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Examining the Surveillance System for Chronic Hepatitis C among Women of Reproductive Age: Implications for Perinatal HCV Management

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Research Article

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Abstract

Objective

This study evaluated a jurisdiction's chronic hepatitis C virus (HCV) surveillance system and examined sociodemographic factors associated with confirmed HCV diagnosis among women aged 15–45 years.

Methods

A convergent mixed-methods design was used. Quantitative analysis included NEDSS surveillance data for women aged 15–45 years reported with HCV in Maryland from 2018–2022. Descriptive statistics, chi-square tests, and logistic regression assessed factors associated with confirmatory diagnosis. Qualitative interviews with public health surveillance personnel were analyzed deductively using the Surveillance Evaluation Framework.

Results

Among 2,197 women, 62.7% had confirmed diagnoses and 37.3% were probable cases. Women aged 26–35 years were more likely to receive confirmatory diagnosis than those aged 15–25 years (adjusted OR = 1.32; 95% CI: 1.03–1.70). Black women were less likely than White women to receive confirmatory diagnosis (adjusted OR = 0.45; 95% CI: 0.35–0.58). Qualitative findings highlighted strengths including standardized reporting and electronic notification, while challenges included incomplete reporting, interoperability limitations, workforce constraints, and weak perinatal follow-up systems.

Conclusions

Jurisdiction's HCV surveillance system supports case reporting and monitoring but faces persistent challenges in data completeness, interoperability, workforce capacity, and identification of perinatally exposed infants. Strengthening surveillance infrastructure, provider reporting, and follow-up for women of reproductive age and exposed infants may improve HCV prevention and elimination efforts.

1. INTRODUCTION

Hepatitis C virus (HCV) infection remains a significant public health challenge globally and in the United States despite the availability of highly effective antiviral therapy. The World Health Organization has established a target of eliminating viral hepatitis as a public health threat by 2030.[1] However, achieving this goal remains challenging because many infected individuals remain undiagnosed, untreated, or inadequately linked to care.[2]

In the United States, the epidemiology of HCV has changed substantially over the last decade. Historically, HCV infection was concentrated among individuals born between 1945 and 1965. More recently, increasing rates of infection have been observed among younger adults, particularly individuals who inject drugs.[3,4] The ongoing opioid epidemic has contributed significantly to the resurgence of HCV transmission through injection drug use.[5,6] Surveillance data have demonstrated increasing HCV incidence throughout many regions of the United States, particularly in areas east of the Mississippi River and within the Appalachian region.[7]

Injection drug use represents the most important risk factor for new HCV infections. Sharing needles and injection equipment facilitates efficient transmission of bloodborne pathogens and contributes to sustained community transmission.[8] Integrated public health approaches addressing both substance use disorders and infectious disease prevention have therefore become increasingly important.[9] Harm reduction interventions, including syringe services programs, expanded testing, and antiviral treatment access, are critical components of HCV prevention strategies.[10]

Social determinants of health substantially influence HCV epidemiology. Poverty, unstable housing, geographic location, educational attainment, race, ethnicity, and social support have all been associated with HCV diagnosis, treatment access, and health outcomes.[11–13] Individuals experiencing homelessness and those residing in disadvantaged communities often face significant barriers to testing and treatment.[14] Geographic disparities have also been documented, with increasing HCV burden reported in rural areas where healthcare access, specialist availability, and surveillance capacity may be limited.[15–17]

Racial and ethnic disparities remain important concerns in HCV prevention and control efforts. Although HCV affects all populations, substantial differences exist in diagnosis, treatment access, and mortality outcomes.[18,19] Structural barriers, healthcare access limitations, and broader social determinants contribute to these disparities and underscore the need for targeted public health interventions.[20]

Particular concern has emerged regarding increasing HCV infections among women of reproductive age. Studies have documented substantial increases in HCV diagnoses among women aged 15–45 years, largely attributable to opioid use and injection-related risk behaviors.[21–23] Maternal HCV infection creates the potential for perinatal transmission, which remains an important source of pediatric HCV infection. Meta-analytic evidence estimates a perinatal transmission rate of approximately 5.8%, with higher rates among women coinfected with HIV.[24]

