Racial and Ethnic Differences in Inpatient Stays Involving Sepsis, 2016–2021

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Introduction

Sepsis is a systemic inflammatory response to infection that results in tissue damage and organ failure, and can lead to death.[1] In 2021, there were about 2.5 million inpatient stays in the U.S. related to sepsis, accounting for 9.9 percent of all hospital costs.[2] One in three patients who died in the hospital had sepsis during their hospitalization.[3] Despite standardization in management and treatment guidelines, racial and ethnic differences in sepsis incidence, hospitalizations, and complications persist.[4] As of 2020, COVID-19 emerged as an important factor in understanding racial and ethnic differences in sepsis-related hospitalizations, given its association with sepsis and disproportionate impact on certain populations.[5]

This Healthcare Cost and Utilization Project (HCUP) Statistical Brief presents national statistics on inpatient stays involving sepsis by patient race and ethnicity using weighted estimates from the 2016–2021 National Inpatient Sample (NIS). First, changes in the population rate of sepsis-related inpatient stays are presented by patient race and ethnicity from 2016–2021. Second, the population rate is presented by patient race and ethnicity and other characteristics in 2019 and 2021. Third, the percentage of sepsis-related inpatient stays is presented by patient race and ethnicity and the most common chronic comorbidities in 2019 and 2021. Finally, select outcomes are presented by patient race and ethnicity for sepsis stays in 2019 and 2021.

The population rate and percentage of sepsis-related inpatient stays were based on any diagnosis of sepsis, including inpatient stays in which sepsis was the reason for the stay (i.e., principal diagnosis) or was a co-occurring condition or complication of the stay (i.e., only reported as a secondary diagnosis). Outcomes (average length of stay, average hospital cost, in-hospital mortality rate, and discharge disposition) are reported only when sepsis was the reason for the stay. For stays in which sepsis was a co-occurring condition or complication of the stay, other conditions, such as cancer, pneumonia, or heart failure, may be the reason for the hospitalization and contribute to increased length of stay or hospital costs. Thus, outcomes for these inpatient stays cannot be attributed solely to sepsis. Additional information on the clinical coding criteria for identifying sepsis is included in the Methods section and Appendix A.

Because of the large sample size of the NIS, small differences can be statistically significant but not clinically important. Thus, only differences greater than or equal to 10 percent are discussed in the text.
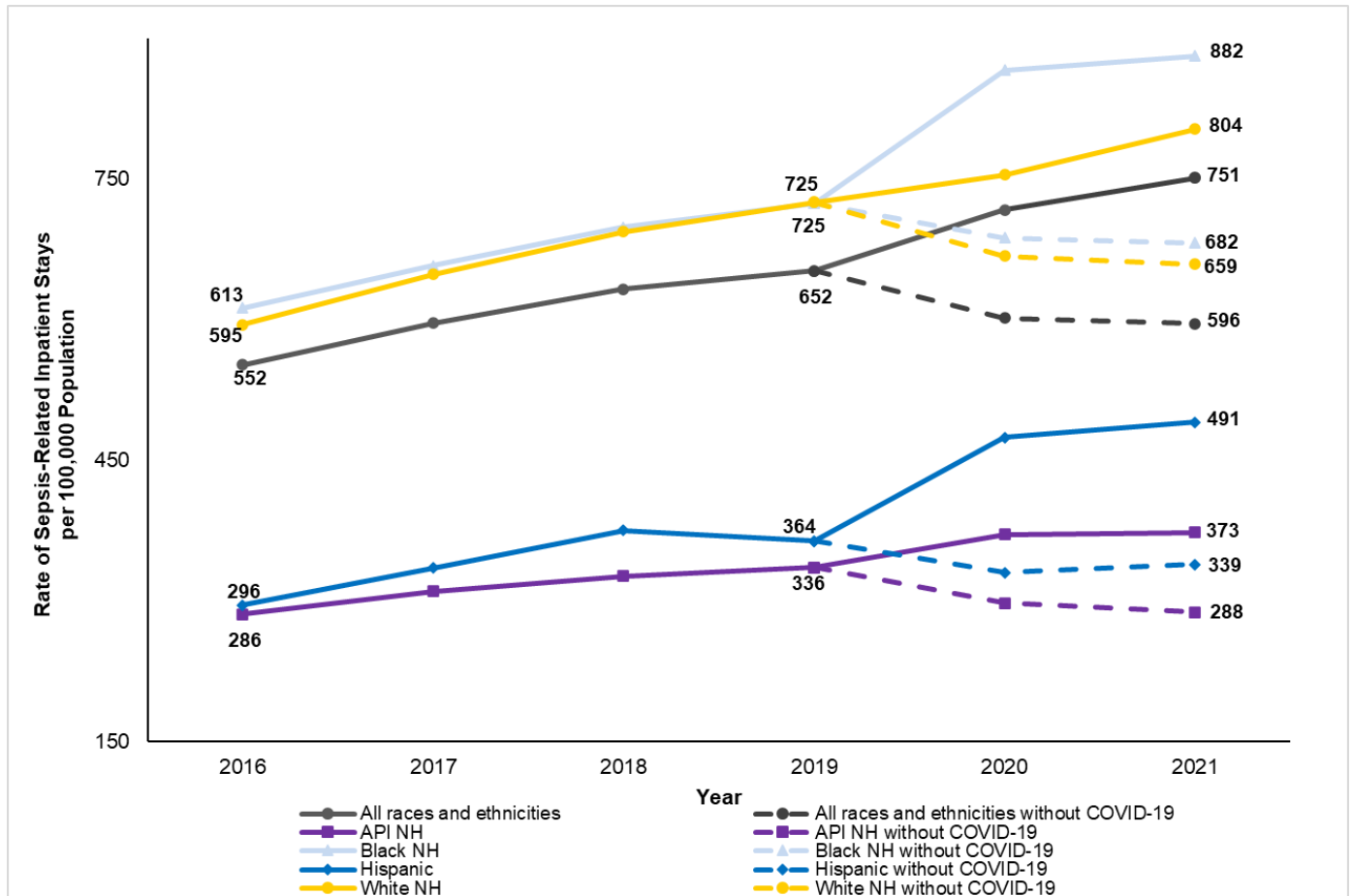
Highlights

- From 2016 to 2019, the population rate of all sepsis-related inpatient stays increased 18.1 percent. With the emergence of COVID-19, the rate increased another 15.2 percent between 2019 and 2021.

- From 2016 to 2021, Black and White non-Hispanic individuals had the highest population rates of sepsis-related inpatient stays compared with Hispanic and Asian and Pacific Islander non-Hispanic individuals.

- For all racial and ethnic groups, population rates of sepsis-related inpatient stays were higher among individuals living in the most socially vulnerable communities than those living in less socially vulnerable communities in 2019 and 2021.

- The average length of a sepsis stay for Asian and Pacific Islander non-Hispanic, Black non-Hispanic, and Hispanic patients was longer than for White non-Hispanic patients in 2021 (9.7, 10.6, and 10.3 vs. 8.6 days, respectively).

- Although the in-hospital mortality rate for sepsis increased for all patients between 2019 and 2021, Hispanic patients had the greatest increase in the in-hospital mortality rate during this period (64.3 percent) compared with patients from other racial and ethnic groups.

Findings

Trends in the Rate of Sepsis-Related Inpatient Stays per 100,000 Population by Patient Race and Ethnicity

Figure 1 presents national trends from 2016 to 2021 in the rate of sepsis-related inpatient stays per 100,000 population by patient race and ethnicity. For 2020 and 2021, trends are presented for all sepsis-related inpatient stays as well as stays without COVID-19 to understand the influence of the COVID-19 pandemic.

