SCAN Data Results and Technical Report #3

August 3, 2020

Summary

1. Although SCAN participants who report having known or suspected contact with someone infected with COVID-19 have a higher risk of testing positive, **a large proportion of SCAN participants who test positive for COVID-19 report that they are unaware of having recently been in close contact with someone who tested positive for the virus.**
2. **Participants who report symptoms of COVID-like illness are more likely to test positive.** Acute loss of sense of smell or taste (anosmia) is the strongest single predictor of COVID-19 infection in our data.
3. Individuals can identify their own risk of contracting COVID-19 through their awareness of contact exposure and symptoms, and should seek testing or contact their healthcare provider if they self-identify as being at risk.
4. Improvements in SCAN's delivery and lab processing logistics have reduced the average time between enrollment in SCAN and return of results to about 48 hours. The largest delay involves people waiting to test after symptom onset. Getting tested soon after onset of symptoms and suspicion of illness is critical to interrupting the chain of COVID-19 transmission.
5. While mask usage has increased over time, rates appears to be stalling below universal compliance. Trading social distancing for mask use is counterproductive for COVID-19 prevention. The best way to protect each other when we must go out is to maintain at least six feet of distance from others and to always wear a mask.
6. Use of SCAN codes, which allow individuals who meet certain criteria to bypass the normal screening process and automatically receive a SCAN test kit, has helped to facilitate greater participation of children and high-risk cases in SCAN.

General updates on SCAN

The greater Seattle Coronavirus Assessment Network, or SCAN, is a public health surveillance (disease monitoring) program for SARS-CoV-2 (the virus that causes COVID-19) infection in greater Seattle and King County. SCAN is designed to help us better understand the COVID-19 outbreak and, with other sources of data, inform public health decisions. The SCAN platform launched on March 23rd, 2020 with an initial focus on testing individuals comprising a broad representation of the greater Seattle and King County region using the method of at-home sample collection with a self-swabbing kit developed by the Seattle Flu Study (SFS).

After a pause beginning on May 10th, SCAN re-launched on June 10th as the SCAN Study. This report primarily focuses on data collected between June 10th and July 28th. For more detailed results for data collected between March 23rd and May 10th, and more information about SCAN, please review our two prior technical reports (April 17th, May 22nd).

We note several other recent updates to the SCAN study:

- In June and July, SCAN 'priority codes' have been increasingly used for enrollment. Codes have been utilized for a number of reasons: for those attending protests, to increase testing in children, in collaboration with community-based organizations to improve access to testing, or for self-administered contact tracing (codes are given to those who test positive to share with their close contacts).
- On June 25th screening criteria for COVID-like illness (CLI) symptoms were changed from a single question asking if prospective participants had fever, cough, or shortness of breath to a multiple choice question. Currently, reporting any symptom qualifies as CLI for enrollment.
- In addition to the SCAN illness questionnaire which all participants fill out, a voluntary web questionnaire was posted to the SCAN website in early May. Data from this survey are explored in this report.

What data has the SCAN Study collected since June 10th?

The SCAN Study has tested 5,644 individuals for SARS-CoV-2 between June 10th and July 28th[1]. Of these, 921 were community enrollments without reported Covid-like illness (CLI) symptoms at screening, 4,045 were community enrollments with CLI symptoms at screening, 644 enrolled using priority codes, and 34 enrolled as groups as part of PHSKC's contact tracing efforts. Group enrollments from a limited number of households had a high positivity rate (41%, N=14) but are excluded from analyses in this report since most did not fill out a questionnaire. Other efforts at testing household contacts through priority codes are reported here. Thus, the number of individuals considered in this analysis was 5610.

The proportion testing positive overall for the three main modes of enrollment (CLI, non-CLI, priority code) was 1.4% (N=79), with 0.1% (N=1) for those enrolling without CLI symptoms, 1.5% (N=61) for those enrolling with CLI symptoms, and 2.6% (N=17) for those enrolling with priority codes. **Figure 1** shows the number of tests and positive results by date of test collection. The proportion positive has slowly increased since mid-June. We caution that this trend should not be

[1] In total, SCAN has conducted 6655 tests since June 10th. Some individuals have been tested multiple times. This report is based on an individual-level analysis, such that each participant is represented only once in the dataset. For those with multiple tests we kept only the first test, if all were negative, or the first positive if any tests were positive.

interpreted directly as a measure of population prevalence as it is not adjusted for recruitment biases; we plan to revisit prevalence estimation in a future report. **Supplementary Table 1** (at the end of this document) reports enrollment numbers by demographic characteristics.