In response to the changing epidemiology of HCV, screening recommendations have expanded substantially. The U.S. Preventive Services Task Force recommends one-time HCV screening for all adults aged 18–79 years, including pregnant persons.[25] Similarly, national clinical guidelines recommend universal screening during each pregnancy.[26] In 2023, the Centers for Disease Control and Prevention further updated recommendations for testing infants and children with perinatal HCV exposure.[27]

Public health surveillance plays a critical role in monitoring HCV trends, identifying populations at risk, and guiding prevention and treatment efforts.[28] The National Electronic Disease Surveillance System (NEDSS) serves as the primary infrastructure supporting reportable disease surveillance in the United States. NEDSS facilitates collection, integration, management, and transmission of disease data across local, state, and federal public health agencies.

Despite the importance of surveillance systems, limited research has evaluated the effectiveness of NEDSS-based hepatitis C surveillance. In particular, little is known about the ability of existing surveillance systems to identify cases among women of reproductive age and support prevention of perinatal transmission. The apparent underreporting of perinatal HCV cases raises concerns regarding surveillance completeness and follow-up mechanisms for exposed infants.

Maryland has experienced increasing reports of chronic HCV among younger populations, yet the burden and characteristics of HCV among women of reproductive age remain incompletely understood. Furthermore, the effectiveness of the surveillance infrastructure supporting hepatitis C prevention and response has not been systematically evaluated. This study therefore examined sociodemographic factors associated with confirmed HCV diagnosis among women aged 15–45 years and evaluated stakeholder perceptions of the strengths and limitations of Maryland's hepatitis C surveillance system.

2. METHODS

Study Design

A convergent mixed-methods design was employed, integrating quantitative secondary data analysis and qualitative key informant interviews. The quantitative component examined surveillance records from the National Electronic Disease Surveillance System (NEDSS) between 2018 and 2022. The qualitative component explored stakeholder perspectives regarding the strengths and limitations of the surveillance system.

The study was guided by the Surveillance Evaluation Framework, which emphasizes assessment of surveillance system attributes, data management processes, utilization of surveillance information, and communication of findings.

Quantitative Data Source

The quantitative analysis utilized de-identified surveillance data from NEDSS. Records included reported hepatitis C cases among women aged 15–45 years residing in Maryland between 2018 and 2022. NEDSS receives electronic reports from laboratories, healthcare providers, health systems, and local health departments and supports case classification according to established CDC and Council of State and Territorial Epidemiologists definitions.[25]

Outcome Variable

The outcome variable was hepatitis C diagnosis status. Cases were categorized as:

• Confirmed HCV diagnosis: positive anti-HCV antibody and positive HCV RNA test.

• Probable HCV diagnosis: positive anti-HCV antibody without confirmatory RNA testing.

Independent Variables

The primary independent variable was place of residence categorized as urban or rural according to U.S. Census Bureau classifications.

Covariates included age group (15–25, 26–35, and 36–45 years), race (White, Black or African American, and Other), and period of diagnosis (2018–2019 versus 2020–2022).

Quantitative Analysis

Data were exported into STATA version 14 for analysis. Descriptive statistics summarized demographic characteristics and HCV diagnosis status. Bivariate analyses employed chi-square tests to evaluate associations between HCV diagnosis and explanatory variables. Logistic regression models estimated crude and adjusted odds ratios with 95% confidence intervals. Statistical significance was established at $P < .05$.

Qualitative Component

Key informant interviews were conducted with public health investigators, communicable disease surveillance nurses, and surveillance personnel from selected Maryland jurisdictions, including Baltimore City, Baltimore County, Howard County, Washington County, Cecil County, Kent County, and Harford County.

Jurisdictions were selected using stratified purposive sampling based on reported HCV burden among women of reproductive age. Participants provided information regarding surveillance system attributes, data quality, case investigation procedures, utilization of surveillance findings, and dissemination practices.

