Regional differences in mortality rates and characteristics of decedents with hepatitis B listed as a cause of death, United States, 2000–2019

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Background

Background

- Hepatitis B
  - Can lead to cirrhosis and hepatocellular carcinoma, resulting in **premature** death
  - Has been associated with elevated mortality rates from **all causes**[1]
- **Stable** US hepatitis B-listed death rate during 1999-2019[2]
- US hepatitis B-listed death rates **highest** among decedents who were
  - **Aged ≥55 years, Non-Hispanic Asian/Pacific Islander, and male**[2]
- Published hepatitis B mortality reports lack information on decedent **place of birth, comorbidities, and underlying vs contributing causes of death**

1. Bixler D, Zhong Y, Ly KN, et al; CHeCS Investigators. Mortality among patients with chronic hepatitis B infection: the Chronic Hepatitis Cohort Study (CHeCS). Clin Infect Dis. 2019;68(6):956-963.
2. Centers for Disease Control and Prevention. Viral hepatitis surveillance—United States. Accessed September 15, 2020. https://www.cdc.gov/hepatitis/statistics/SurveillanceRpts.htm.

Study Rationale and Objectives

- Examination of hepatitis B mortality sub-nationally can identify differences in mortality rates and decedent characteristics.
- Study objectives:
  - To analyze state-level hepatitis B-listed death counts, rates, and characteristics of decedents
  - To examine the distribution of sociodemographic characteristics, median age at death, and UCOD among US-born and non-US-born decedents with hepatitis B-listed deaths

Methods

Data Source and Definitions

- Data Source: Restricted-use US Multiple Cause of Death data, 2000–2019
- Causes of Death
  - *International Statistical Classification of Diseases, Tenth Revision (ICD-10)*

Term	Definition
Underlying COD (n=1)	Disease or injury that initiated the chain of morbid events leading directly to death
Non-underlying COD (n≤19)	Immediate cause, conditions leading to immediate cause, and any other significant condition which unfavorably influenced the course of the morbid process and thus contributed to the fatal outcome
Hepatitis B-listed death	≥1 ICD-10 code indicative of hepatitis B (**B16, B17.0, B18.0, and B18.1**) listed as the UCOD of a CCOD
Hepatitis D virus coinfection death	Hepatitis B-listed death with ≥1 ICD-10 code indicative of hepatitis D **(B16.0, B16.1, B17.0, and B18.0**) present as any COD
Hepatitis C virus coinfection death	Hepatitis B-listed death with ≥1 ICD-10 code indicative of hepatitis C (**B17.1 and B18.2**) present as any COD
HIV coinfection death	Hepatitis B-listed death with ≥1 ICD-10 code indicative of HIV (**B20–B24**) present as any COD
US-born (USB)	Birth in any of 50 US states or DC
Non-US-born (NUSB)	Birth in the remainder of the world

