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Burden and Risk Factors Associated with HCV Infection among People Living with HIV Infection in Nebraska: Population-Based Cross-Sectional Study from 1997 to 2017

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CONTENTS

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ABSTRACT

Background: Previous studies have shown high prevalence of HCV infection among people living with HIV infection. Coinfected people are at risk of developing liver diseases resulting an increase rate of mortality. Several risk factors for HIV/HCV coinfection have previously been identified with injecting drug users (IDU) as the common route of exposure.

Methods: This was cross -sectional study using HIV and HCV registries maintained by Nebraska Department of Health and Human Services (NE DHHS) from1997 to 2017. A descriptive analysis was used to characterize the sample. Chi-squared test and Fisher exact test were selected to compare the different groups. Univariate and multiple variable logistic regression model chose for the analytical analysis for association between variables.

Results: Of 3256 persons with HIV, 356 were coinfected with HCV resulting a proportion of 11%. Based on HIV diagnosis, 52% persons were coinfected by HCV after being diagnosed with HIV while 48% acquired their HCV before becoming infected with HIV. Exposure by IDU (OR=3.8, 95% CI:2.6-6.7), IDU & Heterosexual contact (OR=3.3, 95% CI:1.8-5.8), MSM & heterosexual contact (OR=2.7, 95% CI:1.1-6.7), MSM & IDU (OR=4.5, 95% CI:2.7-7.5) and all three factors MSM & IDU & Heterosexual contact (OR=4.8, 95% CI:2.1-11.1) had higher odds of HIV/HCV coinfection compare to heterosexual contact alone. MSM alone was not a statistically significant risk factor for coinfection. The 56 years and above age group had highest odds of HCV coinfection. Moreover, coinfected persons had 1.87 odds of dying (95% CI: 1.42-2.45) compared to those with HIV alone.

BACKGROUND

HIV and HCV infections are major global public health problems with overlapping modes of transmission and overlapping affected populations (WHO, 2018). Chronic infection with these viruses is among the greatest challenges facing health care systems in the United States and worldwide (Hadigan & Kottilil, 2011). Globally, there are an estimated 36.9 million people living with HIV infection and 1.8 million people were newly infected with HIV during 2017 (UNAIDS, 2018). Hepatitis C prevalence is even higher, with an estimated 115 million people with chronic infection worldwide (WHO,2018) & (Smith & Sterling, 2007). Looking to HIV/HCV coinfection, the WHO reported that approximately 2.3 million people living with HIV are coinfected with hepatitis C virus (HCV) worldwide with 1.3 million of those injecting drugs (persons who inject drugs; PWID) (WHO, 2018).

Overall, it is estimated that HCV infection affects 2–15% of people living with HIV worldwide (and up to 90% of those are PWID) and the burden of these co-infections is greatest in the African and South East Asia Regions (WHO, 2018). The sub-Saharan African region accounts for the majority of HIV/HCV coinfection worldwide due to the high burdens of HIV in this location (Platt et al., 2016). A study also found that HIV-infected people are on average six times more likely than HIV-uninfected people to have HCV infection; furthermore, among people living with HIV infection, the rates of HCV coinfection are elevated among MSM (6.4%) and among PWID can be as high as 82·4% Platt et al., 2016) &(Cuomo et al., 2018).

In studies from Western Europe and the USA, HCV infection has been found in 25–30% of HIV-positive persons overall; 72–95% of injection drug users, 1–12% of MSM and 9–27% of

heterosexuals (Alter, 2006) and Thomas reported that HCV coinfection occurs in one quarter of HIV-infected persons in Europe, Australia, and the United States (Thomas, 2008). HCV is the cause of more than three-quarters of liver-related deaths among people living with HIV infection, Nowadays, approximately one-quarter of HIV-infected individuals in Europe and the USA have HCV coinfection (d'Arminio Monforte et al., 2009).

In the U.S, the CDC estimates that one quarter of people living with HIV infection in the United States are also infected with HCV, a bloodborne virus transmitted through direct contact with the blood of an infected person (CDC, 2018). But a study using surveillance data from 15 states and two cities in the US which collected data from 504 398 persons living with diagnosed HIV infection at the end of 2014, showed that only 6.7% were coinfected with HCV (Bosh et al., 2018). The CDC also notes that, in the U.S, HIV/HCV confection is common (50%–90%) among injection drug users (CDC, 2018).

