Investigation and public health response to a COVID-19 outbreak in a rural resort community — Blaine County, Idaho, 2020

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Short title: COVID-19 outbreak in Blaine County, Idaho

Abstract

Blaine County, Idaho, a rural area with a renowned resort, experienced an outbreak of novel coronavirus disease (COVID-19). We undertook an epidemiologic investigation to describe the outbreak and guide public health action. Confirmed cases of COVID-19 were identified from reports of SARS-CoV-2-positive laboratory test results to South Central Public Health District.
Information on symptoms, hospitalization, recent travel, healthcare worker status, and close contacts was obtained by medical record review and patient interviews. Viral sequence analysis was conducted on a subset of available specimens. During March 13–April 10, 2020, a total of 451 COVID-19 cases occurred among Blaine County residents (1,959 cases per 100,000 population). An additional 37 cases occurred in out-of-state residents. Among the 451 COVID-19 patients, the median age was 51 years (Interquartile range [IQR]: 37–63), 52 (11.5%) were hospitalized, and 5 (1.1%) died. The median duration between specimen collection and a positive laboratory result was 9 days (IQR: 4–10). Forty-four (9.8%) patients reported recent travel. Healthcare workers comprised 56 (12.4%) cases; 33 of whom worked at the only hospital in the county, leading to a 15-day disruption of hospital services. Of 562 close contacts monitored by public health authorities, 22 (3.9%) had laboratory-confirmed COVID-19 and an additional 29 (5.2%) experienced compatible symptoms. Sequencing results from 34 Idaho specimens supported epidemiologic findings indicating travel as a source of SARS-CoV-2, and identified multiple lineages among hospital workers. Community mitigation strategies included school and resort closure, stay-at-home orders, and restrictions on incoming travelers. COVID-19 outbreaks in rural communities can disrupt health services. Lack of local laboratory capacity led to long turnaround times for COVID-19 test results. Rural communities frequented by tourists should consider implementing restrictions on incoming travelers among other mitigation strategies to reduce COVID-19 transmission.

**Introduction**

Novel coronavirus disease (COVID-19) was identified in Wuhan City, China in December 2019 and soon spread internationally, with the first case in the United States reported in Washington state on January 20, 2020. Rural areas might be particularly vulnerable to the COVID-19
pandemic, because people living in rural areas in the US tend to be older, have higher rates of underlying conditions, and less access to health services.\textsuperscript{2,3} Approximately 15\% of Americans live in rural areas. The health gap between rural and urban US was highlighted by a 2017 report identifying higher age-adjusted death rates for the five leading causes of death in nonmetropolitan areas.\textsuperscript{4} Rural health departments face unique challenges related to serving the needs of populations that experience poorer health outcomes in large geographical areas with limited resources.\textsuperscript{3}

Idaho, located in northwest region of the US, has an estimated population of approximately 1.79 million, of which 32.4\% reside in rural areas.\textsuperscript{5} Idaho is divided into 44 counties, 32 (73\%) of which are classified as rural\textsuperscript{6}, and seven autonomous public health districts comprising 4 to 8 counties each. On March 13, 2020, a case of confirmed COVID-19 in a Blaine County resident was reported to South Central Public Health District (SCPHD); this was the second case identified in Idaho. Blaine County is a scenic, mountainous rural area with an estimated 23,021 residents, of whom 23.5\% are Hispanic or Latino.\textsuperscript{7} It is a popular weekend and vacation destination, with abundant outdoors and cultural activities, including the Sun Valley Resort, an internationally renowned ski area. An estimated 32\% of housing units are occupied seasonally as second homes or short-term rentals.\textsuperscript{8} The county is economically diverse, with a 2018 median household income of $51,968 and a poverty rate of 14\%.\textsuperscript{9} In this report, we present the epidemiology of the COVID-19 outbreak in Blaine County including patient characteristics, hospitalization rates, travel history, and healthcare worker status. Sequence analysis of available SARS-CoV-2 specimens supported epidemiological findings. We examine positive COVID-19 test turnaround times and describe the interruption of hospital services, and the public health response.
Methods

