Care-seeking correlates of acute respiratory illness among sheltered homeless adults in Seattle, WA: a community-based cross-sectional study

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Abstract

Care-seeking correlates of acute respiratory illness among sheltered homeless adults in Seattle, WA: a community-based cross-sectional study

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Objectives: To evaluate viral respiratory infection and health care seeking behavior in sheltered homeless individuals, and assess factors that may impact the decision to seek care for acute respiratory illness (ARI).

Methods: This was a prospective cross-sectional surveillance study of 825 participant encounters from 649 unique participants. Enrollments took place between January 2019 and May 2019. The primary outcome was having sought health care from a medical provider, through self-report, for their current ARI episode. Adjusted logistic regression models were used to explore various self-reported clinical and demographic exposures as correlates of having sought health care.

Results: A total of 241 (29.2%) participant encounters reported having sought health care for their ARI episode. Those with chronic lung conditions were 55% more likely to have sought health care and smokers were 35% less likely. Those that reported experiencing influenza-like-illness symptoms were 63% more likely to have sought health care when compared to those with other symptom profiles**.** Having received an

influenza vaccine (aPR 1.39, 95% CI 1.02 – 1.88) and having health insurance (aPR 2.77, CI 95% 1.27 – 6.02) were associated with increased likelihood of seeking health care.

Conclusion: Early identification of viral respiratory illness in homeless populations may be hindered by a lack of prior engagement with primary health care services. Interventions that target screening and on-site testing for early detection of viral ARI episodes and linkage to care with health services before viral shedding peaks is recommended in shelter settings.

I. Background and Significance

Respiratory pathogens are the leading infectious cause of death in the U.S. and pose a disproportionately high risk to individuals experiencing homelessness due to shelter crowding and poor ventilation.[1–5] Past studies have indicated that pneumonia infection rates in the homeless are substantially higher than in the general population, and that mortality in the homeless due to respiratory infections is about seven times greater.[6,7]

For individuals experiencing homelessness, health care can compete with more immediate needs, such as obtaining food and housing.[8] Studies have suggested that frequent utilization of emergency health services observed among homeless persons may be the result of their disproportionately high rates of chronic and acute health conditions, as well as serve as an indicator of poor access to primary health care in ambulatory settings.[9] However, research has shown that those experiencing homelessness are likely to delay seeking care for acute infections, and when they do they are largely dependent on hospital and emergency services.[10,11] Factors such as health insurance status, duration of homelessness, and stability of shelter arrangements have been examined in relation to primary care access for any aggregated acute or chronic conditions within this population, as well as mental health and substance abuse services.[12–16] The frequency of health care utilization among homeless populations, specifically for acute respiratory illness (ARI) episodes or influenza-like-illness (ILI), has not been assessed in prior studies.

The objective of this study was to evaluate viral respiratory infection and seeking health care in sheltered homeless individuals, and assess factors that may impact the decision to seek health care for ARI in a community-based setting.

II. Methods

Study Design

This was a prospective cross-sectional study examining predictors of having sought health care among sheltered adults experiencing homelessness with ARI. The primary

exposure in the analysis is a respiratory illness with detection of at least one viral pathogen, referred to as a viral ARI (binary yes/no). The primary outcome of this study was having sought health care, defined as whether a participant had sought clinical care in the past week for their current ARI illness episode from a medical provider (binary yes/no). Seeking health care was identified through participant self-report.

We explored various clinical and demographic exposures as correlates to address our primary aim. Health insurance coverage included both private and public insurance plans. Smoking status was determined by asking participants if they smoked tobacco, marijuana or vaped. Alcohol consumption was assessed as a binary yes/no in response to the question "*Do you ever drink alcohol?"* Drug use was determined by asking whether a participated used any recreational drugs besides marijuana. Sex was self-reported by participants in response to the question "*What was your assigned sex at birth?"* ILI was defined as self-report of fever with cough or sore throat. A chronic condition was defined as presence of self-reported diabetes, cancer, chronic obstructive pulmonary disease (COPD), asthma, or bronchitis. A chronic respiratory condition was defined as reported COPD, asthma, or bronchitis. Influenza vaccination status was documented based on self-report of month-year of receipt in the last 12 months.