Many other risk factors and demographic characteristics have been associated with a risk of HCV coinfection among people living with HIV. These include: being in prison, low socioeconomic status, the presence of one or more tattoos, a history of trading sex for money or drugs, having 11 or more sexual partners, and having sex with an intravenous drug user. But in England, a study showed that the majority acquired HIV and HCV through sex between men 64.9%, followed by injecting drug use; 22.5% and heterosexual contact 12.4% (Ireland et al., 2018).

Since 2000 there has been recognition in developed countries that there has been a dramatic rise in the incidence of HCV among people living with HIV, especially in the group of MSM (Men who have sex with Men) even though sexual transmission of HCV remains controversial in the general population (Danta & Rodger, 2011). Bollepalli et al., using a

multivariate regression model, concluded that only intravenous drug use is a significant risk factor/predictor of HCV/HIV coinfection (Bollepalli et al., 2007).

HIV/HCV Coinfection is associated with high morbidity and mortality, making identification of these cases crucial as HCV infection progresses more rapidly to liver damage among HIV-infected persons (CDC,2018). Compared to people living with HIV but without HCV, HCV coinfected patients were more likely to develop cirrhosis, had an increased risk of developing AIDS, of HIV-related disease and of overall mortality (Andreoni et al., 2012).

Individuals who are coinfected with both viruses are at risk for accelerated liver disease and consequently cirrhosis, liver failure, and hepatocellular carcinoma with a high rate of mortality, especially in developing countries (Operskalski & Kovacs, 2011) & (Matthews & Dore, 2008). Despite tremendous advances in treatment and management of HIV and HCV, individuals with HIV/HCV coinfection experience a more complicated disease course (Hadigan & Kottilil, 2011). Complications due to the coinfection are accountable for an approximate 30% reduction in life expectancy among people who live with these two chronic infections (Leszczyszyn-Pynka et al., 2018).

In Nebraska, there is a need for current studies examining the burden and risk factors associated with HCV coinfection among people infected with HIV infection. This study was undertaken in order to gain an improved understanding of the HIV/HCV coinfection burden in Nebraska with the expectation that interventions by relevant health authorities could be better focused and made more efficient in order to prevent and decrease the burden of HCV coinfection among people infected with the HIV infection.

In this study we aimed to determine:

1) The prevalence and the sociodemographic characteristics of HCV coinfection among people living with HIV infection in Nebraska from 1997 to 2017
2) The temporal and spatial distribution of HCV coinfection among people living with HIV infection in Nebraska from 1997 to 2017
3) The risk factors for HCV coinfection among people living with HIV in Nebraska from 1997 to 2017

METHODS

Study design and data sources

This was a cross-sectional study using surveillance data from separate HIV/AIDS and HCV registries. The HIV/AIDS data is stored in the Enhanced HIV/AIDS Reporting System (eHARS) which is a browser-based, CDC-developed application that assists health departments with data reporting, data management, and data transfer to CDC.

All Electronic Lab Reports (ELR) are received by the Nebraska Diseases Surveillance System (NEDSS), which is the web-based disease surveillance system for most reportable diseases including HCV and HIV. Prior to the NEDSS, the reportable diseases were stored in the Telecommunications System for Surveillance (NETSS). The HIV lab reports are then imported into eHARS using a CDC-developed import process through SAS software.

To obtain the final dataset which contains all HIV patients having positive lab report for hepatitis C, we merged the three datasets (NETSS, NEDSS and eHARS) and then de-identified using a unique identifier for everyone represented in the dataset using SAS.

Approval for the study was obtained from the Institutional Review Board (IRB) at the University of Nebraska Medical Center and all patient data was de-identified to avoid any risk to patient confidentiality.

Eligibility criteria

The merging process of the registries generated a dataset of 5288 patients from 1983 to 2018. This original dataset contains all the newly diagnosed patients with HIV/AIDS and 424 were coinfected with HCV.