Case identification and investigation

A confirmed COVID-19 case was defined as detection of SARS-CoV-2 RNA in a clinical specimen (nasopharyngeal swab, nasal swab, or oropharyngeal swab) by using real-time reverse transcriptase polymerase chain reaction (RT-PCR), a molecular amplification detection test. Confirmed COVID-19 cases were identified via reporting of SARS-CoV-2-positive laboratory tests to SCPHD. Case information, including electronic laboratory reports, was collected and stored using Idaho’s National Electronic Disease Surveillance System (NEDSS) Base System (NBS), a Centers for Disease Control and Prevention (CDC)-supported integrated disease surveillance system. Initial investigation determined the usual residence of the patient to confirm reporting jurisdiction, as cases in out-of-state residents are not included in official case counts per standard reporting procedures.10

Data on symptom onset, hospitalization, recent travel, healthcare worker status, and close contacts were obtained by medical record review and interviews with patients or their proxies. Healthcare workers were defined as paid employees or volunteers who worked at a hospital or other healthcare facility, pharmacists, emergency medical service responders, and firefighters with emergency medical technician certification.

Initially, close contacts were defined as household members and others who spent ten minutes or more within a six feet of a patient from 1 day prior to symptom onset in the patient with COVID-19; this time frame was expanded to 2 days prior to symptom onset following further evidence of presymptomatic transmission.11 Close contacts were monitored through 14 days after exposure.

Viral sequence analysis
Following diagnostic testing at the Idaho Bureau of Laboratories, aliquots of viral transport media were preserved at -80°C until a subset was selected for sequencing. Selected samples were preserved in Zymo DNA/RNA Shield, a proprietary reagent which stabilizes nucleic acid samples at ambient temperatures, and sent to the University of New Mexico Center for Global Health for whole genome sequence analysis. Sequencing was conducted using the ARCTIC protocol, version 3 and assembly was performed by the Center for Global Health. All finished sequences were uploaded with required metadata to the GISAID EpiCoV™ (S1 Table).

All complete, high coverage, SARS-CoV-2 sequences from samples collected during March 1–March 12, 2020 in the USA were downloaded from the GISAID database (S2 Table). This period represents the 10 days prior to the first laboratory confirmed COVID-19 case in Idaho. Idaho sequences from Blaine County were BLASTed against this subset of sequences using the MEGABLAST tool within Bionumerics. The top two hits by sequence identity were selected for further analysis. The BLAST hits, Blaine County sequences, and sequences from other Idaho counties (collected March 1–April 1, 2020) were compared using Bionumerics Multiple Sequence Alignment Tool and clustered using a Minimum Spanning Tree.

Census block group analysis

Patient addresses were geocoded using Texas A&M Geocoding Services (http://geoservices.tamu.edu/Services/Geocode/) to obtain census block group identifiers. Block groups are statistical divisions of census tracts that typically cover contiguous areas and contain between 600 and 3,000 people. For each block group, median household income, the proportion of Hispanic or Latino residents, and renter-occupied housing units was obtained using
Community mitigation measures

Information on school and business closures and governmental orders was obtained from press releases. Data on the estimated proportion of county residents staying at home were made publicly available by SafeGraph, Inc.\textsuperscript{15}

Data analysis

Data were analyzed using Stata version 14.2 and graphs created in Excel. Data were reported as percentages for categorical variables and median, interquartile range (IQR), and range for continuous variables.

Research determination

COVID-19 is a reportable disease under Idaho Department of Health and Welfare Rules, IDAPA 16.02.10. Case investigation, data collection, and analysis were conducted for public health purposes, and the CDC determined the investigation to be nonresearch as defined in 45 CFR 46.102. As such, ethical approval and informed consent was not required.

