U.S. COVID-19 Epidemiology

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ACIP Meeting
June 24, 2020
Outline

- Overview of U.S. COVID-19 Epidemiology
- Epidemiology among Healthcare Personnel
- Epidemiology among Long Term Care Facility (LTCF) Residents
- Epidemiology among Children
- Epidemiology among Pregnant Women
- Epidemiology among People in Congregate Settings
- Serology
Overview of U.S. COVID-19 Epidemiology
Coronavirus Disease 2019 Case Surveillance — United States, January 22–May 30, 2020

- 1,761,503 aggregate U.S. cases of COVID-19 in this report
- Hospitalizations were 6 times higher among patients with reported underlying conditions than those without underlying conditions
- Deaths were 12 times higher among patients with underlying conditions

- Clinical outcomes varied by sex:
  - **Males**
    - Hospitalized: 16%
    - Admitted to the ICU: 3%
    - Died: 6%
  - **Females**
    - Hospitalized: 12%
    - Admitted to the ICU: 2%
    - Died: 5%

ICU = Intensive Care Unit
Coronavirus Disease 2019 Case Surveillance — United States, January 22–May 30, 2020

FIGURE. Daily number of COVID–19 cases*;¶,†,‡ (A) and COVID–19–associated deaths** (B) reported to CDC — United States, January 22–May 30, 2020

https://www.cdc.gov/mmwr/volumes/69/wr/mm6924e2.htm?s_cid=mm6924e2_w
Coronavirus Disease 2019 Case Surveillance — United States, January 22–May 30, 2020

FIGURE. Daily number of COVID-19 cases*;†;§;¶ (A) and COVID-19–associated deaths** (B) reported to CDC — United States, January 22–May 30, 2020
Percentage testing positive in children <18 years of age is higher than adult age groups.

5.5%
Commercial Laboratories Reporting to CDC

March 1 to June 13, 2020

Percentage positive was low, but has been increasing recently.

6.7%

Levels of Influenza-like illness (ILI) and COVID-like illness (CLI) increased in late March, but declining in recent weeks.
Pneumonia, Influenza and COVID-19 Mortality
NCHS Mortality Reporting System

Through June 13, 2020

7.1%
COVID-NET: Hospitalization Surveillance from 14 States

States participating in COVID-NET

Surveillance network collecting hospitalization data

- Catchment area ~10% of US population
- Patients must be a resident of the surveillance area and have a positive SARS-CoV-2 test within 14 days prior to or during hospitalization
- Charts reviewed by trained surveillance officers

COVID-NET = COVID-19-Associated Hospitalization Surveillance Network

MMWR April 17, 2020
https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e3.htm
COVID-NET: Hospitalization Surveillance from 14 States
March 1 to June 13, 2020

Overall: 94.5/100,000 population

Among adults ≥65 years of age: 287/100,000 population

Cumulative Hospitalization Rate

https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html
COVID-NET:
Age-adjusted COVID-19-associated hospitalization rates, by race and ethnicity

March 1 to June 13, 2020

- Non-Hispanic American Indian or Alaska Native: 221.2
- Non-Hispanic Black: 178.1
- Hispanic or Latino: 160.7
- Non-Hispanic Asian or Pacific Islander: 48.4
- Non-Hispanic White: 40.1

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Compared to non-Hispanic White persons

Race and Ethnicity
91.2% of hospitalized adults reported an underlying condition

Hypertension: 56%
Obesity: 49%
Metabolic Disease (including Diabetes): 42%
Cardiovascular Disease: 33%

7,465 hospitalized adults with available information

[Source: https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html]
53.3% of hospitalized children reported an underlying condition:

- Obesity: 38%
- Asthma: 16%
- Neurologic Disease: 14%

Underlying Medical Conditions Among Children and Adolescents

150 hospitalized children with available information

https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html
Risk Factors for Hospitalization

Characteristics Associated with Hospitalization Among Patients with COVID-19 — Metropolitan Atlanta, Georgia, March–April 2020

