

COVID-19 Issue Brief: Exposure Assessment

Summary of COVID-19 case investigation exposure data and application for social distancing policy

Tri-County Health Department | January 5, 2021

Assessment of possible sources of exposure is an important analytic approach for controlling a pandemic such as that caused by COVID-19. Exposure assessment can help with individual cases and their contacts, identify possible outbreaks, and provide effective approaches to reducing community exposures through social distancing policy approaches such as those included in [Colorado's Dial Framework](#). Public health officials rely on multiple sources of data to assess exposure; these sources include but are not limited to: scientific studies, case interviews and contact tracing, and outbreak investigations. Scientific studies typically come from academic centers or the Centers for Disease Control (CDC), while interview and outbreak investigation data are generated by local public health agencies such as Tri-County Health Department (TCHD).

Scientific studies

Scientific studies are the most important sources of data used for exposure assessment since they typically include thoroughly collected and analyzed epidemiologic data by public health scientists and are usually made available only after stringent peer review processes. In contrast to studies of new treatments or vaccines, which are typically done through randomized controlled trials and generate the highest quality of data, it would be unethical to perform epidemiologic studies of exposures through such trials, and thus they typically rely on observational data and modeling studies.

An important recent example of a controlled observational study is a report among adults with COVID infection and control patients without COVID-19 from a CDC surveillance network including 11 outpatient facilities in the United States which found that the most significant sources of community exposure were restaurants, bars, and coffee shops (Figure 1) (Fisher KA). Similarly, a recent example of a modeling study used hourly movements of cell phones from 98 million persons across 10 of the largest metropolitan areas in the U.S. to determine types of locations which contributed most to community spread. The report found that facilities contributing to the greatest extent included restaurants, fitness centers, hotels and motels, and religious organizations. (Figure 2) (Chang et al)

Indirect data on exposures can also be generated through scientific policy analyses which evaluate the impact of public health orders which reduce exposures in specific settings on COVID-19 case rates. Examples of this type of study include one which evaluated impact of measures at the county level, finding that shelter-in-place orders and restaurant/entertainment business closure had the greatest impact on reducing transmission (Courtemanche) and another which evaluated state-level measures, again finding restrictions on restaurants one of the most impactful in slowing transmission. (White)

Figure 1. Adjusted odds ratio (aOR)* and 95% confidence intervals for community exposures† associated with confirmed COVID-19 among symptomatic adults aged ≥18 years (N = 314) — United States, July 1–29, 2020

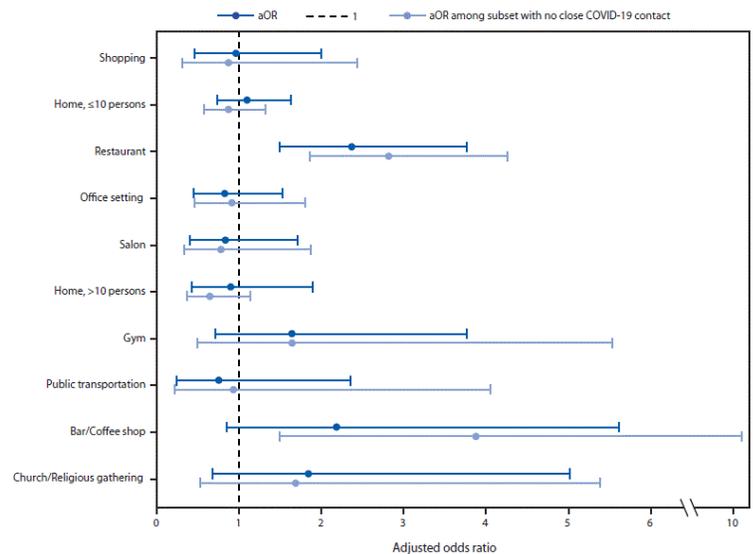


Figure 2. Predicted increase in infections across 10 U.S. metropolitan areas from opening different community-based points of interest categories on May 1, 2020

