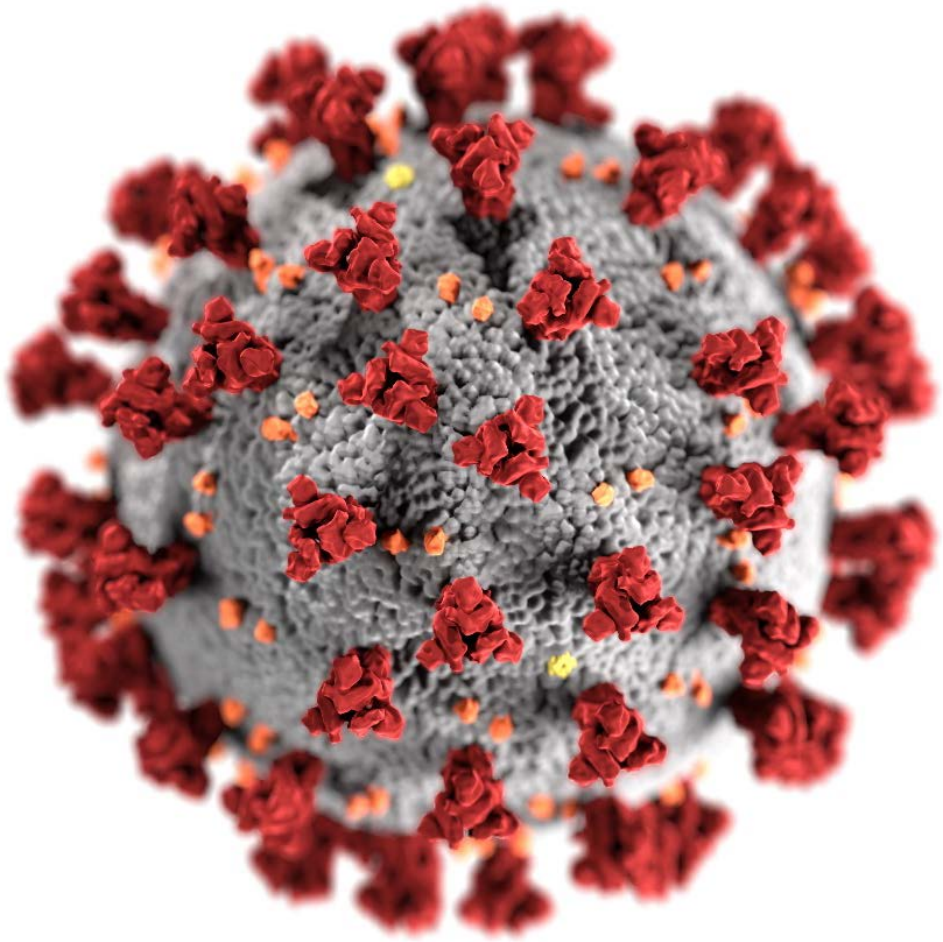
U.S. COVID-19 Epidemiology



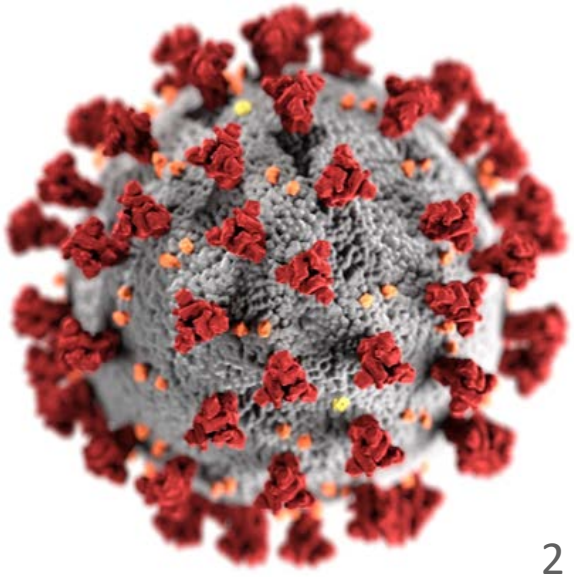
Sara Oliver MD, MSPH

ACIP Meeting
June 24, 2020

For more information: **www.cdc.gov/COVID19**

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

United States COVID-19 Cases by County

January 21 to June 23, 2020

USA

2,302,288

TOTAL CASES

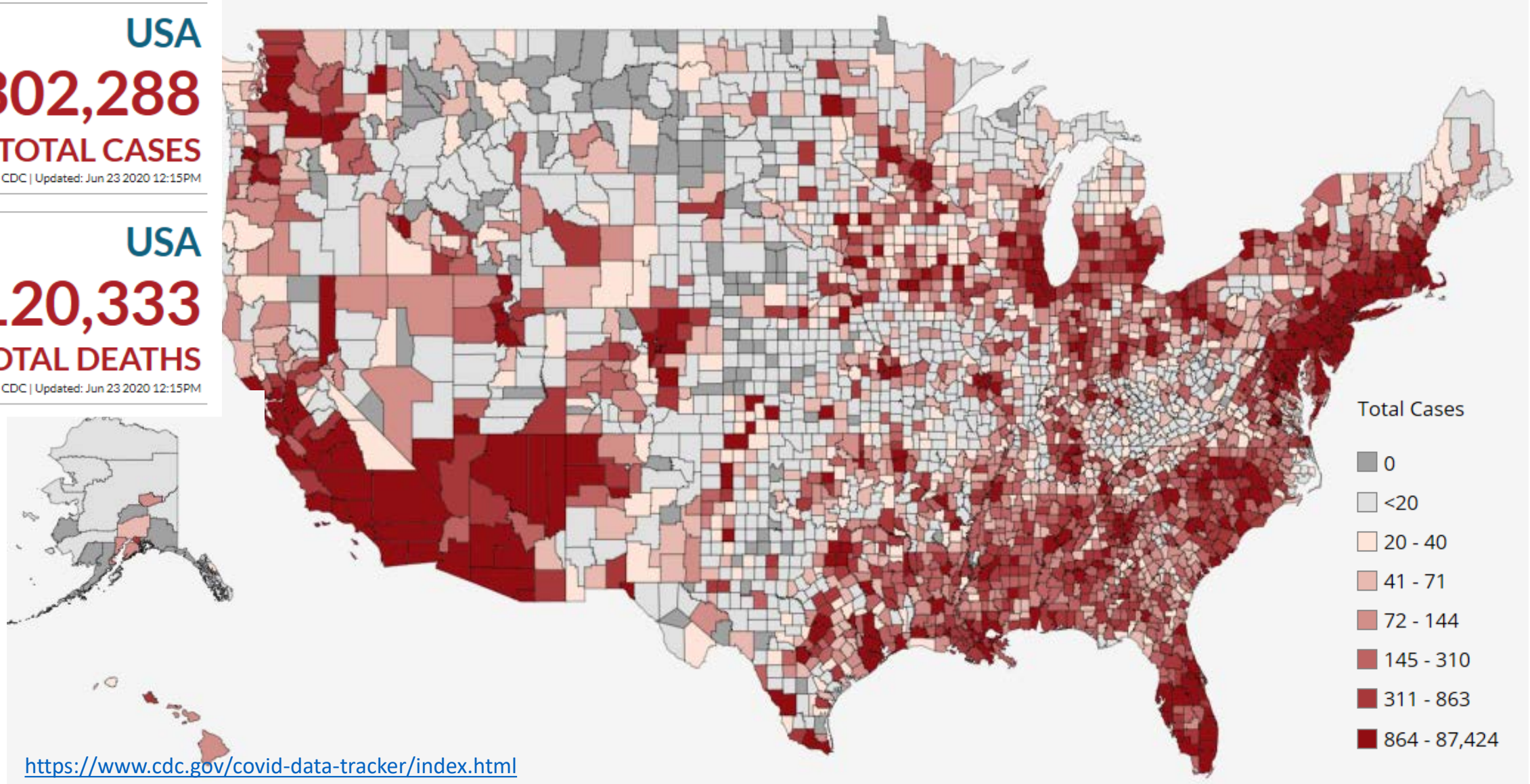
CDC | Updated: Jun 23 2020 12:15PM

USA

120,333

TOTAL DEATHS

