Epidemiology of Individuals at Increased Risk of COVID-19 Disease

Nancy McClung, PhD, RN

ACIP Meeting
August 26, 2020

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

- Overview of U.S. COVID-19 Epidemiology
- Epidemiology of Individuals at Increased Risk of Severe COVID-19 Disease
  - Older Adults (aged 65 years or older)
  - Adults with Underlying Medical Conditions (aged 18 years or older)
Overview of U.S. COVID-19 Epidemiology
Trends in Number of COVID-19 Cases in the US
January 21 to August 23, 2020

5,682,491
TOTAL CASES

https://www.cdc.gov/covid-data-tracker/index.html#trends
U.S. State and Local Public Health Laboratories Reporting to CDC:
Number of Specimens Tested and Percent Positive for SARS-CoV-2
March 1, 2020 – August 15, 2020

Specimen tested: Age Unk
Specimen tested: 65+ yrs
Specimen tested: 50-64 yrs
Specimen tested: 18-49 yrs
Specimen tested: 5-17 yrs
Specimen tested: 0-4 yrs
% pos.: overall
% pos.: 0-4 yrs
% pos.: 5-17 yrs
% pos.: 18-49 yrs
% pos.: 50-64 yrs
% pos.: 65+ yrs

Select Commercial Laboratories Reporting to CDC:
Number of Specimens Tested and Percent Positive for SARS-CoV-2
March 29, 2020 – August 15, 2020

Week 33
6.3%

United States COVID-19 Deaths by County
January 21 to August 23, 2020

Trends in Number of COVID-19 Deaths in the US
January 21 to August 23, 2020

USA
176,223
TOTAL DEATHS

https://www.cdc.gov/covid-data-tracker/index.html#trends
COVID-19 Epidemiology of Adults Aged 65 Years or Older
Adults aged 65 years and older and people of any age with certain underlying medical conditions are at increased risk for severe illness from COVID-19:
Adults aged 65 years and older and people of any age with certain underlying medical conditions are at increased risk for severe illness from COVID-19:

- Hospitalization
- Intensive Care Unit (ICU) care
- Intubation or mechanical ventilation
- Death
In the United States, adults aged 65 years or older represent 16% of COVID-19 cases, but nearly 80% of COVID-19 deaths.

*Data from 4,272,205 cases. Age group was available for 4,109,540 (96%) cases.

*Data from 131,692 deaths. Age group was available for 131,676 (99%) deaths.

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

Updated as of 8/24/20. Data are based on COVID-19 case-level data reported by state and territorial jurisdictions to the Centers for Disease Control and Prevention (CDC). The numbers are confirmed and probable COVID-19 cases as reported by U.S. states, U.S. territories, New York City, and the District of Columbia from the previous day.
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 and data include **underlying medical conditions**

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

https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e3.htm
COVID-NET: Older adults aged 65 years or older have the highest cumulative rate of COVID-19 associated hospitalizations*

**COVID-NET:** Adults aged 50 years and older are more likely to have severe outcomes during COVID-19 associated hospitalizations compared to adults aged 18-49 years.

*COVID-19 associated hospitalizations reported to Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET) surveillance system between March 1 and August 15, 2020. The denominator for intensive care unit, mechanical ventilation, in-hospital mortality, and discharge diagnoses is restricted to cases who are no longer hospitalized and who have complete medical chart reviews. COVID-NET is a population-based surveillance system that collects data on laboratory-confirmed COVID-19-associated hospitalizations among children and adults through a network of over 250 acute-care hospitals in 14 states. [https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html](https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html)*
COVID-NET: Among 2,491 adults with COVID-19 associated hospitalization between March 1 and May 2, 2020, older age was the strongest, independent risk factor for in-hospital death.

Multi-center U.S. cohort study: Among 2,215 adults with COVID-19 associated intensive care unit (ICU)-admission between March 4 and April 4, 2020, older age was the strongest, independent risk factor for in-hospital death within 28 days of admission.