Study Setting

Between January and May 2019, we conducted prospective surveillance of adults aged 18 years and older experiencing homelessness who identified their primary residence as one of two shelters in Seattle, WA. Participants were enrolled through the Seattle Flu Study (SFS).[17]

Study Subjects

Potential participants were enrolled in-person by trained research assistants at one of two shelters (A and B) two to four days per week. Shelter A provides services to all adults 18 years and above with a 200-bed capacity, while Shelter B limits services to men aged 50 years and above and has a 212-bed capacity. Staff at kiosks provided promotional and informational materials.

Individuals were eligible to participate in the study if they reported at least two symptoms of ARI in the last seven days. These symptoms included feeling feverish; runny or stuffy nose; headache; rash; cough; myalgia; excess fatigue; diarrhea; sore throat; increased trouble with breathing; nausea or vomiting; and ear pain or ear discharge.

This analysis included data from 825 eligible encounters from 649 unique individuals between January and May 2019.

Data Collection

For those that met the eligibility criteria, we obtained informed consent and collected demographic, clinical, and behavioral data via an app-based questionnaire on a tablet. Participants were given the choice of completing the questionnaire themselves on the tablet or having the study staff read it aloud and record their responses. Reasons shelter participants may not have been capable of completing the questionnaire alone included if they did not have the appropriate corrective aids (i.e. glasses, contacts) for poor vision; were unfamiliar / uncomfortable with the tablet technology; or possessed a low English-language reading level. A Spanish-language version of the questionnaire was available. All data collected and generated was housed by Audere (Seattle, WA), a centralized electronic data capture system. We collected mid-nasal samples from participants using a sterile nylon flocked nasal swab (Quidel, San Diego, CA).

Specimen Processing and Laboratory Testing

Samples were transported to the University of Washington Brotman Baty Institute for Precision Medicine and the Northwest Genomics Center in universal transport media (Becton, Dickinson and Company, Franklin Lakes, NJ) at 4°C for up to seven days prior to aliquoting and then stored at -80°C until testing. Total nucleic acids were extracted (MagnaPure, Roche) and tested for the presence of 27 respiratory pathogens by TaqMan reverse transcription-qPCR (RT-qPCR) on the OpenArray platform (ThermoFisher). Respiratory pathogens tested for included strains of the following

viruses: influenza; respiratory syncytial virus (RSV); human parainfluenza (hPIV); human coronavirus (HCoV) sub-types HCoV-229E, HCoV-OC43, HCoV-NL63 and HCoV-HKU1; human metapneumovirus (hMPV); rhinovirus (RV); mumps; measles; human parechovirus; enterovirus; human bocavirus; and adenovirus (AdV). In addition to the viral pathogens, we also tested samples for pertussis, *S. pneumoniae*, *M. pneumoniae* and *C. pneumoniae*. These pathogens were not analyzed as primary exposures.

Data Analysis

We performed descriptive statistics of frequency and percentage, and mean and standard deviation for categorical and continuous variables respectively per unique participant. We compared participants that did or did not seek health care to address our first primary aim. Sociodemographic and clinical variables to be analyzed include self-reported age, sex, race, duration of homelessness, smoking status, employment status, number of days since symptom onset, chronic comorbidities, ILI status, and *S. pneumoniae* carriage. Access to health care variables included health insurance status and influenza vaccination status. Any enrollments from the same unique participant that were <14 days apart were excluded from analysis.

To determine correlates of seeking health care given an ARI illness episode, simple logistic regression was performed, then forward selection was used to identify potential confounders. This was performed on each variable independently as opposed to automatically to assess confounding. Confounders assessed included all characteristic variables listed in Table 1. A data-driven approach was utilized to identify confounders, and covariates were retained in the model if their inclusion changed the Prevalence Ratio (PR) estimate by ≥10%. This was also determined for each variable independently as opposed to automatically. A generalized estimating equation (GEE) model for each correlate of interest was constructed to account for repeated observations of individuals within a specific shelter. PR's with 95% confidence interval (CI) were estimated and any intervals that did not contain the null hypothesis value of 1 were considered statistically significant.

