Changing Trends in Viral Hepatitis-Associated Hospitalizations in the American Indian/Alaska Native Population, 1995–2007

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ABSTRACT

Objective. We described the changing epidemiology of viral hepatitis among the American Indian/Alaska Native (AI/AN) population that uses Indian Health Service (IHS) health care.

Methods. We used hospital discharge data from the IHS National Patient Information Reporting System to determine rates of hepatitis A-, B-, and C-associated hospitalization among AI/ANs using IHS health care from 1995–2007 and summary periods 1995–1997 and 2005–2007.

Results. Hepatitis A-associated hospitalization rates among AI/AN people decreased from 4.9 per 100,000 population during 1995–1997 to 0.8 per 100,000 population during 2005–2007 (risk ratio [RR] = 0.2, 95% confidence interval [CI] 0.1, 0.2). While there was no significant change in the overall hepatitis B-associated hospitalization rate between time periods, the average annual rate in people aged 45–64 years increased by 109% (RR=2.1, 95% CI 1.4, 3.2). Between the two time periods, the hepatitis C-associated hospitalization rate rose from 13.0 to 55.0 per 100,000 population (RR=4.2, 95% CI 3.8, 4.7), an increase of 323%. The hepatitis C-associated hospitalization rate was highest among people aged 45–64 years, males, and those in the Alaska region.

Conclusions. Hepatitis A has decreased to near-eradication levels among the AI/AN population using IHS health care. Hepatitis C-associated hospitalizations increased significantly; however, there was no significant change in hepatitis B-associated hospitalizations. Emphasis should be placed on continued universal childhood and adolescent hepatitis B vaccination and improved vaccination of high-risk adults. Prevention and education efforts should focus on decreasing hepatitis C risk behaviors and identifying people with hepatitis C infection so they may be referred for treatment.

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Since 1995, there have been dramatic changes in the prevalence and relative frequencies of infection and hospitalization due to viral hepatitis in the U.S., especially among the American Indian/Alaska Native (AI/AN) population.[1] Historically, hepatitis A was one of the most frequently reported notifiable infectious diseases nationally.[2] The proportion of people ever infected with hepatitis B in the U.S. is estimated to be 5%, with approximately 550,000–940,000 people chronically infected.[3] Hepatitis C is the most common bloodborne infection in the U.S., with an estimated 1.6% of the population ever infected and 80% of those individuals chronically infected.[4]

AI/AN people have long suffered from a disproportionate burden of infectious and chronic diseases, including chronic liver disease and viral hepatitis.[5–9] For example, the incidence of hepatitis A among AI/ANs has historically been 10 times higher than the national average.[10] In 2003, the proportion of deaths attributable to chronic liver disease among AI/ANs was approximately four times greater than that of the total U.S. population and was the fifth-leading cause of death among this group.[6,7] Hepatitis C is one of the most common causes of chronic liver disease among this population.[7]

The Indian Health Service (IHS), a Department of Health and Human Services agency, is responsible for providing health care to eligible AI/AN people. Approximately 1.6 million AI/AN people (approximately 60% of the total AI/AN population) are eligible for IHS-funded medical care.[11,12] The IHS population consists primarily of AI/ANs who reside in rural, and often remote, areas; much of the remaining AI/AN population resides in urban settings where IHS facilities are often unavailable. We describe the changes in viral hepatitis-associated hospitalizations since 1995, documenting the success of hepatitis A immunization and the concomitant rise in hepatitis C. This is the first national study to describe the changing epidemiology of viral hepatitis in the overall AI/AN population that uses IHS health care.

METHODS

We analyzed hospital discharge data from the IHS National Patient Information Reporting System (NPIRS) for calendar years 1995–2007,[13] with comparison of the summary periods 1995–1997 (period 1) and 2005–2007 (period 2). NPIRS includes all inpatient discharge records from IHS and tribally operated hospitals and from hospitals that have contracted with IHS or with tribes to provide health-care services to patients eligible for IHS health care.[14]

Hepatitis A-, B-, and C-associated hospitalizations were identified using the following International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes:[15] 070.0 (viral hepatitis A with coma), 070.1 (viral hepatitis A without mention of coma), 070.2 (viral hepatitis B with coma), 070.3 (viral hepatitis B without mention of coma), 070.41 (acute hepatitis C with coma), 070.44 (chronic hepatitis C with coma), 070.51 (acute hepatitis C without mention of coma), 070.54 (chronic hepatitis C without mention of coma), 070.70 (unspecified hepatitis C without mention of coma), and 070.7 (unspecified viral hepatitis C). Hepatitis C-associated hospitalizations were also divided into total acute (070.41, 070.51) and chronic (070.44, 070.54) hospitalizations. Those ICD-9-CM codes listed as one of the top 15 discharge diagnoses were included in the analysis. The unit of analysis for this study was a hospitalization; an individual who was hospitalized more than once would therefore have each hospitalization counted separately.

