Russian Speaker's Vaccine Hesitancy and VKontakte;

What Social Media Can Tell Us

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Abstract

Russian speakers have low rates of confidence in vaccine safety and effectiveness, which translates to low vaccination rates for several diseases despite good levels of access to vaccines. This study seeks to complement a social science literature investigating this problem by using mixed-methods analysis to explore vaccine-related posts on the largest Russian social media site VKontakte. This study found that users are preoccupied with concerns both about vaccines themselves as well as about the government's role in promoting and enforcing public health measures like vaccination and immunity passports. The chief concerns about vaccines can be grouped into two main areas: low levels of trust in authority and scientific misconceptions. Major scientific misconceptions include misunderstandings about how vaccines work, how they can impact a recipient's immune system, and how they are tested and approved. Conspiracy theories are problematic, but most vaccine-hesitant posts refer to concerns about side effects, the age of vaccines, and other more realistic concerns. This indicates that most vaccine-hesitant Russian speakers could be convinced of the safety, effectiveness, and necessity of vaccination. Unfortunately, these concerns often go unaddressed by other users. Ultimately, mis- and disinformation as well as low rates of trust in authority are correlated to low rates of vaccination among Russian speakers. It would be most impactful to put resources towards building trust between government and public health institutions and Russian speakers, towards Russian-language educational material on the science behind vaccines, and towards resources to help people address vaccine hesitancy more effectively in their conversations.

Introduction

Introduction

Russian-speaking communities have low vaccination rates compared to communities with similar levels of access to vaccines. This is the case in countries with large Russian-speaking populations, like Russia and Ukraine, as well as in Russian-speaking immigrant communities in areas like Washington state in the United States. Previous studies investigate the correlates of this phenomenon using social science methods such as surveys and interviews. This study seeks to contribute to the current understanding of correlates of vaccine hesitancy among Russian speakers by studying vaccine-related content on the Russian social media site VKontakte. By employing mixed-methods data science and qualitative analysis techniques on this dataset, I hope to evaluate the findings of previous studies as well as contribute new nuance and understanding to this increasingly pressing public health issue.

Vaccine Hesitancy among Russian Speakers

Rates of confidence in vaccine safety and effectiveness are substantially lower in Eastern Europe than any other world region. The Wellcome Global Monitor, a part of the Gallup World Poll, conducted a survey on global perceptions of vaccines in 2018. The report outlines that just 50% and 65% of respondents from Eastern Europe, a region in which the Russian language is dominant, expressed that they were sure of the safety and effectiveness of vaccines, respectively. These were the lowest levels of confidence in vaccine effectiveness of any region surveyed, at 22 percentage points lower than the world average of 84% (Gallup, 2018, p. 110). These regional statistics indicate that vaccine confidence is lower where Russian is widely spoken.

Rates of confidence in vaccine safety and effectiveness are lower in Russian-speaking former Soviet Socialist Republics than in other Eastern European countries like Poland or

Hungary, confirming the assumption that vaccine confidence is lower where Russian is spoken. According to the report, just 62% of survey respondents in Russia agreed that vaccines were effective. In other Russian-speaking countries, confidence is substantially lower; 46%, 49%, and 50% of respondents from Belarus, Moldova, and Ukraine agreed that vaccines were effective, respectively. For comparison, confidence levels in the other five regional countries surveyed range from 75-84% (Gallup, 2018, p. 110). Vaccine safety is a concern in addition to vaccine effectiveness. For example, according to the same survey, just 29% of Ukrainians who had heard of vaccines before agreed that vaccines, in general, were safe (Reinhart, 2021). Thus, low confidence in vaccine safety and effectiveness can be narrowed from the Eastern European region to countries in which Russian is widely spoken.

Country-level research in Russia demonstrates that vaccine confidence is low in critical demographics, including among both healthcare workers and parents. A Russian study conducted between 2017 and 2019 and published in the journal *Infekcionnye bolezni* (Infectious diseases) explores each group's attitude towards vaccines. The first of this study's two surveys was administered to parents. 20.7% of parent respondents indicated they were not confident that vaccines were a safe and effective measure for preventing illness. Approximately 70% of unconfident parent respondents indicated that they were simply unsure of vaccine safety and effectiveness, while the remaining 30% indicated that they were certain that vaccines were neither safe nor effective. Furthermore, 11.5% of parents surveyed expressed concerns about the quality of vaccines available in Russia specifically. The second survey was administered to medical school staff and students. The results revealed that 8.3% of faculty respondents and 8.8% of student respondents expressed doubts regarding the effectiveness of vaccines (Platonova, Golubkova, D'yachenko, & Smirnova, 2020). Thus, vaccine hesitancy is problematic

throughout several demographics in Russia, even students and teachers of healthcare, but those that are vaccine hesitant are reachable.

Low rates of vaccine confidence among parents and healthcare workers are correlated to low vaccination rates among Russian children. A Russian study conducted in 2019 found that many children are not being vaccinated according to Russia's national vaccination schedule. The study concluded that a main cause of children falling behind in their vaccinations is parental refusal (Platonova T. , 2019). Thus, low childhood vaccination rates can be correlated to low vaccine confidence among parents.

Low rates of vaccine confidence also correspond to low vaccination rates for adult vaccines, such as the Covid-19 vaccine. The private consulting firm Morning Consult is conducting an ongoing survey on attitudes towards Covid-19 vaccines in 13 large countries, including Russia. In a November 8, 2021 update it was reported that 23% of Russian respondents were unwilling to get vaccinated against Covid-19, while an additional 14% were uncertain about whether they would get vaccinated (Shelburne & Coleman, 2021). In a March 17, 2022 update, it was reported that the number of Russian respondents who were unwilling to get vaccinated rose by 5 percentage points since November 8. These are the highest rates of both unwillingness and uncertainness of any of the 13 countries surveyed and have remained the highest for the entire survey period (Shelburne & Coleman, 2022). Arce et. al. confirms these findings, reporting that Russia's Covid-19 vaccination acceptance rates are far lower than that of countries with comparable levels of access to a vaccine (Arce et. al., 2021, p. 1386). This is even though Russia registered a Covid-19 vaccine in August 2020, being the first country to do so. These statistics demonstrate that lacking confidence in vaccines is correlated to vaccine

hesitancy and, as a result, low vaccination rates among adults and children for new and old vaccines.

Vaccine hesitancy is also problematic in neighboring Ukraine, where vaccination rates are also low among adults. Here, approximately 30% of the population considers Russian a native language and more speak it as a non-native tongue (Bilewicz, 2022). Like in Russia, low rates of vaccine confidence correspond to low vaccination rates among children and adults. According to a Gallup poll conducted in July 2021, 63% of Ukrainian adults said they would not agree to get vaccinated against Covid-19 (Reinhart, 2021). An independent Ukrainian think tank identifies safety concerns as a prime cause of Covid-19 vaccine refusal, reporting that nearly 44% of survey respondents would not get vaccinated against Covid-19 due to fears regarding the vaccine's safety (Ilko Kucheriv Democratic Initiatives Foundation, 2021). Correspondingly, just 18.5% of Ukraine's population was fully vaccinated against the coronavirus as of November 9, 2021. Thus, fears about vaccine safety and effectiveness are correlated to low vaccination rates in Ukraine as well.

Vaccination rates for Covid-19 are lower in Russian-speaking countries than they are in the rest of Europe. Covid-19 vaccination rates are a useful representation of levels of vaccine confidence across countries due to the global nature of this issue and similar start dates of availability of the vaccine across countries. The following visualization depicts vaccinated people out of 100 for countries in which Russian is widely spoken in addition to the United Arab Emirates, the world leader in vaccination, for context.
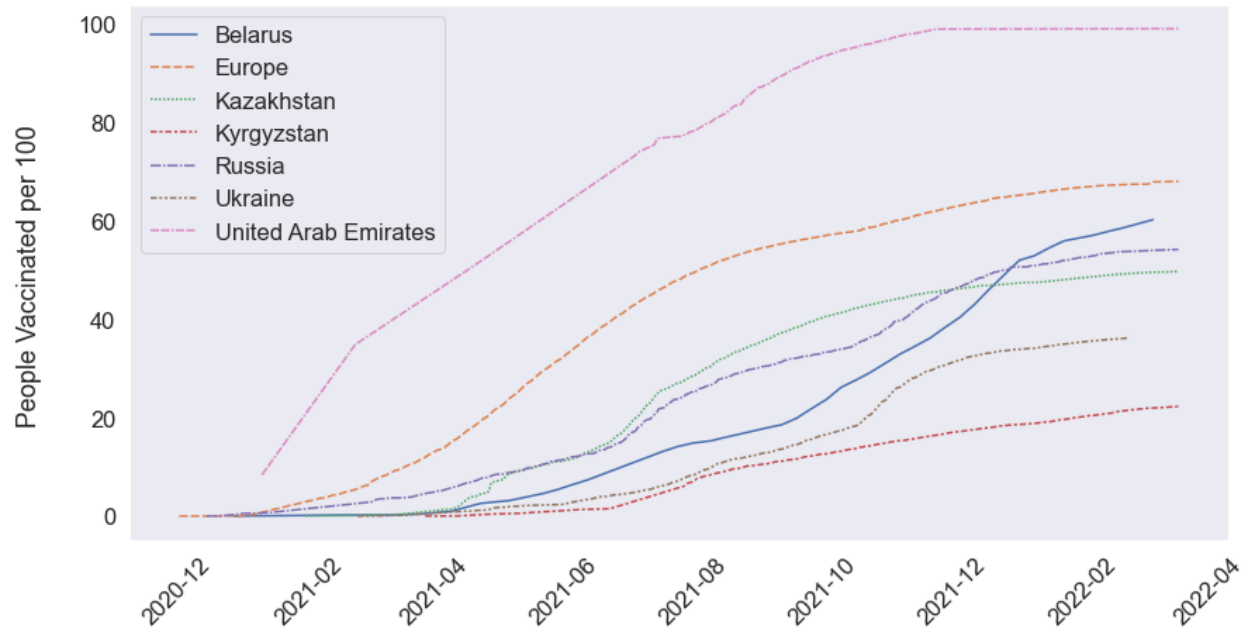
Figure 1, (Appel, Cameron, et. al., 2022)

Europe's average well outpaces vaccination rates for every country in which Russian is widely

spoken. Among the former-Soviet countries, Belarus has the highest vaccination rate, closely

followed by Russia and Kazakhstan. Ukraine follows by approximately 20 percentage points and

Kyrgyzstan rounds out the group with a Covid-19 vaccination rate less than 20%. Thus, the

discrepancy between vaccination rates in countries with many Russian speakers and in European

countries is stark.

