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Evaluation of Public Health Emergency Orders and Reported COVID-19 Rates in the Municipality of Anchorage, Alaska, June – August, 2020

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Executive Summary:

This report summarizes changes in the COVID-19 epidemic in Anchorage following Emergency Orders (EOs) enacted to reduce virus transmission and thus prevent excess severe illnesses and deaths. Following an EO to wear facial covering (masks) in most public locations, self-reported mask use increased, and the growth of the epidemic slowed. After another EO that restricted the number of persons allowed in public venues and the subsequent closure of those venues, daily case counts declined and maintained a declining pattern while these EOs were in effect. The data presented here indicate that the local EOs, a mask mandate, and targeted restrictions on gathering locations in Anchorage appear to have contributed to decreasing SARS-CoV-2 transmission rates.

Background

SARS-CoV-2 infections are transmitted primarily through respiratory droplets and, without vaccines or curative treatments, communities have used a variety of non-pharmaceutical interventions (NPIs) to reduce transmission and control the epidemic. These strategies have included travel restrictions, public school closures, business and public venue closures, gathering limitations, mask use requirements, and stay-at-home orders. Among NPIs that have demonstrated effectiveness, masks are the least disruptive to the economy. Studies have shown masks to be effective in filtering respiratory droplets and aerosols, thereby decreasing the risk of person-to-person viral transmission.[1-3] During the epidemic, evidence supporting mask use has advanced from modeling predictions to case studies to observational epidemiological studies.[1,4-6]

Transmission of SARS-CoV-2 is facilitated by close proximity of extended duration between an infectious individual and a susceptible contact. Environments where social mixing among persons of different households create conditions favorable for virus transmission. Crowded public venues, restaurants, and bars have been frequently implicated as locations for such transmission to occur,[7] and when restrictions are put in place, significant reductions in transmissions have been noted.[8] In an effort to control the accelerating epidemic during the summer of 2020, the Municipality of Anchorage (MOA) issued Emergency Orders (EOs) requiring mask use in public settings, followed by occupancy limitations at public venues, and closure of public venues.[9]

Models of infectious disease epidemics predict an exponential increase in cases if nothing is done to intervene. Methods to evaluate interventions during the COVID-19 epidemic have included evaluating changes in population-level incidence rates, changes in daily growth rates, and changes in the effective reproductive number (R_t).[6,8,10,11] The daily growth rate can be calculated using the natural log of cumulative daily cases minus the log of cumulative daily cases from the day before. Growth rates can be expressed as a percentage growth per day (either positive or negative). In this way, epidemic growth rates are analogous to calculating a daily compound interest rate. R_t is an estimate of the average number of persons each COVID-19 case will infect. Because R_t can change based on human behavior, it is a common measure of transmission dynamics in epidemics. R_t values >1 indicate increasing case counts and exponential growth, while R_t values <1 indicate that daily case counts are decreasing. R_t can be indirectly calculated using daily growth rates or using daily case counts and estimates of the serial interval.[12,13] The serial interval is the average duration between the time of infection from one person to the time of infection to the next person.[12]

On March 11, 2020, the State of Alaska (SOA) issued a Public Health Disaster Emergency Declaration and sought to control transmission of SARS-CoV-2 through a series of mandates (now called Health Orders) to implement NPIs. These included the suspension and limitation of visitations in congregate living settings,[14] closing public schools, public venues, restaurants, and nonessential businesses. Residents were ordered to stay at home except for outdoor exercise and essential shopping trips or critical infrastructure work.[14] Incoming interstate and international air traveler testing and quarantine procedures were enacted. The MOA issued similar actions beginning March 16, including a stay-at-home order. By April 24, the SOA began lifting restrictions; on May 22, SOA removed all mandated NPIs except for testing and quarantine for travelers arriving from out-of-state. On May 25, the MOA removed EOs that included NPIs and eased restrictions on business operations and gatherings.[9]

Later in the summer, as case counts began to rise, MOA implemented a series of EOs to limit transmission. On June 29, the MOA implemented a mask use order (EO 13). Next, EO 14 (capacity limitations in public venues, such as bars, restaurants, and gyms) and EO 15 (closure of those indoor public venues) were implemented on July 24, and August 3, respectively, and remained in effect through August 30.[9] EO 13v2, an updated version of EO 13 with minor changes, was implemented on July 31. Because of the close timing and overlap of EOs 14, 13v2, and 15, they are best evaluated together; however, EO 13 was implemented as a single order and can be evaluated on its own.

