of the posts exhibiting positive, neutral or negative sentiment for the period December 2016 to May 2017 was done by the software.

3.5.3 Classification of vaccine content influencers

Pulsar® software was also used to determine the number of ‘impressions’ and ‘visibility’ of vaccine content influencers. The top ten influencer statistics were exported from Pulsar® into a Microsoft® Excel spreadsheet. This was done for both negative and positive content influencers.

Influencer ‘visibility’ is based on an algorithm designed in Pulsar® that takes into consideration the format of the message (whether it is a post or a reply, contains an image, contains a link), the channel where that messages is being posted (e.g. tweets have a shelf life that is shorter than a news article or a blog post), the size of the audience of the person posting that content (e.g. followers on Twitter or monthly unique followers for a news website) and finally the amount of people who react to the post (including comments, re-shares, retweets).

On the other hand, influencer impressions are based only on how many people would have been exposed to a piece of content. It therefore indicates the potential audience for a post. The number of social media followers an influencer has will therefore have a role in the impression score.

3.5.4 Vaccination themes

A thematic step-wise content analysis was conducted, to identify vaccination themes from the data. Following sentiment assignment by Pulsar® software, all the conversations coded as negative were first exported to a Microsoft® Excel spreadsheet and counter-checked to confirm negative sentiment. These were then imported into NVivo®12, a qualitative data analysis software package, for analysis. Coding of the data commenced, following detailed reading of the data in NVivo®12. Data were first coded into nodes by the researcher and re-coded by the supervisor to ensure the trustworthiness of the coding process. Nodes were
created for subjects of particular interest. Figure 3.2 shows an example from NVivo®12 of text coded into nodes.

![Figure 3.2: Example from NVivo®12 showing text coded into nodes](image)

Continuous discussions between the researcher and the supervisor took place to reach consensus regarding the coding. Nodes with related information were then grouped together into categories and sub-categories. An example was segmenting vaccine conversations into different beliefs and myths shared by the public. Data in sub-categories were re-coded and re-assigned into new nodes where necessary. In addition, a word search query was launched for particular terms of interest for example, a search query married a node on ‘beliefs’ with that on ‘measles’ to gain insight on sentiments around the measles vaccine.

The last step in the data analysis process entailed linking categories and sub-categories to one another to form overarching themes with sub-themes that depicted shared anti-vaccination sentiments.

3.6 TRUSTWORTHINESS

3.6.1 Dependability

To ensure dependability, findings were based on verbatim conversations exported from Pulsar®. Filters and keywords built into the system ensured that only relevant information was extracted. Apart from Pulsar®, the researcher used other computer software such as NVivo®12 to guarantee the dependability of data, which included co-coding of the data by a second person (the supervisor). Continuous discussions between the researcher and the
supervisor to reach consensus regarding code-recode procedures further ensured the dependability of the data. Posts can always be repeatedly generated on Pulsar® for as long as the exact search terms are embedded within the search interface.

3.6.2 Credibility

Credibility was ensured by utilising the tactic of prolonged engagement where data for a 6-month period was actively scrutinised. All posts for the 6-month period were analysed. Triangulation of data was also done where conversations were compared across different platforms namely Twitter, forums, microblogs and online news platforms.

3.6.3 Confirmability

3.6.3.1 Confirmability of sentiment assignment

The Pulsar® software automatically assigned sentiment and this was manually counter-checked and confirmed by two researchers. If both researchers agreed with the software assignment, it was left as is. If both disagreed with the assignment, the assignment was changed, and in this way the software was further “trained” to get the assignment correct. Whenever there was disagreement between the two researchers, the post in question was sent to the principle researcher and supervisor and a consensus was reached. The supervisors made the final decision, and where necessary the assignment was corrected, which further “trained” the software.

3.6.3.2 Confirmability of content analysis

Following coding of the data in Nvivo®12, data were co-coded by one of the supervisors, which strengthened the confirmability of the data. Codes, categories and themes were discussed and compared to confirm similarity.

All data exported from Pulsar® were kept on record. In addition, NVivo®12 software allowed maintenance of an audit trail of all negative sentiments.

3.6.4 Transferability

A set of defined keywords and filters were used to extract vaccination conversations. Similar search results can be generated in a different setting if the same keywords are used. The use of NVivo®12 also enabled the maintenance of an audit trail.
3.7 ETHICAL CONSIDERATIONS

The protocol was reviewed by the School of Pharmacy Research Committee, after which ethical clearance for the study was obtained from Sefako Makgatho University Research Ethics Committee (SMUREC) (SMUREC/P/60/2018: PG), prior to data collection (see Appendix A). Informed consent was not required as this was a review of social media conversations in the public domain. Access to personal identifiable information and usernames were restricted where applicable.

3.8 SUMMARY

This was a descriptive qualitative study with content analysis of vaccine sentiments on Twitter, forums, microblogs and online news using Pulsar® software. A quantitative approach was also incorporated to determine the frequency of the classified sentiments. Firstly, an online Boolean search of vaccine related key words was generated and built into Pulsar® software to extract only relevant conversation on human vaccination. The software assigned and quantified sentiment and the sentiment assignment was counter-checked by the researchers. Vaccine content influencer visibility and impression scores were also generated by Pulsar® software and exported into a Microsoft® Excel spreadsheet.

The vaccine related conversations identified by Pulsar® software were then imported into NVivo® 12 for thematic analysis. Data were coded into sub-themes containing similar sets of vaccine related perceptions and these sub-themes were grouped to form major overarching themes.

Several techniques to ensure trustworthiness of the study were employed and these included co-coding of the data by the supervisor, manual counter-checking of the software assigned sentiment and maintenance of an audit trail of data within Pulsar® and NVivo® 12 software.

The results of the data collected in this study, are presented and discussed in Chapter 4, in the form of two manuscripts for publication in accredited journals.
Chapter 4: Results and Discussion

CHAPTER 4
RESULTS AND DISCUSSION

4.1 INTRODUCTION

In this chapter, the results of the study, and discussion thereof, are presented in the form of two manuscripts that will be submitted for publication to Vaccine, a peer-reviewed journal.

Manuscript 1 will be published under the title ‘A profile of vaccine sentiments and vaccine content influencers in South Africa’.

Manuscript 2 will be published under the title ‘South Africa follows America’s lead on anti-vaccination sentiments on social media’.

The manuscripts are formatted according to the requirements and author guidelines of the journal (see Appendix B). The author guidelines are also available in electronic format at: https://www.elsevier.com/wps/find/journaldescription.cws_home/30521?generatepdf=true. For the purpose of the dissertation, text within the manuscripts is presented using 1.5 line spacing and tables and figures are embedded within the text.

Each manuscript is preceded by a letter to the editor of the journal. Please note that Manuscript 1 will be submitted for publication first. Once published, Manuscript 2 will be submitted for publication, as it makes reference to Manuscript 1.

4.2 MANUSCRIPT 1

4.2.1 Manuscript 1: Letter to the editor

This section contains the letter to the editor of Vaccine journal, which will accompany the submission of the manuscript to the journal.
Dear Dr Poland

RE: SUBMISSION OF MANUSCRIPT: A profile of vaccine sentiments and vaccine content influencers in South Africa

Please consider the abovementioned manuscript for publication in the Vaccine journal. The authors (MM Matsangaise, JC Meyer and RJ Burnett) have consented to publication in your journal, and the article has not been published in or submitted to any other journal.

