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Short Communication

Antibiotics on the rise: Google trends as a monitoring tool in India

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ABSTRACT

Coronavirus disease 2019 (COVID-19) pandemic has put enormous strains on health care and public sector resources globally, especially in low- and middle-income countries. The extensive and often inept use of antibiotics during the pandemic is suspected. Data from Google trends (GT) enables the assessment of Google users' interest in a specific topic. A strong correlation between active COVID-19 cases and GT search terms of antibiotics (r=0.90) azithromycin (r=0.96) and doxycycline (r=0.93) were noticed with $p<0.05$. However, hydroxychloroquine (r=0.21) was not significant. Further investigation is needed to determine GT as a possible adjunctive monitoring tool for antibiotic use and formulate drug resistance patterns in India.

Keywords: Google trends, Antibiotics, Antibiotic resistance, Azithromycin, COVID-19, Hydroxychloroquine

INTRODUCTION

Coronavirus disease 2019 (COVID-19) has laid immense burdens on health care and public sector resources globally. Similarly, antibiotic use associated with COVID-19 is increasingly reported.[1,2] India is the largest consumer of antibiotics worldwide and with over 30 million cases of COVID-19 as of July 2021, the concern for random use of antibiotics during the pandemic is augmenting.[1] Reports on indiscriminate antibiotics use and growing antibiotic resistance have already emerged in the literature. Azithromycin (AZM) and hydroxychloroquine (HCQ) are of particular interest even though several safety concerns have been raised.[3-7] HCQ and AZM have been recommended by Indian Ministry Health and Family Welfare (MoHFW) during the pandemic when evidence was scarce regarding any effective agents. These drugs also gained worldwide attention because of the debating use in the pandemic. A recent study that analyzed the sales of antibiotics has also seen a significant rise in sales of HCQ, AZM and doxycycline (DYX) during the pandemic correlating to their usage in the general population.[7]

METHODS

Google trends (GT) software provides data on the relative search volumes (RSV) of search terms/topics searched over time and across geographical areas in Google, the most popular search engine globally. It supports the assessment of trends for any specific query from 2004 to the present. Data gathered is normalized to the time and location then scaled to a range of 0 to 100 in proportion to all searches, with higher values indicating increased interest. GT represents the public interest and popularity of any search query at any specific time frame or location with a numerical and graphical representation of the data. We think that Google data may show the variations in global interest in the search terms related to antibiotics. We aim to present the search trends of antibiotics during the COVID-19 pandemic in India.

Also, we evaluate the role of GT as an identifying and monitoring tool for antibiotic use and resistance by comparing with evidence on antibiotic sales data during the first wave of COVID-19 in India, as Sulis et al reported.[7]

We examined GT data for RSV of the following terms' antibiotics,' 'azithromycin,' 'hydroxychloroquine,' and 'doxycycline' in India from the emergence of the first COVID-19 cases from 01 March 2020 to the present, 12 July 2021. Although the first case of COVID-19 was diagnosed in January 2020, cases were not closely followed and reported until March 2020. Descriptive analyses were done for the data during the observation period. Pearson's correlation coefficient (r) was computed for correlation between RSV of a specific search term and active COVID-19 cases in India using Microsoft excel during the examined period. A p value of less than 0.05 is considered statistically significant. Time trend and scatter plots were constructed to assess the relationship between Google search trends of antibiotics and COVID-19 cases in India.

RESULTS

Data shows that overall interest in antibiotics had a mean of 12.12±1.90 with April and May 2021 with the highest rates. A much higher interest was recorded for the specific antibiotics' AZM, HCQ, and DYX. AZM had a mean of 20.12±14.43; HCQ 13.59±24.32 and DYX 8.18±9.68 (Table 1). Out of all the search terms, AZM had the highest RSV. Sales of AZM are also noted to increase compared to the other antibiotics significantly.[7]

Table 1: Summary of data from Google trends.

Topic	Mean RSV From Jan 2020 to July 2021	Months with the highest RSV	Month with the lowest RSV	Subregions with highest interest	Subregions with lowest interest
Antibiotic	12.12±1.90	May and April 2021	May 2020 and Jan 2021	Tripura	Rajasthan
Azithromycin	20.12±14.43	May and April 2021	May 2020 and Jan 2021	Andhra Pradesh	Meghalaya
Hydroxychlo-roquine	13.59±24.32	April 2020	Dec 2020, Jan-Mar 2021	Puducherry	Arunachal Pradesh
Doxycycline	8.18±9.68	May and April 2021	April 2020	Sikkim	Kerala

RSV – relative search volume.

In our analysis, there is a strong correlation between COVID-19 cases and GT search terms of antibiotics (r=0.90) AZM (r=0.96) and DYX (r=0.93). All correlations were statistically significant ($p<0.05$). However, HCQ (r=0.21) was shown to have a very weak positive correlation which was not significant. The time trend graphs for the two data sets are shown in Figure 1. All antibiotics showed a relative increase in RSV for April and May 2021. Throughout the observation period, we see that RSV for antibiotics begins to increase during March 2020, July 2020, and March 2021.