Link to NVSS mortality data: https://www.cdc.gov/nchs/nvss/deaths.htm

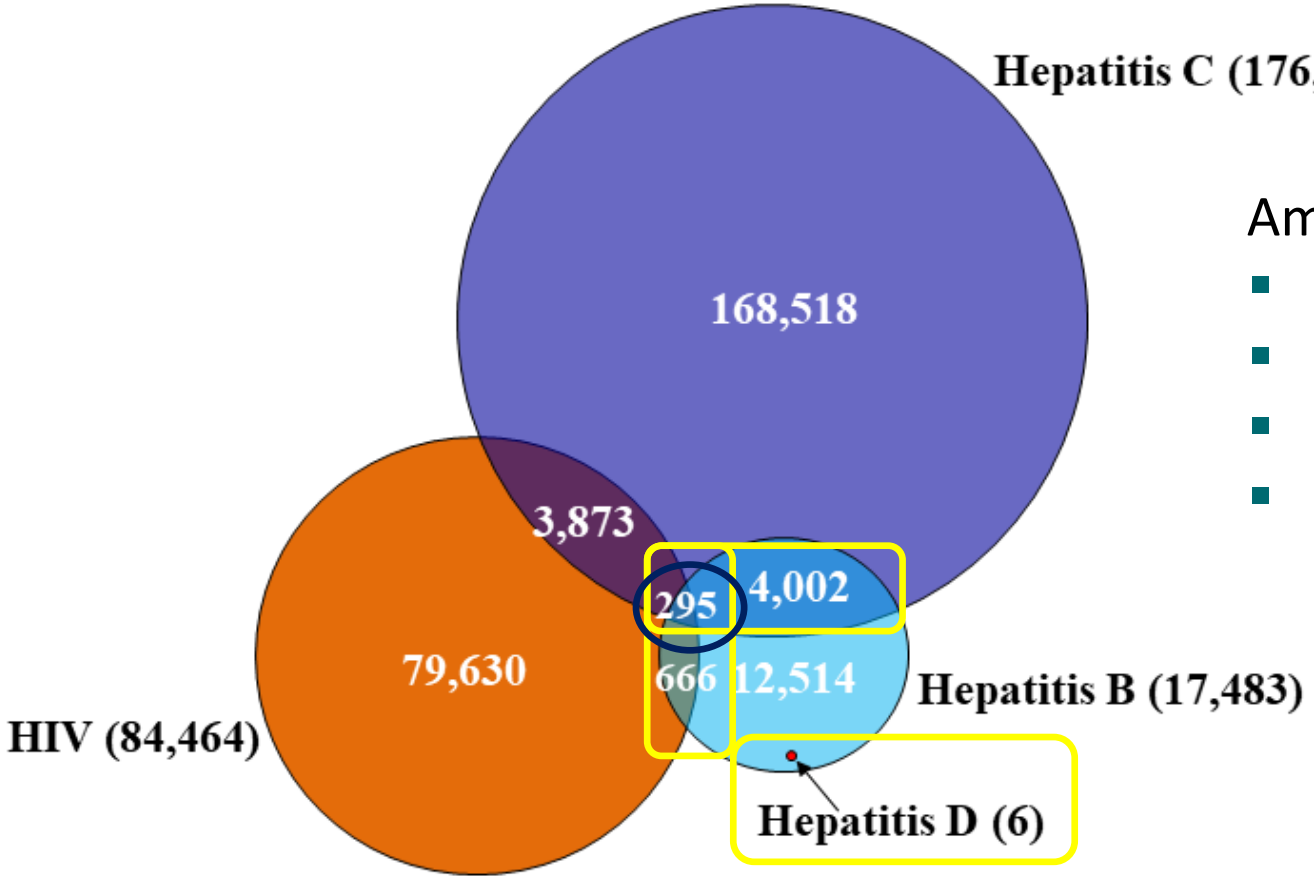
Statistical Analyses

- Hepatitis B-listed death **state-level** analyses
  - Hepatitis B-listed death **counts** and age-adjusted **rates**[1, 2]
  - **Median age** at hepatitis B-listed death
  - Distribution of **US birthplace status**
  - Distribution of **HCV, HIV, and HDV coinfection status**
- Hepatitis B-listed death **US-birthplace** analyses (US-born vs non-US-born)
  - Distribution of
    - Sociodemographic characteristics (sex, age, year of birth, and race/ethnicity)
    - UCOD categories[3] (for decedents who had hepatitis B listed as a CCOD)

1. https://www.cdc.gov/nchs/data/statnt/statnt20.pdf
2. https://seer.cancer.gov/stdpopulations/
3. Bixler D, Zhong Y, Ly KN, et al; CHeCS Investigators. Mortality among patients with chronic hepatitis B infection: the Chronic Hepatitis Cohort Study (CHeCS). *Clin Infect Dis*. 2019;68(6):956-963.

Results

Distribution of deaths listed with hepatitis B, hepatitis C, HIV, and hepatitis D–United States, 2010–2019, N=269,504