It would be remiss to discount vaccine hesitancy as a cause for low Covid-19 vaccination

rates, however, vaccine supply issues also play a role. Countries such as Kazakhstan and Ukraine

started their vaccination programs February 2021, while many European Union countries began

widespread vaccination in December 2020 (BBC, 2020). Some countries have also relied on

international aid programs to procure vaccines. For example, Kyrgyzstan first received access to

vaccines in March of 2021 with a donation from China (Putz, 2021). The country has continued

to rely on donations and development aid to implement its vaccination campaigns, receiving a

recent batch of vaccines from the United States in January of 2022 and vaccine funding from the

World Bank in 2021 (USAID, 2022; World Bank, 2021). According to the Kennan Institute,

Ukraine declined to purchase vaccines from Russia and instead chose to rely on the United

States, China, India, and European Union for Covid-19 vaccines. Procurement was thus

problematic, and Ukraine began mass vaccinations in February 2021 with a donation from India.

Although countries included in this analysis have had trouble procuring vaccines, experts agree

that low levels of vaccine confidence compound supply issues. For example, although supply

was problematic for Ukraine in early 2021, surveys also demonstrated that during this period,

just 53% of Ukrainians were ready to get vaccinated (Possamai, 2021). Furthermore, it is

apparent in the above visualization that Ukraine's vaccination rate plateaus during the first two

months of 2022, which is a trend cannot be explained by supply issues as vaccines have become

widespread throughout Europe. This is supported by the cases of Russia, which registered the

first Covid-19 vaccine, and Kazakhstan, which began its campaign in February 2021, having

produced Sputnik V vaccines and introduced its own vaccine, QazVac, in 2021 as well

(Arystanbek, 2021; Reuters Staff, 2020; Najibullah, 2021). Thus, it is important to consider

supply as a factor in lower Covid-19 vaccination rates, however, this alone cannot explain lower-

than-average Covid-19 vaccination rates within Russian-speaking countries.

Rates for vaccines typically administered during childhood, like MMR and polio, which

have been administered for decades, are also low. In 2021, a conference concerning polio was

held between international organizations such as the World Health Organization (WHO),

UNICEF, and the U.S. Center for Disease Control (CDC). The participants noted that just 53%

of Ukrainians were vaccinated against polio, which has resulted in several serious polio cases

among children (Ministry of Health of Ukraine, 2021). Most recently, two paralytic polio cases

were discovered in Zakarpattya while 20 other children tested positive for non-paralytic cases (Kluger & Law, 2022). Low vaccination rates in Ukraine also became apparent during a measles epidemic in 2019, which consisted of over 57,000 cases (World Health Organization, 2020). For comparison, the United States also experienced a 2019 surge in measles cases that garnered widespread media attention. This outbreak consisted of 1,282 cases (Centers for Disease Control and Prevention, 2022). This discrepancy emphasizes the particularly severe state of vaccine hesitancy in this demographic.

In countries where Russian is spoken as a minority language, vaccine hesitancy is more correlated to Russian speakers. This is a critical note, as this study includes countries such as Ukraine, in which the majority and national language is Ukrainian. Ukraine is more correlated to Russian speakers than it is to Ukrainian speakers. A study conducted by Premise, a data analysis firm, demonstrates that Western Ukraine, which is primarily Ukrainian speaking, is generally more confident in the safety of vaccines than Eastern and Southern Ukraine, which is primarily Russian speaking (Wilson A. , 2021). In fact, there is a weak inverse correlation of 0.41 between an oblast's rate of vaccine confidence and the percent of an oblast's population that considers Russian a native language. These visuals help to represent the overlap between oblasts with low
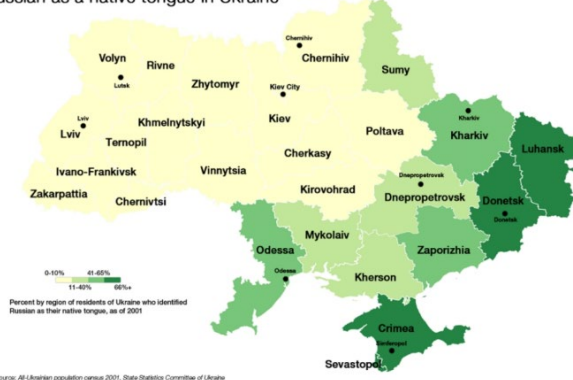

Figure 3, Russian speaking oblasts green and Ukrainian yellow, (Said, 2014)
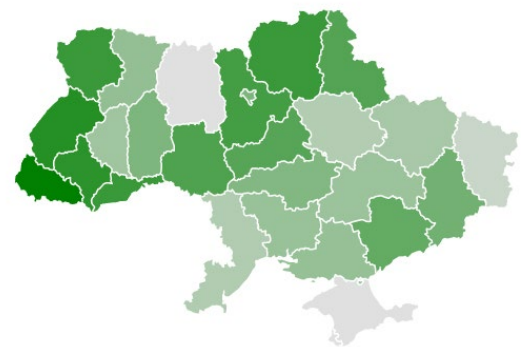

Figure 2, More intense green represents higher rates of vaccine confidence, (Wilson A. , 2021)

vaccine confidence and oblasts with many Russian native speakers. Supporting this finding, a survey conducted by Rating Group Ukraine found that supporters of the three main pro-Russian opposition parties in Ukraine were more likely to refuse a Covid-19 vaccine than supporters of pro-Ukrainian parties (Hyde, 2021). This is particularly relevant given the strong relationship between identity, politics, and language in Ukraine. Thus, while a problem nationwide, Russian native speakers seem more prone to vaccine hesitancy in Ukraine, which further justifies a vaccine study focused exclusively on Russian speakers. However, vaccine hesitancy among Russian speakers is not isolated to Russian-speaking countries. Russian-speaking enclaves also suffer from this trend. A study published in Pediatrics in 2016 demonstrated that from January 1, 2008 to May 1, 2013, children of Russian and Ukrainian parents were the least likely to be fully vaccinated among all six demographic groups surveyed (Mexicans, Somalians, Indians, Americans, Russians, and Ukrainians) (Wolf, Rowhani-Rahbar, Tasslimi, Matheson, & Debolt, 2016). This study points to the conclusion that vaccine hesitancy is a problem in Russian-speaking communities globally and is not isolated to the former Soviet Union.

These statistics reveal important truths. First, Russian-speaking areas uniquely struggle with vaccine hesitancy. Second, many Russian speakers are vaccine hesitant, but not all are anti-vaccine. Surveys that have been conducted thus far have revealed that most vaccine-hesitant Russian nationals are simply unsure of the safety and effectiveness of vaccines. This indicates that there is room for vaccine education in the Russian-speaking world. It is thus critically important to study vaccine hesitancy in this demographic, as well as to recommend data-driven approaches to remedy the problem.

Literature Review

Studies exploring vaccine hesitancy in Russian speakers primarily employ qualitative data collection and analysis methods. It is, however, worthwhile to pursue studies on vaccine sentiment using Russian data science tools and social media data. Studies have demonstrated that social media is a major source of vaccine information and that bad information about vaccines available on social networks can translate to lower vaccination rates. Wilson & Wiysonge 2020 finds that there are significant relationships between "organization on social media and public doubts of vaccine safety" and between "foreign disinformation campaigns and declining vaccination coverage" (Wilson & Wiysonge, 2020). Given that social networks are core sources of information on this topic, they cannot be ignored as a source for opinions and sentiment regarding vaccines.

It is also useful to investigate social media because it enables the gathering of more data points than traditional social science methods may. Interviewing is time-consuming, and convincing people to participate in surveys can be difficult, thus limiting a dataset. Data science approaches are not constrained in this way. Furthermore, social media posts do not follow a prescribed structure and can address whichever topics are important to the writer. This may allow for the expression of more nuanced opinions and beliefs regarding vaccines than structured survey and interview formats might. Other public health researchers share this sentiment, as is evidenced by several studies analyzing vaccine-hesitant content on Western social media platforms.

Previously conducted studies focus on discussions on English-language, Western social media sites surrounding a variety of vaccines. These studies use data mining tools such as sentiment analysis and topic modelling, among other tools, to extract topics of discussion and

vaccine attitudes from the data. Most studies published prior to 2020 focus on general vaccine content. However, because of the pandemic, research has shifted its focus to sentiment surrounding Covid-19 vaccines. Furthermore, most vaccine studies that employ social media data focus on the Western world, using primarily English language data from American social networking platforms like Twitter and Facebook. Examples include Malova 2021, Bonnevie et. al. 2020, Tahir et.al. 2020, and Gunaratne et. al. 2019. This leaves large foreign social media sites or sites on which English is not the dominant language under-researched.

This project thus seeks to simultaneously close two research gaps. Many social media studies employ English-language data from American social networking platforms. This study will break from this trend, employing Russian-language data from the Russian social networking platform VKontakte (VK), a site with over 66 million active users (Melkadze, 2021). This study will also produce a unique analysis of vaccine hesitancy within the Russian-speaking world. While vaccine hesitancy is a well-studied topic, there is a lack of literature focusing on vaccine hesitancy within this demographic. By exploring the space between well-researched topics, I hope to produce unique recommendations designed to increase vaccination rates among an underserved demographic.

Methodology & Terms

The data consist of 23,698 vaccine-related posts from the Russian social networking platform VKontakte (VK). The data were collected from October to December of 2021. This was during a serious surge in Covid-19 cases, hospitalization, and deaths in Russia and other Russian-speaking countries. The surge corresponded with key vaccine-related events, including the introduction of vaccine passports, mandates, and campaigns in many Russian-speaking regions. The posts range in length from 1 to 2,477 words. The mean post length is 78.5 words.

The posts were collecting using the VK API's keyword search functionality. Keywords used to find vaccine-related content include the following Russian terms: *ukol', vaktsina,* and *privivka*. Each of these terms can be translated to English as *vaccine*. These search terms included results in both plural and singular format as well as in each of Russian's six case formats. Several steps were taken to preprocess the data for analysis. The data was first cleaned of punctuation and additional alphanumeric characters, for example, html tags. The text data was also lemmatized. Emojis were left in the text.

The data is analyzed using supervised and unsupervised data science tools. First, the posts were classified by sentiment using the Dostoevsky sentiment classifier. This is a Russian-language classifier was trained on posts from VKontakte. Research suggests that this model skews neutral (Nugumanova, Ahmed-Zaki, Baiburin, & Apaev, 2021), so corrective adjustments were made to the classification results to encourage more negative and positive posts, a pattern that is also reflected in a manual analysis of the posts. After dividing the data into sentiment categories, I employed several more data science tools to extract major topics, concerns, and themes from the dataset. I first used the named entity recognition (NER) capability of NLTK's Russian corpus to extract the individuals and institutions that are frequently referred to. Also using NLTK's Russian corpus, I extracted words that commonly co-occurred with a term translating to "vaccine." By determining co-occurring words, nuances in the vaccine discussed can be revealed, such as which vaccines are being discussed and which adjectives are being used to describe them. Finally, I conduced Latent Dirichlet Allocation topic modelling using the Gensim library. Topic modelling is used to extract commonly occurring themes in a large text dataset. This tool was used to reveal major vaccine-related concerns and beliefs in the VK post dataset. This analysis will reveal high-level themes and patterns from the dataset.

