

Reporting of Infectious Diseases in the United States During the COVID-19 Pandemic

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ABSTRACT

Reporting of infectious diseases other than COVID-19 has been greatly decreased throughout the COVID-19 pandemic. We find this decrease varies by routes of transmission, reporting state, and COVID-19 incidence at the time of reporting. These results underscore the need for continual investment in routine surveillance efforts despite pandemic conditions.

Keywords:

Covid-19, Infectious Diseases, Epidemiology, Transmission Patterns, Disease Reporting

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has led to substantial changes in population behaviors within the United States, potentially resulting in altered patterns of exposure to other infectious pathogens.¹ Evidence suggests the same nonpharmaceutical interventions employed to prevent transmission of SARS-CoV-2 likely led to reduced incidence of influenza in the United States and other countries in 2020.²⁻³ The COVID-19 pandemic has also caused disruptions in the reporting of other infectious diseases. It has been shown that reporting of sexually transmitted diseases (STDs) was reduced during national surges in COVID-19 incidence⁴ and STD programs nationwide report reallocation of resources towards COVID-19 response, with disruption of typical disease intervention services.⁵ Understanding the impact of the COVID-19 pandemic on transmission patterns of other infectious diseases holds significant implications for public health, but this topic has not yet been studied within the United States. We analyzed national and state-level surveillance data from 2015 to 2021 to better understand how infectious diseases reporting changed during the COVID-19 pandemic and how such changes may have varied by geography and route of transmission.

METHODS

We analyzed data from the Nationally Notifiable Diseases Surveillance System (NNDSS) maintained by the Centers for Disease Control and Prevention (CDC).⁶ The NNDSS reports weekly provisional data on diseases and conditions from all 50 states and the District of Columbia. We collected data on 42 NNDSS-reported human diseases from 2015 to 2021. Diseases were analyzed if more than 50 cases were recorded in both 2019 and 2020. Two steps were taken to avoid counting cases multiple times: when probable cases were reported alongside confirmed cases for a particular

disease, only confirmed cases were included. Additionally, if cases of different serotypes of a disease were reported individually in addition to an “all serotypes” category, we included only the “all serotypes” category.

To investigate differences in reporting by route of transmission, diseases reported by the NNDSS were classified into five categories by main route of transmission: sexually transmitted, foodborne/waterborne, vectorborne, injection drug use-associated, and respiratory (**Supplementary Table 1**). For each route we compiled annual and weekly incident case counts. For context, we included incident daily COVID-19 cases alongside trends in transmission routes.⁷ We also analyzed geographic differences in disease reporting by comparing year-end case totals across diseases between all 50 states and Washington D.C. This study was determined to not constitute human subjects research by the Johns Hopkins Medicine Institutional Review Board.

RESULTS

Reporting Differences by Route of Transmission

We found substantial differences in reporting of diseases between 2019 and 2020 by route of transmission. The greatest relative decrease in reporting compared to 2019 levels was in respiratory diseases (76,147 cases in 2019; 37,558 cases in 2020; -50.7%). Significant decreases in reported cases were also found among injection drug use-associated diseases (6,143 in 2019; 3,246 in 2020; -47.2%), vectorborne diseases (12,737 in 2019; 7,184 in 2020; -43.6%), and foodborne/waterborne diseases (186,491 in 2019; 112,387 in 2020; -39.7%). Sexually transmitted diseases accounted for the largest proportion of the total difference among all reported cases, but

the smallest percent difference among the five categories analyzed (2,141,404 in 2019; 1,933,109 in 2020; -9.7%) (**Figure 1; Panel A**).

Analysis over time showed a coinciding increase in COVID-19 cases and decrease in weekly reporting of other infectious diseases nationwide. The COVID-19 pandemic was declared a national emergency in the United States on March 13, 2020. Prior to this date, we note a relative increase in 2020 at timepoints for all transmission routes. Following the emergency declaration, however, we found that weekly reported cases of respiratory diseases were consistently 50% below 2019 cases (median relative change by week -52.0%; IQR -58.0% to -41.6%). Reporting for vectorborne (median relative change by week -42.7%; IQR -58.0% to -25.1%), foodborne (median relative change by week -52.2%; IQR -58.1% to -43.8%), and injection drug use-associated (median relative change by week -54.8%; IQR -76.2% to -36.7%) routes similarly showed consistent decreases for the remainder of 2020. Reporting of sexually transmitted diseases decreased at most timepoints but increased towards the end of 2020 and showed greater variability overall (median relative change -24.0%; IQR -30.8% to 4.2%). (**Figure 1; Panel B**).

The individual diseases with the largest decreases in reported cases between 2020 and 2019 are also shown. We note the particularly significant decreases in cases of chlamydia (-234,007; -14.9%) and campylobacteriosis (-24,581; -37.9%). (**Figure 1; Panel C**). These findings underscore the large number of reported cases of sexually transmitted and foodborne/waterborne diseases analyzed, respectively accounting for 63.6% and 22.6% of the decrease in total cases of all diseases observed from 2020 to 2019. In order to investigate whether year-specific reporting variations in 2019 may have influenced our findings, we also investigated reporting relative to 5-year mean of provisional cases and found largely consistent results. We found that reported cases of 37 of the 42 diseases decreased in 2020 relative to 2019 counts and reported cases of 33 of the 42 diseases decreased in 2020 relative to the 5-year mean from 2015-2019 (**Supplementary Table 1**).