After, applying the following selection criteria:

- People newly diagnosed with HIV infection between 1997 to 2017. The implementation of highly active antiretroviral therapy (HAART) in 1996 dramatically altered the life expectancy, and potentially the behavior, of HIV-infected individuals. Patients with much longer expectancies have more time and opportunities to acquire additional infections such as HCV infection. We thus chose to limit our study to the HAART era
- Reported and enrolled as person living with HIV/AIDS in Nebraska at DHHS registries.
- Person HIV infected, tested for hepatitis C and the result reported to the NE-DHHS

The final dataset contains 3236 people living with HIV and 356 coinfected with HCV

Modeling and Statistical analysis

This study is divided in three parts as following:

- A descriptive analysis was conducted in order to summarize the characteristics of the study sample, including sociodemographic characteristics and effects of HCV coinfection among people living with HIV. This was accomplished by comparing the different

proportions (percentage) of people living with HIV infection and those with the coinfection HIV/HCV. Frequencies were generated to compare the different groups.

- Our study focused on describing the characteristics of those with the coinfection HIV/HCV and identified risk factors associated with HCV coinfection among HIV infected patients. Univariate and multiple logistic regression analyses were conducted in order to assess the influence of these risk factors.
- Finally, a descriptive analysis was conducted in order to compare people diagnosed as having HCV before HIV with those who acquired HCV after receiving an HIV diagnosis.

All variables were transformed to categorical variables and patients were stratified in specific groups to reduce interaction and confounding effects. Fisher's exact test was used for the descriptive analysis. The Interaction among the following variables was checked and all analysis was conducted using SAS 9.4. The alpha level of 0.05 and confidence interval excluding 1 were used to determine the statistical significance. ArcGIS was used to determine the geographical distribution of HIV/HCV coinfected patients within Nebraska.

Variables:

The principle outcome variable in our study was HIV/HCV Coinfection. A person with HIV/HCV coinfection is defined as someone who has both infections. The main exposures (transmission categories) were grouped into MSM only, IDU only, Heterosexual contact, MSM and IDU, MSM & Hetero, IDU and Hetero, MSM & IDU & Hetero, and other (Perinatal, No Identified Risk, No Reported Risk).

RESULTS

Of a total 3236 persons reported to the NE-DHHS from 1997 to 2017 as persons living with HIV/AIDS and 356 people were coinfected with HCV as result, the estimated proportion of HCV among people living with HIV/AIDS was around 11%.

Figure 1 below represents the percentage per year of HCV coinfection among PLWHA in Nebraska with an overall increase from 1997 to 2015 and a slight decrease since 2015

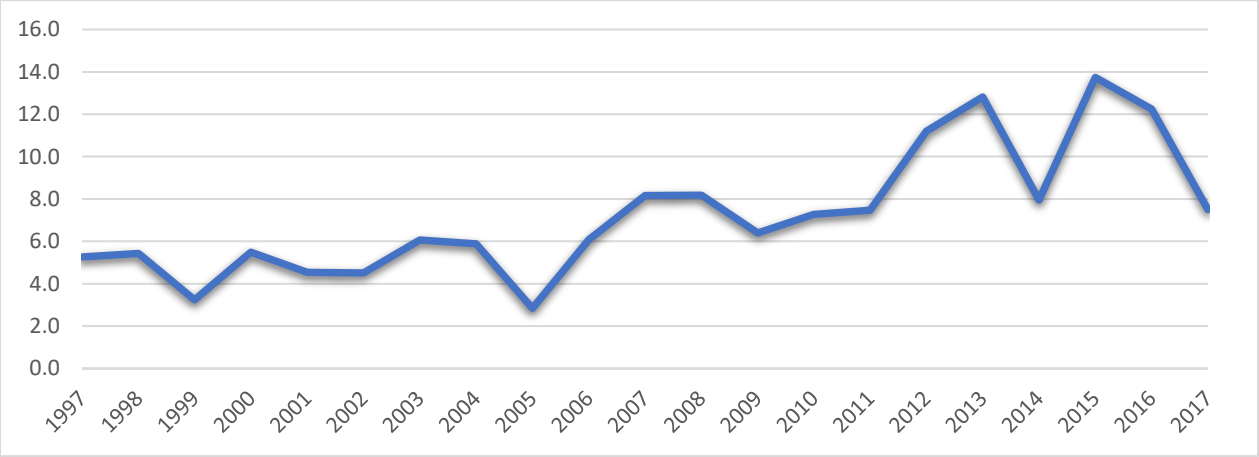

Figure 1: Proportion(percentage) of HCV infection among PLWHA in Nebraska, 1997-2017

Figure 2 and 3 below shows the geographical repartition of HIV infection and HIV/HCV coinfection in Nebraska during 1997 to 2017. Most of reported cases of HIV/AIDS infection and HIV/HCV coinfection were in Douglas and Lancaster health districts.