Figure 1. Trends in the rate of sepsis-related inpatient stays per 100,000 population, by patient race and ethnicity, 2016–2021

Abbreviations: API, Asian and Pacific Islander; NH, Non-Hispanic.

Notes: The rate of sepsis-related inpatient stays per 100,000 population was based on any-listed diagnosis of sepsis. Rates were rounded to the nearest whole number. Patient race and ethnicity information was missing for less than five percent of all sepsis-related inpatient stays in 2016 and less than three percent of stays in 2019 and 2021.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2016–2021

- From 2016 to 2019, the population rate of all sepsis-related inpatient stays increased 18.1 percent (an average of 5.7 percent per year from 552 to 652 per 100,000 population).

- With the emergence of COVID-19, the rate increased 15.2 percent, from 652 per 100,000 population in 2019 to 751 per 100,000 population in 2021. Hispanic and Black non-Hispanic individuals experienced the highest percentage increase in the population rate of sepsis-related inpatient stays during this period (34.8 percent and 21.7 percent, respectively).

- From 2016 to 2021, Black non-Hispanic and White non-Hispanic individuals had the highest population rates of sepsis-related inpatient stays, whereas Hispanic and Asian and Pacific Islander non-Hispanic individuals had the lowest rates.

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Characteristics of Sepsis-Related Inpatient Stays by Patient Race and Ethnicity, 2019 and 2021

Table 1 presents the rate of sepsis-related inpatient stays per 100,000 population by patient race and ethnicity and other select characteristics in 2019 and 2021. Figure 2 presents the percentage in 2019 and 2021 of sepsis-related inpatient stays by patient race and ethnicity and presence of the most common chronic comorbidities (i.e., the top five comorbidities across all racial and ethnic groups in 2021).

Table 1. Rate of sepsis-related inpatient stays per 100,000 population, by patient characteristics and race and ethnicity, 2019 and 2021

Characteristic	All races and ethnicities	API NH	Black NH	Hispanic	White NH
2019					
All sepsis-related inpatient stays	652	336	725	364	725
Age group, years					
Pediatric (0-17)	112	83	143	105	92
Adult (18-64)	402	163	563	277	406
Adult (65+)	2,314	1,631	2,751	2,110	2,215
Sex					
Male	692	376	771	384	767
Female	614	299	682	344	685
Community-level income					
Low-income	792	405	806	430	949
Middle-income	634	381	663	334	711
High-income	492	286	579	265	541
Patient residence					
Urban	639	336	723	369	718
Rural	736	326	736	297	761
Patient community (social vulnerability† designation)					
Most vulnerable	731	407	795	453	906
Less vulnerable	623	316	677	294	688
2021					
All sepsis-related inpatient stays	751	373	882	491	804
Age group, years					
Pediatric (0-17)	96	64	116	89	77
Adult (18-64)	508	207	723	426	483
Adult (65+)	2,477	1,644	3,141	2,486	2,320
Sex					
Male	816	427	938	545	870
Female	687	323	829	436	738
Community-level income					
Low-income	931	434	986	563	1,066
Middle-income	738	433	826	454	801
High-income	551	320	705	358	592
Patient residence					
Urban	739	375	878	499	794
Rural	828	337	915	379	846
Patient community (social vulnerability† designation)					
Most vulnerable	815	424	923	558	944
Less vulnerable	706	342	812	385	754

Abbreviations: API, Asian and Pacific Islander; NH, Non-Hispanic.
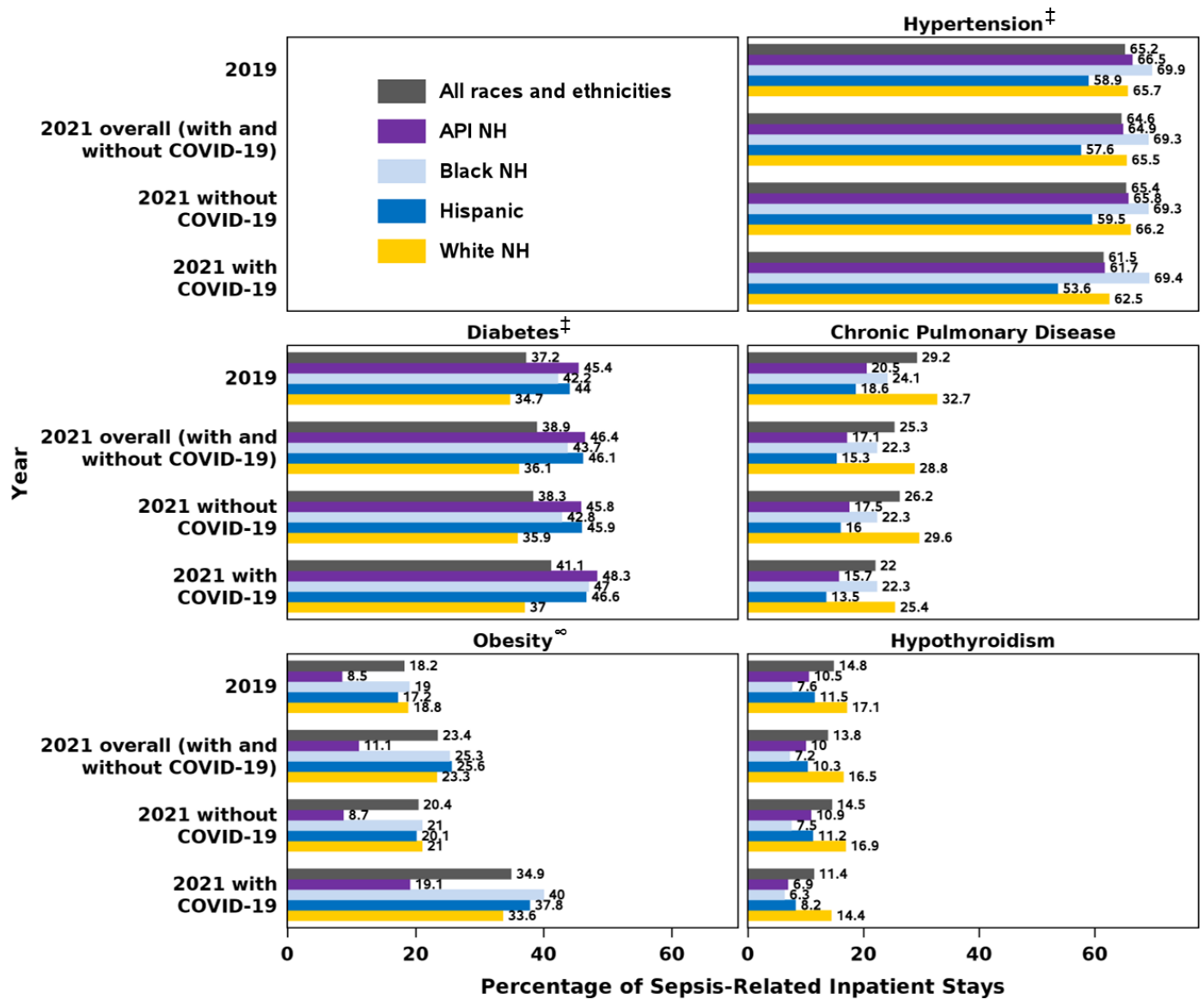
Notes: The rate of sepsis-related inpatient stays per 100,000 population was based on any-listed diagnosis of sepsis. Rates were rounded to the nearest whole number. Patient race and ethnicity information was missing for less than three percent of all sepsis-related inpatient stays in 2019 and 2021.