### Table: Odds ratio (95% CI) for death

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Odds ratio (95% CI) for death</th>
<th>Decreased risk of death</th>
<th>Increased risk of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-39</td>
<td>1 [Reference]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>1.65 (0.97-2.80)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-59</td>
<td>1.71 (1.05-2.80)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>3.18 (1.95-5.18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-79</td>
<td>5.36 (3.20-9.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥80</td>
<td>11.15 (6.19-20.06)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Modified from Gupta et al, 2020, JAMA Int Med. Multivariable risk model for 28-day death after ICU admission. Model adjusted for age, sex, race, other patient-level characteristics such as comorbidities, symptoms, and body mass index, and hospital-level characteristics such as number of ICU beds.
COVID-19 Epidemiology of Individuals with Underlying Medical Conditions
COVID-NET: Underlying conditions among adults aged 18 years or older with COVID-19 associated hospitalizations

* COVID-19 associated hospitalizations reported to Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET) surveillance system from March 1-August 15, 2020. The denominator is restricted to cases with a discharge disposition and for which chart review was completed. COVID-NET is a population-based surveillance system that collects data on laboratory-confirmed COVID-19-associated hospitalizations among children and adults through a network of over 250 acute-care hospitals in 14 states. https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html
**COVID-NET:** The most common underlying medical conditions among hospitalized adults varies by age group

*COVID-19 associated hospitalizations reported to Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET) surveillance system between March 1 and August 15, 2020. The denominator is restricted to cases with a discharge disposition and for which chart review was completed. COVID-NET is a population-based surveillance system that collects data on laboratory-confirmed COVID-19-associated hospitalizations among children and adults through a network of over 250 acute-care hospitals in 14 states. https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html*

<table>
<thead>
<tr>
<th>18-49 years</th>
<th>50-64 years</th>
<th>65+ years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Obesity (61.5%)</strong></td>
<td><strong>Hypertension (60.5%)</strong></td>
<td><strong>Hypertension (77.8%)</strong></td>
</tr>
<tr>
<td><strong>Hypertension (27.2%)</strong></td>
<td><strong>Obesity (56.5%)</strong></td>
<td><strong>Cardiovascular disease (55.2%)</strong></td>
</tr>
<tr>
<td><strong>Diabetes (21.8%)</strong></td>
<td><strong>Diabetes (37.9%)</strong></td>
<td><strong>Neurologic disease (42.5%)</strong></td>
</tr>
<tr>
<td><strong>Asthma (14.1%)</strong></td>
<td><strong>Cardiovascular disease (26.3%)</strong></td>
<td><strong>Diabetes (41.8%)</strong></td>
</tr>
<tr>
<td><strong>Chronic lung disease (9.8%)</strong></td>
<td><strong>Chronic lung disease (18.8%)</strong></td>
<td><strong>Obesity (34.6%)</strong></td>
</tr>
</tbody>
</table>
COVID-NET: Over 60% of hospitalized adults had 3 or more of the selected underlying medical conditions*

*Defined as one or more of hypertension, obesity, diabetes, cardiovascular disease, neurologic disease, chronic lung disease, renal disease, asthma, immune suppression, gastrointestinal/liver disease, and autoimmune disease. **Unadjusted for age or other demographic variables.

COVID-19 associated hospitalizations reported to Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET) surveillance system from March 1-August 15, 2020. The denominator is restricted to cases with a discharge disposition and for which chart review was completed. COVID-NET is a population-based surveillance system that collects data on laboratory-confirmed COVID-19-associated hospitalizations among children and adults through a network of over 250 acute-care hospitals in 14 states.
COVID-NET: Of hospitalized adults that died, nearly 80% had 3 or more underlying medical conditions*

*Defined as one or more of hypertension, obesity, diabetes, cardiovascular disease, neurologic disease, chronic lung disease, renal disease, asthma, immune suppression, gastrointestinal/liver disease, and autoimmune disease. **Unadjusted for age or other demographic variables. Each severe outcome adds up to 100 percent.