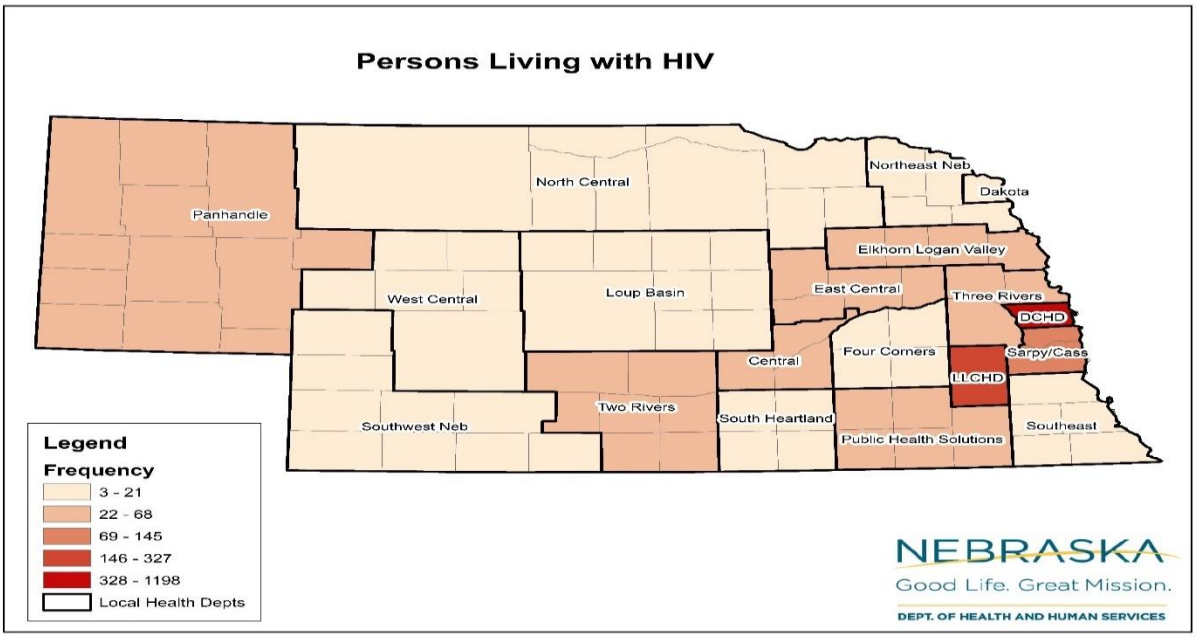

Figure 2: Distribution of HIV infection only per health district between 1997 to 2017 Nebraska