†Social vulnerability is based on the Centers for Disease Control and Prevention (CDC)/Agency for Toxic Substances and Disease Registry (ATSDR) Social Vulnerability Index (SVI), which is a measure of a community's ability to prevent human suffering and financial loss during a disaster.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2019 and 2021

- For all racial and ethnic groups, the population rate of sepsis-related inpatient stays was highest among individuals aged 65 years and older in 2019 and 2021. Black non-Hispanic individuals had the highest rates across all age groups in both years.

- For all racial and ethnic groups, the population rates of sepsis-related inpatient stays were over 60 percent higher among individuals living in low-income communities versus high-income communities in 2019 and 2021. The difference between rates by community-level income was highest for White non-Hispanic individuals in both years (75.2 and 79.9 percent, respectively).

- For all racial and ethnic groups, males had higher population rates of sepsis-related inpatient stays than females in 2019 and 2021. The disparity in rates by sex was highest among Asian and Pacific Islander non-Hispanic individuals. In both years, Asian and Pacific Islander non-Hispanic males had a rate over 25 percent higher than Asian and Pacific Islander non-Hispanic females.

- For all racial and ethnic groups, the population rate of sepsis-related inpatient stays was higher among individuals living in the most socially vulnerable communities versus less socially vulnerable communities in 2019 and 2021. Among Hispanic individuals in particular, the rate for those living in the most socially vulnerable communities was around 50 percent higher compared to those living in the least socially vulnerable communities in both years.

Figure 2. Percentage of sepsis-related inpatient stays, by patient race and ethnicity and presence of most common chronic comorbidities, 2019 and 2021

Abbreviations: API, Asian and Pacific Islander; NH, Non-Hispanic.

Notes: The percentage of sepsis-related inpatient stays was based on any-listed diagnosis of sepsis. The identification of chronic comorbidities is based on the Elixhauser Comorbidity Software Refined for ICD-10-CM for the subset of comorbidity measures available on the NIS. Only the top five comorbidities across all racial and ethnic groups in 2021 are included. Comorbidities are not mutually exclusive. Patient race and ethnicity information was missing for less than three percent of all sepsis-related inpatient stays in 2019 and 2021.

‡ Related comorbid conditions were grouped together for reporting. Hypertension includes hypertension with and without complications. Diabetes includes diabetes with and without chronic complications.

∞Diagnosis codes indicating obesity are likely underreported in HCUP data.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2019 and 2021

- Among the five most common chronic comorbidities for sepsis-related inpatient stays, the percentage with a comorbidity of hypertension was highest across all racial and ethnic groups in 2019 at 65.2 percent and 2021 at 64.6 percent.

- In 2019 and 2021, the percentage of sepsis-related inpatient stays with a comorbidity of diabetes for Asian and Pacific Islander non-Hispanic, Black non-Hispanic, and Hispanic patients was higher than for White non-Hispanic patients.

- Among all sepsis-related inpatient stays with a comorbidity of chronic pulmonary disease or hypothyroidism, White non-Hispanic patients had the highest percentages compared with patients from other racial and ethnic groups in 2019 and 2021.

- From 2019 to 2021, the percentage of sepsis-related inpatient stays with a comorbidity of obesity increased across all racial and ethnic groups. Hispanic patients had the greatest increase in the percentage of sepsis-related inpatient stays with a comorbidity of obesity during this period compared with patients from other racial and ethnic groups (48.5 vs. 23.9 to 33.4 percent increase).

Average Length of Stay, Average Total Hospital Cost, In-hospital Mortality Rate, and Discharge Disposition for Inpatient Stays for Sepsis by Patient Race and Ethnicity, 2019 and 2021

Figures 3, 4, and 5 present the average length of stay, average total hospital cost, and in-hospital mortality rate for sepsis stays (i.e., sepsis is the principal diagnosis), respectively, in 2019 and 2021 by patient race and ethnicity. For 2021, information is presented with and without COVID-19. Figure 6 presents the distribution of inpatient stays for sepsis by patient race and ethnicity and discharge disposition in 2019 and 2021.