Results

Four weeks after the first case was identified, a total of 452 confirmed cases were reported among Blaine County residents. One case was excluded because the patient was temporarily residing in another state during the outbreak. An additional 37 cases were identified among out-of-state residents who were tested in Blaine County; these included 26 residents of areas where
COVID-19 outbreaks were known to have been occurring (15 patients from King County, Washington and 11 patients from counties in California where community spread had occurred). Blaine County experienced one of the highest rates of COVID-19 cases per capita (1,959/100,000) in the US at the time of this investigation. Of the 451 patients, 239 (53.0%) were female. The median age at onset was 51 years (IQR: 38–63 years), with 5 (1.1%) patients aged <18 years, 169 (37.4%) aged 18–44 years, 172 (38.1%) aged 45–64 years, and 106 (23.5%) aged >65 years. Race and ethnicity data indicated that 332 (73.5%) patients were white, 9 (2.0%) other race, and 73 (16.2%) Hispanic or Latino, with data missing for 37 (8.2%) patients. Among 447 patients with symptom data available, 446 (99.8%) reported at least one symptom. Most commonly reported symptoms included cough (n = 299, 66.9%), fever (measured or subjective; n = 275, 61.5%), myalgia or body aches (n = 208, 46.5%), fatigue (n = 205, 45.9%), headache (n = 164, 36.7%), and shortness of breath (n = 137, 30.6%). Other reported symptoms included chills (n = 111, 24.8%), loss of taste or smell (n = 101, 22.6%), sore throat (n = 83, 18.6%), diarrhea (n = 83, 18.6%), congestion (n = 81, 18.1%), pain or tightness in chest (n = 55, 12.4%), nausea or vomiting (n = 54, 12.1%), loss of appetite (n = 39, 8.7%), and runny nose (n = 36, 8.1%).

A total of 52 (11.5%) patients were hospitalized. The number and proportion of patients who were hospitalized increased with age, ranging from no (0%) patients aged <18 years, 5 (3.0%) patients aged 18–24 years, 14 (8.1%) aged 45–64 years, and 33 (31.4%) persons aged >65 years. The median length of admission was 5 days (IQR: 2–11 days, range = 1–38 days). Of 50 hospitalized patients with available data, 21 (42%) were admitted to the intensive care unit. Overall, five (1.1%) patients died; all were aged >60 years and 4 (80%) were male.
The median duration between symptom onset and specimen collection was 5 days (IQR: 2–8; range = 0–24). The median duration from specimen collection to reporting of a positive SARS-CoV-2 laboratory result was 9 days (IQR: 4–10 days; range = 1–22 days): 2 days (IQR: 1–3; range = 1–5) for high-priority specimens (e.g., from healthcare workers and hospitalized patients) tested by the Idaho Bureau of Laboratories (n = 41), and 9 days (IQR: 5–10; range = 1–22) for specimens tested at commercial laboratories (n = 410). Idaho Bureau of Laboratories began SARS-CoV-2 testing on March 2, and regional commercial laboratories began SARS-CoV-2 testing on March 5. Testing availability increased in Blaine County following the March 17 opening of a COVID-19 screening and testing center adjacent to the sole hospital in the county (Hospital A) and operated by their health system.

At least 11 cases were linked to three events (a ski festival and two private events) held during the first week of March that attracted many out-of-state and international travelers. Data on recent travel history and healthcare worker status were available for 450/451 (99.8%) cases. Of these, 44 (9.8%) patients reported travel from another state or country during the 2 weeks prior to symptom onset. In total, 56 (12.4%) cases were among healthcare workers, 33 of whom worked at Hospital A, a critical access hospital (a designation given to eligible rural hospitals by the Centers for Medicare and Medicaid Services). Affected hospital staff held clinical and non-clinical roles throughout the hospital.