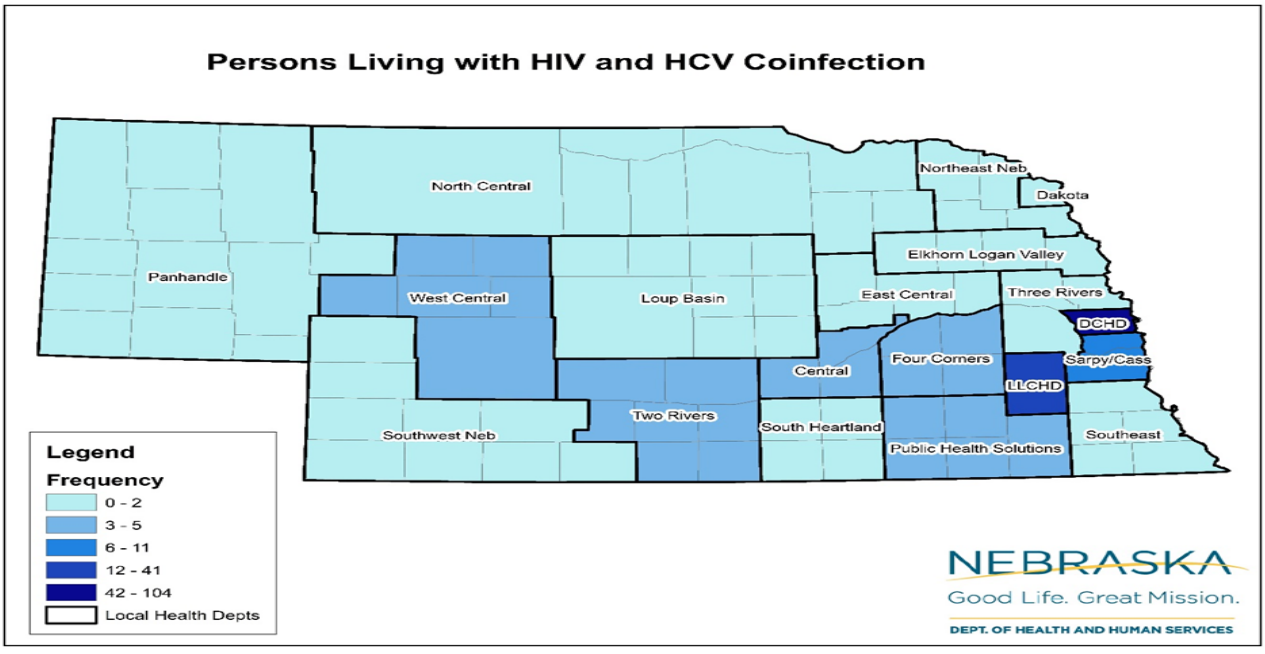

Figure 3: Distribution of HCV/HIV coinfection per health district between 1997 to 2017, in Nebraska

Table 1 describes the characteristics of people living with HIV infection and those living with HIV/HCV coinfection. The total number of people living with HIV/AIDS (PLWHA) was 3236 and 356 persons were coinfected. Non- Hispanic whites represented over 50% of cases and non-Hispanic blacks composed around the third of cases. The proportion of Hispanics among PLWHA was found to be15% vs 8% for HIV/HCV coinfection.

Males accounted for approximately 80% of cases of PLWHA, as well as 80% of coinfected people. Men who sex with men (MSM) represent 46.5% of PLWHA and only 39 % for coinfected persons. A heterosexual exposure was found in 15.9% among PLWHA compared to 9.5% for people coinfected with HCV. The proportion of injection drugs users (IDU) was 3 times higher among people with coinfection HCV compared to those with HIV infection only. There was no identified risk or reported risk in 24.4% of PLWHA and 18% of coinfected patients.

When examining by age, approximately 2/3 of cases were between 26 to 45 years, with a tendency towards older age among people with HIV/HCV coinfection. The percentage of foreign-born individuals was 28.4% among PLWHA vs 17.3% for those with coinfection. The stage of HIV infection was similar between the two groups, but the number of deaths was approximately twice as high (22.7% vs 13.6%) among people with coinfection compared to those with HIV only.

Table 1: Descriptive characteristics of people living with HIV/AIDS vs People coinfected with HCV in Nebraska from 1997 to 2017

	HIV only (%)	HIV/HCV (%)
Race		
White	1482(51.4)	207 (58.1)
Black	798 (27.7)	96 (26.9)
Hispanic	**426(14.7)**	**30 (8.4)**
Asian	62(2.1)	5(1.4)
Multi-race	54(1.8)	10(2.8)
Other (AI/AN, NHw/PI)	58(2)	8(2.2)
Gender		
Male	2245(78)	268(75.3)
Female	635(22)	88(24.7)
Exposure		
MSM only	1339(46.5)	139(39)
IDU only	94(3.2)	**31(8.7)**
Heterosexual only	459(15.9)	**34(9.5)**
MSM and IDU	130(4.5)	44(12.3)
IDU and Hetero	94(3.2)	27(7.6)
MSM & Hetero	33(1.1)	7(2)
MSM & IDU & Hetero	27(0.9)	10(2.8)
Other	704(24.4)	64(18)
Age group		
Less than 16	55(1.91)	1(0.28)
17-25	555(19.2)	48(13.4)
26-35	1029(35.7)	100(28)
36-45	768(26.6)	129(36.2)
46-55	374(13)	60(16.8)
56 and above	99(3.4)	18(5)
Birth Country		
USA	2058 (71.4)	295(82.9)
Foreign	822(28.5)	61(17.1)
State of HIV diagnostic		
Nebraska	1844(64)	207(58.1)
Non-Nebraska	1036(36)	149(41.8)
HIV stage		
Acute HIV	1378(47.8)	158(44.4)
Clinical Latency	1493(51.8)	198(55.6)
AIDS	9(0.31)	0(0)

Vital Status		
Alive	2484(86.4)	275(77.2)
Death	**391(13.6)**	**81(22.7)**
Total	2880	356

Other/Exposure: (Perinatal, No Identified Risk, No Reported Risk, Sharing Sex Toys, etc.); other/Race: (Native Hawaiian/Pacific Islander, Native American/Alaska Natives).