Qualitative Analysis

Interview transcripts were analyzed using a deductive thematic approach informed by the Surveillance Evaluation Framework. Data were coded and organized using Taguette qualitative analysis software. Codes were grouped into subthemes and overarching themes corresponding to surveillance system attributes, case investigation processes, utilization of surveillance data, and communication of surveillance findings.

3. RESULTS

Quantitative Findings

A total of 3,882 probable and confirmed hepatitis C virus (HCV) cases among women aged 15–45 years were reported in Maryland through the National Electronic Disease Surveillance System (NEDSS) between 2018 and 2022. Of these, 2,209 (57.0%) were confirmed by diagnostic testing and 1,673 (43.0%) were classified as probable cases. Approximately 58.9% of all reported cases resided in urban jurisdictions, while 41.1% resided in rural jurisdictions. Baltimore City and Baltimore County accounted for approximately 30% of the total HCV burden reported during the study period.

Women aged 26–35 years represented the largest proportion of reported HCV cases, accounting for approximately half of all reported infections. More than half of all cases were reported during the pre–COVID-19 period (2018–2019), while the remaining cases were reported during the pandemic and immediate post-pandemic years (2020–2022).

Because ethnicity and marital status contained substantial missing information, these variables were excluded from the final multivariable analyses.

Characteristics of Women With HCV Diagnoses

The final analytical sample consisted of 2,197 women aged 15–45 years diagnosed with HCV and reported through NEDSS between 2018 and 2022. Among these women, 1,378 (62.7%) had a confirmed diagnosis based on laboratory confirmation, while 819 (37.3%) were classified as probable cases. More than half of the study population resided in urban jurisdictions (55.4%), while 44.6% were residents of rural Maryland jurisdictions.

Women aged 26–35 years represented the largest age category (51.1%), followed by women aged 36–45 years (32.0%). Women aged 15–25 years accounted for 17.0% of the study population.

Most women diagnosed with HCV identified as White (77.9%), while Black or African American women accounted for 20.4% of reported cases. Women categorized as belonging to other racial groups represented 1.6% of the sample.

The distribution of diagnoses across study years remained relatively stable. The largest proportion of diagnoses occurred in 2018 (25.8%), followed by 2019 (23.5%), 2021 (18.8%), 2022 (16.2%), and 2020 (15.7%). When grouped according to the COVID-19 pandemic period, 49.3% of diagnoses occurred before the pandemic (2018–2019), while 50.7% occurred during and after the pandemic (2020–2022).

Association Between Residence and Confirmatory HCV Diagnosis

Bivariate analysis demonstrated a statistically significant association between place of residence and receipt of a confirmatory HCV diagnosis ($\chi^2 = 8.42$, $P = .004$).

Among women residing in rural jurisdictions, 66.1% had completed confirmatory diagnostic testing compared with 60.0% among women residing in urban jurisdictions. Conversely, women residing in

urban jurisdictions were more likely to remain classified as probable cases without documented confirmatory testing.

The findings suggest that women residing in rural Maryland jurisdictions were more likely to receive complete laboratory confirmation of HCV infection than women residing in urban jurisdictions.

Association Between Age and Confirmatory HCV Diagnosis

A statistically significant association was observed between age group and HCV diagnosis status (χ^2 = 9.58, P = .008). Among women aged 15–25 years, 57.6% had a confirmed diagnosis. The proportion with a confirmed diagnosis increased to 65.7% among women aged 26–35 years and remained high among women aged 36–45 years (60.7%). These findings indicate that women in the middle reproductive age category were more likely to complete confirmatory testing than younger women.

Association Between Race and Confirmatory HCV Diagnosis

Race was strongly associated with receipt of a confirmatory HCV diagnosis (χ^2 = 67.62, P < .001). Among White women, 67.2% had a confirmed diagnosis. In contrast, only 46.6% of Black women had a confirmed diagnosis. Women categorized as belonging to other racial groups demonstrated a confirmatory diagnosis rate of 50.0%. More than half of Black women with reported HCV infection remained classified as probable cases because confirmatory testing was not documented within the surveillance system.