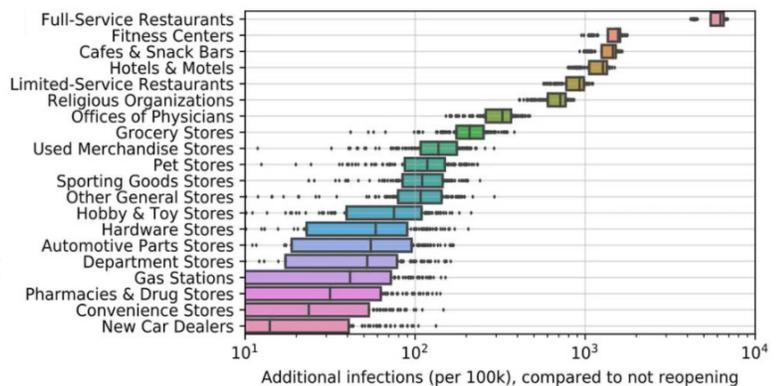


Figure 2 is from figure 5d in the following report: Chang et al. (Nov 10, 2020). Mobility Network Models of COVID-19 Explain Inequities and Inform Reopening. Nature. <https://doi.org/10.1038/s41586-020-2923-3>

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Data from studies such as these were included in a recent CDC guidance document about public health strategies to address high levels of community transmission, included among the recommendations are policies that restrict highest transmission-risk settings such as restaurants (Honein MA). It is widely recognized that restrictive policies can be extremely harmful to businesses (Samet), and modeling studies can also offer approaches to finetune shutdowns and mitigate economic harm. For example, the modeling study cited above indicated that reducing capacity could be a more balanced approach than total shutdown, and that by limiting capacity to 20%, 80% of new infections could be prevented with only a 42% loss of visits to the facility (Chang, Serkez)

Case Investigation Exposure Data

TCHD exposure data gathered from local COVID-19 case interviews and outbreak investigations are critical to understanding current local trends in COVID-19 incidence and can help corroborate findings about exposure transmission from scientific literature. During case interviews, TCHD attempts to identify the more likely scenarios in which a person might have become infected based on the current science of how COVID-19 spreads. TCHD disease control staff ask about activities a case participated in during the 14 days before their illness began (or before a COVID-19 test was performed), which defines when a person would have been exposed to the virus (also called the 'exposure period'). Interviewers ask about higher risk activities including being in close contact with someone with COVID-19, or having been in crowded places or indoor spaces with non-household members. TCHD, like many local health departments nationwide, is not always able to complete a case investigation if a case cannot be reached or refuses to answer interview questions. Table 1 outlines the format of questions used in case investigations through December 1 as part of the TCHD Investigation System as well as the system in use since December 2 when we moved to a centralized Colorado Department of Public Health and Environment (CDPHE) system. Questions related to exposure common to both include known exposure to a person with COVID-19 infection, recent travel, occupation, and other types of prolonged community exposure (> =60min in a given venue).

Figure 3 summarizes exposure data based on completed case investigations in Adams, Arapahoe, and Douglas Counties for the period September 29, 2020 through December 1, 2020 during which time the evolving case interview questionnaire used a consistent set of questions. During this two-month period, TCHD completed 19,749 (51.6%) COVID-19 case interviews out of 38,257 total cases reported during that timeframe. We were not able to interview 15,920 cases due to staffing shortages or delays in receiving the case report and another 2,558 were transferred to CDPHE for investigation. Of the 19,749 completed case interviews, 6,393 persons responded to the question of whether they had known contact with someone with COVID-19 prior to their illness onset or a positive test, 3,410 (53.3%) of whom were aware of such an exposure. The table also summarizes findings regarding other types of prolonged community exposure ("places you went for > 60 minutes when you were in close contact with other people"). Table Y provides a detailed summary of responses to the last category. Of 16,339 without known exposure to a COVID-19 infected person, 2096 (13%) noted a possible community exposure, 4,539 (28%) did not, and 9698 (59%) did not respond. Of those who did report an exposure, the following are the five top reported activities.