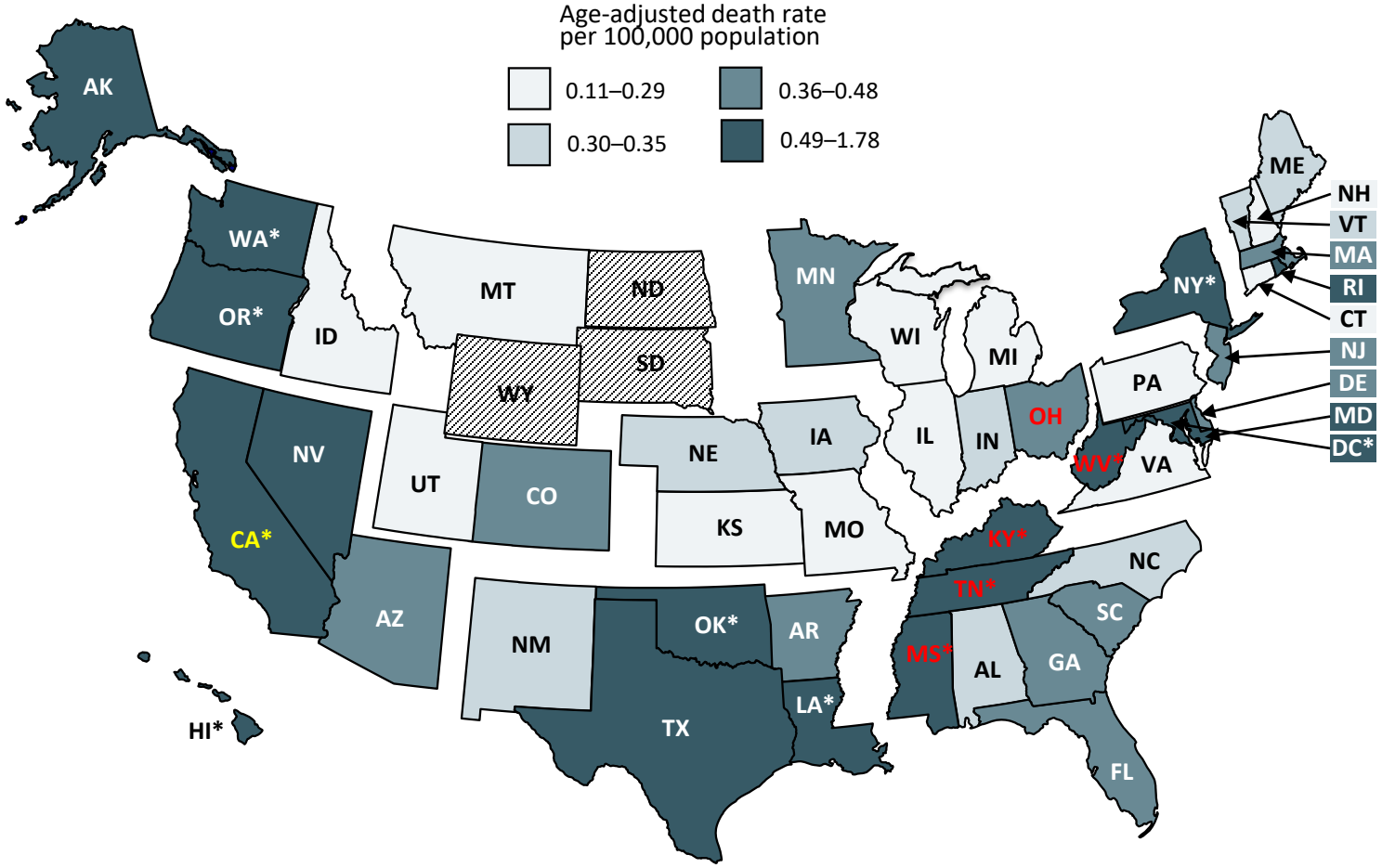


Among **17,483 (6.5%)** hepatitis B-listed deaths,

- **24.6%** (4,297) were with HCV infection
- **5.5%** (961) were with HIV infection
- **1.7%** (295) were with both HCV and HIV infection
- **0.03%** (6) deaths included HDV infection

*Condition was listed as the underlying or a contributing cause of death.

Age-adjusted hepatitis B-listed death rates in 50 states and DC, United States, 2010–2019



*Adjusted P<.05, statistically different death rate than the overall death rate

- Death rates in **12** states significantly surpassed the national death rate **(0.47)**
  - **Primarily coastal and Appalachian states**
  - **DC (high, 1.78), HI, OK, CA, TN, WV, MS, OR, WA, LA, KY, and NY (Adjusted P<.05)**
- Death rates were lowest in
  - **MT (0.14) followed by ID and IL (0.21 for both)**
- US median age (IQR) at hepatitis B-listed death: **60.0 (53.0-69.0) years.**
- Significantly younger median age at death in **KY, WV, TN, OH, and MS** (red)
  - **Range: 54.0-59.0 years**
- Significantly older median age at hepatitis B-listed death (yellow)
  - **CA (63.0 years)**