We expressed annual and average annual hospitalization rates as the number of hospitalizations per 100,000 AI/AN people. We estimated the annual IHS population denominators using the IHS annual user population adjusted by the change in the service population from the fiscal year 2001 user population, excluding the IHS California and Portland (i.e., Washington, Oregon, and Idaho) areas.[8,11,16] We defined the user population as all AI/AN people who received IHS-funded health-care service at least once in the previous three years, which represents approximately 81% of the 1.6 million eligible AI/AN people.[14]

We examined hospitalizations for hepatitis A, B, and C by age group (0–4, 5–19, 20–44, 45–64, and ≥65 years of age), gender, IHS region, and time period. We defined IHS regions as follows: East region (Maine, New York, Massachusetts, Connecticut, Rhode Island, Pennsylvania, North Carolina, South Carolina, Florida, Alabama, Mississippi, and Louisiana); Northern Plains (Montana, Wyoming, North Dakota, South Dakota, Nebraska, Iowa, Minnesota, Wisconsin, Michigan, and Indiana); Alaska (Alaska); Southern Plains (Oklahoma and Kansas); and Southwest (Arizona, New Mexico, Colorado, Utah, and Nevada). We excluded the IHS California (California) and Portland (Washington, Oregon, and Idaho) regions from the analysis because neither region had any IHS- or tribally operated hospitals.[11] In addition, the California region did not report contract health services inpatient data by diagnosis, and the Portland region had limited contract health service for inpatient care.[14,16,17] Approximately 12% of all AI/AN people receiving care in IHS facilities receive care in these two regions. We made comparisons of

hospitalization rates by period and characteristic using Poisson regression analysis to create risk ratios (RRs) with 95% confidence intervals (CIs).[18]

RESULTS

From summary periods 1995–1997 to 2005–2007, hepatitis A-associated hospitalization rates decreased 83% (RR=0.2, 95% CI 0.1, 0.2). There was no significant change in hepatitis B-associated hospitalization rates. Hepatitis C-associated hospitalization rates increased 323% (RR=4.2, 95% CI 3.8, 4.7) (Figure 1).

Hepatitis A

From summary periods 1995–1997 to 2005–2007, the average annual hepatitis A-associated hospitalization rate decreased from 4.9 to 0.8 per 100,000 population. There were <10 hospitalizations during both time periods for children aged 0–4 years and <10 hospitalizations in 2005–2007 for children aged 5–19 years. A significant rate decrease was seen among those aged 5–19 and 20–44 years and in both genders. The Alaska region had <10 hospitalizations during both time periods. In period 2, there were no reported hospitalizations in the East region and <10 hospitalizations in the Northern and Southern Plains regions (Table 1).

Hepatitis B

There was no significant change between summary periods in the overall hepatitis B-associated hospitalization rate. However, the average annual rate increased by 109% among those aged 45–64 years (RR=2.1, 95% CI 1.4, 3.2) (Table 2). There were no hospitalizations among children 0–4 years of age and <10 hospitalizations among children 5–19 years of age during both time periods. Rates for adults aged 20–44 years and ≥65 years did not demonstrate statistically significant changes between time periods. Hospitalization rates did not change significantly in either gender or any region between time periods.

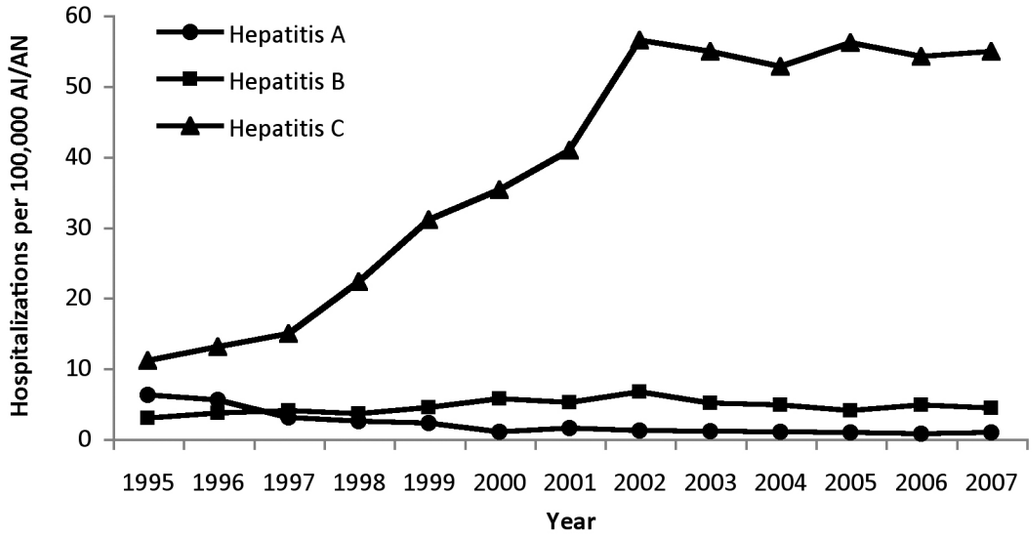
During 2005–2007, the highest risk of hepatitis B-associated hospitalization was among people aged 45–64 years (RR=2.6, 95% CI 1.9, 3.6, with patients aged 20–44 years as the reference group); males (RR=1.6, 95% CI 1.9, 3.6); and people from the Alaska region (RR=5.6, 95% CI 3.2, 9.6, with the Northern Plains region as the reference group) (data not shown).

