

Original Article

Acute Coronary Syndrome During the Era of COVID-19: Perspective and Implications Using Google Trends

Juan A. Quintero-Martinez, MD,^a Joaquin Espinoza, MD,^a Diego Celli, MD,^b Carlos Vergara-Sanchez, MD,^c Jonathan Salter, MD,^a William Aitken, MD,^d Igor Palacios, MD,^e Mauricio G. Cohen, MD,^f Pablo Rengifo-Moreno, MD,^a Eduardo de Marchena, MD,^d Rosario Colombo, MD,^d Carlos E. Alfonso, MD,^d and George R. Marzouka, MD^{d,g}

^aDepartment of Internal Medicine, University of Miami Miller School of Medicine/Jackson Memorial Hospital, Miami, Florida, USA

^bDepartment of Cardiovascular Diseases, The Texas Heart Institute, Houston, Texas, USA

^cDepartment of Cardiovascular Diseases, Mayo Clinic, Jacksonville, Florida, USA

^dDepartment of Medicine, Department of Cardiovascular Diseases, University of Miami/Jackson Memorial Hospital, Miami, Florida, USA

^eDepartment of Cardiovascular Diseases, Massachusetts General Hospital, Boston, Massachusetts, USA

^fHeart, Thoracic and Vascular Institute, Cleveland Clinic Florida, Weston, Florida, USA

^gCardiology Section, Miami Department of Veterans Affairs, Miami, Florida, USA

ABSTRACT

Background: Acute coronary syndrome (ACS) hospital admissions decreased during the start of the COVID-19 outbreak. Information is limited on how Google searches were related to patients' behaviour during this time.

Methods: We examined de-identified data from 2019 through 2020 regarding the following monthly items: (i) admissions for ACS from the Veterans Affairs Healthcare System; (ii) out-of-hospital cardiac arrest (OHCA) from the National Emergency Medical Services Information System (NEMSIS) public dataset; and (iii) Google searches for “chest

RÉSUMÉ

Contexte : Les admissions à l'hôpital pour un syndrome coronarien aigu (SCA) ont diminué au début de la pandémie de COVID-19. Or, il existe peu de données sur les recherches effectuées par les patients dans Google pendant cette période.

Méthodologie : Nous avons examiné des données mensuelles dépersonnalisées de 2019 à 2020 sur les éléments suivants : i) admissions pour un SCA dans le système de santé de Veterans Affairs aux États-Unis; ii) arrêts cardiaques extrahospitaliers (ACEH) de l'ensemble de données publiques du *National Emergency Medical Services Information*

In late 2019, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) emerged from Wuhan, China, quickly spreading around the globe, giving rise to the first worldwide health crisis of this century —the COVID-19 pandemic. Up until December 2020, the US had reported the most severe outbreak of COVID-19 in the world, with more than 19 million people infected and over 300,000 deaths as a consequence of the novel virus.^{1,2}

Due to the rapidly increasing numbers of COVID-19 patients, authorities implemented social distancing and

masking regulations to help curb the spread of the virus.³ Meanwhile, hospital systems reallocated their resources to cope with the ongoing public health crisis. Yet, despite the extensive efforts made by the medical community to provide contingency plans ensuring the safety of healthcare workers and patients, a growing body of evidence suggests that a significant decrease occurred in the number of acute care visits to the emergency department during the most critical months of the pandemic. This phenomenon has been associated with the population's increasing fear of getting infected with COVID-19. Consequently, a willing delay of care was witnessed even in life-threatening conditions, such as acute coronary syndrome (ACS), leading to increased morbidity and mortality.⁴⁻⁹

Using Google's search engine data analysis tool Google Trends, we sought to investigate whether the general public was consulting the Internet for medical advice during the early stages of the COVID-19 pandemic. By employing the

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Corresponding author: Dr George R. Marzouka, Bruce W. Carter VAMC 111, 1201 NW 16th Street, Miami, Florida 33125, USA. Tel.: +1-305-575-3160.