This study also employs thematic analysis to extract nuances that are not extractable using natural language processing methods. A recent article in *Medical Teacher* outlines the structure and benefits of this approach. This methodology consists of analyzing a dataset to report patterns in themes. It is best suited towards inductive reasoning and can be adapted to different document types (Kiger & Varpio, 2020). Given the flexible nature of this methodology, this is a suitable qualitative analysis choice. The initial data exploration step is covered by the data analysis portion of the project, as this process will reveal themes computationally that merit additional investigation. From there, anomalous keywords and keywords associated with vaccine debates were extracted from the dataset for qualitative analysis. For example, "administer" or "dose" are words that would be expected in a non-controversial conversation about vaccines; thus, words such as these were not investigated. However, words such as "trust" and "Soviet" are anomalous, and words such as "experimental" and "children" are associated with concerns about vaccine safety and effectiveness. These were the kinds of keywords selected for deeper analysis. Given the sheer number of posts, it was impossible to review every representative text. Therefore, keyword sampling was conducted. I randomly sampled 50 posts from the dataset that contained the keyword of interest and analyzed them for relevant themes and ideas. From this collection of posts, theme buckets were created for discussion.

In addition to thematic analysis, this study also employs the World Health Organization's framework for analyzing vaccine hesitancy and anti-vaccine sentiment. Vaccine hesitancy is a "delay in acceptance or refusal of vaccines" despite their availability (Butler & MacDonald, 2015). The anti-vaccine community, which categorically rejects vaccination, is vaccine-hesitant, as are those who delay vaccination but who may not be categorically against vaccines. This framework divides the causes of vaccine hesitancy into three categories: complacency,

convenience, and confidence. Complacency refers to the case when an individual's "perceived risk" of a vaccine preventable disease is low. The individual is thus not motivated to get vaccinated. Convenience is a factor that refers to the availability and accessibility of vaccines. Barriers such as inaccessible information, high cost, and geographic inaccessibility may cause an individual to delay vaccination. Finally, confidence in vaccine safety and effectiveness as well as in the institutions and people that manufacture and administer them plays a major role in calculating whether to get vaccinated. If an individual is not confident in institutions responsible for vaccines or in the safety and effectiveness of vaccines, they may not be motivated to get vaccinated. It is with these frameworks that vaccine hesitancy in the Russian-speaking world will be discussed.

This study suffered several limitations. The best natural language processing (NLP) tools are available in English, so it was difficult to find high-quality, cutting-edge NLP tools for Russian. The amount of data collected was also a limitation in two ways. First, while 23,000 posts are sufficient for quantitative analysis, but insufficient for training a custom sentiment classifier that could compete with the performance of other pretrained classifiers, for example. Second, the sheer number of posts made it impossible to analyze every document. Thus, smaller sample sizes had to be used for the thematic analysis portion of this research.

Overarching Thematic Findings

Pandemic

The Covid-19 pandemic was the central topic in this dataset because the disease was at its worst in many Russian-speaking countries in late 2021. During the data collection period, Russia and Ukraine were both experiencing a surge in Covid-19 cases and were introducing new, controversial public health measures in response to the pandemic. The following graph visualizes

new Covid-19 cases in countries where Russian is widely spoken, aggregated for every seven days.
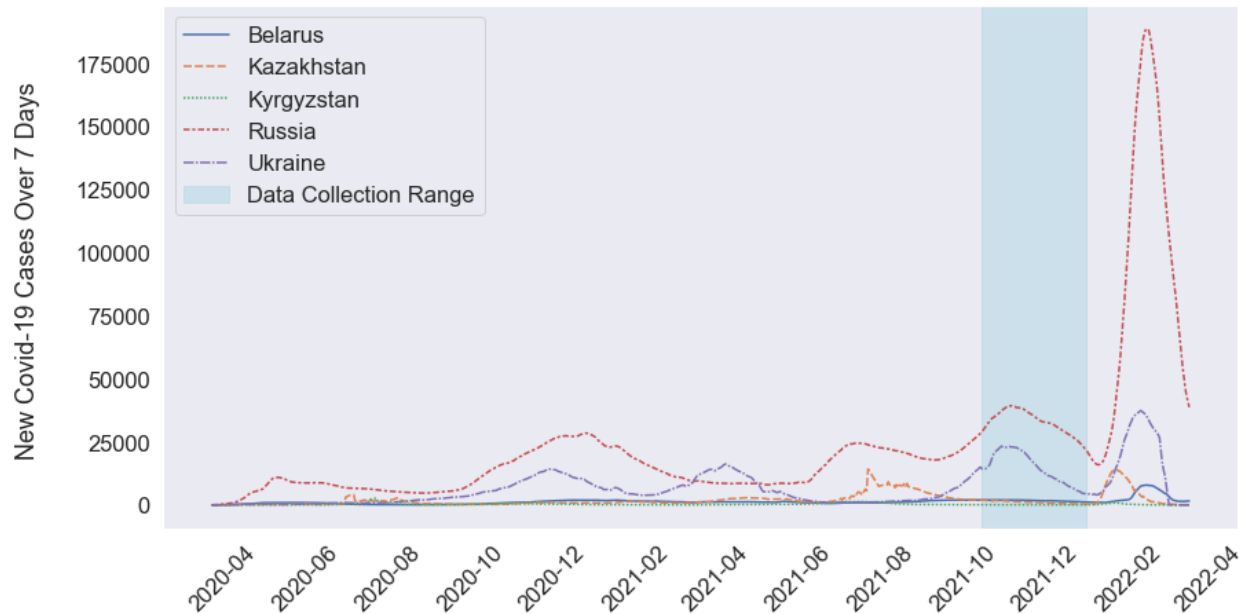

Figure 4, Appel. et. al. 2022.

This graph demonstrates that there were several case peaks in each country, culminating in a huge surge of cases in February and March 2022 due to the highly contagious Omicron variant, followed by a sharp decline in cases. The blue column highlights the state of the pandemic during this study's data collection period. At this time, Russia and Ukraine were experiencing the largest surge in cases that each country had seen since the start of the pandemic. Corresponding to the surge, several governments in the region began to introduce immunity passports and vaccine mandates. As such, most posts from this dataset reference vaccines and regulation for Covid-19 rather than vaccines for other diseases.

Corresponding to the pandemic, in addition to discussing vaccines themselves, users focused on public health regulations related to vaccination. The debate on Covid-19 passports began to heat up in late 2021 in Russia. Radio Free Europe/Radio Liberty (RFE/RL), an American-backed news outlet, reported that in November, many of Russia's local municipalities
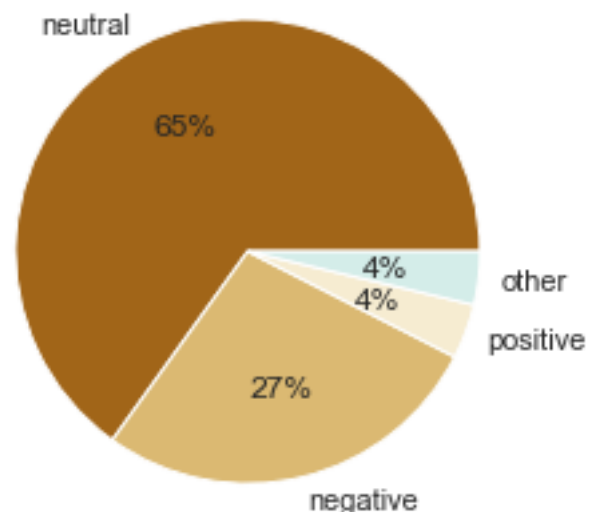
began implementing a Covid-19 passport in the form a QR code. The codes, administered by Russia's Rospotrebnadzor, a consumer protection and public health bureau, indicate that a user has either received a vaccine against Covid-19, is otherwise immune, or has an exception. Local governments that have opted to use the QR system for public gathering places, such as public transport, have faced controversial responses. RFE/RL reports that protests occurred around Russia, including in Tatarstan, where violence ensued and over 2,000 people were denied access to public transport (Coalson, 2021). The Levada Center has reported that 76% of Russians oppose a QR code system for public transport, which seems to have impacted the passage of relevant legislation, with Reuters reporting a "health pass" bill's failure as late as January of 2022 (Levada Center, 2021; Marrow, 2022). This topic has captured the attention of Russians and sparked a discussion on the role of government in mitigating public health disasters. Opponents range from anti-vaxxers to those concerned about discrimination against unvaccinated people to those who simply distrust the Russian state (Tyan, 2021). Other countries included in this study also have vaccine passports available, such as Ukraine, however here passports are for optional business use and are not required by the government (Reuters, Ukrainian government announces vaccine passports, 2021). It thus seems that this topic is less controversial among Russian speakers in Ukraine. Kazakhstan has taken a more stringent approach, requiring a passport for public areas and gathering places (Reuters, Kazakhstan Rolls Out App to Control Access to Public Areas, 2021). Thus, vaccine and immunity passports have proven a dominant theme is both the VK dataset and in media coverage surrounding vaccination in the Russian-speaking world.

Vaccine mandates, separate from QR codes, are also a topic of discussion. In Russia, although Putin has publicly stated that he does not support a national vaccination mandate, much

of the pandemic response has been left to local leaders (Troianovski, Kramer, & Nechepurenko, 2021). Thus, several local mandates have been put in place. For example, the mayor of Moscow Sergei Sobyanin announced a vaccine mandate for city workers in late October 2021 as Covid-19 cases began to surge beyond levels previously seen in the country (Stronski, 2021). In addition to explicit mandates, some regulation requires businesses to take on the task of vaccinating their employees (Dixon, 2021). While Russia has shied away from national mandates, other countries where Russian is widely spoken have opted for different responses. Ukraine introduced a national Covid-19 vaccine mandate for teachers and state employees, which was expanded in November 2021 to include healthcare workers and municipal employees (Polityuk, 2021). Finally, Kazakhstan instituted stringent vaccine or testing requirements for those who work in groups of 20 people or more (Reuters, Kazakhstan to introduce mandatory workplace vaccination, 2021). Thus, the vaccine discourse features debates on vaccine mandates in addition to content related to vaccines themselves.

Sentiment & Tone

The discussion surrounding vaccines on VK in late 2021 is overwhelmingly negative and neutral in sentiment, but this distribution does not necessarily reflect the distribution of pro-vaccine, vaccine-hesitant, and anti-vaccine posts. An analysis of the data revealed that 65.1% of posts were neutral in sentiment, while 27.4% were negative and 3.8% were positive. The out-of-the box classifier, Dostoevsky, reported classifications that were skewed strongly

neutral. This shortcoming was also reported by researchers at two universities in Kazakhstan (Nugumanova, Ahmed-Zaki, Baiburin, & Apaev, 2021, p. 102). Adjustments were thus made to the algorithm to produce a more equitable and accurate distribution of sentiment, which performed at 74% accuracy. This is lower than the standard 80-85% threshold for sentiment classifiers, as this is typically the rate of agreement among human sentiment coders. However, classifier distribution better reflects the distribution discovered during a manual analysis of the data, in which it was found that most posts were neutral or negative and a smaller amount were positive. This classifier still had shortcomings after tuning. While sentiment analysis is a powerful tool, current sentiment analysis algorithms are unable to take context into account and cannot target attitudes towards specific objects. Thus, if many negative words are used in a post, any positive sentiment towards vaccines themselves would be overlooked and the post would be counted as negative. For example, consider this vaccine-positive post found in the dataset:

> "[username], strangely the flu virus also mutates all the time, but flu vaccinations take place every year and are for free. How is covid fundamentally different from the flu, except for more severe consequences? If you do not force the people to get vaccinated, 50% of the population will not be vaccinated. Someone is stupid lazy or doesn't give an [expletive] about their own health or anyone else's, someone was brainwashed by anti-vaxxers with their crazy ideas, and someone else believes in chipping" (Sergey on November 21, 2021).