Reporting Differences by Geography

Analysis of case totals among all diseases between states demonstrated variation by geography but decreased reporting in a majority of states (median change among total cases -14.4%; IQR -29.6% to -14.4%). Five states exhibited a decrease in cases in 2020 relative to 2019 that exceeded 50%: Hawaii (8,588 in 2019 to 2,118 in 2020; -75.3%), Kentucky (20,003 to 10,139; -66.2%), Nebraska (14,033 to 4,931; -64.9%), Missouri (54,168 to 22,472; -58.5%), and North Dakota (5,700 to 2,558; -55.1%). We found 5 states with a relative decrease from 40 to 49%, 3 states with relative decrease from 30 to 39%, 7 states with relative decrease from 20 to 29%, and 16 states with relative decrease from 10 to 19%. We also found 8 states with increase in reported cases in 2020, most notably South Carolina (23,722 to 55,186; 132%) (**Figure 1; Panel D**). We also examined the 5-year mean in all cases reported by states and found similar but reduced results when looking beyond 2019, with 34 states showing decreased reporting relative to mean case totals from 2015-2019 (median change by state -5.9%; IQR -20.5% to 4.0%) (**Supplementary Table 2**). On standard linear regression we found no trend between cumulative annual COVID-19 cases per 100,000 population and the relative difference in reporting from 2019 to 2020 (**Supplementary Figure 1**).

Reporting Differences Through March 2021

We also investigated differences in reporting from mid-March 2020 to mid-March 2021, finding that reporting of 28 of 42 diseases decreased in this comparison (median change between cases in 2021 relative to 2020 -36.6%; IQR -64.8% to 15.7%). (**Supplementary Table 3**). On state-level analysis, 28 states showed a decrease in total cases reported to-date, (median change among total cases by state -7.0%; IQR -15.1% to 11.1%). (**Supplementary Table 4**). Conclusions from these data

are limited by smaller case numbers for comparison and differential timing of typical reporting by state to the CDC.

DISCUSSION

We found decreased reporting of almost all nationally notifiable infectious diseases and conditions during the COVID-19 pandemic. These decreases were found nationwide and at the state level. Decreases varied by route of transmission, with sexually transmitted diseases least reduced and respiratory infections most reduced. Transmission routes of foodborne/waterborne, vectorborne, and injection drug use-associated also exhibited marked reduction in comparison to prior years.

It is unknown whether the observed decrease in reporting indicates a true decrease in disease or an impairment of typical disease reporting during the COVID-19 pandemic. Both factors likely contributed to our findings. Our study is limited by a reliance on provisional data from a single database. This data will be updated and finalized over time as cases are investigated and fully tabulated.⁸ In order to mitigate limitations posed by provisional data use, we compared only provisional case counts in our analysis between years. Furthermore, our conclusions regarding patterns of disease transmission are limited by the selection of diseases that are nationally notifiable.

Time series analysis and state differences suggest that disease detection systems were impacted by the pandemic. This hypothesis is supported by practitioner accounts and the known phenomenon of medical care avoidance during the pandemic.^{5,9-10} This idea is also supported by the discrepancy between our observed decrease in injection drug use-associated diseases with recent reports of increased drug overdose deaths during the pandemic.¹¹ Differences between transmission

routes suggest that behavioral changes have also impacted transmission patterns. This hypothesis is supported by observational studies on influenza as well as a similar analysis conducted on notifiable diseases in Australia.^{2-3, 12}

These results indicate a need for robust surveillance in the wake of the COVID-19 pandemic to respond to potentially undiscovered patterns of disease transmission. Furthermore, they point to preliminary consequences of infectious disease resource reallocation for COVID-19 response and underscore the need for continual investment in routine surveillance efforts despite pandemic conditions. As healthcare systems return to pre-pandemic conditions, additional attention will be necessary to compensate for prior medical care avoidance and engage patients with underreported conditions, both to reduce immediate morbidity as well as to promote public health.

NOTES

AUTHOR CONTRIBUTIONS

M.A.C., A.P., J.A.R, and K.G.G designed the study. M.A.C., A.P., and R.P. collected and analyzed data. M.A.C. wrote the first draft of the manuscript. All authors contributed to developing the manuscript and provided input on the final manuscript.

ACKNOWLEDGEMENTS

We acknowledge assistance from Tushar Jois (Johns Hopkins University), who provided uncompensated assistance in data collection. We are grateful to the Centers for Disease Control and Prevention Division of Health Informatics and Surveillance for maintaining the Nationally Notifiable Diseases Surveillance System and we are grateful to the healthcare providers and public health professionals who have contributed towards data collection.