E-mail: gmarzouka@med.miami.edu

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pain,” “coronavirus,” “chest pressure,” and “hospital safe” from Google Trends. We analyzed the trends for ACS admissions, OHCA, and Google searches.

Results: During the early months of the first COVID-19 outbreak, the following occurred: (i) Veterans Affairs data showed a significant reduction in ACS admissions at a national and regional (Florida) level; (ii) the NEMSIS database showed a marked increase in OHCA at a national level; and (iii) Google Trends showed a significant increase in the before-mentioned Google searches at a national and regional level.

Conclusions: ACS hospital admissions decreased during the beginning of the pandemic, likely owing to delayed healthcare utilization secondary to patients fear of acquiring a COVID-19 infection. Concomitantly, the volume of Google searches for hospital safety and ACS symptoms increased, along with OHCA events, during the same time. Our results suggest that Google Trends may be a useful tool to predict patients' behaviour and increase preparedness for future events, but statistical strategies to establish association are needed.

platform's real-time analytics, we aimed to detect whether a relationship existed between the increase in Google searches for medical advice and the observed changes in ACS admissions and out-of-hospital cardiac arrests over the same time during the pandemic, using 3 different hospital databases.

Methods

Using Google Trends, we conducted a query to investigate the extent to which people were consulting the Internet for advice related to symptoms and hospital safety during different periods of the pandemic. We analyzed how often specific search terms were entered into Google, and compared them to the total search volume in specific areas and at specific time points, using the “relative search volume” (RSV). This ratio shows how many searches have been done for a particular term, relative to the total number of searches on Google, and it is constantly readjusted as the circumstances change. For our analysis, we looked for the RSV for “coronavirus,” “chest pain,” “chest pressure,” and “hospital safety.”

To establish a relationship between ACS admissions and COVID-19 incidence, we used data collected from the Center for Systems Science and Engineering (CSSE) interactive dashboard at Johns Hopkins University (Baltimore, MD). Then, we employed the diagnostic classification standard billing codes, the International Classification of Diseases, 10th revision (ICD-10), to examine de-identified data about the monthly admissions for chest pain, unstable angina, non-ST-segment-elevation myocardial infarction (NSTEMI), and ST-segment-elevation myocardial infarction (STEMI) among adult patients in the Veterans Affairs Healthcare System from January 2019 through September 2020 ($n = 75,552$). The endpoints were the following:

System (NEMSIS); et iii) les recherches dans Google selon Google Trends pour « chest pain » (douleur thoracique), « coronavirus », « chest pressure » (oppression thoracique) et « hospital safe » (sécurité dans les hôpitaux). Nous avons également analysé les tendances relatives aux admissions pour un SCA, aux ACEH et aux recherches dans Google.

Résultats : Pour les premiers mois de la première vague de COVID-19, les observations sont les suivantes : i) les données de Veterans Affairs ont montré une réduction significative des admissions pour un SCA à l'échelle nationale et régionale (Floride); ii) la base de données du NEMSIS a montré une augmentation marquée des ACEH à l'échelle nationale; et iii) les tendances observées au moyen de Google Trends indiquent une augmentation significative à l'échelle nationale et régionale des recherches dans Google à l'aide des termes mentionnés précédemment.

Conclusions : Les admissions à l'hôpital pour un SCA ont diminué au début de la pandémie, probablement en raison de la crainte des patients de contracter la COVID-19, qui les a amenés à repousser le recours à des soins de santé. Pendant la même période, le volume des recherches dans Google à propos de la sécurité dans les hôpitaux et les symptômes de SCA a augmenté, tout comme le nombre d'ACEH. Nos résultats semblent indiquer que Google Trends pourrait être un outil pratique pour prédire les comportements des patients et mieux se préparer aux événements futurs, mais il convient d'élaborer des stratégies statistiques permettant de mieux caractériser ces liens.

1. Patients admitted with a primary diagnosis of chest pain.
2. A composite endpoint of ischemic heart disease constituted by unstable angina, NSTEMI, and STEMI.