Here, we evaluate the MOA EO 13 using the change in the reproductive number, epidemic growth rate, and self-reported mask usage before and after implementation. We also evaluated EO 14 and 15 by assessing the change in the reproductive number and epidemic growth rate before and after implementation.

Methods

We compared the change in R_t at 14 and 21 days after NPIs were implemented during the summer by using case and R_t data obtained from the Alaska Coronavirus Response Hub and the SOA COVID-19 website.[15,16]

We also calculated the average exponential growth rate during three time periods: (1) the 2 weeks prior to implementation of EO 13; (2) the period when EO 13 was in effect until EO14 was implemented; and (3) the period from when EO 14 was implemented until EO 15 was no longer in effect. Growth rates as well as differences in growth rates between time periods were calculated by fitting a linear model to the log-transformed daily case counts. Wald confidence intervals were obtained for each estimate. Cases were assigned to symptom onset date. If symptom onset date was missing, the earliest of specimen collection date, hospitalization date, or report date was used instead. Time periods were lagged by 5 days from NPI intervention to account for the average incubation period for COVID-19. All calculations were performed using resident cases only.

We utilized Google mobility reports to analyze trends before and after EOs were implemented in the MOA.[17] Google mobility reports are publicly available data, which have been aggregated and anonymized from devices where the user has specifically turned "on" their phone's location history; no individual's movements in the community can be identified.[17] These reports categorize mobility from cell phones in the domains of residential, workplace, grocery and pharmacy, retail and recreation, transit stations and parks. Non-parametric tests (Spearman rho and Rank sum) were used to evaluate trends.

From May through November 2020, Alaska Survey Research conducted three population-based cell phone surveys among Anchorage residents regarding the COVID-19 epidemic. The first cell phone survey was conducted May 6–10, which was followed by four panel surveys conducted at 2-week intervals. The panels consisted of a subset of survey respondents who agreed to participate in these follow-up surveys. The second cell phone survey was conducted July 16–18 and was followed by seven panel surveys conducted at 2-week intervals. The third cell phone survey was conducted on November 5–7, followed by a panel survey conducted just after Thanksgiving on December 3–5. The surveys asked about use of masks when the person was away from their home, whether they had come within 6 feet of someone not from their household, whether they had a visitor at their home, and whether they had physical contact (e.g., hugging or shaking hands) with someone not from their household. The University of Alaska-Anchorage (UAA) research group analyzed all of the survey data.[18]

Results

Anchorage (population 291,845) constitutes approximately 40% of Alaska's residents (731,000) and both populations had rates and daily case counts of COVID-19 that remained low into June. By July 1, Anchorage daily case counts surpassed the remainder of the state and remained higher throughout the summer (Figure 1). Anchorage's 7-day average case rate and R_t both increased rapidly in late June prompting the issuance of EO 13 (Figure 2). New case rates and R_t plateaued in mid-July before rising sharply again in late July, leading to EO 14 and 15. Case rates declined thereafter and remained stable throughout August; R_t declined and remained below 1 for most of the month.

Implementation of EO 13 was followed by a reduction in SARS-CoV-2 transmission within the MOA and an increase in mask use. R_t was reduced proportionally by 18.6% after 14 days and remained lower (-4.1%) after 21 days (Table 1). The average COVID-19 epidemic growth rate in Anchorage also decreased following EO 13. In the 2 weeks preceding implementation of EO 13 (the mask order), the growth rate was 10.8% per day (95% CI: 6.2%, 15.4%). During the period after mask-wearing was mandated through EO 13, but before restrictions on capacity were placed on public venues, the growth rate decreased to 4.7% per day (95% CI: 2.7%, 6.6%; Table 2, Figure 3). Reported mask use when in public increased by 7%–14% after EO 13

(79% July 16, versus 65%–72% in surveys prior to EO 13; Table 3).

Other reported behaviors from the MOA surveys related to avoiding virus transmission (not coming within 6 feet of non-household members, not having visitors in the home, and avoiding physical contact) were similar before and after EO 13. The Google analytics mobility data for Anchorage showed changes in travel to workplaces and transit corresponding to weekends and holidays, but no sustained downward trends in community mobility that could account for the decline in R_t following EO 13 (Figure 4).