Table 2 shows odds ratios associated with different characteristics and risk factors of HIV/HCV coinfected people. Among the variables considered in the model, using heterosexual contact only as reference group, MSM had 1.4 times odds of HIV/HCV coinfection but this estimate was not statistically significant (CI=0.9-2.1). However, IDU, IDU & Hetero, MSM & hetero, MSM & IDU, MSM & IDU & Hetero had a significant increase in the odds of HIV/HCV coinfection with respective odds ratios of 3.8, 3.3, 2.7, 4.5 and 4.8. Referring to the 17-26 years age group as a reference, 36-45 years old (OR=1.7, 95% CI: 1.2-2.5), 46-55 years old (OR=1.7,95% CI: 1.1-2.6) and 56 years old and above (OR=2.1, 95% CI: 1.1-3.7) had significantly increased odds of having HIV/HCV coinfection. Based on the birth country and comparing to USA born, foreign born had 0.7 odds of having HIV/HCV coinfection, this estimated was statistically significant (OR=0.7, 95% CI=0.4-0.9).

Table 2: Multivariable analysis results summarizing the odds ratio of HIV/HCV coinfection

	Crude OR	95% Wald CI
Race		
Asian vs White	1.1	0.4-3.1
Black vs White	1.2	0.9-1.6
Hispanic vs White	0.8	0.5-1.27
Multi-race vs White	1.7	0.8-3.5
Other vs White	0.8	0.3-1.8
Exposure category		
MSM vs Hetero	1.4	0.9-2.1
IDU vs hetero	3.8	2.2-6.7
IDU & Hetero vs Hetero	3.3	1.8-5.8
MSM & Hetero vs Hetero	2.7	1.1-6.7
MSM & IDU vs Hetero	4.5	2.7-7.5
MSM & IDU & Hetero vs Hetero	4.8	2.1-11.1
Other vs Hetero	1.4	0.9-2.1
Birth sex		
Female vs Male	1.2	0.9-1.6
Age group		
26-35 vs 17-25	1.1	0.7-1.6
36-45 vs 17-25	1.7	1.2-2.5
46-55 vs 17-25	1.7	1.1-2.6
56-above vs 17-25	2.1	1.1-3.7
Less than 16 vs 17-25	0.2	0.0-1.8
Birth Country		
Foreign vs USA	0.7	0.4-0.9
State		
Non-Nebraska vs Nebraska	1.2	0.9-1.5

Table 3 summarizes the descriptive characteristics of HIV/HCV coinfected people based on the timing of HIV diagnosis. Of a total 356 coinfected cases, 248 had enough information to enable a determination as to which infection was diagnosed first. Of those 248 persons, 129 were diagnosed with HCV after the HIV and 119 were diagnosed with HCV before HIV infection. The proportion among different races/ethnicities was approximately similar between people having the HCV before or after HIV infection started. There was not a significant difference in gender between the two groups. When considering exposure, IDU was twice as prevalent among

people diagnosed with HCV before HIV compared to those diagnosed with HCV after HIV. The proportion of people over 46 years old having HCV before HIV was 2 times higher than those having HCV after HIV infection. The proportion of Non-Nebraskans (moved from another state to Nebraska) who contracted their HCV infection after HIV was approximately twice that of those who were infected with HCV first.