CDC | Updated: Jun 23 2020 12:15PM



https://www.cdc.gov/covid-data-tracker/index.html

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**%

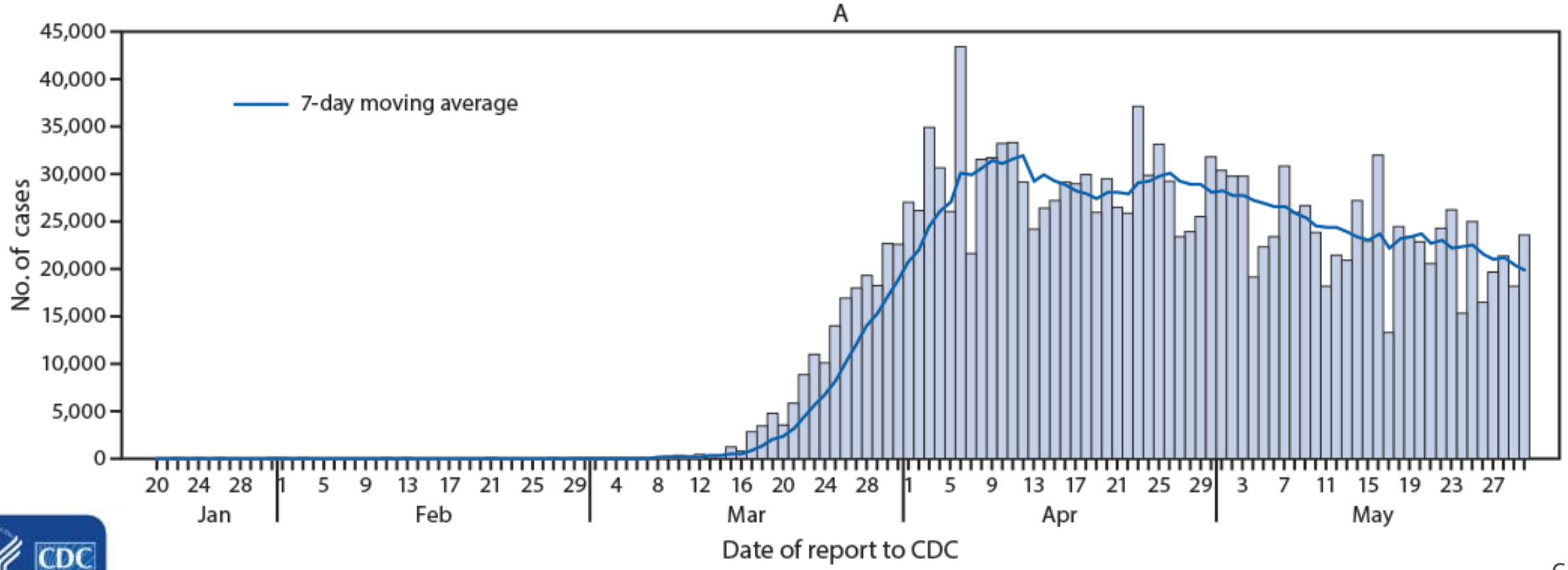
Died: **5**%

MMWR: Published June 15th
https://www.cdc.gov/mmwr/volumes/69/wr/mm6924e2.htm?s_cid=mm6924e2_w

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**



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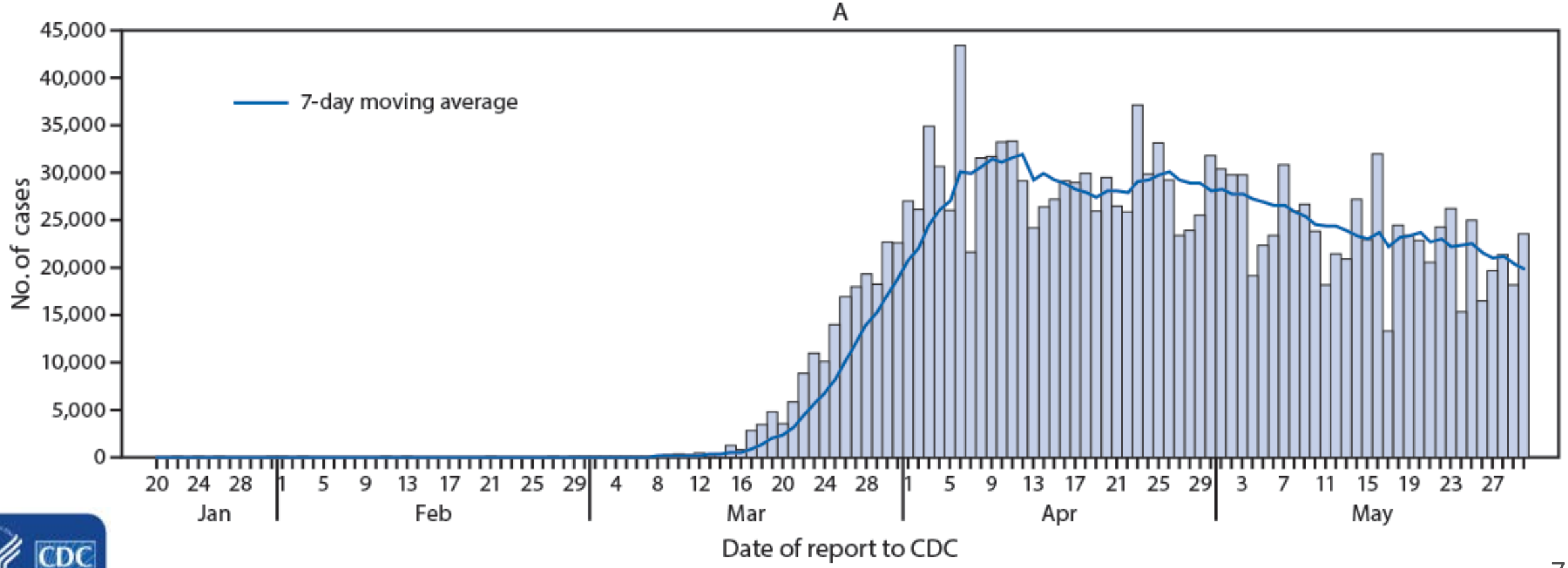
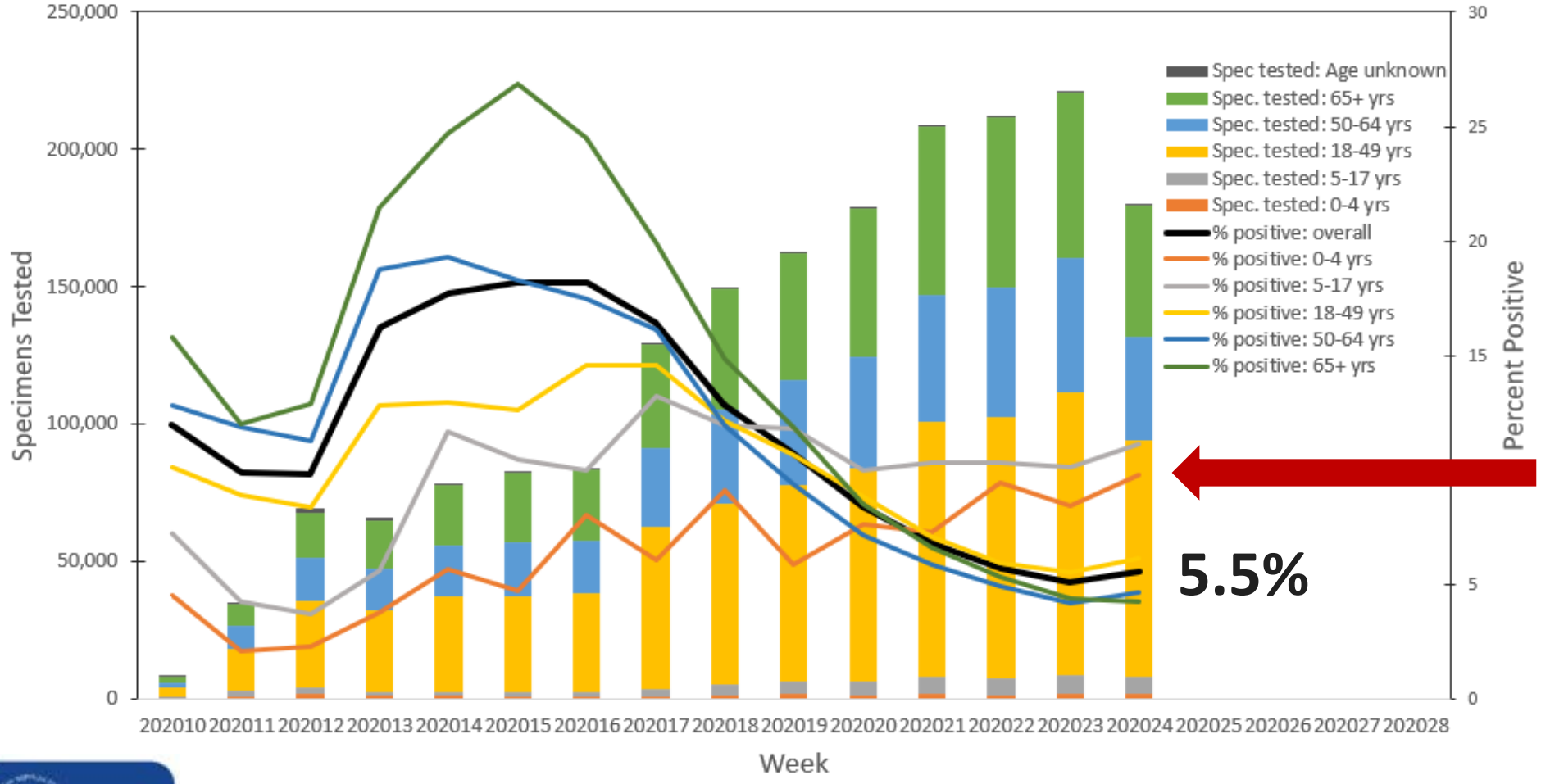


