Letters

Internet Searches for Unproven COVID-19 Therapies in the United States

There are no highly effective prescription drug therapies supported by any reliable evidence for the ongoing coronavirus disease 2019 (COVID-19) pandemic of severe acute respiratory syndrome coronavirus 2. However, fears among the public can lead to searches for unproven therapies. Therefore, when several high-profile figures, including entrepreneur Elon Musk and President Donald Trump, endorsed the use of chloroquine, a malarial prophylaxis drug, and hydroxychloroquine (with the antibiotic azithromycin), a lupus and rheumatoid arthritis treatment, to treat COVID-19, it drew massive public attention that could shape individual decision-making.

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Editor's Note

This attention is especially troublesome because chloroquine and hydroxychloroquine (1) are thus far only known to inhibit severe acute respiratory syndrome coronavirus 2 in vitro,[1] (2) have potential cardiovascular toxic effects,[2] and (3) can be confused with commercially available chloroquine-containing products, such as aquarium cleaner. Poisonings, including 1 fatality, attributed to persons taking chloroquine to prevent or treat COVID-19 without the supervision of a licensed physician have already been reported.[3] To better understand the scope of demand for these drugs, we examined internet searches indicative of shopping for chloroquine and hydroxychloroquine.[4]

Methods | The fraction of Google searches (http://google.com/trends) originating from the United States that included the terms *buy*, *order*, *Amazon*, *eBay*, or *Walmart* (the latter being the top 3 e-commerce companies) in combination with *chloroquine* or *hydroxychloroquine* per 10 million total searches were monitored. Raw search volumes were inferred using Comscore estimates (https://comscore.com).

We examined daily searches from February 1, 2020, to March 29, 2020, using the date Musk endorsed the drugs on March 16 as the cut-point for when knowledge of using chloroquine and hydroxychloroquine became widespread to compare observed search volumes with expected search volumes. We evaluated 2 postperiods of interest: (1) all days after March 16 (the entire period, including when President Trump first endorsed these drugs on March 19) and (2) all days after March 22 (when news reports on chloroquine-related poisonings were published). Expected volumes were calculated using Hyndman and Khandakar's algorithm,[5] and the ratio of observed and counterfactual volumes with bootstrap confidence intervals were computed using R Software, version 3.6.3 (R Foundation for Statistical Computing).

Results | The query fraction (QF) of Google searches per 10 million for purchasing chloroquine on February 1, March 16, March 22, and March 29 were 4.78 (equivalent to 542 estimated searches), 26.90 (3052 estimated searches), 66.16 (7506 estimated searches), and 19.19 (2177 estimated searches), respectively. The QFs for purchasing hydroxychloroquine on February 1, March 16, March 22, and March 29 were 4.35 (494 estimated searches), 7.68 (871 estimated searches), 79.37 (9006 estimated searches), and 31.95 (3625 estimated searches), respectively. Queries for purchasing chloroquine were 442% (95% CI, 215%-1220%) higher following high-profile claims that these drugs were effective COVID-19 therapies (**Figure 1**). Similarly, searches for purchasing hydroxychloroquine were 1389% (95% CI, 779%-2021%) higher (**Figure 2**). The first and largest spike in searches corresponded directly with Musk's tweet and Trump's first televised endorsements, respectively, with the latter occurring on March 19 (chloroquine QF, 249.58 [28 319 estimated searches]; and hydroxychloroquine QF, 179.00 [20 311 estimated searches]). These changes represent about 93 000 and 96 000 more searches than expected for chloroquine and hydroxychloroquine, respectively, with 216 000 total searches for both drugs over just 14 days.

Following news reports of the first fatal poisoning, searches to buy chloroquine or hydroxychloroquine remained substantially above expected levels at 212% (95% CI, 66%-1098%) and 1167% (95% CI, 628%-1741%) higher, respectively.

Discussion | Demand for chloroquine and hydroxychloroquine increased substantially following endorsements by high-profile figures and remained high even after a death attributable to chloroquine-containing products was reported. In times of public health crises, therapies not supported by adequate evidence—such as would lead to US Food and Drug Administration approval—should not be touted by public figures. Endorsements can lead to unsupervised use of the products with dangerous consequences to the people who take them, and hoarding of these medications can result in shortages for those who require them for legitimate health reasons. These negative consequences are magnified in this circumstance because chloroquine-containing products are commercially available to the public through such sites as Amazon.

