

# Letters

## RESEARCH LETTER

### Characteristics of X (Formerly Twitter) Community Notes Addressing COVID-19 Vaccine Misinformation

Social media can magnify health misinformation, especially about vaccination.<sup>1</sup> Platform countermeasures have included censoring, shadowbanning (limiting distribution without disclosure), and adding warning labels to problematic content. Yet, evaluating these countermeasures is challenging due to restrictive public disclosures about their inner workings.<sup>2</sup>

#### Supplemental content

In late 2022, X (formerly Twitter) introduced Community Notes, a crowdsourced misinformation countermeasure. Anonymous volunteer contributors independently identify posts containing misinformation and propose corrections called “notes.” Notes labeled as helpful by contributors who disagreed on past notes (to rely on a diversity of perspectives) are shown alongside the original post.<sup>3</sup> Because Community Notes is open source, we were able to evaluate the topics, accuracy, and credibility of notes addressing COVID-19 vaccination.

**Methods** | Notes from the first year of Community Notes (December 12, 2022, to December 12, 2023) were obtained from X’s public data page. We filtered for notes that were visible on X that mentioned “vaccin\*” and “covid\*” or “coronavirus.”

A random sample of notes was double-annotated by M.R.A. and N.D. to determine topic, accuracy, and credibility. Open coding, which entails deriving labels from review of raw data, was used to determine the primary topic of each note. Axial coding was used to resolve open codes into 4 overarching topics (adverse events, conspiracy, vaccine recommendations,

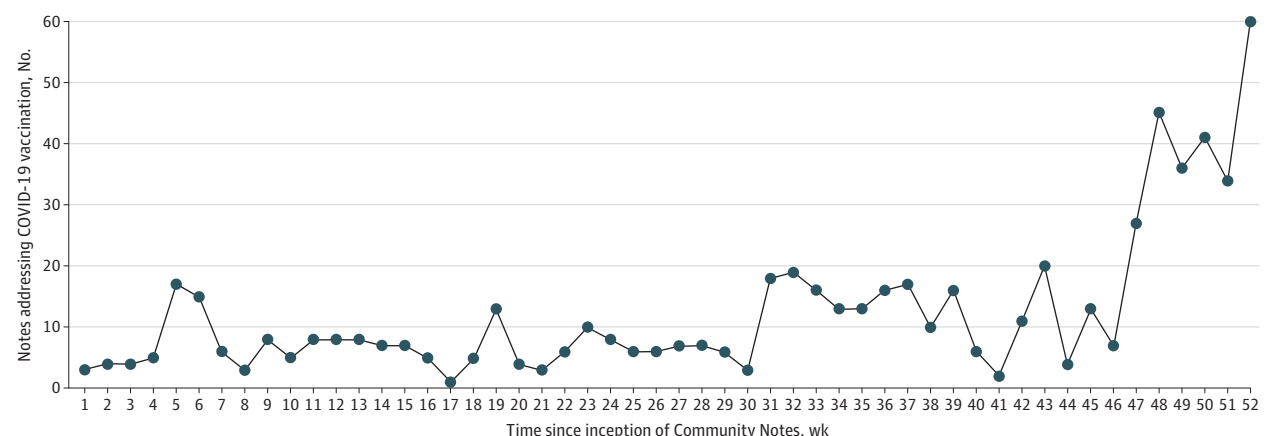
and vaccine effectiveness); all labeled notes were resolved to a primary subject label, or the 4 topics described all annotated notes. Notes were categorized as entirely (scientifically supported), partially (scientifically debated), or not (scientifically unsupported) accurate. Annotators were instructed to use their training, experience, and primary sources to evaluate accuracy. Since notes require citations, top-level domains in citations were rated as having high (primary sources, such as peer-reviewed journals or government websites), moderate (reputable secondary sources, such as major news outlets or fact checkers), or low (less reputable secondary sources, such as blogs or tabloids) credibility. When notes cited multiple sources, the highest credibility domain was used. Annotations were reviewed and disagreements adjudicated by a third clinician-author (D.M.S.).

Weekly rates of notes, the prevalence of note labels with bootstrapped 95% CIs, and total view counts for noted posts were computed with Python, version 3. The study, using public data (45 CFR §46), was exempted from ethical review.

**Results** | Of the 45 783 notes made visible on X, 657 mentioned COVID-19 vaccination. Monthly rates increased from 22 to 186 notes during the study (**Figure**). Of the 205 randomly sampled notes, there was strong agreement on note topics (90% agreement, Cohen  $\kappa$  = 0.83), source credibility (87% agreement, Cohen  $\kappa$  = 0.77), and accuracy (96% agreement, Cohen  $\kappa$  = 0.90) before resolving disagreements.