*Adjusted for age, sex, race, obesity, past or current smoking, insurance status, and other underlying conditions

220 hospitalized and 311 non-hospitalized COVID-19 patients from 6 metropolitan Atlanta hospitals/clinics

Several factors independently associated with hospitalization, through adjusted Odds Ratios (aORs)*

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>aOR</th>
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<tbody>
<tr>
<td>Age ≥65 years</td>
<td>3.4 (1.6-7.4)</td>
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<tr>
<td>Black race</td>
<td>3.2 (1.8-5.8)</td>
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<tr>
<td>Having diabetes mellitus</td>
<td>3.1 (1.7-5.9)</td>
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<tr>
<td>Lack of insurance</td>
<td>2.8 (1.1-7.3)</td>
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<tr>
<td>Male sex</td>
<td>2.4 (1.4-4.1)</td>
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<tr>
<td>Smoking</td>
<td>2.3 (1.2-4.5)</td>
</tr>
<tr>
<td>Obesity</td>
<td>1.9 (1.1-3.3)</td>
</tr>
</tbody>
</table>

*Adjusted for age, sex, race, obesity, past or current smoking, insurance status, and other underlying conditions

MMWR June 17, 2020
https://www.cdc.gov/mmwr/volumes/69/wr/mm6925e1.htm?s_cid=mm6925e1_w
COVID-19
Epidemiology among Healthcare Personnel
Healthcare Personnel (HCP)

Characteristics of Health Care Personnel with COVID-19 — United States, February 12–April 9, 2020

CDC COVID-19 Response Team

Among 1,423 HCP patients who reported contact with a lab-confirmed COVID-19 patient in either healthcare, household or community settings, 780 (55%) reported having such contact only in health care setting within 14 days.

Most HCP not hospitalized.

Severe outcomes occurred across all age groups.

- 27 (of 4407: 0.6%) deaths

315,531 COVID-19 cases reported to CDC

49,370 (16%) with information on HCP status

9,282 (19%) identified as a HCP

MMWR April 17, 2020 [Link to CDC report]
# Healthcare Personnel (HCP)

- CDC reports and routinely updates cases and deaths among healthcare personnel on the CDC website

## Cases & Deaths among Healthcare Personnel

As of June 23rd

Data were collected from 1,952,346 people, but healthcare personnel status was only available for 424,304 (21.7%) people. For the 83,673 cases of COVID-19 among healthcare personnel, death status was only available for 53,902 (64.4%).

<table>
<thead>
<tr>
<th>CASES AMONG HCP</th>
<th>DEATHS AMONG HCP</th>
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<tbody>
<tr>
<td>83,673</td>
<td>464</td>
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Next Steps: Healthcare Personnel (HCP)

- Prospective cohort study of 1,600 HCP working in US Emergency Departments (ED)
  - Estimate attributable risk of occupational acquisition of COVID-19 infection for emergency physicians and nurses
  - Estimate attributable risk of occupational acquisition of COVID-19 infection related to endotracheal intubation
  - Identify risk factors associated with SARS-CoV-2 transmission during intubation
  - Determine the prevalence of symptomatic and asymptomatic COVID-19 infections occurring in ED HCPs

- Serial symptom questionnaires, SARS-CoV-2 serology (IgG) and self-collected nasal swabs (PCR) over a 12-week period

https://medicine.uiowa.edu/content/study-overview
Emerging Infections Program (EIP): network of 10 state health departments and local public health and academic partners

EIP sites initiated projects on HCP COVID-19 case tracking
- Surveillance for and interviews of HCP cases (10 EIP sites)
- Comparison of HCP cases and HCP non-cases (5 EIP sites)

As of 6/12, 1,044 cases reported among HCP from 9 sites, 425 interviews conducted

Next Steps:
Healthcare Personnel (HCP)

https://www.cdc.gov/ncezid/dpei/eip/index.html
### Next Steps: Healthcare Personnel (HCP)