https://www.cdc.gov/mmwr/volumes/69/wr/mm6924e2.htm?s_cid=mm6924e2_w

Public Health Laboratories Reporting to CDC

March 1 to June 13, 2020

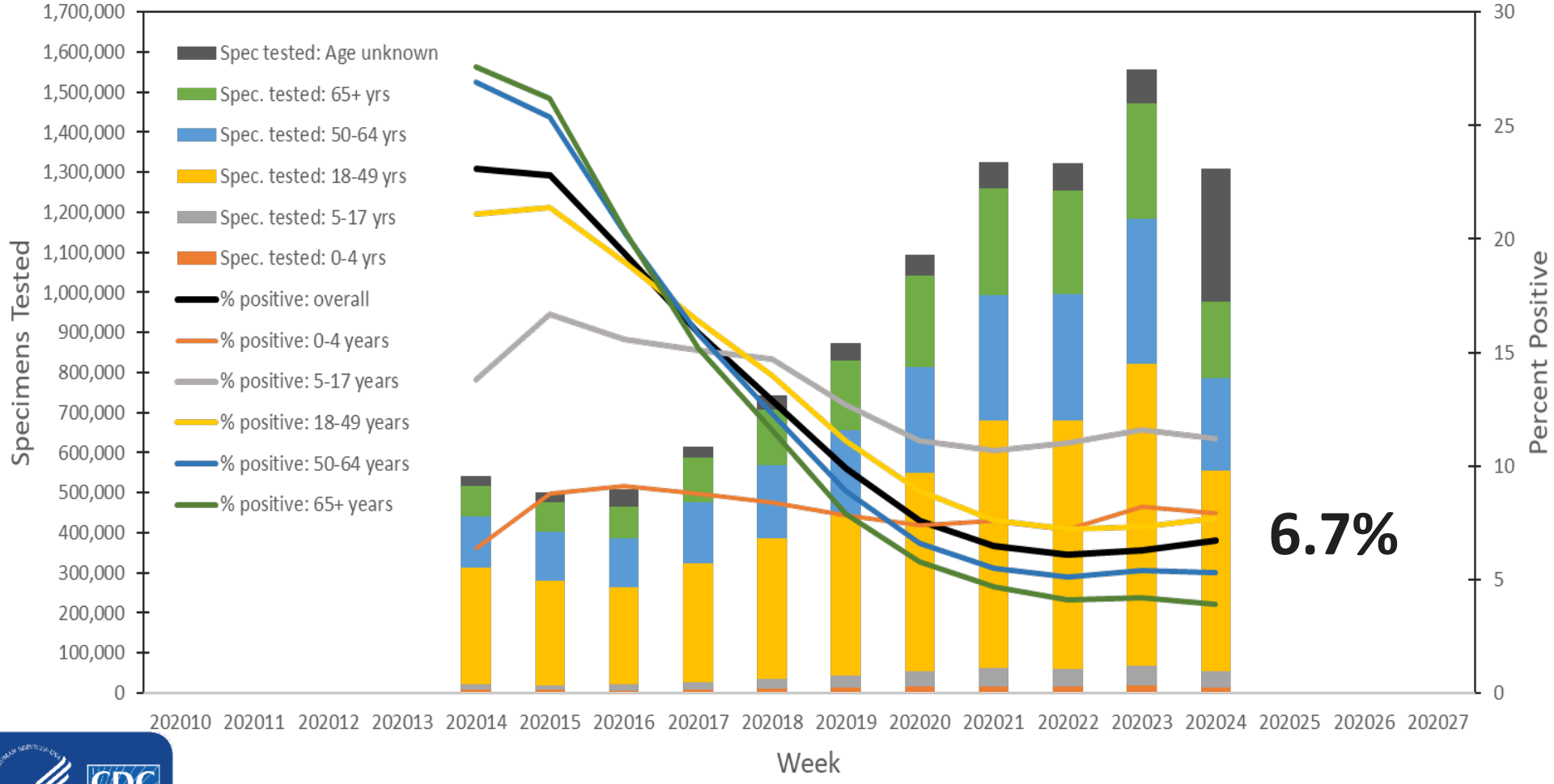


Percentage testing positive in children <18 years of age is **higher** than adult age groups

https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/index.html

Commercial Laboratories Reporting to CDC

March 1 to June 13, 2020



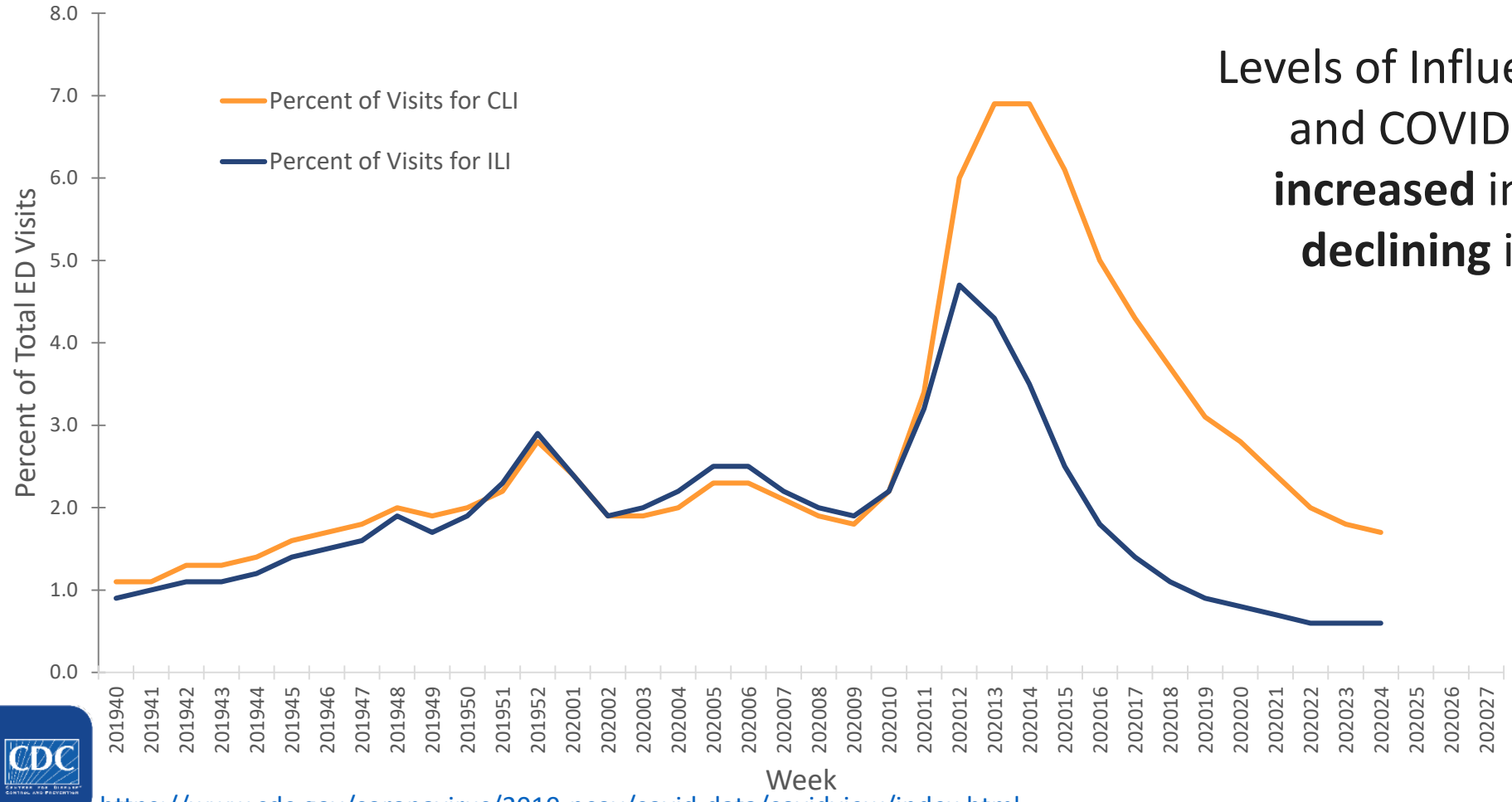
Percentage positive **low**, but **increasing** recently

https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/index.html

Percent of Visits for ILI and CLI in Emergency Departments

National Syndromic Surveillance Program (NSSP)