Hepatitis C

From summary periods 1995–1997 to 2005–2007, the hepatitis C-associated hospitalization rate increased in all age groups with the exception of children aged 0–4 years, for which there were no hospitalizations during either summary period (Table 3, Figure 2 [Panel A]). There was a 456% (RR=5.6, 95% CI 4.6, 6.6) increase in adults aged 45–64 years. Smaller but substantial increases were seen in adults aged 20–44 years (217%, RR=3.0, 95% CI 2.6, 3.4) and ≥65 years (298%, RR=4.0, 95% CI 2.5, 6.4).

Both genders and all regions had an increase in

Figure 1. Annual hospitalization rates (per 100,000 population) associated with diagnoses of hepatitis A, B, and C among AI/ANs: Indian Health Service, 1995–2007



AI/AN = American Indian/Alaska Native

Table 1. Hepatitis A-associated hospitalizations for American Indians/Alaska Natives: Indian Health Service, 1995–1997 vs. 2005–2007

	1995–1997		*2005–2007*		*1995–1997 vs. 2005–2007*
Characteristic	N	*Rate[a] (95% CI)*	N	*Rate[a] (95% CI)*	*Risk ratio (95% CI)*
Gender					
Male	72	4.8 (3.8, 6.1)	22	1.2 (0.8, 1.9)	0.3 (0.2, 0.4)
Female	80	4.9 (3.9, 6.2)	9	0.5 (0.2, 0.9)	0.1 (0.0, 0.2)
Age group (in years)					
0–4	2	0.6 (0.1, 3.0)	2	0.5 (0.1, 2.2)	0.9 (0.1, 6.2)
5–19	35	3.5 (2.5, 4.9)	1	0.1 (0.0, 0.6)	0.0 (0.0, 0.2)
20–44	98	8.6 (7.0, 10.5)	13	0.9 (0.5, 1.7)	0.1 (0.1, 0.2)
45–64	13	2.8 (1.6, 4.9)	15	2.3 (1.3, 3.9)	0.8 (0.4, 1.7)
≥65	4	2.2 (0.7, 5.9)	NA	NA	NA
Region					
East	2	2.0 (0.4, 8.4)	NA	NA	NA
Northern Plains	36	5.2 (3.7, 7.3)	7	0.8 (0.4, 1.8)	0.2 (0.1, 0.4)
Southern Plains	65	8.4 (6.6, 11.0)	5	0.5 (0.2, 1.3)	0.1 (0.0, 0.2)
Southwest	41	3.3 (2.4, 4.5)	15	1.0 (0.6, 1.7)	0.3 (0.2, 0.6)
Alaska	8	2.6 (1.2, 5.3)	4	1.0 (0.3, 2.8)	0.4 (0.1, 1.3)
Total	152	4.9 (4.2, 5.7)	31	0.8 (0.6, 1.2)	0.2 (0.1, 0.2)

[a]Per 100,000 population

NA = not applicable

the overall hepatitis C-associated hospitalization rate between time periods. There was a 350% and 295% increase in hospitalization rates in males and females, respectively. The Northern Plains region experienced the greatest rate increase at 821% (RR=9.2, 95% CI 6.9, 12.2). All other regions experienced significant increases: the East region rose 461% (RR=5.6, 95% CI 2.9, 10.9); the Southern Plains region increased 349% (RR=4.5, 95% CI 3.5, 5.7); the Alaska region rose 214% (RR=3.1, 95% CI 2.5, 3.9); and the Southwest region

Table 2. Hepatitis B-associated hospitalizations in American Indians/Alaska Natives: Indian Health Service, 1995–1997 vs. 2005–2007