Implementation of EOs 14, 13v2, and 15 was also followed by a substantial decline in COVID-19 transmission and rates. R_t fell below 1 for most of August and we observed a corresponding decline and stabilization of daily COVID-19 case counts while these EOs were in effect. In late July, an outbreak in a local seafood plant that employs MOA residents contributed to the rise in R_t during this time, as well as the decline in R_t once the outbreak ended. However, the resolution of the outbreak cannot solely explain the sustained decline in transmission seen through August in both R_t and case rates. This was the first time Anchorage saw a R_t consistently below 1 since mid-May. The average daily growth rate further declined to -0.9% (95% CI: -1.8%, 0.1%) per day, as exponential growth not only slowed but was reversed. Reported mask use among MOA survey respondents increased through August (87%) and late September (89%). Other avoidance behaviors reported in the surveys remained similar before and after EO 14 and 15 and Google mobility data did not show trends that could account for the decline in transmission, such as large increases in residential activity and declines in workplace, transit, or retail activity.

Discussion

The MOA mask order (EO 13) in late June was followed by a decrease in the growth rate of the COVID-19 epidemic in Anchorage. The Emergency Orders that limited and then closed public venues in late July and early August were followed by an even greater drop in transmission and the epidemic in Anchorage began to decline. The conclusion that these Emergency Orders contributed to decreased SARS-CoV-2 transmission is supported by several lines of evidence. Emergency Order 13 was implemented at a time of increasing transmission and was followed within 2 weeks by a roughly 20% reduction in R_t and a roughly 60% decline in the daily growth rate over the following month. Also, surveys of Anchorage residents indicate that reported mask use in public settings increased by 7%–14% after EO 13.[18] Further, other behaviors related to viral transmission reported in the MOA surveys did not change after EO 13, and Google mobility data do not provide another plausible explanation for the decline in transmission. Following EOs 14 and 15, R_t dropped by over 30% to <1, and daily case counts and rates declined throughout August.

A growing number of observational studies suggest that mask orders are associated with decreased SARS-CoV-2 transmission.[5,6,10] This report adds further support to this body of literature. Although this study lacks a suitable comparison community that had similar COVID-19 rates and no intervention, the observations herein meet many of the criteria for a cause-and-effect relationship, including a strong association supported by several measures of effectiveness (R_t, growth rates, mask use), decreased incidence rates after the EOs were implemented, sustained lower rates while the EOs were in effect, and results that are consistent with what is known about SARS-CoV-2 transmission.[19]

The Anchorage experience indicates that even if a high proportion of people use masks, this may not be sufficient to control SARS-CoV-2 transmission if enough persons are engaged in high-risk behaviors such as close contact in crowded environments with persons outside of their household. The rise in transmission in late July may have been due to multiple factors such as transmission in congregate work settings; gatherings in private and public venues; and decreased compliance with maintaining physical distance, handwashing, and avoiding crowds. The decline in case counts after implementation of EOs 14 and 15 supports the hypothesis that bars and restaurants played an important role in SARS-CoV-2 transmission in Anchorage during the early Summer.

Mask use has been recommended by federal, state, and local public health officials since early in the epidemic. Many Alaska communities besides

Anchorage have enacted mask mandates, but a large proportion of Alaskans reside in communities without mandates. In Anchorage, following EO 13, mask use has steadily risen; in the December 3–5 panel survey, 90% of residents reported wearing masks when away from home. This is consistent with published reports which submit that mandates lead to increased compliance with public masking.[6,10,20]