Association Between Pandemic Period and Confirmatory Diagnosis

No statistically significant association was observed between the period of diagnosis and receipt of a confirmatory HCV diagnosis (χ^2 = 2.55, P = .110). Approximately 64.4% of women diagnosed before the COVID-19 pandemic received confirmatory testing compared with 61.1% during the pandemic and post-pandemic period. Although a slight decline was observed, the difference did not reach statistical significance.

Logistic Regression Analysis

Unadjusted Model

The unadjusted logistic regression model examined the relationship between place of residence and receipt of a confirmed HCV diagnosis. Women residing in rural Maryland jurisdictions had significantly greater odds of receiving a confirmatory diagnosis than women residing in urban jurisdictions (OR = 1.30; 95% CI, 1.09–1.54; P = .004).

Age was also associated with receipt of confirmatory diagnosis. Women aged 26–35 years had 41% higher odds of receiving confirmatory testing than women aged 15–25 years (OR = 1.41; 95% CI, 1.11–1.79; P = .005).

Women aged 36–45 years demonstrated slightly increased odds of receiving confirmatory diagnosis compared with younger women; however, this association was not statistically significant (OR = 1.13; 95% CI, 0.88–1.46; P = .333).

Substantial racial disparities were observed. Compared with White women, Black women had significantly lower odds of receiving confirmatory diagnosis (OR = 0.42; 95% CI, 0.34–0.52; P < .001). Similarly, women classified as belonging to other racial groups had significantly lower odds of receiving confirmatory diagnosis than White women (OR = 0.49; 95% CI, 0.25–0.94; P = .033).

The period of diagnosis was not significantly associated with confirmatory diagnosis status (OR = 0.86; 95% CI, 0.73–1.03; P = .110).

Adjusted Model

An adjusted logistic regression model was estimated controlling simultaneously for age, race, residence, and diagnosis period.

After adjustment, the association between place of residence and confirmatory diagnosis was attenuated and no longer statistically significant (OR = 1.07; 95% CI, 0.89–1.29; P = .449).

The association between age and confirmatory diagnosis persisted. Women aged 26–35 years remained significantly more likely to receive confirmatory diagnosis compared with women aged 15–25 years (OR = 1.32; 95% CI, 1.03–1.70; P = .023).

Women aged 36–45 years did not differ significantly from women aged 15–25 years in their likelihood of receiving confirmatory testing (OR = 1.09; 95% CI, 0.84–1.41; P = .510).

Racial disparities remained substantial after adjustment for other demographic factors. Compared with White women, Black women were 55% less likely to receive confirmatory diagnosis (OR = 0.45; 95% CI, 0.35–0.58; P < .001). Women belonging to other racial groups were 49% less likely to receive confirmatory diagnosis than White women (OR = 0.51; 95% CI, 0.26–0.99; P = .049).

The diagnosis period remained unrelated to confirmatory testing after adjustment (OR = 0.91; 95% CI, 0.84–1.41; P = .288).

Overall, age and race emerged as the strongest predictors of receipt of a confirmed chronic HCV diagnosis among women of reproductive age in Maryland.

Qualitative Findings

Participant Characteristics

Seven public health professionals participated in the qualitative interviews. Participants represented local health departments from both urban and rural Maryland jurisdictions.

Most respondents were female and identified as White. Participants included communicable disease surveillance nurses and public health investigators with varying educational backgrounds and years of experience in communicable disease surveillance. Experience ranged from less than 10 years to more than 30 years in public health practice.

Theme 1: Attributes of the Surveillance System

Participants consistently identified electronic laboratory reporting and standardized reporting mechanisms as important strengths of the hepatitis C surveillance system. Respondents reported that most HCV notifications were received through electronic laboratory reporting systems, which facilitated rapid case notification and reduced delays associated with paper-based reporting. Standardized reporting forms and case definitions were described as promoting consistency in case classification across jurisdictions.