COVID-19 associated hospitalizations reported to Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET) surveillance system from March 1-August 15, 2020. The denominator is restricted to cases with a discharge disposition and for which chart review was completed. COVID-NET is a population-based surveillance system that collects data on laboratory-confirmed COVID-19-associated hospitalizations among children and adults through a network of over 250 acute-care hospitals in 14 states.
COVID-NET: Of hospitalized adults 65 years or older, 80% had 3 or more underlying medical conditions*

*Defined as one or more of hypertension, obesity, diabetes, cardiovascular disease, neurologic disease, chronic lung disease, renal disease, asthma, immune suppression, gastrointestinal/liver disease, and autoimmune disease. **Unadjusted for other demographic variables. Each age group adds to 100 percent.

-COVID-19 associated hospitalizations reported to Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET) surveillance system from March 1-August 15, 2020. The denominator is restricted to cases with a discharge disposition and for which chart review was completed. COVID-NET is a population-based surveillance system that collects data on laboratory-confirmed COVID-19-associated hospitalizations among children and adults through a network of over 250 acute-care hospitals in 14 states.
Are underlying medical conditions an independent risk factor for COVID-19-associated hospitalization in adults aged 18 years or older?

Population-based data sources

- COVID-19-Associated Hospitalization Surveillance Network (COVID-NET)
  - 14 sites representing 10% of U.S. population
  - Community-dwelling adults (≥ 18 years of age) prior to hospitalization with chart-abstracted data on underlying medical condition (N=5,416)
  - March 1 – June 23, 2020
- Behavioral Risk Factor Surveillance System (BRFSS)
  - Annual, cross-sectional survey on health behaviors and self-reported underlying medical conditions among community-dwelling adults (≥ 18 years of age) in all 50 statues, D.C., and 3 U.S. territories
  - Weighted to be representative of population residing in COVID-NET catchment area

https://medrxiv.org/cgi/content/short/2020.07.27.20161810v1
Are underlying medical conditions an independent risk factor for COVID-19-associated hospitalization in adults aged 18 years or older?

Statistical Analysis

- Prevalence of underlying medical conditions was calculated among COVID-NET hospitalized adults, COVID-NET catchment area, and nationwide

- Unadjusted and adjusted rate ratios and 95% confidence intervals (CIs) associated with hospitalization
  - Generalized Poisson regression models with a scaled deviance term to account for overdispersion
  - Multivariable models included an individual underlying medical condition and were adjusted for age, sex, and race/ethnicity

- Non-overlapping 95% CIs were considered to represent statistically significant differences

https://medrxiv.org/cgi/content/short/2020.07.27.20161810v1
The prevalence of underlying medical conditions was greater among adults with COVID-19 associated hospitalizations compared to COVID-NET catchment areas.

§Estimates for hypertension from COVID-NET Catchment Area and Nationwide BRFSS estimates are from 2017, Obesity = BMI ≥30kg/m²; Severe obesity = BMI ≥40kg/m².

https://medrxiv.org/cgi/content/short/2020.07.27.20161810v1
The magnitude of risk for COVID-19 associated hospitalization was greatest for adults with severe obesity, chronic kidney disease, and diabetes.

Severe obesity
Chronic kidney disease
Diabetes
Obesity
Hypertension
Asthma
Coronary Artery Disease
History of Stroke
COPD

Adjusted Rate Ratios and 95% Confidence Intervals

COPD: Chronic obstructive pulmonary disease
Obesity=BMI ≥30kg/m² ; Severe obesity = BMI ≥40kg/m²
*Each underlying medical condition is in a separate model, adjusted for age, sex, race/ethnicity
The magnitude of risk for COVID-19 associated hospitalization was greatest for adults aged 65 years or older for all underlying medical conditions.