Figure 1 illustrates the epidemiologic curve for COVID-19 illness onset among 447 patients with available data, including healthcare workers. Hospital A suspended normal operations on March 20, one day after community spread in Blaine County was announced. Hospital A’s emergency department and COVID-19 screening and testing center remained open; however, non-emergent appointments and procedures were postponed, inpatient services discontinued, and affiliated
community clinics closed. Patients requiring admission were transported by emergency medical services to the nearest regional hospital located 78 miles away. Hospital A resumed limited services on April 3. S3 Figure depicts hospitalizations over time by date of admission.

**Figure 1.** Epidemic curve showing cases of COVID-19 in Blaine County, Idaho residents by date of illness onset (n = 447). Cases in health care workers (HCW) are shown in orange and non-HCW in blue. Onset dates from cases reported from March 13–April 10, 2020 are included on the graph.

Analysis of SARS-CoV-2 sequences was conducted on a convenience sample of available specimens from Idaho patients diagnosed with COVID-19, including 23 from Blaine County residents and 11 from other counties in Idaho. Several genomes from Blaine County residents were closely related to sequences identified in other states including New York, Louisiana, Mississippi, and Rhode Island (Figure 2). Three genomes from patients who were residents of other Idaho counties but spent time in Blaine County prior to illness onset were closely related to genomes from Blaine County residents (Figure 2). Analysis of viral sequences from Hospital A staff members identified three SARS-CoV-2 lineages, suggesting that the outbreak among Hospital A staff was not due to a single source (S4 Figure).

**Figure 2.** Minimum spanning tree showing SARS-CoV-2 sequences from Blaine County residents who worked at Hospital A (n = 14, dark blue), Blaine County residents who did not work at Hospital A (n = 9, light blue), residents of other Idaho counties with no travel to Blaine County (n = 7, light green), residents of other Idaho counties who traveled in Blaine County prior to illness (n = 3, dark green), related sequences from other US states identified by BLAST (n =...
19, white), and the reference sequence from Wuhan, China (black). GSAID accession numbers are listed in S1 Table.

Census block group estimates were used to examine geographic distribution and community characteristics for 402 (89.1%) COVID-19 patients whose addresses were matched to a census block group. At least one case occurred in each of the 13 census block groups in Blaine County (S5 Table). Community characteristics varied substantially by census block group. Over half (n = 216, 53.7%) of cases occurred among residents of four census block groups. Within these four census block groups, the proportion of the population that are Hispanic or Latino ethnicity ranged from 4.6% to 47.1% and the proportion of persons in renter-occupied housing ranged from 11.1% to 49.2%.

Public health authorities, the county government, and local stakeholders undertook several measures to contain the outbreak and limit community transmission. SCPHD conducted contact tracing and monitored 562 close contacts of Blaine County cases; 22 (3.9%) of these close contacts tested positive for COVID-19 and an additional 29 (5.2%) became symptomatic but were not tested. During March 9–April 10, SCDPH staff worked 4,074 hours on COVID-19 emergency response. This response supported all eight counties in the jurisdiction, however 452/495 (91.3%) cases occurred in Blaine County. Volunteers spent 158 hours conducting contact monitoring activities. Blaine County School District closed school buildings on March 14. Sun Valley Resort closed for the season on March 16. The Idaho Department of Health and Welfare (IDHW) issued an order of isolation for Blaine County residents on March 20. Central District Health, whose jurisdiction borders SCPHD and includes the state capital of Boise (less than three hours driving time from Sun Valley Resort) issued a statement on March 22 instructing anyone with recent travel to Blaine County to shelter in place following identification
of four COVID-19 cases among residents who had recently been in Blaine County. On March 25, IDHW issued a statewide order to self-isolate. On March 27, Blaine County issued an order with additional restrictions including the prohibition of non-essential travel into or out of Blaine County and 14-day self-quarantine for residents or visitors coming from out of state. Figure 3 shows the timing of these measures along with cumulative case counts. Publicly accessible data from SafeGraph, Inc. reported county-level percentage of people staying home all day (based on GPS data from anonymous mobile devices) indicating that the proportion of people staying at home increased steadily from March 15 through early April (Figure 4).