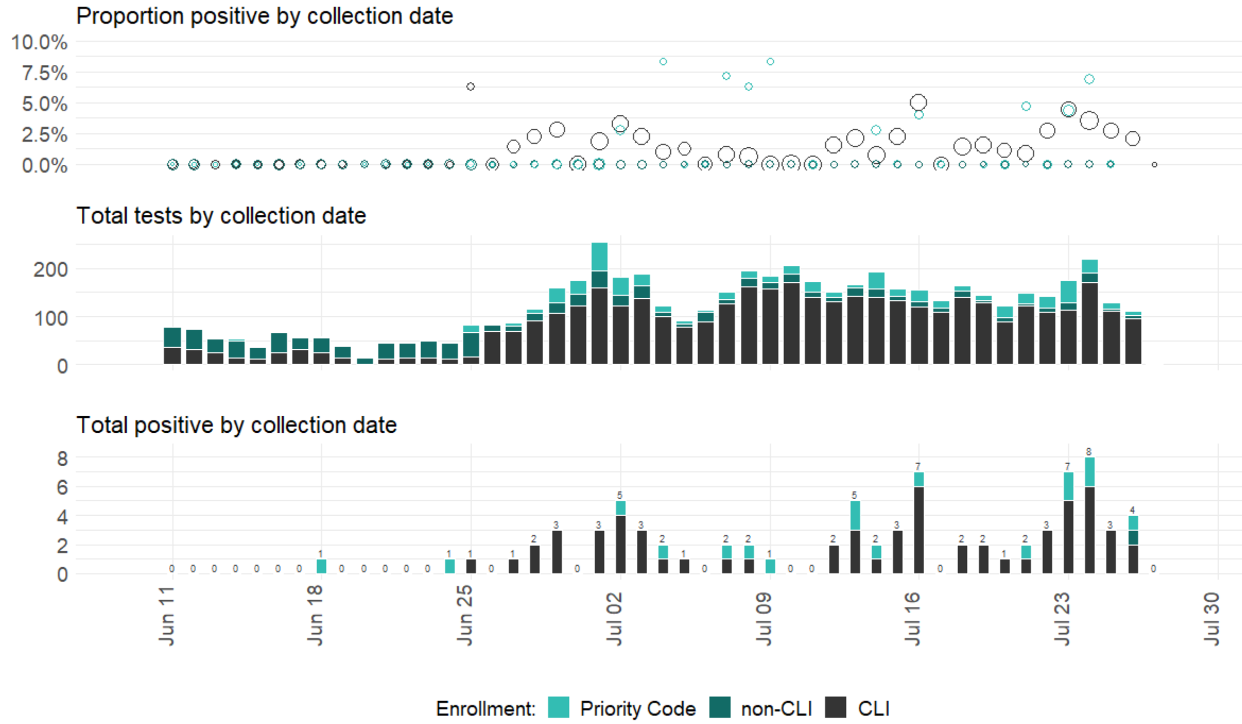


Figure 1. *From top to bottom: test positivity by collection date, total tests collected, and samples returning a positive result. Bubble size in the top panel corresponds with daily sample size in the middle panel. Bubbles and bars are colored by the type of participant enrollment. A change to SCAN's CLI screening definition on June 25th caused an increase in enrollees qualifying as CLI symptomatic.*

<u>Self-identified risk</u>

In this section, we explore the extent to which participants are able to self-identify their own risk, as well as community risk, by responding to questions about known or suspected contact with someone who is infected with COVID-19 or through reporting on their own symptoms.

Like other viral respiratory diseases, close contact with infectious individuals is the most important causal risk for COVID-19 transmission. People's knowledge of their own risk is thus critically important to guide behaviors which will help stem further spread of the virus. Using data from SCAN's illness questionnaire, SCAN's voluntary website questionnaire, individual lab results, and population-level testing data, we find that individual knowledge of one's own risk can indicate COVID-19 presence -- both at the individual and community levels.

The SCAN questionnaire asks participants: “In the past 2 weeks, have you been in close contact with someone who tested positive for COVID-19? Close contact means that you were less than 6 feet away for at least 10 minutes.” **Table 1** reports the questionnaire result with associated lab results.

Most participants (80%) responded that they have had no recent contact with a known or suspected infected individual, or did not know if they did. Among these participants, 0.7% (33 of 4,476) tested positive.

Roughly one-fifth (20%, N=1,117) of SCAN participants report having a known or suspected contact who tested positive for COVID-19. The relative risk of infection from someone with a known contact vs. someone without was 10.8 (95% confidence interval 6.6 - 17.7), and the relative risk with a suspected contact was 2.4 (95% confidence interval 1.3 - 4.7). The majority of these known contacts were between friends (57%), co-workers (27%), and household members (19%). Positivity rates were 2.5% (3 of 120) among those who had contact with COVID-positive coworkers, 3.5% (9 of 254) for those with COVID-positive friends, and roughly ten times higher at 28% (23 of 83) for those with COVID-positive household members. Interactions with household members are more likely to be prolonged, closer, and indoors, thus increasing transmission risk relative to those with friends or coworkers.