	1995–1997		*2005–2007*		*1995–1997 vs. 2005–2007*
Characteristic	N	*Rate[a] (95% CI)*	N	*Rate[a] (95% CI)*	*Risk ratio (95% CI)*
Gender					
Male	69	4.6 (3.6, 5.9)	97	5.4 (4.4, 6.6)	1.2 (0.9, 1.6)
Female	41	2.5 (1.8, 3.5)	67	3.4 (2.7, 4.4)	1.4 (0.9, 2.0)
Age group (in years)					
0–4	NA	NA	NA	NA	NA
5–19	6	0.6 (0.2, 1.4)	1	0.1 (0.0, 0.6)	0.2 (0.0, 1.3)
20–44	69	6.1 (4.8, 7.7)	65	4.7 (3.7, 6.1)	0.8 (0.6, 1.1)
45–64	27	5.8 (3.9, 8.6)	80	12.2 (9.7, 15.2)	2.1 (1.4, 3.2)
≥65	8	4.3 (2.0, 8.9)	18	7.3 (4.5, 11.8)	1.7 (0.7, 3.9)
Region					
East	5	5.2 (1.9, 12.9)	3	2.5 (0.6, 7.9)	0.5 (0.1, 2.0)
Northern Plains	12	1.7 (0.9, 3.1)	18	2.1 (1.3, 3.4)	1.2 (0.6, 2.5)
Southern Plains	29	3.8 (2.6, 5.5)	51	5.5 (4.2, 7.3)	1.5 (0.9, 2.3)
Southwest	39	3.1 (2.3, 4.3)	46	3.1 (2.3, 4.2)	1.0 (0.7, 1.5)
Alaska	25	8.0 (5.3, 12.0)	46	11.7 (8.7, 15.8)	1.5 (0.9, 2.4)
Total	110	3.5 (2.9, 4.3)	164	4.4 (3.7, 5.1)	1.2 (1.0, 1.6)

[a]Per 100,000 population

NA = not applicable

Table 3. Hepatitis C-associated hospitalizations in American Indians/Alaska Natives: Indian Health Service, 1995–1997 vs. 2005–2007

	1995–1997		*2005–2007*		*1995–1997 vs. 2005–2007*
Characteristic	N	*Rate[a] (95% CI)*	N	*Rate[a] (95% CI)*	*Risk ratio (95% CI)*
Gender					
Male	203	13.7 (11.9, 15.7)	1,106	61.6 (58.0, 65.3)	4.5 (3.9, 5.2)
Female	202	12.4 (10.8, 14.3)	962	49.0 (46.0, 52.3)	3.9 (3.4, 4.6)
Age group (in years)					
0–4	NA	NA	NA	NA	NA
5–19	4	0.4 (0.1, 1.1)	14	1.3 (0.7, 2.2)	3.2 (1.0, 9.6)
20–44	245	21.5 (19.0, 24.5)	882	64.2 (60.6, 68.6)	3.0 (2.6, 3.4)
45–64	135	29.1 (24.5, 34.5)	1,061	161.6 (152.1, 171.7)	5.6 (4.6, 6.6)
≥65	21	11.3 (7.2, 17.6)	111	45.0 (37.2, 54.5)	4.0 (2.5, 6.4)
Region					
East	10	10.4 (5.3, 19.9)	71	58.5 (46.0, 74.2)	5.6 (2.9, 10.9)
Northern Plains	52	7.6 (5.7, 10.0)	595	69.7 (64.3, 75.6)	9.2 (6.9, 12.2)
Southern Plains	79	10.2 (8.2, 12.8)	424	45.9 (41.7, 50.6)	4.5 (3.5, 5.7)
Southwest	168	13.5 (11.5, 15.7)	599	40.8 (37.6, 44.2)	3.0 (2.6, 3.6)
Alaska	96	30.8 (25.1, 37.8)	379	96.6 (87.2, 106.9)	3.1 (2.5, 3.9)
Total	405	13.0 (11.8, 14.4)	2,065	55.0 (52.7, 57.5)	4.2 (3.8, 4.7)

[a]Per 100,000 population

NA = not applicable

increased 203% (RR=3.0, 95% CI 2.6, 3.6) (Figure 2 [Panels B and C], Table 3).

Both acute and chronic hepatitis C-associated hospitalizations increased between time periods. There was an increase in acute and chronic hospitalizations of 336% (RR=4.4, 95% CI 3.8, 5.0) and 299% (RR=4.0, 95% CI 3.3, 4.8), respectively (Figure 2 [Panel D]). The acute hospitalization rate increased in people aged ≥20 years, with the greatest increase (411%) seen in those aged 45–64 years (RR=5.1, 95% CI 4.1, 6.3). Smaller increases were seen in people aged ≥65 years (300%, RR=4.0, 95% CI 2.2, 7.2) and 20–44 years (240%, RR=3.4, 95% CI 2.9, 4.1) (data not shown).

Acute hepatitis C-associated hospitalizations increased among both genders—340% and 331% in males and females, respectively. The rate increase of acute hospitalizations was greatest in the Northern Plains region (609%, RR=7.1, 95% CI 5.2, 9.8) followed by the East region (545%, RR=6.5, 95% CI 2.8, 15.1); the Southern Plains region (378%, RR=4.8, 95% CI 3.6, 6.3); the Alaska region (281%, RR=3.8, 95% CI 2.8, 5.2); and the Southwest region (219%, RR=3.2, 95% CI 2.6, 3.9) (data not shown).

