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Examining the Impact of HIV Medical and Social Case Management Program on Viral Load for Clients Living with HIV/AIDS in Nebraska

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Placement Site: Nebraska Department of Health and Human Services (DHHS)

The DHHS Nebraska is one of the largest state-governmental agencies that provide critical human and health services to all Nebraskans. The services provided by the DHHS aim to improve Nebraskans well-being, and it is regulated through 5 main divisions; Behavioral Health, Children and Family Services, Developmental Disabilities, Medicaid and Long-Term Care, and Public Health. (Nebraska Department of Health and Human Services [NE DHHS, 2017])

The majority of this project completed under the public health division that has two subsections. First, the Health Licensure and Health Data section, which is responsible for epidemiology and informatics, licensure, health-related investigations, public health preparedness and emergency response, and vital records such as death certificates. Second, Community and Environmental Health section, which is responsible for environmental health, lifespan health services, health promotion, and community and rural health planning. (NE DHHS, 2017)

Service learning activities

Multiple activities have been performed during the service learning hours. The main activities involved drafting the housing need survey to address the housing status for Ryan White (RW) clients in Nebraska, identifying the unmet needs for HIV-infected individual in the state, identifying local dental providers who are willing to provide services to RW clients who have no dental insurance, and reviewing the Nebraska HIV Ryan White standards of care. Here are the details of these activities:

Housing Survey Development

a. Drafting and developing a housing survey which started with defining the needs and the goals of the survey, then reviewing other housing surveys performed by peer-state health departments. Housing needs assessment survey designed to help case managers and program planners address the current housing status and needs for RW clients.

b. Discussing the appropriate form of incentives to thank survey respondents for their time and to increase the response rate.

c. Develop an introduction letter for the Housing Survey. This letter is crucial to get good return rate because it describes survey goals, how it works, the confidentiality of collected information, why it is important to participate, how long it takes to complete the survey, and what direct benefits can a participant get after completing the survey.

Identifying Unmet Needs for HIV persons in NE

This is a national project meant to determine the number of individuals who know they are HIV-positive but are not receiving regular HIV-related primary medical care or those who are out of care. It allows State Health Departments to address the shifting demographics of new HIV/AIDS cases throughout the State. Also, it helps in adapting care systems to respond to the needs of emerging communities and populations. In fact, I was lucky to be a part of this team who is working on this project as it allowed me to practice the epidemiological concepts to identify the population at risk, distribution of health concerns, and contribute in national planning and resource allocations. Although, I was unable to complete this project because of the time as I reached my end of service learning hours, I learned about the type of data used for this project, and the process toward computing the unmet needs

Identifying Local Dental Providers who are willing to provide services to Ryan White clients who have no dental insurance.

Dental health care is a crucial part of HIV treatment plans as it affects persons' overall health. However, many of HIV infected persons are unable to pay for dental care or don't have dental insurance. Thus, we worked on building a network of local dental providers to offer oral care for RW Clients. I had the opportunity to communicate with local dental providers by phones, explaining the goals of our project and prepare a list of dental providers who were interested in participating.

Ryan White Program meetings

I had the chance to attend several meetings with HIV case managers regarding the housing survey and my project. For the housing needs survey, we focused on improving the contents, and find the best way for survey distribution and collection. For the capstone project, we discussed about the Case Management program enrollment process, and the application forms completed by the clients. Also, I verified the definitions for some of reported variables in the dataset such as medication adherence, so I can be familiar when doing the analysis. Additionally, we discussed what the case managers are looking to find about their RW clients, and how our study findings would help program managers in future works.

Abstract

Case management (CM) is one of the standard practices that has been implemented since 1990 to help people living with HIV/AIDS (PLWHA) in the United States. The program is designed for low-income populations and it aims to address the barriers related to access to health care and improve the HIV outcomes. Previous studies identified a positive association with the provision of CM and improvement in viral outcomes. Increasing the viral suppression rates among HIV diagnosed individuals proved to reduce the risk of transmitting the infection, and disease incidence. Although CM program is provided to Nebraskans diagnosed with HIV, but little is known about its effect on clients' viral outcomes. Thus, we aimed to define the case managed population in Nebraska, addresses the impacts of CM on HIV outcomes, and identify risk factors associated with unimproved HIV outcomes.

Methods. We conducted a retrospective observational cohort study utilizing the Ryan White Provide© Case Management Database which contains the demographic information for all clients served, along with calendar dates of viral load tests and CD4+ cell counts. The primary outcome, viral load improvement (improved vs. not-improved), was computed based on the baseline and the last viral load results. Improved group included; 1) those who had suppressed viral load when entered into the CM and continue to be virally suppressed, and 2) those who entered with unsuppressed viral but developed suppression while they were in the CM program.