We also obtained data from a private hospital located in Tallahassee, Florida, for in-house referrals to the cardiac laboratory. Additionally, we used the 2018-2020 National Emergency Medical Services Information System (NEMSIS) public research dataset to identify out-of-hospital cardiac arrests by emergency medical services. We specifically examined reports of cardiac arrest, cardiac arrest resuscitation, and defibrillation performance.

Results

Our analysis on Google Trends concluded that a significant increase occurred in the number of searches for the terms “coronavirus,” “chest pain,” “chest pressure,” and “hospital safe,” which began in early March 2020 (Fig. 1). These increased RSVs were quantified as all-time highs, compared to the previous 5 years, and this increase was concurrent with the COVID-19 outbreak (Fig. 2), returning to normal levels by the end of the month.

After quantifying and comparing the number of cardiac-related hospitalizations at the Veterans Affairs Healthcare System before and after the COVID-19 outbreak (March 1, 2020), we observed a substantial decrease in admissions for cardiac-related issues at the national, regional, and local levels following the outbreak (Table 1; Fig. 3). This trend appeared to recover at all levels after May 2020. Similarly, we noted a decrease in in-hospital referrals for elective or urgent cardiac angiographies after March 1st at Tallahassee Memorial Hospital (Fig. 4). As cardiac-related hospitalizations and referrals decreased, Google searches for the terms “coronavirus,” “chest pain,” and “chest pressure,” in the same geographic zone