Similar trends were seen for chronic hepatitis C-associated hospitalizations. The chronic rate increased in adults ≥20 years of age, with the greatest increase seen in those aged 45–64 years at 566% (RR=6.7, 95% CI 4.8, 9.2). Smaller increases were seen in people aged ≥65 years (305%, RR=4.1, 95% CI 1.9, 8.6) and 20–44 years (123%, RR=2.2, 95% CI 1.7, 2.8) (data not shown).

Chronic hepatitis C-associated hospitalizations increased in both genders—379% in males and 236% in females. The Northern Plains region experienced the greatest rate increase in chronic hospitalizations at 1,711% (RR=18.1, 95% CI 9.6, 34.1) followed by the East region (335%, RR=4.3, 95% CI 1.5, 12.6); the Southern Plains region (270%, RR=3.7, 95% CI 2.2, 6.1); the Southwest region (169%, RR=2.7, 95% CI 2.0, 3.7); and the Alaska region (153%, RR=2.5, 95% CI 1.8, 3.5). While the overall trend between the two time periods increased, rates began to decrease starting in 2003 (data not shown).

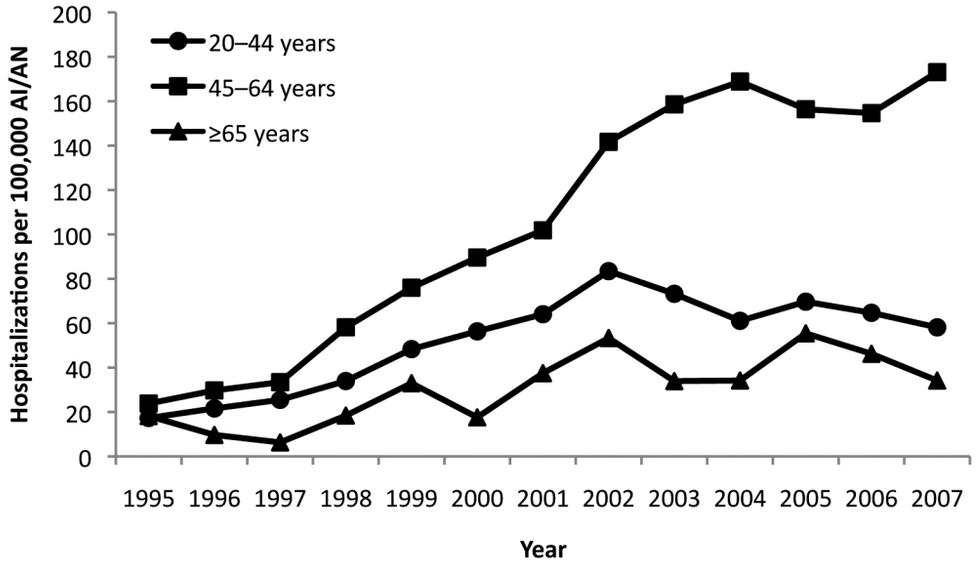
During 2005–2007, the highest risk of overall hepatitis C-associated hospitalizations was among people aged 45–64 years (RR=2.5, 95% CI 2.3 2.8, with patients aged 20–44 years as the reference group); males (RR=1.3, 95% CI 1.2, 1.4); and people from the Alaska region (RR=2.4, 95% CI 2.1, 2.7, with the Southwest region as the reference group) (data not shown).

DISCUSSION

Hepatitis A

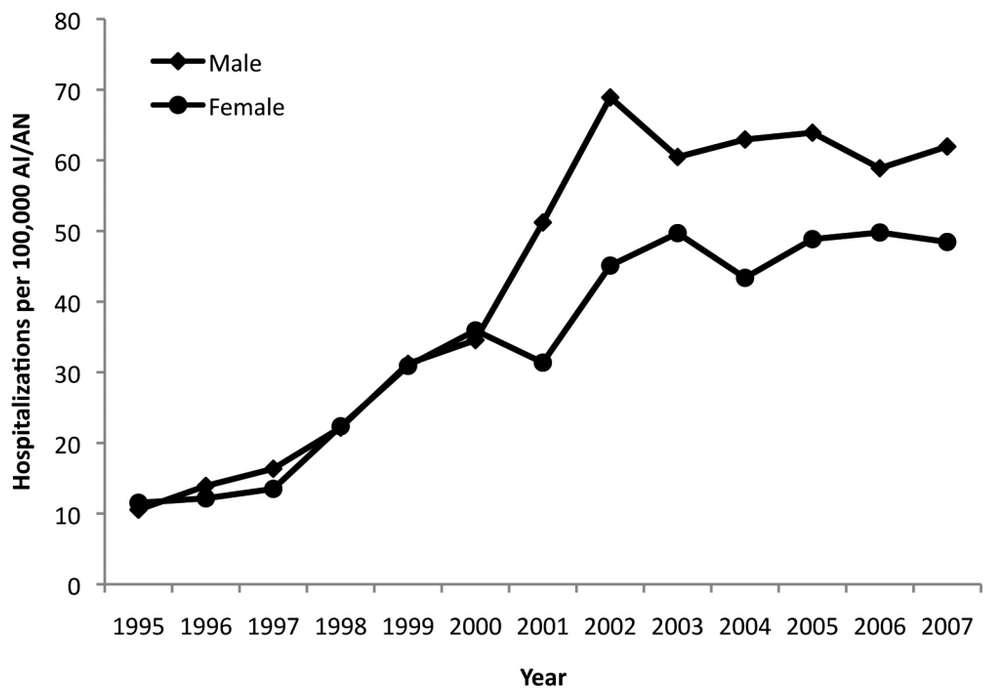
Hepatitis A-associated hospitalizations decreased in both genders, all age groups, and all regions during the study period, although not all decreases were statistically significant. Historically, hepatitis A has