**Figure 3.** Timeline of the COVID-19 outbreak in Blaine County, Idaho depicting cumulative number of confirmed COVID-19 cases by date of report and implementation dates for key community mitigation measures. Cases reported during March 13–April 10, 2020 are included in the figure.

**Figure 4.** Daily estimates of the percent of people in Blaine County, Idaho staying at home all day during March 1–April 10, 2020. Data were obtained from SafeGraph, Inc. and are based upon global positioning system data from mobile devices. Dates of isolation orders and travel restrictions are indicated on the graph.

**Discussion**

The start of the outbreak in Blaine County was likely linked to travel to the ski resort, high rates of seasonal residence, and three events held during the first week of March which attracted numerous out-of-state attendees. COVID-19 outbreaks have been identified in mountain resort communities elsewhere in the US and in Europe. The epidemic curve indicated a peak in illness onset in mid-March, consistent with exposures occurring during the two weeks prior. The
median incubation period of COVID-19 is estimated to be 5 days, and of exposed people who experience illness, the vast majority display symptoms within 14 days.¹⁸

Several additional COVID-19 cases identified in Blaine County occurred in residents of King County, Washington and counties in California where community spread had occurred prior to detection of the first COVID-19 case in Idaho. Cases in out-of-state residents, although not included in official case counts, are indicative of frequent travel from the west coast and likely contributed to the level of transmission observed. Blaine County was the first county in Idaho to announce community spread of COVID-19 despite being the 17th most populous county.

Interstate spread has been implicated in SARS-CoV-2 importations in other regions of the United States. Sequence analysis of SARS-CoV-2 found that 7 of 9 viral genomes from early COVID-19 cases in Connecticut clustered with a clade dominated by viruses from cases in Washington state.¹⁹ Sequence analysis of SARS-CoV-2 from Blaine County supported the epidemiological findings, as several genomes clustered with viruses from other states, suggestive of links to travel. Because certain states were likely overrepresented in the database of available sequences from early in the pandemic, and Idaho sequences indicate multiple introductions of SARS-CoV-2, the geographic source of the outbreak could not be identified. Limitations on the use of viral sequencing for this epidemiologic investigation include that only a subset of specimens tested and stored at the state public health laboratory were available for sequence analysis, as commercial laboratories typically do not store specimens.

Nearly 13% of cases in Blaine County occurred among healthcare workers. This proportion is consistent with data from 12 US states reporting healthcare profession status on >80% of COVID-19 case reports, in which healthcare personnel accounted for 11% of cases.²⁰ Healthcare workers from Hospital A held both clinical and non-clinical roles, and it was not possible to
determine whether they were infected in the community or in the workplace. Sequencing analysis of SARS-CoV-2 from Hospital A staff indicated multiple exposures rather than a point-source outbreak caused by a single viral strain. Rural counties have fewer healthcare workers and facilities compared with urban areas, and the high number of affected workers from Hospital A led to temporary cessation of inpatient services at the only hospital in the county. Work exclusion of Hospital A staff who were identified as close contacts of COVID-19 cases also contributed to the staffing shortage. As Hospital A is part of a larger and well-resourced health system, it was able to remain partially open and received support from partner hospitals. Hospital planning for community spread of COVID-19 and developing strategies for mitigating staffing shortages are critical for maintaining healthcare access in rural areas. In Thailand, a rural hospital closed following confirmed cases of COVID-19 in three medical personnel and quarantine of the remaining 21 medical personnel of the hospital. A 2007 study on hospital preparedness for pandemic influenza in Ontario, Canada determined that small and rural hospitals were especially disadvantaged and identified challenges of smaller and rural hospitals as the top priority area for a proposed pandemic preparedness learning portal. A survey of COVID-19 preparedness among hospitals in Idaho identified inconsistent implementation of CDC guidelines for infection prevention, and only 8 of 21 (38%) critical access hospitals had a written respiratory protection program. Limited isolation facilities pose a challenge, as only 2 (10%) critical access hospitals had an airborne infection isolation room.