This post is aggressively vaccine-positive, but the user derides those who are unvaccinated as brainwashed, stupid, lazy, and selfish and uses words with negative connotations such as "forced." The sentiment classifier cannot recognize this post as positive due to the amount of negative language it contains. Thus, while sentiment categories will be used to add nuance to

quantitative analysis, the tuned pre-trained classifier did not perform well on the kind of data used in this study, as it was only able to distinguish positive and negative sentiment rather than pro-vaccine or anti-vaccine sentiment as originally anticipated. Thus, while the distribution of pro-vaccine, vaccine hesitant, and anti-vaccine sentiment cannot be determined with this algorithm, it is safe to conclude that the current discussion surrounding vaccines is not positive in sentiment. Feelings of anger, frustration, or fear dominate the dataset, rather than notions of assuredness, comfort, or positivity.

Countries Covered

The last general thematic finding is that the dataset is dominated by referenced to Russian or Russian-occupied territory, Russian organizations, and Russian nationals. Thus, while the purpose of this research is to focus on general vaccine content from any Russian-speaking community, it seems that the discussion in the collected VK posts is dominated by issues specific to Russia. The locations extracted from the dataset using named entity recognition shows that, as expected, locations with high amounts of Russian speakers occur the most frequently, such as Russia, RF (Russian Federation), Ukraine, and Moscow. Notably, there are also many references to the Soviet Union, an unexpected occurrence that merits qualitative study. These occurrences are consistent across the sentiment categories. Top locations identified by name entity recognition are dominated by internationally recognized Russia as well as occupied areas of Ukraine.

Number of Posts Featuring Org
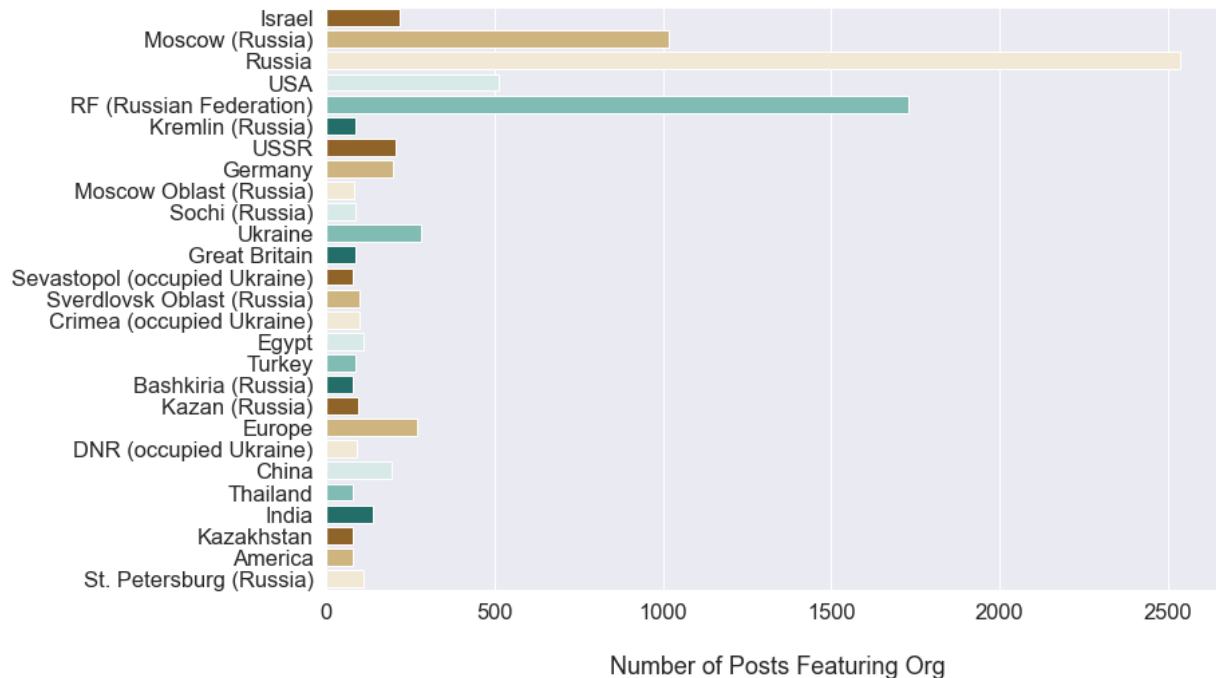
Every city and sub-national political division mentioned in more than 75 posts belongs to Russia

or occupied Ukraine. Other notable geographic entities mentioned are Ukraine and Kazakhstan,

with Belarus and Kyrgyzstan, two smaller Russian-speaking countries, missing from the most

frequently mentioned places. So, while much of the Russian-speaking world appears to occur in

the conversation surrounding vaccines, Kremlin-controlled territory dominates VK's vaccine

discourse.

Trust in Authority

Trust in Government

Quantitative analysis reveals that trust and government are major independent themes in

this dataset. Correspondingly, 5.04% of posts use the word "trust" in some capacity, while 19.4%

of posts referenced an organization. Named entity recognition analysis extracted several

organizations, many affiliated with the Russian state. Organizations' appearances are consistent

across sentiment, meaning that there is negligible variance between the negative, positive, and neutral post groups.

Number of Posts Featuring Org
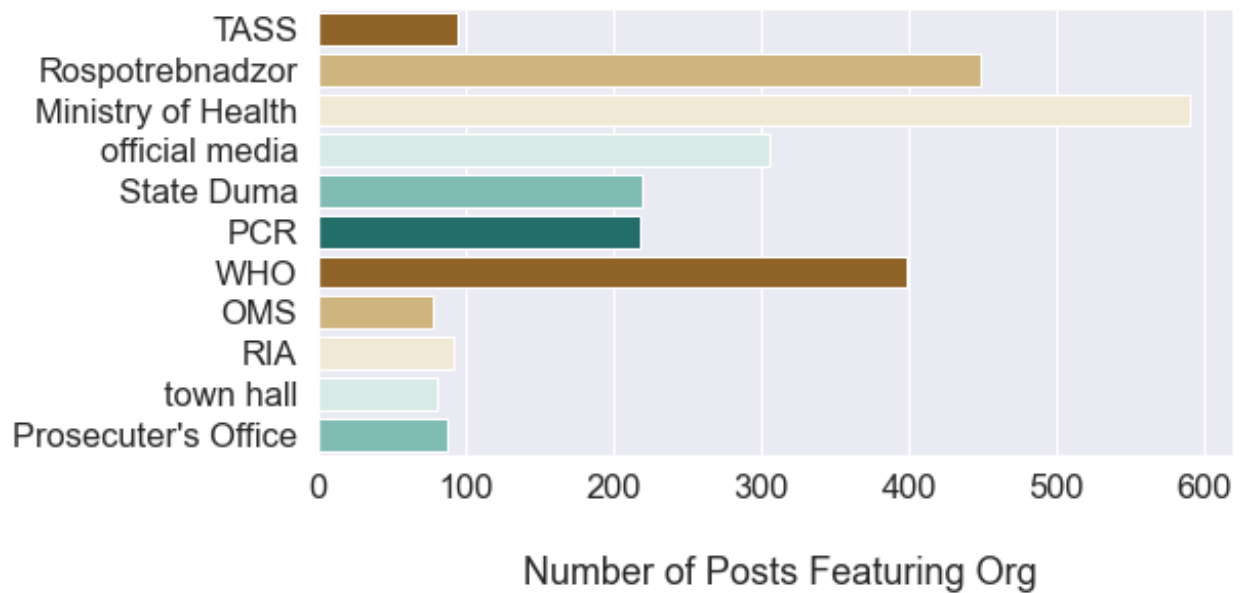
Russia's Ministry of Health is often referenced, as is *Rospotrebnadzor*, which is Russia's consumer protection and regulation bureau. Russian state-backed media also appears frequently in the dataset, with many references to TASS and RIA Novosti. Thus, government institutions feature very prominently in VK's vaccine discourse. Correspondingly, government officials from several Russian-speaking countries also figure prominently in the posts. Russia's national leaders President Vladimir Putin, former Prime Minister and President Dmitry Medvedev, and current Deputy Prime Minister Tatyana Golikova were mentioned frequently. Various local Russian leaders were frequently mentioned as well. Examples include the governors of Murmansk oblast, Volgograd oblast, and Perm krai, among other administrative divisions. This is likely due to the number of public health policies that have been implemented at local rather than national levels in Russia. National health leaders of other Russian-speaking countries were also mentioned frequently, including Belarus' Minister of Health Dmitry Pinevich and Kazakhstan's former Minister of Healthcare Alexey Tsoi. Mentions of people in government appear to be driven by

the Covid-19 pandemic, as national and local officials created public health and vaccine policies to combat the spread of the virus. Thus, both trust and governmental figures feature prominently in the dataset.

Qualitative analysis indicates that the two themes, trust and government, are intertwined. Trust is frequently discussed when describing a VK user's relationship to the state; posts reveal that there is little trust in the Russian government's ability to create, procure, stores, and administer safe and effective vaccines. The following posts provide valuable illustrations of this sentiment:

> "For people to go for this vaccine, they need trust in the state, but we don't have it. And in general, it seems to me that the more people are agitated and forced, the more the people will resist [the vaccine]" (Mayya on November 8, 2021).

This user expresses that "we," presumably citizens of the Russian Federation, lack trust in the state. Consequently, she argues that the more the state advocates for vaccination, the less Russian citizens will trust the vaccine. Other users also communicate this sentiment:

> "[username] …everyone thinks that those who do not get vaccinated are like idiots. But in fact, this is justified because the people do not trust our government. In my opinion, everything is clear and simple" (Alexey on November 16, 2021).

This user sympathizes with the unvaccinated, saying that it is simple to follow their logic due to widespread distrust in the state. These users summarize a plethora of posts that display vaccine hesitancy due to a lack of trust in the state. Hence, confidence, one of the WHO's three causes for vaccine hesitancy, appears instrumental in Russian speakers' willingness to get vaccinated, particularly against Covid-19.

Further analysis of representative posts confirms that many Russian speakers choose not to vaccinate not due to distrust in the science behind vaccines, but rather due to distrust their own government's ability to procure and administer safe and effective vaccines. This is a nuance that is exaggerated by direct comparisons of vaccines made in Russia to those made abroad. This theme is present in a November post:

> "But what do you say to the argument of one of my colleagues: I do not trust the government, therefore I will not be vaccinated with a domestic vaccine" (Alexander on November 14, 2021).

