Prevalence of Hepatitis C Virus Infection in US Hispanic/Latino Adults: Results from the NHANES 2007–2010 and HCHS/SOL Studies

Mark H. Kuniholm,[1] Molly Jung,[1] James E. Everhart,[2] Scott Cotler,[3] Gerardo Heiss,[4] Geraldine McQuillan,[5] Ryung S. Kim,[1] Howard D. Strickler,[1] Bharat Thyagarajan,[6] Marston Youngblood,[4] Robert C. Kaplan,[1,a] and Gloria Y. F. Ho[1,a]

[1]Department of Epidemiology and Population Health, Albert Einstein College of Medicine, Bronx, New York; [2]Epidemiology and Data Systems Program, Division of Digestive Diseases and Nutrition, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, Maryland; [3]Division of Hepatology, Department of Medicine, Loyola University Medical Center, Maywood, Illinois; [4]Department of Epidemiology, University of North Carolina, Chapel Hill, North Carolina; [5]Division of Health and Nutrition Examination Surveys, Centers for Disease Control and Prevention, Hyattsville, Maryland; and [6]Department of Laboratory Medicine and Pathology, University of Minnesota, Minneapolis, Minnesota

Prevalence of hepatitis C virus (HCV) antibody has been reported in Mexican Americans, but its prevalence in other US Hispanic/Latino groups is unknown. We studied 2 populations of US Hispanic/Latino adults; 3210 from the National Health and Nutrition Examination Survey (NHANES) 2007–2010 and 11 964 from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Age-standardized prevalence of HCV antibody was similar in NHANES 2007–2010 (1.5%) and HCHS/SOL (2.0%) but differed significantly by Hispanic/Latino background in HCHS/SOL (eg, 11.6% in Puerto Rican men vs 0.4% in South American men). These findings suggest that the HCV epidemic among US Hispanics/Latinos is heterogeneous.

Keywords. hepatitis C virus; HCV; Hispanic; Latino; United States; prevalence; antibody; RNA; risk factor.

Prevalence of hepatitis C virus (HCV) antibody in US populations, such as non-Hispanic/non-Latino Whites, non-Hispanic/

non-Latino Blacks, and persons of Mexican background, is commonly estimated using data from the National Health and Nutrition Examination Surveys (NHANES) [1–3]. NHANES include substantial numbers of Mexican background participants but relatively small numbers of Hispanic/Latino participants from other backgrounds. Whether HCV antibody prevalence differs between US Hispanic/Latino groups of different backgrounds is therefore not well understood.

During 2008–2011 Hispanic/Latino adults from 4 US communities (Bronx, Miami, Chicago, and San Diego) were recruited to participate in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). In addition to Hispanic/Latino background, HCHS/SOL interviews assessed many of the same characteristics as NHANES. In this study we present data from NHANES 2007–2010 and HCHS/SOL side by side to provide a current picture of HCV antibody prevalence and correlates of HCV infection in US Hispanics/Latinos.

MATERIALS AND METHODS

Study Populations

NHANES are nationally representative samples of the noninstitutionalized US population conducted by the National Center for Health Statistics (NCHS). NHANES 2007–2010 participants completed in-person interviews that assessed demographics and many aspects of health and behavior; those over the age of 19 also provided information on drug use and sexual behaviors. NHANES 2007–2010 oversampled individuals of all Hispanic/Latino backgrounds, but only Hispanics/Latinos of Mexican background were enrolled in sufficient numbers to permit separate analyses of this group [4]. Hispanic/Latino NHANES participants who were not of Mexican background were classified as "Other Hispanic."

NHANES protocols were approved by the NCHS Research Ethics Review Board, and all participants provided informed consent. NHANES 2007–2010 included 20 686 participants of whom 6875 were Hispanic/Latino. Because HCHS/SOL recruited individuals 18–74 years of age, we excluded 3388 NHANES 2007–2010 Hispanics/Latinos with ages outside this range. Also excluded were 277 participants without HCV antibody data.

HCHS/SOL is a study of 16 415 Hispanic/Latino adults recruited from 4 US communities (Bronx, Miami, Chicago, and San Diego) [5, 6]. Participants completed physical examinations, in-person interviews, and provided blood samples. Interviews did not include questions related to drug use or sexual behaviors.