Figure 2 (Panel A). Hepatitis C-associated annual hospitalization rates by age group[a] among AI/ANs: Indian Health Service, 1995–2007



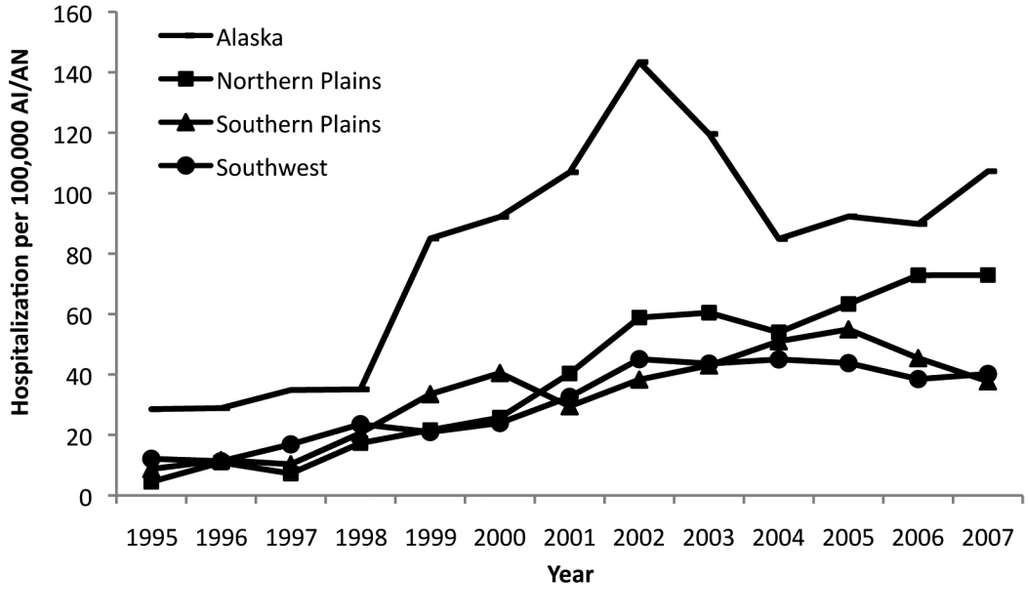
[a]The 0–4- and 5–19-year age groups and the East region were excluded due to the small number of hospitalizations.
AI/AN = American Indian/Alaska Native

Figure 2 (Panel B). Hepatitis C-associated annual hospitalization rates by gender among AI/ANs: Indian Health Service, 1995–2007



AI/AN = American Indian/Alaska Native

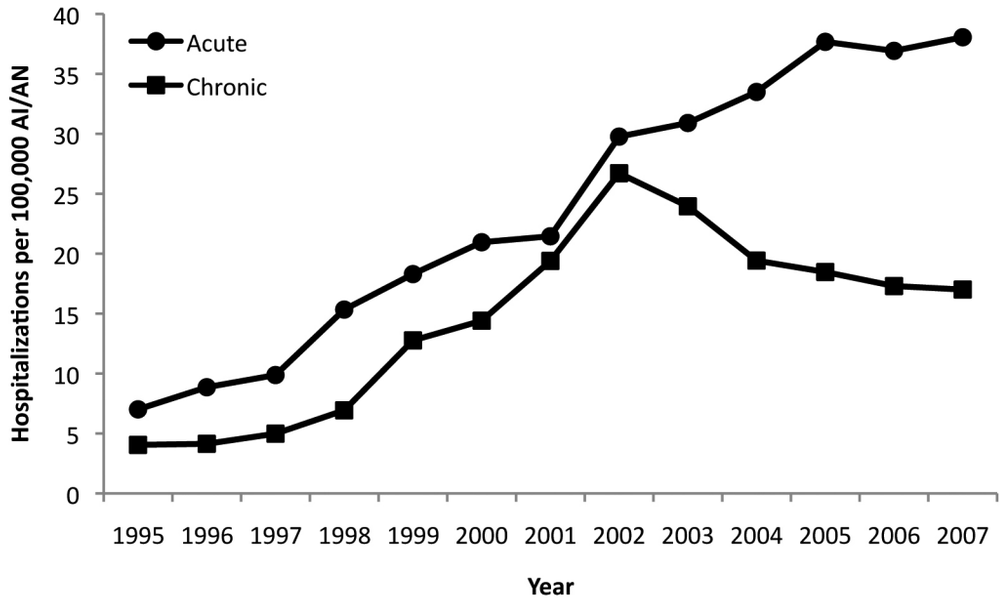
Figure 2 (Panel C). Hepatitis C-associated annual hospitalization rates by region[a] among AI/ANs: Indian Health Service, 1995–2007