This user commented on a pro-vaccine post, saying that his coworker does not trust the government and will therefore not be vaccinated with a "domestic" vaccine. Implicit in this post is the idea that domestic vaccines cannot be trusted, as opposed to those produced abroad. Other users repeat this sentiment:

> "[username] …I trust countries that create high-tech and high-quality things more, Russia does not belong to these countries... Here it is a question of reputation. What is more likely, that all of Europe is lying or that Russia is lying? And why am I an anti-vaxxer? I'm not against vaccines..." (Leonid on November 22, 2021).

This user explicitly states that which is implied in the previous post, saying that he trusts vaccines from countries that create "high-tech and high-quality" products, but distrusts those made in Russia, implying that Russia is incapable of meeting global production standards. He closes his post by explicitly stating that he is not an anti-vaxxer, reiterating that his distrust is not in the science behind vaccines, but rather in the capacity of Russia to produce, distribute, and administer safe and effective vaccines. Note that in this post, the ability of the state procure good vaccines is in doubt, rather than its willingness. The following user expresses similar sentiment:

"[username]…Until our vaccines are tested, [I would] definitely not [get vaccinated].

Maybe I would have taken in an imported pfizer, but we don't have that" (Alexey on

October 23, 2021).

This user says she would get vaccinated with Pfizer, but will not get vaccinated with Sputnik

until the vaccine is tested. Although the discussion around Pfizer in the dataset was not

unanimously positive, there were many posts like this one. Thus, some Russian speakers decide

whether to get vaccinated based on their trust in the state's ability to procure and administer safe

and effective vaccines rather than their trust in the science behind vaccines.

There is also an important nuance among users that express distrust in the state, namely

the difference between distrust in the state's *ability* to procure safe and effective vaccines and the

state's *willingness* to do so. The previously discussed posts seem to hint at the state's inability to

procure good vaccines, but some users express that Russia's "elite" procure vaccines for

themselves and administer *zhizha*, or goo, to the people.

"Vaccinations? Since when did Putkin's [expletive] become a vaccine? Give me Pfizer!

The State Duma has already bought 400 thousand copies, so give it to the people!"

(Marina on November 1, 2021).

This user expresses doubts about the Sputnik vaccine and calls for the government to release its

store of Pfizer vaccines to the public. The next user expresses similar sentiment:

"[username] all anti-vaccination trends in our country come from distrust of the

authorities. There are a lot of questions and few answers. For example, why was Pfizer's

vaccine purchased for officials, and only local vaccines are injected into an ordinary

citizen?" (Alexander on November 10, 2021).

This user questions why Pfizer was purchased for Russia's officials, while domestic vaccines are the only ones available to the "ordinary citizen." These posts are representative of the sentiment that the state can procure good vaccines but is not interested in administering them to the people. Thus, some users are concerned about the state's willingness to ensure the safety and effectiveness of vaccines administered to them.

Previous research suggests that lacking trust in home government contributes to vaccine hesitancy and that people from Russian-speaking countries are more likely to trust foreign vaccines. A Polish survey administered to Ukrainian migrant workers in 2019 found that Ukrainian immigrants trusted vaccines administered in Poland more than they trusted those administered in Ukraine. In fact, data from Premise suggests that more Ukrainians would prefer a Covid-19 vaccine from the United States over Russia (Wilson A. , 2021). Adding complexity to Russian speakers' relationship to vaccine and the government, ongoing research suggests that refusing vaccination may be a way that Russian speakers exercise autonomy. An ongoing study led by Russian sociologist Ekaterina Borozdina demonstrates that parents who choose not to vaccinate their children often do so as a way of exercising autonomy. For most of Soviet rule, vaccination was not optional. It was not until Gorbachev's *glasnost'* that vaccination became an individual choice. As such, she argues that, empowered by laws such as informed consent, the people of many post-Soviet states that had so long lived under autocracy leveraged their choice to not get vaccinated as a way of exercising autonomy against states such as Russia, Ukraine, and Belarus (Borozdina, 2022). Thus, trust in vaccines and healthcare institutions are important things to work towards to improve confidence in vaccines and raise vaccination rates. This is especially so within a culture where being unvaccinated may be an expression of autonomy against what many consider untrustworthy governing institutions. This is important to note, as it

denotes that vaccine hesitancy may be larger than a health communication issue. It may also be

ingrained in a post-Soviet culture in which small rebellions are victories against the state and in

which rates of trust in the state are low.

It is important to note that affinity for foreign vaccines does not correlate to affinity for

foreign countries. Although references to foreign countries are also prominent in the dataset,

most of the discussion revolves around debates in pandemic response rather than comparisons of

the quality of vaccines. While large countries and international entities, like Europe, the United

States, and China, are mentioned throughout each sentiment category, some smaller countries are

mentioned occasionally in different sentiment categories. Notably, foreign entities feature less

prominently in the neutral posts than in positive and negative ones. In both positive and negative,

the countries mentioned had issues with the Covid-19 pandemic. For example, Israel had a

particularly effective vaccination campaign, and India struggled with heavy Covid-19 caseloads.

Thus, just as in the United States, Russian speakers appear to be discussing foreign responses to

the pandemic and even comparing their home countries' public health regimes to those of other

nations. The following posts illustrate the conversation:

> "[username] then why do Asian countries, with all the measures, now stop or are
>
> preparing to stop pandemic measures? Why do the United States and Europe also provide
>
> free vaccinations? Even in Israel with all vaccines, including both pfizer and sputnik?"
>
> (Alexey on November 4, 2021).

This user attempts to justify Russia's pandemic response and vaccination measures by

referencing the responses of other countries, including Asian and European countries as well as

the United States and Israel. The next post is in response to the first post:

"[username], let's also tell us about Israel, how they vaccinated everyone, and closed

within a week, then a month later they began to administer a third dose and nothing ...

They will NEVER tell you the TRUTH about other countries on our television" (Evgenia

on November 4, 2021).

Again, a user references Israel's vaccination program, arguing that it is ineffective, and that the

media does not tell the truth about foreign countries' pandemic responses. This kind of

conversation explain the majority of conversation surrounding foreign countries and, as

exemplified by the previous posts, the references can be positive as well as negative. The posts

referencing foreign vaccines positively seem to be selecting the lesser of two evils so speak, as

conversations surrounding the countries that created alternative vaccines usually do not praise

the country that made it.

Trust in Healthcare Institutions

The data also demonstrates that healthcare is a major theme. Among the authorities

discussed in the dataset, healthcare workers and organizations were also referenced frequently.

The most frequently referred to people held positions in health and medicine. One of the most

frequent first names in the dataset was 'Alexander.' Upon analysis of surrounding text, this was

mostly found to refer to Alexander Ginsburg, an immunologist, and the director of the Gamaleya

Center, the institution that developed Sputnik V, the first registered vaccine against Covid-19.

Several other immunologists, doctors, and public health officials featured prominently as well.

Examples include Doctor Dmitry Chentsov, Doctor Anna Popova, a public health official, and

Elena Malesheva, a health talk show host. Russian speakers are thus referencing doctors and

health workers in their conversations, particularly those who have played key roles in the

response to the Covid-19 pandemic.

Qualitative analysis reveals that trust and healthcare institutions are intertwined themes, similar to the manner of trust and government. VK posts that reference the Alexander Ginsburg and his Gamaleya Center, the maker of Russia's Sputnik Covid-19 vaccines, support this conclusion. Several users indicated that the Gamaleya Center exclusively or primarily created and distributed the vaccine to increase profits. For example, the following post outlines the profits that the institution allegedly stands to make and cites this as the reason for the Center's work on vaccines:

> "[username], of course he will lobby for this, I think it costs the government 900 ruble per dose if you believe the search engines… 1800 ruble per year per person. And provided that 80% should be vaccinated, the math for Gamaleya under the ideal outcome is the following 146000000 people*0.8*1800 ruble=210 billion rubles per year. I made a mistake with costs, but for example if a vaccine dose costs the government not 900 rubles but 450 rubles, that's 105 billion rubles per year" (Igor on November 8, 2021).

The user claims that the Gamaleya Center's motives lie primarily with profit. If health and wellbeing are priorities for the Center, these are secondary. Other VK users expressed this exact sentiment, claiming the vaccine was just "more dough" for Gamaleya and insinuating that the vaccine, presumably that against Covid-19, was ineffective (Akatov, 2021). Another user explicitly states that his concern about corruption is the reason why he has not gotten vaccinated:

> "[username] if there was a goal to vaccinate everyone, I would be vaccinated. but their goal is to pump money into the budget…They don't care if I'm vaccinated or not. The only difference is whether or not they earn [money]" (Artem on November 24, 2021).

Russian speakers are anticipating corruption and taking corresponding steps to protect their own interests, in this case their health, against ill-willed healthcare institutions. This perspective in

part explains some Russian speakers' unwillingness to pursue vaccination. Government

healthcare institutions are also subjects of conversation, and some posts reflect a lack of trust in

agencies such as Rospotrebnadzor and Minzdrav. Although more conspiratorial in nature than

other example posts, the following user expresses distrust towards both vaccine manufacturers

and the Ministry of Health:

"[username], … from the manufacturer and the Ministry of Health, etc. …. they remove

all responsibility because all of them together are not sure how any person's body will

react to their experimental vaccine. In another case, they didn't save the guy, and even

wrote that [his death] is supposedly not from a vaccine, well, you can't prove it in court -

this is a conspiracy. Some information is starting to leak" (Ella on November 16, 2021).

The user suggests that the vaccine, presumably that against Covid-19, is not safe. She even

suggests that there has been a cover up of a death related to vaccination and that manufacturers

and Ministry of Health together refused responsibility for the death. Thus, there is widespread

belief that the vaccine campaign exists to create profit for healthcare institutions, while the

Ministry of Health and other governmental institutions are alleged to be complicit in the scheme.

This believe appears to have led some to believe that the vaccine is not effective and perhaps not

safe, since the vaccine exists only to create profit. Thus, low rates of trust in healthcare

institutions also appear to be causal in low vaccination rates in the Russian-speaking world.

Previous research on this topic also suggests that Russian speakers doubt the impartiality

of healthcare workers and pharmaceutical companies. A 2012 report on vaccine sentiment

among Russian-speaking communities in Washington state found that suspicion about the

healthcare system both contributed to vaccine hesitancy. Some parents believed, for instance,

that doctors were bribed by pharmaceutical companies to promote vaccines in order to increase

profits. Distrust in healthcare institutions was also found among Ukrainian immigrants in Poland. Polish researchers at the University of Zielona Gora conducted a vaccine attitude survey among local Ukrainians in 2019. The study found that distrust in the state as well as healthcare institutions influence willingness to get vaccinated. It thus appears that vaccine hesitancy among Russian speakers is fueled not solely by concerns about vaccines categorically, but by lacking confidence in healthcare institutions' willingness and ability to safely procure, store, and administer effective vaccines.