Distribution of sociodemographic characteristics by birthplace of hepatitis B-listed decedents–United States, 2010–2019

- Compared to non-US-born decedents, **US-born decedents** (63.3%) **were more frequently***

Category	US-born	Non-US-born
Aged 45–64 years	60%	46%
Born 1945–1965	66%	54%
Non-Hispanic, White	67%	11%
Non-Hispanic, Black	25%	9%
Had HCV, HIV, or HDV co-infection	39%	9%

*Chi-Square test of independence to assess differences in characteristics between US-born and non-US-born decedents. Statistically significant, *P*<.001 for all comparisons.

Distribution of US birthplace status among hepatitis B-listed deaths, United States, 2010–2019

% of Hepatitis B-listed Deaths by US birthplace	No.	Jurisdiction
Significantly* higher % **NUSB** vs national distribution	7	CA (64.7%), MN, HI, NY, MA, WA, NJ (47.1%)
Higher % of **NUSB** vs national distribution (not significant)	3	CT (44.0%), RI, IL (38.4%)
At national % (USB 63%, NUSB 37%)	3	UT, OR, NV
Significantly* higher % of **USB** than national distribution	22	MS (95.2%), KY, TN, LA, IN, AR, SC, OH, OK, MI, GA, MO, NC, DC, ME, KS, NM, IA, PA, AZ, TX, and FL (70.6%)
Higher % of **USB** than national distribution but not significantly	7	AK (73.9%), ID, MD, WI, CO, NE, VA(64.4%)

*P<.05 vs overall national distribution.
US birthplace data for Alabama, Delaware, Montana, New Hampshire, North Dakota, South Dakota, Vermont, West Virginia, and Wyoming were not displayed because at least 1 cell (either US-born or non-US–born) had fewer than 10 deaths.

Distribution of underlying causes of death by birthplace of hepatitis B-listed decedents, United States, 2010–2019

- There was **no difference** in the frequency with which "**hepatitis B**" was listed as the **UCOD** among US- and non-US-born hepatitis B-listed decedents (Both **~30%,** P=.24)

- For decedents with **hepatitis B** listed as a **CCOD**,
  - **Liver cancer** was more frequently listed as UCOD among **non-US decedents** compared with US-born decedents (53.7% vs 20.6%, P<.001)
  - Several conditions more frequently* listed as UCOD among **US-born** (Table)

Underlying cause of death when hepatitis B listed as contributing cause of death

	US Born	Non-US Born
Liver cancer	20.6%	**53.7%**
Hepatitis C	**3.5%**	0.7%
Other viral hepatitis	**0.8%**	0.1%
Liver, alcohol	**10.2%**	3.3%
Liver, non-alcohol	**5.5%**	3.8%
HIV	**8.2%**	1.8%
Circulatory	**12.6%**	7.1%
Respiratory	**4.6%**	1.6%
Injuries/trauma	**3.7%**	1.0%
Mental/behavioral	**2.1%**	0.8%
Other	**6.4%**	4.5%

*Chi-Square test of independence to assess differences in characteristics between US-born and non-US-born decedents. *P*<.001 for all comparisons.

Median age at hepatitis B-listed death by causes of death, US- vs. non-US place of birth, United States, 2010–2019

- Compared to non-US-born hepatitis B-listed decedents, **US-born decedents had a significantly* younger median age at death** for the following **UCOD** conditions:

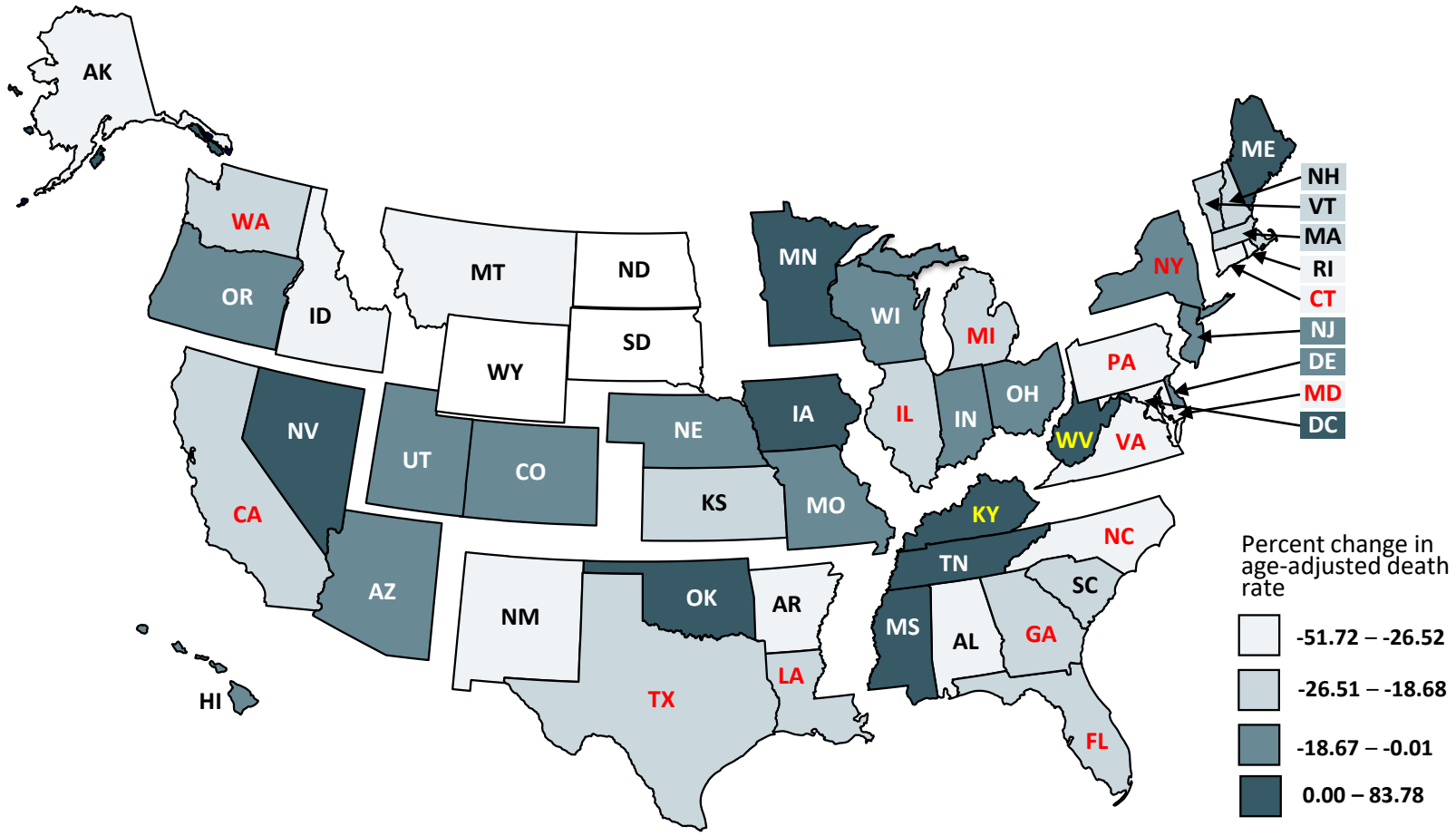
	US Born	Non-US Born
Hepatitis B	59 yrs	63 yrs
Hepatitis C	58 yrs	62 yrs
Liver, non-alcohol	59 yrs	65 yrs
Circulatory	62 yrs	68 yrs
Respiratory	63 yrs	73 yrs
Diabetes	61 yrs	65 yrs
Injuries/trauma	56 yrs	64 yrs

*Kruskal-Wallis test to assess differences in median age at death between US-born and non-US-born decedents, $P<.01$ for all comparisons.

Median age at death and underlying COD among decedents with and without hepatitis B, 2010–2019

- Overall and for most UCOD categories, both US-born and non-US born hepatitis B-listed decedents had a significantly younger median age at death when compared to decedents who did not have hepatitis B listed at death.
- Most frequently listed UCOD categories among both US-born and non-US-born hepatitis B decedents were
  - Hepatitis B (USB: 30.2%, NUSB: 29.4%)
  - Liver cancer (USB: 14.4%, NUSB: 37.9%)
  - Non-liver cancers (USB: 11.4%, NUSB: 11.7%)
- Most frequently UCOD categories among decedents who did NOT have hepatitis B listed
  - Circulatory conditions (30.9%) and non-liver cancers (21.7%)