[a]The East region was excluded due to the small number of hospitalizations.

AI/AN = American Indian/Alaska Native

Figure 2 (Panel D). Acute and chronic hepatitis C-associated annual hospitalization rates among AI/ANs: Indian Health Service, 1995–2007



AI/AN = American Indian/Alaska Native

been a significant burden among the AI/AN population, with large outbreaks occurring every five to 10 years.[9,19] Seroprevalence studies performed in the 1980s showed antibody to hepatitis A virus (anti-HAV) in 7% of children and in 85% of adults in certain AI/AN populations.[19] Since the institution of hepatitis A vaccination programs, the incidence of hepatitis A among the AI/AN population has decreased from >60 per 100,000 population before 1996 to 0.5 per 100,000 population in 2007.[3]

The extensive decrease in hepatitis A-associated hospitalizations may be largely attributed to hepatitis A immunization. By 1995–1996, the IHS had implemented hepatitis A immunization programs for children in certain Northern Plains reservations; by 1998, the programs had expanded to include most IHS health-care facilities.[20] The decline in adult hospitalizations, which can be seen in our study, may be explained by high hepatitis A vaccination coverage among AI/AN children, as childhood immunity to hepatitis A virus (HAV) decreases the incidence of adult infections.[21] By 2007, 86% of AI/AN children aged 24–35 months had been vaccinated for hepatitis A.[22]

The results of this study are consistent with a previous study of hepatitis A vaccination in a subset of AI/AN people[20] and a study using national data.[23] Bialek et al. described the incidence of hepatitis A among southwestern AI/AN people prior to and after the implementation of hepatitis A immunization programs.[20] They recorded a 20-fold decrease in incidence in the post-immunization period. Wasley et al. found an overall decrease of 76% when comparing national incidence between 1990–1997 (pre-vaccination baseline period) and 2003.[23] Although neither study distinguished between inpatient and outpatient cases, they both demonstrated a trend similar to that seen in our study.

Hepatitis B

While the overall hepatitis B-associated hospitalization rate did not change during the study period, the hospitalization rate in people aged 45–64 years demonstrated a twofold increase.

The Advisory Committee on Immunization Practices (ACIP) recommended universal infant hepatitis B immunization in 1991 and expanded its recommendation to include all children younger than 18 years of age in 1999.[24] Vaccination has contributed to an 82% national decline in hepatitis B incidence between 1990 and 2007, most dramatically among those younger than 24 years of age in whom incidence fell by 93%–98%.[3]

In 2007, adults aged 25–44 years had the highest hepatitis B incidence in the U.S.[3] Although there is an overall downward national trend for incident hepatitis B, there has been a 5% increase in acute cases in males aged 20–39 years and a 20%–31% increase in adults ≥40 years of age between 1990 and 2002.[25] In our study, the increasing hepatitis B hospitalization rate among AI/AN people aged 45–64 years followed a similar trend.

It is difficult to infer whether hepatitis B hospitalizations in our study represented acute or chronic disease due to the increase in acute adult cases nationally and because only 37% of acute cases require hospitalization.[26] Given the high rate of hepatitis B vaccination among AI/AN children[27] and the age distribution of hepatitis B hospitalizations seen in this study, it is possible that many of these hospitalizations represent chronic disease, which may explain the lack of decreased hospitalization rates for this vaccine-preventable disease.

Historically, hepatitis B virus (HBV) was endemic in rural Alaska, although this was not the case for the other IHS regions. In the Yukon Kuskokwim Delta region of Alaska, where about 30% of the Alaska Native population resides, data collected by the Alaska Native Medical Center (ANMC) showed that there had not been an acute hepatitis B case in more than 10 years (1996–2006) among Alaska Natives (Personal communication, Brian McMahon, Program Director, Liver Disease and Hepatitis Program, ANMC, June 2008). It is therefore likely that the hepatitis B-associated hospitalizations in the Alaska region represent chronic disease.