These results show that having a known or suspected contact with COVID-19 puts a person at elevated risk of having COVID-19 themselves relative to those without. But we also found many infections in individuals who did not know or suspect they were in close contact with COVID-19. This highlights that it is important for people to seek testing and take steps to prevent transmitting COVID-19 themselves if they have a known or suspected exposure, but also that vigilance about masking, broad physical distancing, and attention to symptoms are required of everyone to prevent transmission in the absence of clear risks.

***Table 1**. Survey and lab results for the question “In the past 2 weeks, have you been in close contact with someone who tested positive for COVID-19? Close contact means that you were less than 6 feet away for at least 10 minutes.” Survey sampling includes a mix of community symptomatic and asymptomatic samples as well as responses obtained through contact tracing. Furthermore, participants can choose more than one response, as such rows are not mutually exclusive. 95% confidence intervals likely under-estimate uncertainty as they assume random binomial sampling.*

Close contact in the past 2 weeks	**Responses**	**Positive tests**	**Percent Positive (95%CI)**
No known infected contact or don’t know	4476	33	0.7% (0.5%-1.0%)
Yes			
Household member has tested positive	83	23	27.7% (19.2%-38.2%)
Coworker has tested positive	120	3	2.5% (0.9%-7.1%)
Friend has tested positive	254	9	3.5% (1.9%-6.6%)
Maybe			

Contact with symptoms, no test	477	4	0.8% (0.3%-2.1%)
Contact with test, result pending	244	8	3.3% (1.7%-6.3%)
Prefer not to say	20	1	5% (0.3%-23.6%)

Since May 8th, the SCAN website has been hosting an additional questionnaire outside of testing enrollment windows, which has collected voluntary information from visitors not participating in SCAN on that given day. As of July 27th, the questionnaire has recorded responses from 13,297 website visitors residing in King County. Volunteers are asked a number of demographic, symptom, and risk behavior questions, including whether they had known or suspected contact with an infected individual. This survey is a simple convenience sample of website visitors and is not sampled for representativeness. These questionnaires are not linked to individual lab results like the rest of SCAN questionnaire data, but can be used to explore ecological associations.

Figure 2 compares these questionnaire responses to COVID-19 testing data from the Washington Disease Reporting System (WDRS) aggregated at the ZIP code-level for all data from June 10th to July 27th. Data from the WDRS snapshot we used covers all tests done in the county with associated ZIP code, which were 333,193 tests and 8,450 positive results during this time period. The ‘proportion of tests positive’ metric is shown to represent intensity of ZIP code-level transmission; we also obtained similar results using cases per capita (not shown). Overall, there was broad agreement between survey responses and COVID-19 transmission, with known or possible contact explaining over half of the variation in test positivity, showing that results from a simple survey question (using convenience sampling methods) were strongly correlated with disease spread at the community level.