Infant vaccination coverage in South Africa has been shown to be far below the targets set by the World Health Organization and the South African National Department of Health. This resulted in outbreaks of vaccine-preventable diseases which are targeted by the Expanded Programme on Immunisation in South Africa. The contribution of internet-based anti-vaccination lobbying to low vaccination coverage has not been established in South Africa. However, it has been shown globally that vaccination sentiments on social media may contribute to shaping the extent of vaccine uptake by members of the public who use social media.

This study investigated vaccine sentiments on social media. In addition it also explored vaccine content influencers on social media to gain an understanding of individuals and entities who potentially have the largest impact (positive or negative) in order to inform appropriate interventions.

Thank you for your consideration. We look forward to your positive response.

Yours sincerely

Ms MM Matsangaise
03 January 2019
4.2.2 Manuscript 1 for publication.

A profile of vaccine sentiments and vaccine content influencers in South Africa

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Abstract

Introduction and objectives: The South African Vaccination and Immunisation Centre began a social media tracking project in June 2016, to analyse sentiment on vaccination-related posts. Baseline results of the first 6 months of tracking found that 18% of posts were anti-vaccination. This study reports on the second 6 months of the project. The objective of the study was to classify anti-vaccination themes expressed on South African publicly available social-media platforms, including online news, forums, Twitter and other microblogs. In addition the study sought to identify and classify the main influencers of vaccine content.

Method: Pulsar® software was used to identify human vaccine related conversations on Twitter, news forums and microblogs in South Africa for the period December 2016 to May 2017. A quantitative approach was employed to determine the frequency of the classified sentiments and anti-vaccination themes as well as the impression and visibility scores for vaccine influencers. Data were coded into positive, neutral or negative sentiments and quantified by Pulsar® software.

Results: A total of 11 111 conversations were identified, of which 16.5% were anti-vaccination. Twitter emerged as the biggest source of vaccine-related posts, with tweets making up 83% of all posts. After determining the top 10 influencers of negative vaccine content by visibility score as well as by impression score, a permaculture expert recorded the highest visibility score, while a news agent emerged with the largest impression score.

Conclusion: The vaccination conversational landscape in South Africa is predominantly pro-vaccination with Twitter as the medium of choice for sharing vaccine concerns. Natural health experts seemed to drive the anti-vaccination narrative the most. Anti-vaccination sentiments on South African social media platforms present a serious cause for concern warranting ongoing surveillance of these sites.

Key words
Anti-vaccination, South-Africa, vaccination, sentiments, influencers, social-media
1. Introduction

Each year vaccination saves millions of lives, and remains the most cost-effective way of preventing vaccine-preventable diseases [1]. It is recognised for its role in preventing infectious diseases, thereby reducing the need for antibiotics which in turn reduces antimicrobial resistance. EPI-SA currently provides free universal infant vaccination against disseminated tuberculosis, polio, diphtheria, pertussis, tetanus, *Haemophilus influenzae* type b (Hib) disease, hepatitis B, rotavirus diarrhoea, pneumococcal disease and measles [2]. In addition, the human papillomavirus (HPV) vaccine against cervical cancer is provided to public sector girls from the age of nine [2].

Although EPI-SA has gone to great lengths to improve access to adequate infant immunisation [2] outbreaks of vaccine-preventable diseases continue to occur. For example, cases of measles and diphtheria have been reported in South Africa in 2017 [3,4]. Measles cases were reported in eight provinces of the country in 2017 and as a result it has become increasingly obvious that infant vaccines are not reaching all intended areas and people [3,4]. This supposition is supported by South Africa’s 2016 Demographic and Health Survey, which reported that only 53% of children aged 12 to 23 months had received all their age appropriate vaccines in their first year of life [5].

Reasons for low vaccination coverage range from a lack of confidence in vaccines to limited access to basic healthcare in some communities [6]. Factors related to vaccination coverage include amongst others, socio-economic status and religion [7]. In middle and high income countries, there is better internet access than in lower income countries, which therefore plays a significant role in dissemination of vaccine information and misinformation, shaping sentiment and ultimately the decision on whether or not to vaccinate.

Vaccine sentiments reaching the general public through mass media have also been observed to have an impact on the uptake of vaccines. Previous studies have shown a correlation between a surge in vaccine conversations in the media and a decline/increase in uptake [8,9]. For example, in a study to determine the impact of media coverage of the measles mumps and rubella vaccine (MMR)-autism controversy, a decrease in MMR coverage was observed following media publications [8]. Similarly, a strong correlation was observed between sentiments expressed on Twitter towards a newly introduced influenza vaccine and Centres for Disease Control-estimated vaccination rates in the United States [9]. The impact of the media on vaccination was also demonstrated when Japan suspended its HPV vaccine recommendation following online media outcry about the perceived HPV vaccine adverse effects [7].
Chapter 4: Results and Discussion

Vaccine sentiments may be categorised as positive, neutral or negative based on the tone or nuance gathered from the posts [9,10]. Conversations or posts expressing concerns about adverse effects following immunisation or any form of vaccination hesitancy towards the immunisation programme, would be classified as negative sentiment [10]. Positive or neutral sentiments are those conversations which lack an indication of concern about vaccines or the vaccination programme [11,12]. Some studies have classified conversations as either pro-vaccination, anti-vaccination or neutral [13]. Understanding the different sentiments that the public share about vaccines will help shape interventions tailor-made for a social media audience. However, there are currently no published data from South Africa on the perceptions of social media users towards vaccination.

In addition to understanding sentiments shared on social media, it is equally important to explore vaccine content influencers to identify individuals or organisations who are contributing to shaping vaccine conversations and sentiment. Several public health organisations such as the World Health Organization United Nations Children's Fund and national departments of health are among influential entities harnessing the power of social media in disseminating important vaccination messages. These large organisations capitalise on their relatively extensive social media following and therefore are capable of increasing direct engagement with the public Other influencers include independent social media users who may or may not be affiliated to a public health organisation, are healthcare workers or lay people with a large social media following [14,15]. In addition, online news agents have been observed to make great impressions and are often the most shared/reposted and referenced source of vaccine information on social media [12]. Influencers with an extensive following, pushing anti-vaccination content on social media platforms increase the likelihood of a reduction in vaccine confidence amongst the audiences in their virtual space [16]. Identifying health influencers on social media gives rise to potential partnership between positive influencers and public health organisations for the purposes of designing important health advocacy strategies including interventions for increasing vaccination uptake [14,16].

This study aimed to identify, classify and determine the frequency of sentiments towards human vaccination as well as to profile vaccine content influencers on South African Twitter posts, online news, forums and other microblogs.
Chapter 4: Results and Discussion

2. Methodology

A quantitative retrospective content analysis of all publicly available vaccination conversations on Twitter, online news platforms, forums and microblogs in South Africa for a 6-month period (1 December 2016 to 31 May 2017) was conducted using Pulsar® software, an online ‘social listening’ tool (https://www.pulsarplatform.com/). A Boolean search using the ‘or’ operator was used to identify posts containing at least one of the following terms: Vaccination, vaccinate, vaccine, vaccinations, vaccinates, vaccines, vaccinated, #vaccination, #vaccinate, #vaccine, #vaccinations, #vaccinates, #vaccines, #vaccinated, #vinentings, #vinentings, #vinentings, #vinentings, #vinentings, #vinentings, #vinentings.