The HCHS/SOL protocol was approved by each local institutional review board, and all participants provided informed

consent. In total, 2694 participants recruited early in the study were not asked to provide consent for HCV testing and were not tested for HCV. A further 1502 participants were not tested for HCV because consent for HCV testing was not provided in time for inclusion in the testing panel. Also excluded were 213 participants who refused consent, 6 participants older than 74 years of age, 11 participants whose HCV testing had not been completed, and 25 participants with indeterminate HCV antibody results.

We compared 11 964 HCHS/SOL participants included in the analysis to those who were excluded. There were no differences by age and sex (both $P \geq .05$). However, there were differences by geographic region and Hispanic/Latino background (both $P < .01$), which reflect the timeline by which consent for HCV testing was introduced into the 4 recruitment sites. Specifically, included participants were more likely to be of Cuban background and less likely to be of Puerto Rican background than those excluded.

Laboratory Methods
The VITROS Anti-HCV assay (Ortho Clinical Diagnostics, Raritan, NJ) was used to test NHANES samples for antibody directed against HCV. Positive samples were repeated in duplicate, and repeatedly positive samples were confirmed using the CHIRON RIBA HCV 3.0 SIA assay (Bio-Rad Laboratories, Hercules, CA). HCV antibody-positive samples were tested for HCV RNA using the COBAS AMPLICOR HCV Test, v2.0 (Roche Molecular Diagnostics, Pleasanton, CA).

The ADVIA Centaur HCV immunoassay (Siemens Diagnostics, Deerfield, IL) was used to perform HCV antibody testing in HCHS/SOL. If the HCV immunoassay was positive, the Abbott RealTime HCV assay (Abbott Molecular, Des Plaines, IL) was used to test for HCV RNA. If the HCV RNA test result was negative, the sample was retested with the CHIRON RIBA HCV 3.0 SIA assay (Bio-Rad Laboratories, Hercules, CA) to confirm the result of the immunoassay.

Statistical Methods
Prevalence estimates of HCV antibody overall and within strata of interest were calculated using sampling weights provided by NHANES 2007–2010 and HCHS/SOL. To enable comparison of prevalence estimates from the two studies, we age-standardized the weighted prevalence estimates by the direct method using data from the US 2010 Census. To facilitate interpretation, throughout the article we refer to age-standardized weighted prevalence of HCV antibody as "HCV prevalence."

Survey-weighted χ^2 tests were used to assess differences in HCV prevalence between strata. Prevalences of HCV in NHANES 2007–2010 and HCHS/SOL were compared by calculating a standardized rate ratio and its 95% confidence interval (CI). Survey-weighted logistic regression was used to assess whether demographic and behavioral characteristics had independent associations with HCV prevalence. Prevalence of HCV RNA is reported among those positive for HCV antibody with nonmissing HCV RNA data.

RESULTS

Characteristics of the Study Populations
Fifty-two percent of the 3210 NHANES 2007–2010 Hispanics/Latinos were male, and the median age was 36. The majority (63%) were born outside the 50 US states, 63% were of Mexican background, and 23% had incomes <$20 000. Forty percent of the 11 964 HCHS/SOL participants were male, and the median age was 47. The majority (83%) were born outside the 50 US states, and 47% had incomes <$20 000. HCHS/SOL included Hispanics/Latinos of multiple backgrounds: Mexican (39%), Cuban (16%), Puerto Rican (15%), Dominican (9%), Central American (11%), South American (7%), and mixed/other Hispanic/Latino (3%).

Prevalence of HCV by Demographic and Behavioral Characteristics: NHANES 2007–2010 and HCHS/SOL
HCV prevalence was 1.5% (95% CI, 1.0–2.2, 47 HCV-seropositives) in NHANES 2007–2010 and 2.0% (95% CI, 1.6–2.4, 260 HCV-seropositives) in HCHS/SOL. HCV prevalence was higher in men than women in both NHANES 2007–2010 (2.1% vs 0.9%, $P < .01$) and HCHS/SOL (2.9% vs 1.2%, $P < .01$).

Both NHANES 2007–2010 and HCHS/SOL identified men 40–69 years of age as the group with the highest prevalence of HCV. Prevalence of HCV was, however, significantly ($P < .05$) higher among men 50–59 years of age in HCHS/SOL (7.3%) than in NHANES 2007–2010 (2.1%). Differences in age-specific HCV prevalence between NHANES 2007–2010 and HCHS/SOL women and among participants of Mexican background were not statistically significant.