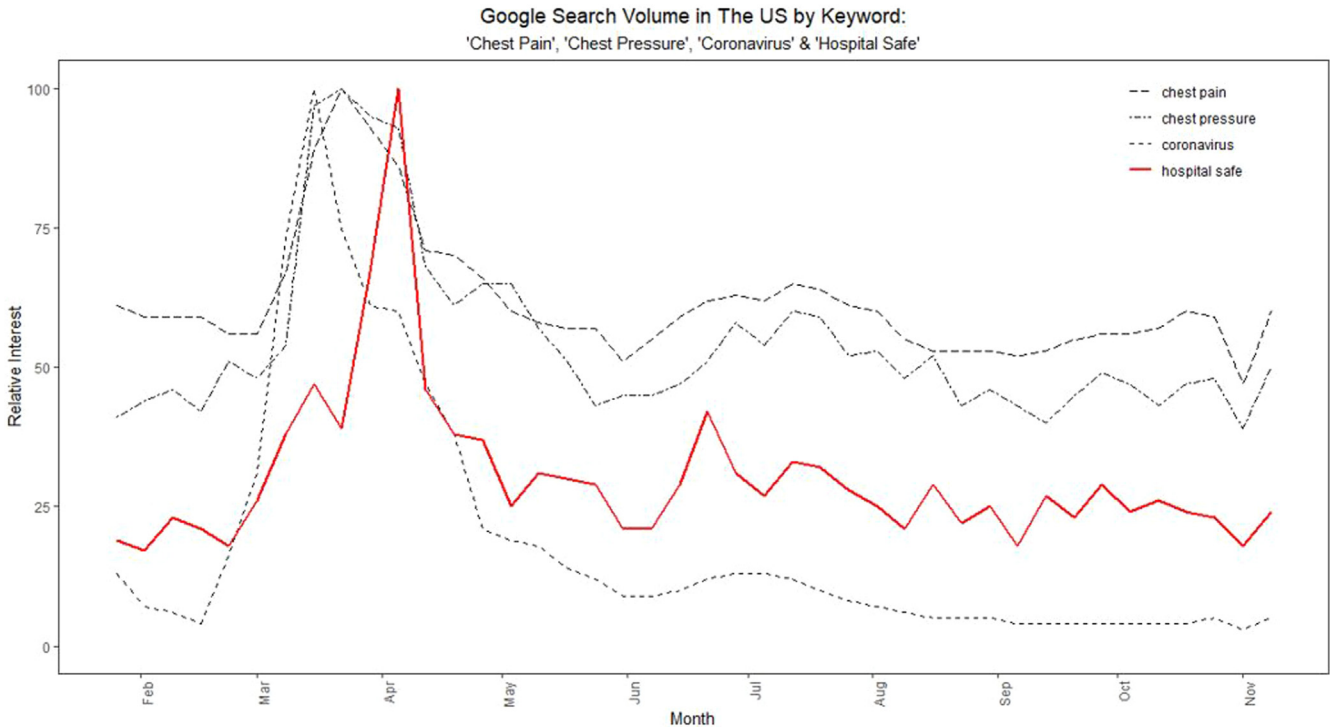


Figure 1. Histogram represents a significant increase in the Google Trends relative search volume for the term “hospital safe,” starting in March, with a peak in late April 2020, in relation to the relative search volumes for “chest pain,” “chest pressure,” and “coronavirus” in the US.

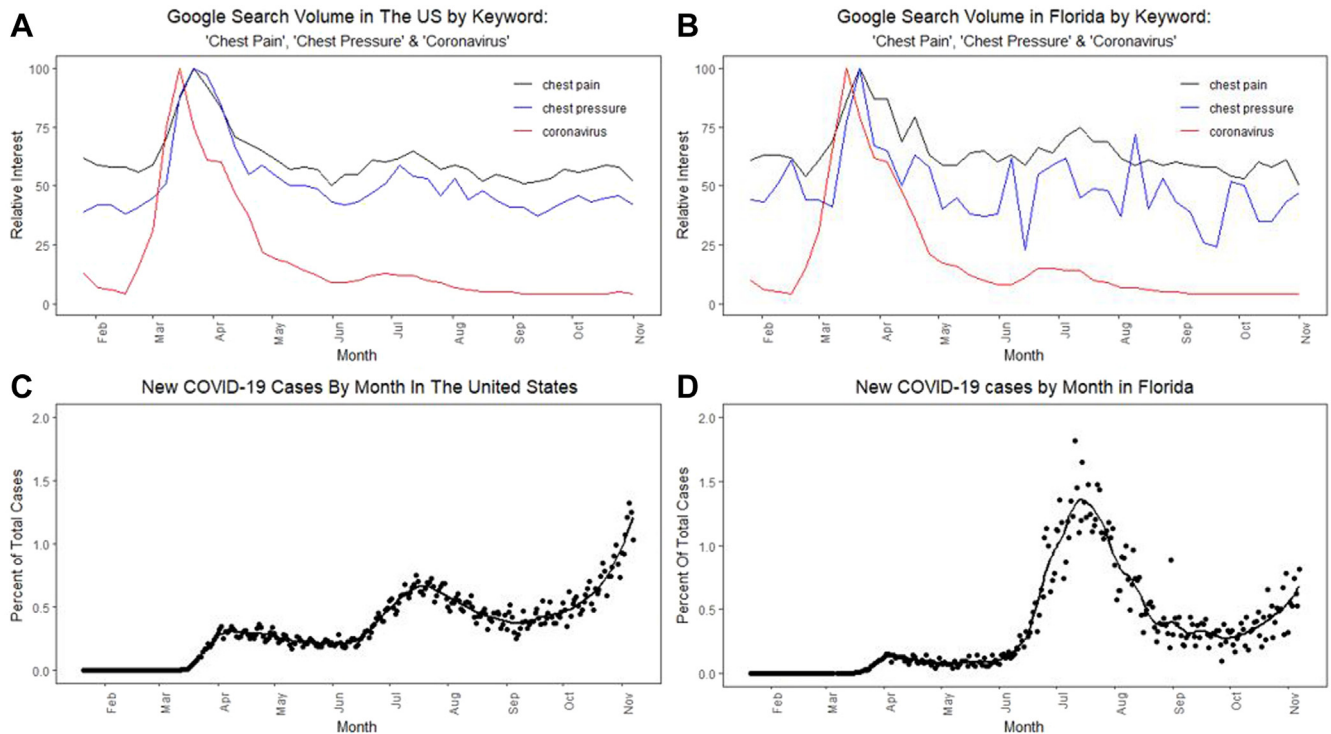


Figure 2. Graph depicts Google Trends relative search volume, with a significant peak in the queries for (A) “chest pain” and (B) “chest pressure” at the national level, starting in early March 2020, with the highest peak in late March and early April 2020 at the national and state levels, with a correlation with accrued COVID-19 cases per month in (C) the US and (D) Florida.