We defined the prevalence of viral ARI detection as the number of episodes with at least one viral pathogen tested positive out of the total number of illness episodes. Separate GEE models were fit to independently assess whether there was effect modification for seeking health care when a specific virus detected. Symptom duration and having received treatment for an illness episode were selected *a priori* as confounders for these models.

A complete case analysis was performed as no variables had missingness that exceeded 10% of observations. As a sensitivity analysis, type of self-reported chronic comorbidity was stratified to discern whether certain conditions had a stronger association with the outcome of health care utilization. Statistical analyses were performed using R Statistical Software (Version 3.6.0. “Planting of a Tree”, Foundation for Statistical Computing, Vienna, Austria).

III. Results

Overall, 649 unique participants had 825 illness episodes, or study encounters, across the two sites. There were 529 (81.5%) participants with one encounter, 84 (12.9%) with two, and 36 (5.5%) with three or more. Of the 120 participants with multiple encounters, 47 had differential care seeking behavior over multiple ARI episodes. The characteristics of participants, stratified by care seeking at first ARI episode, are shown in Table 1. The mean age of participants was 53 years (standard deviation [SD]: 11), and 496 (76.4%) were male. White (44.1%) and Black or African American (31.6%) were the predominant racial groups represented. The majority were smokers (78.3%), and nearly half (47.8%) reported having experienced homelessness for more than two years. A total of 254 (39.1%) participants had at least one chronic comorbidity. Each shelter represented half of our study’s unique participants. Of the unique participants, 567 (87.4%) had health insurance and 111 (17.1%) indicated having received antiviral or antibiotic treatment from a medical provider for their ARI episode prior to enrollment**.**

There were 118 (18.2%) unique participants that tested positive for at least one respiratory virus.

A total of 181 (27.9%) participants reported having sought health care based upon their first ARI episode prior to study enrollment (**Table 1**). A marginally larger proportion of participants with symptom onset occurring ≥ 7 days ago had sought health care for their symptoms (67.5% vs. 75.1%). Of the 181 unique participants that had sought health care, 95 (52.5%) had symptoms of ILI upon first enrollment. More than half (51.9%) of those who sought health care reported having received an influenza vaccine within the last 12 months, and 91.7% of unique participants who sought health care had health insurance. Of the unique participants who sought health care for their ARI, 89 (49.2%) received treatment from a provider**.**

Across all ARI episodes at the two shelters, 241 of the 825 (29.2%) encounters indicated having sought health care for that ARI episode. The prevalence of health insurance, influenza vaccination, and prior treatment were also similar at the encounter and unique participant level. In adjusted analyses, a number of predictive factors were found to be significantly associated with seeking health care (**Table 2**). Individuals identifying as American Indian or Alaskan Native (AIAN) were associated with a 38% higher prevalence than those that identified as White (aPR 1.38, 95% CI 1.06 – 1.79). Smokers were 35% less likely to have sought health care for their illness (aPR 0.65, 95% CI 0.45-0.92). Those with chronic lung conditions were 55% more likely to have sought health care (aPR 1.55, 95% CI 1.12 – 2.15). However, neither having been diagnosed with cancer nor diabetes was significantly associated with this outcome (aPR 0.64, 95% CI 0.31 – 1.33, and aPR 1.43, 95% CI 0.92 – 2.20, respectively). Those that reported experiencing ILI symptoms were 63% more likely to have sought health care (aPR 1.63, 95% CI 1.20 – 2.20) when compared to those with other symptom profiles**.** Those with health insurance were nearly three times as likely to have sought health care when compared to uninsured participants (aPR 2.77, CI 95% 1.27 – 6.02). Those that received the influenza vaccine within the last 12 months were 39% more likely to

have sought health care when compared to those who were not vaccinated (aPR 1.39, 95% CI 1.02 – 1.88).