- 1) Attendance at a small private gathering (9 or less persons) (21.2%)**
- 2) Patronizing a restaurant or café (13.4%)**
- 3) Office/work (13.0%)**
- 4) Large private gatherings (>10 persons) (12.5%)**
- 5) Church/religious gathering (7.7%)**

Case interviews are an important public health tool and are essential in describing patterns among cases in terms of person, time,

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Table 1. Exposure questions asked during case investigation

The process for COVID-19 case investigation and contact tracing has changed throughout Tri-County Health Department's (TCHD) response based on the data systems being used. Prior to December 2, 2020, TCHD used a system developed and managed by our agency staff; beginning December 2, TCHD transitioned to a state-based data system managed by the Colorado Department of Public Health and Environment (CDPHE).

The manner in which data were collected from cases regarding potential COVID-19 exposures differed slightly between TCHD's and CDPHE's data systems. In addition, the transition between systems has caused some interruptions in exposure data reporting due to different process in collecting those data and with each change, the exposure questions have expanded in scope.

Exposure Questions by Investigation System

Tri-County Health Department Investigation System

June 11, 2020 - Dec 1, 2020

Did you attend work (or school, or child in childcare) during your infectious period of (start date) to (end date)?

(yes/no),

What type of job? (Select a category)

Name of your place of employment, OR school, OR child care center where case-child attends This information is just about the case. For example, if the case has a child in childcare, do not put that information here. (free type)

Work Address (free type)

What dates did you attend? (Date)

What is your occupation? (free type)

** (Student Specific) What type of school are you attending? Select grade level

** (Student Specific) What is your current learning environment? InPerson, Remote, Hybrid

** (Student Specific) How would describe your current living situation? At home with parents or family, In a dormitory or similar facility, With Roommates in house/apt, Alone in house/apt

Did you travel in Colorado? If yes: Where did you travel in Colorado? (yes/no), (free type)

Did you travel in the US? If yes: Where did you travel? (yes/no), (free type)

Did you travel internationally? (yes/no)

Did you travel on a cruise ship? (yes/no)

Airport/Airplane (yes/no)

Residence type: Private residence, Institution, Homeless

Contact with a confirmed COVID-19 case? (yes/no)

Were there places you were at for 60 or more minutes where you were in close contact with other people? (yes/no)

If yes: Describe type of event *small private gathering, large private gathering, small public gathering, large public gathering, church/religious gathering, sports practice/game/tournament, protest/rallies, professional sports event, camping/boating, restaurant/café, bar/club, casino/hotel, gym/personal training/workout group, funeral, wedding, school/class/in-person training, hospital/ER/medical appointment, office/work, shopping/flea market, concert/rodeo, out of state travel, recreational facility (parks, zoo, top golf), other*

If yes: Name of setting (free type)

If yes: other exposures, specify (free type)

*Scripts preceding these questions have been removed to reduce the length of this document

**Student specific questions were added to the case investigation Sept 29, 2020

CDPHE Investigation System

*Questions are updated and adjusted as we learn more about cases and individuals activities

Dec 2, 2020 - Current

In the 14 days prior to your illness (or specimen collection if asymptomatic), or at any time since then, did you work or volunteer outside of your home? (yes/no)

What kind of industry do you work or volunteer in? (Healthcare, Emergency Response (Fire, Police, EMS), Grocery Store, Retail Store (not food), Restaurant or Fast Food, Construction, Transportation, Education (Child Care, K-12, or Higher Education Settings), Food Manufacturing or Meat Packing, Manufacturing (not food), Hospitality, Agriculture, Military, Other (please specify below)

What is your occupation? (free type)

What is the name of your employer (business name)? (free type)

Where do you work (work location)? (free type)

What was the last date you worked outside of your home? (date)

Did you work while experiencing symptoms? (Yes, No, Unknown)

Employment Information Notes (free type)

Are you a student or childcare attendee (specifically, is the case a young adult or child who goes to school or is in a childcare setting, such as a daycare)? (Yes, No, Unknown)

School Information Notes (free type)

Travel during the 2 weeks prior to onset of symptoms or at any time since becoming ill (or testing positive, if asymptomatic).