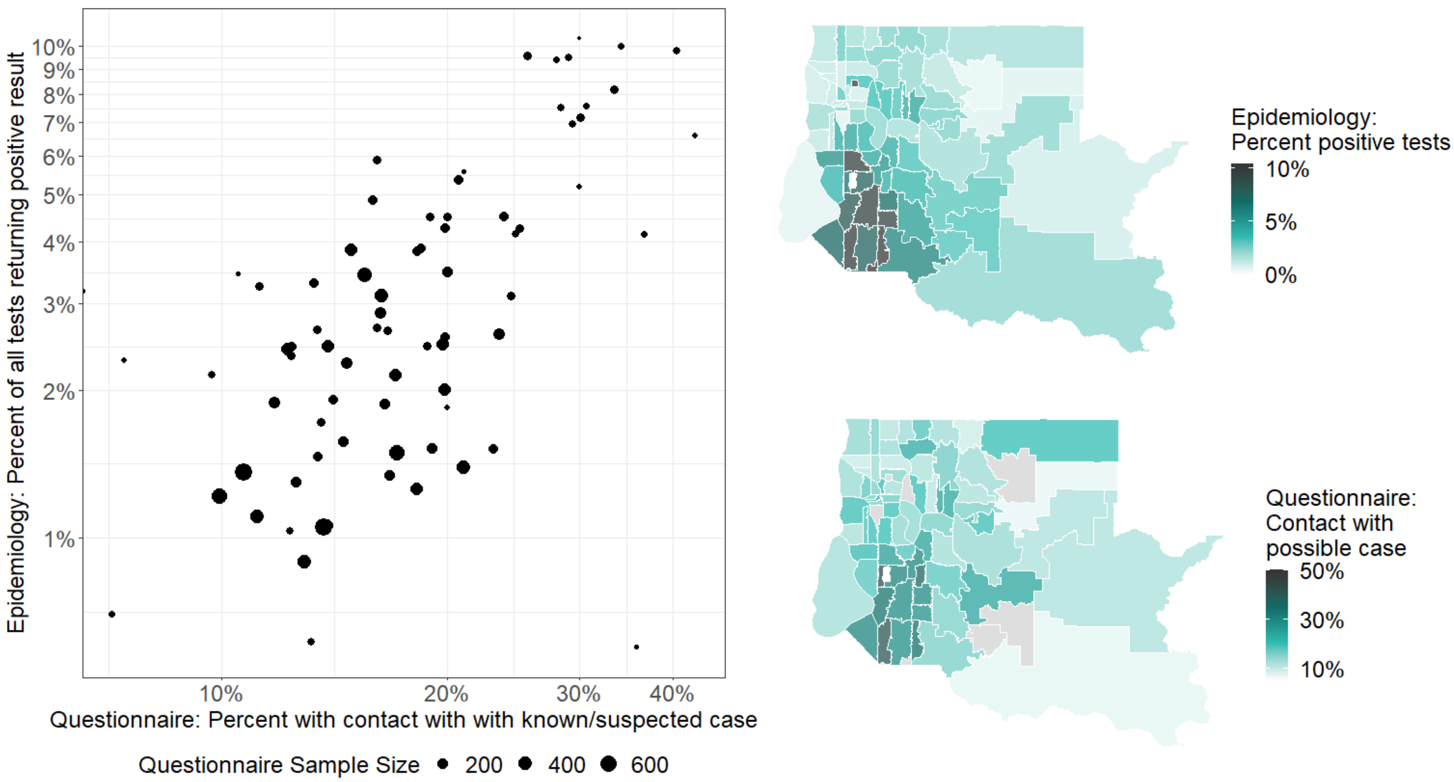


***Figure 2**. Comparison of web questionnaire responses to the question "In the past 2 weeks, have you been in close contact with someone who tested positive for COVID-19? Close contact means that you were less than 6 feet away for at least 10 minutes." with epidemiological testing data from WDRS. Both datasets are aggregated to the ZIP code level, using data starting June 10th through the end of July. Questionnaire responses explain more than 50% of the variation in the ZIP code level epidemiological data. Similar results were found when using cases per capita as the epidemiological indicator. ZIP codes with fewer than 20 web questionnaire responses are not shown.*

Another potential individual-level indicator of infection risk are the symptoms that individuals experience. COVID-19 infection can present with different symptoms, from completely asymptomatic to a variety of symptoms at varying levels of severity. SCAN participants are asked about the symptoms they are experiencing as part of an illness questionnaire upon enrollment and upon sample collection. **Table 1** shows the univariate relative risks of infection for all reported symptoms (the proportion of positive test results amongst those reporting a symptom over the proportion of positive results amongst those not reporting any symptoms).

Replicating other research on this topic, we find that anosmia (loss of smell or taste) is the most predictive single symptom for infection, with a relative risk of 10.1 [7.1 - 14.3]. Relative to other symptoms, anosmia is rare in the general population, but among those reporting anosmia, COVID-19 infection is common (8.4% reporting anosmia are positive, a higher rate than any other single symptom). Other top symptoms related to testing positive include feeling feverish, eye pain, chills or shivering, sweats, and muscle aches (myalgia). The most commonly reported symptoms among SCAN participants were headache, cough, sore throat, and fatigue, but since these are so broadly common in the population, they alone are less predictive of infection. It is interesting to note that increased trouble breathing was found to have no association with COVID-19 infection despite being an important symptom of severe COVID-19. This perhaps indicates that SCAN participants tend not to have severe disease at time of specimen collection. Among participants since March 23rd who marked no symptoms, 0.3% (13 of 4857) were positive for COVID-19, with a relative risk compared to those reporting any symptoms of 0.2 [0.1 - 0.4].

Overall, we find that reporting any symptom is predictive of COVID-19 infection compared to reporting no symptoms whatsoever. Despite the non-trivial presence of asymptomatic infections, identification of potential infections through symptoms remains a key tool in preventing the spread of COVID-19. It is important to note that these data have been collected at a time when the prevalence of other circulating pathogens is low. The presence of other respiratory pathogens could impact the sensitivity of these measures, making symptoms less predictive of COVID-19 infection in the future.

Table 2: *Univariate relative risks of testing positive given symptoms. Relative risks are interpreted as the proportion testing positive with a given symptom over the proportion testing positive without the symptom. Relative risks and confidence intervals were estimated using a log-binomial regression model. This table uses all collected SCAN data since March 23rd, total sample size 17,957. "Does not mark any symptoms" can broadly be understood as 'asymptomatic', but it may include those who neglected to fill out specific symptoms in their questionnaire.*

Symptom	Number reporting	Number of positive test results	Percent positive	Relative risk (95% CI)
Loss of smell or taste	430	36	8.4%	10.1 (7.1-14.3)
Feeling feverish	2784	91	3.3%	5.6 (4.2-7.4)
Chills or Shivering	1954	62	3.2%	4.3 (3.2-5.8)
Eye Pain	619	23	3.7%	4.1 (2.7-6.3)
Sweats	1601	46	2.9%	3.5 (2.5-4.9)
Muscle or body muscle aches	3899	88	2.3%	3.5 (2.6-4.6)
Cough	5968	105	1.8%	2.8 (2.1-3.8)
Headaches	5968	101	1.7%	2.6 (1.9-3.4)
Diarrhea	2289	45	2.0%	2.3 (1.6-3.2)
Fatigue	6442	98	1.5%	2.1 (1.6-2.9)
Runny or stuffy nose	5930	79	1.3%	1.6 (1.2-2.1)
Ear pain or ear discharge	976	14	1.4%	1.5 (0.9-2.5)
Nausea or Vomiting	1364	18	1.3%	1.4 (0.8-2.2)
Sore throat	6077	73	1.2%	1.3 (1-1.8)