Scientific Misunderstanding

Childhood Vaccination & Pregnancy

Unscientific superstitions about childhood vaccination are also causal in low vaccination rates. Children appeared in topics extracted using topic modelling in all three sentiment categories. Children are a major topic of discussion, and this likely due to special concern given to which exceptions should be made for children regarding vaccination. One common misconception is that young children's immune systems are too weak to receive vaccines. This myth was referenced several times in this dataset. Take, for example, the following post:

> "[She] was not vaccinated (at that time vaccinations were not yet available to the masses) she got sick with Covid at a late stage, there were no complications despite the lack of treatment... An adult body is one thing. And another thing is the body of a child with a fragile immune system. Questionable vaccine policy does not inspire confidence" (Yulia on October 24, 2021).

This user combines vaccine hesitant rhetoric, discounting the potential severity of Covid-19, with the myth that children's immune systems are not prepared for vaccination. The misconception

suggests that parents should until their children's immune systems are mature enough to vaccinate them. The next user implies that she has taken this approach with her children:

> "[username] every parent decides for himself when to administer a vaccine. I refuse them for my children until 2.5 years" (Alexandra on December 22, 2021).

This mother states that the decision to vaccinate should be up to parents alone, and then states that she delays vaccination for her children until they are at least two years old. She is presumably waiting for her children to be old enough and strong enough to get vaccinated. This is emphasized by her opinion about parents' roles in vaccination, stating that parents should decide "when" to vaccinate rather than "whether" to vaccinate. Thus, lacking knowledge on the benefits and safety of childhood vaccination may be a cause for low vaccination rates among children for a variety of diseases.

Previous research supports this conclusion as well. In 2012, the Washington State Department of Health released a report on childhood immunization patterns within the state's large Russian-speaking community. The study found that misconceptions about vaccines among parents contributed to vaccine hesitancy and low vaccination rates among children. A commonly held misconception was the belief that some children's immune systems are "too weak" for vaccination. If a child was sick or too young, Russian speaking parents reported that vaccination should be delayed (Washington State Department of Health, 2012, p. 2). Thus, this community exhibited poor knowledge of the science behind vaccines, which influences parents; willingness to vaccinate their children.

There is also a great degree of concern over childhood vaccination due to reasons adults also hold for delaying vaccination against Covid-19. Namely, many users feel that the Covid-19 vaccine has not been sufficiently tested for administration to children.

"…Where are the results of the third phase? Nobody has seen them, but I would like to.

The trial of the second phase of the children's vaccine ends in 22 years, and the injections

will be given now. No one is against a vaccine, people just need answers to simple

questions..." (Nikolay on December 3, 2021).

While "untested" and "experimental" vaccines are themes in this dataset, this user specifies that

children's testing period should be much longer than the adult period. This suggests that children

are of special concern in this conversation, and that standards should be higher for approving a

vaccine for children than for approving a vaccine for adults. The next user also exhibits special

concern for how the Covid vaccine may impact children:

"Is anyone responsible at least for vaccinating children?! Just reduce the concentration?!

Isn't that right? Even Pfizer was banned for children because children have a lot of

complications! For that, our vaccine is so good that there are no side effects at all! Does

anyone actually believe this?" (Igor on November 1, 2021).

This user expresses that there should "at least" be concern for how vaccines affect children, if

not for adults. He also warns of potential side effects that children could have as a result of the

vaccine. Thus, special concern and attention is granted to risks associated with childhood Covid

vaccination, and users generally appear to expect higher standards for approving a vaccine for

children than for adults.

Users also mentioned that they delayed or refused vaccination because they were

pregnant and expressed concern about how vaccine side effects may impact them or their babies.

Pregnancy was a topic revealed in topic modeling analysis for neutral sentiment. This is due to

users posting concerns about the safety of vaccines for pregnant people, unborn children, and

those who are breastfeeding. The following post is an excellent example of this sentiment:

"I have a question…If anything, during pregnancy, while breastfeeding, many drugs are

prohibited. So what the hell, what crap can these vaccines be from??? Where is the

guarantee that nothing will happen to me or my child? Or, like it was said, will you die

and will your relatives be paid 30 thousand [bucks]? Bunch of idiots. There is no cure for

cancer and HIV! But this vaccine will save [lives].. Well well" (Anna on October 25,

2021).

This user expresses concern about pregnant people, seemingly about herself. She states that the

administration of other medications is often restricted when people are pregnant or breastfeeding,

and then expresses concern about what effects the vaccine might have on herself and her child.

Others also expressed concern about what effects vaccination might have on children after they

were born, stating that for the Covid-19 vaccine, there was insufficient time to test such results

(Ezova, 2021). Thus, Russian speakers have special concerns about especially vulnerable people,

such as children and pregnant people, taking the vaccine. It appears these concerns have not been

adequately addressed in informational material surrounding vaccines.

Other General Misconceptions

Other vaccine misconceptions also appeared in the dataset. Some users expressed concern

about how, in adults in addition to in children, immune systems can be destroyed by vaccines:

"Mikhail, the immune system can be completely destroyed by experimental "vaccines",

and then what ?! We already see it's only getting worse" (Boronovna, 2021).

This post again exemplifies a poor understanding of how vaccines can impact the immune

system. Other users also expressed misunderstanding of how Covid-19 vaccines work:

"…was pregnant, caught a cold, cough…Now what??? Get vaccinated?...a live virus

enters, and it can infect and everything will be fine ???... (Anya on December 6, 2021).

This user believes that Covid vaccines infect the recipient to create antibodies. Although

different vaccines create antibodies in different ways, no Covid vaccine infects the recipient with

a live virus. These misconceptions seem to impact the users' decision to get vaccinated.

Covid-19 Vaccines

Trigram analysis reveals that most posts reference Russian Covid-19 vaccines and that

vaccine ingredients may be a concern. While every post collected contained a keyword for

"vaccine", much of the online discussion surrounding vaccines focuses on public health

regulation, government, and other related concerns. To get a better sense of the discourse directly

surrounding vaccines themselves, I conducted bigram and trigram collocation analysis on the

word "vaccine." Trigram collocations revealed, again, that VK's current online vaccine discourse

centers on Covid-19 vaccines. Below is a chart of trigrams that occur more than 20 times in our
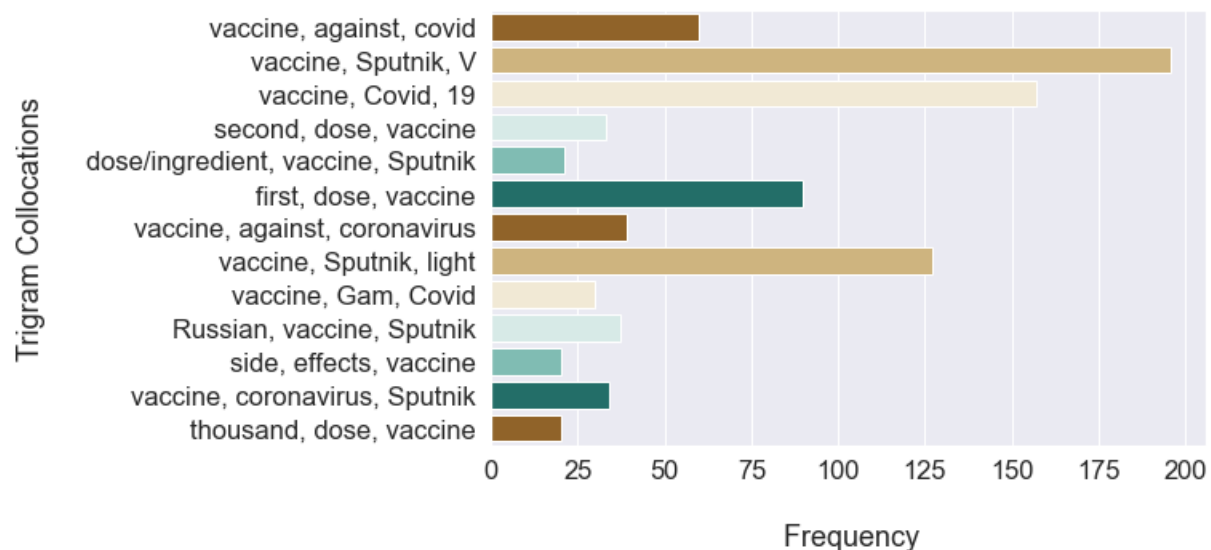
dataset:

Figure 5, Trigram Collocation Bar Chart

Six of the thirteen trigrams refer to the two Russian-made Sputnik vaccine, Sputnik V and

Sputnik Light. Several also use generic language, talking about first and second doses of the

vaccine. Notably, in addition to dose, Russian speakers use the word '*komponent*' to describe doses of a vaccine, however, this word can also be used to refer to vaccine ingredients. This was translated based on context, for example, first *'kompenent'* makes more sense as "first dose." Where there as ambiguity, "dose/ingredient" is used. Notably, vaccine side effects are also a concern highlighted in the trigram collocations. Thus, the vaccine conversation is dominated by Covid-19 and vaccine side effects are a major concern.

Bigram analysis revealed that the safety and effectiveness of vaccines are in question and that Covid-19 is central to the current discourse surrounding vaccines. Below is a chart of bigrams that occur at least 50 times in the dataset (the threshold for bigrams is higher because bigrams frequency will probabilistically be higher than trigram frequency):
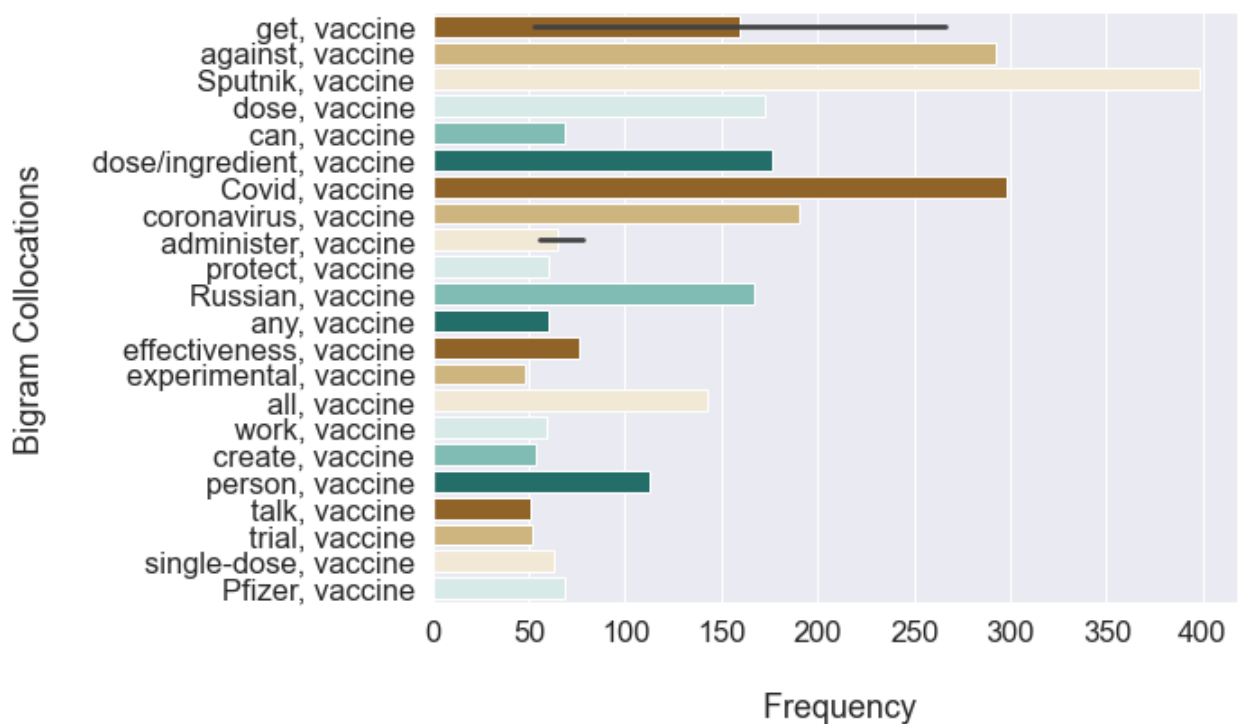