Pulsar® software is designed to code post sentiment as positive, neutral or negative. For this study, two researchers reviewed each post, and manually changed the software assigned sentiment if they both agreed that it was incorrect. Where there was disagreement between the two, the post was sent to the supervisor, who made the final decision on sentiment allocation. Negative sentiment was characterised by concerns about vaccination, such as concerns about adverse effects, ingredients or any other concern that suggested a negative attitude towards vaccines. Positive sentiments were those that promoted vaccination in any way. Neutral sentiments were those where no clear tone or attitude could be discerned. The proportion of each sentiment in relation to the total number of posts, and the proportion of posts from each respective platform (Twitter/online news/forums/microblogs) was calculated by the software. Data were also automatically filtered according to whether the post was an original post or a reaction/engagement, i.e. retweets, shares and replies. However, for the purposes of sentiment analysis, reactions/engagements were not separated from original posts as it was assumed that users retweet/share posts that reflect their own attitude.

Pulsar® software also calculated the number of ‘impressions’ and ‘visibility’ of both negative and positive vaccine content influencers. Influencer ‘visibility’ is based on an algorithm designed in Pulsar® that takes into consideration the format of the message (e.g. whether it is a post or a reply; if it contains an image or a link), the channel where that message is being posted (e.g. tweets have a shelf life that’s shorter than a news article or a blog post), the size of the audience of the person posting that content (e.g. followers on Twitter or monthly unique users of a news website) and finally the amount of people who react to the post (including comments, re-shares, retweets etc.). On the other hand, influencer “impressions” are based only on how many people may have been exposed to a piece of content. It therefore indicates the potential audience for a post.
3. Results

3.1 Distribution of vaccine conversations on online platforms

Over the six months of the study period, 11 111 posts about human vaccinations were identified on Twitter, online news platforms, forums and microblogs. The largest proportion of all the posts (83.1% [9238/11 111]) were on Twitter; 12.6% (1404/11 111) were on online news platforms; 3.9% (431/11 111) were on forums; and 0.3% (38/11 111) were on microblogs. More than half (57.5% (6388/11 111)) of all the posts were original posts. The rest (4723) comprised of engagements/reactions which include retweets, shared posts and replies to original posts.

3.2 Distribution of sentiments towards vaccination

The majority of these posts (72.5% [8064/11 111]) were positive about vaccination. Negative and neutral sentiments made up 16.5% (1834/11 111) and 10.9% (1213/11 111) respectively. Table 1 presents the proportion of the vaccine sentiments with examples of posts, retweets, shared posts and replies to original posts.

3.3 Vaccine content influencers

The software quantified the visibility and impressions of vaccine content influencers, and filtered them according to either negative or positive sentiment (see Table 2 to Table 5). For ethical reasons, the influencers are identified by the description of their biography in the header section on the relevant social media platform.

3.3.1 Negative vaccine content influencers

The top ten negative vaccine content influencers by visibility are shown in Table 2 with the corresponding posts or tweets with the highest visibility for each influencer. The top 10 negative vaccine content influencers by impressions are displayed in Table 3 with corresponding tweets or posts that had the greatest impression score.

3.3.2 Positive vaccine content influencers

Similarly, positive vaccine influencers were identified according to the biography descriptions in their headers on the relevant social media platforms. The top 10 influencers by visibility and impression score were also identified and are shown in Table 4 and Table 5 respectively. The number of social media followers for the influencers is also illustrated.
Table 1: Frequencies of vaccine sentiments on Twitter, online news platforms, forums and microblogs with example posts.

<table>
<thead>
<tr>
<th>Sentiment</th>
<th>Vaccine posts n (%)</th>
<th>Example post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>8064 (72.5%)</td>
<td>“My throat is rusty and rough, started this morning. Flu is on its way. Antibiotics and medlemon or I got to get flu vaccine…”</td>
</tr>
<tr>
<td>Neutral</td>
<td>1002 (10.9%)</td>
<td>“#WHO to Pilot #Malaria Vaccine in #Africa”</td>
</tr>
<tr>
<td>Negative</td>
<td>1834 (16.5%)</td>
<td>“Don’t want none of that man-made stuff around my precious snowflake” #antivax #natural #toxins #vaccines</td>
</tr>
</tbody>
</table>

Total 11 111

Table 2: Top 10 negative vaccine influencers’ visibility according to scores.

<table>
<thead>
<tr>
<th>Influencer biography or affiliation</th>
<th>Source</th>
<th>Visibility score</th>
<th>Post with highest visibility score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permaculture advocate</td>
<td>Twitter</td>
<td>2235</td>
<td>“Shocking vaccine study finds that teens are being wildly overdosed with multiple HPV injections that do NOTHING to prevent genital warts…”</td>
</tr>
<tr>
<td>Geopathology expert</td>
<td>Twitter</td>
<td>1886</td>
<td>“Hello @##. The #Malaria #Vaccine is a #Scam &amp; #Fraud, just like the #HPV #Vaccine! Everyone supporting it is a #Fraudster!!”</td>
</tr>
<tr>
<td>Consumer health advocate /Editor of naturalnews.com</td>
<td>Twitter</td>
<td>1416</td>
<td>“…want to hear a f##d up #vaccine story? How about cancer put in polio vaccines on purpose…”</td>
</tr>
<tr>
<td>Educator/Blogger</td>
<td>Twitter</td>
<td>1325</td>
<td>“Vaccine fraud exposed: Measles and mumps making a huge comeback because vaccines are designed to fail, say Merck…”</td>
</tr>
<tr>
<td>Blogger</td>
<td>Blog</td>
<td>1029</td>
<td>“That’s the way my wife and I feel about it, along with millions of others. I was never vaccinated. At 41 years old I’m in perfect health. My kids of 3 and 9 are also unvaccinated and perfectly healthy.”</td>
</tr>
<tr>
<td>Writer/organic farmer</td>
<td>Twitter</td>
<td>899</td>
<td>“You Can’t Just Trust #Doctors Anymore” – 13-Year-Boy Is Paralyzed From the Neck Down After #Gardasil #HPV Vaccine…”</td>
</tr>
<tr>
<td>Blogger</td>
<td>Blog</td>
<td>882</td>
<td>“Another girl seriously ill after HPV vaccine…”</td>
</tr>
<tr>
<td>Blogger</td>
<td>Blog</td>
<td>882</td>
<td>“RE: Another girl seriously ill after HPV vaccine”*</td>
</tr>
<tr>
<td>Blogger</td>
<td>Blog</td>
<td>735</td>
<td>“RE: Another girl seriously ill after HPV vaccine”*</td>
</tr>
<tr>
<td>Blogger</td>
<td>Blog</td>
<td>593</td>
<td>“The government in Italy has ruled that children must be vaccinated against 12 common illnesses before they can enrol for state-run schools…But when it comes to abortion the argument is pro-choice”</td>
</tr>
</tbody>
</table>

*Re-shared a post
### Table 3: Top 10 negative vaccine influencers’ impressions according to scores.