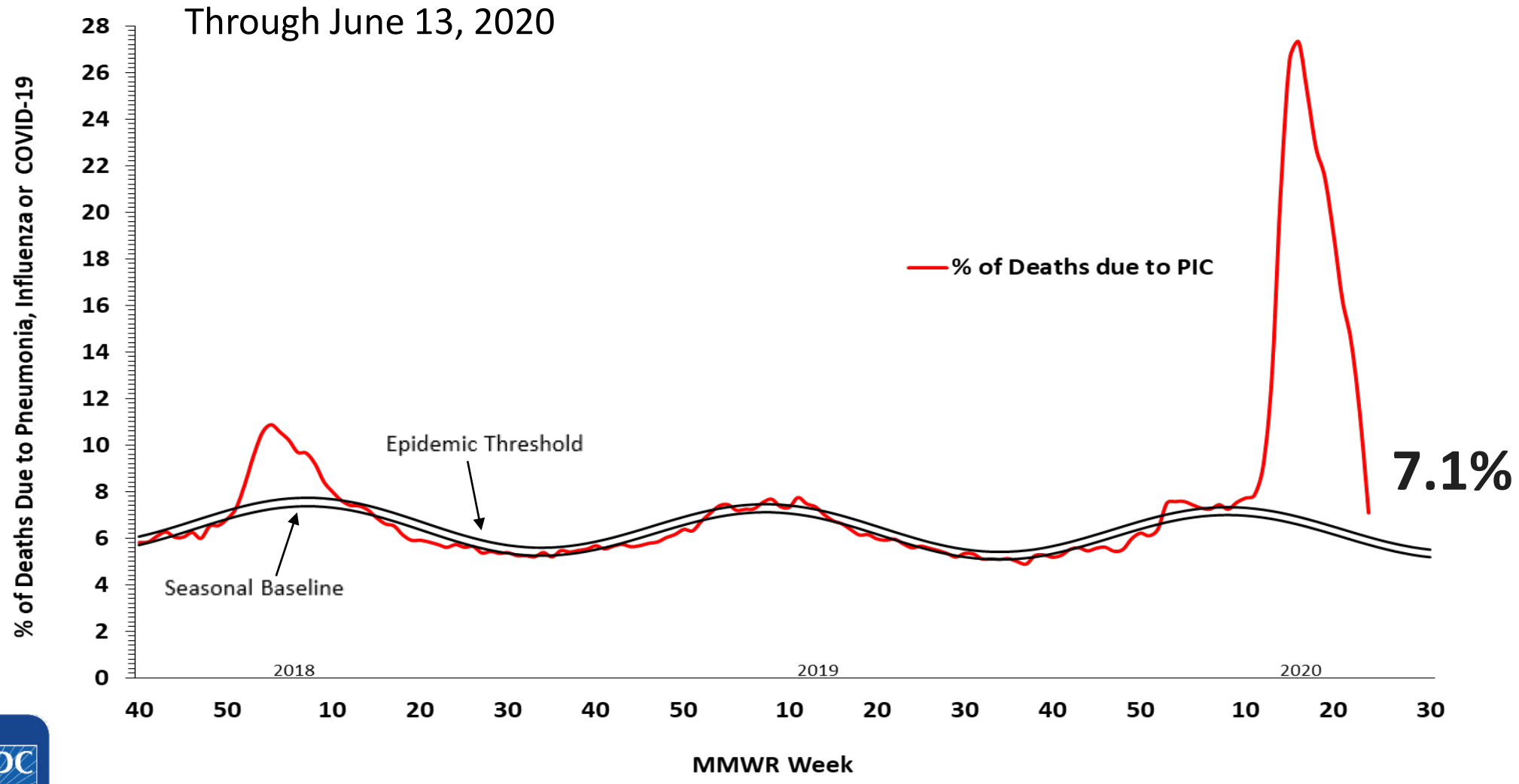
September 29,2019 to June 13, 2020



Levels of Influenza-like illness (ILI) and COVID-like illness (CLI) **increased** in late March, but **declining** in recent weeks

https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/index.html

Pneumonia, Influenza and COVID-19 Mortality
NCHS Mortality Reporting System



https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/index.html

NCHS = National Center for Health Statistics

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

MMWR April 17, 2020
https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e3.htm

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

COVID-NET: Hospitalization Surveillance from 14 States

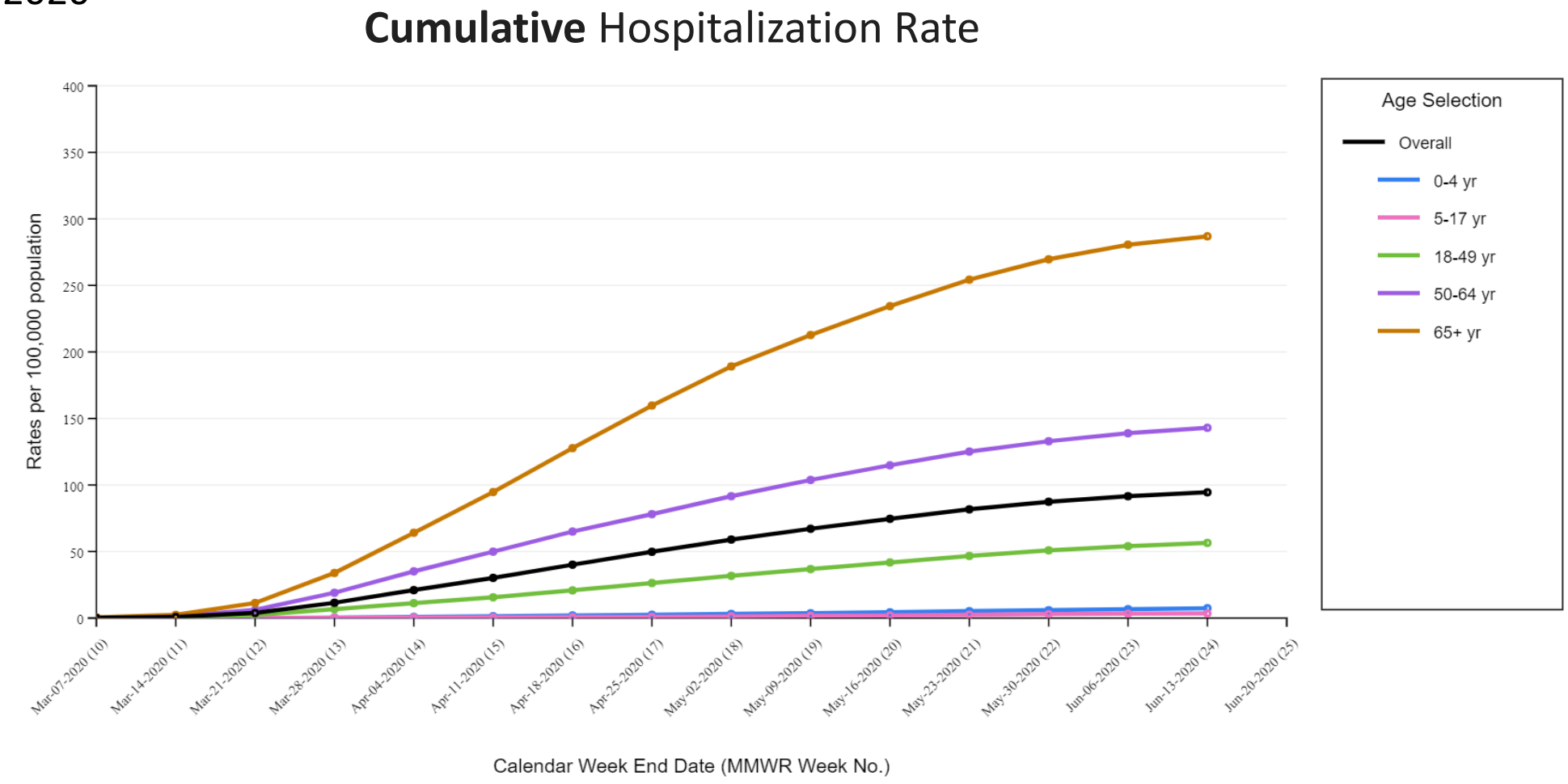
March 1 to June 13, 2020

Overall:

94.5/100,000 population

Among adults ≥65 years of age:

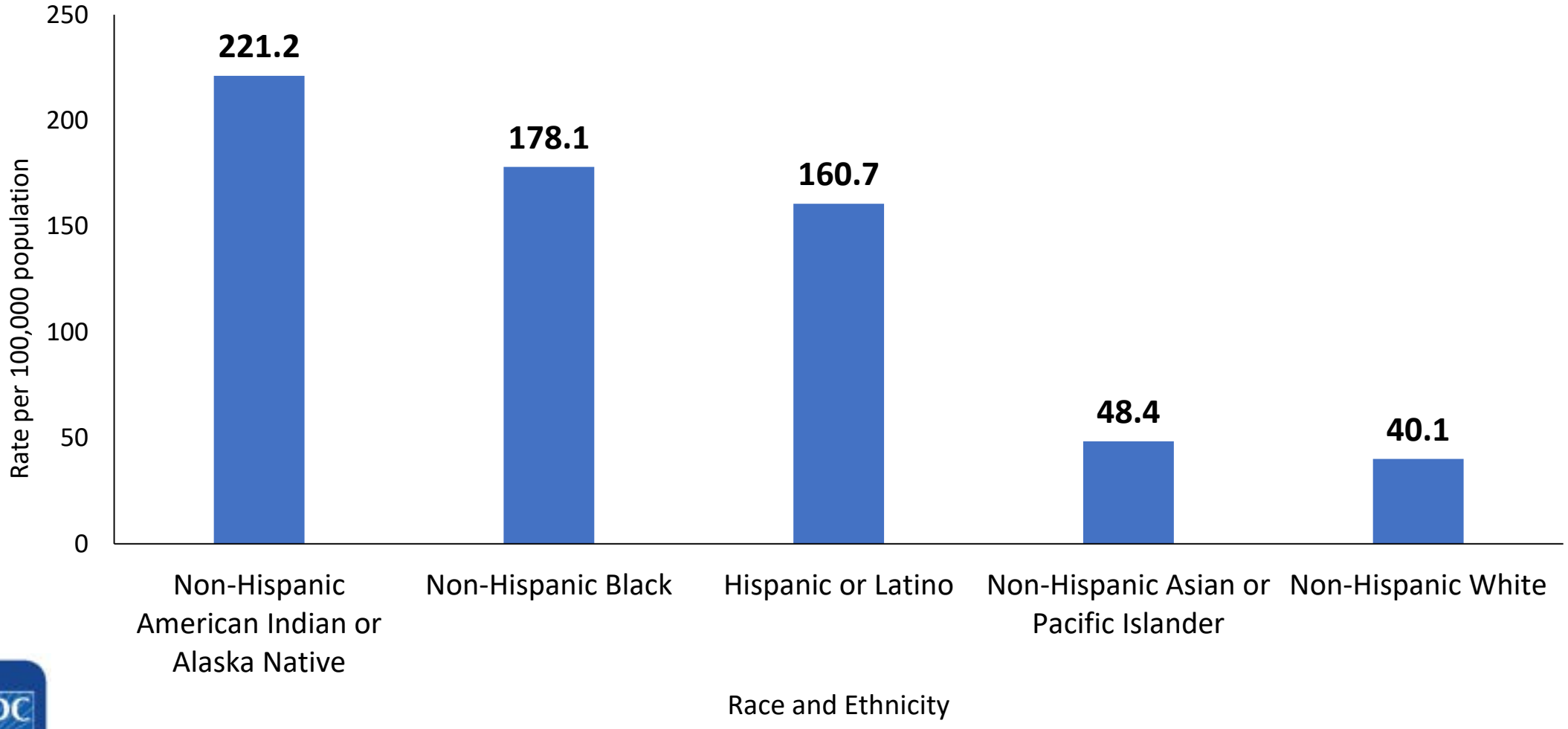
287/100,000 population



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



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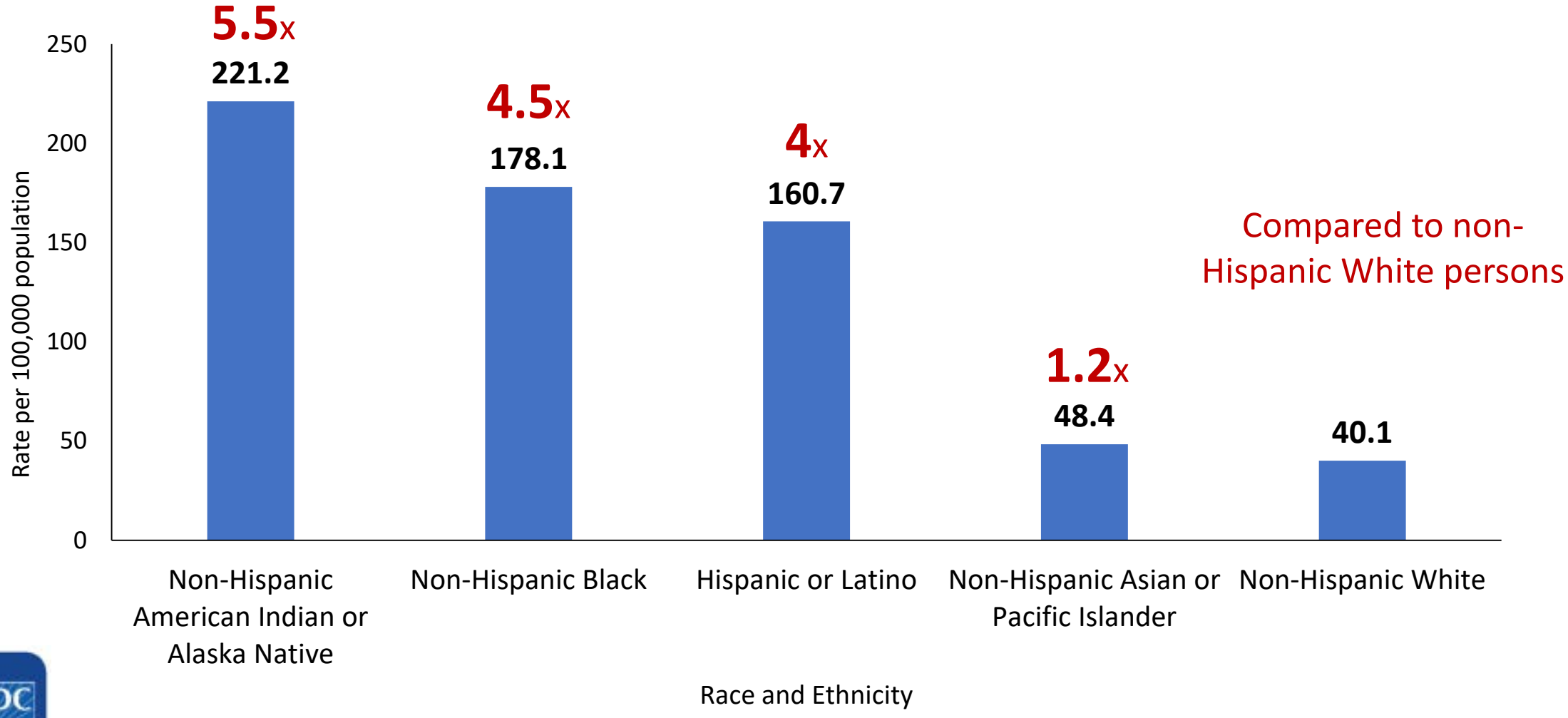
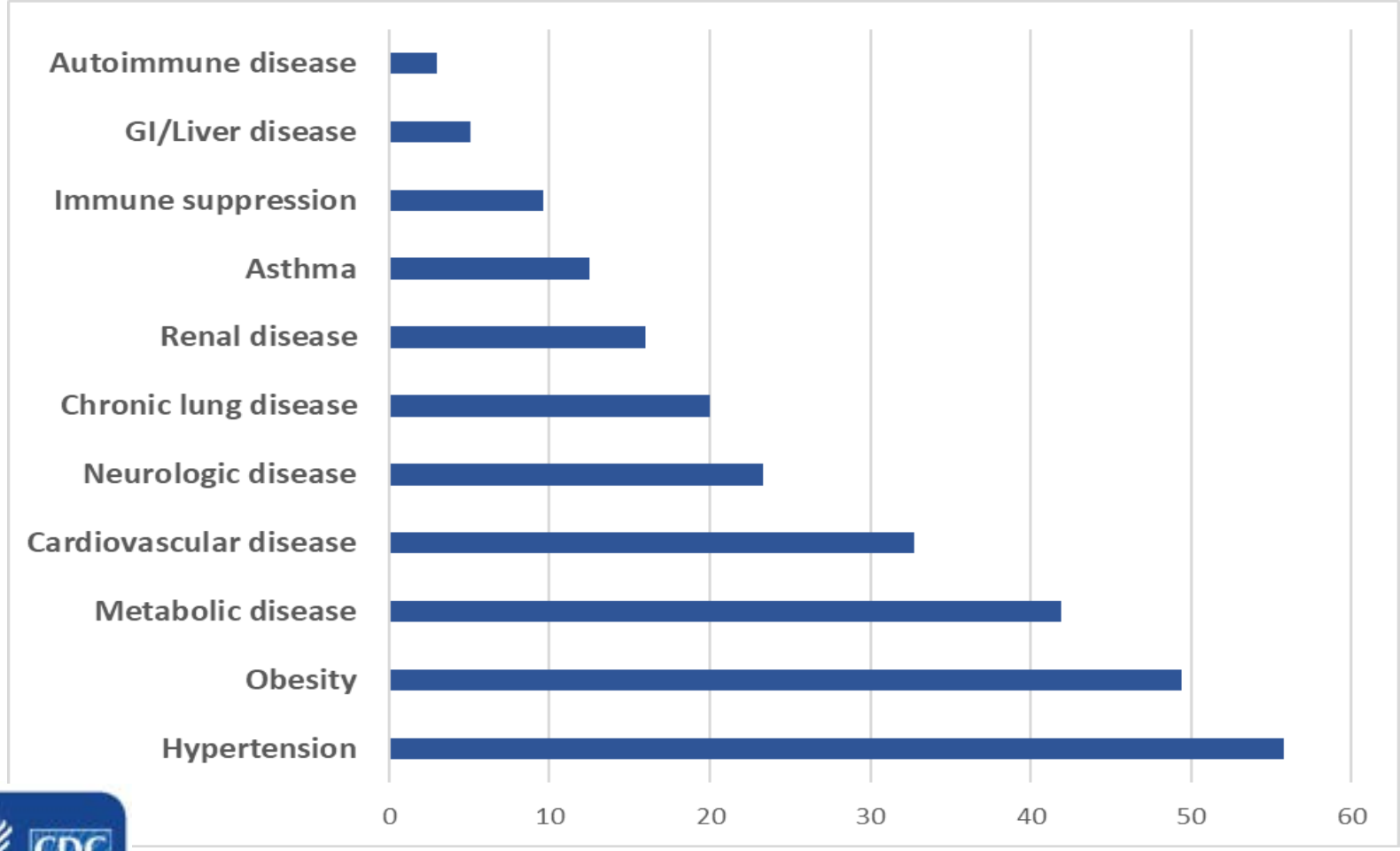


https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html

COVID-NET: Hospitalization Surveillance from 14 States

March 1 to June 13, 2020

Underlying Medical Conditions Among **Adults**



91.2% of hospitalized adults reported an underlying condition

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

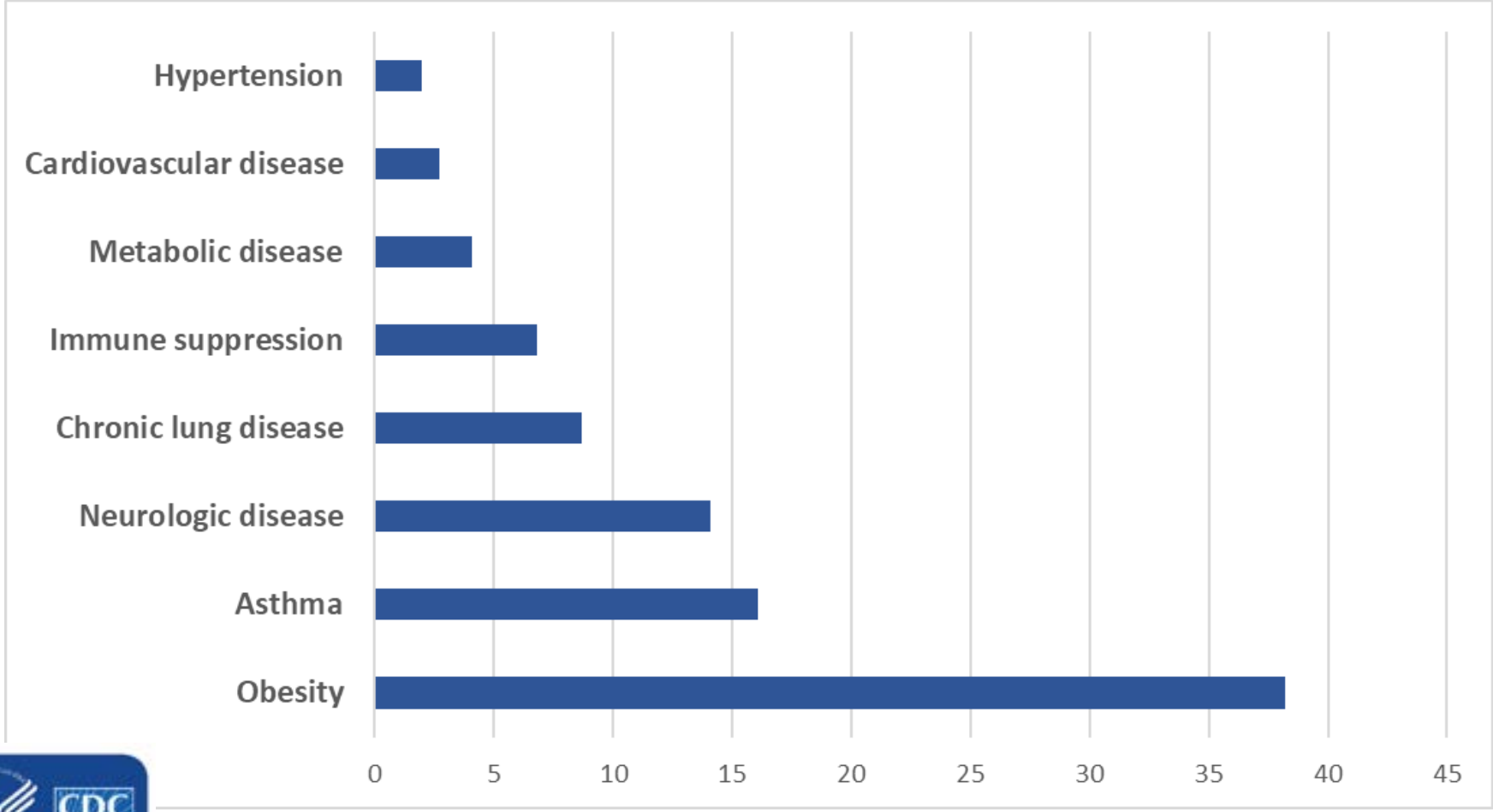
7,465 hospitalized adults with available information

https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html

COVID-NET: Hospitalization Surveillance from 14 States

March 1 to June 13, 2020

Underlying Medical Conditions Among **Children** and **Adolescents**



53.3% of hospitalized children reported an underlying condition

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

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

Early Release / June 17, 2020 / 69

- **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)*

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

*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)

Morbidity and Mortality Weekly Report

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

CDC COVID-19 Response Team

315,531 COVID-19 cases reported to CDC → **49,370 (16%)** with information on HCP status → **9,282 (19%)** identified as a HCP

- 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

MMWR April 17, 2020 https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e6.htm?s_cid=mm6915e6_w

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 23st

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%).