Despite these strengths, respondents identified several challenges affecting data quality. Commonly reported issues included incomplete demographic information, delayed data entry, duplication of records, and inconsistencies in laboratory reporting.

Participants also described limitations in interoperability between information systems. Several respondents reported that local systems did not always communicate effectively with external healthcare systems, creating challenges for case investigation and follow-up activities.

Perinatal hepatitis C surveillance emerged as a recurring concern. Respondents indicated that systems for identifying and monitoring exposed infants were inconsistent and often dependent on local resources and staff availability.

Theme 2: Case Investigation, Analysis, and Interpretation

Participants described hepatitis C case investigation as a resource-intensive process requiring prioritization because of competing communicable disease responsibilities. Most jurisdictions relied on established investigation protocols to review laboratory reports, classify cases, and conduct follow-up activities when feasible. However, respondents noted that staffing limitations frequently restricted comprehensive investigation of all reported HCV cases.

Participants reported routinely reviewing demographic trends, geographic distribution of cases, and available risk factor information. Several respondents indicated that surveillance data were useful for identifying populations disproportionately affected by HCV and for monitoring changes in disease patterns over time.

Theme 3: Utilization of Surveillance Data

Respondents reported using surveillance data to guide planning activities, allocate resources, and identify communities requiring targeted outreach interventions. Several participants indicated that

surveillance findings informed public health education activities, screening initiatives, and collaboration with healthcare providers. Data were also used to support grant applications and program planning efforts.

Despite these applications, respondents reported limited resources for translating surveillance findings into sustained prevention programs. The absence of dedicated hepatitis C prevention infrastructure was frequently cited as a barrier to effective public health action.

Theme 4: Communication and Dissemination of Findings

Participants reported multiple approaches for communicating surveillance findings, including internal reports, presentations, stakeholder meetings, and communication with state health authorities. Regular dissemination of surveillance data supported situational awareness and informed decision-making among public health partners. However, respondents indicated that communication with clinical providers could be improved, particularly regarding reporting requirements and follow-up recommendations for women of reproductive age and perinatally exposed infants.

Across jurisdictions, participants emphasized the need for stronger coordination between surveillance programs, healthcare providers, maternal and child health services, and state public health agencies to improve hepatitis C prevention and surveillance outcomes.

4. DISCUSSION

This study evaluated the surveillance system for chronic hepatitis C (HCV) in Maryland jurisdictions using a mixed-methods approach that combined analysis of surveillance data from the National Electronic Disease Surveillance System (NEDSS) with qualitative interviews of public health professionals involved in communicable disease surveillance. The findings provide important insights into both the epidemiology of chronic HCV among women of reproductive age and the operational strengths and limitations of the surveillance infrastructure used to monitor and respond to hepatitis C in Maryland.

The quantitative findings demonstrated that approximately two-thirds of women included in the analysis had completed confirmatory diagnostic testing and were classified as confirmed HCV cases. Although residence appeared associated with confirmatory diagnosis in the unadjusted analysis, the association was no longer statistically significant after adjustment for demographic factors. Instead, age and race emerged as the most important determinants of confirmatory diagnosis. The qualitative findings complemented these observations by identifying surveillance system strengths, including electronic laboratory reporting and standardized reporting procedures, as well as persistent challenges related to data completeness, interoperability, workforce capacity, and perinatal HCV surveillance.

Confirmatory Diagnosis of Chronic HCV

A major finding of this study was that 62.7% of women aged 15–45 years with reported hepatitis C infection had completed confirmatory diagnostic testing, while more than one-third remained classified as probable cases. Confirmatory testing is an essential component of the HCV care continuum because a positive antibody test alone cannot distinguish between current and resolved infection. Current clinical recommendations require nucleic acid testing to establish active infection and determine eligibility for treatment.[1]

The proportion of probable cases observed in this study suggests that gaps continue to exist in the diagnostic pathway following initial HCV screening. Similar findings have been reported in other jurisdictions where incomplete follow-up testing has limited the ability of surveillance systems to accurately estimate disease burden and monitor treatment needs.[2][3] Failure to complete confirmatory testing may result in missed opportunities for linkage to care, delayed treatment initiation, and continued risk of disease transmission.