The CDC has developed relevant resources including hospital preparedness checklist for COVID-19 (https://www.cdc.gov/coronavirus/2019-ncov/hcp/hcp-hospital-checklist.html). Telehealth is another strategy that can be leveraged to help rural hospitals during the COVID-19 pandemic by expanding healthcare capacity, reducing potential exposures of healthcare workers,
and linking with tertiary hospitals to provide additional staffing support and reduce unnecessary patient transfers.24

Case identification and contact tracing efforts were hindered by long lag times between symptom onset and receipt of laboratory results. Many contacts were not notified of their potential exposure until the second week of the 14-day isolation period. Delays in testing turnaround times might be more prominent in predominantly rural states like Idaho, where commercial testing during the investigation time frame was only available at regional laboratories located in other states. Public health laboratory support enabled faster turnaround times for high-priority specimens. Expansion of diagnostic testing availability, including at hospital diagnostic laboratories, point-of-care testing, and commercial laboratories has led to shorter turnaround times in Idaho. A recent commentary advocated for expanded testing in rural areas, as the authors’ analysis found that states with higher prevalence of COVID-19 risk factors (hypertension, diabetes, and lung cancer), which tend to be more common in rural populations, had lower overall testing rates, and medically vulnerable people in rural areas have greater potential for severe outcomes.25 Contact tracing, which has been highlighted by the National Association of County & City Health Officials as a key component of safely easing social distancing measures, depends on the ability to detect COVID-19 cases in a timely manner.26 Social distancing and stay-at-home orders remain valuable tools for reducing transmission within communities affected by COVID-19, especially in areas with limited or delayed testing. The increase in cumulative cases began to slow approximately two weeks following implementation of the county order of isolation. In our experience, after the implementation of community mitigation measures, most contacts identified were household members.
Evidence from four US metropolitan areas including Seattle (King County) indicated that community mobility declined following implementation of stay-at-home orders. Placing restrictions on incoming travelers may help slow the spread of COVID-19 into rural areas. In Blaine County, mitigation strategies including closure of the ski resort and a county-wide isolation order began within a week of the first reported case. The estimated percentage of people staying at home, obtained via anonymous cellular phone data, increased following orders of isolation, consistent with community mobility studies in other areas.

Part-time residents are typically not included in population estimates, limiting the accuracy of disease incidence estimates in areas where tourism and seasonal residence are common, such as Blaine County, where the ski season attracts tourists and seasonal workers. Cases of COVID-19 among visitors to Blaine County who were tested outside of Idaho were not captured in our analysis. Additionally, this report only includes information on laboratory-confirmed cases, as reporting and investigation of probable cases, guided by the Council of State and Territorial Epidemiologists, began after the data collection period ended. The rapid rise in reported cases seen in late March and early April might reflect expanded testing availability as well as disease transmission. However, testing during this time was primarily conducted on symptomatic persons, and testing of children was relatively uncommon. Data on underlying conditions were not available, and relationships between patients (other than cases in contacts under monitoring) were not systematically captured, although several household clusters were identified.

Geocoding patient addresses and census block group data indicated that the outbreak was not limited to a specific geographical region of the county, and it affected communities of varying socio-economic characteristics. Of patients with available race and ethnicity information, 17.6% were Hispanic or Latino, compared with 23.5% of the overall Blaine County population. This
slight underrepresentation might be because of several factors including disparities in access to health care and testing.\textsuperscript{29}

Using mobile phone data to estimate mobility has known limitations including incomplete representation.\textsuperscript{30} It is challenging to directly assess the impact of community mitigation measures on disease transmission, because of the time lag between exposure, symptom onset, and case detection, and the multitude of unmeasured factors that might influence COVID-19 transmission and case detection. The Blaine County outbreak attracted intense local and national media coverage that could have encouraged residents’ adherence to stay-at-home orders.\textsuperscript{30,31}

Conclusions

Rural communities frequented by travelers can be heavily impacted by COVID-19, leading to disruption in available health services. Rural hospitals should develop COVID-19 preparedness plans that include strategies for mitigating staffing shortages. Improving COVID-19 testing availability and turnaround times will help rural health departments and other stakeholders detect and respond to COVID-19 outbreaks. In addition to stay-at-home orders and other policies targeting local residents, closing tourist attractions and implementing restrictions on incoming travelers can be considered as strategies for limiting community spread in rural areas prior to widespread availability of COVID-19 vaccines.