Supplementary Tables 1 and 2 show HCV prevalence for men and women, respectively, by characteristics assessed in both NHANES 2007–2010 and HCHS/SOL. In HCHS/SOL, HCV prevalence was highest in Puerto Rican background participants (vs Mexican background participants, $P < .01$ for both men and women) and lowest in South American background participants (vs Mexican background participants, $P < .05$ for both men and women). In NHANES 2007–2010, there was no significant difference in HCV prevalence between Mexican background participants and those of "Other Hispanic" background.

In logistic regression analyses that included all demographic and behavioral characteristics as covariates, associations between Puerto Rican and South American backgrounds and HCV prevalence remained statistically significant in HCHS/SOL men, whereas South American background remained significant and Puerto Rican background was borderline significant ($P = .05$) in HCHS/SOL women (Table 1). Other

Table 1. Independent Associations Between Demographic and Behavioral Characteristics and Prevalence of HCV Antibody in HCHS/SOL and NHANES 2007–2010 Hispanics/Latinos, Ages 18–74

	HCHS/SOL				NHANES 2007–2010			
	Men (n = 4376)[a]		Women (n = 6146)[a]		Men (n = 1225)[a]		Women (n = 1319)[a]	
	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value
Age group								
18–29	0.03 (.01, .19)	<.01	0.18 (.04, .78)	.02	[b]	[b]	[b]	[b]
30–39	0.21 (.09, .52)	<.01	0.16 (.04, .59)	.01	0.20 (.04, 1.18)	.07	1.11 (.08, 15.27)	.94
40–49	0.39 (.22, .72)	<.01	0.62 (.32, 1.22)	.17	2.20 (.76, 6.36)	.14	1.44 (.22, 9.30)	.69
50–59	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
60–69	0.44 (.20, .95)	.04	2.52 (.81, 7.78)	.11	1.64 (.43, 6.28)	.46	2.67 (.54, 13.27)	.22
70–74	0.20 (.05, .77)	.02	0.36 (.07, 1.75)	.21	[b]	[b]	[b]	[b]
Recruitment Site								
Bronx	1.0	Ref	1.0	Ref	[c]	[c]	[c]	[c]
San Diego	1.26 (.53, 3.02)	.60	1.56 (.61, 4.01)	.36	[c]	[c]	[c]	[c]
Miami	0.68 (.15, 3.14)	.62	0.86 (.11, 6.46)	.88	[c]	[c]	[c]	[c]
Chicago	0.38 (.18, .79)	.01	0.44 (.21, .95)	.04	[c]	[c]	[c]	[c]
Hispanic/Latino background								
Mexican	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
Central American	0.64 (.14, 2.97)	.57	0.51 (.08, 3.07)	.46	[d]	[d]	[d]	[d]
Cuban	0.31 (.05, 1.76)	.19	0.56 (.06, 5.50)	.62	[d]	[d]	[d]	[d]
Dominican	0.95 (.32, 2.83)	.93	2.13 (.49, 9.19)	.31	[d]	[d]	[d]	[d]
Puerto Rican	4.92 (2.10, 11.53)	<.01	2.90 (1.01, 8.30)	.05	[d]	[d]	[d]	[d]
South American	0.04 (.00, 0.39)	<.01	0.07 (.01, .65)	.02	[d]	[d]	[d]	[d]
Mixed/other in HCHS/SOL	1.18 (.30, 4.70)	.81	1.69 (.39, 7.24)	.48	[d]	[d]	[d]	[d]
"Other Hispanic" in NHANES 2007–2010	[e]	[e]	[e]	[e]	1.15 (.41, 3.26)	.78	2.79 (.89, 8.79)	.08
Interview language								
Spanish	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
English	0.72 (.36, 1.47)	.37	1.44 (.67, 3.12)	.35	4.91 (1.46, 16.58)	.01	3.43 (.79, 14.92)	.10
Education								
Less than high school	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
High school or equivalent	1.68 (.94, 3.00)	.08	1.09 (.57, 2.09)	.78	0.95 (.21, 4.23)	.95	0.42 (.07, 2.49)	.33
More than high school	0.84 (.44, 1.57)	.58	0.60 (.24, 1.50)	.28	0.28 (.06, 1.27)	.10	0.62 (.09, 4.29)	.62
Nativity								
Born outside the 50 states	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
Born in the 50 states	1.43 (.70, 2.93)	.33	1.46 (.65, 3.30)	.36	3.36 (.98, 11.51)	.05	1.29 (.31, 5.34)	.72
Marital status								
Married/living with partner	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
Single	1.85 (1.02, 3.34)	.41	0.67 (.29, 1.55)	0.35	1.79 (.37, 8.58)	.46	8.47 (2.02, 35.55)	<.01
Separated, divorced, or widow(er)	2.63 (1.40, 4.94)	<.01	1.03 (.38, 2.79)	.95	1.13 (.33, 3.80)	.84	1.15 (.25, 5.28)	.86
Annual household income								
≥$20 000	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
<$20 000	1.37 (.86, 2.20)	.19	1.47 (.68, 3.18)	.33	4.15 (1.52, 11.32)	.01	4.11 (.64, 26.36)	.13
Health insurance								
Yes	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
No	1.14 (.67, 1.95)	.63	0.96 (.48, 1.91)	.91	0.52 (.20, 1.33)	.16	0.98 (.18, 5.33)	.98