Travel? (yes/no)

What Date? (date)

What location? (free type)

Travel on a cruise ship or vessel as a passenger or crew member? (yes/no)

Spend time on an airplane or in an airport? (yes/no)

Travel Notes (free type)

During the 2 weeks prior to symptom onset or at any time since becoming ill (or testing positive, if asymptomatic), were you living in a group setting? For example, a group home, dormitory, longterm care facility, migrant worker housing, or any other setting where people live in close quarters. (yes/no)

Were you in a correctional facility either during the 2 weeks prior to symptom onset (or positive test, if asymptomatic) or at any time since then? (yes/no)

Are you currently experiencing homelessness, or were you experiencing homelessness

while you were ill or during the 2 weeks prior to becoming ill (or testing positive, if asymptomatic)? (yes/no)

Please provide the total number of people in your household, including yourself.

Household members are people you live with some or most of the time. This might be roommates, family, or others who share living areas including sleeping, bathroom, and kitchen eating areas. (Number)

High Risk Setting Notes (free type)

Did you visit a healthcare setting as a patient but NOT for this illness? (yes/no)

Did you visit a healthcare setting for any reason other than as a patient (e.g., went to someone's appointment or visited someone in the hospital)? (yes/no)

As far as you are aware, did you have contact* with anyone with confirmed or suspected COVID-19? (yes/no)

Did you have exposure where there may have been a cluster or outbreak of cases? (yes/no)

What you did each day from the period 2 weeks prior to symptom onset or at any time since becoming ill (or testing positive, if asymptomatic) *Gathering, Church / Religious Gathering, Sports Practice / Game / Tournament, Protest / Rallies, Sporting Events (including professional sporting events), Camping / Boating / Hunting, Snow Sports (skiing, snowboarding, snow shoeing, etc.), Restaurant / Café, Bar / Club, Casino / Hotel, Gym / Personal Training / Workout Group, Wedding / Funeral / Birthday Party (other similar gathering), Shopping / Flea Market*

Date of activity (date)

Location and details of activity (free type)

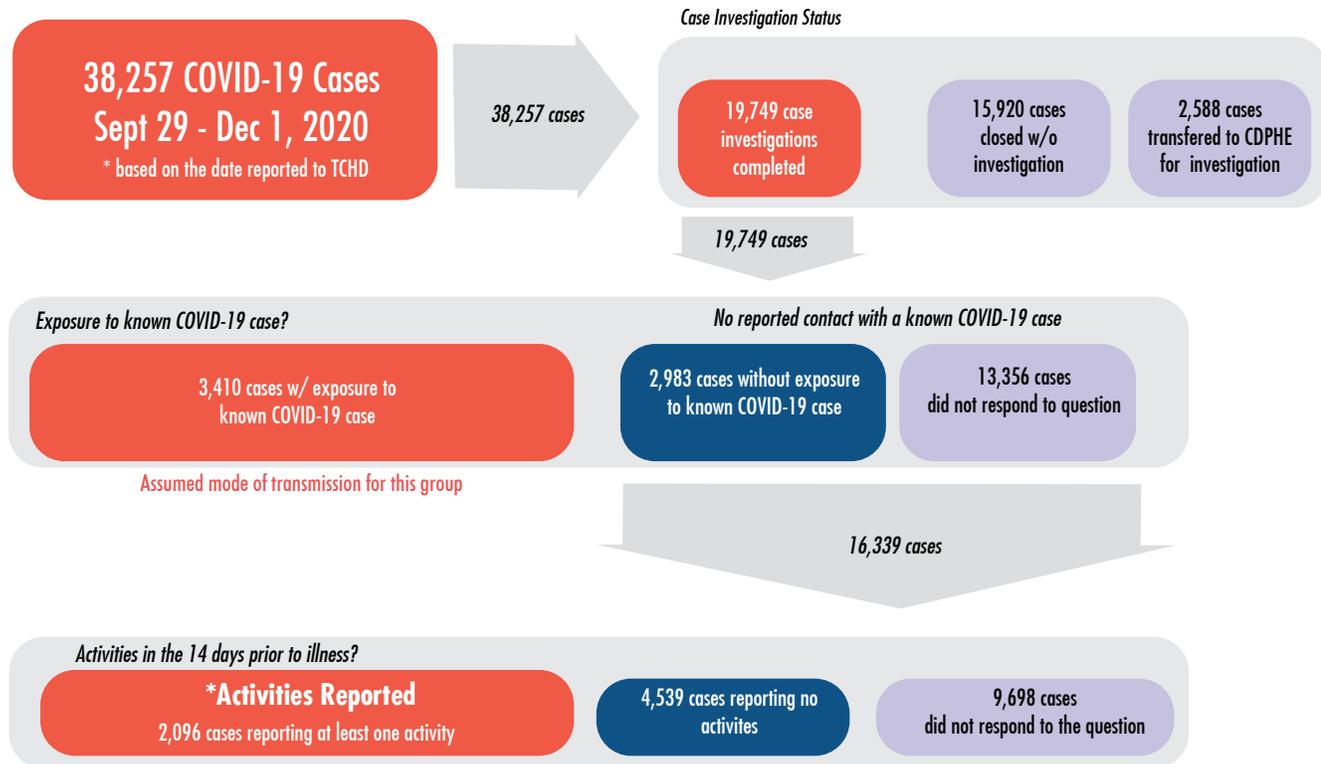
Exposures and Activities Notes (free type)

