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COVID-19 communication of the UK government and health institutions on Twitter

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Introduction

The impact of social networks on people's lives is huge, many do not even fully realize the scale of this phenomenon. Social networks have become an integral part of life, especially among young people and influenced the change in the mood and the quality of life (Jevtić & Dajić, 2021). Social media are ideal for quick updating of information for business organisations in crisis, as well as for government institutions. Timothy Coombs refers to Stephen Waddington's quote that "an issue that breaks on a social form of media such as a blog or Twitter can quickly shift and be amplified by more traditional forms of media" (Coombs, 2019, p.95). So government institutions, sharing information online, do it not only for those who read them directly but spread this message to broader masses when the media collects and disseminates it further.

At the moment, social networks are essentially a huge database with digital footprints containing a wide variety of information about hundreds of millions of people around the world, which is also well structured. Twitter for example has 353 million monthly active users worldwide, with the account of the political leader, Barack Obama, being the most popular with the most followers in 2021 (Statista, 2021a). This paper takes Twitter, the 3rd most popular and famous social network in the UK, as the main social media for the analysis (YouGov, 2021).

Definitions

Talking about government representatives in the case study country of this paper – the United Kingdom, it is considered that the Prime Minister and government are responsible for deciding how the country is run and how best to deliver public service such as health service, the police and armed forces, etc. The Prime Minister performs the role of the legislature as well as the role of the executive. Parliament consisting of the House of Commons and the House of Lords being members of the executive office make sure that all citizens' concerns are taken into account.

Health institutions in their term are organizations that carry out activities in the field of health care, support the development of medicine as a science, are engaged in measures to maintain health and provide medical care to people through the study, diagnosis, treatment and possible prevention of diseases and injuries.

Relevance

As in any other communication plan, development, political, or crisis one, it is important to remember as soon as you know who you want to reach "the next step is find the channels and platforms that will reach the desired target audience" (Coombs, 2019, p.140). Talking about other virus outbreaks and the effective use of Twitter, Coombs (2019) brought an example of the Centers for Disease Control and its number of Twitter accounts that went from a few thousand to hundreds of thousands after the news media created awareness of the H1N1 risk. It is easily explained by the fact that social media became a natural source to search for information for example to protect themselves from a crisis risk because uncertainty pushed the audience to seek information (Coombs, 2019). Thus, government institutions only win

when they exploit social media, it reduces uncertainty by presenting instructing information and explaining protective measures.

However, it is important to remember that "social media is best used as a supplemental system for mass notification, not the primary system" (Coombs, 2019, p.100) and not because of the limitation in the number of people who use Twitter but also because of social platforms algorithms: what if it gets some updates and "reduce the effectiveness of the platform as mass notification" (Coombs, 2019, p.101).

Research Questions

In order to understand what statements and messages about COVID-19 and related protective measures governments and health institutions of the UK have communicated on social media, the following research questions were posed:

RQ 1: How frequently do governments and health institutions communicate information about COVID-19 on Twitter according to institutional breakdown?
RQ 2: How has the number of tweets about vaccination changed over the examined period?
RQ 3: Do governments and health institutions support each other in Twitter communications?
RQ 4: Is there a relationship between the number of Tweets and the COVID-19 incidence rate?

Literature review

The literature search by keywords "government" AND "social media" AND "covid" in the database of Web of Science gave 31 results. After initial screening, 14 articles were removed due to irrelevance or non-availability. The remaining 17 articles are divided according to the social media under investigation, and results are demonstrated as follows: Twitter – 5 papers; Weibo – 3; Facebook – 3; Youtube – 1; Instagram – 1; and four papers on the general topic of social media.

Only articles on Twitter and Weibo were taken for the main literature analysis due to appropriateness to the topic of this paper. After a closer look at five papers analysing activity on Twitter, it can be said that not all of them were about solely government communication, but they included the public's preferences for pandemic responses (Genie, 2020) and public concerns toward "prevention strategies applied by the government to instill a sense of responsibility and to increase awareness among people" (Alomari et al., 2021, p. 17). The study featuring government communication spotted "insufficiency, incongruency and inconsistency" (Wang et al., 2021, p.10) across preventative topics such as instructions and orders to stay at home, wear masks, sanitize and disinfect, which were given at different levels not synchronously among U.S states, highlighting spatial disparities (Wang et al., 2021). Besides, there was an underestimation of the outbreak risk at the beginning that followed increasing attention to the crisis over time (Wang et al., 2021). The analysis of tweets shared by the media and the Ecuadorian government accounts showed the incompetence of the government: "neither trying to divert public opinion attention nor remaining silent have sufficed for the government to counteract elements that were exogenous to its logics, i.e., global media, and anonymous people who have witnessed the true reality of the tragic events in Guayaquil" (Luque et al., 2020, p. 62).

Speaking in economic theory language: where there is demand, there will always be supply, but in the reality, when prevention strategies were matters of public concernment (Alomari et al., 2021), the government was incompetent in providing immediate information (Luque et al., 2020; Wang et al., 2021). However, Lu and colleagues' (2020) simulation to illustrate the trade-off governments faced between information disclosing and blocking identified that governments gave priority to the accuracy of disclosed information rather than speed of the disclosure in case of a high-level medical recognition of the virus and a high public health awareness, with the contrary actions in the opposite situation (Lu et al., 2020). Researchers used a model of two main systems: information dissemination system and behavioral response system. They assumed that information was distorted and misrepresented each time it went from individual to neighbors and "the government might intervene in the information dissemination to reduce infections by either disclosing or blocking information" (Lu et al., 2020, p.8). The information intervention could depend on governance capability: a) an unaccountable government - "a blame-evading government would delay the disclosing" (Lu et al., 2020, p.13); b) a risk-averse government intending to minimize the maximum infection rate in uncertain scenarios would prefer a more restrictive blocking; c) government with lower capability and credibility would bring the most restrictive blocking strategy, because "a lower credibility will discount the effects of disclosing information or even annul it" (Lu et al., 2020, p.15).

Methods applied in these five studies on communication on Twitter during COVID-19 included different techniques. Alomari et al. (2021) collected 14 million tweets from the Kingdom of Saudi Arabia with the help of Twitter API within a frame of 4 months. They developed the software as a part of the tool Iktishaf, comprising a collection of unsupervised Latent Dirichlet Allocation (LDA) topic modelling algorithms, used natural language processing (NLP), correlation analysis, and other spatio-temporal information extraction and visualization methods (Alomari et al., 2021).

In the study of Wang and colleagues (2021), once tweets shared by specified accounts in January-April of 2020 were queried by Twitter User Timeline API and filtered by COVID19-relevant keywords, researchers got 13,598 relevant tweets, which they manually annotated with 16 categories; they also applied dynamic network analysis to examine the communication coordination between federal agencies, stakeholders, and the state health agencies (Wang et al., 2021). Another study by Luque et al. (2020) did not use Twitter API for tweets extraction but other tools such as Vicinitas, which allowed them to get an average of 3,200 tweets within a month from each of the users they identified, further analysis was done with MAXQDA software.

For a broader coverage of previous studies, we checked preprints from ArXiv E-Print Repository (2021). Accessed on June 26, 2021, there were 4,396 general results in the pool, manual skim for those connected to the government and Twitter/Weibo resulted in eight articles. Unfortunately, none of the identified unpublished articles studied particularly the government communication on COVID-19 via Twitter. Four papers studied public sentiment on governmental measures and announcements (Chire Saire & Vilca Zuniga, 2020; Cui & Kertesz, 2021; Scott et al., 2021; Wang et. al, 2020). Chire Saire & Vilca Zuniga (2020) analysed what Twitter users were talking about and what was the impact of its usage but the main focus was not COVID-19 itself rather the impeachment of the Peruvian president. Cui and Kertesz

(2021) studied citizens perception of COVID-19 based on the dynamics of the ranks and the durations of COVID-related hashtags on the Weibo Hot Search List, they referred Weibo to Twitter due to their similarities and mentioned that Twitter data can serve as the basis of studying the relationship between public attention and social emotions (Pen et al., 2017, as cited in Cui & Kertesz, 2021).