Hepatitis B-listed Death Rate Changes from 2000-2009 to 2010-2019



- National hepatitis B-listed death rate **declined** by **19.0%**, from **0.58 deaths/100,000 population** during 2000–2009 to **0.47 deaths/100,000 population** during 2010–2019

- State-level death rates significantly decreased in
  - **CT (-45.8%), PA, NC, MD, VA, LA, TX, MI, IL, GA, WA, FL, CA, and NY (-18.7%)**

- State-level death rates significantly increased in
  - **WV (+83.8%) and KY (+69.4%)**

Discussion

Limitations

- Lack of population denominators to calculate age-adjusted deaths rates in US-born and non-US-born persons
- Variability in provider reporting of conditions leading to death
- Underestimation of the true hepatitis B mortality burden due to under-diagnosis of hepatitis B[1]
- American Indian and Alaska Native persons are often misclassified as other race groups on their death certificate, resulting in underreporting of conditions[2]

1. Bixler D, Zhong Y, Ly KN, et al; CHeCS Investigators. Mortality among patients with chronic hepatitis B infection: the Chronic Hepatitis Cohort Study (CHeCS). Clin Infect Dis. 2019;68(6):956-963.
2. Arias E, Heron M, Hakes J; National Center for Health Statistics; US Census Bureau. The validity of race and Hispanic-origin reporting on death certificates in the United States: an update. Vital Health Stat 2. 2016;2(172):1-21.

Conclusions & Public Health Relevance

Main Finding	Interpretation/Comment
• Hepatitis B-listed death rates were significantly higher in 12 coastal and Appalachian states.	• Baseline estimates of state and regional level hepatitis B deaths can be used to identify high mortality burden areas and inform state public health and elimination efforts.
• Significant increases in hepatitis B-listed death rate were observed exclusively in WV and KY.	• These states have also experienced high death rate from all causes and pronounced declines in life expectancy (e.g., opioid deaths). • Support universal hepatitis B vaccination and harm reduction efforts.
• US-born decedents constituted 63% of all hepatitis B-listed deaths.	• Contrary to published NHANES prevalence data indicating more non-US-born persons living with chronic hepatitis B, US-born decedents constituted most hepatitis B-listed deaths.
• Significantly younger median age at death occurred in KY, WV, TN, OH, and MS where most decedents were US-born. • Significantly older median age at death occurred among California decedents, who were predominantly non-US-born. • Hepatitis B-listed decedents had a significantly younger median age at death when compared to non-hepatitis B-listed decedents.	• In the context of chronic hepatitis B, despite US-born persons having presumably a shorter duration of infection, they had a significantly younger median age at death.

Conclusions & Clinical Relevance

Main Finding	Interpretation/Comment
• Liver-related conditions were the most frequently listed UCOD among both US-born and non-US-born hepatitis B-listed decedents. • Liver cancer was the predominant UCOD among non-US-born decedents. *(Nearly ½ had any cancer listed as UCOD.)* • Compared to non-US-born decedents, US-born decedents more frequently had non-hepatic conditions listed as UCOD.	• US-born persons with hepatitis B may more frequently require diagnosis and management of viral coinfections, respiratory and cardiovascular conditions, non-viral liver disease, and addiction-related sequelae. • These findings support universal adult hepatitis B screening and vaccination. • All persons with chronic hepatitis B need diagnosis and ongoing clinical management.

Work in Progress

Follow-up Questions

- Are there differences in social vulnerability indicators among hepatitis B decedents according to US- vs non-US birth, to state/county location?
- Is there a relationship between social vulnerability and mortality rates?
- Is there a relationship between social vulnerability and early hepatitis B-related mortality?
- Can identification of geolocation-specific social vulnerabilities among HBV decedents inform, focus, and improve public health interventions for persons living with CHB?

CDC ATSDR Social Vulnerability Index

- Social determinants of health (e.g., socioeconomic and health insurance status, minority status and language, access to housing and transportation) can affect access to health care and treatment, as well as patient-level outcomes for a variety of conditions.
- Social Vulnerability Index (SVI) was created by the CDC/ATSDR[1] as a standardized metric that incorporates census tract- and county-level social determinants to identify and compare communities deemed vulnerable.
- We plan to merge SVI data with US MCOD data by county of residence.