Figure 3. Average length of sepsis stay, by patient race and ethnicity, 2019 and 2021
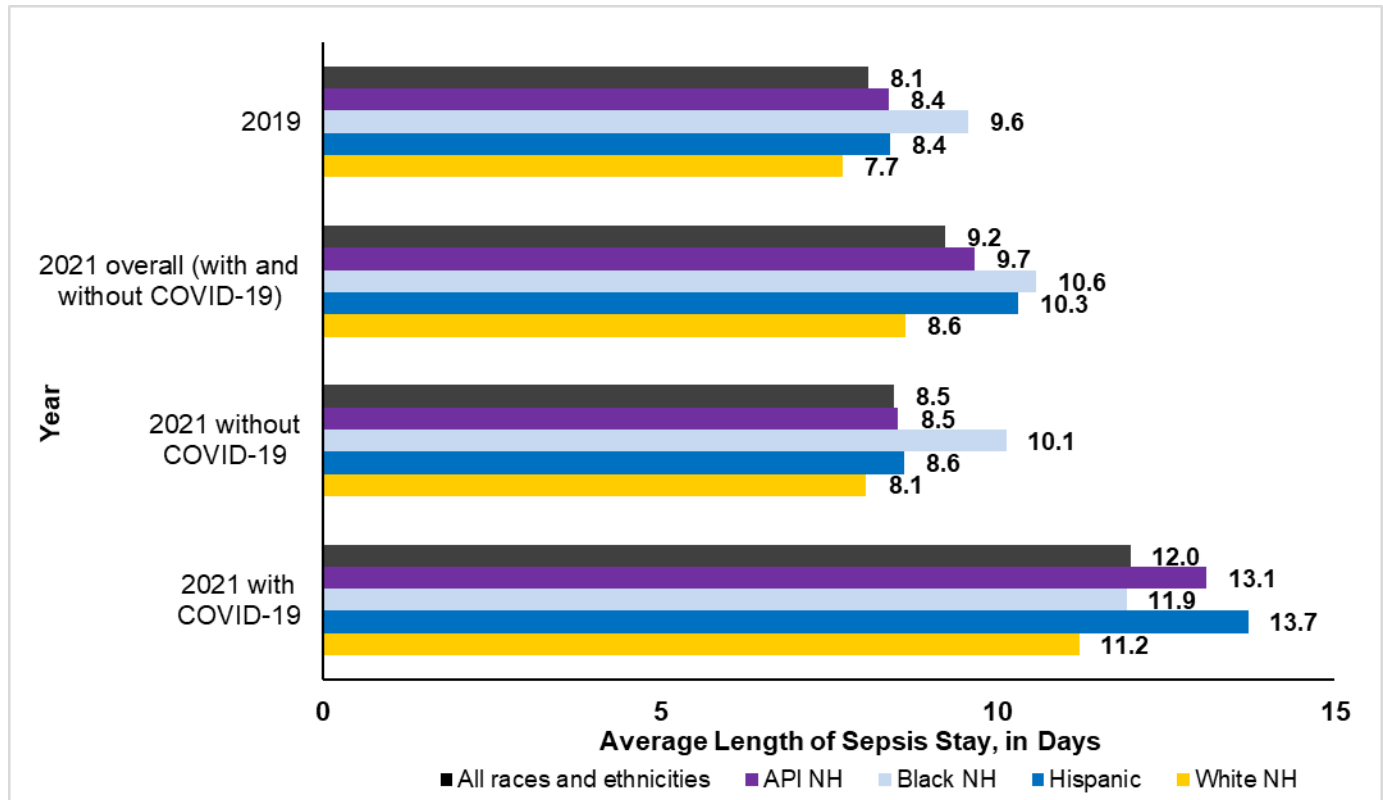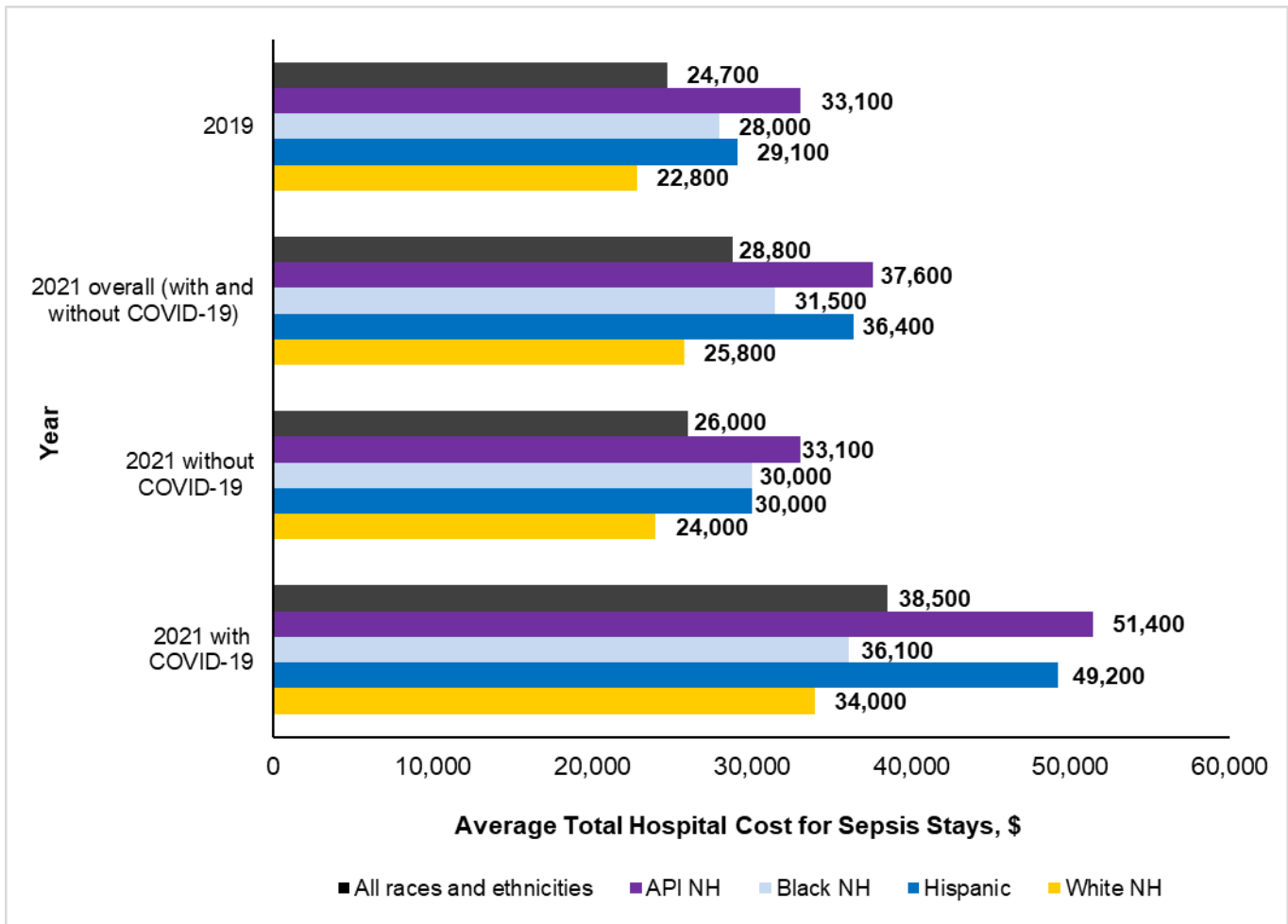

Abbreviations: API, Asian and Pacific Islander; NH, Non-Hispanic.

Notes: Average length of sepsis stay was based on stays in which sepsis was the reason for the stay (i.e., the principal diagnosis). Patient race and ethnicity information was missing for less than three percent of all sepsis-related inpatient stays in 2019 and 2021.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2019 and 2021

- In 2019, Black non-Hispanic patients had the longest average length of sepsis stay (9.6 days) compared with patients from other racial and ethnic groups.

- Compared to 2019, the average length of sepsis stay in 2021 was longer across all racial and ethnic groups. Hispanic patients had the greatest increase in the average length of sepsis stay during this period compared with patients from other racial and ethnic groups (22.7 vs. 10.6 to 15.0 percent increase).

- In 2021, the average length of sepsis stay for Asian and Pacific Islander non-Hispanic, Black non-Hispanic, and Hispanic patients was longer than for White non-Hispanic patients (9.7, 10.6, and 10.3 vs. 8.6 days, respectively).

- Among stays for sepsis and COVID-19 in 2021, the average length of stay was longest among Hispanic patients at 13.7 days followed by Asian and Pacific Islander non-Hispanic patients at 13.1 days.

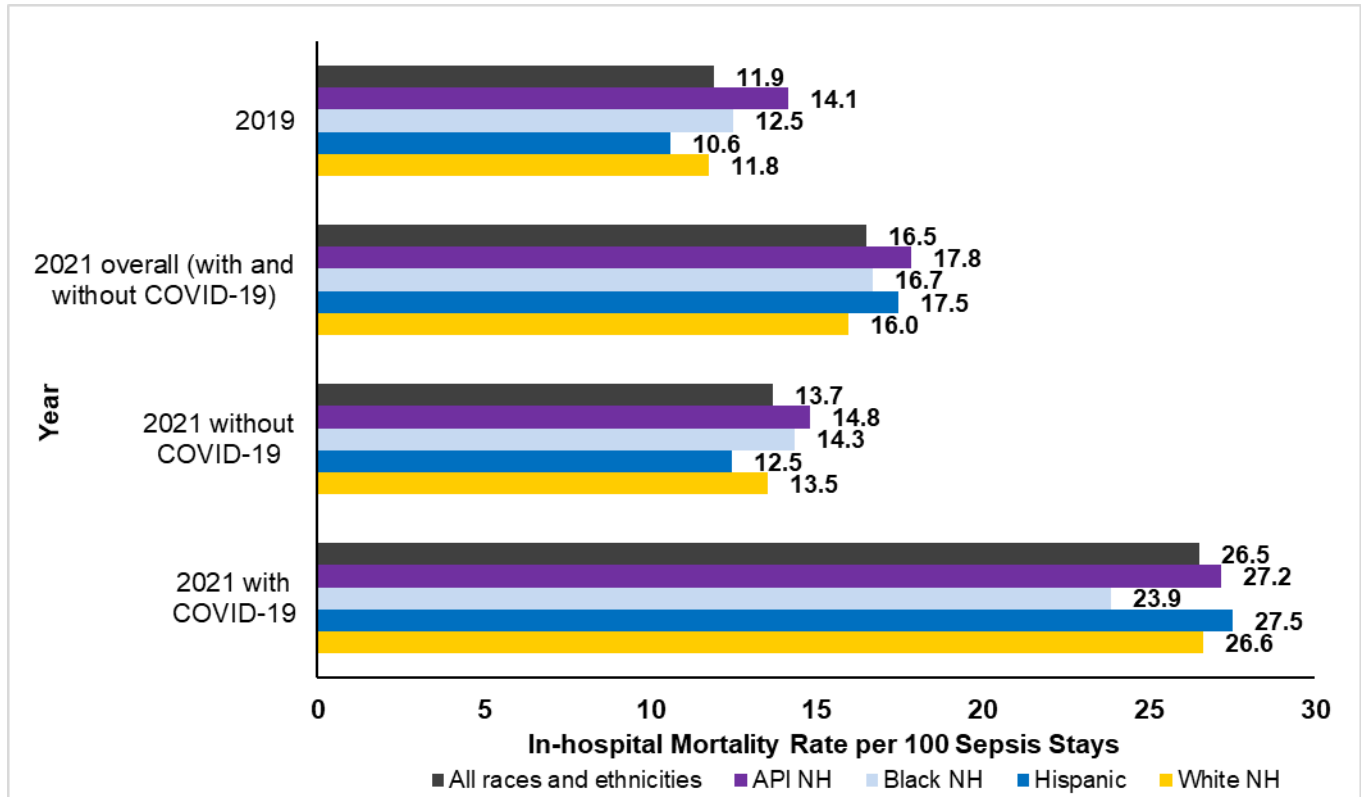**Figure 4. Average total hospital cost for sepsis stays, by patient race and ethnicity, 2019 and 2021**

Abbreviations: API, Asian and Pacific Islander; NH, Non-Hispanic.