Three studies on Weibo activity during COVID-19 also did not study exclusively government communication but also public responses and engagement. Liao et al. (2020) analysed 1,028,204 posts on Weibo for one month, based on data extracted utilizing four hashtags via built-in Weibo searching function and screened them using the Python Web Crawler. Researchers identified a dramatic increase in Weibo activity with a substantial increase of daily new confirmed cases. Information that was shared by government agencies from the health sector were more likely about situation updates. Public reactions followed the disease dissemination and government actions but also responded earlier than the government that "evidences the value of infodemiology or infoveillance studies" (Liao et al., 2020, p.8).

Yang et al. (2020) studied government communication on Weibo and citizen engagement with it. Researchers used a python toolkit to crawl related posts for four months, manually checked them and resulted in 3,596 posts connected to COVID-19. Eight main themes were identified: thank the workers; news reports; government measures; scientific guidance; epidemic data release; notice release; encouragement; and dispelling rumors. As a crisis response, messages on tackling a rumor were always essential, additionally, a dialogic loop (the use of hashtag and @function) of the Wuhan local government information release was partially associated with citizen engagement (Yang et al., 2020). Higher media richness (picture, video, web-links) positively correlated with citizen participation. This study highlighted the importance of social media as a key tool in the citizens-government dialogue and pointed to a preference of people toward official information.

The results of Chen et al. (2020) on media richness were opposite to Yang et al. (2020), respectively they suggest that it negatively predicted citizen engagement, but regarding dialogic loop those two papers were unanimous about the increase in citizen engagement through government social media.

Methods

To reach a better understanding of the UK government's role in COVID-19 on Twitter and to answer our inquiries in this regard, we need to parse meaningful data from this social media. In this section, the procedure of collecting, cleaning, and structuring efficient datasets are elaborated.

Table 1 demonstrates the list of packages used during this project in various stages of creating the target datasets. These packages are used in Python 3 programming language and executed on Google Colaboratory.

Table 1. List of packages used during the project

Package Name	Usage
os, sys	Primary packages
Tweepy	Twitter API
Numpy, Pandas	Database management and cleaning
Datetime	Handling date object
Matplotlib	Plotting graphs and illustration of Data

Data Collection

The first step onward creating meaningful and relevant data of the UK government and health departments is to target relevant official accounts. Based on our definitions presented in the introduction, we have manually identified suitable Twitter accounts. The official website of the UK government had been checked to find representatives who fill the positions of departments related to COVID-19 and their social media accounts, Google Search engine had been used to find health organisations working in the country. As a result, we collected 48 influential accounts and extracted their tweets. Our gathered raw database stored more than 72,000 tweets and consisted of five columns (which seemed potentially valuable for answering our inquiries) titled Tweet id, creation date, favorite counts, retweet counts, Tweet text.

Data Filtering

The given raw dataset was developed into various databases to satisfy data requirements of each question.

First, we extracted a dataset with quantities of various hashtags being repeated in the given time span with a threshold on repetitions (Dataset_01). This threshold was devised to be 50 repetitions as it implies that the given hashtag with repetitions below 50 times has an importance of 1% with respect to our first Hashtag (COVID19) seen 5125 times. This dataset was further analyzed and sorted based on relevancy of hashtags and their quantities, which allowed extracting further information based on these tweets and evaluation of several factors important to our research, such as relative ratio of relevant hashtags (Tweets) to irrelevant Tweets and percentage of each relevant hashtag being used in our dataset.
We used this list of relevant hashtags from Dataset_01 to extract COVID-19 related Tweets in our raw dataset. Additionally, as demonstrated in **Table 2**, we used several related keywords to vaccination to extract vaccination data from our primary raw data. Both lists of words are depicted in **Table 2**.

Table 2. List of relevant COVID-19 hashtags and keywords about the vaccination

Relevant hashtags extracted	#COVID19, #coronavirus, #HouseofLords, #Coronavirus, #StayHomeSaveLives, #LordsQs, #KeepWalesSafe, #COVID—19, #StayAlert, #OurNHSPeople, #Covid19, #PMQs, #HelpUsHelpYou, #vaccine, #COVIDVaccine, #ThankYouNHS, #EveryMindMatters, #HereForYou, #COVID, #NHS, #ClinicalResearch, #flu, #BackToSchoolSafely, #TravelSafely, #LetsTalkLoneliness, #CovidVaccine, #HandsFaceSpace, #HowAreYouDoing, #YouAreNotAlone, #EnjoySummerSafely, #covid19, #ResearchVsCovid, #FMQs, #OxfordVaccine, #MentalHealth, #WelshQs, #howareyoudoing, #vaccines, #WorkingSafely, #StayHome, #StayAtHome, #InThisTogether, #PHEHealthMatters, #ICYMI, #StaySafe, #YellowCard, #WeAreScotland, #RECOVERYtrial, #COVID19LessonsLearnt, #SafeOnline, #PriorityCovidResearch, #NHSCOVIDVaccine, #VaccinesWork, #BePartofResearch, #mentalhealth, #PublicHealth, #BuildBackBetter, #WorldMentalHealthDay
Keywords related to vaccinations	vaccine, vaccination, vaccinated, coronavaccine, covidvaccine, immunization, immunisation, immunize, immunise

These lists enabled us to create two separate datasets related to each topic. The prior, Dataset_02, is allocated for vaccination data and includes 6,209 relevant Tweets; the latter, Dataset_03, is for relevant hashtags and contains 11,285 relevant Tweets.

As soon as a set of relevant hashtags was identified, we determined how many tweets about COVID-19 were written from all of our respective government and health institutes accounts. In Dataset_02, each Tweet is sorted based on search keyword, account username, ID, and creation time. This dataset is further used to investigate the percentage and quantities of vaccination per each government or health institution account and also, tweet quantities per month division. In Dataset_03 also, we have collected related tweets based on our defined hashtags.

Dataset_03 is also of value to us for answering the question regarding the support between government and health organizations; thus, we parsed the retweets of tweets in Dataset_03 and cleaned the raw datasets with our constraint on the accounts to be among our specified influential accounts. Twitter developer API has a limitation on the number of retweets being parsed from each tweet per time unit, which impelled us from parsing all the retweets. Therefore, we only parsed the first 100 retweets which is a fair value as only 15.8% of the tweets were retweeted more than 100 times and our search results ended up in Dataset_04 with 1851 tweets being retweeted by a member inside the specified government.

Moreover, to answer our inquiries about the Covid situation in the UK, we have downloaded all Covid statistics from the PHE's dashboard website and extracted the statistics based on variables such as death ratio, active cases, vaccination ratio (GOV.UK, 2021). This information is further combined with our own extracted datasets to give us more valuable insights into a real-life situation.

Dataset Structure

All mentioned datasets are made using the Pandas package DataFrame. In this data structure, the columns are devised for various variables under investigation and each row contains various objects, e.g. numbers, strings, and lists. Pandas DataFrame allows us to implement complex operations on our datasets with less effort. For example, Sortings and Groupings or more complex functions are implemented in our project using this package.