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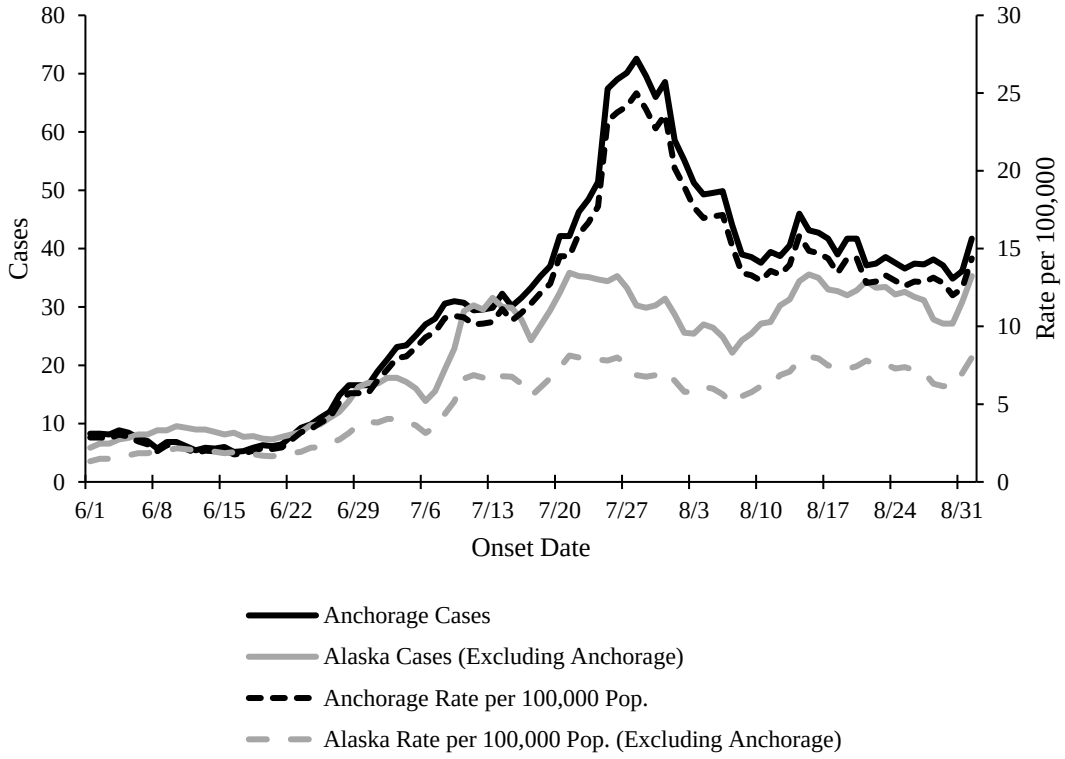
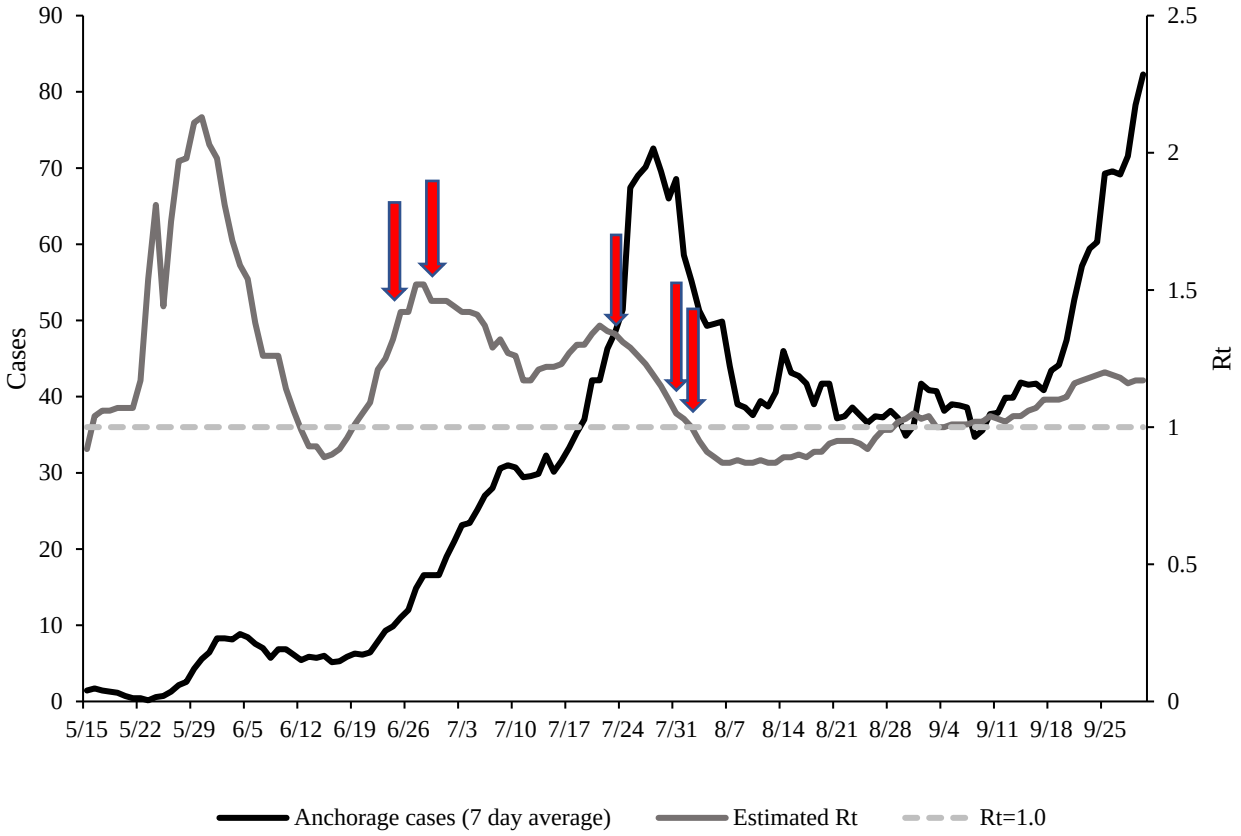
Figure 1. COVID-19 Cases by Onset Date and Rates* — Anchorage and the Rest of Alaska, June–August 2020