Notes: Average total hospital cost for sepsis stays were based on stays in which sepsis was the reason for the stay (i.e., the principal diagnosis). Charges were imputed to account for missing information prior to conversion to hospital costs. Hospital costs were adjusted to the base year of 2021. Average hospital costs were rounded to the nearest hundreds. Patient race and ethnicity information was missing for less than three percent of all sepsis-related inpatient stays in 2019 and 2021.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2019 and 2021

- In 2019, the average total hospital cost for sepsis stays was highest among Asian and Pacific Islander non-Hispanic patients at $33,100 compared with the hospital cost for patients from other racial and ethnic groups ($22,800 to $29,100).

- Regardless of the patient's race and ethnicity, the average total hospital cost for sepsis stays was higher in 2021 than in 2019. Hispanic patients experienced the highest increase in hospital cost during this period compared with patients from other racial and ethnic groups (24.9 vs. 12.7 to 13.4 percent increase).

- In 2021, the average total hospital cost for sepsis stays was highest among Asian and Pacific Islander non-Hispanic and Hispanic patients ($37,600 and $36,400, respectively) compared with patients from other racial and ethnic groups ($25,800 and $31,500).

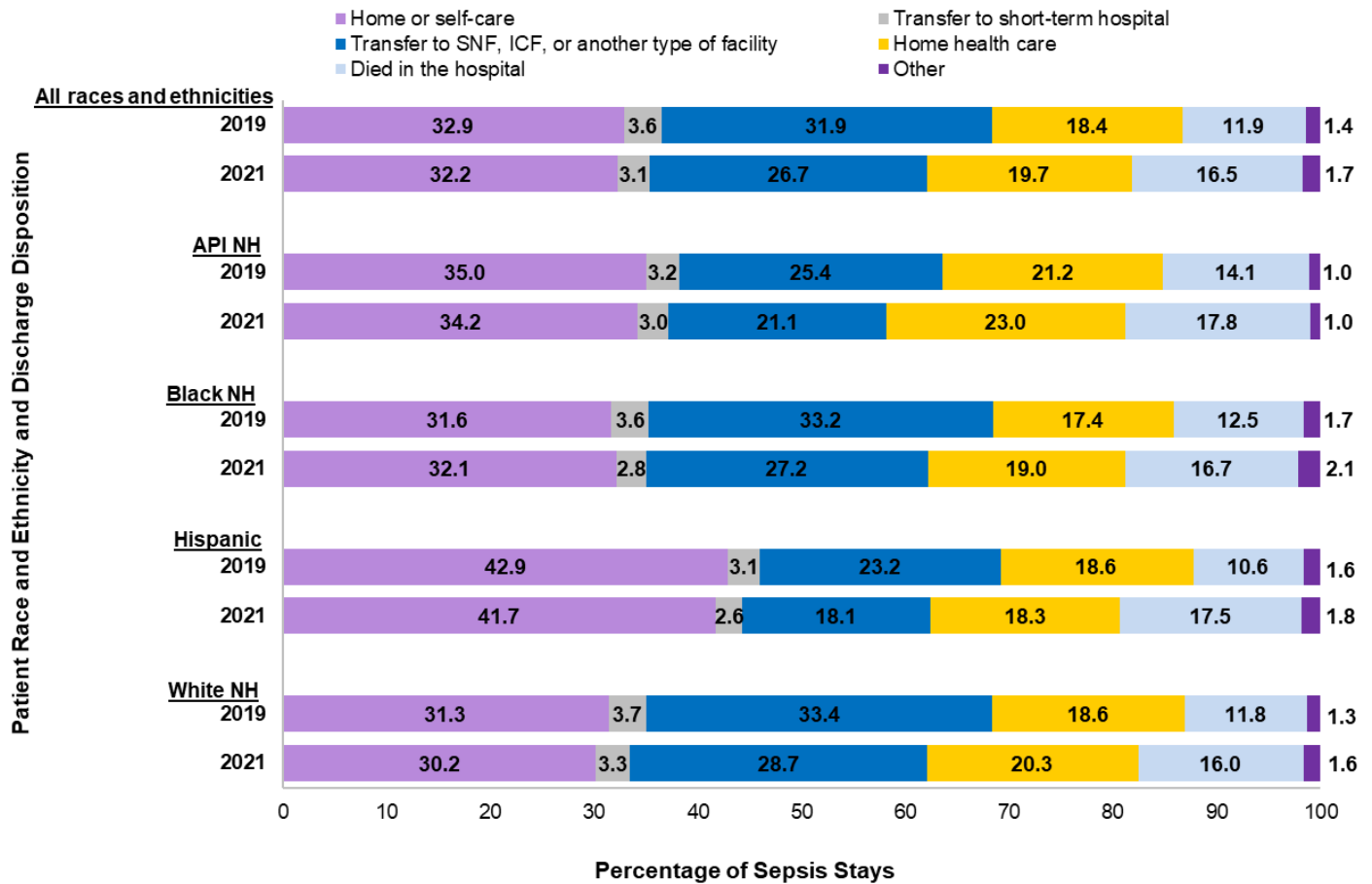**Figure 5. In-hospital mortality rate per 100 sepsis stays, by patient race and ethnicity, 2019 and 2021**

Abbreviations: API, Asian and Pacific Islander; NH, Non-Hispanic.

Notes: In-hospital mortality rate per 100 sepsis stays was based on stays in which sepsis was the reason for the stay (i.e., the principal diagnosis). Patient race and ethnicity information was missing for less than three percent of all sepsis-related inpatient stays in 2019 and 2021.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2019 and 2021

- In 2019, the in-hospital mortality rate for sepsis stays was highest among Asian and Pacific Islander non-Hispanic patients at 14.1 per 100 sepsis stays compared with patients from other racial and ethnic groups (10.6 to 12.5 per 100 sepsis stays).

- Compared to 2019, the in-hospital mortality rate for sepsis stays in 2021 was higher across all racial and ethnic groups. Hispanic patients had the greatest increase in the in-hospital mortality rate during this period (64.3 percent) compared with patients from other racial and ethnic groups (26.1 to 35.7 percent increase).

- Across patients from all racial and ethnic groups in 2021, the in-hospital mortality rate was 16.5 per 100 sepsis stays.

- Among stays for sepsis and COVID-19, the in-hospital mortality rate for Asian and Pacific Islander non-Hispanic, Hispanic, and White non-Hispanic patients was higher than for Black non-Hispanic patients (27.2, 27.5, and 26.6 vs. 23.9 per 100 sepsis stays, respectively).