Findings about the clinical efficacy of chloroquine and hydroxychloroquine were inconclusive at the time these drugs were promoted.[6] Until such time as these or other drugs are found to be effective for COVID-19 treatment, regulatory agencies and public-facing companies should be actively mitigating the negative consequences of this misinformation. The US Food and Drug Administration should warn the public against procuring unapproved therapies unless prescribed. Google responded to COVID-19 by integrating an educational website into search results related to the outbreak, and this could be expanded to include searches for unapproved COVID-19 therapies. Similarly, retailers must establish warnings or withhold
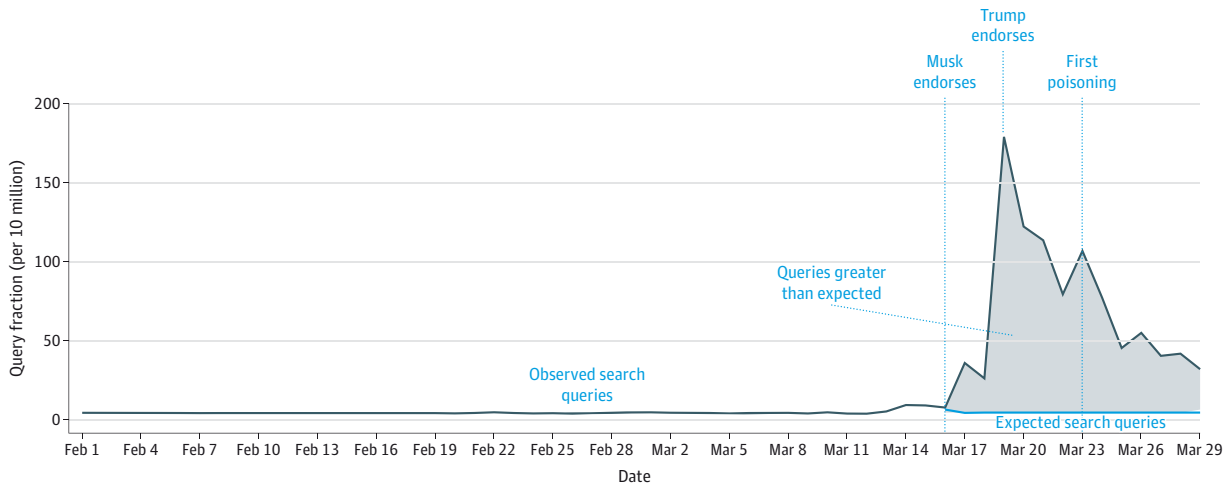

Figure 1. Internet Searches for Purchasing Chloroquine
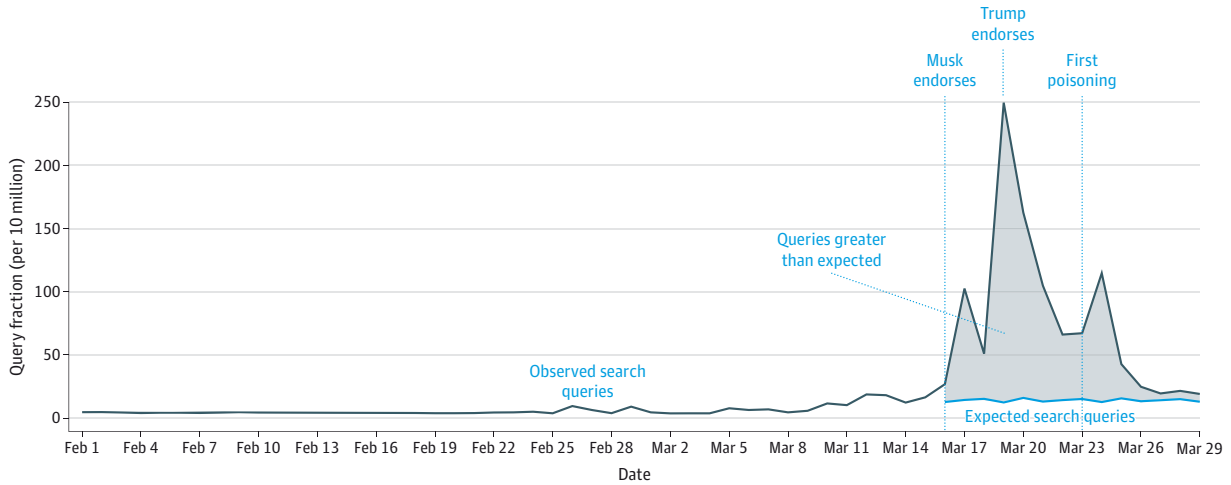
Queries included *chloroquine* in combination with *buy*, *order*, *Amazon*, *eBay*, or *Walmart* (the latter being the top 3 e-commerce companies). The first dotted vertical line corresponds to entrepreneur Elon Musk's tweet on March 16, the second corresponds to President Donald Trump's endorsement on March 19, and the third corresponds to the first reported chloroquine poisoning on March 23.

Figure 2. Internet Searches for Purchasing Hydroxychloroquine

Queries included *hydroxychloroquine* in combination with *buy*, *order*, *Amazon*, *eBay*, or *Walmart* (the latter being top 3 e-commerce companies). The first dotted vertical line corresponds to entrepreneur Elon Musk's tweet on March 16, the second corresponds to President Donald Trump's endorsement on March 19, and the third corresponds to the first reported chloroquine poisoning on March 23.

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products that might be linked to use for COVID-19 treatment, as was exemplified by eBay's removing chloroquine sales from its site.

Additional surveillance will clarify this study's findings, including estimating the number of sales of chloroquine-containing products. Nonetheless, the present analysis suggests that in times of public health crises, demand for unproven and potentially hazardous COVID-19 treatments is massively increased by endorsements. Public health leaders, regulatory agencies, media, and retailers must amplify accurate information.

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