Adjusted Rate Ratios and 95% Confidence Intervals for Age and COVID-19-Associated Hospitalizations

<table>
<thead>
<tr>
<th></th>
<th>Hypertension</th>
<th>Coronary Artery Disease</th>
<th>History of Stroke</th>
<th>Diabetes</th>
<th>Obesity</th>
<th>Severe Obesity</th>
<th>Chronic Kidney Disease</th>
<th>Asthma</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age 65+ vs. 18-44 years</strong></td>
<td>2.2 (1.7, 2.7)</td>
<td>3.7 (2.9, 4.6)</td>
<td>3.8 (3.1, 4.7)</td>
<td>2.5 (1.9, 3.4)</td>
<td>4.5 (3.4, 5.9)</td>
<td>4.6 (3.6, 5.9)</td>
<td>3.4 (2.7, 4.2)</td>
<td>3.8 (3.1, 4.6)</td>
<td>3.8 (3.0, 4.8)</td>
</tr>
<tr>
<td><strong>Age 45-64 vs. 18-44 years</strong></td>
<td>1.6 (1.3, 1.9)</td>
<td>2.3 (1.9, 2.9)</td>
<td>2.4 (2.0, 2.9)</td>
<td>1.9 (1.4, 2.4)</td>
<td>2.5 (2.0, 3.3)</td>
<td>2.7 (2.1, 3.4)</td>
<td>2.2 (1.8, 2.7)</td>
<td>2.3 (2.0, 2.8)</td>
<td>2.4 (1.9, 2.9)</td>
</tr>
</tbody>
</table>

*Each underlying medical condition is modeled separately; models include the specific underlying medical condition of interest, age, sex, and race/ethnicity categories.

COPD: Chronic obstructive pulmonary disease; Obesity=BMI ≥30kg/m²; Severe obesity = BMI ≥40kg/m²

https://medrxiv.org/cgi/content/short/2020.07.27.20161810v1
The magnitude of risk for hospitalization increased with the number of underlying medical conditions, with the greatest risk among adults with 3 or more conditions.

### Unadjusted and Adjusted* Rate Ratios for Number of Underlying Medical Conditions and COVID-19-Associated Hospitalization

<table>
<thead>
<tr>
<th>Number of conditions†</th>
<th>Unadjusted Rate Ratio (95%CI)</th>
<th>Adjusted Rate Ratio* (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.8 (2.7, 3.1)</td>
<td>2.5 (2.1, 3.0)</td>
</tr>
<tr>
<td>2</td>
<td>5.6 (5.2, 6.1)</td>
<td>4.5 (3.7, 5.5)</td>
</tr>
<tr>
<td>3+</td>
<td>7.2 (6.6, 7.9)</td>
<td>5.0 (3.9, 6.3)</td>
</tr>
<tr>
<td>Age 45-64 years‡</td>
<td>-----</td>
<td>1.8 (1.5, 2.2)</td>
</tr>
<tr>
<td>Age 65+ years‡</td>
<td>-----</td>
<td>2.6 (2.1, 3.1)</td>
</tr>
<tr>
<td>Male§</td>
<td>-----</td>
<td>1.2 (1.1, 1.4)</td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other race/ethnicity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CI: Confidence Interval; COVID-NET: Coronavirus Disease 2019-Associated Hospitalization Surveillance Network

*Model for number of conditions (variable) is adjusted for age, sex, and race/ethnicity.

†Reference group is no underlying medical condition; Number of conditions is a sum of underlying medical conditions excluding hypertension; the most recent year of available BRFSS data for hypertension was 2017.

‡Reference group is 18-44 years

§Reference group is female

||Reference group is non-Hispanic white
COVID-NET/BRFSS Analysis Summary

- Accounting for age, race and ethnicity, and sex, higher hospitalization rates observed for community-dwelling adults with underlying medical conditions
  - Adults with 3+ medical conditions had highest hospitalization risk
  - Certain underlying medical conditions with higher risk
    - Severe obesity and chronic kidney disease associated with 4x hospitalization risk
    - Diabetes, obesity, hypertension associated with approximately 3x hospitalization risk
- Accounting for the presence of an individual underlying medical condition, higher hospitalization rates were observed:
  - Adults 65 years or older, 45-64 years (versus 18-44 years)
COVID-NET: Among 2,491 adults with COVID-19 associated hospitalization between March 1 and May 2, certain underlying medical conditions were independent risk factor for in-hospital death:

- 85+ years vs 18-39 years: 10.98
- 75–84 years vs 18-39 years: 7.67
- 65–74 years vs 18-39 years: 5.77
- 50-64 years vs 18-39 years: 3.11
- Male: 1.3
- Immunosuppression: 1.39
- Renal disease: 1.33
- Chronic Lung Disease: 1.31
- Cardiovascular Disease: 1.28
- Neurologic disorder: 1.25
- Diabetes: 1.19

Multi-center U.S. cohort study: Among 2,215 adults with COVID-19 associated intensive care unit (ICU)-admission between March 4 and April 4, 2020, certain underlying medical conditions were independent risk factor for death within 28 days of admission

<table>
<thead>
<tr>
<th>Characteristic</th>
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<th>Decreased risk of death</th>
<th>Increased risk of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>1.06 (0.83-1.36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.14 (0.91-1.43)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI &lt;25</td>
<td>1 (Reference)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-29.9</td>
<td>1.01 (0.73-1.39)</td>
<td></td>
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</tr>
<tr>
<td>30-34.9</td>
<td>0.97 (0.69-1.37)</td>
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<tr>
<td>35-39.9</td>
<td>1.24 (0.81-1.89)</td>
<td></td>
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<tr>
<td>≥40</td>
<td>1.51 (1.01-2.25)</td>
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<tr>
<td>Coronary artery disease</td>
<td>1.47 (1.07-2.02)</td>
<td></td>
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</tr>
<tr>
<td>Congestive heart failure</td>
<td>1.08 (0.75-1.58)</td>
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<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>1.39 (0.95-2.04)</td>
<td></td>
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<tr>
<td>Current smoker</td>
<td>1.21 (0.76-1.93)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active cancer</td>
<td>2.15 (1.35-3.43)</td>
<td></td>
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</tr>
</tbody>
</table>

*Modified from Gupta et al, 2020, JAMA Int Med. Multivariable risk model for 28-day death after ICU admission. Model adjusted for age, sex, race, other patient-level characteristics such as comorbidities, symptoms, and body mass index, and hospital-level characteristics such as number of ICU beds.

Gupta et al, July 2020; https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2768602
Supplementary U.S. case-based surveillance: Among a convenience sample of 10,647 COVID-19 deaths that occurred during February 12-April 24 in 16 health jurisdictions, 76% of decedents had at least one underlying medical condition, and majority of decedents of any age had multiple conditions.

Most common conditions:
- Cardiovascular disease (60.9%)
- Diabetes (39.5%)
- Chronic Kidney Disease (20.8%)
- Chronic Lung Disease (19.2%)

Wortham et al, 2020: https://www.cdc.gov/mmwr/volumes/69/wr/mm6928e1.htm
CDC has an ongoing, evidence-informed process to assess the risk for severe illness from COVID-19 for individuals with underlying medical conditions

- Comprehensive literature review ongoing
  - Internal database to track reviewed articles (U.S. and global)
  - Collaborating with SMEs across agency
  - Standardized process for weekly updates of new peer-reviewed or in-press articles that may change our current understanding of the evidence
- Monthly updates to published list of underlying medical conditions and associated evidence

Evidence Informed Process

- Two-tiered system based on level of evidence
  - **ARE** associated with risk of severe illness from COVID-19 → informed by STRONG evidence
  - **MIGHT BE** associated with risk of severe illness from COVID-19 → informed by MIXED or LIMITED evidence

- *Strongest evidence*: consistent evidence from multiple small studies or a strong association from a large study
- *Mixed evidence*: multiple studies that reached different conclusions
- *Limited evidence*: consistent evidence from a small number of studies

People with the following conditions ARE at increased risk for severe illness from COVID-19

- Cancer
- Chronic kidney disease
- Chronic obstructive pulmonary disease
- Immunocompromised state from solid organ transplant
- Obesity (Body Mass Index of 30 or greater)
- Serious heart conditions (heart failure, coronary artery disease or cardiomyopathies)
- Sickle cell disease
- Type 2 diabetes mellitus

People with the following conditions MIGHT BE at increased risk for severe illness from COVID-19

- Asthma (moderate-to-severe)
- Cerebrovascular disease
- Hypertension
- Immunocompromised state from blood or BMT, immune deficiencies, HIV, steroid use, or other immunomodulators
- Neurologic conditions
- Liver disease
- Pregnancy
- Pulmonary fibrosis
- Smoking
- Thalassemia
- Type 1 diabetes mellitus

Nationally, 41% of U.S. adults have at least one underlying medical condition that puts them at higher risk for severe illness from COVID-19

- By county, the prevalence varies from almost **one in four** to as many as **two-thirds** of adults having at least one underlying medical condition.