ACIP recommends hepatitis B vaccination for adults at risk, including those with multiple sexual partners, men who have sex with men, and injection drug users.[28] While approximately 97% of AI/AN children aged 19–35 months completed the hepatitis B vaccination series during 2004–2006,[27] there is no method of systematic documentation of adult immunizations in this population. However, data from the 2004 National Health Interview Survey revealed that 45% of high-risk adults aged 18–49 years had received ≥1 dose of hepatitis B vaccination. Due to the success of childhood and adolescent immunization programs and the resultant decline in national hepatitis B incidence among young people, adults comprise the majority of new cases.[29] Declines in incident cases will likely continue with the ongoing success of childhood immunization programs. To decrease the burden of HBV infection among adults, efforts should continue to target vaccination of high-risk adults.

Hepatitis C

We found a dramatic increase in both acute and chronic hepatitis C-associated hospitalization rates.

Nationally, most chronically infected people were born between 1945 and 1964.[4] This age distribution is similar to that found in our study; AI/AN patients 45–64 years of age had both the highest rate of chronic hepatitis C-associated hospitalizations and the greatest rate increase. Adults aged 45–64 years also had the highest rate of acute hospitalizations. Given that most acute hepatitis C virus (HCV) infections are asymptomatic or mild,[30] it is possible that some acute diagnoses seen in this study were in actuality flares of chronic hepatitis. This finding could explain the high rate of acute hospitalizations for those aged 45–64 years, who are known to have high rates of chronic HCV infection.[4]

The Alaska region had the highest rate of hepatitis C-associated hospitalizations among the IHS regions. The ANMC and the Arctic Investigations Program of the Centers for Disease Control and Prevention (CDC) have offered free HCV testing to all AI/AN people since 1989. The program has identified more than 1,200 anti-HCV-positive people.[31] This outpatient screening-based program has likely increased awareness of this disease, which may translate to better inpatient coding for hepatitis diagnoses and, consequently, to higher rates for this region. In addition, the increased rates in the Alaska and Northern Plains regions may be due to a higher prevalence of risk behavior. However, prevalence of injection drug use (the main risk factor for HCV infection) among the AI/AN population is largely unknown. Investigation into the prevalence of risk factors within each IHS region is necessary to target prevention efforts.

The increase in the hepatitis C-associated hospitalization rate is concerning for several reasons. There is significant morbidity and mortality associated with HCV infection.[32] CDC estimates that 10%–20% of infected patients will develop cirrhosis, and 1%–5% will develop hepatocellular carcinoma.[30] In addition, even in the absence of cirrhosis, patients have been shown to have a decreased quality of life, with decreased social functioning and energy, increased fatigue, and perceived physical limitations.[33] Substantial medical costs are associated with hepatitis C: future annual direct medical costs have been estimated at $10.7 billion for 2010–2019.[34] Given the limited financial resources of the IHS, increased hepatitis C hospitalizations will likely cause a significant burden on facilities serving this population. A high prevalence of comorbidities among this population, which can affect liver outcomes (e.g., alcohol abuse,[35] obesity, and diabetes), will compound the future morbidity and mortality associated with hepatitis C.[36] In addition, increases in acute hospitalizations are concerning because they indicate increasing risk behavior for transmission of HCV and other bloodborne pathogens.

Unlike hepatitis A and B, there is no vaccine for HCV. Preventive measures, therefore, should focus on community and patient education to increase awareness of the disease and to reduce risk behavior associated with infection. Early recognition and treatment with antiviral medications can significantly reduce morbidity, and efforts should be made to identify these patients prior to hospitalization.

Limitations

Our study had several limitations. First, individuals who sought care outside of IHS health-care services would not be identified as cases in this study; as such, there may be an underestimation of hospitalizations due to failure to capture urban-dwelling AI/AN people who may have a higher prevalence of risk behaviors but may not have access to IHS health-care services. The unit of analysis for the study was a hospitalization; therefore, an individual who was hospitalized for viral hepatitis more than once would have each hospitalization counted separately. We were unable to differentiate between acute and chronic hepatitis B-associated hospitalizations; therefore, we were unable to draw conclusions about the impact of hepatitis B vaccination in this population. This study analyzed hospital discharge data for AI/AN people who received IHS health care only; as such, it may not be representative of all AI/AN people.

CONCLUSIONS

We observed three distinct patterns in hospitalization rates among AI/AN people who used IHS health-care services from 1995–1997 to 2005–2007: a decrease for hepatitis A, no change for hepatitis B, and a dramatic increase for hepatitis C. The large decrease in hepatitis A-associated hospitalization rates can likely be attributed to childhood hepatitis A immunization. Differentiation between acute and chronic hepatitis B-associated hospitalizations requires further investigation to evaluate the effect of hepatitis B vaccination programs. High-risk AI/AN adults should continue to be targeted for hepatitis B immunization. Because there is no hepatitis C vaccine, prevention efforts should focus on education to reduce risk behavior and identify people with chronic infection to follow for progression of liver disease and to target for antiviral therapy.

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