This section aimed at explaining our data collection and cleaning procedure in more detail. Our project resulted in 9 different tables which are further used in answering our questions. The answers and our projection of the data are further shown in the next section.

Results of descriptive analysis

The result of data collection and its filtering can be found online at GitHub repository via the link: https://github.com/ahmadr75/UK_gov_Twitter_Covid_data_analysis . We were able to collect a data set based on all the hashtags, presented in **Table 2**, used by the accounts of the government and health institutes during the time period of the 1st of February, 2020 - 30th of April, 2021. Naturally, taking into account the current situation in the world, the number of hashtags related to the COVID-19 as well as posts about it exceeds other topics by almost 3 times. The graph (see ***Figure* 1**) shows the use of hashtags about COVID-19 and other topics from February 2020 to the end of April 2021, as well as in the diagram ***Figure 2*** using relevant hashtags. The most popular were keywords in the following way of writing: COVID19, and coronavirus with 49% of use, the other part of the charter pie was divided in small shares between different measures against the disease and appreciation of the workers.

In the analyzed posts, relevant hashtags were used 16,784 times, while irrelevant ones, namely hashtags not related to COVID-19, were used 5,970 times. The dependence of the number of tweets with time is shown in the graph ***Figure 3***, which has an increasing tendency from the late March of 2020 until its peak in May 2020, after that daily number of tweets followed a descending path, and started growing again in September of 2020.

Having determined how many tweets about COVID-19 in each government and health institutes account were posted on Twitter, we found out that most of the tweets were from The House of Lords and Public Health England, which are a government agency and health institutes, respectively. Top 5 for the dissemination of information about COVID-19 can be found in the ***Table 3***:

Table 3. Top 5 for the dissemination of information about COVID-19

Twitter username	Full name of the organisation
1. @UKHouseofLords	The House of Lords is the upper house of the Parliament of the United Kingdom
2. @PHE_uk	Public Health England
3. @NHSEngland	The National Health Service
4. @DHSCgovuk	Department of Health & Social Care
5. @NHSResearchScot	NHS Research Scotland

More information is presented on the diagram ***Figure 4*** and the graph **Figure *5***.
Also, as our analysis shows, one of the most important topics related to COVID-19 is vaccination. The graph **Figure *6*** shows the dependence of vaccination posts as a function of time.

We have determined that in all accounts, most of the posts related to vaccination were written from January to March 2021. The number of posts from a certain account, depending on the month, is shown in the graph **Figure *7***, and the total number of posts from all accounts, depending on a certain month, as follows m = 412, s_x= 634, min. score of 22 in March 2020 and max.score of 1361 in January 2021.

As for specific accounts, information about vaccination was mainly received from health institutes, such as the Department of Health & Social Care (@DHSCgovuk) and from The National Health Service (@NHSEngland), more information is provided in the diagram **Figure *8*** and the graph **Figure *9***.

As real-world data, we have collected official data on vaccination, mortality, and cases of COVID-19 from the governmental website, **Figure *10***, **Figure *11***, and **Figure *12***, respectively. Using this data and the data collected about hashtags, we have built a graph **Figure *13*** of the dependence of the number of hashtags and death on time, the data on the number is presented in the form of standardized data with the division of each variable from its maximum for the most visual representation of the data dependence.

In January 2021, mass vaccination began in the UK, just when there was the maximum number of posts about it on Twitter, **Figure *14***. The number of tweets began to grow already in December 2020, when the main vaccines, for example, such as Moderna and AstraZeneca, were approved for use in the vaccination program in the UK. Also in the same month, there was a peak in mortality and new cases of Covid19, as can be seen in the graphs. Data as of April 30, 2021: total cases of infection = 4 417 507; total deaths = 127 564.

Informing people and spreading information about COVID-19 is an important mission to prevent a pandemic. Therefore, in respect to RQ3, we also drew attention to how the government and health institutes support each other in communicating on Twitter. On the graph **Figure *15***, we can see the dependence of retweets of posts on accounts, depending on the month (m = 161, s_x= 194, min. score of 37 in February 2020 and max.score of 392 in January 2021). The biggest number of the retweets can be hypothetically related to the start of mass vaccination in the UK.

The accounts that were retweeted the most, as by the number of tweets **Figure *16***, and by the number of accounts that retweeted **Figure *17***, are the Department of Health & Social Care (@DHSCgovuk) and the Official page for Prime Minister (@10DowningStreet).

Outlook

The information demonstrates that COVID-19 widespread disease has affected the lives of people in 223 countries and demands prevention and other measures taken by the officials in power. During this pandemic, social networks played a big role in spreading information among the population. Various governments and health institutes took advantage of it and used social networks to reduce disinformation and disseminate the necessary information to fight COVID-19, the UK was no exception.

In this project, we aim at analyzing the government's prospect in this pandemic in the UK with parsed data from Twitter which is widely being used among people of the UK and includes verified governmental and health organization accounts. However, our study has limitations. First, method's limitations lay in a small number of government and health institutions' Twitter accounts; a threshold of 50 times repetition; way of parsing retweets only of specific accounts and specific hashtags. Second, API limitations were mentioned in the methods section, like extracting 100 retweets only and excluding self-retweets.

We have clearly illustrated various graphs to show the evolving trend of COVID-19 related tweets, real-world comparison with our findings, and vaccination-related tweets, so the situation in social networks reflected the real agenda. Our studies show that the government is actively using this social platform to communicate with the people as the depicted results show threefold content about COVID-related topics in comparison with the irrelevant topics. Furthermore, the quantities of the retweets to support this subject among the UK government and health departments culminated in January 2021, which is the time span in which the vaccination in the UK began.

The results of our project show the potential of social media in health-related issues and how direct and indirect communication of governments via social media (in our case Twitter) can give them more control over such issues. In the future, more issues related to COVID-19 prevention and control can be taken into account, which based on the project's timeline we were not able to, such as more detailed scrutiny on traffic rules about COVID, the geographical distribution of the tweets and COVID cases, and people's prospective analysis for the target community. It would be also useful to conduct further studies with a wider sample of data and an elaborated analysis in order to confirm our early observation and calculate the partial

distance correlation between COVID-19 Twitter activity and the number of confirmed cases. COVID-19 pandemic is considered one of the most important topics in 2020-2021 years but within the scope of this paper we focused only on official accounts of government and health institutions, so in order to get a full picture, future empirical research could analyse the public perception and behavioural impacts to assess the effectiveness of the official communication. This will help to better evaluate and study social networks as a source of information, to what extent they reflect the real state of affairs in the world.