<table>
<thead>
<tr>
<th>AZ HEROES</th>
<th>RECOVER</th>
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<tbody>
<tr>
<td><strong>Collaboration between University of Arizona, CDC and NCI</strong></td>
<td><strong>CDC</strong></td>
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<tr>
<td><strong>Study Population</strong></td>
<td><strong>HCP, first responders, essential and frontline workers</strong></td>
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<tr>
<td><strong>Study Design</strong></td>
<td>Prospective longitudinal cohort</td>
</tr>
<tr>
<td><strong>Timeline</strong></td>
<td>12 months</td>
</tr>
<tr>
<td><strong>Specimen Collection</strong></td>
<td>Repeat PCR and serology</td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
<td>Determine incidence of asymptomatic and symptomatic infection</td>
</tr>
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<td></td>
<td>Estimate incidence of novel infection and repeat infection</td>
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**AZ HEROES:** Arizona Healthcare, Emergency Response and Other Essential Workers Surveillance Study

**RECOVER:** Research on the Epidemiology of COVID-19 in Emergency Response and Healthcare Personnel
COVID-19
Epidemiology among Long Term Care Facility (LTCF) Residents
Long Term Care Facilities:
Skilled Nursing Facility, King County, Washington

- As of March 18\textsuperscript{th}, 167 confirmed COVID-19 cases associated with the facility
  - 101 residents
  - 50 staff/HCP
  - 16 visitors

- 86\% of tested residents were confirmed positive

- 34\% of residents died

MMWR March 27, 2020 [https://www.cdc.gov/mmwr/volumes/69/wr/mm6912e1.htm?s_cid=mm6912e1_w](https://www.cdc.gov/mmwr/volumes/69/wr/mm6912e1.htm?s_cid=mm6912e1_w)
McMichael TM, et al. NEJM 2020
Long Term Care Facilities

- Reports suggest that once COVID-19 has been introduced into a long-term care facility, it has the potential to result in high attack rates among residents, staff members, and visitors.

- Many areas contribute to vulnerability of LTCFs:
  - Inadequate familiarity with PPE
  - Inadequate supplies of PPE
  - High prevalence of underlying conditions
  - Atypical presentations in elderly
  - Facilities share staff and patients

McMichael TM, et al. NEJM 2020
Long Term Care Facilities

- As of the week ending June 7, almost 15,000 nursing homes are reporting COVID-19 in NHSN
  - These facilities reported over 107,000 confirmed COVID-19 cases, over 71,000 suspected cases and almost 30,000 deaths in residents
  - CMS began publicly reporting data from nursing homes on June 4, 2020

- CDC also tracks what states report publicly; these numbers include a broader range of LTCFs beyond nursing homes, such as assisted living facilities

- As of June 11, 2020, there were at least 245,605 cumulative confirmed or probable COVID-19 cases in residents and staff from 10,708 LTCFs across 51 U.S. states and territories based on state health department websites and other publicly available information

Next Steps: Long Term Care Facilities

- Information collected through NHSN will be used to:
  - Strengthen COVID-19 surveillance locally and nationally
  - Monitor trends in infection rates
  - Help local, state, and federal health authorities get help to nursing homes faster

https://www.cdc.gov/nhsn/ltc/covid19/index.html
COVID-19: Infants and Children

- Children may have different or minimal symptoms
  - Abdominal pain or GI symptoms\textsuperscript{1}
- May be more likely to be asymptomatic\textsuperscript{1,2}

- Early in the outbreak in China, school-aged children had largest number of close contacts of any age\textsuperscript{3}
- Efficiency of spread in schools by children is unknown. Existing data are reassuring, but limited\textsuperscript{4-6}

\textsuperscript{1}MMWR April 10, 2020 \url{https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e4.htm?s_cid=mm6914e4_w}
\textsuperscript{2}Dong et al. Pediatrics, June 2020
\textsuperscript{3}Zhang et al. Science April, 2020
\textsuperscript{4}Heavey et al. Eurosurveillance May 2020
\textsuperscript{5}Johansen et al. Eurosurveillance May 2020
\textsuperscript{6}COVID-19 in schools- the experience in NSW April 2020 Report
Inflammatory Multisystem Syndrome in Europe