Table 1. Comparison of the number of monthly cardiac admissions at the Veterans Affairs Healthcare System for the diagnoses of chest pain and ischemic heart disease before vs after COVID-19

Location	Before COVID-19*	After COVID-19	P
National	64,261 ± 2743	50,796 ± 9811	0.002
South Florida	7020 ± 310	5461 ± 1170	0.002
Miami	656 ± 39	483 ± 118	0.001

* Data from January 2019 to February 2020.

(South Florida) and study period, were increased (Supplemental Figs. S1-S3).

Finally, the NEMSIS database revealed a pronounced increase in daily out-of-hospital cardiac arrests after March 2020, compared with the data from the corresponding period in 2018 and 2019 (Fig. 5).

Discussion

The COVID-19 pandemic had a drastic effect on almost every aspect of life worldwide. A significant proportion of this impact affected the approach people took to seeking and receiving healthcare, especially during the most critical points of the pandemic. A significant decrease in the number of hospitals admissions was evidenced during the peaks of the virus outbreaks, corresponding with an increase

in the number of Internet searches looking for medical advice.

As observed in our study, the volume of admissions for cardiovascular disease and chest pain similarly declined at local (Miami-Dade County), regional (South Florida), and national levels during this period. In contrast, the number of Internet searches related to acute ischemic heart disease dramatically increased from April 1 to May 18, when a statewide stay-at-home order was issued by the government. Similar behavioural trends were observed for respiratory syndromes such as asthma and chronic obstructive pulmonary disease.¹⁰

This phenomenon can be attributed to heightened concerns about contracting SARS-CoV-2 in medical facilities, especially those with high concentrations of COVID-19-positive patients, which led to hesitancy in seeking hospital care. A significant finding in our study was the remarkable rise in the number of searches on the topic "hospital safety" on Google Trends. This rise was correlated with both the increase in searches related to chest pain or pressure and the decrease in hospital admissions for ischemic heart disease. This directly proportional relationship strongly suggests that people avoided visiting hospitals for ischemic heart disease, owing to concerns about COVID-19 transmission in healthcare settings. Furthermore, with the progression of the pandemic, an increase occurred in hospital admissions for ACS, as did a decrease in out-of-hospital cardiac arrests, and a decline in