Figure 6. Distribution of sepsis stays, by patient race and ethnicity and discharge disposition, 2019 and 2021

Legend:
- Home or self-care
- Transfer to SNF, ICF, or another type of facility
- Died in the hospital
- Transfer to short-term hospital
- Home health care
- Other

Y-axis: Patient Race and Ethnicity and Discharge Disposition

All races and ethnicities
- 2019: 32.9 | 3.6 | 31.9 | 18.4 | 11.9 | 1.4
- 2021: 32.2 | 3.1 | 26.7 | 19.7 | 16.5 | 1.7

API NH
- 2019: 35.0 | 3.2 | 25.4 | 21.2 | 14.1 | 1.0
- 2021: 34.2 | 3.0 | 21.1 | 23.0 | 17.8 | 1.0

Black NH
- 2019: 31.6 | 3.6 | 33.2 | 17.4 | 12.5 | 1.7
- 2021: 32.1 | 2.8 | 27.2 | 19.0 | 16.7 | 2.1

Hispanic
- 2019: 42.9 | 3.1 | 23.2 | 18.6 | 10.6 | 1.6
- 2021: 41.7 | 2.6 | 18.1 | 18.3 | 17.5 | 1.8

White NH
- 2019: 31.3 | 3.7 | 33.4 | 18.6 | 11.8 | 1.3
- 2021: 30.2 | 3.3 | 28.7 | 20.3 | 16.0 | 1.6

X-axis: Percentage of Sepsis Stays (0 to 100)

Abbreviations: API, Asian and Pacific Islander; ICF, intermediate care facility; NH, Non-Hispanic; SNF, skilled nursing facility.

Notes: The Other category includes dispositions of against medical advice, discharged alive, missing, and invalid. The distribution of the number of inpatient stays for sepsis by discharge disposition was based on stays in which sepsis was the reason for the stay (i.e., the principal diagnosis). Patient race and ethnicity information was missing for less than three percent of all sepsis-related inpatient stays in 2019 and 2021.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2019 and 2021

- In 2019 and 2021, the proportion of inpatient stays for sepsis that resulted in a discharge to home or self-care was highest among Hispanic patients (2019, 42.9 percent and 2021, 41.7 percent, respectively) compared with patients from other racial and ethnic groups (2019, 31.3 to 35.0 percent and 2021, 30.2 to 34.2 percent).

- Across patients from all racial and ethnic groups, the percentage of inpatient stays for sepsis that resulted in a transfer to a skilled nursing, intermediate care, or another facility decreased from 31.9 percent in 2019 to 26.7 percent in 2021. Hispanic patients experienced the largest percentage decrease in transfers during this period (22.1 percent decrease, from 23.2 to 18.1 percent of sepsis stays) compared with patients from other racial and ethnic groups (14.1 to 18.0 percent decrease).

- In 2019 and 2021, the proportion of inpatient stays for sepsis that resulted in a discharge to home health care was highest among Asian and Pacific Islander non-Hispanic patients (2019, 21.2 percent and 2021, 23.0 percent, respectively) compared with patients from other racial and ethnic groups (2019, 17.4 to 18.6 percent and 2021, 18.3 to 20.3 percent).

References

[1] Singer M, Deutschman CS, Seymour CW et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016;315(8):801-810.

[2] Owens PL, Miller MA, Barrett ML, Hensche M. Overview of Outcomes for Inpatient Stays Involving Sepsis, 2016–2021. HCUP Statistical Brief #306. April 2024. Agency for Healthcare Research and Quality, Rockville, MD. https://hcup-us.ahrq.gov/reports/statbriefs/sb306-overview-sepsis-2016-2021.pdf.

[3] What is Sepsis? Centers of Disease Control and Prevention. https://www.cdc.gov/sepsis/index.html. Accessed January 23, 2024.

[4] DiMeglio, M., Dubensky, J., Schadt, S., Potdar, R., & Laudanski, K. (2018). Factors Underlying Racial Disparities in Sepsis Management. *Healthcare, 6*(4), 133. https://doi.org/10.3390/healthcare6040133

[5] Racial Equity in Sepsis Care Matters. Sepsis Alliance. https://www.sepsis.org/news/racial-equity-in-sepsis-care-matters/. Accessed May 3, 2024.

Data Source

This Statistical Brief uses data from the HCUP 2016–2021 National Inpatient Sample (NIS). For additional information about the HCUP NIS, see: https://hcup-us.ahrq.gov/db/nation/nis/nisdbdocumentation.jsp.

Population Studied

This analysis focused on inpatient stays with any ICD-10-CM diagnosis of sepsis. Although the maximum number of diagnoses varies in the 2016–2021 NIS (30 diagnoses in the 2016 NIS and 40 diagnoses in 2017–2021), this analysis used all available diagnoses in the data year. Within each year, the number of diagnoses in the individual State Inpatient Databases (SID) used to create the NIS vary and may be different than the maximum retained in the NIS. No more than one percent of records have diagnoses excluded from the NIS in any given year.

The unit of analysis is the hospital discharge (i.e., the inpatient stay), not a person or patient. This means that a person who is admitted to the hospital multiple times in one year will be counted each time as a separate discharge from the hospital.

Case definition of sepsis by patient populations
Consistent with the Third International Consensus Definitions Task Force definition of Sepsis-3, the identification of inpatient stays related to sepsis was based on ICD-10-CM diagnoses indicating sepsis and organ dysfunction.[a] Patients were divided into five mutually exclusive categories for the identification of inpatient stays related to sepsis with varying age and sepsis criteria: 1) maternal regardless of age, 2) adults 18 years and older, 3) pediatrics aged 28 days–17 years, and 4) neonates aged 0–27 days (Table 2).

The ICD-10-CM diagnoses codes used to identify sepsis are included in Appendix A, Table A.1. The ICD-10-CM diagnoses codes used to identify organ dysfunction are included in Appendix A, Table A.2. The ICD-10-CM/PCS codes used to identify a maternal case are included in Appendix A, Table A.3.

Table 2. Clinical coding criteria for identifying sepsis-related inpatient stays for mutually exclusive patient populations

Population	Maternal	Age Criteria	Sepsis Criteria
Maternal	Yes – Any DX indicating a maternal condition as identified by QI setname MDC14PRINDX[*]	Any age	Any ICD-10-CM diagnosis of the following: • Septic shock[**] • Severe sepsis[***] • Any other diagnosis indicating sepsis _with_ at least one diagnosis indicating organ dysfunction (including maternal "O" organ dysfunction codes)

Population	Maternal	Age Criteria	Sepsis Criteria
Adult	No	18 years and older[****]	Any ICD-10-CM diagnosis of the following: • Septic shock[**] • Severe sepsis[***] • Any other diagnosis indicating sepsis _with_ at least one diagnosis indicating organ dysfunction
Pediatric	No	Age 0 with age in days > 27 days _or_ age 1-17 years	Any ICD-10-CM diagnosis of the following: • Septic shock[**] • Severe sepsis[***] • Any other diagnosis indicating sepsis (no requirement to have indication of organ dysfunction)
Neonatal	No	Age in days of 0-27	Any ICD-10-CM diagnosis of the following: • Septic shock[**] • Severe sepsis[***] • Any other diagnosis indicating sepsis (no requirement to have indication of organ dysfunction)

[*]AHRQ Prevention Quality Indictor (PQI), Appendix F: MDC 14 and MDC 15 Principal Diagnosis Codes, v2023 (https://qualityindicators.ahrq.gov/Downloads/Modules/PQI/V2023/TechSpecs/PQI_Appendix_F.pdf). Accessed November 10, 2023.
[**] Septic shock identified by ICD-10-CM diagnoses R6521 and T8112XA.
[***] Severe sepsis identified by ICD-10-CM diagnosis R6520.
[****] The adults aged 18 years and older group included a small percentage of records (less than 0.02 percent) of sepsis-related inpatient stays missing patient age information. Records missing patient age information were included in this group because it was the largest of the patient populations.