Increased trouble Breathing	2122	19	0.9%	0.9 (0.5-1.4)
Did not mark any symptoms	*4857*	*13*	*0.3%*	*0.2 (0.1-0.4)*

Either through understanding their own symptoms or communicating with their close contacts about their own real or perceived risks of infection, individuals can be empowered to understand their own risk and the risk they pose to their community. A key finding is that a large proportion of the participants testing positive did not know they had a COVID-positive contact. Cooperating with contact tracers and also informing contacts of even potential exposure are important actions individuals who have tested positive, or suspect they may be infected, can take to reduce latency in testing for others and to help stem the spread of COVID-19. Often, it is through such information sharing that asymptomatic cases can be found. For example, since June 10th, 11 SCAN respondents under 10 years old tested positive. Of these, six did not report symptoms, and of those six, five were recruited to test only after another household member first tested positive. Furthermore, many of the symptoms above are predictive of elevated infection risk and so it is important to get tested even without known exposure to COVID-19.

Reducing latency in testing

Recognizing that individuals can assess their own individual risks and the risks of those closest to them motivates testing platforms like SCAN that try to reduce barriers to test seeking. SCAN is now part of an ecosystem of testing in King County which includes many clinical testing venues and free drive-through sites. In all, SCAN results represent about 2% of all COVID-19 tests conducted in King County since June 10th. All testing in King County currently requires sample processing in a centralized laboratory, which introduces potential delays in reporting results. SCAN's at-home test kits add additional logistical complexity. Reducing time between infection and testing is critical for informing individuals and their contacts about their status and potential exposure. **Figure 3** shows how testing latencies have improved over the course of the SCAN Study, starting from initial launch on March 23rd. The figure shows the average number of days between symptom onset, to enrollment in SCAN, to receiving lab results. The average participant now receives results between five and six days from their initial symptom onset. It takes about 48 hours on average from when an individual enrolls in SCAN until they receive their results. Recent changes to enrollment procedures in SCAN are expected to further improve this latency. The largest latency is now between symptom onset and SCAN enrollment; an average of 3.5 days, with large variation (5th and 95th percentiles: 1 to 15 days).

A number of improvements to kit delivery and laboratory workflows enabled SCAN to reduce the time between enrollment and results to about 48 hours. In SCAN's subjective assessment, key amongst these were: 1) Increasing staff to cover evenings and weekends. 2) Four months into SCAN, staff members had gained more experience and cross-training, and were consequently considerably more efficient in completing processes. 3) Minor but additive changes to streamline SCAN workflows for both kit delivery and laboratory processing. 4) Staff with any suspicion of exposure are encouraged to seek testing quickly through whatever route is most accessible to them.