CASES AMONG HCP	DEATHS AMONG HCP
83,673	464

https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html

Next Steps: Healthcare Personnel (HCP)

PROJECT COVERED

- 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

Next Steps: Healthcare Personnel (HCP)

- 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

https://www.cdc.gov/ncezid/dpei/eip/index.html

Next Steps: Healthcare Personnel (HCP)

	AZ HEROES	RECOVER
	Collaboration between University of Arizona, CDC and NCI	CDC
Study Population	HCP, first responders, essential and frontline workers	HCP, first responders with direct contacts with patient and public with COVID-19
Study Design	Prospective longitudinal cohort	Cohort
Timeline	12 months	12 months
Specimen Collection	Repeat PCR and serology	Repeat PCR and serology
Objectives	Determine incidence of asymptomatic and symptomatic infection Estimate incidence of novel infection and repeat infection	Determine incidence of asymptomatic and symptomatic infection, with a focus on the clinical epidemiology and impact on missed work, presenteeism and functioning Immune response to SARS-CoV-2 infection

AZ HEROES: Arizona **H**ealthcare, **E**mergency **R**esponse and **O**ther **E**ssential Workers **S**urveillance Study
RECOVER: **R**esearch on the **E**pidemiology of **CO**VID-19 in **E**mergency **R**esponse 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 18th, **167** confirmed COVID-19 cases associated with the facility

101	50	16
residents	staff/HCP	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
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

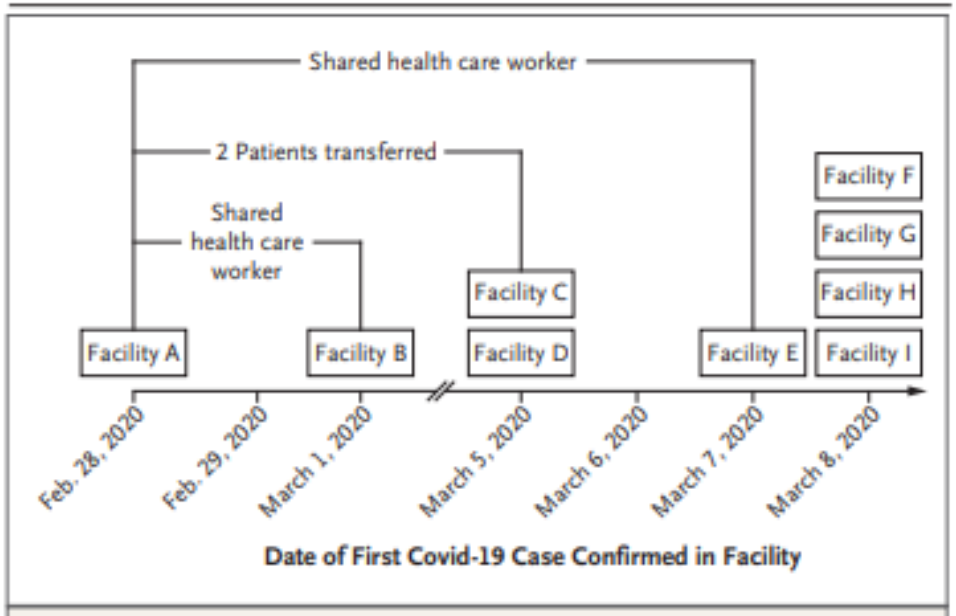


Figure 2. Timeline Showing Long-Term Care Facilities in King County with One or More Confirmed Cases of COVID-19.

McMichael TM, et al. NEJM 2020

Long Term Care Facilities

NHSN
NATIONAL HEALTHCARE SAFETY NETWORK

- 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

CDC

https://data.cms.gov/stories/s/COVID-19-Nursing-Home-Data/bkwz-xpvg/

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
Epidemiology among Children

COVID-19: Infants and Children

- Children may have different or minimal symptoms
  - Abdominal pain or GI symptoms[1]
- May be more likely to be **asymptomatic**[1,2]

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

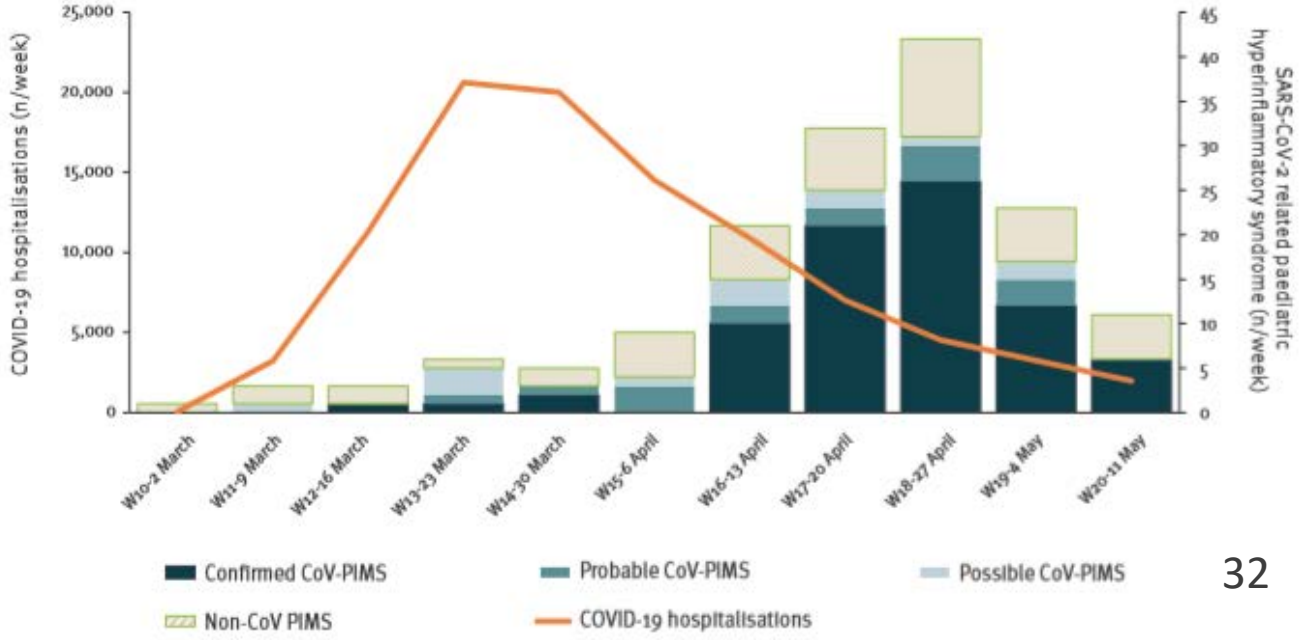
[1]MMWR April 10, 2020 https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e4.htm?s_cid=mm6914e4_w
[2]Dong et al. Pediatrics. June 2020
[3]Zhang et al. Science April, 2020
[4]Heavey et al. Eurosurveillance May 2020
[5]Johansen et al. Eurosurveillance May 2020
[6]COVID-19 in schools- the experience in NSW April 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)



Belot et al. Euro Surveill 2020

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

  → 45/58 (**78**%) had evidence of current or prior SARS-CoV-2 infection

  - All patients presented with persistent fever (3-19 days)
  - Abdominal pain n=31/58, **53**% Rash n=30/58, **52**%

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

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

Key findings	
SARS-CoV2 PCR+ or antibody positive at admission	**73%**
Age, median (IQR)	**8.4** (3.6, 12.8)
<5 years	33%
5-21 years	67%
Previously healthy (except obesity)	73%
Male	63%
ICU	81%
Died	3%

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 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 conducing 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]

[1]Ramsey PS et al. Pneumonia in pregnancy. Obstet Gynecol Clin North Am 2001
[2]Galang RR et al. Severe Coronavirus Infections in Pregnancy: A Systematic Review [online ahead of print, 2020 Jun 16]. Obstet Gynecol. 2020
[3]Mertz D et al. Populations at risk for severe or complicated influenza illness: systematic review and meta-analysis. BMJ 2013
[4]Mosby LG et al. 2009 pandemic influenza A (H1N1) in pregnancy: a systematic review of the literature. Am J Obstet Gynecol 2011