- In half of U.S. counties almost **half** of adults are estimated to have an underlying medical condition.
Summary
Summary

- As of August 23, over 5.6 million cases of COVID-19 diagnosed and over 173,000 COVID-19-associated deaths reported in the United States

- Older adults aged 65 years or older have the highest risk of severe COVID-19 disease
  - Risk increases with increasing age

- Adults with underlying medical conditions are at increased risk for severe COVID-19
  - Obesity, diabetes, and cardiovascular disease are common conditions observed across data sources
  - Multi-morbidity increases risk of severe COVID-19 disease

- Surveillance/projects ongoing to continue to monitor COVID-19-associated hospitalizations and deaths and identify persons at higher risk for severe COVID-19 disease
For more information, contact CDC
1-800-CDC-INFO (232-4636)

Acknowledgements:
- COVID-NET Hospitalization Surveillance Team
- Community Interventions & Critical Populations Task Force

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.
Coronavirus Disease 2019-Associated Hospitalization Surveillance (COVID-NET)

- All age population-based surveillance system of laboratory-confirmed COVID-19-associated hospitalizations
  - Positive SARS-CoV-2 test no more than 14 days before admission or during hospitalization
  - Be a resident of the pre-identified surveillance catchment area
  - Be admitted to a hospital where residents of the surveillance catchment area receive care
- Medical chart abstractions using a standard case report form
  - Patient demographics and underlying medical conditions
Behavioral Risk Factor Surveillance System (BRFSS) Overview

- Cross sectional survey that collects data on health-related risk behaviors, chronic health conditions, and use of preventative services among adults (≥ 18 years).

- BRFSS collects data annually in all 50 states, D.C., and three U.S. territories.

- More than 400,000 adult interviews each year.

- Standardized methodology for weighting data to be representative of population.

https://www.cdc.gov/brfss/index.html
20,046 adults with laboratory-confirmed COVID-19-associated hospitalizations as of June 23, 2020 from 70 counties in 12 states* participating in COVID-NET

Excluded: 2,258 non-community dwelling adults and 12,073 adults with data yet to be abstracted†

Eligible adults
N= 5,715

299 excluded due to missing data on all the underlying medical conditions

Included in analysis
N=5,416

*California, Colorado, Connecticut, Georgia, Maryland, Michigan, Minnesota, New Mexico, New York, Oregon, Tennessee, and Utah.
†Additional data beyond the minimum required data elements may be subject to a time lag for submission to CDC.
Demographic Characteristics of Adults with COVID-19-Associated Hospitalizations in Analytic Sample (N=5,416)

- **Sex**
  - Male (53%)
  - Female (47%)

- **Age Group**
  - 18-44 years (30%)
  - 46-64 years (40%)
  - 65+ years (31%)

- **Race/Ethnicity**
  - Non-Hispanic White (34%)
  - Non-Hispanic Black (32%)
  - Other (34%)

*197 hospitalizations missing race/ethnicity information
## Defining Underlying Medical Conditions