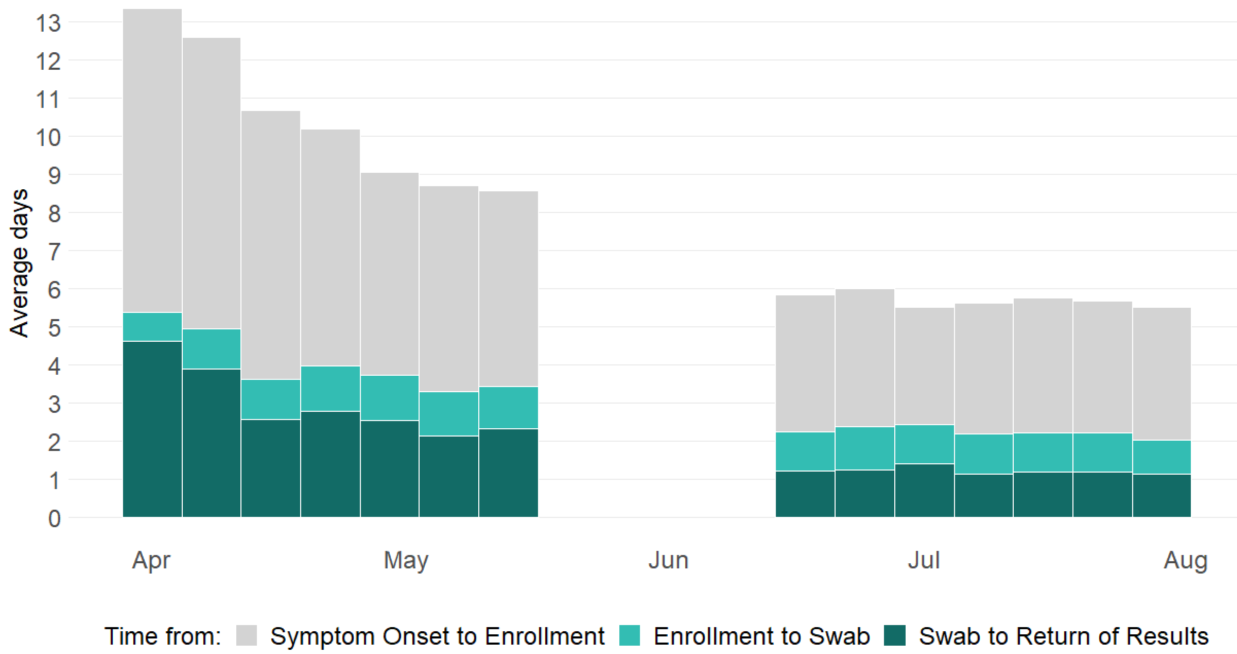


Figure 3. *Showing the changing system latencies in SCAN testing by week since April. Total bar height represents the average time between reported symptom onset and return of results. All latencies have reduced to a recent average of about 5 to 6 days. SCAN delivery and lab processing logistics improvements have reduced average latency from enrollment to return of results to about 2 days. The largest latency remains in the gap between symptom onset to enrollment. No data is available for mid-May to mid-June due to a temporary pause in SCAN enrollment at that time.*

How are we protecting ourselves?

Wearing masks when in public and keeping at least six feet of physical distance from others remain the best tools individuals have to protect themselves and their community from the spread of COVID-19. The website survey described earlier in this report, along with the SCAN participant questionnaire allow us to monitor trends in adherence to these guidelines. Respondents to both questionnaires were asked how often (always, sometimes, never) they did each of the following in the past seven days: "wear a face mask in public to protect others from getting sick?" and "try to stay six feet away from people who don't live with you?"

Figure 4 is an update to a figure first shown on PHSKC's Public Health Insider Blog. This version shows weekly aggregated results and is current as of July 28th. Combining the website and SCAN questionnaires yields a sample size of 19,430 responses. Both questionnaires are based on a convenience sample of self-selected volunteers and are not a representative sample of the population. Given the generally low-risk profile of SCAN volunteers, it is likely that these responses are biased toward greater protective behavior than the King County population more broadly.

Nearly half of the surveyed population said that they always both maintain six feet of distance and wear a mask (and this proportion has increased slightly). A small proportion (10% or so) of respondents consistently report neither physically distancing or wearing a mask. Self-reported mask usage has increased since early May, rising from a little over half to about 90% reporting always wearing masks.[2] This has coincided with several public directives and requirements aimed at increasing mask usage in public. Concurrently, there has been a reduction in the proportion of respondents who report staying six feet away from non-household members. These data do not follow individuals over time, so it is not technically feasible to say with certainty that individuals are changing behavior, but the aggregate data suggest there is a fungible 40% (or so) of the population which has traded one risk reduction strategy for another. Unfortunately, while masking is protective, it is far from perfect. Distancing and masking is a better strategy than masking alone.