Sepsis as the reason for the inpatient stay

For this Statistical Brief, outcomes (average length of stay, average total hospital cost, in-hospital mortality rate, and discharge disposition) are reported only when sepsis was the reason for the inpatient stay (i.e., principal diagnosis). Outcomes for stays when sepsis was a co-occurring condition or complication of the stay (i.e., only reported as a secondary diagnosis) are not examined in this Statistical Brief. For stays in which sepsis was a co-occurring condition or complication of the stay, other conditions such as cancer, pneumonia, or heart failure may be the reason for the inpatient stay and contribute to increased length of stay or hospital costs. Thus, outcomes for these inpatient stays cannot be attributed solely to sepsis.

The proportion of inpatient stays in which sepsis was the reason for the inpatient stay varies by patient population partially because of ICD-10-CM clinical coding guidelines. As such, these guidelines are important to consider in the development of the case definition for sepsis.

Table 3 presents the number of inpatient stays related to sepsis by patient race and ethnicity. Information is presented for 2019 and with and without COVID-19 for 2021. Additionally, information is presented separately for sepsis as the reason for the stay versus a co-occurring condition or complication of the stay.

Table 3. Number of Inpatient Stays Related to Sepsis by Patient Race and Ethnicity, 2019 and 2021

Patient race and ethnicity	2019	2021 overall (with and without COVID-19)	2021 with COVID-19	2021 without COVID-19
Sepsis was the reason for the inpatient stay				
All races and ethnicities	1,543,065	1,811,043	394,610	1,416,433
API NH	46,475	55,080	13,540	41,540
Black NH	204,185	260,535	64,895	195,640
Hispanic	149,925	217,990	72,380	145,610
White NH	1,056,695	1,168,168	216,695	951,474

Patient race and ethnicity	2019	2021 overall (with and without COVID-19)	2021 with COVID-19	2021 without COVID-19
Sepsis was a co-occurring condition or complication of the stay				
All races and ethnicities	598,670	683,024	121,510	561,514
API NH	19,660	21,240	3,935	17,305
Black NH	94,270	108,510	18,545	89,965
Hispanic	70,090	89,450	22,545	66,905
White NH	374,375	414,344	67,650	346,695

Abbreviations: API, Asian and Pacific Islander; NH, Non-Hispanic.
Notes: Patient race and ethnicity information was missing for less than three percent of all sepsis-related inpatient stays in 2019 and 2021.
Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2019 and 2021

Identification of inpatient stays for COVID-19

The identification of inpatient stays related to COVID-19 was based on any of the following ICD-10-CM diagnoses:

- J1282, Pneumonia due to coronavirus disease 2019
- U071, COVID-19
- U099, Post COVID-19 condition, unspecified.

Definitions

Diagnoses

The *principal diagnosis* is that condition established after study to be chiefly responsible for the patient's admission to the hospital. *Secondary diagnoses* are conditions that coexist at the time of admission that require or affect patient care treatment received or management, or that develop during the inpatient stay. *Any-listed diagnoses* include the principal diagnosis plus all secondary diagnoses.

ICD-10-CM Coding System

ICD-10-CM is the *International Classification of Diseases, Tenth Revision, Clinical Modification*. There are over 70,000 ICD-10-CM diagnosis codes.

Discharge status

Discharge status reflects the disposition of the patient at discharge from the hospital and includes the following six categories: routine (to home or self-care); transfer to another short-term hospital; transfer to skilled nursing facility (SNF), intermediate care (ICF), or another type of facility, such as a nursing home; home health care; died in the hospital; or other, which includes against medical advice (AMA), discharged alive (destination unknown), missing, and invalid.

Identification of comorbidities

The identification of comorbidities among sepsis-related inpatient stays used the HCUP Elixhauser Comorbidity Software Refined for ICD-10-CM comorbidity measures on the 2019 and 2021 NIS. The NIS includes a subset of comorbidity measures that do not require an indication that the diagnosis was present on admission (POA). Only the top five comorbidities across all racial and ethnic groups in 2021 are included in this Statistical Brief. Table 4 provides the number of sepsis-related inpatient stays (in descending order) for each comorbidity. Comorbidities are not mutually exclusive. Related comorbid conditions were grouped together for reporting. Hypertension includes hypertension with and without complications. Diabetes includes diabetes with and without chronic complications.

Table 4. Number of Sepsis-Related Inpatient Stays with a Comorbidity that does not Require Indication of Being Present on Admission, 2021

Comorbidity	Number of sepsis-related inpatient stays
Hypertension (with and without complications)	1,609,938
Diabetes (with and without chronic complications)	970,014
Chronic pulmonary disease	631,694
Obesity	583,164
Hypothyroidism	345,340
Depression	298,020
Dementia	281,615
Peripheral vascular disease	182,860
Alcohol abuse	134,295
Metastatic cancer	127,905
Drug abuse	121,030
Solid tumor without metastasis, malignant	112,825
Autoimmune conditions	97,075
Lymphoma	40,770
Leukemia	33,435
Other thyroid disorders	30,145
Acquired immune deficiency syndrome	20,060
Solid tumor without metastasis, in situ	655

Notes: Related comorbid conditions were grouped together for reporting. Hypertension includes hypertension with and without complications. Diabetes includes diabetes with and without chronic complications.
Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2021

Length of stay

The length of stay is calculated as the difference of the discharge date and the admission date. A patient admitted and discharged on the same day has a length of stay of zero days.

Total hospital costs and charges

Total hospital charges were converted to hospital costs using HCUP Cost-to-Charge Ratios based on hospital accounting reports from the Centers for Medicare & Medicaid Services (CMS).[b] *Hospital costs* reflect the actual expenses incurred in the production of hospital services, such as wages, supplies, and utility costs. *Charges* represent the amount a hospital billed for the case. For each hospital, a hospital-wide cost-to-charge ratio is used. Hospital charges reflect the amount the hospital billed for the entire hospital stay and do not include professional (physician) fees. Further information on the Cost-to-Charge Ratio can be found at: https://hcup-us.ahrq.gov/db/ccr/costtocharge.jsp.

Annual hospital costs were inflation-adjusted using the Gross Domestic Product (GDP) Price Index from the U.S. Department of Commerce, Bureau of Economic Analysis (BEA), with 2021 as the index base.[c] All hospital costs are expressed in 2021 dollars.

Patient race and ethnicity

Data on Hispanic ethnicity are collected differently among the States and also can differ from the census methodology of collecting information on race (White, Black, Asian and Pacific Islander, American Indian and Alaska Native, Other [including mixed race]) separately from ethnicity (Hispanic, non-Hispanic). Most State data organizations collect Hispanic ethnicity as one of several categories that include race. Therefore, for multistate analyses, HCUP creates the combined categorization of race and ethnicity for data from States that report ethnicity separately. When a State data organization collects Hispanic ethnicity separately from race, HCUP uses Hispanic ethnicity to override any other race category to create a Hispanic category for the uniformly coded race and ethnicity data element, while also retaining the original race and ethnicity data. This Statistical Brief reports race and ethnicity for the following categories: Asian and Pacific Islander non-Hispanic, Black non-Hispanic, Hispanic, and White non-Hispanic. Categories that are not reported include American Indian and Alaska Native non-Hispanic and Other non-Hispanic.