Table 3: Descriptive analysis of HIV/HCV coinfection comparing HCV diagnosed after HIV onset vs HCV diagnosed before HIV

	HCV after HIV	HCV before HIV
Race		
White	74(57.3)	76(63.8)
Black	34(26.3)	27(22.7)
Hispanic	10(7.7)	11(9.2)
Asian	2(1.5)	2(1.7)
Multi-race	6(4.6)	0(0)
Other (AI/AN, NHw/PI)	3(2.3)	3(2.5)
Gender		
Male	98(76)	96(80.7)
Female	31(24)	23(19.3)
Exposure		
MSM only	61(47.3)	46(38.6)
IDU only	7(5.4)	12(10.1)
Heterosexual only	12(9.3)	12(10.1)
MSM and IDU	14(10.8)	11(9.2)
IDU and Hetero	9(7)	4(3.3)
MSM & Hetero	1(0.8)	3(2.5)
MSM & IDU & Hetero	4(3.1)	1(0.8)
Other	21(16.3)	30(25.2)
Age group		
Less than 16	0(0)	1(0.8)
17-25	23(17.8)	16(13.4)
26-35	42(32.5)	31(26)
36-45	46(35.6)	38(31.9)
46-55	14(10.8)	24(20.2)
56 and above	4(3.1)	9(7.5)

Birth Country		
USA	105(81.4)	98(82.3)
Foreign	24(18.6)	21(17.6)
State of HIV diagnostic		
Nebraska	71(55)	96(80.7)
Non-Nebraska	58(45)	23(19.3)
Total	129	119
HIV stage		
Acute HIV	51(39.5)	58(48.7)
Clinical Latency	78(60.5)	61(51.3)
AIDS	0(0)	0(0)
Vital Status		
Alive	94(72.9)	93(78.2)
Death	35(27.1	26(21.8)
	129	119

Estimated mortality: in a univariate analysis with death as the outcome, coinfected HCV/HIV had 1.87 odds of dying compare to those with HIV infection only (OR=1.87; 95% CI: 1.42-2.45).

DISCUSSION

Our study found an estimated proportion of HCV infection among PLWHA of 11%, this proportion is less than the overall estimate reported by the Centers for Disease Control and Prevention (2018) of about 25% and less than the 25-30% reported by Alter et al. (2006) in Europe and the U.S. In contrast, a population-based study using surveillance data from 15 states in the US and involving 504,398 persons living with diagnosed HIV infection in 2014, revealed that only 6.7% were coinfected with HCV (Bosh et al., 2018). This study estimated the proportion of HCV among newly diagnosed HIV infection which may explain the differences with other studies referring to the prevalence or the incidence rate.

The incidence of HIV/AIDS infection has declined over the past two decades, but the prevalence of HCV coinfection increased over the past two decades in Nebraska. This trend was corroborated by Smith & Sterling (2007) who also reported an increase in acute HCV from 2007 to 2010. According to Hagan et al. (2002) and Edlin, Eckhardt, Holmberg & Swan (2015), public health surveillance tools may misrepresent the true rates due to under-reporting of cases of high-risk groups and because better programs of screening may explain the constant increase in the number of HCV cases reported to health authorities. Since 2015, a decrease of proportion of notified cases has been seen, but future investigations are needed in order to understand the real cause of this diminution.

Most cases of HIV/HCV coinfection were reported in the Douglas and Lancaster County health districts; this is almost certainly due to the number of people in these two counties, which account for around 50% of persons of all Nebraska according to Nebraska Department of Health and Human Services (2015).

This study showed that non-Hispanic Whites represented approximately two thirds of all cases and non-Hispanic Blacks represented approximately one quarter of all cases. In Nebraska, 80% of people are non-Hispanic white and 4.7% are non-Hispanic Black (Nebraska Department of Health and Human Services, 2015); therefore, Blacks seem to have a high incidence than whites in both the PLWHA and HCV coinfection groups). Silverberg, Leyden, Quesenberry & Horberg (2009) found similar results in a retrospective cohort study of 4,686 HIV-infected patients. Multivariate analysis of our data showed that the odds of having HCV coinfection was not statistically significantly different when comparing whites to other races. In England, a study based on national surveillance using Public Health England HIV/AIDS

database, Blacks had a 3.19-fold increase in the odds of having HIV/HCV coinfection. (Ireland et al., 2018)

The ratio of males to females was approximately 4:1 among PLWHA and among those coinfected with HCV. A similar study using surveillance data in New York obtained approximately the same results males accounting for 70-80% of those living with HCV coinfection (Prussing et al., 2015). Comparing female and males, the odds of having HCV coinfection was not statistically significant (OR=1.2; 95% CI 0.9-1.6; see table).