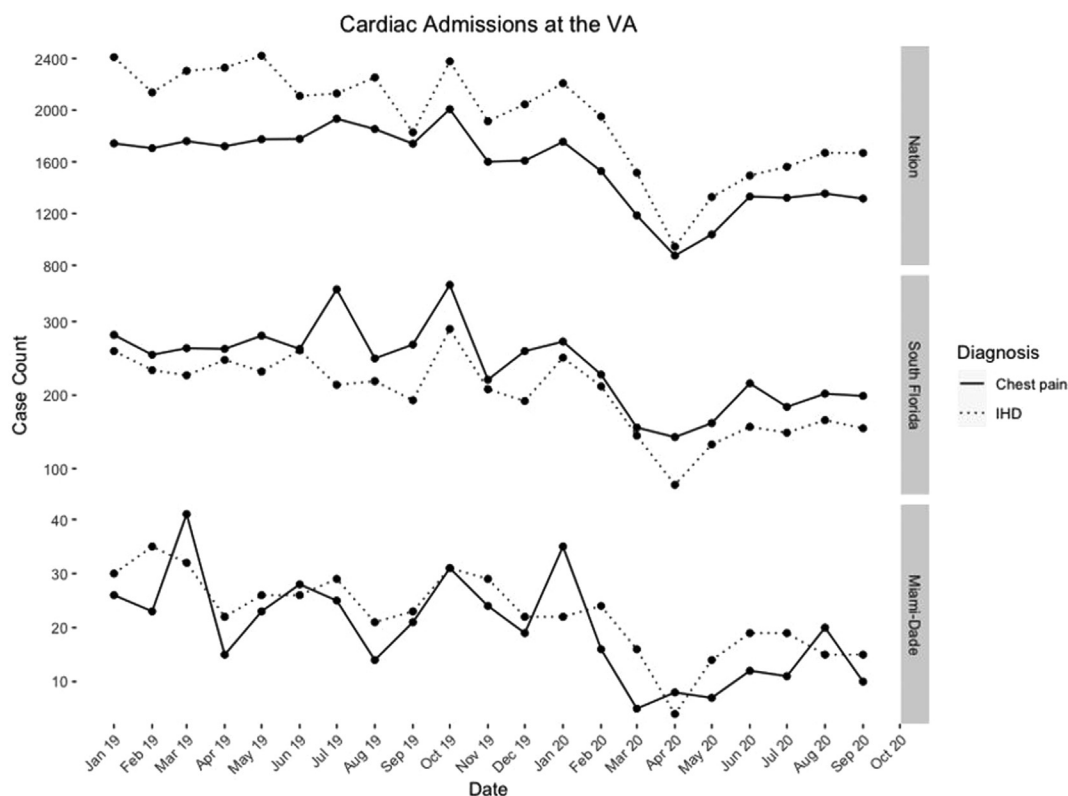


Figure 3. Graph depicts the total number of admissions at the Veterans Affairs (VA) Healthcare System per month at the national, South Florida [VISN8], and Miami VA Medical Centre level for the diagnoses of chest pain (solid line) and ischemic heart disease (IHD; dotted line) between January 2019 and October 2020, demonstrating a significant decrease in the volume of hospital admissions for chest pain or ischemic heart disease starting in February 2020. Apr, April; Aug, August; Dec, December; Feb, February; Jan, January; Jul, July; Jun, June; Mar, March; Nov, November; Oct, October; Sep, September.