Figure 6, chart of bigram collocations with black lines indicating multiple Russian bigrams found with the same meaning

The conversation is again shown to be dominated by Russian Covid-19 vaccines, with bigrams containing Covid-19, Sputnik, and Russian. However, bigram analysis reveals that Pfizer, a

western vaccine, is also discussed with significant frequency. General vaccine-related words also appear, including get, administer, and dose. However, the bigrams also add nuance and additional topics to those discovered in the trigram collocations. Words such as "experimental" and "trial" appear frequently with "vaccine", indicating some may consider the Covid vaccine insufficiently tested and thus unsafe, ineffective, or both. Another bigram was "effectiveness" and "vaccine", indicating that there may be a debate on how effective a vaccine, likely the Covid-19 vaccine, is. An additional notable bigram is "protect" and "vaccine," a seemingly vaccine-positive notion. Vaccine safety and effectiveness as well as the positives and negatives of vaccination are central topics in this dataset.

This analysis informed a qualitative discovery of relevant posts, in which it was uncovered that the safety and effectiveness of the Covid-19 vaccine is questioned. Perhaps the major concern is the amount of testing the Covid-19 vaccine has endured:

> "Konstantin, I am not against vaccination. Did I say that vaccination is useless? And that I don't get vaccinated at all? I'll make plans for the summer.... If the vaccine works, has been tested for years - I'm all for it! But modern covid vaccines, besides their marketability, have not yet proven anything - not effective, not safe…" (Konstantin on November 14, 2021).

This user does not think the Covid-19 vaccine has been around for long enough, and is generally pro-vaccine but does not trust this particular vaccine. Other users share his sentiment, and frequently refer to the Covid vaccine as experimental:

> "Gennady, because it is goo, it cannot be called a vaccine. This is an experimental drug that is currently being tested. It is being tested on volunteers. And they are presented as

the only salvation, but why did they decide that it helps? The vaccinated get sick and die

in batches" (Vitaly on November 2, 2021).

This user says that the Covid vaccine cannot be called a vaccine; rather, it is an experimental

drug. This was a major theme in the dataset, with "experimental" cooccurring with vaccine

nearly 150 times. The next user also shares the sentiment:

"Valentine, keep your distance, for example. Use masks if you are sick. However, I am

not against the vaccine as such. Let the tests be carried out as expected and then put into

circulation, and not according to an accelerated scheme, bypassing all the regulations.

Until the completion of the trials, the drug is considered experimental. Are you ready to

take responsibility for your health by being vaccinated with an experimental drug?"

(Viktor on December 2, 2021).

This user says that he is not against the vaccine but expresses alarm about an "accelerated"

regime for vaccine approval, saying that the makers "bypassed" the necessary regulation. These

conclusions are also commonly heard in the United States, where people also expressed concerns

about the safety and effectiveness of Covid-19 vaccines due to their relative newness. These

concerns also appear problematic in the Russian-speaking world. This is a concern that appears

specific to the Covid vaccine rather than to vaccines in general.

There are also concerns about whether Covid-19 vaccines are effective at preventing the

disease at all. Some of these concerns are based on the level of testing the vaccines have

received, but others point to breakthrough infections and deaths to justify their doubts.

"They vaccinate for a year, why does [the pandemic] only get worse?! So the "vaccine"

does not work! Or it works in the wrong direction!"

This user expresses that the vaccine has not helped the pandemic, since case counts have continued to rise in several countries since the widespread availability of the vaccine.

> "The goal is code and dehumanization. Everyone sees perfectly well that a total injection, on the example of Israel, does not save [lives]…" (Sam on November 21, 2021)

Likewise, this user says that despite high vaccination levels in Israel has not eliminated the pandemic. Thus, while some users express doubt in the Covid vaccine due to its relative newness, other express doubt that the vaccine works because it has not yet ended the pandemic.

Dis- & Misinformation

A major cause for lacking trust and widespread misconceptions about vaccines among Russian-speakers is dis- and misinformation. Research demonstrates that misinformation about vaccines contributes to low rates of confidence among Russian speakers. Public health researchers in Washington state found in 2012 that exposure to Russian-language media contributed to vaccine hesitancy among parents, reporting that "misinformation and negative reinforcement" about vaccines was "prevalent in Russian-speaking countries" (Washington State Department of Health, 2012, p. 5). Since this study was published, Russia has been accused of strategically spreading vaccine disinformation to other Russian-speaking communities. For example, Ulana Suprun, Ukraine's former acting Minister of Health, claimed that Russia was spreading disinformation about vaccines. She cited this as a major factor in Ukraine's 2019 measles epidemic. During the Covid-19 pandemic, Russia has been accused of scaling up its vaccine disinformation. Ukraine's current Minister of Health Viktor Lyashko said in an October 2021 interview with Voice of America that:

"We have the vaccine, we also have the capacity of the health care system. But Russian

propaganda, which disperses [fake news] on the territory of our country, does not allow

us to [achieve the same vaccination rates] as other European countries" (Lisunova, 2021).

In fact, the Security Service of Ukraine arrested an anti-vaccine leader with connections to the

Kremlin in 2021, alleging that the arrestee was supported by Russian handlers (Meduza, 2021).

These accusations correspond with other Kremlin-backed efforts to conduct "hybrid war" against

Ukraine. Studies conducted on Twitter have confirmed that Russia manufactures a vaccine

debate and spreads vaccine disinformation (Broniatowski et. al., 2018). Given that the Kremlin

has been demonstrated to fuel anti-vaccine rhetoric and that it targets neighboring Russian-

speaking countries, it is reasonable to conclude that disinformation, some state-sponsored, likely

contributes to vaccine hesitancy among Russian speakers.

Vaccine misinformation, which is incorrect information that is unintentionally spread, is

also common. In 2008, a 17-year-old Ukrainian boy died within days of receiving the MMR

vaccine during a national Ukrainian vaccination campaign. Although the death was not

associated with the vaccine, the flurry of irresponsible reports on the death and subsequent

dismissal of public health officials had a severely negative impact on vaccine attitudes in

Ukraine. In fact, many journalists have traced modern vaccine hesitancy in Ukraine to this event

(Wesolowsky & Saska, 2017). Although not state-sponsored, this misinformation along with

disinformation campaigns have likely impacted confidence in the safety and effectiveness of

vaccines and in the capability of those that procure and administer them.

Other Themes

Public Health Regulation

Public health regulation is another major topic in the dataset. As most posts in the dataset are about the Covid-19 pandemic, many posts discuss pandemic measures that Russian-speaking countries have proposed or implemented. A controversial topic, most users oppose regulation such as QR codes and vaccine mandates. Users frequently argue that using QR codes as a public health measure is a form of discrimination which will result in the segregation of vaccinated and unvaccinated people. Many communicate that this is a violation of human rights and express concern about the government's role in what they consider to be their personal lives. The post below is representative of this sentiment:

> "Hello!!! No to segregation!! I am against qr codes! Vaccines are a voluntary matter! Do
> not violate human rights! Give the choice!" (Katya on November 14, 2021).

Notably, this user does not discuss the safety or effectiveness of vaccines. Rather, the discussion is completely directed at public health regulations and mandates' relationship to personal rights.

However, concerns about public health regulation are more often concurrently discussed with vaccine hesitant rhetoric. Thus, a predominate theme in posts opposing public health regulations is a poor understanding of both vaccines and the Covid-19 disease. For example, the following user argues that the use of QR codes is a violation of personal rights and a form of segregation:

> "Hello! I ask that these laws are rejected. QR codes do not give information about
> whether a person is sick or healthy. Vaccines can also cause illness. Wonder at the rights
> of millions of citizens, for example, who got sick without visits to the doctor or who use

their lawful right to refuse vaccination. This is segregation, the separation of people,

humiliation. This is not about health!" (Marina on November 15, 2021).

The user justifies her argument by concurrently stating that, just like a disease, vaccines can

make people sick, indicating a misunderstanding regarding the science behind vaccines. A user

who indicates he is in Belarus made a similar argument, saying that despite less stringent public

health regulation in Belarus, case counts remained similar. This user then theorizes that the goal

of regulation is to collect fines, rather than to promote the health and interests of the country

(Tkachenko, 2021). This sentiment corresponds to the results of a Levada Center survey. While

current research does not demonstrate whether those who are against mandatory vaccination

have lower rates of vaccination, research by the Levada Institute sheds light on vaccine opinions

among those against mandates. 37% of opponents to mandatory vaccination are opposed because

they believe that mandatory vaccination is a violation of human rights. Another 49% expressed

that they were against mandatory vaccination because they were not confident in the vaccine's

safety and effectiveness (Levada Center, 2021). Thus, while many Russians are against vaccine

mandates due to principal, a greater portion oppose due to concerns about the vaccine itself. The

following post upholds this pattern:

> "[usernames] children have always gotten sick with covid, the flu and resistant
>
> pneumonia, died, but this does not mean that all need to be subject to experiments. I am
>
> not against vaccination. I believe that it should be voluntary. I am again QR-codes. We
>
> have really been driven to a corner…" (Pavel on November 24, 2021).

This user argues against QR codes by citing low levels of concern about Covid-19 and a distrust

of the "experimental" Covid-19 vaccine. Thus, some users who oppose public health mandates

also exhibit vaccine-hesitant attitudes, discounting the severity of vaccine-preventable diseases, expressing doubts as to the effectiveness of vaccines, and citing concerns about vaccine safety.

Other users, however, do support mandates, and frequently exhibit nostalgia for the Soviet Union in their posts. Quantitative exploration uncovered that the USSR featured prominently in this dataset, referenced by 686 posts. Upon qualitative analysis, it appears that the Soviet Union was largely referenced in a positive light. Users reminisced on Soviet scientific and public health dominance. Users referenced Soviet-era universal vaccination programs. The following user expresses a frustration with perceived degradation of his country.

> "....If you see that in terms of vaccination rates, we have regressed to the 97th place in the world, having our own vaccines that we distribute to 70 countries. At the same time, [we] came out on top in mortality, ahead of India, China, and the United States. No, but our anti-vaxxers are first in the world. I would understand if we lived in North Korea or Turkmenistan, where everyone [believes] conspiracy. In Soviet times, everyone was vaccinated without asking for medical advice, we were among the most advanced who overcame smallpox, plague and cholera. And now it seems that people deliberately zombifies others through the internet, pushing them into the abyss…Think with your head. Read articles, not social media posts. Take care of yourselves" (Gennady on November 1, 2021).