<table>
<thead>
<tr>
<th>Underlying medical condition</th>
<th>COVID-NET (medical chart abstraction)</th>
<th>BRFSS (self-report)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Has a doctor, nurse, or other health professional ever told you that you had any of the following?</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Hypertension</td>
<td>Yes to ever told you have high blood pressure and are currently taking medication for high blood pressure (2017 BRFSS)</td>
</tr>
<tr>
<td>Coronary Artery Disease</td>
<td>History of myocardial infarction, coronary artery disease, coronary artery bypass graphing</td>
<td>Yes to ever told you had a heart attack also called myocardial infarction? Or Yes to ever told you had angina or coronary heart disease?</td>
</tr>
<tr>
<td>Stroke</td>
<td>Stroke</td>
<td>Yes to ever told you had a stroke</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Diabetes</td>
<td>Yes to ever told you have diabetes?</td>
</tr>
<tr>
<td>Obesity</td>
<td>BMI≥30kg/m²; denominator is everyone in sample</td>
<td>Obesity defined as BMI≥30kg/m² based on self-reported height and weight.</td>
</tr>
<tr>
<td>Severe Obesity</td>
<td>BMI≥40kg/m²; denominator is everyone in sample</td>
<td>Severe obesity defined as BMI≥40kg/m² based on self-reported height and weight.</td>
</tr>
<tr>
<td>Chronic Kidney Disease</td>
<td>Chronic Kidney Disease</td>
<td>Yes to ever told kidney disease</td>
</tr>
<tr>
<td>Asthma</td>
<td>Asthma</td>
<td>Yes to do you still have asthma</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease (COPD)</td>
<td>COPD</td>
<td>Yes ever told you have COPD, emphysema, or chronic bronchitis</td>
</tr>
<tr>
<td><strong>Number of conditions</strong></td>
<td>Sum of any of the above underlying medical condition except for hypertension categorized (0, 1, 2, 3+)</td>
<td>Sum of any of the above underlying medical condition except for hypertension (because hypertension not available in 2018 BRFSS data); categorized (0, 1, 2, 3+)</td>
</tr>
</tbody>
</table>
### Adjusted Rate Ratios (aRR) and 95% Confidence Intervals for Race/Ethnicity and COVID-19-Associated Hospitalizations by Underlying Medical Condition*

<table>
<thead>
<tr>
<th></th>
<th>Hypertension</th>
<th>Coronary Artery Disease</th>
<th>History of Stroke</th>
<th>Diabetes</th>
<th>Obesity</th>
<th>Severe Obesity</th>
<th>Chronic Kidney Disease</th>
<th>Asthma</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Hispanic black vs. non-Hispanic white</strong></td>
<td>4.0 (3.3, 4.8)</td>
<td>4.7 (3.8, 5.8)</td>
<td>4.7 (3.9, 5.7)</td>
<td>4.0 (3.1, 5.2)</td>
<td>4.4 (3.4, 5.7)</td>
<td>4.7 (3.8, 5.9)</td>
<td>4.5 (3.7, 5.6)</td>
<td>4.7 (3.9, 5.6)</td>
<td>4.7 (3.8, 5.9)</td>
</tr>
<tr>
<td><strong>Other race/ethnicity vs. non-Hispanic white</strong></td>
<td>3.5 (2.9, 4.2)</td>
<td>3.3 (2.7, 4.0)</td>
<td>3.3 (2.7, 4.0)</td>
<td>3.0 (2.3, 3.9)</td>
<td>3.5 (2.8, 4.5)</td>
<td>3.5 (2.8, 4.3)</td>
<td>3.3 (2.7, 4.1)</td>
<td>3.2 (2.7, 4.0)</td>
<td>3.3 (2.7, 4.1)</td>
</tr>
</tbody>
</table>

**COPD**: Chronic obstructive pulmonary disease

*Each underlying medical condition is modeled separately; models include the specific underlying medical condition of interest, age, sex, and race/ethnicity categories*
Adjusted Rate Ratios (aRR) and 95% Confidence Intervals for Sex and COVID-19-Associated Hospitalizations by Underlying Medical Condition*

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<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male vs. females</strong></td>
<td>1.2 (1.1, 1.4)</td>
<td>1.2 (1.03, 1.4)</td>
<td>1.2 (1.1, 1.4)</td>
<td>1.2 (0.98, 1.5)</td>
<td>1.4 (1.1, 1.7)</td>
<td>1.4 (1.1, 1.7)</td>
<td>1.2 (1.02, 1.4)</td>
<td>1.2 (1.1, 1.5)</td>
<td>1.2 (1.03, 1.5)</td>
</tr>
</tbody>
</table>