DISCUSSION

On 11 March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic and urged countries to take immediate action.[8] Although we observe a modest increase in RSV for AZM and DYX, interest in HCQ had a dramatic rise, eventually reaching a maximum RSV of 100 in April 2020. This is also reflected in the results of Sulis et al where they reported HCQ sales peak in March 2020, most likely due to its use as a prophylactic for COVID-19 as per the recommended guidelines by the Indian Ministry of Health and Family Welfare (MoHFW) early in the COVID-19 pandemic.[7,9]

By the end of March 2020, the Indian government announced a lockdown that would last until May 2020. GT data show that interest in AZM, HCQ and DYX were also low during this period. According to Sulis et al antibiotic sales declined in April and May 2020.[7] The communities' interest probably shifted to more fundamental issues such as unemployment and food shortage, supported by the results in several other studies that show an increased RSV for these terms globally.[10,11]

The MoHFW issued guidelines for re-opening religious places, restaurants, shopping malls, offices, and other

public areas in June 2020 [12]. Alongside the increasing number of COVID-19 cases, the ability of individuals to leave their homes and seek medical care may explain the increased interest in antibiotics' AZM and DYX. The trend of HCQ returned to baseline after 27 June 2020 as the national guidelines were modified, limiting its use only in moderate to severe cases of COVID-19 or immunocompromised.[7,9] Sulis et al also report a similar pattern during this period for antibiotic sales.[7] Although the exact data was not available, we can postulate a correlation between GT search interest and antibiotic sales, given the parallel increase and decrease of the two data sets.

The GT search trends for antibiotics, AZM, and DYX remained relatively stable until RSV peaks in March 2021, most likely due to the second wave of COVID-19 infection that had more devastating effects. The high infectivity of the new COVID-19 variant and the lack of hospital beds, oxygen supplies and scarcity of healthcare facilities and resources prompted health care individuals to provide home-based management to those affected.[13] Hence, this includes the interest in antibiotics to mitigate the symptoms of the disease and use them empirically in a wide range of cases.

Prescriptions of antimicrobials are higher in India compared to other countries thus antibiotic resistance has long been a healthcare issue in India.[14] With the emergence of the COVID-19 pandemic and increased antibiotic misuse, antibiotic resistance poses a greater threat than ever, leading to more difficulty treating illnesses with complicated clinical management. The recent emergence of azithromycin-resistant *Salmonella typhi* in Northern India reflects an overuse of azithromycin. Similar azithromycin-resistance isolates have been reported recently in neighboring countries, Pakistan, Bangladesh, and Nepal, showing a similar predicament of antibiotic misuse in the developing nations.[15]

Also, India has reported a syndemic of mucormycosis infections amid the COVID-19 pandemic, with over 40,000 cases reported as of 28 June 2021.[16] Overuse of antibiotics is one of the possible contributing factors for the alarming rise of mucormycosis infections in India.[17]

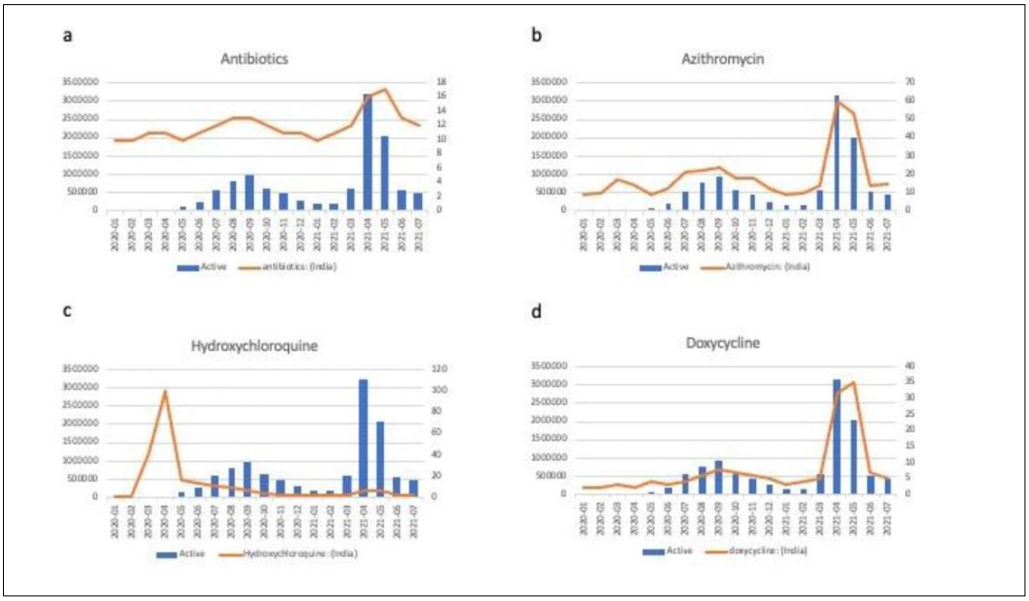

Figure 1: Overlay of number of COVID-19 cases per month with Google search trends data of a) antibiotics b) azithromycin c) hydroxy choloroquine and d) doxycycline.

CONCLUSION

GT is a modestly reliable tool to predict disease outbreaks.[18-20] Our report proposes that internet-based surveillance can predict antibiotic overuse in the population and support the need for antibiotic stewardship. GT data can be acquired in real-time, proving beneficial in initiating a rapid response to potentially harmful events than other traditional and time-consuming data collection methods. Considering the positive correlations between GT and COVID-19 cases, along with the findings from Sulis et al there is a possibility to use the GT data as an adjunctive monitoring tool for antibiotic use and formulate drug resistance patterns in sub-regions of India. However, it is essential to take these findings with caution since GT data can primarily be driven by environmental circumstances such as the news. Since correlation is not equal to causation, we cannot accurately determine whether the increase in the search for antibiotics is due to an individual's need or simply curiosity. Therefore, further investigation is needed to determine the use of GT data as a monitoring tool for antibiotic use.

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