We assessed encounter-specific health care seeking by viral infection. Comparisons are first for each specific pathogen versus not having that pathogen, and then for any identified pathogen versus no pathogen. Of the 825 ARI episodes, 154 (18.6%) were positive for at least one of the 27 viral pathogens tested for, and we observed 11 episodes of viral coinfection. Overall, no statistically significant difference was detected when comparing a viral-positive ARI episode and a viral-negative episode (aPR 0.96, 95% CI 0.65 – 1.42, **Figure 1**). There was also no significant difference detected between participants with a certain virus and seeking health care. HCoV was the only pathogen observed that had a slightly higher prevalence of illness episodes where the participant sought health care, but not significantly so (aPR 2.06, 95% CI 0.85 – 4.97). Participants tested positive for the influenza were 47% less likely to have sought health care than those with another viral pathogen detected (aPR 0.53, 95% CI 0.18 – 1.56). Those with RSV were 55% less likely to have sought health care than those with another viral pathogen (aPR 0.45, 95% CI 0.07 – 3.09), and participants with a viral coinfection were 12% more likely than those with a singular infection (aPR 1.12, 95% CI 0.29 – 4.24), though none of these associations were significant.

IV. Discussion

We found that less than a third of participants enrolled at Seattle homeless shelters with an ARI episode had sought health care for their symptoms in the past week from a medical professional. AIAN race, smoking, having a chronic lung condition, self-assessed ILI symptoms, health insurance status, and influenza vaccination status were significantly correlated with having sought health care. Participants that tested positive for a specific virus were not more likely to seek care compared to other viral-positive ARI episodes observed.

The reported proportion of ARI episodes that resulted in seeking care from a clinical provider is difficult to contextualize as studies investigating health care utilization for ARI in this population have not been conducted to our knowledge. Past national-level cohort studies have shown that the majority of individuals with ARI did not access health care, indicating that care-seeking in the general population is not common.[18]

Factors indicative of a shelter participant's access to care were particularly strongly associated with having sought clinical care for their illness. We found health insurance coverage to be the strongest predictor of having sought health care for ARI. This is concordant with research assessing use of ambulatory care for any reason, and factors associated with decreased barriers to care in homeless populations.[12] Seattle's 2018 One Night Count Survey, which reported 52% of respondents as unsheltered, found 19% of respondents were insured by Medicaid/Medicare.[19] This study observed 87.4% insurance coverage, comparable to coverage in homeless populations of other US-metropolitan areas in recent years since the advent of the ACA.[20,21] Despite high rates of insurance coverage, however, homeless populations are observed to be additionally hindered and/or driven in their health care use by barriers directly related to the organization of care.[22,23]

The significant association detected between influenza vaccination and seeking care is also consistent with findings from other studies.[13] In comparison, this relationship has not been reported as significant in the general population.[18] Overall influenza vaccine coverage reported here is higher than previously reported rates observed in homeless populations both inside and outside of the US (25% - 36%).[3,24] It is possible that having a chronic illness may have modified the correlation between influenza vaccine uptake and having sought health care for an ARI if vaccination due to their high risk status is being encouraged by these patients' providers.

The association observed between having a chronic lung condition and seeking care is consistent with findings from studies assessing predictors of health care utilization in other populations.[18,25] Participants with chronic lung conditions were specifically

assessed rather than having any chronic comorbidity as these conditions were disproportionately reported by participants in our study when compared to the general adult population (39% vs. 15%).[26] These individuals may be at risk of disease-related exacerbations commonly associated with viral illness.[27,28] Similar rates of care seeking amongst the general population with these conditions suggests that they are more cognizant of their high risk condition due to provider health education and/or having pre-existing linkage to care, compared to homeless individuals without a chronic lung condition. The inverse association we detected between being a smoker and seeking care, however, is concerning as cigarette smoking use has been shown to increase the incidence, duration and severity of viral respiratory infections.[29]

Fulfillment of the ILI definition during an ARI episode was found to be independently associated with seeking care in this study. Prior research using syndromic surveillance of national-level populations have reported inconsistent findings assessing ILI as a predictive factor.[18,30,31] One such study that observed an increased likelihood of visiting a health facility when participants self-diagnosed their illness as influenza compared to cold, and suggested that individuals are capable of gauging their disease severity and categorizing more severe episodes as “flu-like.”[18] Another found between 40.9 and 46.8% of adult participants reporting ILI symptoms sought medical care, substantially higher when compared to the 33.3% in our study.[32] Our significant findings of ILI as a predictor indicates that sheltered homeless populations’ care seeking behavior is impacted by specific symptom profiles, and that they are capable of disease severity self-assessment when symptoms are flu-like.