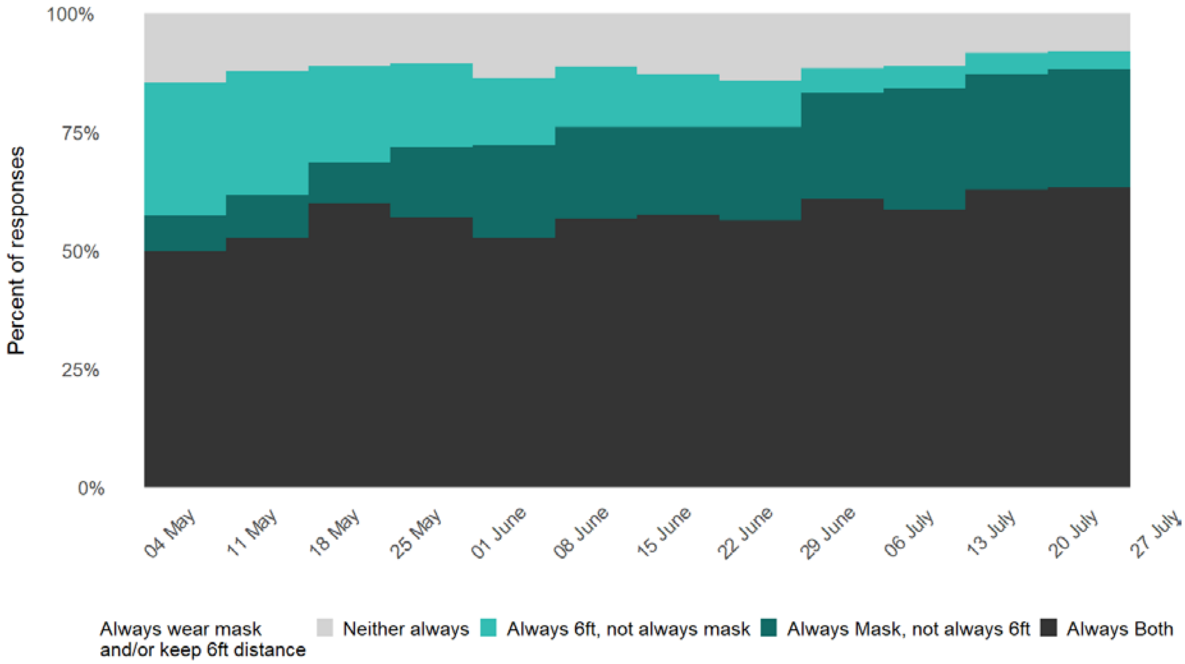


Figure 4. *Aggregate responses from SCAN illness questionnaires and website questionnaires asking how often (never, sometimes, always) respondents "wear a face mask in public to protect others from getting sick?" and "try to stay six feet away from people who don't live with you?". Overall reported mask usage has increased while adherence to physical distancing has decreased. Based on responses from 19,430 respondents.*

[2] During July 2 - 14, a poll conducted by the New York Times found 72% reported always wearing masks, which is slightly lower than the estimate here (84%). This small difference may reflect a bias toward more COVID-conscientious behavior among SCAN participants relative to the general population.

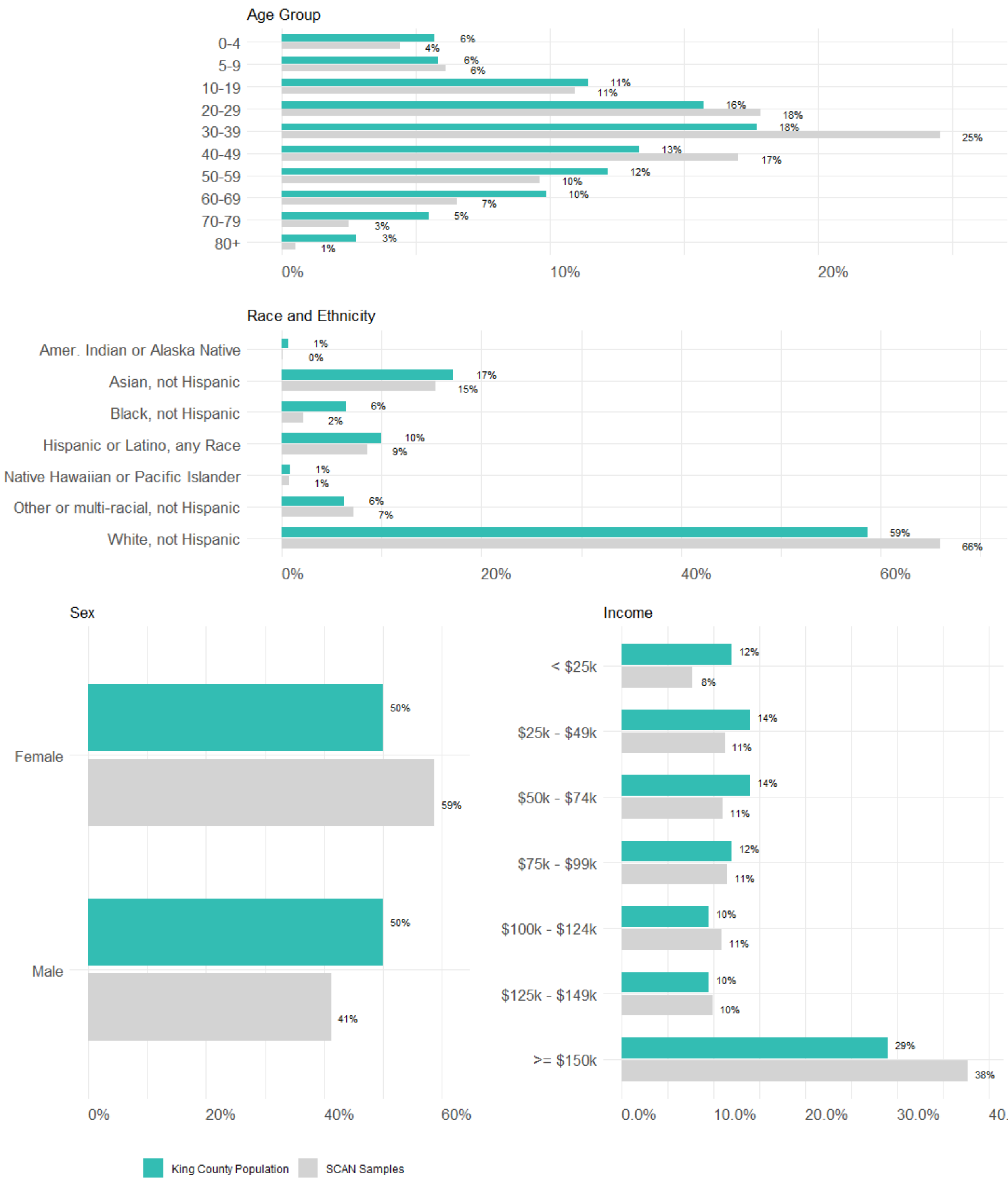
Appendix

Supplementary Table 1: *Characteristics of SCAN participants between June10 and July 28 (the period since our last technical report). Note that the numbers and ratios of those who did vs. did not report CLI in this table reflect the population tested and not the total population screened for participation in SCAN.*