Table 1   continued.

	HCHS/SOL				NHANES 2007–2010			
	Men (n = 4376)[a]		Women (n = 6146)[a]		Men (n = 1225)[a]		Women (n = 1319)[a]	
	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value
Cigarette use								
Never	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
Former	2.45 (1.18, 5.11)	.02	1.45 (.60, 3.49)	.41	1.75 (.47, 6.48)	.40	6.59 (2.23, 19.48)	<.01
Current	7.94 (4.15, 15.19)	<.01	5.38 (2.53, 11.44)	<.01	4.64 (1.17, 18.34)	.03	10.65 (3.08, 36.87)	<.01
Alcohol use								
Never	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
Former	1.39 (.54, 3.61)	.49	0.93 (.33, 2.68)	.90	0.49 (.04, 5.53)	.55	0.99 (.08, 12.72)	.99
Current	0.59 (.23, 1.51)	.27	1.39 (.45, 4.29)	.56	0.52 (.06, 4.88)	.55	1.36 (.08, 22.38)	.83

Abbreviations: CI, confidence interval; HCHS/SOL, Hispanic Community Health Study/Study of Latinos; HCV, hepatitis C virus; NHANES, National Health and Nutrition Examination Survey.

[a] Results from a single survey-weighted multivariable logistic regression model that included all covariates shown in the table. Individuals with complete data on all covariates are included.

[b] Values are not estimable because prevalence of HCV antibody in this group is 0.

[c] Recruitment site is not reported in NHANES 2007–2010.

[d] Values are not estimable because NHANES 2007–2010 groups participants who identify as Hispanic/Latino but not of Mexican background as "Other Hispanic."

[e] The mixed/other Hispanic/Latino background group in HCHS/SOL includes those participants of mixed Hispanic/Latino background and also those participants who did not identify as belonging to a specific Hispanic/Latino background group. This category is not equivalent to the "Other Hispanic" group in NHANES 2007–2010.

characteristics with significant associations in multivariable analyses of HCHS/SOL or NHANES 2007–2010 (Table 1) included (1) current smoking (men and women in both studies), (2) separated/divorced/widower vs married marital status (men in HCHS/SOL), (3) English language interview vs Spanish (men in NHANES 2007–2010), and (4) income <$20 000 (men in NHANES 2007–2010).

Prevalence of HCV by High-Risk Behaviors: NHANES 2007–2010
HCV prevalence was significantly higher in individuals who reported (i) using marijuana or hashish, (ii) using cocaine, heroin or methamphetamine, (iii) having first sex at younger than 18 years, and (iv) having >10 sexual partners vs <5 partners in univariable analyses. In logistic regression analyses that included adjustment for the characteristics shown in Supplementary Tables 1 and 2, the association with cocaine, heroin, or methamphetamine use remained statistically significant (data not shown).

Prevalence of HCV by Recruitment Site and Hispanic/Latino Background Group: HCHS/SOL
Participants in the Bronx had an HCV prevalence of 4.5%, significantly higher than those in San Diego (1.7%), Chicago (1.2%), and Miami (0.8%; P < .01 for the Bronx compared to other sites). As shown in Figure 1, men and women of Puerto Rican background in the Bronx had the highest HCV prevalence (14.2% and 4.1%, respectively). In comparison, HCV prevalences among men and women of Puerto Rican background in Chicago were 4.7% and 1.3%, respectively.