COPD: Chronic obstructive pulmonary disease
*Each underlying medical condition is modeled separately; models include the specific underlying medical condition of interest, age, sex, and race/ethnicity categories

https://medrxiv.org/cgi/content/short/2020.07.27.20161810v1
Laboratory-Confirmed COVID-19-Associated Hospitalizations

Preliminary weekly rates as of Aug 15, 2020

Calendar Week End Date (MMWR Week No.)
Selected underlying medical conditions contributing to deaths involving COVID-19 from U.S. death certificate data (n=153,504)

Provisional death counts are based on death certificate data received and coded by the National Center for Health Statistics and do not represent all deaths that occurred in that period, data as of 8/15/20: https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm#Comorbidities
Recent global meta-analysis of underlying medical conditions and severe COVID-19 disease showed similar results to U.S. studies. Most prevalent conditions, unadjusted for age:

- Obesity
- Hypertension
- Diabetes
- Cardiovascular Disease

COVID-19 ASSOCIATED HOSPITALIZATION RELATED TO UNDERLYING MEDICAL CONDITIONS

FACTORS THAT INCREASE COMMUNITY SPREAD AND INDIVIDUAL RISK

- Crowded situations
- Close/physical contact
- Enclosed space
- Duration of exposure

RISK FOR HOSPITALIZATION IF YOU HAVE ANY OF THESE CONDITIONS AND GET COVID-19 COMPARED TO PEOPLE WITHOUT THE CONDITION(S).

- Asthma: 1.5x
- Hypertension: 3x
- Obesity (BMI ≥ 30): 3x
- Diabetes: 3x
- Chronic Kidney Disease: 4x
- Severe Obesity (BMI ≥ 40): 4.5x
- 2 Conditions*: 4.5x
- 3 or More Conditions*: 5x

*Conditions include asthma, obesity, diabetes, chronic kidney disease, severe obesity, coronary artery disease, history of stroke and COPD.

Data has shown that racial and ethnic minority groups with the referenced conditions are at even higher risk for severe COVID-19 illness. Race and ethnicity are risk markers for other underlying conditions that impact health — including socioeconomic status, access to health care, and increased exposure to the virus due to occupation (e.g., frontline, essential, and critical infrastructure workers).

ACTIONS TO REDUCE RISK OF COVID-19

- Wearing a mask
- Social distancing (6 ft goal)
- Hand hygiene
- Cleaning and disinfection

ALTHOUGH RISK GENERALLY INCREASES WITH AGE, ALL INDIVIDUALS SHOULD ROUTINELY TAKE ACTIONS TO REDUCE RISK OF INFECTION AND AVOID ACTIVITIES THAT INCREASE COMMUNITY SPREAD.

cdc.gov/coronavirus

Source: Ko JY, Danielson ML, Town M et al. 2020.
CS319360-A 08/06/2020
The Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET) conducts population-based surveillance for laboratory-confirmed COVID-19-associated hospitalizations in children (persons younger than 18 years) and adults. The current network covers nearly 100 counties in the 10 Emerging Infections Program (EIP) states (CA, CO, CT, GA, MD, MN, NM, NY, OR, and TN) and four additional states through the Influenza Hospitalization Surveillance Project (IA, MI, OH, and UT). The network represents approximately 10% of US population (~32 million people). Cases are identified by reviewing hospital, laboratory, and admission databases and infection control logs for patients hospitalized with a documented positive SARS-CoV-2 test. Data gathered are used to estimate age-specific hospitalization rates on a weekly basis and describe characteristics of persons hospitalized with COVID-19. Laboratory confirmation is dependent on clinician-ordered SARS-CoV-2 testing.

Therefore, the unadjusted rates provided are likely to be underestimated as COVID-19-associated hospitalizations can be missed due to test availability and provider or facility testing practices. COVID-NET hospitalization data are preliminary and subject to change as more data become available. In particular, case counts and rates for recent hospital admissions are subject to lag. As data are received each week, prior case counts and rates are updated accordingly. All incidence rates are unadjusted. Please see the following citation when referencing these data: "COVID-NET: COVID-19-Associated Hospitalization Surveillance Network, Centers for Disease Control and Prevention. WEBSITE. Accessed on DATE."