He ascribes scientific prowess to the Soviet Union and Russia, expressing pride that Russia has created vaccines against Covid-19 that are being distributed to over 70 countries. However, he laments Russia's high mortality rates and high rates of vaccine hesitancy. While this would be appropriate for countries like North Korea, who lack access to information, this is not appropriate for a country of Russia's caliber. He reminisces on Soviet times, when "everyone

was vaccinated without asking for medical advice" and diseases like smallpox and cholera were eliminated. The next user also speaks of the Soviet Union's public health practices in a positive light, recommending that Russia adopt Soviet vaccination policy.

> "…do it right. People older than 18 years study or work. So why not make mobile teams at places of work and study, like it was in the days of the USSR and in the 90s, when doctors came to workplaces and schools and did examinations, administered the necessary vaccines and so on" (Kir on November 1, 2021).

He suggests that teams of healthcare workers travel to places of work and study and "administer the necessary vaccines" as was done in the USSR and 1990s Russia. The next user expresses the same sentiment.

> "[username] under the Soviets idiots didn't bark about vaccines, but instead calmly got vaccinated as necessary" (Konstantin on November 29, 2021).

While he does not make specific policy recommendations, this user wishes that Russians would "calmly" get vaccinated instead of "barking" about vaccines like now. Thus, while it appears that some VK users are concerns about personal rights and a resurgence of authoritarianism, others reminisce on the simplicity of public health under the Soviet Union and the positive impact stringent vaccination regulation had in the country.

Engagement with the Vaccine Hesitant

Scientific misunderstandings and distrust related to vaccines are not always addressed effectively by pro-vaccine users. While several posts promoted vaccines and addressed those who expressed vaccine-hesitant sentiment, most of these users failed to address the concerns of the vaccine hesitant. Instead, when some users expressed concerns, they were told that they were "anti-vaxxers" or conspiracy theorists. For example, a post in a thread made on November 10,

2021 states concerns about the effectiveness of the Covid-19 vaccine. "This is Singapore, where, despite 80% of those vaccinated, the infection rates are still running rampant? They no longer know who to shift responsibility to" (Machalov, 2021). The user expresses that despite very high vaccination rates in Singapore, infection rates for Covid-19 are still high. Another user responded multiple times, explaining that high vaccination rates still reduce morbidity, but simultaneously comparing the original poster to a "ruthless anti-vaxxer" (Bobov, 2021). Other said that the unvaccinated lacked any common sense or sense of self-preservation (Pakhomov, 2021). Another example is the following post, which ridicules another user's concerns about vaccine side effects, including blood clots, as well as the vaccine's effectiveness

"[username] Well, that is, a blood clot from vaccination? Who said? A third of your friends is how much? 3? From how much? What is their medical history? What vaccine did they get? Do you know that the vaccine has a percentage of effectiveness? Where did you get the idea that the vaccine is 100% protective? I understand that people don't tend to think much, but you need to reason a little" (Sergey on November 13, 2021).

The responding user ridicules these concerns, indicating that the vaccine hesitant are unreasonable and stupid. This kind of pattern is frequently found in the data; users post vaccine hesitant rhetoric and are called names and ridiculed. This pattern echoes the findings of sentiment analysis, which revealed that less than 4% of posts were positive in sentiment, with negative and neutral sentiment posts dominating the dataset. Thus, vaccine concerns are generally not addressed effectively and exchanges about the topic are far more likely to be negative than positive in sentiment.

This was not always the case though. Many users did attempt to spread knowledge on the vaccine and address user concerns. The following comment was in response to a user suggesting

policy makers wait until the Phase 3 trials for one of Russia's Covid-19 vaccines on vaccine

passports:

> "[username], on February 2, 2021, The Lancet published the interim results of a phase III
>
> study, according to which the effectiveness of the Sputnik V vaccine was 91.6%, and the
>
> effectiveness of the vaccine against moderate or severe COVID-19 was 100%[10
>
>][eleven]. After that, the vaccine received permission to enter into civil circulation for a
>
> period of 5 years" (Nadezhda on November 22, 2021).

Rather than ridicule the user's expressed concerns about Covid-19 vaccine, this user gently but

directly addressed the concern, communicating that Phase 3 trials had been completed. Despite

the evident ability and willingness of some users to address concerns in a logical and respectful

manner, this post does not seem to represent most interactions between pro-vaccine and vaccine

hesitant Russian speakers. This is a key issue, as previous research on vaccine hesitancy among

Russian speakers suggests that people seek doctors that take their questions and concerns

seriously and address them kindly (Washington State Department of Health, 2012, p. 3). The

Cleveland Clinic also stresses the importance of compassion and understanding when discussing

vaccines with the vaccine hesitant (Cleveland Clinic, 2021). Thus, exhibiting compassion and

gently correcting vaccine hesitant

Other VK users recognize this issue. Although this user expresses doubt about the

effectiveness of vaccines, presumably those against Covid-19, her understanding and explanation

of vaccine hesitancy is succinct and poignant:

> "Most of those who do not vaccinate are afraid of complications after it or do not believe
>
> in its effectiveness at all. There are many examples with a fatal outcome, many of whom
>
> she did not help - they get sick in a severe form. And fear has big eyes! Calls for

consciousness and responsibility do not work with these categories of citizens!!! And I

understand those who have not yet been vaccinated. Vaccine fears must be removed first"

(Olga on October 22, 2021).

The user suggests that the fears of the vaccine hesitant are not being addressed sufficiently,

which, based on quantitative and qualitative analysis of the VK posts as well as a summary of the

Covid-19 ground truth in Russian-speaking countries, is accurate.

Conspiracy

Although not the dominant cause for vaccine hesitancy, the final theme present in this

dataset is conspiracy about vaccines. One of the major conspiratorial narratives is that vaccines

were a method of genocide. One user suggested that many would die within two to three years

from the vaccine, saying that a "genocide is in full swing" (Ezova, 2021). Others shared this

sentiment, claiming that the vaccine caused cancer, heart attacks, and strokes within several

months (Andrenashvili, 2021). Others talked about alleged GMO material in the vaccine that

would cause long-term impacts on a recipient's genetic makeup (Tyabin, 2021). Related to

genocide, there were also conspiracies referencing New World Order conspiracies, connecting

Alexander Ginsburg, the director of the Gamaleya Center, which created the Sputnik Covid

vaccines, with Rockefeller and other staple "globalists" in conspiracy theories (Lvova, 2021;

Potekhina, 2021). Thus, there are several Russian speakers who may not be reachable due to the

high level of suspicion these people have for government, media, and the vaccines themselves.

In addition to conspiracies regarding vaccines themselves, there were some conspiracies

about public health regulation as well. Some argued that QR codes, which function as vaccine

passports in some countries of the former Soviet Union, turn people into products

(Andrenashvili, 2021). These users also express fear that QR codes are a "globalist project" to

steal the personal data of Russian citizens (V*******, 2021). These users, again, would be hard to reach given their strong, nearly religious, distrust in authority. However, it is worth noting that the words "genocide" and "globalist" each appear in less than 1% of posts. Other research supports the conclusion that most users are not preoccupied with conspiracy, with a Levada Center survey reporting that 2% of those who are against vaccine passports claim that mandatory vaccination was homicide (Levada Center, 2021) Thus, while conspiracy is a problem that may prevent some from vaccinating, the majority of vaccine hesitant users have more addressable concerns regarding vaccine safety and effectiveness.

Conclusions, Recommendations, & Future Research

This study revealed that the conversation surrounding vaccines among Russian speakers on VKontakte in late 2021 was dominated by Covid-19 and concerns specific to the Russian Federation. Users are preoccupied with concerns both about vaccines themselves as well as the government's role in promoting and enforcing public health measures like vaccination and immunity passports. The chief concerns about vaccines can be grouped into two main areas: low levels of trust in authority and scientific misconceptions. Major scientific misconceptions include misunderstandings about how vaccines work, how they can impact a recipient's immune system, and how they are tested and approved. Conspiracy theories are problematic, but most vaccine-hesitant posts refer to side effects, the age of vaccines, and other more realistic concerns. This indicates that most vaccine-hesitant Russian speakers could be convinced of the safety, effectiveness, and necessity of vaccination. Unfortunately, concerns are not always addressed by other users in a productive, compassionate, and educational manner. Ultimately, mis- and disinformation as well as low rates of trust in authority are causal in low rates of vaccination among Russian speakers.

Some of these tendencies coincide with sentiment found in previous research on vaccine hesitancy among other demographic groups. A state of the field paper published in 2013, for example, reports that 5-10% of individuals are against vaccination, while far more are vaccine hesitant. Trust plays an important role in determining whether to vaccinate worldwide, and people tend to discuss trust with relation to "socially remote institutions" like large corporations and governmental institutions. However, the review also reports that previous experiences with health services and previous interactions with family and friends can influence vaccine hesitancy (Dube, et al., 2013). This indicates that vaccine hesitancy is a broader socio-demographic issue that should be addressed and analyzed within the specific contexts of the target demographic. Thus, causes for vaccine hesitancy may vary across cultures. Thus, while the factors and correlates for vaccine hesitancy in the Russian speaking world are important globally, levels of trust, understanding, and other important factors seem to be especially low in this demographic group.

Resources would be best put in three places to target vaccine hesitant Russian speakers. First, efforts to increase trust between the governmental and healthcare authorities would likely increase Russian speakers' willingness to get vaccinated. Users tend to perceive healthcare and governmental figures as corrupt and profit-driven, thus causing them to question key figures' true motives. Reform efforts to curb corruption may be well-received. It may also be worthwhile to recruit the assistance of trusted non-governmental organizations where possible, as these may be perceived as more neutral than governmental organizations may.

Second, Russian-language educational materials informing recipients on how vaccines work, and the testing and approval process of vaccines may also be useful. Focus should be given to stereotypically vulnerable demographic groups, such as children and pregnant people.

Focus should also be given to vaccine ingredients as well as the impacts a vaccine has on the immune system, as these were special concerns uncovered in the dataset. Also common among the vaccine hesitant world-wide are misunderstandings of how vaccines work as well as staunch opposition to mandatory vaccination.

Finally, it may be worthwhile to educate Russian speakers on outreach approaches to the vaccine hesitant. Social media interactions can often be unpleasant and devolve into petty arguing and personal attacks. These kinds of interactions commonly took place between Russian speakers who expressed specific concerns about vaccines and those who were pro-vaccine. Pro-vaccine users often did not address the concerns of the vaccine hesitant in their responses, which is a missed opportunity for conversion. If users were better educated on outreach strategies and conversion tactics, this problem may be mitigated and interactions between pro-vaccine and vaccine hesitant users may become more productive.

This study also presents several avenues for future research. The phenomenon of Soviet nostalgia among pro-public health regulation users merits future exploration. It would also be useful to explore various demographic factors correlation to various vaccine opinions, including age, gender, and location.

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