The predominant note topic was adverse events (51%; 95% CI, 44%-58%), followed by conspiracy theories (37%; 95% CI, 31%-44%), vaccine recommendations (7%; 95% CI, 4%-11%), and vaccine effectiveness (5%; 95% CI, 2%-8%). Ninety-seven percent (95% CI, 96%-99%) of notes were entirely accurate, 2% (95% CI, 0%-4%) partially accurate, and

**Figure. Community Notes Addressing COVID-19 Vaccine Misinformation**



A weekly time series of the volume of notes made publicly visible between December 12, 2022, and December 12, 2024, that discussed COVID-19 vaccination is shown.

Table. Example Community Notes With Annotations

| Original post <sup>a</sup>   | Community Note <sup>b</sup>  | Note topic <sup>c</sup> | Note credibility <sup>d</sup> | Note accuracy <sup>e</sup> | Post view count <sup>f</sup> | Post creation date <sup>g</sup> |
|--|--|-------------------------|-------------------------------|----------------------------|------------------------------|---------------------------------|
| Marburg Virus is baked into the covid shots and will be activated by four 1 min pulse waves at 15GHz from 5G towers throughout the country.<br><br>The government has been planning this for years now and it will be "released" in October 2023.<br><br>#pandemic #CovidIsNotOver<br>#marburg #5g #zombieapocalypse | There is no evidence for Marburg virus being in the COVID-19 vaccines. 5G does not cause viral illnesses. COVID-19 vaccines do not contain 5g technology.<br><br><a href="https://apnews.com/article/fact-check-covid-mrna-vaccine-nanotech-390958734912">https://apnews.com/article/fact-check-covid-mrna-vaccine-nanotech-390958734912</a><br><br><a href="https://www.reuters.com/article/factcheck-covid19vaccines-5g/fact-check-covid-19-vaccines-are-not-a-ploy-to-connect-people-to-5g-idUSL1N2OR2C1/">https://www.reuters.com/article/factcheck-covid19vaccines-5g/fact-check-covid-19-vaccines-are-not-a-ploy-to-connect-people-to-5g-idUSL1N2OR2C1/</a><br><br><a href="https://fullfact.org/health/marburg-covid-vaccines/">https://fullfact.org/health/marburg-covid-vaccines/</a> | Conspiracy              | Moderate credibility          | Entirely accurate          | 1.6 Million                  | September 4, 2023               |
| So the FDA finally came out and admitted that Pfizer's shot for Covid causes blood clots?<br><br>Only 2 y late!  | A recent published literature review on vaccines and blood clots did not find strong evidence to support this claim. However, it did find that "occurrence of blood clots in COVID-19 is up to 10 times more common than from the vaccines' injection."<br><br><a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9055170/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9055170/</a>   | Adverse events          | High credibility              | Entirely accurate          | 18.4 Million                 | December 17, 2022               |
| The monovalent Moderna and Pfizer-BioNTech COVID-19 vaccines are no longer authorized for use in the United States.  | The reason monovalent COVID vaccines aren't used any more is because bivalent vaccines were released to target newer variants.<br><br><a href="https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-authorizes-changes-simplify-use-bivalent-mrna-covid-19-vaccines">https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-authorizes-changes-simplify-use-bivalent-mrna-covid-19-vaccines</a>  | Recommendations         | High credibility              | Entirely accurate          | 6 Million                    | April 19, 2023                  |
| In a society with uncorrupted legacy media every front page would announce this in letters two inches high.<br><br>From the CDC:<br>NEW COVID VARIANT<br>MORE LIKELY<br>TO INFECT<br>THE VACCINATED  | The CDC believes that the new strain may be more likely to infect vaccinated people than prior strains were, not that it is more likely to infect vaccinated people than the unvaccinated.<br><br><a href="https://time.com/6308418/ba-2-86-covid-19-variant-vaccine/">https://time.com/6308418/ba-2-86-covid-19-variant-vaccine/</a>  | Effectiveness           | Moderate credibility          | Entirely accurate          | 2.2 Million                  | August 25, 2023                 |
| Praying for [Celebrity]<br>I can't imagine how many individuals are dealing with similar side effects and the media doesn't care.<br><br>[Celebrity] Ends Up 'Paralyzed And Blind' From Covid Vaccination, Sources Claim   | [Celebrity] debunked these rumors, emphasizing the importance of accurate information when it comes to public health matters. He has urged fans and the public not to fall victim to misinformation and conspiracy theories surrounding vaccines.<br><br><a href="https://celebmagazine.com/jamie-foxx-dispels-false-claims-of-paralysis-and-blindness-linked-to-covid-19-vaccine/">https://celebmagazine.com/jamie-foxx-dispels-false-claims-of-paralysis-and-blindness-linked-to-covid-19-vaccine/</a>   | Adverse events          | Low credibility               | Entirely accurate          | 3.0 Million                  | June 6, 2023                    |

<sup>a</sup> Reported with text slightly modified to shield online identities.<sup>b</sup> Reported verbatim.<sup>c</sup> Refers to the subject matter of the note.<sup>d</sup> Refers to the credibility of the most credible domain cited in support of the note.<sup>e</sup> Refers to the accuracy of the note.<sup>f</sup> The number of views associated with the post attached to the note and reported on X.<sup>g</sup> Refers to the date the post was published on X.