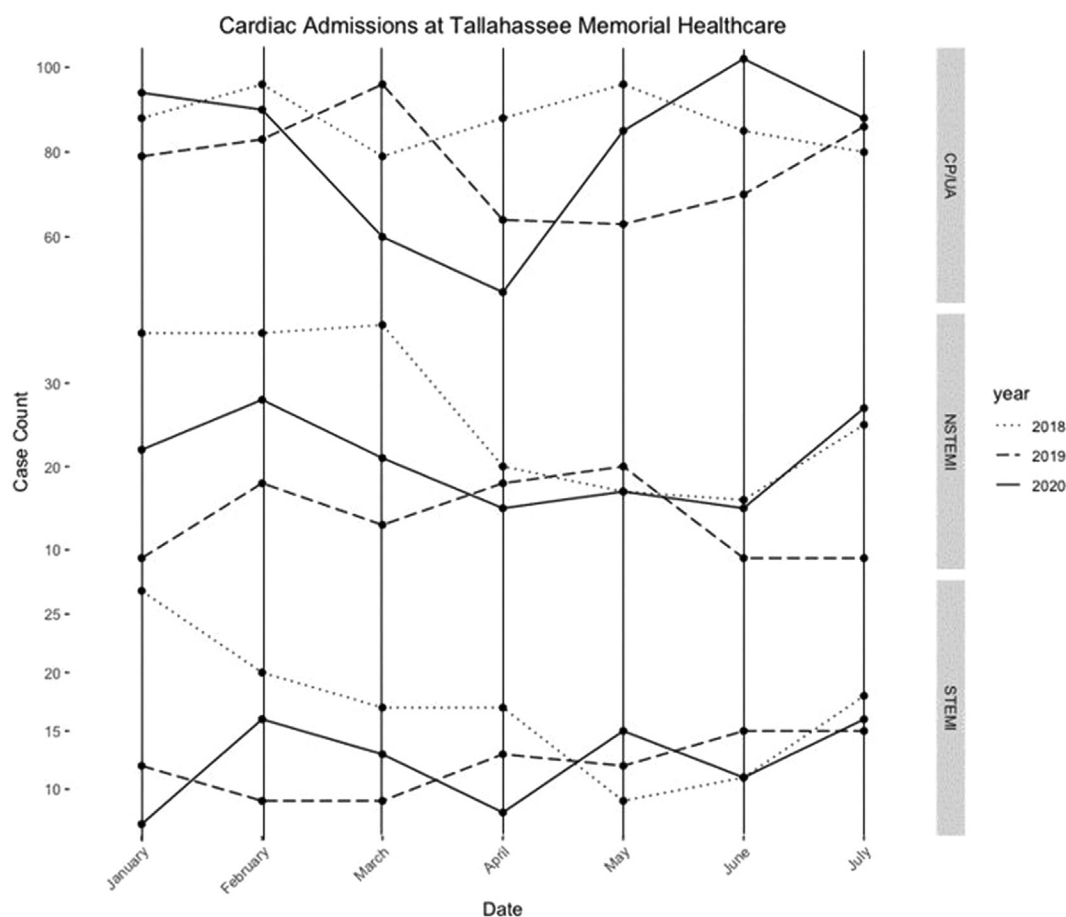


Figure 4. This diagram shows a significant decrease in the total number of in-patient referrals to the cardiac laboratory at Tallahassee Memorial Healthcare for chest pain and unstable angina (CP/UA), non-ST-segment-elevation myocardial infarction (NSTEMI) and ST-segment-elevation myocardial infarction (STEMI) between the months of January and July for the years 2018 (dotted line), 2019 (dashed line), and 2020 (solid line).

searches for the previously mentioned terms, likely attributable to heightened public awareness and reduced anxiety concerning the pandemic.

The fact that people delayed seeking care, even for life-threatening illnesses, was also evident for other conditions such as acute strokes. During the pandemic, the time to presentation from the last known normal state increased by 36% (160 minutes) at 12 comprehensive stroke centres across 6 states in the US, and it nearly doubled (88% increase) at a comprehensive stroke centre in California.^{11,12} Similarly, our study reveals that an increase occurred in cardiac arrest events attended to by emergency medical services starting in March 2020. Although this significant increase may reflect people's reluctance to seek proper medical attention, it cannot be attributed solely to the virus, as the numbers returned to baseline despite a steady increase in COVID-19 cases by June 2020. Further studies should focus on trending heart failure and arrhythmia diagnoses to assess for delayed complications of ACS in the subsequent months.

Finally, in the midst of a public health crisis, established data sources and conventional research methods often are subject to delays in delivering insights. Google Trends can provide precious real-time data, shedding light on the current situation among patients—their responses to the emergency,

the questions they are asking and seeking answers to, the decisions they are mulling over, and the potential health consequences of those decisions. This insight is especially vital during a period marked by significant distrust between the general public and the scientific community, as it can serve as a compass for shaping public health messages that address these particular questions and concerns.

Limitations

Although the analysis of these data is subject to limitations, given the increased death toll inherent to the pandemic, we believe that delayed presentations to the hospital likely played an important role. The utilization of Google Trends to show the impact that shifts in the public interest have on disease presentation and behaviour is a developing and promising modality. This approach is, however, not without limitations. Google Trends cannot show that the people who searched for one term are the same people who searched for another term. Furthermore, Google Trends data cannot show causation. Specific to our study, the emergency medical services data we present do not differentiate the underlying diagnosis for those found to be dead on arrival; possibly, the increase was due to the increased mortality associated with the ongoing COVID-19 pandemic and not to complications of untreated ischemic