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Figure 3. Responses to exposure questions asked during case investigations September 29-December 1, 2020



- | | |
|---|---------------------------------|
| 21.2 % Small private gathering | 2.3 % Bar/Club |
| 13.4 % Restaurant/Café | 2.3 % Out of state travel |
| 13.0 % Office/Work (in person) | 1.9 % Recreational Facility |
| 12.5 % Large private gathering | 1.7 % Small public gathering |
| 7.7 % Church/religious gathering | 1.2 % Wedding |
| 4.4 % Large public gathering | 1.2 % Funeral |
| 3.9 % School/Class/In-person training | 1.2 % **Shopping/Flea market |
| 3.2 % Hospital/ER/Medical appointment | 0.7 % Casino/Hotel |
| 2.9 % Other | 0.2 % Professional sports event |
| 2.6 % Gym/personal training/workout group | 0.2 % Concert/Rodeo |
| 2.4 % Sports practice/game/tournament | 0.1 % Protest/Rallies |

* Question about activities only applies to places the individual was for 60 or more minutes where they were in close contact with other people.

** Question about activities does not include grocery shopping or shopping at Big Box retailers.

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and place. However, COVID-19 has a long incubation period which can make it difficult for cases to recall all of their activities. Based on our experience interviewing cases with other diseases, we know that the history of recent activities we get may not be complete in many instances either because of difficulty with recall or reluctance to share information. Hence, while exposure assessment through case interviews can provide local data to supplement scientific studies, this source of information has a number of limitations, including the bias introduced by low-response rates and the potential bias introduced by all self-reported data and thus cannot definitively be used to determine where a case acquired a COVID-19 infection.

Outbreak Investigations

Outbreak investigations can provide important supplemental information to case interviews regarding patterns of local disease transmission. Identification of a facility as having an outbreak often helps with identifying additional cases and can lead to measures that will interrupt the outbreak or prevent similar situations in the future. Defined as > 2 cases epidemiologically related to a common facility over 14 days, outbreaks provide stronger evidence that transmission is occurring within the facility than a single case interview.

Figure 4 provides a summary of recognized outbreaks by county and setting over a recent two-month timeframe. The most common setting was related to school and childcare facilities, with other relatively common ones including manufacturing/construction and offices/indoor workplaces. For most settings, the majority of cases that are linked to an outbreak occur among employees rather than other individuals given difficulty in linking non-employees to specific settings. That people visit certain business or community venues alone or in relatively small groups makes it especially hard to recognize an outbreak compared with larger workplaces and events where more people are exposed at a one time. This problem is magnified because not everyone will report visiting a particular business or activity even if they have done so, making it harder to recognize a connection. Likewise, workers in retail and food service establishments are not likely to know and report when they have been exposed to COVID-19 by patrons.