- Primarily described among children
- Initially called PIMS (Pediatric Inflammatory Multisystem Syndrome) in Europe
- Kawasaki-like disease and cardiac involvement

Epidemic curve peaked 4-5 weeks after peak of COVID-19 epidemic in France

Temporal distribution of COVID-19 hospitalisations and SARS-CoV2 hyperinflammatory paediatric cases, France, 2 March–17 May (n = 108)
Inflammatory Multisystem Syndrome in Europe

- Pediatric Inflammatory Syndrome in England: March 23 to May 16
  - 58 children with fever and laboratory evidence of inflammation
  - SARS-CoV-2 PCR positive 15/58 (26%) children
  - SARS-CoV-2 IgG positive in 40/46 (87%) children
  - All patients presented with persistent fever (3-19 days)
  - Abdominal pain n=31/58, 53%
  - Rash n=30/58, 52%
  - 45/58 (78%) had evidence of current or prior SARS-CoV-2 infection
  - 29 (50%) children developed shock and myocardial dysfunction
  - 8 (14%) children developed coronary artery dilation or aneurysm
  - 2 (3%) children required extracorporeal membrane oxygenation (ECMO)

Whittaker et al. JAMA 2020
Multisystem Inflammatory Syndrome in Children (MIS-C)
Case definition among children aged <21 years

- Fever > 38.0°C
  AND
- Laboratory evidence of inflammation
  AND
- Evidence of clinically severe hospitalized illness with multisystem (≥2) organ involvement (cardiac, renal, respiratory, hematologic, gastrointestinal, dermatologic or neurological)
  AND
- One of the following:
  1. SARS-CoV-2 positive PCR test
  2. SARS-CoV-2 positive antibody test
  3. SARS-CoV-2 negative PCR and antibody tests but with identified COVID exposure within the four weeks prior to the onset of symptoms

*Details available at: [https://emergency.cdc.gov/han/2020/han00432.asp](https://emergency.cdc.gov/han/2020/han00432.asp)
Multisystem Inflammatory Syndrome in Children (MIS-C)
The Overcoming COVID-19 Study

- Coordinated by Boston Children’s Hospital, funded by CDC
- **213** MIS-C cases enrolled at 53 participating health centers in 26 states
- Most were previously healthy and cardiovascular involvement was prominent

<table>
<thead>
<tr>
<th>Key findings</th>
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<tbody>
<tr>
<td>SARS-CoV2 PCR+ or antibody positive at admission</td>
<td><strong>73%</strong></td>
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<tr>
<td>Age, median (IQR)</td>
<td><strong>8.4 (3.6, 12.8)</strong></td>
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<tr>
<td>&lt;5 years</td>
<td><strong>33%</strong></td>
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<tr>
<td>5-21 years</td>
<td><strong>67%</strong></td>
</tr>
<tr>
<td>Previously healthy (except obesity)</td>
<td><strong>73%</strong></td>
</tr>
<tr>
<td>Male</td>
<td><strong>63%</strong></td>
</tr>
<tr>
<td>ICU</td>
<td><strong>81%</strong></td>
</tr>
<tr>
<td>Died</td>
<td><strong>3%</strong></td>
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</tbody>
</table>

- **81%** cardiovascular involvement
- **50%** with elevated troponin
- **38%** with ejection fraction <55%
- **50%** required vasopressor support
- ~**9%** had coronary aneurysms (z-score ≥2.5) *has long-term implications*
Next Steps:
Multisystem Inflammatory Syndrome in Children (MIS-C)

- **CDC MIS-C Surveillance**
  - CDC recommends that healthcare providers report suspect cases of MIS-C to local, state or territorial health departments
  - Health departments then report cases to the National Notifiable Diseases Surveillance System for case counts and case report forms are submitted using other MIS-C specific surveillance systems

- **New Vaccine Surveillance Network**
  - Seven US pediatric medical centers conducting active surveillance for acute respiratory and gastrointestinal illness