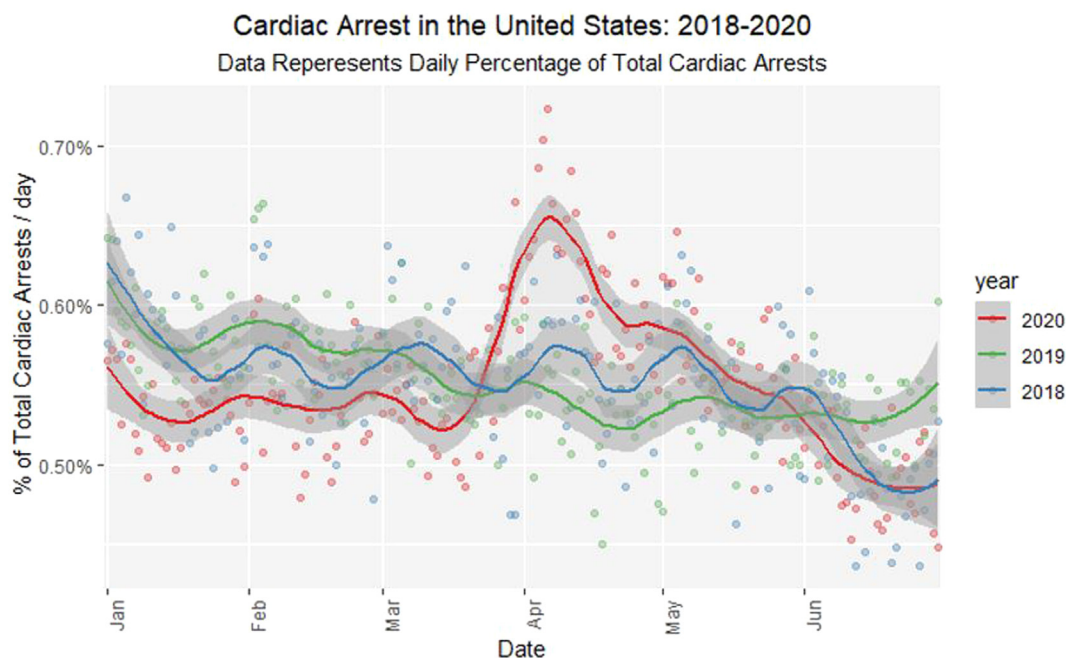


Figure 5. Graph depicts data from the National Emergency Medical Services Information System (NEMSIS) database regarding daily percentages of out-of-hospital cardiac arrests. Apr, April; Feb, February; Jan, January; Jun, June; Mar, March.

heart disease. An additional limitation is that no statistical test can establish an association between the findings in Google Trends and the findings in the other 3 databases, as this is not a traditional methodology, but rather a proposal for social behaviour and prediction of response. Further validation needs to be done on this method to establish it as a form of study in public health.

Conclusions

The COVID-19 pandemic has had global effects on nearly every aspect of life. People's approach to receiving and seeking healthcare was impacted significantly by the increasing fear of contracting SARS-CoV-2 in healthcare institutions. Our study utilized Google Trends data to assess the number of searches conducted for symptoms of ischemic heart disease and the number of inquiries about the safety of visiting hospitals, comparing them with the number of hospital admissions for chest pain, ischemic heart disease, and incidents of out-of-hospital cardiac arrest.

These data indicate a correlation between the decrease in hospital admissions for chest pain and the rise in Google searches related to these symptoms. This model hypothesizes that Google Trends may serve as a valuable tool for predicting patient behaviour and enhancing preparedness for future events, as it can provide crucial real-time data, offering insights into patients' reactions to the emergency, the questions they have, the decisions they are considering, and the potential health impacts of those decisions. However, more-robust statistical strategies are required to establish a valid association.

Ethics Statement

The authors affirm that the research adhered to all applicable ethical standards, including but not limited to the

responsible conduct of research, the protection of human subjects, the welfare of research animals (if applicable), and the proper use of institutional resources. Any potential conflicts of interest have been disclosed and addressed to ensure the integrity and impartiality of the research. The authors confirm that there was no involvement of any financial or personal relationships that could have influenced the outcomes of this work.

Patient Consent

This is a retrospective study using de-identified data. Therefore, the authors confirm that patient consent is not applicable to this article.

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Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at <https://www.cjcopen.ca/> and at <https://doi.org/10.1016/j.cjco.2024.03.002>.