While outbreaks provide greater certainty about exposures resulting in new cases than case interviews, it is important to understand that only a small fraction ($< 1\%$) of all cases are identified as part of an outbreak due to inability to identify everyone who might be infected in a specific setting. Given this reality, although case interview data have the limitations noted above, they provide exposure data on a far larger proportion of our cases and thus gives us the most meaningful insight into likely exposures related to acquiring COVID-19. Notably, because outbreak data are more prominently noted on CDPHE's website than individual case interview data, several recent editorials and op-eds in Colorado periodicals have cited very low percentages of cases found to be linked to restaurants, mistakenly concluding that they are not important sites of community transmission (Kedl, The Gazette editorial). It is important to understand that the patterns in the data we have on sources of COVID-19 outbreaks is significantly different from our findings from case interviews of COVID-19 cases NOT associated with an outbreak.

Conclusion

Public health's understanding of exposure risk and transmission settings is typically based on several sources of information, including scientific studies, case investigations, and reported outbreaks, as well as biologic plausibility based on knowledge about COVID-19 transmission dynamics. It is important to note that for each reported case, there are many others that go undetected and for which we have no information. It is often not possible to determine with certainty from public health case and outbreak investigations alone where a person acquired COVID-19 in the community. For this reason, it can be difficult to accurately estimate the burden or risk of transmission associated with venues such as restaurants, bars, other service establishments, and other community settings. However, triangulating information from each of the above sources—all of which should improve as we gain greater experience with the control of this novel infectious disease—allows us to make optimally evidence-based decisions to protect individual and community health.

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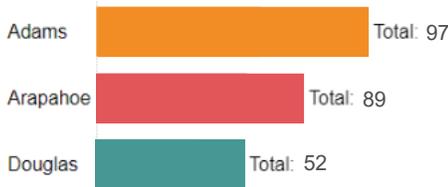
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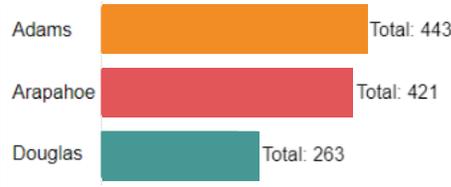
Figure 4. Outbreaks reported from CDPHE October 9-December 9, 2020

Summary of Outbreaks in Adams, Arapahoe, and Douglas Counties (Oct 9 -Dec 9)