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Appendix

Supplementary data to this paper can be found online at https://github.com/ahmadr75/UK_gov_Twitter_Covid_data_analysis

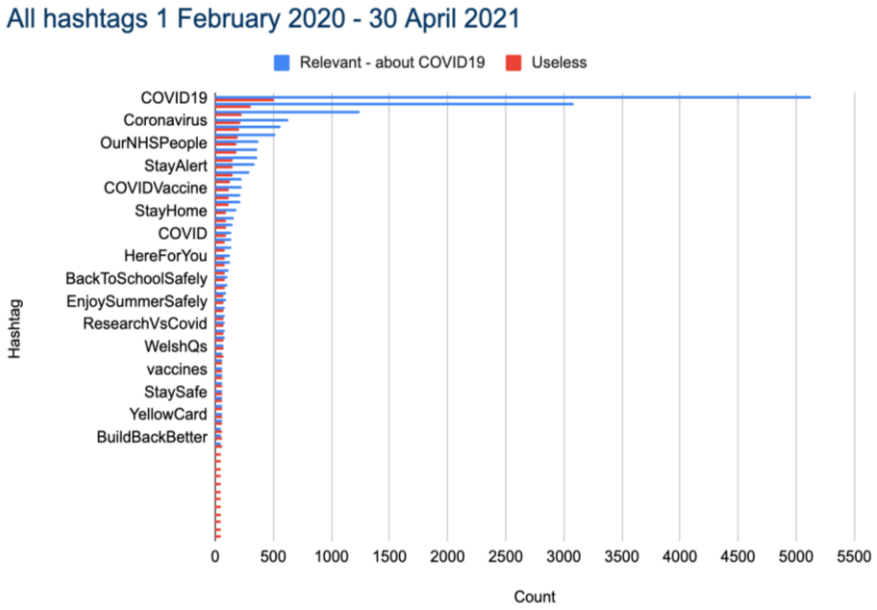

Figure *1.* All hashtags 1 February 2020 - 30 April 2021

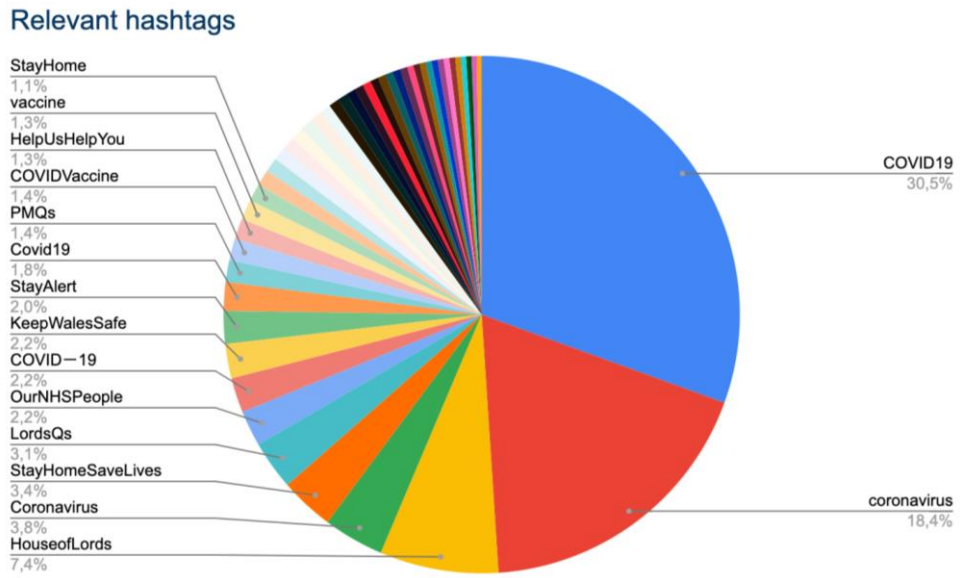

Figure 2. *Relevant hashtags*

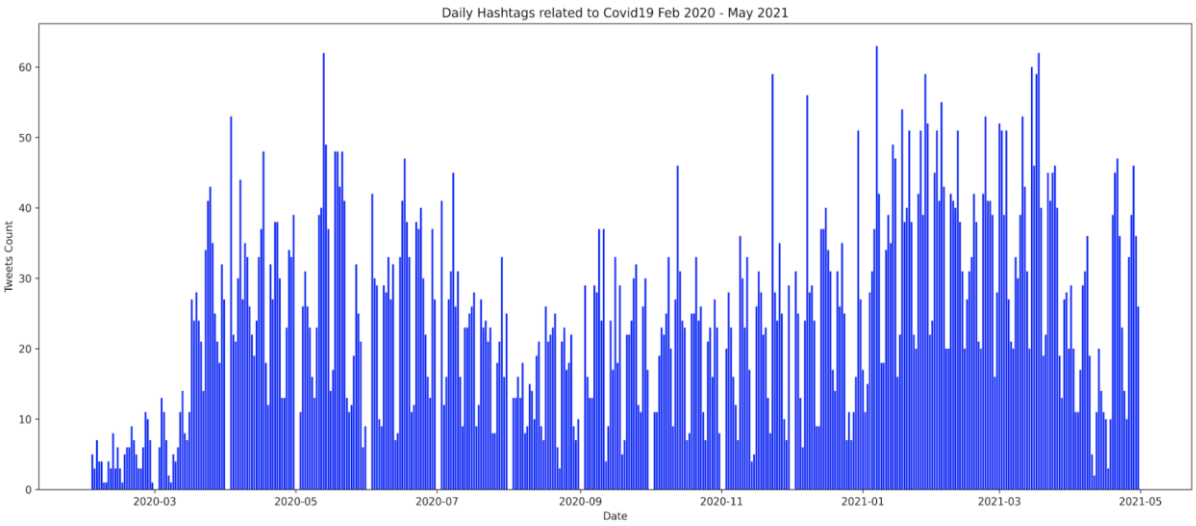

Figure 3. Daily Hashtags related to Covid19 February 2020 - May 2021

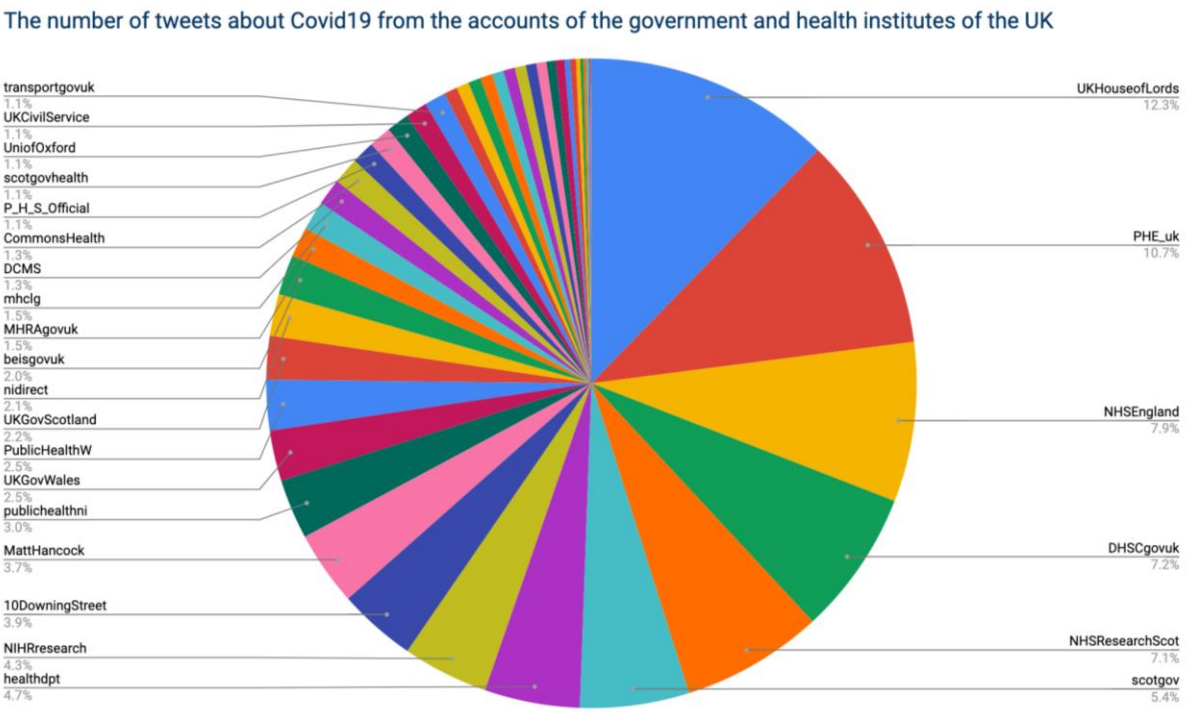

Figure 4. The number of tweets about Covid19 from the accounts of the government and health institutes of the UK