The lack of any significant association identified between viral presence and seeking care after stratifying by specific pathogen was unexpected. Among respiratory viruses, influenza has the greatest overall impact with regards to both morbidity and mortality. This is more pronounced amongst the elderly and those with underlying conditions such as COPD, congestive cardiac failure, and diabetes,[33] conditions that are well-represented in our study participants. Other studies have observed greater risk of complications and poorer outcomes for RSV and influenza in homeless patients.[34] This

is also at odds with our finding that those with ILI symptoms were more likely to have sought health care. These discordant findings may be due to this study having been conducted in a community-setting rather than clinical or hospital setting where severity estimates may be inflated due to selection bias.

The higher prevalence of seeking care given detection of common HCoV strains is notable, despite not being significant, as HCoV symptoms are typically mild. This observation may be related to longer acute symptom duration and viral shedding periods of HCoV strains when compared to influenza and other viral pathogens, but much about the epidemiology of HCoV is still unknown and additional exploration is required.[35–37] The overall lack of associations and wide confidence intervals detected post-stratification may be due to low prevalence of many pathogens, as a small sample size may have hampered precise effect estimates. The overall finding that those with a viral positive ARI episode were not more likely to have sought health care for treatment may indicate that health care utilization is not sought until later in the illness episode following the onset of severe or prolonged symptoms. This is supported by the higher prevalence of seeking care in those reporting ≥7 days of symptom duration observed in this study. In the context of the COVID-19 pandemic, this may have major implications for the demand of hospital resources if cases are not detected and clinically managed early on due to delayed access to testing in this population.

We found no relationship between pneumococcal carriage and health care seeking for an ARI episode. This was unanticipated as secondary pneumoniae and exacerbations of COPD or asthma that may result in provider-supported care or hospitalization are commonly associated with influenza and other viral respiratory infections.[33] Other risk factors for pneumonia include smoking, drug or alcohol use, and HIV – all commonly observed in homeless populations. These factors are responsible for the many-fold higher incidence of pneumonia observed when compared to the general population (266.7 vs. 9.7 per 100,000 reported in one study).[38] Exploration of *S. pneumonia* carriage as a potential mediating factor for seeking health care should be considered for

future research within this population, as well as interventions targeting the impact of pneumococcal vaccination amongst high risk homeless individuals.

Limitations

Convenience sampling is a core limitation to this study. Voluntary participation through passive recruitment at shelters may have introduced selection bias and resulted in a spuriously low detection of viral positivity. Misclassification of self-assessed symptoms as criteria for enrollment is another concern. Given the high rates of underlying conditions in this population, associated chronic symptoms may have allowed individuals to enroll who did not have new acute respiratory illnesses. Sample collection from participants with ≥7 days of symptom duration may have failed to detect viral-positive ARI episodes if viral shedding was no longer occurring. True prevalence estimates of viral positivity may have been improved if screening for participation was based upon *new or worsening* symptoms only within the past 7 days.[39] However, there was no significant difference when we conducted a sensitivity analysis to determine whether viral detection varied by the reported time since symptom onset. While enrollments not beginning until January may have resulted in an under-detection of some viruses, surveillance from the Washington State Department of Health reported a peak in influenza cases in March that year.[40,41]

Temporality is another limitation in this study. The cross-sectional nature of the data means the temporal relationship and therefore causal inferences about predictive factors and having sought health care cannot be ascertained. Collecting samples at time of health care seeking decision making, or collecting follow-up data in subsequent weeks to determine whether they sought health care before their illness episodes resolved, would have addressed this issue. This is recommended for future community-based studies of ARI health care seeking behavior, but may prove difficult in transient homeless populations.