The findings are particularly relevant among women of reproductive age because undiagnosed chronic infection may increase the likelihood of perinatal transmission. Recent national recommendations emphasizing universal screening during pregnancy have highlighted the importance of complete diagnostic evaluation and linkage to care among women with positive screening results.[4][5]

Age Differences in Confirmatory Diagnosis

Women aged 26–35 years were significantly more likely to receive confirmatory diagnosis compared with women aged 15–25 years. This finding remained statistically significant after adjustment for race, residence, and diagnosis period.

Several explanations may account for this observation. Women in the 26–35-year age group are more likely to engage with healthcare services through reproductive health care, prenatal care, family planning services, and routine primary care visits. Increased healthcare utilization may facilitate completion of recommended diagnostic testing following an initial positive screening result.[6]

Previous studies have similarly reported variations in HCV testing and treatment engagement across age groups. Younger individuals often experience barriers related to healthcare access, insurance coverage, perceived stigma, and lower engagement with preventive health services.[7][8] These barriers may contribute to lower rates of confirmatory testing and delayed diagnosis among younger women.

The finding has important implications for public health practice. Because women aged 15–25 years remain within the reproductive age range and may become pregnant before diagnosis or treatment, targeted interventions to improve confirmatory testing among younger women could contribute to reducing future perinatal transmission of HCV.

Racial Disparities in Confirmatory Diagnosis

One of the most significant findings of the study was the persistent racial disparity in confirmatory diagnosis. Compared with White women, Black women were substantially less likely to receive confirmatory testing even after controlling for age, residence, and diagnosis period. Similar disparities were observed among women classified in other racial groups.

These findings are consistent with a substantial body of literature documenting racial inequities across the hepatitis C care continuum. Previous studies have identified disparities in access to testing, specialist referral, antiviral treatment, and treatment completion among racial and ethnic minority populations.[9–12]

Several factors may contribute to these disparities. Structural barriers, including unequal healthcare access, transportation challenges, insurance limitations, and socioeconomic disadvantage, may reduce opportunities for follow-up testing after an initial positive screening result. Additionally, historical mistrust of healthcare institutions, experiences of discrimination, and differences in healthcare utilization patterns may influence engagement with diagnostic and treatment services.[13,14]

The persistence of racial disparities after adjustment suggests that differences in diagnosis are not explained solely by geographic location or age distribution. Instead, broader social and structural determinants likely influence progression through the diagnostic pathway. These findings support ongoing efforts to address health equity within hepatitis elimination initiatives and highlight the need for targeted interventions aimed at improving diagnostic completion among underserved populations.

Urban–Rural Differences in HCV Diagnosis

The unadjusted analysis demonstrated higher odds of confirmatory diagnosis among women residing in rural jurisdictions. However, this association disappeared after adjustment for demographic characteristics.

The initial finding was somewhat unexpected given previous studies that have documented healthcare access challenges in rural communities, including shortages of healthcare providers, transportation barriers, and limited access to specialty care.[15,16] However, the disappearance of the association in the adjusted model suggests that observed differences may have been attributable to demographic characteristics rather than residence itself.

Recent research has demonstrated substantial variation in HCV epidemiology across rural and urban communities. Although rural areas have experienced increasing HCV incidence associated with the opioid epidemic, surveillance and healthcare delivery systems vary considerably across jurisdictions.[17] In Maryland, local factors such as public health infrastructure, healthcare system organization, and community characteristics may influence diagnostic practices more strongly than geographic classification alone.

The findings suggest that rural residence should not necessarily be viewed as an independent barrier to confirmatory diagnosis within Maryland. Instead, interventions should focus on addressing demographic

and structural factors that influence access to testing and care regardless of geographic location.