**CLI = self-reported new COVID-like illness symptoms (cough, fever, shortness of breath) in the past 7 days, as reported on the enrollment screener; **Individuals can have more than one underlying condition.*

	Reported CLI on screener	Did not report CLI on screener	Used priority code to enroll
All Participants	4045	921	655
Age			
0-4	100 (2.5%)	88 (9.6%)	58 (9%)
5-9	100 (2.5%)	131 (14.2%)	110 (17.1%)
10-19	250 (6.2%)	264 (28.7%)	95 (14.8%)
20-29	824 (20.4%)	75 (8.1%)	102 (15.8%)
30-39	1156 (28.6%)	101 (11%)	121 (18.8%)
40-49	811 (20%)	85 (9.2%)	59 (9.2%)
50-59	433 (10.7%)	63 (6.8%)	41 (6.4%)
60-69	251 (6.2%)	68 (7.4%)	43 (6.7%)
70-79	90 (2.2%)	38 (4.1%)	14 (2.2%)
80+	20 (0.5%)	7 (0.8%)	1 (0.2%)
Sex at Birth			
Female	2480 (61.3%)	496 (53.9%)	307 (47.7%)
Male	1545 (38.2%)	421 (45.7%)	335 (52%)
Other	3 (0.1%)	1 (0.1%)	0 (0%)
Unknown	17 (0.4%)	3 (0.3%)	2 (0.3%)
Race and Ethnicity			
Amer. Indian or Alaska Native	6 (0.1%)	1 (0.1%)	1 (0.2%)
Asian, not Hispanic	699 (17.3%)	92 (10%)	57 (8.9%)
Black, not Hispanic	89 (2.2%)	11 (1.2%)	20 (3.1%)

Hispanic or Latino, any Race	348 (8.6%)	61 (6.6%)	60 (9.3%)
Native Hawaiian or Pacific Islander	35 (0.9%)	2 (0.2%)	3 (0.5%)
Other or multi-racial, not Hispanic	247 (6.1%)	83 (9%)	65 (10.1%)
White, not Hispanic	2543 (62.9%)	659 (71.6%)	429 (66.6%)
missing	78 (1.9%)	12 (1.3%)	9 (1.4%)
Household Income			
< $25k	295 (7.3%)	37 (4%)	28 (4.3%)
$25k - $49k	390 (9.6%)	58 (6.3%)	80 (12.4%)
$50k - $74k	395 (9.8%)	68 (7.4%)	51 (7.9%)
$75k - $99k	383 (9.5%)	91 (9.9%)	62 (9.6%)
$100k - $124k	385 (9.5%)	81 (8.8%)	47 (7.3%)
$125k - $149k	329 (8.1%)	85 (9.2%)	54 (8.4%)
>= $150k	1204 (29.8%)	345 (37.5%)	217 (33.7%)
Prefer not to say	527 (13%)	114 (12.4%)	78 (12.1%)
Don't know	137 (3.4%)	42 (4.6%)	27 (4.2%)
Sought Care			
No	3754 (92.8%)	911 (98.9%)	618 (96%)
Yes; Doctor's /Urgent Care	47 (1.2%)	4 (0.4%)	6 (0.9%)
Yes; Pharmacy	9 (0.2%)	0 (0%)	1 (0.2%)
Yes; Telemedicine	205 (5.1%)	7 (0.8%)	11 (1.7%)
Yes; Hospital/ED	5 (0.1%)	0 (0%)	5 (0.8%)
Yes; Other	32 (0.8%)	0 (0%)	6 (0.9%)
Underlying conditions**			
Chronic heart disease	31 (0.8%)	4 (0.4%)	5 (0.8%)
Chronic lung disease	84 (2.1%)	15 (1.6%)	7 (1.1%)
Diabetes	93 (2.3%)	14 (1.5%)	13 (2%)
Immunosuppressed	138 (3.4%)	19 (2.1%)	5 (0.8%)
None	3721 (92%)	871 (94.6%)	616 (95.7%)



***Supplementary Figure 1**: Distribution of SCAN participants since June 10th across age, race and ethnicity, sex, and household income, compared to the distribution in King County. We have noted improving geographic representativeness over time, with areas of south King County seeing increased enrollment in recent weeks.*

SCAN acknowledgements

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