1. https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html

DCIPHER Data Integration Project

- Web-based data platform used by many CDC programs for data integration, management, and analyses of public health surveillance data
- DVH plans to use DCIPHER for viral hepatitis case-based surveillance and mortality data
  - Jurisdictional health departments can access the platform to view their data and produce reports
- Integration of NNDSS and mortality data with SVI and other place-based SDOH datasets so jurisdictions can view their surveillance and mortality data in context of SDOH data sources
- Starting pilot with six health departments this month
- Anticipate to onboard other jurisdictions beginning later this year

CDC WONDER Mortality

- CDC Online query tool
- Aggregated data at the US, region, state, and county
- Examples:
  - Hawai'i Hepatitis B Mortality Report (2000-2020)
  - CDC DVH Annual Viral Hepatitis Surveillance Reports

Table 3.8 – Part 2 of 3

Numbers and rates* of deaths with hepatitis C virus infection listed as a cause of death† among residents, by demographic characteristics
United States, 2016–2020

Characteristics	2016 No.	2016 Rate* (95% CI)	2017 No.	2017 Rate* (95% CI)	2018 No.	2018 Rate* (95% CI)	2019 No.	2019 Rate* (95% CI)	2020 No.	2020 Rate* (95% CI)
Race/ethnicity										
White, non-Hispanic	11,389	3.95 (3.88 - 4.03)	10,781	3.70 (3.63 - 3.78)	9,858	3.35 (3.28 - 3.42)	9,056	3.08 (3.01 - 3.14)	9,397	3.18 (3.12 - 3.25)
Black, non-Hispanic	3,360	7.42 (7.16 - 7.68)	3,262	7.03 (6.79 - 7.28)	2,978	6.31 (6.08 - 6.54)	2,646	5.44 (5.23 - 5.65)	2,743	5.63 (5.42 - 5.85)
Hispanic	2,510	5.76 (5.53 - 6.00)	2,399	5.29 (5.08 - 5.51)	2,190	4.64 (4.44 - 4.84)	1,865	3.84 (3.66 - 4.02)	1,979	4.00 (3.82 - 4.18)
Asian/Pacific Islander, non-Hispanic	384	2.03 (1.82 - 2.24)	368	1.86 (1.67 - 2.05)	300	1.43 (1.27 - 1.60)	308	1.43 (1.27 - 1.59)	324	1.44 (1.28 - 1.60)
American Indian/Alaska Native, non-Hispanic	285	9.80 (8.63 - 10.97)	299	10.24 (9.04 - 11.44)	264	9.05 (7.93 - 10.17)	259	8.63 (7.55 - 9.72)	308	10.17 (9.00 - 11.34)
HHS Region: Regional Office¶										
Region 1: Boston	616	3.10 (2.85 - 3.35)	602	2.97 (2.72 - 3.21)	519	2.56 (2.33 - 2.79)	448	2.15 (1.94 - 2.36)	467	2.34 (2.11 - 2.56)
Region 2: New York	1,167	3.12 (2.94 - 3.30)	1,043	2.76 (2.59 - 2.93)	924	2.48 (2.31 - 2.64)	780	2.06 (1.91 - 2.21)	819	2.11 (1.96 - 2.26)
Region 3: Philadelphia	1,478	3.68 (3.48 - 3.87)	1,441	3.53 (3.35 - 3.72)	1,253	3.04 (2.87 - 3.22)	1,185	2.85 (2.68 - 3.02)	1,242	2.98 (2.81 - 3.15)

* Rates for race/ethnicity, sex, HHS region, and the overall total are age-adjusted per 100,000 US standard population during 2000 by using the following age group distribution (in years): <1, 1–4, 5–14, 15–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75–84, and ≥85. Missing data are not included. For age-adjusted death rates, the age-specific death rate is rounded to 1 decimal place before proceeding to the next step in the calculation of age-adjusted death rates for NCHS Multiple Cause of Death on CDC WONDER. This rounding step might affect the precision of rates calculated for small numbers of deaths.

† Cause of death is defined as one of the multiple causes of death and is based on the International Classification of Diseases, 10th Rev. (ICD-10) codes B17.1, and B18.2 (hepatitis C).