Impact of the COVID-19 Pandemic

The study found no statistically significant association between diagnosis period and receipt of confirmatory diagnosis. Although a modest decline in confirmatory testing was observed during the pandemic and immediate post-pandemic period, the difference did not reach statistical significance.

The COVID-19 pandemic disrupted many public health programs and healthcare services throughout the United States. Several studies documented reductions in viral hepatitis screening, diagnostic testing, surveillance activities, and treatment initiation during the pandemic period.[18][19] Resources were frequently redirected toward pandemic response activities, resulting in reduced capacity for communicable disease investigations and routine public health functions.

The absence of a significant decline in confirmatory diagnosis may indicate resilience within Maryland's surveillance infrastructure. Electronic laboratory reporting systems likely contributed to continuity of surveillance activities despite broader healthcare disruptions. Nevertheless, the observed reduction in confirmatory testing warrants continued monitoring, particularly because pandemic-related disruptions may have affected vulnerable populations disproportionately.

Evaluation of the Surveillance System

The qualitative findings identified several strengths of the Maryland hepatitis C surveillance system. Participants consistently described electronic laboratory reporting as a critical component of surveillance operations. Automated reporting improved timeliness of case notification and facilitated rapid identification of reportable conditions.

These findings are consistent with previous evaluations demonstrating that electronic laboratory reporting improves surveillance efficiency, enhances timeliness, and reduces reporting delays associated with paper-based systems.[20][21] Standardized reporting processes and established case definitions were also viewed positively by respondents because they promoted consistency in surveillance activities across jurisdictions.

Another strength identified by participants was the routine use of surveillance data to support program planning, public health education, outbreak detection, and resource allocation. Effective surveillance systems generate actionable information that can inform public health interventions and policy decisions.[22] The findings suggest that surveillance data are actively used within Maryland jurisdictions to guide public health activities.

Despite these strengths, respondents identified several important weaknesses. Data completeness emerged as one of the most frequently reported concerns. Missing demographic information, incomplete laboratory results, and inconsistent reporting practices were identified as barriers to accurate surveillance.

Data quality challenges have been reported in numerous public health surveillance systems and may affect the validity of epidemiologic analyses and public health decision-making.[23] Incomplete data may obscure disparities, reduce the ability to identify populations at risk, and limit evaluation of prevention programs.

Interoperability and Information Exchange

Participants also identified interoperability challenges between surveillance systems and healthcare information systems. Although electronic reporting has improved substantially, respondents reported that information sharing across systems remains imperfect.

Interoperability has become increasingly important as public health agencies seek to integrate information from multiple sources. Fragmented information systems may contribute to duplication of records, delays in case investigation, and incomplete capture of relevant clinical information.[24] Strengthening interoperability remains a priority within national public health modernization initiatives and may improve surveillance effectiveness.

Perinatal Hepatitis C Surveillance

Perhaps the most important qualitative finding involved limitations in perinatal HCV surveillance. Participants consistently described challenges in identifying, monitoring, and following infants born to women with HCV infection.

These findings are particularly important given the increasing prevalence of HCV among women of reproductive age and growing concern regarding perinatal transmission. Previous studies have documented substantial under-identification of perinatally exposed infants and incomplete follow-up testing among exposed children.[25][26]

The CDC's recent recommendations for testing infants and children with perinatal HCV exposure underscore the importance of effective surveillance systems capable of linking maternal and infant records and supporting long-term follow-up.[27] Respondents indicated that existing systems frequently lack mechanisms necessary to track exposed infants systematically, creating potential gaps in case identification and intervention.

Strengthening maternal-infant linkage within surveillance systems may represent one of the most important opportunities for improving hepatitis C prevention and control efforts. Enhanced coordination among maternal health programs, pediatric providers, and communicable disease surveillance programs may improve identification of exposed infants and facilitate timely testing and treatment.

Public Health Implications

The findings of this study have several implications for hepatitis C elimination efforts. First, strategies are needed to improve completion of confirmatory testing following positive HCV screening results.