Community-level income

Community-level income is based on the median household income of the patient's ZIP Code of residence. Quartiles are defined so that the total U.S. population is evenly distributed. Cut-offs for the quartiles are determined annually using ZIP Code demographic data obtained from projections of the U.S. Census Bureau data.[d] The value ranges for the income quartiles vary by year. Patients in the first quartile are assigned to the *lowest income* category, patients in the middle two quartiles are assigned to the *middle income* category, and patients in the highest quartile are assigned to the *highest income* category. The income quartile is missing for patients who are homeless or foreign.

Location of patients' residence (urban/rural designation)

Place of residence is based on the urban-rural classification scheme for U.S. counties developed by the National Center for Health Statistics (NCHS). For this Statistical Brief, we collapsed the NCHS categories into either urban or rural according to the following:

Urban:

- Large Central Metropolitan: includes metropolitan areas with 1 million or more residents,
- Large Fringe Metropolitan: includes counties of metropolitan areas with 1 million or more residents, or
- Medium and Small Metropolitan: includes areas with 50,000 to 999,999 residents.

Rural:

- Micropolitan and Noncore: includes nonmetropolitan counties (i.e., counties with no town greater than 50,000 residents).

Location of patients' residence (social vulnerability designation)

The Centers for Disease Control and Prevention (CDC)/Agency for Toxic Substances and Disease Registry (ATSDR) Social Vulnerability Index (SVI) is a measure of a community's ability to prevent human suffering and financial loss during a disaster. The SVI uses U.S. Census data to determine the social vulnerability of every census tract. Census tracts are subdivisions of counties for which the census collects statistical data. The SVI ranks each tract on 15 social factors, including poverty, lack of vehicle access, and crowded housing, and groups them into four related themes (socioeconomic status, household composition and disability, minority status and language, housing type and transportation). Each tract receives a separate ranking for each of the four themes and an overall ranking. Detailed descriptions of the CDC/ATSDR SVI and data downloads are available at www.atsdr.cdc.gov/placeandhealth/svi/index.html.

Social vulnerability designation in this Statistical Brief is based on the overall SVI measure in the patient's county of residence. Counties with SVI values in the fourth quartile are included in the *most vulnerable communities* category. Counties with social vulnerability index values in the lower three quartiles are included in the *less vulnerable communities* category.

Calculations

Population rates

Rates of sepsis-related inpatient stays per 100,000 population were calculated using 2016–2021 hospital discharge totals in the numerator and U.S. Census Bureau estimates of the 2016–2021 U.S. population by race and ethnicity in the denominator. Individuals hospitalized multiple times are counted more than once in the numerator.

Population rate of sepsis-related inpatient stays = $\left(\dfrac{\text{Number of sepsis-related inpatient stays}}{\text{Number of U.S. residents}} \right) \times 100{,}000$

In-hospital mortality rates

In-hospital mortality rates per 100 sepsis stays were calculated as follows:

- Numerator of inpatient stays for sepsis in which the patient died in the hospital
- Denominator of inpatient stays for sepsis (any discharge status).

Average annual percentage change

Average annual percentage change was calculated using the following formula:

Average annual percentage change $= \left[\left(\dfrac{\text{End value}}{\text{Beginning value}} \right)^{\frac{1}{\text{change in years}}} -1 \right] \times 100$

Percentage differences

Percentage differences between groups were calculated using the following formula:

Percentage difference $= \dfrac{(\text{Group 1 value} - \text{Group 2 value})}{\text{Group 2 value}} * 100$

The percentage differences were based on un-rounded numbers.

Imputation of missing charges and costs

The NIS is missing information on total hospital charges for less than two percent of records in 2021. The missing charges were imputed using the average total hospital charges for the Diagnosis Related Group (DRG) calculated using the NIS for the same data year. The imputation of total hospital charges occurred prior to the calculation of total hospital costs. The imputation of missing charges and the calculation of hospital costs were performed per discharge prior to the calculation of average hospital costs in 2021.

About HCUP

The Healthcare Cost and Utilization Project (HCUP, pronounced "H-Cup") is a family of healthcare databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). HCUP databases bring together the data collection efforts of State data organizations, hospital associations, and private data organizations (HCUP Partners) and the Federal government to create a national information resource of encounter-level healthcare data. HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to healthcare programs, and outcomes of treatments at the national, State, and local market levels. For more information about HCUP, see: https://hcup-us.ahrq.gov/

HCUP would not be possible without the contributions of the following data collection Partners from across the United States.

Alaska Department of Health
Alaska Hospital and Healthcare Association
Arizona Department of Health Services
Arkansas Department of Health
California Department of Health Care Access and Information
Colorado Hospital Association
Connecticut Hospital Association
Delaware Division of Public Health
District of Columbia Hospital Association
Florida Agency for Health Care Administration
Georgia Hospital Association
Hawaii Laulima Data Alliance
Hawaii University of Hawai'i at Hilo
Illinois Department of Public Health
Indiana Hospital Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Louisiana Department of Health
Maine Health Data Organization
Maryland Health Services Cost Review Commission
Massachusetts Center for Health Information and Analysis
Michigan Health & Hospital Association
Minnesota Hospital Association
Mississippi State Department of Health
Missouri Hospital Industry Data Institute
Montana Hospital Association

Nebraska Hospital Association
Nevada Department of Health and Human Services
New Hampshire Department of Health & Human Services
New Jersey Department of Health
New Mexico Department of Health
New York State Department of Health
North Carolina Department of Health and Human Services
North Dakota (data provided by the Minnesota Hospital Association)
Ohio Hospital Association
Oklahoma State Department of Health
Oregon Association of Hospitals and Health Systems
Oregon Health Authority
Pennsylvania Health Care Cost Containment Council
Rhode Island Department of Health
South Carolina Revenue and Fiscal Affairs Office
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems
Virginia Health Information
Washington State Department of Health
West Virginia Department of Health and Human Resources
Wisconsin Department of Health Services
Wyoming Hospital Association

Suggested Citation

Acknowledgments

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For More Information

For more information on this and other topics, please visit our HCUP Statistical Briefs topic area page located at www.hcup-us.ahrq.gov/reports/statbriefs/sbtopic.jsp.

For additional HCUP statistics, visit:

- HCUP Fast Stats at https://datatools.ahrq.gov/hcup-fast-stats for easy access to the latest HCUP-based statistics for healthcare information topics
- HCUPnet, HCUP's interactive query system, at https://datatools.ahrq.gov/hcupnet
- HCUP Summary Trend Tables at www.hcup-us.ahrq.gov/reports/trendtables/summarytrendtables.jsp for monthly information on hospital utilization

AHRQ welcomes questions and comments from readers of this publication who are interested in obtaining more information about access, cost, use, financing, and quality of healthcare in the United States. We also invite you to tell us how you are using this Statistical Brief and other HCUP data and tools, and to share suggestions on how HCUP products might be enhanced to further meet your needs. Please email us at hcup@ahrq.gov or send a letter to the address below:

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This Statistical Brief was posted online on August 14, 2024.

[a] Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *Jama.* 2016;315(8):801-810.

[b] Agency for Healthcare Research and Quality. Cost-to-Charge Ratio Files. Healthcare Cost and Utilization Project (HCUP). Agency for Healthcare Research and Quality. Updated November 2021. www.hcup-us.ahrq.gov/db/state/costtocharge.jsp. Accessed January 23, 2024.

[c] BEA Interactive Data query tool, National Data, GDP & Personal Income, Section 1 Domestic Product and Income, Table 1.1.4. Price Indexes for Gross Domestic Product. Accessed November 15, 2023.

[d] Claritas. Claritas Demographic Profile by ZIP Code. https://claritas360.claritas.com/mybestsegments/.