<table>
<thead>
<tr>
<th>Influencer user biography/affiliation</th>
<th>Source</th>
<th>Impressions score</th>
<th>Post with highest impression score</th>
</tr>
</thead>
<tbody>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>50,238</td>
<td>“Cervical cancer vaccine gave my child brain disease”</td>
</tr>
<tr>
<td>Social media strategist</td>
<td>Twitter</td>
<td>33,707</td>
<td>*Tweet taken down.</td>
</tr>
<tr>
<td>Journalist</td>
<td>Twitter</td>
<td>24,942</td>
<td>“Vaccines cause disease, I can refer you to vast literature on the dangers of vaccines.”</td>
</tr>
<tr>
<td>Lay person reporting on Capetown news</td>
<td>Twitter</td>
<td>23,566</td>
<td>“RE:Cervical cancer vaccine gave my child brain disease”</td>
</tr>
<tr>
<td>Radio station</td>
<td>Twitter</td>
<td>10,031</td>
<td>“The only effective Vaccines to end new HIV/TB/Cancer Infections is Free Quality Edu, LAND, BAN GMOs #StopProfiteering…”</td>
</tr>
<tr>
<td>Geopathology expert</td>
<td>Twitter</td>
<td>9,830</td>
<td>“Hello @_SaveSA, it is our Duty to #WAKE_UP_SouthAfrica, if @GovernmentZA does not care about its people and … #Vaccines #KILL!”</td>
</tr>
<tr>
<td>Celebrity/fashion designer</td>
<td>Twitter</td>
<td>8,794</td>
<td>“Ginger, cinnamon, and garlic with honey does the trick. Forget the vaccine. Gave my kids flu”</td>
</tr>
<tr>
<td>Blogger</td>
<td>Blog</td>
<td>7,894</td>
<td>“That's the way my wife and I feel about it, along with millions of others. I was never vaccinated. At 41 years old I'm in perfect health. My kids of 3 and 9 are also unvaccinated and perfectly healthy”</td>
</tr>
<tr>
<td>Sportscience expert</td>
<td>Twitter</td>
<td>7,423</td>
<td>“Docs profit from vaccines. Dieticians get $$$ for prescribing hi-carb diets. Lots of imaginary money out there in conspiracy land…”</td>
</tr>
<tr>
<td>Lay person (not specified)</td>
<td>Twitter</td>
<td>6,803</td>
<td>*Tweet taken down</td>
</tr>
</tbody>
</table>

*Post could not be retrieved as it had been taken down from the social media platform at time of study.
### Table 4: Top 10 positive vaccine influencers’ visibility according to scores.

<table>
<thead>
<tr>
<th>Influencer user biography/affiliation</th>
<th>Source</th>
<th>Visibility Score</th>
<th>Post with highest visibility score</th>
</tr>
</thead>
<tbody>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>7295</td>
<td>“The Federal Government has reiterated its commitment to eradicating polio in Nigeria by making funds available early for the purchase of vaccines for immunization against the disease.”</td>
</tr>
<tr>
<td>News agents</td>
<td>Twitter</td>
<td>6485</td>
<td>“Is your kid up-to-date with their shots? Our @### explains why vaccinations are important…”</td>
</tr>
<tr>
<td>Paediatric infectious diseases fellow/child health advocate</td>
<td>Twitter</td>
<td>4353</td>
<td>“I don’t make a penny from promoting vaccines. And I’m saying: vaccinate!”</td>
</tr>
<tr>
<td>Virologist</td>
<td>Twitter</td>
<td>4267</td>
<td>“Sad! ANOTHER vaccine that works, that’s getting side-lined!!”</td>
</tr>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>3296</td>
<td>“Thumbs up for HPV cancer vaccine on young girls”</td>
</tr>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>2750</td>
<td>“An Australian mom warns about the dangers of skipping whooping cough vaccine…”</td>
</tr>
<tr>
<td>Blogger</td>
<td>Blog</td>
<td>2644</td>
<td>“It isn’t like vaccines are replacing your immune system. It’s more like they’re exercising it.”</td>
</tr>
<tr>
<td>Journalist</td>
<td>Twitter</td>
<td>2518</td>
<td>“Thumbs up for HPV cancer vaccine on young girls…”</td>
</tr>
<tr>
<td>Departmental store/Pharmacy</td>
<td>Twitter</td>
<td>2511</td>
<td>“The flu vaccine is NOW available in over 195 Clicks clinics. Book today, BEFORE you get sick!”</td>
</tr>
<tr>
<td>‘Non-profit initiative’</td>
<td>Twitter</td>
<td>2482</td>
<td>“On the 20th HIV Vaccine Awareness Day, UNAIDS is calling for continued research to find a vaccine for HIV.”</td>
</tr>
</tbody>
</table>
Table 5: Top 10 positive influencers’ impressions by scores.

<table>
<thead>
<tr>
<th>Influencer user biography/affiliation</th>
<th>Source</th>
<th>Impressions score</th>
<th>Post with highest impression score</th>
</tr>
</thead>
<tbody>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>2,421, 201</td>
<td>“Experts stress importance of vaccination against measles.”</td>
</tr>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>1,271, 465</td>
<td>“SA has launched the world’s best hope at an #HIV Vaccine. Read what will happen next if it works…”</td>
</tr>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>1,217, 627</td>
<td>“New vaccine could curb child deaths in Africa…”</td>
</tr>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>942, 079</td>
<td>“I’m making history’ - First HIV vaccine volunteers…”</td>
</tr>
<tr>
<td>Journalist</td>
<td>Twitter</td>
<td>456, 208</td>
<td>“Polio GPEI says vaccination teams are aiming to reach every child under age five in 13 countries in West &amp; Central Africa. #sabcnews…”</td>
</tr>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>336, 543</td>
<td>“Promising Results With Ebola Vaccine in Guinea…”</td>
</tr>
<tr>
<td>Radio station</td>
<td>Twitter</td>
<td>33, 1029</td>
<td>“This is inspiring &amp; this vaccine is of paramount importance, your guests are sounding very positive &amp; convincing…”</td>
</tr>
<tr>
<td>Municipality official page</td>
<td>Twitter</td>
<td>258, 926</td>
<td>“Parents and caregivers urged to ensure they are up to date with children’s vaccinations as per the immunisation schedule.#measlesoutbreak…”</td>
</tr>
<tr>
<td>Departmental store/pharmacy</td>
<td>Twitter</td>
<td>253, 372</td>
<td>“Reduce your child’s risk of cancer with the HPV vaccine.”</td>
</tr>
<tr>
<td>News agent</td>
<td>Twitter</td>
<td>250, 691</td>
<td>“Bite-mimicking malaria vaccine shows promise.”</td>
</tr>
</tbody>
</table>

4. Discussion

This study profiled vaccine sentiments expressed on publically available South African social media platforms over a six month period from December 2016 to May 2017, and identified the top influencers of sentiment during this period. The results add to baseline data collected from June to November 2016, in which Twitter was also the biggest source of vaccine-related posts, with tweets making up 81% of posts [17] which is very similar to 83% found in this study. The relatively wide use of Twitter as compared to other publically available social media platforms in these studies shows its potential as a tool for reaching a larger audience and for possible dissemination of vaccine safety information. Moreover, Twitter is ideal for use in real-time surveillance of new vaccine preventable disease outbreaks as seen in previous studies [18,10]. Real-time tracking of new disease outbreaks allows for ‘rumour surveillance’ and early detection of outbreaks to inform timely interventions [10].
The conversations comprised of 57.5% of original posts and 42.4% reactions to original posts. This is comparable to figures from a global study of measles vaccination conducted on Twitter with a proportion of 55.7% of original posts [19].