Prevalence of HCV RNA in NHANES 2007–2010 and HCHS/SOL
Prevalence of HCV RNA was 53.2% in 41 NHANES 2007–2010 Hispanics/Latinos and 73.2% in 260 HCHS/SOL Hispanics/Latinos who were HCV-seropositive with HCV RNA data. In HCHS/SOL, prevalence of HCV RNA was higher in men than women (86.3% vs 55.2%, P < .01). No significant difference in prevalence of HCV RNA by sex was seen in NHANES 2007–2010.

DISCUSSION

Age-standardized HCV prevalence among Hispanics/Latinos 18–74 years of age in NHANES 2007–2010 (1.5%) and HCHS/SOL (2.0%) was similar to, if slightly higher than, prevalence among non-Hispanic/non-Latino Whites (1.2%–1.5%) in NHANES conducted between 1988 and 2008 [3]. However, prevalence of HCV was high in those of Puerto Rican background, low in those of South American background, and intermediate in those of Mexican, Dominican, Cuban, and Central American backgrounds (Supplementary Tables 1 and 2). These data signify that the scale of the HCV epidemic varies between Hispanic/Latino background groups.

Many of the same associations with HCV prevalence were observed in NHANES 2007–2010 and HCHS/SOL. For example, English language interview, birth in the 50 US states, and cigarette smoking were associated with significantly higher HCV prevalence in men and women in both studies. However, in multivariable analyses of HCHS/SOL that included
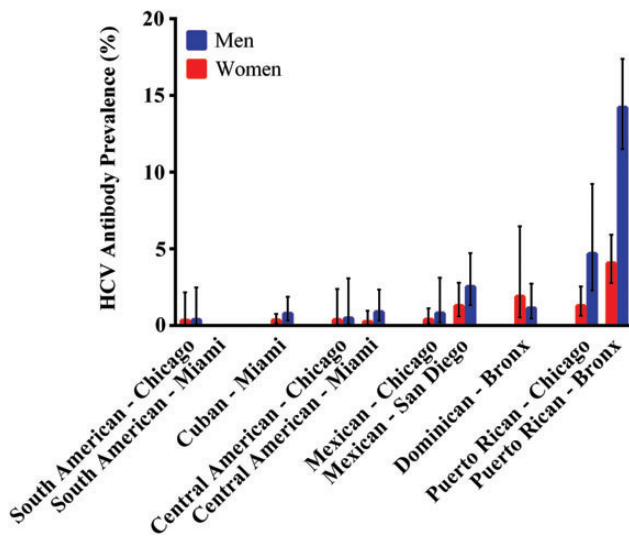
Figure 1. Age-standardized prevalence of HCV antibody by Hispanic/Latino background and residency among men and women, ages 18–74 in HCHS/SOL (A–C). A, Values (except n) are standardized to the 2010 US Census population and are weighted for survey design and nonresponse. B, Hispanic/Latino background and residency combinations with sample sizes <250 are not shown. C, Sample sizes for Hispanic/Latino background and residency combinations are i) South American/Chicago (n = 136 men and 154 women); ii) South American/Miami (n = 109 men and 228 women); iii) Cuban/Miami (n = 878 men and 1014 women); iv) Central American/Chicago (n = 150 men and 177 women); v) Central American/Miami (n = 289 men and 456 women); vi) Mexican/Chicago (n = 771 men and 1014 women); vii) Mexican/San Diego (n = 941 men and 1755 women); viii) Dominican/Bronx (n = 365 men and 682 women); ix) Puerto Rican/Chicago (n = 232 men and 297 women); x) Puerto Rican/Bronx (n = 486 men and 711 women). Abbreviations: HCHS/SOL, Hispanic Community Health Study/Study of Latinos; HCV, hepatitis C virus.

Hispanic/Latino background, associations between interview language, nativity, and HCV prevalence became nonsignificant. In contrast, interview language retained a significant association and nativity had a marginal ($P = .05$) association with HCV prevalence in multivariable analysis of NHANES men. Together, these data suggest that differences in HCV prevalence by language and nativity may actually reflect differences between Hispanic/Latino background groups.