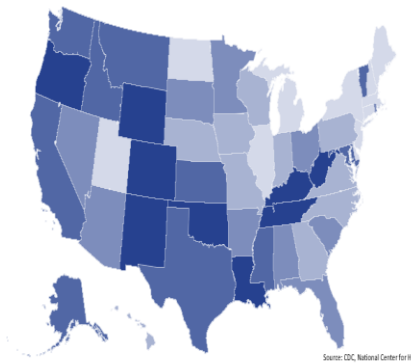
¶ US Department of Health and Human Services (HHS) regions were categorized according to the grouping of states and US territories assigned under each of the 10 HHS regional offices (https://www.hhs.gov/about/agencies/iea/regional-offices/index.html). For the purposes of this report, regions with US territories (Region 2 and Region 9) contain data from states only.

Source: CDC, National Center for Health Statistics, Multiple Cause of Death 1999–2019 on CDC WONDER Online Database. Data are from the 2016–2020 Multiple Cause of Death files and are based on information from all death certificates filed in the vital records offices of the 50 states and the District of Columbia through the Vital Statistics Cooperative Program. Deaths of nonresidents (e.g., nonresident aliens, nationals living abroad, residents of Puerto Rico, Guam, the Virgin Islands, and other US territories) and fetal deaths are excluded. Numbers are slightly lower than previously reported for 2016 because of NCHS standards that restrict displayed data to US residents. Accessed at http://wonder.cdc.gov/mcd-icd10.html on January 13, 2022. CDC WONDER data set documentation and technical methods can be accessed at https://wonder.cdc.gov/wonder/help/mcd.html.

Centers for Disease Control and Prevention. Viral Hepatitis Surveillance Report – United States, 2020. https://www.cdc.gov/hepatitis/statistics/2020surveillance/index.htm. Published September 2022.

Figure 3.9

Rates* of death with hepatitis C virus infection listed as a cause of death† among residents, by state or jurisdiction
United States, 2020



Cases/100,000 Population
- 0.00–2.34
- 2.35–2.65
- 2.66–3.50
- 3.51–5.54
- 5.55–10.28

Color Key	Death/100,000 Population	State or Jurisdiction
	0.00–2.34	IL, DE, CT, NH, NJ, ME, NY, MA, MI, UT, ND
	2.35–2.65	IA, GA, PA, MO, WI, NE, IN, VA, HI, NC
	2.66–3.50	AL, NV, SD, MN, OH, FL, SC, AZ, AR, RI
	3.51–5.54	KS, MD, ID, MS, TX, WA, CA, VT, AK, MT
	5.55–10.28	LA, WV, TN, CO, KY, WY, NM, OR, DC, OK

* Rates are age-adjusted per 100,000 US standard population in 2000 using the following age group distribution (in years): <1, 1–4, 5–14, 15–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75–84, and ≥85. For age-adjusted death rates, the age-specific death rate is rounded to one decimal place before proceeding to the next step in the calculation of age-adjusted death rates for NCHS Multiple Cause of Death on CDC WONDER. This rounding step may affect the precision of rates calculated for small numbers of deaths. Missing data are not included.

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Centers for Disease Control and Prevention. Viral Hepatitis Surveillance Report – United States, 2020. https://www.cdc.gov/hepatitis/statistics/2020surveillance/index.htm. Published September 2022.

MORTALITY IN HAWAI'I

Hepatitis B and Liver Cancer in the Past 20 Years

In February 2023, the Hawai'i Department of Health released Hawai'i Hepatitis B Mortality and Liver Cancer, the first such report ever developed in the state. Below are the main report findings that demonstrate the importance of hepatitis elimination, in alignment with Hep Free 2030.

Higher rates of liver cancer mortality were also found when comparing Hawai'i to the United States.

In Hawai'i, higher rates were found among male and/or API residents as well.

Higher Rates of Hepatitis B Deaths in Hawai'i (2000-2020)

3 Times Higher

In 2019, Hep B mortality rate for Hawai'i was **1.17 deaths per 100,000**, compared to 0.42 per 100,000 for the United States.

Male Residents

Hep B mortality rates for male residents in Hawai'i were **up to 1.7 times state average** from 2000 to 2020.

API Residents

Hep B mortality rates for Asian and Pacific Islander (API) residents were **up to 1.4 times state average** from 2000 to 2020.

Thank you!

Acknowledgement:
Shaoman Yin, PhD, MSPH

For more information, contact CDC
1-800-CDC-INFO (232-4636)
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