The results of this study showed an overwhelming positive conversational landscape on human vaccination (72.5%), which was very similar to the 69% of posts found in the baseline study [18]. In agreement with this trend, a slight reduction in negative sentiment from 18% [18] to 16.5% was found. These findings confirm the presence of vaccine hesitancy as a result of anti-vaccination lobbying on the South African internet as observed in a previous study [20]. Timely interventions aimed at curbing this growing phenomenon in the South African context may be necessary as the country is already threatened by suboptimal coverage of vaccinations due to poor access to immunisation services [2]. A positive correlation between anti-vaccination sentiments in the media and a resultant decrease in vaccine uptake has previously been observed [8, 9].

This study also determined major influencers of vaccine content on social media, taking into consideration both positive and negative influencers. The top 10 negative influencers were neither communicable disease experts nor healthcare practitioners, raising questions about their credibility. Natural health enthusiasts (geopathologist, permaculture experts, and the editor of naturalnews.com) in this study seemed to drive the anti-vaccination narrative as evident from their higher visibility scores (Table 2). The influence of news agents in the spread of positive vaccination content is noteworthy. News agents with their large impression and visibility scores, present a possible channel through which targeted vaccine safety information can be conveyed more efficiently. The absence of public health organisations at the fore-front of the pro-vaccination narrative is a cause for concern, as pointed out by a previous study [13] highlighting the lack of participation of government and public health organisations in refuting anti-vaccination claims on social media.

The study had a number of limitations including the fact that it was conducted on selected social media networks hence the results exclude the proportion of the South African population that do not use these networks as well those who do not have access to the internet. In addition some posts did not contain the original user’s content but were made up of re-tweets or re-shared posts to which in this study an assumption was made that one re-shares content that they agree with unless they explicitly provide additional accompanying text contrary to this. Moreover some challenges with the Pulsar® software made the sentiment re-assignment by researchers cumbersome, as the software was unable to detect certain sentiments, for
example, sarcasm. As a result a lot of the software assigned sentiment had to be re-assigned manually.

5. Recommendations and conclusion

Although the majority of conversations on South African social media are predominantly positive, the infiltration of anti-vaccination elements needs to be addressed. Adopting the use of social media as a real-time surveillance system for new outbreaks allows public health organisations to take a more pro-active role in disease prevention as opposed to a reactive role when outbreaks have already spread. Because of the challenges faced with using the Pulsar® software, more improved, thoroughly tested computer software for such surveillance is highly recommended for use by public health organisations.

It is also important to capitalise on the existing strongly positive proportion of positive sentiments by augmenting these with educational material on vaccine safety, and to design tailor-made interventions that are specific to the targeted audience. The involvement of government and public health organisations as credible sources of vaccine safety information is of paramount importance. Such organisations already boast huge social media following, for example, the South Africa National Department of Health Twitter account has over 49 700 followers (https://twitter.com/HealthZA) equipping it with the potential to spread educational material with greater efficiency. The use of facts coupled with emotional appeals has been seen to be effective in countering the anti-vaccination narrative [22]. The viral nature of social media and the internet in general requires vigilance from public health practitioners in reacting to public concerns about vaccines as well as in ensuring the correct information is communicated towards shaping positive sentiment.

Acknowledgements: The authors thank Mr Neil Burnett for assisting with Pulsar® software and sentiment assignment.

Funding: This project was funded by the National Research Foundation, South Africa.

References:


Chapter 4: Results and Discussion


Chapter 4: Results and Discussion


4.3 MANUSCRIPT 2

4.3.1 Manuscript 2: Letter to the editor

This section contains the letter to the editor of *Vaccine* journal, which will accompany the submission of the manuscript to the journal.
Dr Gregory Poland  
Editor in Chief: Vaccine  
Rochester, Minnesota, USA

Dear Dr Poland

RE: SUBMISSION OF MANUSCRIPT: South Africa follows America’s lead on anti-vaccination sentiments on social media

Please consider the abovementioned manuscript for publication in Vaccine. The authors (MM Matsangaise, JC Meyer and RJ Burnett) have consented to publication in your journal, and the article has not been published in or submitted to any other journal.

The re-emergence of vaccine preventable diseases in some provinces in South Africa has made it apparent that vaccines are not reaching all. Evidence of internet based anti-vaccination lobbying in South Africa as well as a paucity of conversations exhibiting vaccination hesitancy on South African social media has been a cause for concern. No data on anti-vaccination sentiments in South Africa has been published as yet. This study therefore sought to decipher anti-vaccination sentiments on selected South African social media.

This is the first South African study on anti-vaccination sentiments on social media, providing insight into common themes based largely on American anti-vaccination lobbying.

Thank you for your consideration. We look forward to your positive response.

Yours sincerely

_________________________________
Ms MM Matsangaise
03 January 2019
4.3.2 Manuscript 2 for publication

South Africa follows America’s lead on anti-vaccination sentiments on social media

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Abstract

Introduction and objectives: Although vaccination is recognised as one of the most cost-effective public health interventions, outbreaks of vaccine preventable diseases in South Africa have made it apparent that vaccines are not reaching all. Evidence of anti-vaccination lobbying on the South African internet in a previous study further raised concerns and identified the need to determine anti-vaccination sentiments on South African social media. The objectives of the study were therefore to identify and describe anti-vaccination themes on Twitter, news platforms, forums and microblogs in South Africa.

Method: A descriptive qualitative study using content analysis of vaccination-related social media posts, identified by Pulsar® software for the period December 2016 to May 2017 was conducted. Conversations classified as negative were then imported into NVivo™12 software and open-coding was used to develop a framework of categories and themes.

Results: Common anti-vaccination themes included the following: the conspiracy theory that Big Pharma develops vaccines for financial gain; the theory linking vaccines to autism; issues surrounding safety of vaccines and vaccine ingredients; and concerns about the effectiveness of vaccines. Frequent reference to American based anti-vaccination posts was also observed.

Conclusion: Anti-vaccination sentiments on South African social media platforms present a serious cause for concern. Themes identified provide further valuable information that can be used by the South Africa National Department of Health to develop targeted messages about vaccine safety. Data from global studies showing the correlation between negative sentiments and the possibility of deciding not to vaccinate, make it especially important to address this growing phenomenon. Targeted interventions addressing a social media audience are therefore paramount. The viral nature of the internet makes these interventions especially urgent.