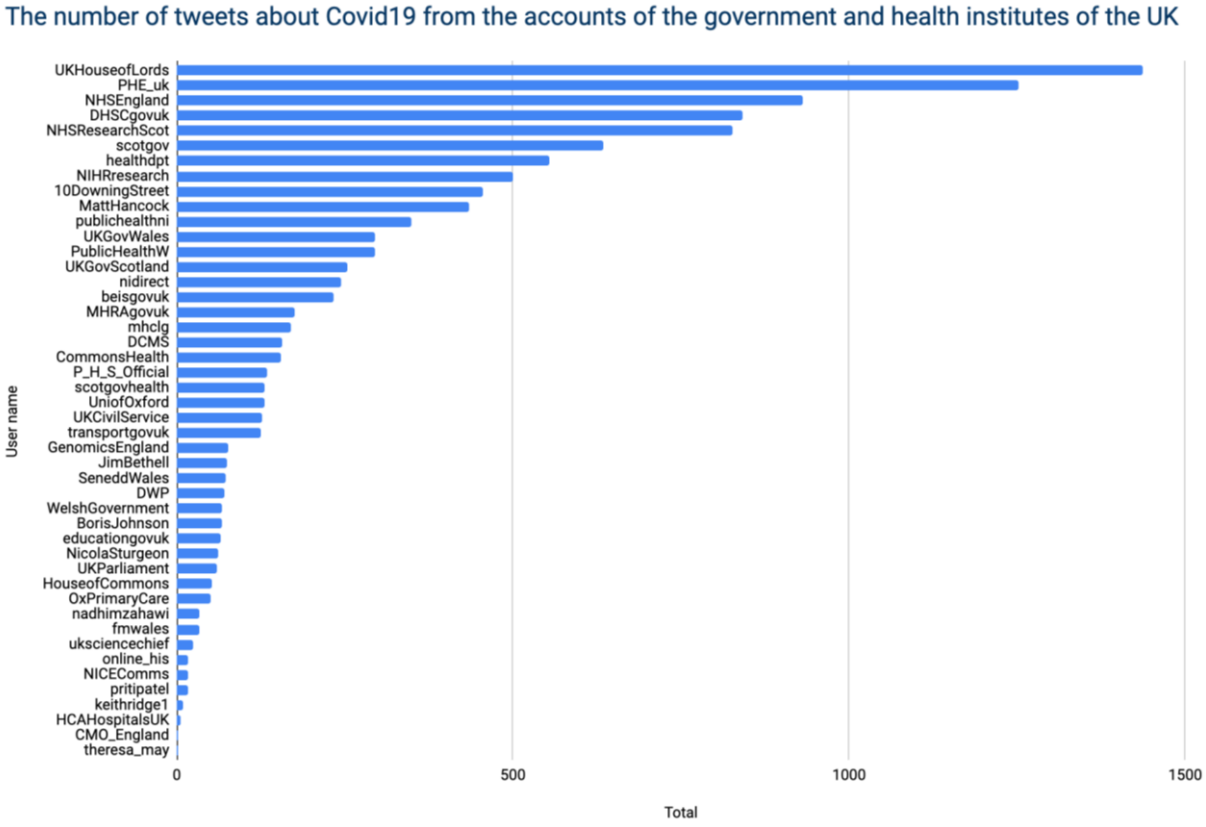

Figure 5. The number of tweets about Covid19 from the accounts of the government and health institutes of the UK