- **COVID-NET**
  - A population-based surveillance system collecting data on lab-confirmed SARS-CoV-2-associated hospitalizations among children
COVID-19

Epidemiology among Pregnant Women
Pregnancy and risk for severe respiratory viral illness

- Physiologic changes of pregnancy may increase the risk of severe illness \(^1\)
  - Increased heart rate and oxygen consumption
  - Decreased lung capacity
  - Shift away from cell-mediated immunity

- Severe disease has been associated with other viral respiratory infections in pregnant women\(^1\)–\(^4\)

\(^3\)Mertz D et al. Populations at risk for severe or complicated influenza illness: systematic review and meta-analysis. BMJ 2013
Pregnant Women: New York City

- Prospective cohort study of pregnant women with lab-confirmed SARS-CoV-2 from March 13–April 12 at 5 NYC medical centers
- 241 women with positive SARS-CoV-2 test
  - 89% admitted for obstetric indications
- 148 (61%) asymptomatic at time of admission
  - 46 developed COVID-19 symptoms during hospitalization
- Body mass index (BMI) ≥30 associated with COVID-19 severity
  - Insurance type, age, race and ethnicity, and underlying medical conditions not associated with COVID-19 severity

Khoury R et al. Obstet Gynecol 2020
Pregnant Women: New York City

- 236/245 liveborn neonates with documented SARS-CoV-2 test results
  - 230 (98%) tested negative

- Preterm (<37 weeks gestation) birth rate in this cohort (14.6%) higher than in the general population (10.2%*).
  - Statistically significant linear trend between COVID-19 maternal severity and the risk of preterm birth

Khoury R et al. Obstet Gynecol 2020;
Women of reproductive age (WRA) with SARS-CoV-2 infection by pregnancy status — Jan 22–Jun 7

Inclusion Criteria
- Women aged 15-44 years
- Laboratory-confirmed SARS-CoV-2 infection
- 50 states, NYC, and DC
- Reported to CDC January 22–June 7, 2020 (data as of June 17, 2020)

Women aged 15–44 years
N=326,335

Pregnancy status not reported
n=234,923

Pregnancy status reported
n=91,412

Pregnant
n=8,207

Not pregnant
n=83,205
Hospitalization, ICU admission, mechanical ventilation, and death among pregnant women and nonpregnant WRA with SARS-CoV-2 infection

<table>
<thead>
<tr>
<th>Outcomes of Interest</th>
<th>No. (%)*</th>
<th>Crude RR (95% CI)</th>
<th>aRR (95% CI) †</th>
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<tbody>
<tr>
<td><strong>Pregnant women</strong></td>
<td></td>
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<tr>
<td>with COVID-19</td>
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<tr>
<td>(N = 8,207)</td>
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<td></td>
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<tr>
<td>Hospitalization§</td>
<td>2,587 (31.5)</td>
<td>5.4 (5.2-5.7)</td>
<td>5.4 (5.1-5.6)</td>
</tr>
<tr>
<td>ICU Admission</td>
<td>120 (1.5)</td>
<td>1.6 (1.3-1.9)</td>
<td>1.5 (1.2-1.8)</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>42 (0.5)</td>
<td>1.9 (1.4-2.6)</td>
<td>1.7 (1.2-2.4)</td>
</tr>
<tr>
<td>Death</td>
<td>16 (0.2)</td>
<td>0.8 (0.5-1.3)</td>
<td>0.9 (0.5-1.5)</td>
</tr>
<tr>
<td><strong>Nonpregnant women</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with COVID-19</td>
<td>4,840 (5.8)</td>
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<tr>
<td>(N = 83,205)</td>
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* Percentages calculated among total in pregnancy status group; those with missing data on outcomes were counted as not having the outcome.
† Adjusted for age as a continuous variable, dichotomous yes/no variable for presence of underlying conditions, and categorical race/ethnicity. Nonpregnant women are the referent group.
§ May include women admitted for obstetric care reasons who receive routine SARS-CoV-2 testing upon admission.
Hospitalization Bias

- Challenges in interpretation of hospitalization as an outcome, since data are not available to determine whether hospitalization was due to COVID-19 or pregnancy-related condition.