**The average rate of COVID-19 cases per 100,000 persons per day, averaged over the previous 7 days.*

Figure 2. Effective Reproductive Number (Rt), New COVID-19 Cases, and Timing of Emergency Orders — Anchorage 2020*



***Notes:** The left vertical axis references the average of the daily COVID-19 cases over the previous 7 days. The right vertical axis shows the effective reproductive number. The red arrows indicate the date of Emergency Orders. From left to right they are: EO 13 (mask order) announced, EO 13 effective, EO 14 effective (capacity limitations in public venues), EO 13v2 effective (modified mask order), EO 15 effective (closure of indoor public venues). EO 15 remained in effect through Aug 31. EO13v2 remains in effect.*

Table 1. Change in Effective Reproductive Number following Emergency Orders — Anchorage, June–August 2020

Order #	Effective Date	Reproductive Number, R_t (95% Credible Interval)			Percent Change (%)	
		At Start	Day 14	Day 21	Day 14	Day 21
13 (Masks)	June 29	1.45 (1.26, 1.65)	1.18 (1.07, 1.31)	1.39 (1.29, 1.5)	-18.6	-4.1
14 (Venue Capacity)	July 24	1.31 (1.22, 1.4)	0.89 (0.83, 0.96)	0.90 (0.83, 0.97)	-32.1	-31.3
13v2 (Mask Update)	July 31	1.02 (0.95, 1.09)	0.90 (0.83, 0.97)	0.92 (0.85, 1.0)	-11.8	-9.8
15 (Venue Closure)	Aug. 3	0.94 (0.87, 1.0)	0.90 (0.83, 0.98)	0.97 (0.89, 1.05)	-4.3	+3.2

Table 2. COVID-19 Epidemic Growth Rates, Before and After Emergency Orders — Anchorage 2020*

Intervention	Onset Date Range	Growth Rate per Day (95% CI)	Daily Change in Growth from Prior Period, (95% CI)
Baseline	6/20–7/3	0.108 (0.062, 0.154)	--
After masking use order (EO 13)	7/4–7/28	0.047 (0.027, 0.066)	-0.061 (-0.111, -0.011)
After limits on indoor activities (EOs 14 and 15)	7/29–9/5	-0.009 (-0.018, 0.001)	-0.055 (-0.077, -0.034)

***With 5-day lag between implementation and relevant case onset dates.*

Figure 3. Fitted Epidemic Growth Rates for COVID-19 Cases in Three Phases: Before EO 13, after EO 13 but before EO 14, and after EO 14 until expiration of EO 15 — Anchorage 2020