Supporting Information

S1 Table. SARS-CoV-2 sequences from Idaho and others included in Figure 2.

S2 Table. SARS-CoV-2 sequences from GSAID used in analyses.

S3 Figure. Hospitalization of Blaine County, Idaho residents for COVID-19 by date of admission (n = 52).

S4 Figure. SARS-CoV-2 lineages identified among Hospital A staff.
**S5 Table.** Distribution of confirmed COVID-19 cases (n = 402) and census block group characteristics for Blaine County, Idaho.

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**References**

1. Holshue ML, DeBolt C, Lindquist S, et al. First case of 2019 novel coronavirus in the United States. *N Engl J Med*. 2020;382(10):929-936. doi:10.1056/NEJMoa2001191

2. Centers for Disease Control and Prevention. About rural health. https://www.cdc.gov/ruralhealth/about.html. Accessed May 11, 2020.

3. Leider JP, Meit M, McCullough JM, et al. The state of rural public health: enduring needs in a new decade. *Am J Public Health*. 2020 Jul 16;e1-e8. doi: 10.2105/AJPH.2020.305728.

4. Moy E, Garcia MC, Bastian B, et al. Leading causes of death in nonmetropolitan and metropolitan areas - United States, 1999-2014. *MMWR Surveill Summ*. 2017;66(1):1-8. doi:10.15585/mmwr.ss6601a1
5. United States Department of Agriculture Economic Research Service. State fact sheets, Idaho. 
https://data.ers.usda.gov/reports.aspx?StateFIPS=16&StateName=Idaho&ID=17854. Accessed June 30, 2020.

6. United States Department of Agriculture Economic Research Service. Idaho - Rural Definitions: State-Level Maps
https://www.ers.usda.gov/webdocs/DataFiles/53180/25567_ID.pdf?v=0

7. United States Census Bureau. QuickFacts Blaine County, Idaho. 
https://www.census.gov/quickfacts/fact/table/blainecountyidaho/PST120219. Accessed June 1, 2020.

8. *Blaine County Comprehensive Plan - Chapter 2 Housing.*
https://www.co.blaine.id.us/DocumentCenter/View/3512/Chp-2-Housingpdf.

9. United States Census Bureau. Blaine County, Idaho. 
https://data.census.gov/cedsci/profile?q=Blaine County, Idaho&g=0500000US16013&tid=ACSDP5Y2018.DP05. Accessed May 11, 2020.

10. Centers for Disease Control and Prevention. *Revised Guidelines for Determining Residency for Disease Notification Purposes.* https://wwwn.cdc.gov/nndss/document/11-SI-04.pdf.

11. Wei WE, Li Z, Chiew CJ, Yong SE, Toh MP, Lee VJ. Presymptomatic Transmission of SARS-CoV-2 — Singapore, January 23–March 16, 2020. *MMWR Morb Mortal Wkly Rep.* 2020;69(14):411-415. doi:10.15585/mmwr.mm6914e1
12. DNA Pipelines R&D, Farr B, Rajan D, et al. COVID-19 ARTIC v3 Illumina library construction and sequencing protocol. protocols.io. 2020.

13. Elbe S, Buckland-Merrett G. (2017) Data, disease and diplomacy: GISAID’s innovative contribution to global health. Glob Chall. 2017 Jan 10;1(1):33-46. doi: 10.1002/gch2.1018.