FUNDING: The authors report no financial support.

CONFLICTS OF INTEREST: KGG reports 2018 travel support from Roche Diagnostics for travel to attend diagnostics meeting in Vienna, outside the submitted work. JR reports contracts/grants from Bureau of Economic Analysis, UCLA, paid to them, and grants/contracts from NIA, Cedars-Sinai, California Hospital Association, paid to their institution, both outside the submitted work. All other authors report no conflict of interest.

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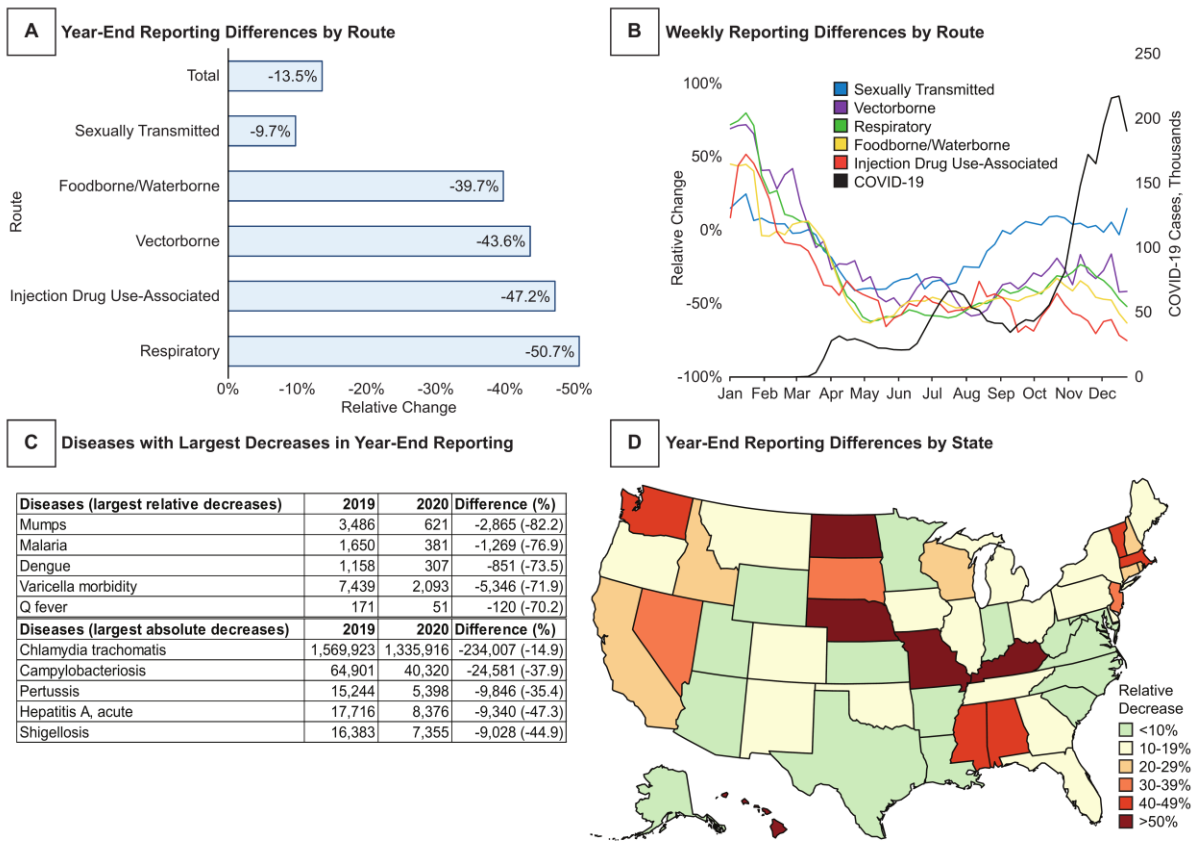
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Figure 1. Nationally Notifiable Disease Reporting in the United States, 2019-2020

Panel A shows relative change in 2020 compared to 2019 for the year-end cumulative count of all reported cases within each route of transmission. **Panel B** shows relative change between weekly new provisional cases in 2020 compared to 2019, as reported by end date of epidemiological week. Relative change shown as a moving 5-week average of the difference between epidemiologic weeks in 2020 compared to 2019. Second vertical axis shows moving 7-day average of new daily COVID-19 cases reported nationally in 2020.⁷ Final epidemiologic week of 2020 (week 53) not shown in figure. Some data excluded in panel for vectorborne diseases prior to week 2 and injection drug use-associated diseases prior to week 2 and at week 5 due to minor reporting abnormalities resulting in an excessive relative difference. **Panel C** shows the diseases with the largest relative and absolute decreases in year-end cumulative count of reported cases in 2020 compared to 2019. COVID-19 is not tabulated among other nationally notifiable infectious diseases in this panel. **Panel D** shows relative change in 2020 compared to 2019 for the year-end cumulative count of all reported cases of all routes of transmission by all 50 US states. District of Columbia not pictured.

Figure 1



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