Total Outbreaks

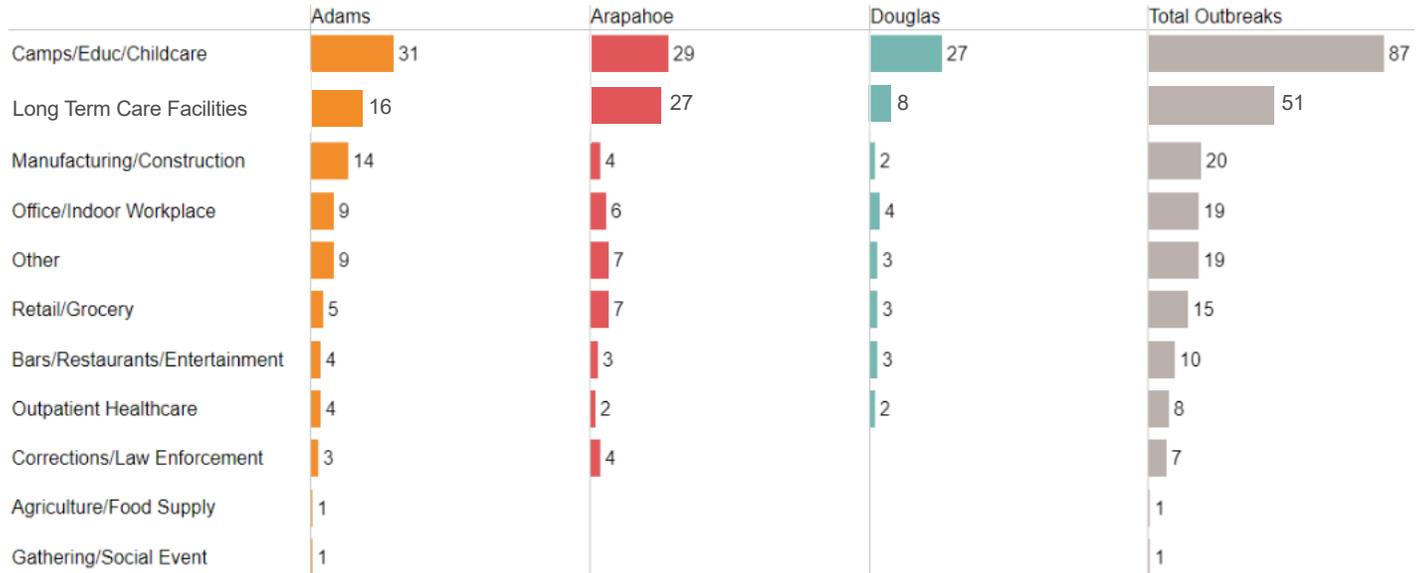


Total Cases Attributed to Outbreaks

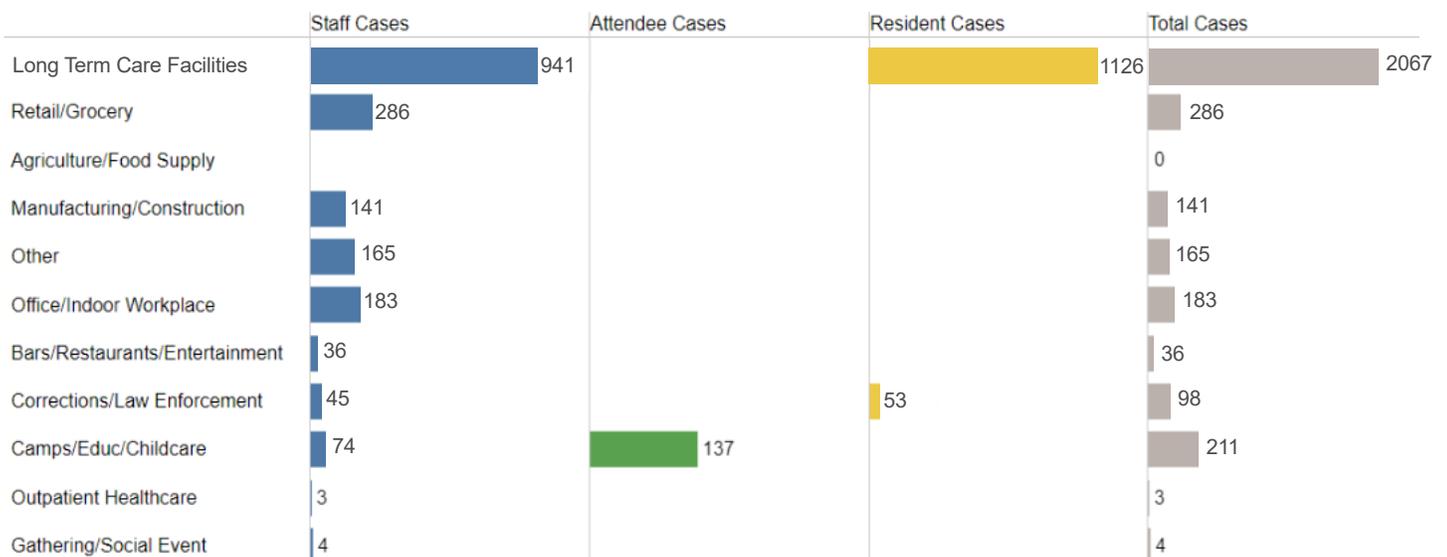


*Total cases does not include long term care facility cases

Outbreaks by Setting (Oct 9 -Dec 9)



Confirmed and Probable Cases by Setting (Oct 9 -Dec 9)



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