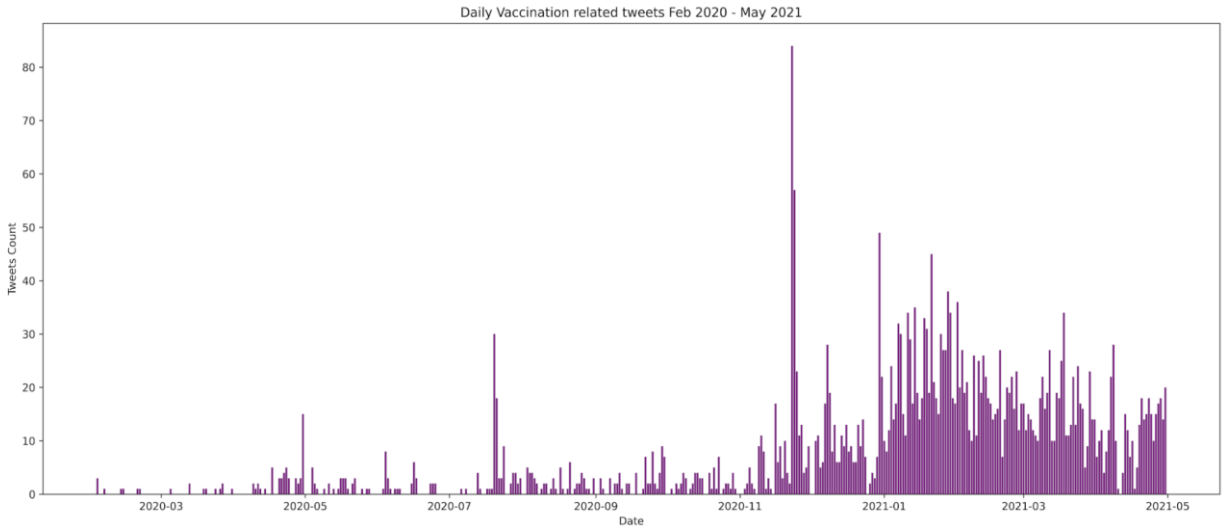

Figure 6. Daily Vaccination related tweets February 2020 - May 2021

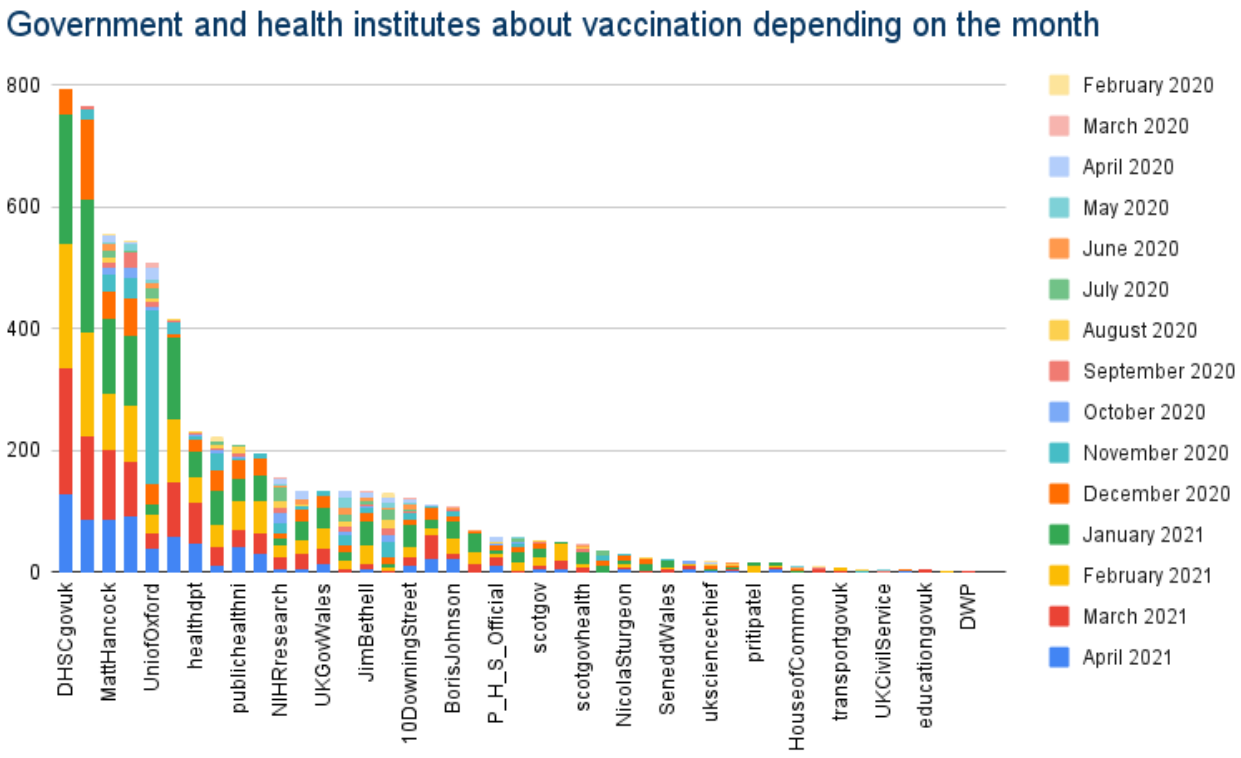

Figure 7. Government and health institutes about vaccination depending on the month