0.5% (95% CI, 0%-1%) inaccurate. Forty-nine percent (95% CI, 42%-56%) of notes cited high, 44% (95% CI, 37%-51%) moderate, and 7% (95% CI, 4%-11%) low credibility sources.

Post view data were available for 189 of 205 posts, totaling 201 281 364 views (mean number of views, 1 064 981; 95% CI, 689 821-1 548 471). Example notes are provided in the Table.

**Discussion |** A sample of Community Notes added to posts on X containing COVID-19 vaccination misinformation primarily addressed adverse events and conspiracy theories, were accurate, cited moderate and high credibility sources, and were attached to posts viewed hundreds of millions of times.

The US Food and Drug Administration commissioner recently urged health professionals to redouble their vaccine education efforts.<sup>4</sup> The small number of notes addressing posts with COVID-19 vaccine misinformation suggests opportunities for health professionals to contribute to this mission via participating in Community Notes.

The primary limitation of this study is that only note quality was studied, but these attributes are predictive of effectiveness (eg, higher credibility yields greater persuasiveness<sup>5</sup>). Additional limitations include a narrow focus on COVID-19 vaccination, a small sample, human judgments were used to assess accuracy, user engagement with notes was not studied, and effects on perceptions or behaviors were not studied.

Investigations of other health topics and note influence (including unintended effects<sup>6</sup>) are needed. More social media firms should open-source their misinformation countermeasures for evaluation by independent scientists to illuminate, foster public trust in, and scale the most effective strategies.

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## Preoperative GLP-1 Receptor Agonist Use and Risk of Postoperative Respiratory Complications

In June 2023, the American Society of Anesthesiologists issued guidelines recommending preoperative withholding of glucagon-like peptide 1 receptor agonists (GLP-1 RAs),<sup>1</sup> used for type 2 diabetes management and weight loss. These guidelines, which have been questioned,<sup>2</sup> arose from reports of delayed gastric emptying and pulmonary aspiration following induction of anesthesia in patients using GLP-1 RAs. Although preoperative medication guidelines can prevent complications, withholding medications can also result in adverse effects.<sup>3</sup> Furthermore, associated logistical burdens can result in surgical cancellations, significant care delays, and financial losses from unused operating room time.<sup>4,5</sup> These downsides are pronounced for GLP-1 RAs due to recommended withholding periods of up to a week. Given increasing use of GLP-1 RAs, larger-scale evaluations of their perioperative risks are needed; however, a randomized trial of preoperative GLP-1 RA withholding may not be feasible. Therefore, we used a claims database to evaluate the risk of postoperative respiratory complications among patients with diabetes and a prescription fill for GLP-1 RAs who underwent emergency surgery because these patients would be unlikely to withhold their medication in accordance with guidelines.

**Methods |** We used administrative claims from the Merative MarketScan Commercial Database, a large national database of about 250 million individuals younger than 65 years enrolled in employer-sponsored health insurance plans. We evaluated all patients with type 2 diabetes and a GLP-1 RA prescription fill who had undergone any of 13 emergency surgeries between January 1, 2015, and December 31, 2021 (eTable 1 in [Supplement 1](#)). We restricted our sample to patients who had undergone surgery on the same day as an emergency department visit because these patients would be unlikely to have sufficient time to withhold their GLP-1 RA medication. Because patients with diabetes are at higher risk of postoperative respiratory complications,<sup>6</sup> our comparison group comprised patients with diabetes and at least 1 fill for a non-GLP-1 RA antidiabetic agent. The outcome was a composite of aspiration pneumonia, postoperative respiratory failure, and/or admission to the intensive care unit from 0 through 7 postoperative days (eMethods 1, eTable 2 in [Supplement 1](#)).

We assessed differences in characteristics between patients with vs without a GLP-1 RA fill using standardized mean differences (SMD), with SMD greater than 0.1 reflecting meaningful differences between groups. To estimate the association between having a fill for a GLP-1 RA preoperatively and postoperative respiratory complications, we used multivariable