This study showed that most people in Nebraska were infected because they were Men who have Sex with Men (MSM) and/or Injection Drug Users (IDU). Around 40% of HCV coinfected individuals acquired their infections through MSM and over 40% were IDU in addition to other types of exposure. In the multivariate analysis, using heterosexual as reference, IDU only, IDU & Hetero, MSM & Hetero, MSM & IDU, MSM & IDU & Hetero had significant odds of having HCV coinfection (Table 3).

MSM had 1.4 times the odds of HIV/HCV coinfection compared to the Hetero group, but this estimate was not significant (CI=0.9-2.1). Several authors have corroborated these findings, Bollepalli et al. (2007) found that HCV coinfection was associated with IDU but not with sexual risk factors and the distribution of sterile needles produced a decline in the prevalence of HIV among IDU (Burt & Thiede,2016). Another study showed that there was a low prevalence of HCV coinfection among non-IDU with high-risk sexual behavior, similar to our conclusions regarding MSM. (Chew et al., 2015). The Centers for Disease Control and Prevention (2011) reported that 59.9% of hepatitis cases were associated with the use of injection drugs and only 12.9% were associated with sexual exposures.

There was a difference in the distribution of HIV/AIDS and HCV coinfection among the different age groups; HIV/AIDS proportion was highest among the 26-35 age groups and HCV coinfection was highest among the 36-45 age group. HCV coinfected patients tend to be older compared to the HIV infected only group. After examining the coinfected patients only, those ages 36-45, 46-55 and 56 and above had positive significant odds of having HIV/HCV coinfection compared to the 17-25 age group. Furthermore, this study showed that the 56 and above age group had 2.1 times odds of having HCV coinfection compare to the 17-25 age group. Most programs are targeting the younger age group (17-25), but this study showed that older people were more at risk for HCV coinfection may be due to some risk factors/ sexual risk behaviors and IDU; furthermore, thes persons have lived longer compare to young people with more opportunities to be exposed.

The proportion of foreign-born individuals is lower among those coinfected with HCV and multivariate analysis showed that the foreign born had 0.7 times odds of having HCV coinfection compare to USA born persons with 95% CI= 0.4-0.9. It is known that t foreign born individuals have higher odds of having HIV infection (table 3), but our study showed that the risk of HCV coinfection is lower. These results need to be investigated further for confirmation.

The mortality rate was high among HCV coinfected persons; the current study concluded that having HCV coinfection increased by 1.87 times the odds of dying compared to having HIV infection only (OR=1.87; 95% CI: 1.42-2.45). Several studies have published similar results regarding an increase of the mortality rate among those coinfected with HCV (Prussing et al., 2015). This high mortality is likely related to liver damage and the acceleration to AIDS (Andreoni et al., 2012).

Of a total of 248 persons with HIV/HCV coinfection, 129 persons were infected with HCV after the HIV started compare to 119 persons who had HCV before the HIV infection. we could not figure out which group had the higher odds due to the sample size and the type of study design. Future studies are needed to determine which group is more at risk; these may help to focus effort for preventing the state of HCV coinfection.

LIMITATIONS AND RECOMMENDATIONS

Missing information and underreporting were on the limitation of this study. Many persons did not have all their information recorded making challenging the analysis process. Moreover, this fact decreased the sample size, and the consequence is the loss of power. Underreporting is a limitation because we could find the exact number of people with HCV coinfection. Due to the data collection method, we could not capture the real number of people moved out-Nebraska having coinfection and should be taken into consideration in the reporting electronic system.

Based on the results of this study, an improved data surveillance of HCV infection, widespread adoption of electronic health record systems and electronic information exchange can provide a wealth of new data sources and better monitor the true incidence of HCV infection among people. High-risk PLWHA should be monitored and targeted for preventive measures to prevent HCV coinfection. Finally, there is a need for future studies to identify the best public health interventions to decrease the HCV coinfection among PLWHA in Nebraska.

CONCLUSION

This study showed that the odds of having HCV coinfection were not statistically significant based on race. The odds of having HCV coinfection was significant with IDU used and increased in the case where IDU was associated to another risk sexual behavior, but surprisingly MSM did not show any increase odds of HCV coinfection compare to the heterosexual group. Furthermore, it is found that 36 years and above had higher odds of having HCV compare to 17-25 age group. The mortality was increased among HCV coinfected people. Future and better study designs are needed to better understand the epidemiology of some specific groups such as foreign-born. Future and better study designs are required to understand better some the burden of HCV coinfection among PLWHA in Nebraska.

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