Second, targeted interventions should address persistent racial disparities in diagnosis and linkage to care. Third, investments in surveillance infrastructure should prioritize data quality, interoperability, and workforce capacity. Finally, surveillance systems should strengthen mechanisms for identifying and monitoring perinatally exposed infants.

As the United States continues to pursue viral hepatitis elimination goals, surveillance systems will remain essential for monitoring progress, identifying disparities, and guiding resource allocation. Continued evaluation of surveillance performance is therefore necessary to ensure that public health agencies can effectively respond to evolving epidemiologic trends and emerging prevention needs.

5. CONCLUSION

This study evaluated the surveillance system for chronic hepatitis C among women of reproductive age in Maryland using a mixed-methods approach that combined surveillance data analysis with qualitative assessment of surveillance practices across local health jurisdictions.

The quantitative findings demonstrated that a substantial proportion of women reported with hepatitis C infection did not complete confirmatory diagnostic testing. Although residence was associated with confirmatory diagnosis in unadjusted analyses, age and race emerged as the strongest predictors after adjustment for potential confounding factors. Women aged 26–35 years were more likely to receive confirmatory diagnosis, whereas Black women and women from other racial groups were significantly less likely to complete confirmatory testing than White women.

The qualitative findings identified several strengths of Maryland's hepatitis C surveillance system, including standardized reporting procedures, electronic laboratory reporting, and routine utilization of surveillance data for public health planning and response activities. However, important challenges remain. These include incomplete reporting, data quality concerns, limited interoperability between surveillance and healthcare information systems, workforce constraints, and insufficient mechanisms for identifying and monitoring infants exposed to hepatitis C during pregnancy.

Taken together, the findings suggest that Maryland's surveillance system provides a valuable foundation for monitoring chronic hepatitis C but requires continued strengthening to support hepatitis elimination goals. Efforts to improve confirmatory testing, address racial disparities in diagnosis, enhance data quality, strengthen interoperability, and improve maternal-infant surveillance linkages may improve the effectiveness of hepatitis C prevention and control activities.

As hepatitis C elimination initiatives continue at the national and state levels, surveillance systems must evolve beyond case reporting alone and increasingly support linkage to care, prevention planning, and long-term monitoring of vulnerable populations, including women of reproductive age and perinatally exposed infants.

Limitations

Several limitations should be considered when interpreting the findings of this study.

First, the quantitative component relied on secondary surveillance data collected through the National Electronic Disease Surveillance System. Surveillance data are collected primarily for public health monitoring rather than research purposes and may contain inaccuracies, incomplete information, or reporting inconsistencies.

Second, several variables of interest contained substantial missing data and were excluded from the final analyses. In particular, ethnicity and marital status were not included in multivariable modeling because of the extent of missing information. Consequently, the study could not fully evaluate the potential influence of these characteristics on confirmatory diagnosis.

Third, the analysis was limited to reported cases captured by the surveillance system. Individuals with undiagnosed hepatitis C infection or cases not reported to public health authorities were not included, which may have resulted in underestimation of the true burden of disease.

Fourth, the cross-sectional nature of the quantitative analysis limits causal inference. The associations observed between demographic characteristics and confirmatory diagnosis should therefore be interpreted as correlational rather than causal relationships.

Fifth, the qualitative component involved a relatively small number of participants representing selected Maryland jurisdictions. Although respondents possessed extensive surveillance experience, their perspectives may not fully reflect the experiences of all local health departments, healthcare providers, or public health stakeholders involved in hepatitis C surveillance activities throughout the state.

Finally, because the study focused on Maryland, the findings may not be fully generalizable to other states with different demographic characteristics, healthcare systems, surveillance infrastructures, or hepatitis C epidemiology.

Despite these limitations, the study provides important insights into the performance of a state-level hepatitis C surveillance system and identifies opportunities for improving surveillance practice, public health response, and prevention efforts among women of reproductive age.

Declarations

Ethics approval: This study was reviewed and approved by the Morgan State University Institutional Review Board (IRB #24/11-0244) Participant consent: Informed consent was obtained from all participants before they took part in the study.

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