- In an analysis of outcomes among pregnant versus non-pregnant women hospitalized with lab-confirmed COVID-19 from COVID-NET, the risk of ICU and mechanical ventilation was lower among pregnant compared to non-pregnant women, and there was no statistically significant difference in the risk of in-hospital death.
  - Reason for admission is not specified; it is possible that non-pregnant women were predominately admitted for medical illness, whereas pregnant women admitted for medical illness or labor/delivery.
  - Pregnant women admitted solely for labor/delivery are likely healthier than pregnant or non-pregnant women admitted for medical illness.
Summary

- Largest U.S. cohort of pregnant women with lab confirmed SARS-CoV-2 infection
- More complete data are needed to fully understand the risk of severe illness due to SARS-CoV-2 infection in pregnant women and neonates
- Results suggest an increased relative risk of ICU admission and mechanical ventilation comparing pregnant women with nonpregnant women; however, the absolute risk of these clinical interventions is still very low in this population
Next Steps: Pregnant Women

- Cohort studies, including retrospective electronic cohorts and prospective community cohorts
  - Assess incidence and seroprevalence of SARS-CoV-2 in pregnancy
  - Predictors for severity of disease

- Collecting surveillance data on pregnancy and neonatal outcomes
  - Surveillance for Emerging Threats to Mothers and Babies Network (SET-NET)

- Leveraging existing pregnancy surveillance systems
  - Pregnancy Risk Assessment and Monitoring System (PRAMS)
  - COVID-NET
COVID-19 Epidemiology among People in Congregate Settings
Congregate Settings: Meat & Poultry Processing

- 115 meat or poultry processing plants in 19 states reported COVID-19 cases to CDC in April 2020

- COVID-19 diagnosed in 4,913 (~3%) workers
  - By state, ranged from 0.6% to 18.2% of workers

- 20 COVID-19 related deaths reported
Congregate Settings: Correction & Detention Facilities

- **420** correctional/detention facilities with ≥1 COVID-19 case from 32 state and territorial health department jurisdictions

- COVID-19 diagnosed in **4,893** incarcerated persons and **2,778** staff

- 88 COVID-19 related deaths reported among incarcerated persons, 15 among staff
Increased Prevalence of COVID-19 Among Homeless Shelters

Homelessness poses multiple challenges that can amplify spread of COVID-19. A study conducted from March 27 to April 15 in 19 homeless shelters in 4 U.S. cities tested 1,192 residents and 313 staff members. The cities included Seattle, Boston, San Francisco, and Atlanta. The results showed:

- In shelters associated with a cluster:
  - Seattle: 17% positive
  - Boston: 36% positive
  - San Francisco: 66% positive

- In shelters NOT associated with a cluster:
  - Seattle: 5% positive
  - Atlanta: 4% positive

This highlights the increased risk for COVID-19 in homeless shelters and the importance of targeted interventions to mitigate this risk.
Serology
Seroprevalence Surveys

- Large-scale geographic Seroprevalence Surveys: estimate the number of people previously infected with SARS-CoV-2 and not included in official case counts
  - Including specimens from commercial laboratories and blood donations

- Community-level Seroprevalence Surveys: cover smaller areas, with selection of participants systematically selected

- Special populations Seroprevalence Surveys: answer questions about specific populations, such as healthcare workers or pregnant women

Additional information: https://www.cdc.gov/coronavirus/2019-ncov/covid-data/seroprevalence-types.html#special-populations-seroprevalence-surveys
Summary
Summary

- ~2 million cases of COVID-19 diagnosed in the United States through June
- Multiple sub-populations appear to have an increased risk, including older adults, healthcare workers, individuals at long term care facilities or other congregate settings, and those with underlying medical conditions
- Many projects are ongoing to better define characteristics of SARS-CoV-2 infections
For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.