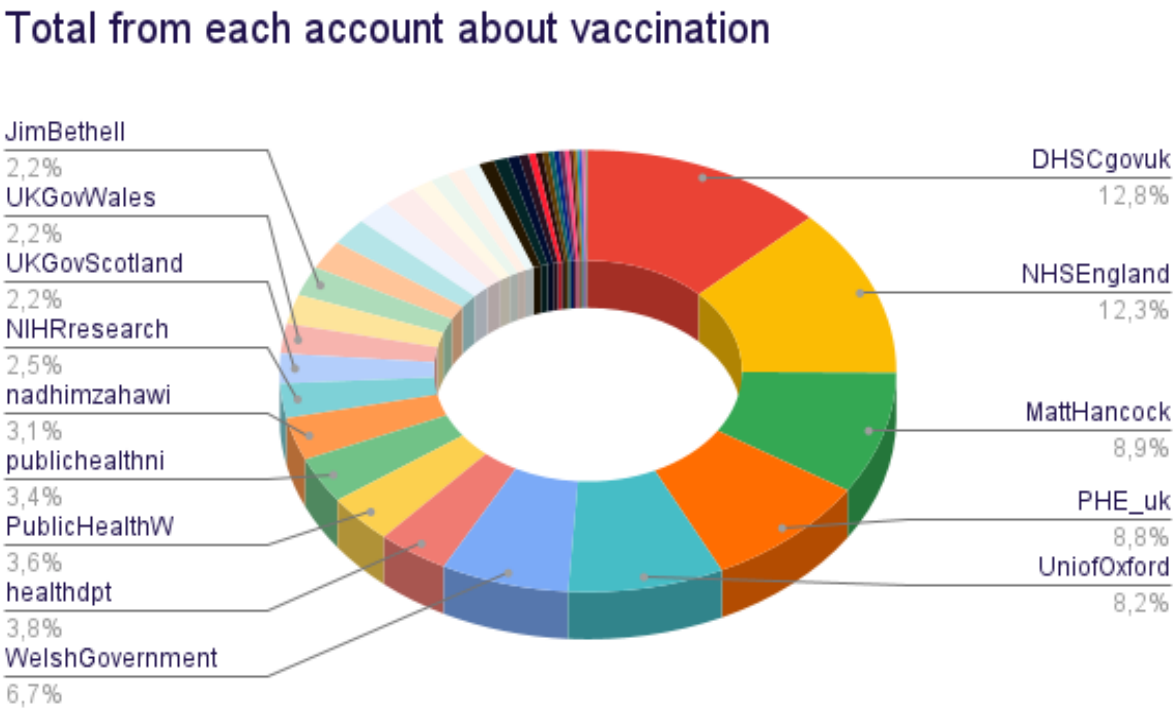

Figure 8. Total from each account about vaccination

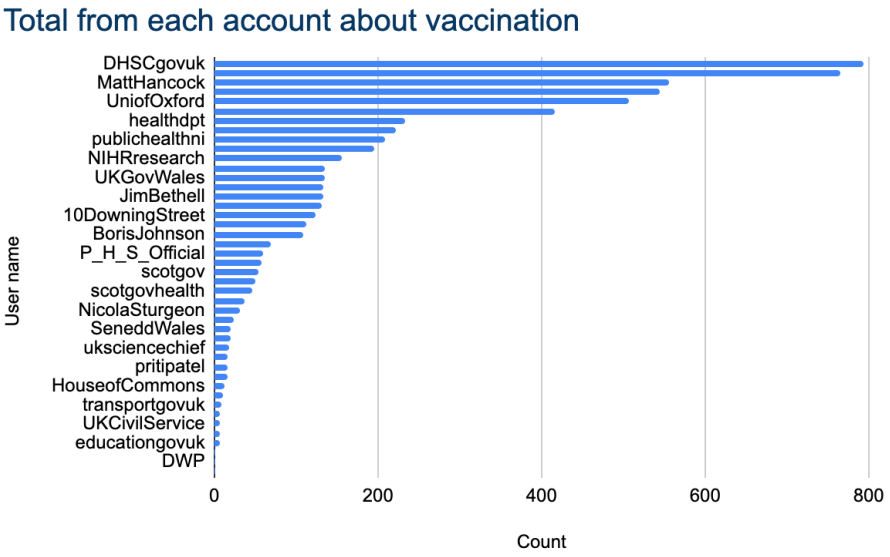

Figure 9. Total from each account about vaccination

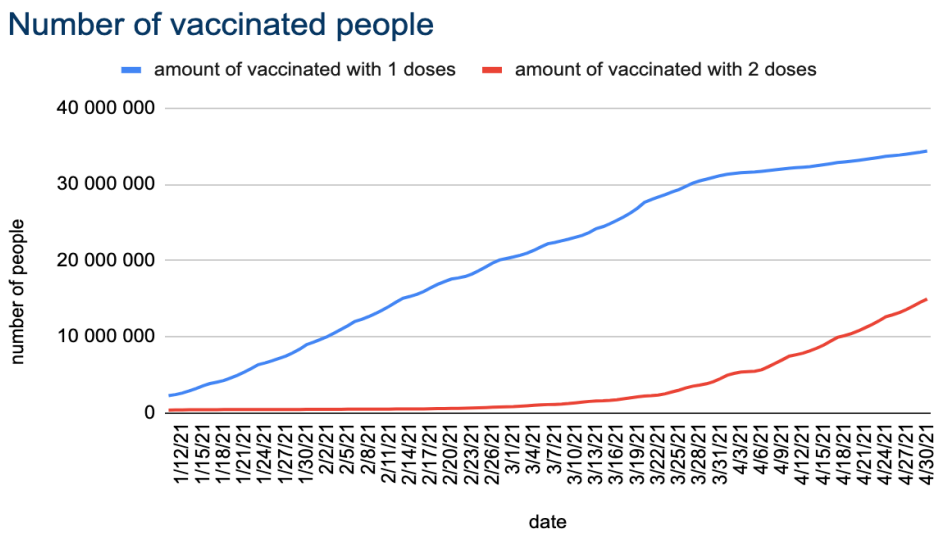

Figure 10. Number of vaccinated people

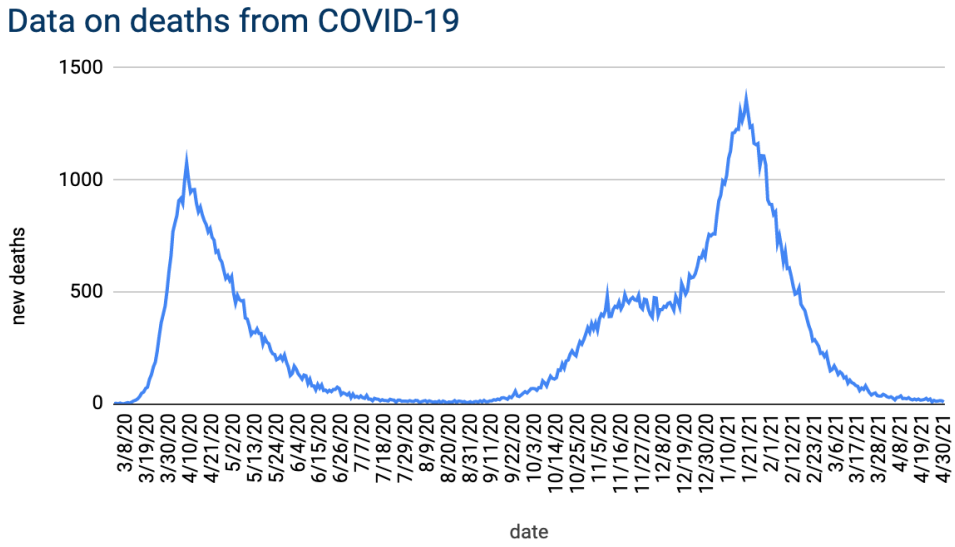

Figure 11. Data on deaths from Covid19

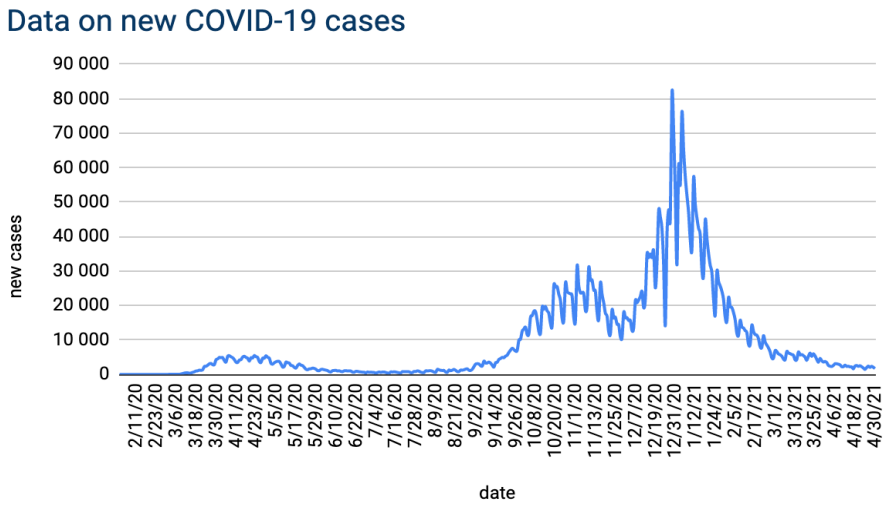

Figure 12. Data on new Covid19 cases

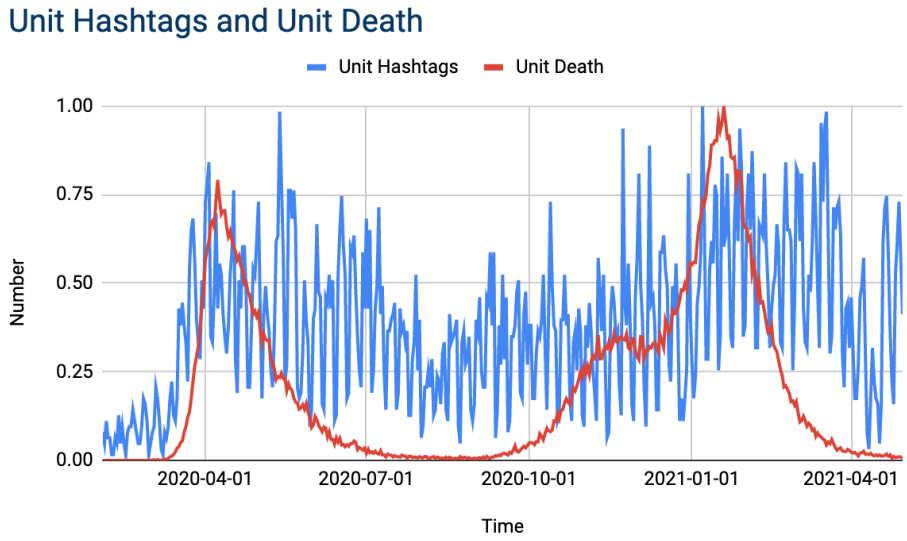