We analyzed the data for 385 subjects who had at least two viral load results available in the database and the last result was reported in the last three years (2016-2018.

Results: The overall viral suppression rate increased from 63% at baseline to 88% after enrollment, and only 45 out of 385 (11.7%) did not develop viral suppression. The lowest viral improvement observed among these groups who were female (26.8%), uninsured (15.2%), ≤ 40 years of age at baseline (46.2%), non-adherent to treatment (2.2%), and those who started the CM with a non-suppressed viral load (7.3%).

Conclusion.   Case management programs serve predominantly low-economic population, yet we found the viral suppression rate increased remarkably among the CM clients after enrollment and it is relatively high compared to the national and state rates. However, in order to improve community's health, we need to focus on certain minorities that had low viral suppression rates.

Introduction

Problem Statement

Medical and social comprehensive HIV care programs result in positive overall health outcomes in similar intervention programs conducted across the U.S. However, little is known about the effectiveness of this intervention among persons with HIV/AIDS in Nebraska. Thus, this project will describe the medically case managed clients' characteristics, the effectiveness of this intervention and identify risk factors associated with having non-suppressed viral load results after enrollment.

Hypothesis

We hypothesize that the comprehensive medical and social HIV case management program has an impact on patients' biological outcomes, viral load, after program enrollment.

Literature Review

Progress has been made to improve the quality of life, longevity, and to minimize the opportunities for transmitting the infection for people living with human immunodeficiency virus (HIV) in the United States. However, according to the Center for Disease Control and Prevention (CDC), an estimated of 37,600 new US residents were infected in 2014, and by the end of 2015,

over 1.2 million adults and adolescents were living with HIV in the U.S, while about 15%, or 1 in 7, were unaware of their infection. (CDC, 2017) Among those living with HIV in 2014, about 62% received some HIV-related medical care, and only 49% had achieved viral suppression. (CDC, 2017)

Viral suppression refers to the inability of the HIV test to detect the virus due to a very low level of the virus in the blood or the observation of fewer than 200 copies of HIV per milliliter in a blood sample, which means the risk of disease progression is low. (CDC, 2017) Basically, it means that if the HIV patient adhered to prescribed treatments and maintained virally suppressed, he/she would no longer pose a risk to their partners. However, if the infection was not controlled and the disease progressed, then the viral load increases in the blood and the count of $CD4^+$ T cells, a type of white blood cells that fights the infection, will decline, which affects the overall person's immunity and may pose a threat of transmitting the virus to others. (CDC, 2018) Viral load and $CD4^+$ T-cell counts are used clinically to determine a patients' infection status and their response to prescribed treatments. (WHO, 2018)

According to NE DHHS, in the state of Nebraska, a total of 2,247 persons were living with HIV/AIDS by the end of 2015, and the HIV incidence rate was 4.27 per 100,000 persons in the same year. The incidence was similar to that of the U.S with a range of 81-88 cases reported per year for the five-year period from 2010 to 2015. The highest rate of new infections occurred among the 15-34 age group (57%), males (85%), and white non-Hispanic persons (58%). The most frequent exposure routes for new infections reported from 2011 to 2015 was men having sex with men (63%) followed by heterosexual exposure (8.2%). Among females, 54.7% of new cases were attributed to heterosexual contacts followed by 7.9% by exposure to injection drugs. (DHHS 2016)

People living with HIV/AIDS in Nebraska are supported by many federal services provided through the state health department including Ryan White Part B, C and D programs, and the Housing Opportunities for Persons with HIV/AIDS (HOPWA) program.

Ryan White Program

This program was named to honor Ryan White who was diagnosed with AIDS at age 13 because of contaminated blood treatment in 1984. His community in Indiana rallied against his right to attend the school due to the concern of spreading the disease, as HIV and AIDS were poorly understood at that time. A few months after he died, the Ryan White program was authorized by the Congress in August 1990 under the Ryan White Comprehensive AIDS Resources Emergency (CARE) Act, and it is the largest federal source of funding for people living with HIV/AIDS in the U.S. (Health Recourses and Services Administration [HRSA], 2016)

The funding goes toward improving care to HIV/AIDS patients and their families who are uninsured or underinsured and who live in low economic status. (NE DHHS, 2016) The program reached around 52% of all HIV individuals diagnosed in the US, and every year, over 500,000 HIV individuals nationally are receiving HIV care and treatments through cities, states, and local community-based organizations. (HRSA, 2016) In 2016, the program was funded at $2.32 billion, and it is operated by the U.S. Department of Health and Human Services (HHS), Health Resources and Services Administration (HRSA), and HIV/AIDS Bureau (HAB). (NE DHHS, 2016)