Potential unmeasured confounding variables include whether participants had a primary care provider and symptom severity. Distinction between type of health care provider

participants saw for their ARI episode (e.g. emergency department, clinic, shelter nurse, etc.) was also not measured. Unmeasured behavioral health disorders or mental illnesses also may have played a confounding role in our analyses. Prior research has shown concurrent disorders of mental health diagnosis and problematic substance use to be associated with higher rates of health care utilization among homeless individuals and vulnerably housed adults.[42] Based on published literature, we also expect respondent recall bias, as vaccination status and other clinical variables were by self-report.[43,44]

V. Public Health Implications & Conclusion

This study provides novel insights into predictive factors associated with sheltered homeless individuals seeking care for ARI episodes. The relatively small proportion of symptomatic participants who sought health care, despite high levels of health insurance coverage, suggests challenges to the early identification of viral illness in this population if prior engagement has not been made with primary health care services. Given the high vulnerability of sheltered homeless populations and their inability to adhere to physical distancing measures in a congregate setting, understanding when and how they seek care for ARI is critical to mitigating the rapid spread of respiratory viruses during both seasonal and pandemic outbreaks. Further research is required to assess how symptom severity and duration may impact the decision to seek care for an ARI episode.

Standard surveillance measures for respiratory viruses that rely heavily on care-seeking individuals tested in a clinical setting are failing to detect a large proportion of cases amongst the sheltered homeless. Interventions that target screening and on-site testing for early detection of viral ARI episodes and linkage to care with health services before viral shedding peaks is recommended in shelters and other congregate settings. The COVID-19-related recession and unemployment rate projections (reaching as high as 32.1% in the US) are likely to result in homelessness and viral transmission exacerbating one another.[45,46] Now more than ever do researchers and public health

practitioners need to elucidate the barriers to testing and care for ARI within this vulnerable population.

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Table 1 – Self-reported baseline characteristics of unique participants upon first acute respiratory illness (ARI) episode among sheltered homeless individuals, Seattle Flu Study January 2019 – May 2019 (n = 649).

	Did not seek health care N = 468 (%)	Sought health care N = 181 (%)	Total N = 649 (%)
Sociodemographic			
Age			
Mean (SD)	52.8 (11.0)	53.6 (11.9)	53.1 (11.3)
Median [Min, Max]	55.0 [20, 78]	56.0 [24, 88]	55.0 [20.0, 88.0]
Male Sex	369 (78.8)	127 (70.2)	496 (76.4)
Race / ethnicity*			
White	207 (44.2)	79 (43.6)	286 (44.1)
Black or African American	149 (31.8)	56 (30.9)	205 (31.6)
Asian	13 (2.8)	5 (2.8)	18 (2.8)
Native Hawaiian or Pacific Islander	3 (0.6)	1 (0.6)	4 (0.6)
American Indian or Alaskan Native	5 (1.1)	3 (1.7)	8 (1.2)
Other	45 (9.6)	13 (7.2)	58 (8.9)
Multiple Races	33 (7.1)	18 (9.9)	51 (7.9)
Missing	13 (2.8)	6 (3.3)	19 (2.9)
Hispanic / Latinx			
Yes	44 (9.4)	14 (7.7)	58 (8.9)
No	419 (89.5)	164 (90.6)	583 (89.8)
Missing	5 (1.1)	3 (1.7)	8 (1.2)
Duration of homelessness			
≤6 months	101 (21.6)	38 (21.0)	139 (21.4)
7-12 months	68 (14.5)	27 (14.9)	95 (14.6)
13-24 months	58 (12.4)	25 (13.8)	83 (12.8)
>24 months	225 (48.1)	85 (47.0)	310 (47.8)
Missing	16 (3.4)	6 (3.3)	22 (3.4)
Smoker†			
Yes	379 (81.0)	129 (71.3)	508 (78.3)
No	88 (18.8)	51 (28.2)	139 (21.4)
Missing	1 (0.2)	1 (0.6)	2 (0.3)
Number of encounters per unique individual‡			
1	386 (78.9)	143 (69.1)	529 (81.5)
2	72 (14.7)	42 (20.3)	84 (12.9)
≥ 3	31 (6.3)	22 (10.6)	36 (5.5)
Shelter site			
A	234 (50.0)	113 (62.4)	347 (53.5)
B	234 (50.0)	68 (37.6)	302 (46.5)
Clinical & Laboratory			
Viral ARI			
Yes	88 (18.8)	30 (16.6)	118 (18.2)
No	380 (81.2)	151 (83.4)	531 (81.8)
Coinfection (≥ 2 viruses detected)			
Yes	6 (1.3)	3 (1.7)	9 (1.4)
No	462 (98.7)	178 (98.3)	640 (98.6)
Symptom duration			
1-2 days	56 (12.0)	18 (9.9)	74 (11.4)
3-6 days	109 (23.3)	27 (14.9)	136 (21.0)