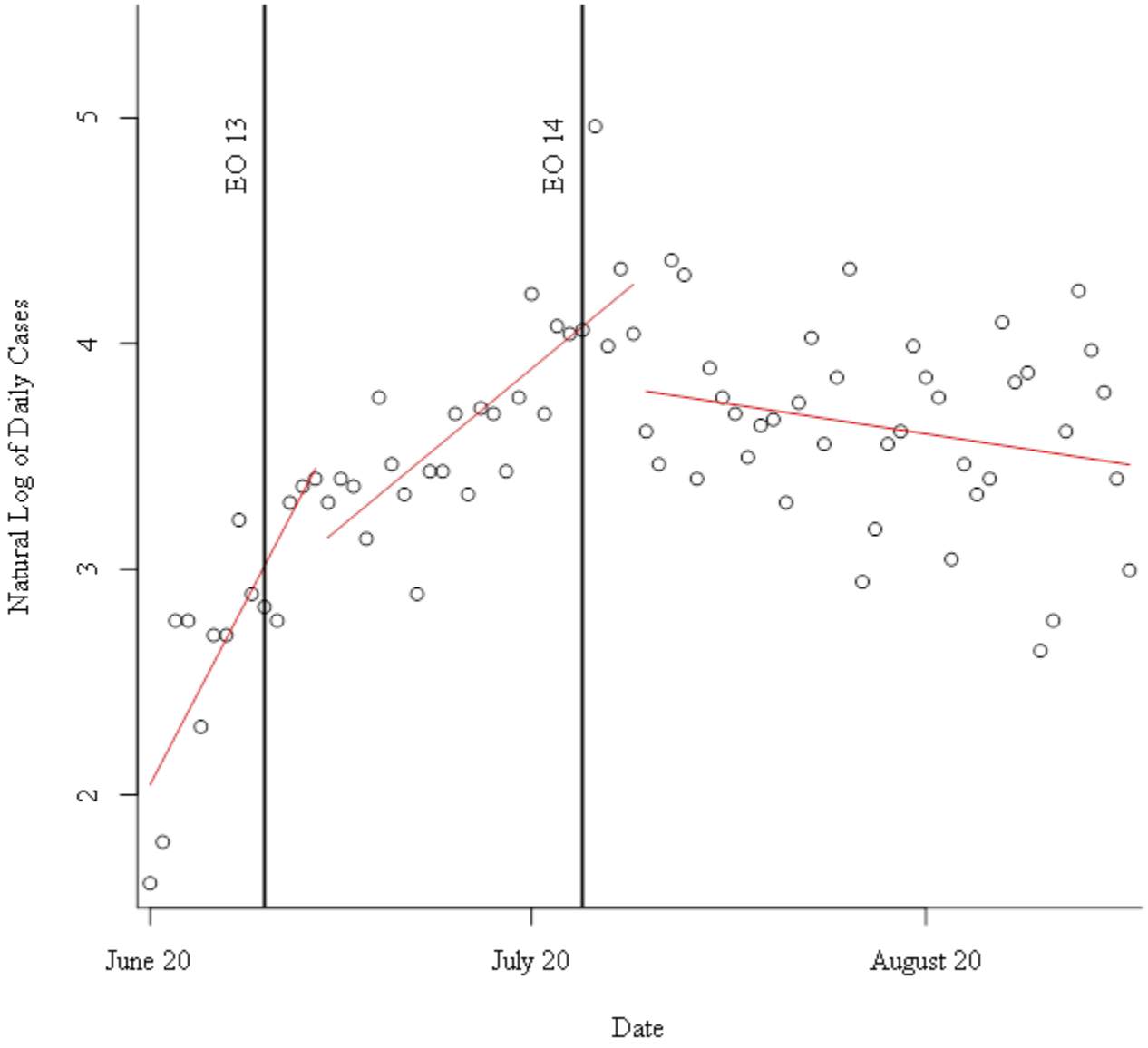


Table 3. Telephonic and Follow-up Surveys of Anchorage Residents, May–September 2020

Date Survey Started	Number of Respondents	Wore Mask All or Most of Time Outside their Home	Did Not Come within 6 ft of Someone Not in their Household	Did not Have a Visitor in their Home	Did Not Make Physical Contact with a Person Outside their Household
May 6	**996***	**68%**[1]	**38%**[1]	**81%**[1]	**83%**[1]
May 22	**316****	**65%**	**26%**	**77%**	**65%**
June 2	**309****	**69%**	**13%**	**76%**	**64%**
June 16	**295****	**72%**	**24%**	**68%**	**53%**
June 29, Mask Order					
July 16	**600***	**79%**[1]	**28%**[1]	**74%**[1]	**76%**[1]
Aug. 25	**859****	**87%**	**18%**	**74%**	**67%**
Sep. 22	**322****	**89%**	**13%**	**71%**	**63%**
Nov. 5	**600***	**82%**[1]	**30%**[1]	**83%**[1]	**75%**[1]
Dec. 3	**355****	**90%**	**19%**	**75%**	**66%**

***Population-based cell phone survey. **Panel survey of a subset of prior population surveys.*

[1]Percentages reported in the population-based cell phone survey have margin of error of ± 4.0% at 95% Confidence Interval.

Figure 4. Google Mobility Trends — Anchorage, June–September 2020