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

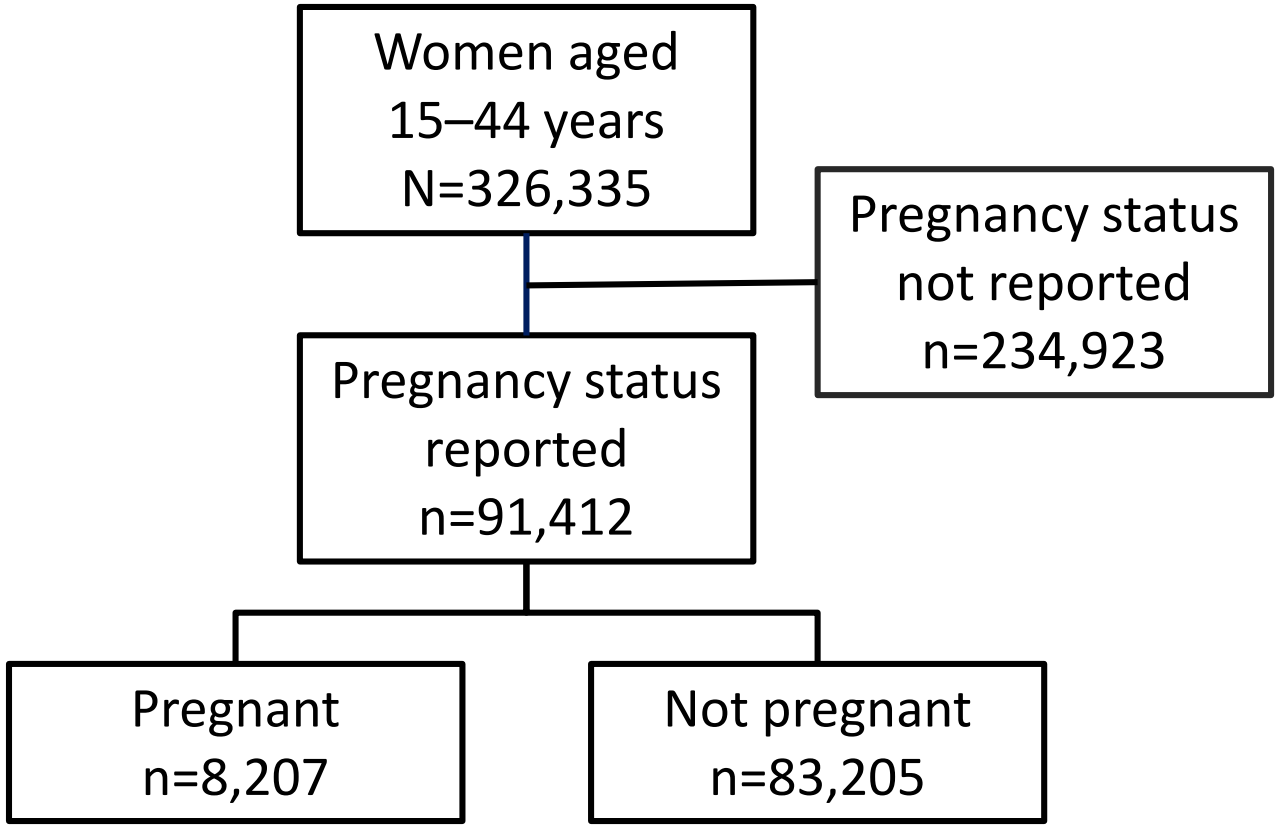
Pregnant Women: New York City

- 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;
*Martin J et al. Births in the United States, 2018. National Center for Health Statistics

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)

Hospitalization, ICU admission, mechanical ventilation, and death among pregnant women and nonpregnant WRA with SARS-CoV-2 infection

Outcomes of Interest	No. (%)*		Crude RR (95% CI)	aRR (95% CI) †
	Pregnant women with COVID-19 (N = 8,207)	Nonpregnant women with COVID-19 (N = 83,205)		
Hospitalization§	2,587 (31.5)	4,840 (5.8)	**5.4 (5.2-5.7)**	**5.4 (5.1-5.6)**
ICU Admission	120 (1.5)	757 (0.9)	**1.6 (1.3-1.9)**	**1.5 (1.2-1.8)**
Mechanical Ventilation	42 (0.5)	225 (0.3)	**1.9 (1.4-2.6)**	**1.7 (1.2-2.4)**
Death	16 (0.2)	208 (0.2)	0.8 (0.5-1.3)	0.9 (0.5-1.5)

* 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

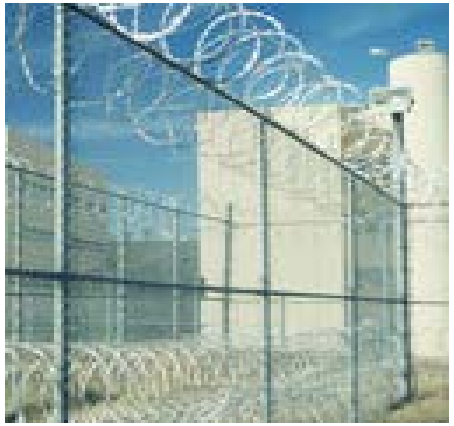
Congregate Settings:
Meat & Poultry Processing

- 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

MMWR May 1, 2020 https://www.cdc.gov/mmwr/volumes/69/wr/mm6918e3.htm?s_cid=mm6918e3_x

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



MMWR May 6, 2020 https://www.cdc.gov/mmwr/volumes/69/wr/mm6919e1.htm?s_cid=mm6919e1_e

Congregate Settings: Homeless Shelters

- 1,192 residents and 313 staff members tested in 19 homeless shelters in 4 U.S. cities from March 27–April 15
- Homelessness poses multiple challenges that can amplify spread of COVID-19

Shelters associated with a cluster

Seattle: **17%** positive

Boston: **36%** positive

San Francisco: **66%** positive

Shelters NOT associated with a cluster

Seattle: **5%** positive

Atlanta: **4%** positive

MMWR April 22, 2020 https://www.cdc.gov/mmwr/volumes/69/wr/mm6917e1.htm?s_cid=mm6917e1_w

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

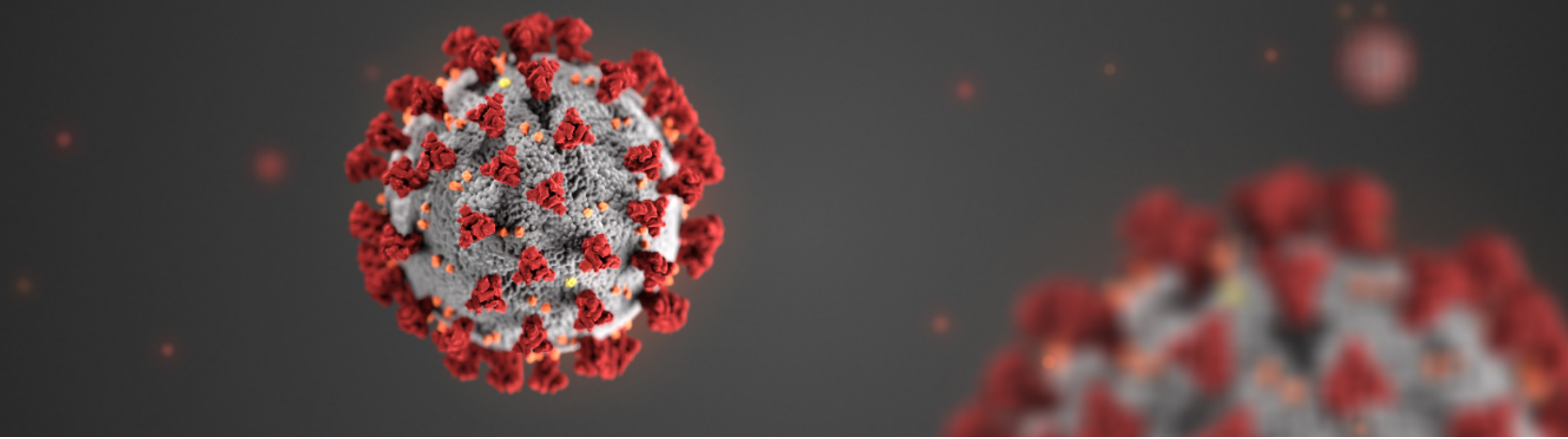
Special populations Seroprevalence Surveys: answer questions about specific populations, such as healthcare workers or pregnant women

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
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TTY: 1-888-232-6348 www.cdc.gov