Figure 13. The dependence of the number of hashtags and death on time

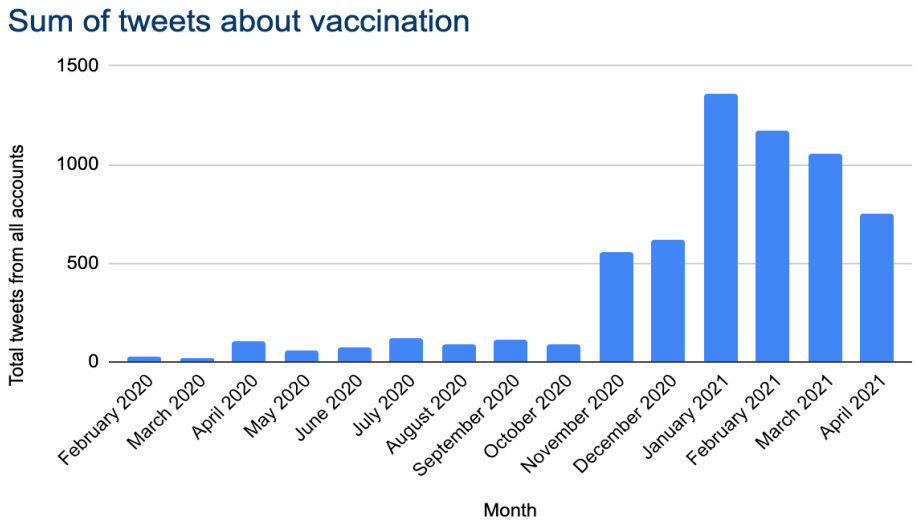

Figure 14. Sum of tweets about vaccination

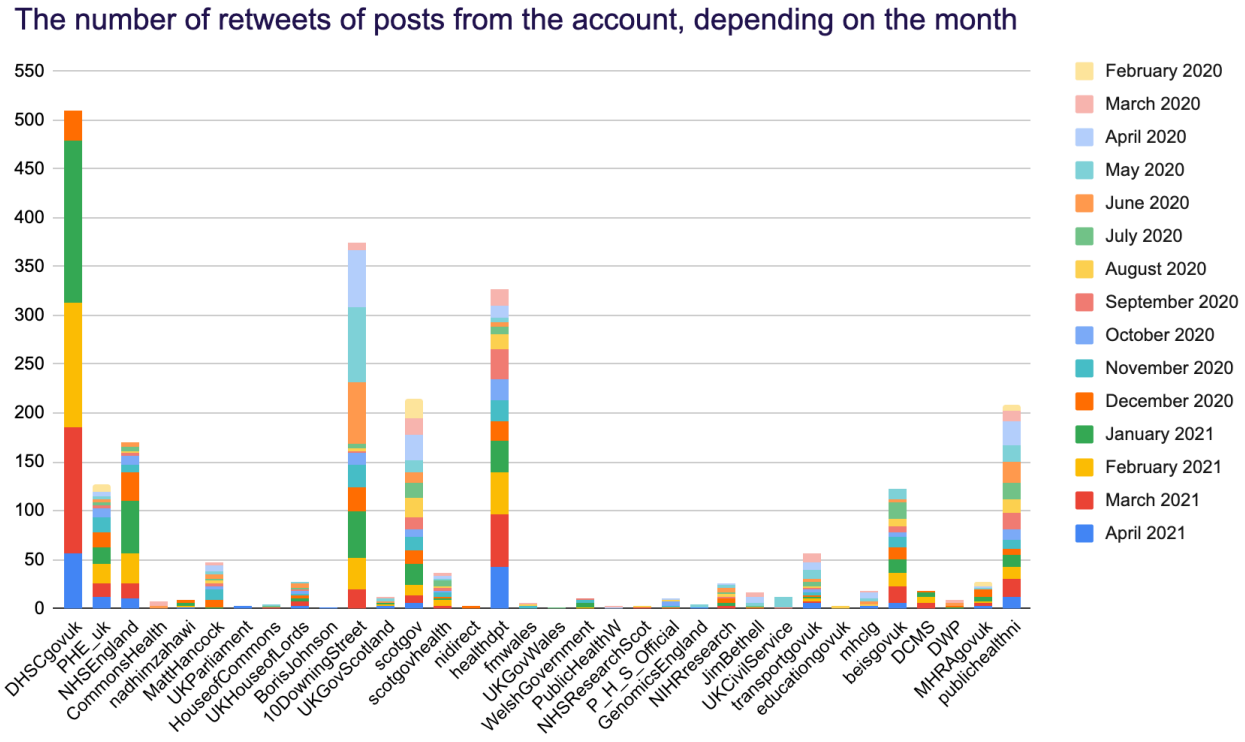

Figure 15. The number of retweets of posts from the account, depending of the month

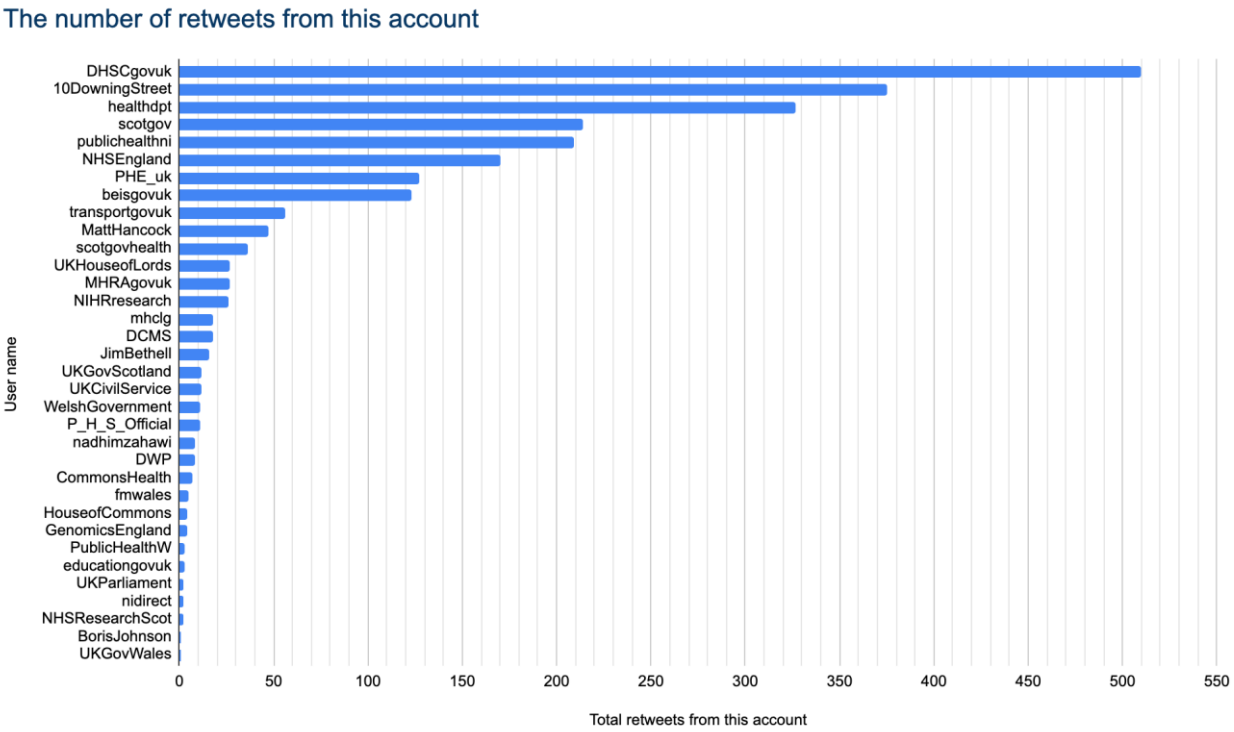

Figure 16. The number of retweets from this account

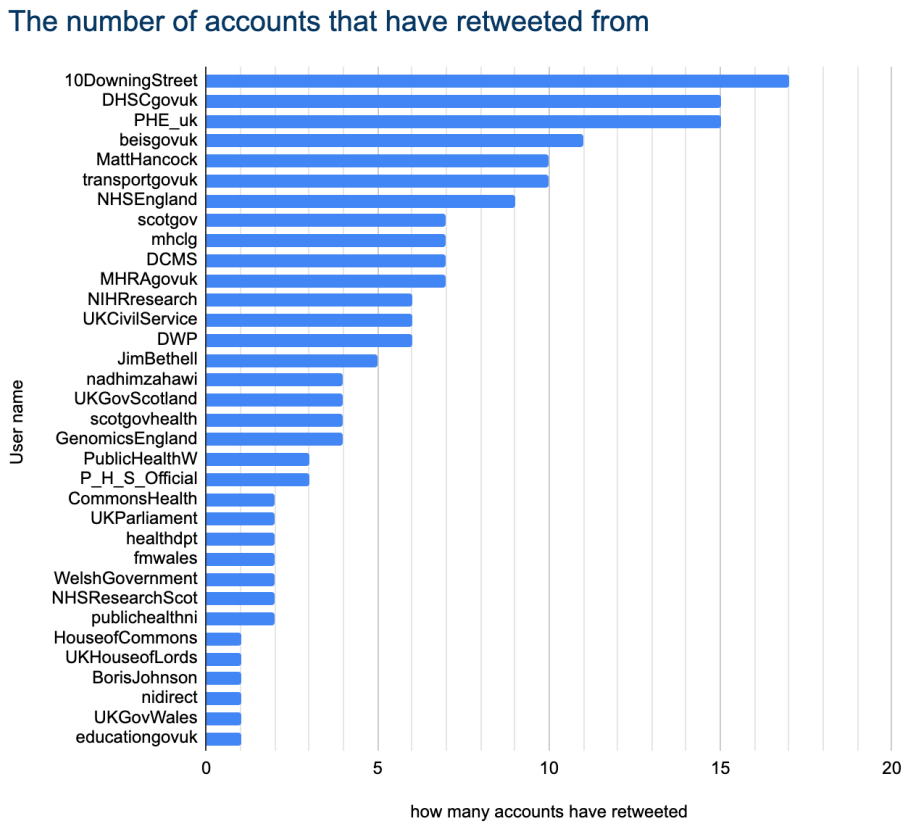

Figure 17. The number of accounts that have retweeted from