	≥7 days	302 (64.5)	136 (75.1)	438 (67.5)
	Missing	1 (0.2)	0 (0)	1 (0.2)
Chronic comorbidity[§]				
	Yes	181 (38.8)	73 (40.3)	254 (39.1)
	No	287 (61.2)	108 (59.7)	395 (60.9)
Influenza-like-illness[|]				
	Yes	190 (40.5)	95 (52.5)	285 (43.9)
	No	278 (59.5)	86 (47.5)	364 (56.1)
S. pneumoniae carriage				
	Yes	105 (22.4)	46 (25.4)	151 (23.3)
	No	363 (77.6)	135 (74.6)	498 (76.7)
Access to Care				
Health insurance[¶]				
	Yes	401 (85.7)	166 (91.7)	567 (87.4)
	No	46 (9.8)	6 (3.3)	52 (8.0)
	Missing	21 (4.5)	9 (5.0)	30 (4.6)
Influenza vaccine received within the last 12 months				
	Yes	203 (43.4)	94 (51.9)	297 (45.8)
	No	262 (56.0)	84 (46.4)	346 (53.3)
	Missing	3 (0.6)	3 (1.7)	6 (0.9)
Received treatment from a medical provider**				
	Yes	22 (4.7)	89 (49.2)	111 (17.1)
	No	445 (95.1)	90 (49.7)	535 (82.4)
	Missing	1 (0.2)	2 (1.1)	3 (0.5)

* *Percentages may not add up to 100 as categories are not mutually exclusive*
† *Tobacco, marijuana, or vaping*
‡ *Columns may not add up to total N as categories are not mutually exclusive due to differential care seeking behavior over multiple ARI episodes*
[§]*Includes chronic obstructive pulmonary disorder/emphysema, chronic bronchitis, asthma, diabetes, or cancer*
[|] *Self-reported fever & cough, or fever & sore throat*
¶ *Self-reported coverage by government, private, or other*
** *Antiviral or antibiotics*

Table 2 – Correlates of having sought health care for an acute respiratory illness (ARI) episode in the past 7 days among sheltered homeless individuals, Seattle Flu Study, January 2019 – May 2019 (n=825).

	Sought health care (%)	Adjusted estimates aPR (95% CI)
Sociodemographic		
Age*		
18-49	73 (31.5)	Reference
50-64	132 (26.5)	1.06 (0.72 – 1.55)
≥65	36 (37.9)	1.49 (0.90 – 2.47)
Male Sex (ref. female) *	167 (26.6)	0.77 (0.52 – 1.15)
Race / ethnicity†		
White	111 (29.8)	Reference
American Indian or Alaskan Native	6 (42.9)	**1.38 (1.06 – 1.79)**
Asian	5 (25.0)	0.97 (0.74 – 1.26)
Black or African American	68 (27.8)	1.02 (0.78 – 1.32)
Native Hawaiian or other Pacific Islander	2 (33.3)	1.29 (0.99 – 1.68)
Multiple Races	26 (35.1)	1.26 (0.97 – 1.63)
Hispanic or Latinx (ref. no) ‡	19 (27.1)	0.80 (0.45 – 1.41)
Duration of homelessness		
≤6 months	57 (30.0)	Reference
7-12 months	32 (29.1)	0.95 (0.56 – 1.58)
13-24 months	34 (30.6)	1.01 (0.61 – 1.71)
>24 months	111 (28.8)	0.93 (0.56 – 1.56)
Smoking (ref. no)		**0.65 (0.45 – 0.92)**
Clinical & Laboratory		
Viral ARI detected		
No	197 (29.4)	Reference
Yes	44 (28.6)	0.96 (0.65 – 1.42)
Coinfection (≥ 2 viruses detected)§	4 (36.4)	1.21 (0.35 – 4.26)
Symptom duration		
1-2 days	25 (24.8)	Reference
3-6 days	38 (21.0)	0.81 (0.46 – 1.45)
≥7 days	178 (32.8)	1.49 (0.84 – 2.65)
Chronic lung condition (ref no)	85 (36.2)	**1.55 (1.12 – 2.15)**
Cancer (ref no)ǀ	12 (24.5)	0.64 (0.31 – 1.33)
Diabetes (ref no)	37 (35.9)	1.43 (0.92 – 2.20)
Influenza-like-illness	126 (34.9)	**1.63 (1.20 – 2.20)**
S. pneumoniae carriage	58 (31.2)	1.11 (0.78 – 1.59)
Access to Care		
Health insurance ¶	223 (30.7)	**2.77 (1.27 – 6.02)**
Influenza vaccine received within the last 12 months	123 (32.6)	**1.39 (1.02 – 1.88)**