14. United States Census Bureau. Glossary. https://www.census.gov/programs-surveys/geography/about/glossary.html. Accessed May 11, 2020.

15. SafeGraph. Social distancing metrics. https://docs.safegraph.com/docs/social-distancing-metrics. Published 2020. Accessed April 17, 2020.

16. Epi-X report: CDPHE recommends self-quarantine for anyone leaving Colorado ski resort communities -- March 15, 2020. https://epix2.cdc.gov/v2/Reports/Display.aspx?id=84755. Published 2020.

17. Correa-Martinez CL, Kampmeier S, Kumpers P, et al. A pandemic in times of global tourism: superspreading and exportation of COVID-19 cases from a ski area in Austria. J Clin Microbiol. 2020;(April):1-8. doi:10.1128/JCM.00588-20

18. Lauer SA, Grantz KH, Bi Q, et al. The incubation period of Coronavirus Disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. Ann Intern Med. 2020;2019. doi:10.7326/m20-0504

19. Fauver JR, Petrone ME, Hodcroft EB, et al. Coast-to-coast spread of SARS-CoV-2 during the early epidemic in the United States. Cell. 2020;181:1-7. doi:10.1016/j.cell.2020.04.021
20. CDC COVID-19 Response Team. Characteristics of Health Care Personnel with COVID-19 — United States, February 12–April 9, 2020. *Morb Mortal Wkly Rep.* 2020;69(15):477-481.

21. Mungmunpuntipantip R, Wiwanitkit V. A coronavirus disease 2019 (COVID-19) outbreak in a hospital and hospital closure: A note. *Infect Control Hosp Epidemiol.* 2020;2019:1-3. doi:10.1017/ice.2020.194

22. Zoutman DE, Ford BD, Melinyshyn M, Schwartz B. The pandemic influenza planning process in Ontario acute care hospitals. *Am J Infect Control.* 2010;38(1):3-8. doi:10.1016/j.ajic.2009.10.002

23. Kanwar A, Heppler S, Kanwar K, Brown C. A Survey of SARS-CoV-2 Preparedness Among Hospitals in Idaho. *Infect Control Hosp Epidemiol.* 2020:1-25. doi:10.1017/ice.2020.218

24. Gutierrez J, Kuperman E, Kaboli PJ. Using Telehealth as a Tool for Rural Hospitals in the COVID-19 Pandemic Response. *J Rural Health.* 2020:1-7. doi:10.1111/jrh.12443

25. Souch JM, Cossman JS. A Commentary on Rural-Urban Disparities in COVID-19 Testing Rates per 100,000 and Risk Factors. *J Rural Health.* 2020;9:1-6. doi:10.1111/jrh.12450

26. National Association of County & City Health Officials. *NACCHO Position Statement: Building COVID-19 Contact Tracing Capacity in Health Departments to Support Reopening American Society Safely.*

27. Lasry A, Kidder D, Hast M, Poovey J, Sunshine G, Winglee K. Timing of Community Mitigation and Changes in Reported COVID-19 and Community Mobility — Four U.S.
Metropolitan Areas, February 26–April 1, 2020. *Morb Mortal Wkly Rep.* 2020;69(15):451-457.

28. Turner K, Davidson SL, Collins J, Park SY, Pedati CS. *Standardized Surveillance Case Definition and National Notification for 2019 Novel Coronavirus Disease (COVID-19).* 2020. Council of State and Territorial Epidemiologists

29. Henning-Smith C, Tuttle M, Kozhimannil KB. Commentary Unequal Distribution of COVID-19 Risk among Rural Residents by Race and Ethnicity. *J Rural Heal.* 2020;1-5. doi:10.1111/jrh.12463

30. Ames M. Why an Idaho Ski Destination Has One of the Highest COVID-19 Infection Rates in the Nation. *New Yorker.* April 3, 2020.

31. Witte G. Tourists brought prosperity to an Idaho ski valley. They also brought covid-19. *The Washington Post.* April 1, 2020.