HCV prevalence was high among Puerto Rican background participants in HCHS/SOL, and it is possible that some of their HCV infections were acquired in Puerto Rico. For example, in 2001–2002, a population-based survey of adults in San Juan, Puerto Rico, found that 10.6% of the male population was HCV-seropositive and that 6.2% of adults (both men and women) reported prior heroin use [7]. Alternatively, it could be that participants of Puerto Rican background were primarily at risk for HCV infection in the 50 US states, particularly in the Bronx. A recent study of 9579 patients receiving care at Bronx primary care clinics estimated HCV prevalence to be 4.6%–

7.7% [8]. These patients were predominantly women (72%) and minority (51% Hispanic/Latino, 32% non-Hispanic/non-Latino Black), with a mean age of 49 years [8]. In subgroup analysis of this population, HCV prevalence was 14.8% among 1334 Hispanic/Latino men and 5.5% among 3581 Hispanic/Latino women (William Southern, personal communication). A similar study of 1000 primary care patients in a neighborhood adjacent to the Bronx found that 8.3% were HCV seropositive [9].

There are several limitations that must be considered. First, the proportion of eligible individuals who agreed to participate was 41.7% in HCHS/SOL and 75.4% and 77.3% in NHANES 2007–2008 and NHANES 2009–2010, respectively. Although both studies were weighted for nonresponse, it is possible that individuals who declined to participate differed from those who did participate, and that these differences were not controlled through weighting procedures. Second, HCHS/SOL is not representative of all US Hispanics/Latinos, and studies of Hispanic/Latino populations in other areas could yield different results. Indeed, the findings suggest that prevalence estimates of HCV antibody in US Hispanics/Latinos depend on the specific populations studied. For example, had more Puerto Rican background participants been included in the HCHS/SOL testing panel, the estimated prevalence of HCV antibody in HCHS/SOL might have been higher.

Overall, this study shows that the HCV epidemic among US Hispanic/Latino adults is heterogeneous. This information will be useful to those who direct public health resources for HCV treatment and prevention. Clinicians who serve Hispanic/Latino communities may also benefit from this information because it highlights specific Hispanic/Latino groups that may benefit from increased levels of HCV testing and treatment.

Supplementary Data

Supplementary materials are available at *The Journal of Infectious Diseases* online (http://jid.oxfordjournals.org/). Supplementary materials consist of data provided by the author that are published to benefit the reader. The posted materials are not copyedited. The contents of all supplementary data are the sole responsibility of the authors. Questions or messages regarding errors should be addressed to the author.

Notes

References

1. Alter MJ, Kruszon-Moran D, Nainan OV, et al. The prevalence of hepatitis C virus infection in the United States, 1988 through 1994. N Engl J Med **1999**; 341:556–62.
2. Armstrong GL, Wasley A, Simard EP, McQuillan GM, Kuhnert WL, Alter MJ. The prevalence of hepatitis C virus infection in the United States, 1999 through 2002. Ann Intern Med **2006**; 144:705–14.
3. McQuillan GM, Kruszon-Moran D, Denniston MM, Hirsch R. Viral hepatitis. NCHS data brief, no 27. Hyattsville, MD: National Center for Health Statistics. **2010**.
4. Analytic note regarding 2007–2010 survey design changes and combining data across other survey cycles. National Center for Health Statistics, **2006**. http://www.cdc.gov/nchs/data/nhanes/analyticnote_2007-2010.pdf.
5. Lavange LM, Kalsbeek WD, Sorlie PD, et al. Sample design and cohort selection in the Hispanic Community Health Study/Study of Latinos. Ann Epidemiol **2010**; 20:642–9.
6. Sorlie PD, Aviles-Santa LM, Wassertheil-Smoller S, et al. Design and implementation of the Hispanic Community Health Study/Study of Latinos. Ann Epidemiol **2010**; 20:629–41.
7. Perez CM, Suarez E, Torres EA, Roman K, Colon V. Seroprevalence of hepatitis C virus and associated risk behaviours: a population-based study in San Juan, Puerto Rico. Int J Epidemiol **2005**; 34:593–9.
8. Southern WN, Drainoni ML, Smith BD, et al. Hepatitis C testing practices and prevalence in a high-risk urban ambulatory care setting. J Viral Hepat **2011**; 18:474–81.
9. McGinn T, O'Connor-Moore N, Alfandre D, Gardenier D, Wisnivesky J. Validation of a hepatitis C screening tool in primary care. Arch Intern Med **2008**; 168:2009–13.