Key words: Anti-vaccination, South-Africa, vaccination, sentiments, hesitancy, social media
1. Introduction
Vaccination hesitancy, fuelled by the emergence of anti-vaccination lobbying, is a growing phenomenon on social media platforms in high income countries [1]. Vaccination hesitancy is defined as a lack of willingness to vaccinate despite vaccination services being available [2]. Evidence from recent studies in South Africa shows the increasing presence of anti-vaccination lobbying on the South African internet [3,4]. However, there is a paucity of scientific literature about the influence that social media-based anti-vaccination lobbying has on vaccination uptake in South Africa.

Several beliefs propagated by anti-vaccination lobbyists pertaining to vaccines and the vaccination programme, are shared on social media by anti-vaccination lobbyists and vaccine hesitant parents. Some of the common anti-vaccination themes encountered on the internet and social media include concerns about vaccine safety, vaccine effectiveness, human rights issues around consent, religious beliefs and conspiracy theories involving pharmaceutical companies and the government [5,6].

The vaccine safety theme is common with fears that vaccines are not safe having been around since the invention of the first vaccine against smallpox [7,8]. However, it was the 1998 report in The Lancet by Wakefield et al., suggesting a link between the measles, mumps and rubella vaccine (MMR) and autism [9] that gave rise to modern anti-vaccination lobbying, which is primarily focused on the myth that vaccines are not safe. Since the advent of social media, this myth has been a dominant and recurring theme, with studies reporting on varying safety related claims being made on social media, ranging from a lack of confidence in vaccine ingredients, to concerns about vaccine adverse effects as well as a belief that vaccines have the potential to cause disease [6,10].

In addition to the vaccine safety theme, a theme around vaccine effectiveness is also recurrent. Vaccine effectiveness has been questioned by vaccine hesitant parents who have been exposed to anti-vaccination misinformation, with sentiments ranging from a complete lack of confidence to partial acceptance [6]. Some questioned why it was possible to still contract the disease against which one is vaccinated. In addition anti-vaccination conversations often recommend alternative therapies such as vitamin C and D supplementation for influenza and lifestyle adjustments in place of vaccines, with these practices being credited for the decline in vaccine preventable diseases [10]. Others are of the belief that vaccines are not ‘natural’ and that complementary medicines are more effective than vaccines for preventing disease [11].
Anti-vaccination sentiments on social media have also been characterised by questioning the perceived breach of human rights through mandatory vaccination in countries where childhood vaccines are legally compulsory [6]. Some parents expressed concern at the ‘lack of respect’ for their decision to have their children abstain from vaccines as they held the belief that they were the ‘experts’ of their own children [12]. Others were of the view that mandatory vaccines were an expression of the government’s excessive control and felt that this was therefore a violation of civil liberties [6,11]. Concerns about the girls-only mandate of the HPV vaccine were also expressed and questions about who should be the decision maker when it comes to HPV vaccination were also observed [11].

Conspiracy theories are also a common occurrence in the anti-vaccination narrative. Negative sentiments around vaccination often stem from a lack of trust in health governing boards as well as the government [10,13,14] Anti-vaccination lobbyists often make reference to the perceived financial benefit that ‘Big Pharma’ and organisations such as the Centres for Disease Control (CDC) stand to gain from the vaccination programme [14].

Because of internet-based anti-vaccination lobbying on South African webpages, in 2016, the South African Vaccination and Immunisation Centre started a project using software that tracks vaccination conversations on social media networks, including online news platforms, forums, Twitter and other microblog platforms. The search algorithm and sentiment allocation methodology were piloted from June to November 2016, rendering the software ready to be used for tracking South African vaccination conversations on social media [15]. The aim of this study was to identify and describe anti-vaccination themes mentioned on South African online news platforms, forums, Twitter and other microblogs.

2. Methodology
This was a descriptive qualitative study, using content analysis of 1834 posts that were previously identified as expressing negative sentiment [16] in online vaccination conversations on Twitter, microblogs, forums and online news platforms in South Africa for a 6-month period (1 December 2016 to 31 May 2017). These posts were stored on Pulsar® software, as previously described [16] and were exported from Pulsar® and imported into NVivo12®, a qualitative data analysis computer software package, developed by QSR International. Posts from the search results often contained hyperlinks to other websites in which some of the search terms were mentioned. These hyperlinks were then opened and the contents extracted to an Adobe® PDF document and reserved for analysis.
A step-wise thematic content analysis of the data was conducted. Coding of the data commenced, following detailed reading of the posts in NVivo®12. Data were coded into nodes by the first author and re-coded by the second author to ensure the trustworthiness of the coding process. Continuous discussions between the two authors followed until consensus was reached about the coding, which further ensured the dependability of the data. Nodes were grouped into categories and sub-categories. Categories were then linked to one another forming overarching themes with sub-themes that depicted shared anti-vaccination sentiments.

3. Results
The thematic analyses of the negative sentiments, generated four overarching themes. These themes are discussed in the following sections with illustrating posts to support the findings. Table 1 presents further examples of posts for the four overarching themes.

Vaccine safety concerns
The overarching theme on concerns about vaccine safety identified varying sub-themes. One sub-theme centered around the perception that vaccinating would result in the development of adverse effects that included obsessive compulsive disorders, anorexia nervosa, a host of other brain and neurological disorders, and death.

Several conversations indicated a belief that vaccines could trigger autoimmune disorders and a recurring concern that vaccines could make one sick. Fears of vaccines causing the disease against which they are supposed to render protection were also expressed. In particular many expressed their hesitancy towards getting the influenza vaccine which they believed increased the chance of getting influenza. Another common belief was that vaccines resulted in the spread of disease. Examples of such posts are shown in Table 1.
### Table 1: Anti-vaccination themes and examples of posts.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Example post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine safety concerns</td>
<td>“…children are routinely brain damaged by vaccines, hospitalized by vaccines, paralyzed, put into comas and sometimes killed.” (Source, Blog)</td>
</tr>
<tr>
<td></td>
<td>“…death was believed to have been caused by eight simultaneous vaccinations.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“The research is hard to ignore, vaccines can trigger autoimmunity with a laundry list of diseases to follow.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“More r vaccines has only given us more sick people…” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“…some new vaccine made in South Africa be tested on our kids...Now It had caused sicknesses 😢😠” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“…just seems so unnatural to inject her with chemicals. &amp; also vaccination injury/getting sick from the vaccine itself.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“…vaccines that are given to us, that later on causes these diseases.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“People vaccinated against #Flu 3 years in a row are @ higher risk of catching the flu.” (Source, Twitter)</td>
</tr>
<tr>
<td>Vaccine-autism theme</td>
<td>“Egyptian study confirms autism is caused by mercury in vaccines.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“Vaccination show clear signs of causing Autism. As a relative of a child who has this; it began after vaccinations. Concerns me.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“@realDonaldTrump: A study says @Autism is out of control-a 78% increase in 10 years. Stop giving monstrous combined vaccinations.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“What Did You Expect From The Vaccines? That's right - what did you expect?! No, thanks I don't want no goddamn autism!”. (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“Autism epidemic is real, and excessive vaccinations are the cause.” (Source, Twitter)</td>
</tr>
<tr>
<td>Concerns about vaccine effectiveness</td>
<td>“…my hubby had measles last year and he has full vaccinations done…” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“My question is, how can unvaccinated kids be a problem to vaccinated kids? If vaccinations work.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“If the vaccine in question is so weak that a small fringe group of people not vaccinated could pose any real threat to those vaccinated, then the issue is with the vaccine’s inefficiency not the anti-vaxxers” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>What if they see that AIDS is not infecting enough people then introduce an ineffective vaccine; to encourage risky sexual behaviour? (Source, Twitter)</td>
</tr>
<tr>
<td>Conspiracy theories</td>
<td>“The fact is that vaccines are a $30 billion dollar a year industry, and those who benefit from it are going to do whatever they can to protect their own interests.” (Source, Blog)</td>
</tr>
<tr>
<td></td>
<td>“Best medical advice would be to tell America that vaccines are a toxic SCAM so Big Pharma can make TRILLIONS” (Source, Blog)</td>
</tr>
<tr>
<td></td>
<td>“Vaccine pushers destroy the lives of children while pocketing money from Big Pharma.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“The Government is Using Vaccines to Give Black Kids Autism…..can someone please share a light on this its disturbing.” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“Vaccines are full of toxins and carcinogens, including fetal tissue. The Elite have admitted that vaccines are being used for depopulation” (Source, Twitter)</td>
</tr>
<tr>
<td></td>
<td>“Clinton was also a favorite pick for Big Pharma and the obscene chemical medication industry that preys upon endless disease to generate massive corporate profits while offering no real cures.” (Source, Twitter)</td>
</tr>
</tbody>
</table>
Mentions of vaccines causing cancer were also common with many believing that the vaccine contained cancer causing enzymes, which predisposed one to developing cancer, as illustrated by the following three Twitter posts:

“DO NOT VACCINATE!!! The sh** is laced with cancer inducing additives”
(Source, Twitter)

“…#vaccine given to millions knowing #cancer virus in it; passed to offspring.”
(Source, Twitter)

“Cancer industry profits & locked in#39; by nagalase molecule injected into humans via vaccines.” (Source, Twitter)

Another sub-theme of commonly expressed conversations was around vaccine additives which were often labelled as ‘harmful’ and ‘toxic’. Mentions of ingredients such as the mercury based preservative thimerosal (sometimes referred to as mercury) were recurrent. There was a common belief that the mercury in vaccines was responsible for causing neurological disorders. Another additive, aluminium, was also mentioned and implicated, for example:

“Vaccine harm may be increasing with each generation; vaccine ingredients such as aluminium have been shown to alter the mitochondria.” (Source, Twitter)

Other conversations included the belief that vaccines contained foetal tissue and some expressed concerns over the use of aborted babies in vaccine preparations. Religious reasons for foregoing vaccines were cited in conversations where the user did not agree with the use of foetal tissue in vaccine additives. Vegans expressed concerns over the use of animal based additives in vaccine formulations, while animal rights activists perceived the use of animal products as an act of cruelty against animals. These sentiments are illustrated by the posts below.

“BOMBSHELL: Complete list of vaccine excipient ingredients approved by CDC
(includes cells from aborted human foetus” (Source, Twitter)

“Vaccine warning for VEGANS: Vaccines are made with a cocktail of animal parts, human foetal tissue cell lines and African monkey cells …”
(Source, Twitter)
Vaccine-autism link
Linked to the vaccine safety theme was another recurring mention of the perceived association between vaccination and the emergence of autism. Several posts showed a general belief that vaccine additives such as mercury resulted in the development of autism and autism spectrum disorders. One Twitter user remarked that they believed their loved one developed autism after vaccination. Many social media users made reference to claims by President Donald Trump of the United States of America (USA), where he had expressed his belief in a possible link between what he termed “monstrous combined vaccines” and autism. Another person who shared his sentiment was opposed to the quantity of vaccines which he regarded as “excessive” and the reason for the emergence of autism.

Concerns about vaccine effectiveness
The conversational landscape on the social media platforms in this study also showed a general lack of confidence in the effectiveness of vaccines. Several people who doubted vaccine effectiveness often questioned why cases of vaccine preventable diseases still existed in people who had been vaccinated. A permaculture expert on Twitter who expressed his/her doubt over vaccine effectiveness mentioned a meningitis case in an 8 year old who developed meningitis despite receiving the vaccines. Similarly, following a measles and mumps outbreak, vaccine hesitant users further queried the efficacy of vaccines. A Twitter user hypothesised that the recently introduced HIV vaccine was designed to be ineffective and was meant to encourage risky sexual behaviour.

Conspiracy theories
Conspiracy theories around government organisations, health boards and Big Pharma emerged as a recurring theme. Health regulatory boards such as the CDC and the USA Food and Drug Administration were often accused of withholding information on vaccine adverse effects and instead overinflating vaccine safety information. One Twitter user was of the opinion that racial motives may have led the CDC to hide data that “revealed relationship between black boys, immunisations and autism”. The same user further mentioned that vaccines were “germ warfare against black kids”. Similarly a Twitter user believed that vaccination was meant to “depopulate the world.”

Another Twitter user doubted the safety of vaccines, perceiving them as weapons of “biological warfare.” A recurring perception of vaccines, as a form of “medical genocide” targeted at Africans was also observed. One post had the following to say about vaccines in Africa:
“In America they infected African Americans with syphilis under the pretence it was a vaccination so imagine what they have done in Africa?” (Source, Twitter)

In another post, the user was concerned about Bill Gates possibly introducing and advertising in South Africa “a new deadly vaccine”. Another Twitter user believed In addition Bill Gates was believed to be funding vaccination programmes, “which would lead to pandemics”.

Conspiracy theories around pharmaceutical companies observed in this study mostly cited profit as the major motive for Big Pharma manufacturing vaccines. There was a common belief that vaccine manufacturing companies do so primarily for financial gains. One blogger called vaccine programmes a “…toxic scam so Big Pharma can make money”. Another Twitter user was of the opinion that pharmaceutical companies manipulate scientific data to make vaccines seem effective in order to make profit.

4. Discussion

This study, which aimed to investigate anti-vaccination sentiments on selected South African social media platforms from 1 December 2016 to 31 May 2017, identified four major themes namely concerns about vaccine safety, a perceived vaccine-autism link, concerns about vaccine effectiveness, and conspiracy theories about vaccines and the vaccine industry. The anti-vaccination conversational landscape in South Africa is comparable to other previous studies in other regions \([5,6,11,12,13,17]\). The influence of anti-vaccination content from first world regions is evident from this study in the South African context as observed by the numerous references to American health regulatory boards’ policies and the opinion of the American president on vaccines.

This study identified concerns falling under the vaccine safety theme that were comparable to other studies in South Africa as well as the Netherlands \([6,10]\). Perceptions about vaccines causing adverse effects as well as causing illness were commonly shared on South African social media platforms. Similarly, a study of YouTube videos related to immunisations had reported that vaccines were perceived to cause a range of serious adverse events including neurological injury and some form of permanent injury \([17]\). In addition many shared fears of vaccines causing the diseases against which they are supposed to render protection, a notion documented in a previous study \([10]\). The vaccine safety theme was also characterised by mention of vaccine additives which were perceived to cause harm. Mercury and aluminium were the ingredients most mentioned in anti-vaccination posts.
Chapter 4: Results and Discussion

The vaccine-autism link theme was characterised by conversations associating vaccination with the onset of autism and autism spectrum disorders. The perception that vaccines cause autism is still a common finding even in a recent study [6] despite the claim having been debunked and the original paper [9] being retracted [18].