* *Adjusted for shelter site identifier*
† *Adjusted for sex*
‡ *Adjusted for smoking status*
§ *Adjusted for influenza-like-illness*
ǀ *Adjusted for age category*
¶ *Adjusted for race / ethnicity*

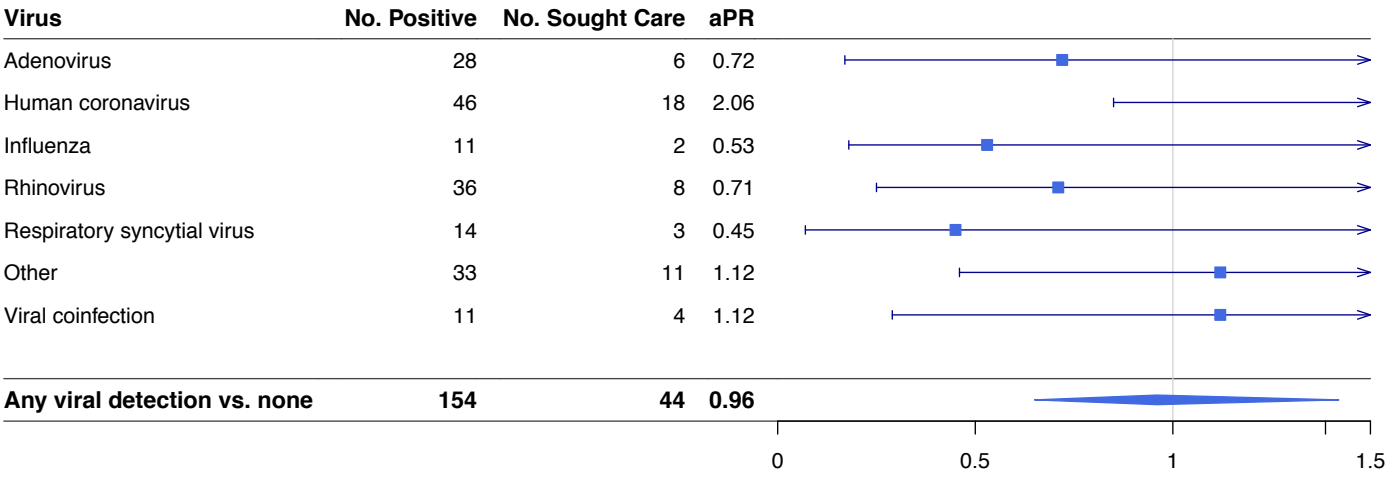

Figure 1 – Stratified analysis of association between virus detected and having sought health care with at least one viral respiratory pathogen detected (n= 154). Number of positives per pathogen do not add up to 154 as positive detection was not mutually exclusive. Adjusted prevalence ratios (aPR) are displayed on the logarithmic scale. Human coronavirus (HCoV) sub-types include HCoV-229E, HCoV-OC43, HCoV-NL63 and HCoV-HKU1. 'Other' viral pathogens detected include enterovirus, human metapneumovirus, and human parainfluenza viruses. All regression models were adjusted for number of days since symptom onset and having received treatment for an illness episode.