The theme regarding lack of vaccine effectiveness, showed a general lack of confidence in vaccine efficacy. People commonly questioned the occurrence of vaccine preventable diseases in previously vaccinated individuals. These people often made reference to recent disease outbreaks and cases to justify their hesitancy towards vaccine effectiveness. This sentiment seems to echo that of findings from previous studies where some social media users were of the belief that vaccines actually increase susceptibility to the diseases against which one is vaccinated [6,10]. This has been demonstrated before in a study that tracked the coverage of influenza vaccine, where people questioned why it was necessary to get the vaccine if one could still contract influenza regardless of one’s vaccination status [10].

Conspiracy theories were very common. As with previous studies [13,14] the motives of governments and health regulatory boards were questioned by anti-vaccine sceptics. In this study some users viewed the introduction of vaccines especially to Africa as a form of medical genocide and biological warfare. The intentions of the Bill and Melinda Gates Foundation were questioned. Pharmaceutical companies’ intentions were similarly questioned and the conversations showed a general belief that vaccine manufacturing was primarily a profit making industry.

Although the study provides some insight into public perception concerning vaccination, it exhibited a number of limitations. Firstly, the use of selected social media sites for data collection may exclude groups of the population who do not use these platforms as well as the those who may not have access to internet facilities. The results of the study can therefore not be generalised to the whole population. The study which was also qualitative in nature had descriptive properties and is therefore not able to provide a causal-effect link. Another limitation existed with thematic assignment which could possibly vary according to different interpretation of nuance. In addition, although the data sources were on social media, some posts contained hyperlinks to other non-social media sites. However, sharing these hyperlinks was perceived as agreeing with the contents unless otherwise stated in the caption accompanying the post.
5. **Recommendations and conclusion**

Anti-vaccination sentiments on South African social media platforms present a serious cause for concern. Data from global studies showing a correlation between negative sentiments possibly influencing the decision not to vaccinate, make it especially important to address this growing phenomenon. The South African National Department of Health, faced by resource constraints and health disparities, recognises vaccination as a key public health intervention that is cost-effective and could save millions of lives [19]. Targeted interventions addressing a social media audience are therefore paramount. The viral nature of the internet makes these interventions especially urgent. A large social media presence and visibility of public health groups, answering public concerns about vaccine safety and improving vaccine confidence, are necessary. Special tactics tailor-made for this particular audience may need to be employed for effective dissemination of educational information. The use of eHealth strategies is recommended by the South Africa National Department of Health. mHealth is an example where healthcare providers are encouraged to capitalise on existing mobile technologies to disseminate health promotional information as well as to maintain an active surveillance system for any arising health concern which may appear even on social media networks. Ongoing surveillance of the South African social media landscape is encouraged, and studies investigating the impact of anti-vaccination conversations in the South African context are recommended.

**Acknowledgements:** The authors thank Mr Neil Burnett for assisting with Pulsar® software and sentiment assignment.

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**References**


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Chapter 4: Results and Discussion


CHAPTER 5
LIMITATIONS, RECOMMENDATIONS AND CONCLUSIONS

5.1 INTRODUCTION

This chapter provides the limitations, recommendations and conclusion of the study.

5.2 LIMITATIONS OF THE STUDY

Although the study provides some insight into public perception concerning vaccination, it exhibited a number of limitations. Firstly, the use of selected social media sites for data collection may exclude groups of the population who do not use these platforms as well as the those who may not have access to internet facilities. The results of the study can therefore not be generalised to the whole population. The study which was also qualitative in nature had descriptive in nature and is therefore not able to provide a causal link. In addition, although the data sources were on social media, some posts contained hyperlinks to other non-social media sites. It is therefore assumed that by sharing these hyperlinks the user was in agreement with the contents, unless otherwise stated in the caption accompanying the post. A similar limitation was also with re-tweets or re-shared posts to which in this study an assumption was made that one re-tweets or re-posts content that they agree with unless they also explicitly provide additional text contrary to this.

5.3 RECOMMENDATIONS

- Capitalise on the existing strongly positive proportion of positive sentiments as seen from the results by augmenting these with educational material on vaccine safety.
- Special tactics tailor-made for this particular audience may need to be employed for effective dissemination of educational information.
- A large social media presence and visibility of public health groups debunking vaccination myths and answering public concerns.
- More emphasis and strategies focused towards re-assuring undecided vaccinators about vaccine benefits and improving vaccine confidence, as opposed to targeting vocal vaccine deniers.
- The use of eHealth strategies as recommended by the South Africa National Department of Health such as mHealth where healthcare providers are encouraged to capitalize on
existing mobile technologies to disseminate health promotional information as well as to maintain an active surveillance system for any arising health concerns which may appear even on social media networks.

- The use of facts coupled with emotional appeals has been seen to be effective in countering the anti-vaccination narrative.

- Ongoing surveillance of the South African social media landscape is encouraged, and studies investigating the impact of anti-vaccination conversations in the South African context are recommended.

5.4 CONCLUSIONS

The results of the study have shown that South Africa is still predominantly pro-vaccination. Twitter, emerged as the social media site of choice for voicing out vaccine related concerns and for this reason could be targeted for dissemination for of vaccine safety information. News agents exhibited large impression and visibility scores and are therefore to be considered as positive vaccine influencers in order to ensure a wider social media audience. The in-depth analysis of the negative vaccine sentiments have demonstrated some public misconceptions about vaccines warranting urgent recourse. The internet is not constrained by geographical location hence the influence of American based anti-vaccination lobbying is not to be ignored. More vigilance and surveillance is therefore of paramount importance.


References


References


Appendices

APPENDICES

Appendix A: SMUREC ethical clearance certificate

[Image of SMUREC ethical clearance certificate]

01 March 2018

Ms NM Matsangale
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F.O Box 218
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MEETING: 02/2018

SMUREC Ethics Reference Number: SMUREC/P/60/2018: PG

The New Application received on 14 February 2018, was reviewed by members of Sefako Makgatho University Research Ethics Committee on 01 March 2018 and was approved on 01 March 2018.

Title: A profile of vaccination sentiments on online news forums, Twitter, and other microblogs in South Africa

Researcher: Ms MM Matsangale
Supervisor: Prof JC Meyer
Co-supervisor: Prof RJ Burnett
Department: Pharmacy
School: Pharmacy
Degree: M Pharm

Please note the following information about your approved research protocol:

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International Organisation (ORGN/0000891), Institutional Review Board (IRB) (020001010988) Expiry date: 05 December 2018, Federal Wide Assurance (FWA00003344) Expiry date: 03 March 2021 and NNREC Ex: NGC 219408-003

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PROF C BAKER
DEPUTY CHAIRPERSON SMUREC

Date: 01/03/2018

Research & Postgraduate Studies Directorate
Sefako Makgatho University Research Ethics Committee
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Appendix B: Vaccine author guidelines

**VACCINE**

**AUTHOR INFORMATION PACK**

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- Impact Factor p.1
- Abstracting and Indexing p.2
- Editorial Board p.2
- Guide for Authors p.5

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GUIDE FOR AUTHORS

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