Funding for the Ryan White program is divided into five parts: Part A provides for medical and support services targeting the most populated areas affected by the HIV/AIDS; Part B aims to improve the quality, availability, and organization of HIV health care and support

services; Part C provides for outpatient HIV early intervention services and ambulatory care and it is administered by local community-based organizations; Part D supports comprehensive care to women, infants, children, and youth living with HIV; and Part F supports research and technical assistance. (NE DHHS, 2016)

Nebraska receives funding through Part B, C and D, and approximately 1,276 Nebraskans with HIV/AIDS were served by the Ryan White program in 2015. It provides economic assistance for rent, utilities, transportation, health insurance, food, case management, and nutritional supplements. (NE DHHS, 2016) The services provided by the Ryan White Program Part B are classified into core medical services and support services. Core medical services include the AIDS Drug Assistance Program (ADAP), AIDS pharmaceutical assistance, early intervention services, home health care, hospice services, health insurance premiums, cost-sharing assistance, home and community-based health services, mental health services, oral health, medical nutrition therapy, outpatient and ambulatory medical care, and Medical case management. Additionally, the RW program provides non-medical supportive services that are linked to medical outcomes, which include medical transportation, linguistic services, respite care, referrals for health care, child care services, and residential substance use disorder treatment services. (NE DHHS, 2016) In fact, most of these services are inaccessible for HIV patients without support from the RW program, which is considered as the "payer of last resort."

Several studies pointed to the critical role of the RW program for HIV patients and especially to the low-income population. The services provided through the RW programs have been associated with improving clients' viral load suppression, engagement in care, and these individuals were more likely to receive antiretroviral therapy (ART) than non-RW program HIV patients (Diepstra et al., 2017) and (Doshi et al., 2014). These core medical and supportive

services usually are provided to HIV/AIDS patients who are eligible to enroll in the Case Management program.

Medical Case Management

Case management or Comprehensive Medical Case Management Program is one of the standard practices used to help PLWHA in the in the U.S since 1990, which promotes access to health care for low-income patients. (Kushel et al., 2006). CM programs, funded through the Ryan White program, aim to improve HIV patients' engagement in care and treatment adherence by minimizing obstacles that affect patients' access to care such as housing, transportation, poor health literacy, and economic issues. (Brennan-Ing et al., 2016). In general, the prevalence of HIV is higher among gay and bisexual men, African American, people who are at or below the poverty level, individuals with less than a high school education and those who are unemployed. (Song et al., 2011) Ryan White services, specifically the case management program, found to be highly effective for these populations.

A randomized control study of a brief case-management intervention on newly HIV diagnosed individuals found a strong association between CM use and an increased rate of HIV care engagement. (Gardner et al., 2005) Another study found that as the rate of meeting with a case manager increases, the $CD4^+$ T-cell counts, cells that fight the HIV, also increases. (Kushel et al., 2006) Moreover, the total cost of treatments increased during the period that patients were in the CM, which reflects the increase in health care utilization and medication usage. (Brennan-Ing et al., 2016) A 1-year pre-post study for Ryan White case management clients in New York City observed that among newly diagnosed patients who were diagnosed with HIV in the last 12 months prior to enrollment 90.5% achieved engagement in care and 66.2% reached the viral load suppression. For patients who have been diagnosed with HIV more than 1 year prior to study

enrollment, called previously diagnosed, their engagement in care increased from 73% to 91% and the VLS increased from 32% to 51%. (Irvine et al., 2015)

Medical and Social Case management in Nebraska

In Nebraska, HIV medical and social case management services were provided in cooperation with the Nebraska AIDS Project (NAP) in five locations across the state; Omaha, Lincoln, Norfolk, Kearney, and Scottsbluff. In the 2015 fiscal year, around $463,944 was allocated for medical case management, and around 474 clients received some type of service. (NE DHHS, 2016) The majority of clients were male (70%), in the age group of 25-64 years (89%), white (64%), non-Hispanic (82%), and (62%) were below 100% of the federal poverty level. (NE DHHS, 2016) Despite all nationally and locally outstanding efforts, gaps still exist in care, treatment, and prevention in the state. It is estimated that in 2015, among those living with HIV in Nebraska (2,217 patients), only 42.2% were linked to care, and about 75% were virally suppressed. (NE DHHS, 2016)

Purpose and rationale of the study

Medical and social case management services for HIV patients have been found to be associated with improved patient outcomes by increasing patient engagement in care and reducing viral load. In other words, failure to keep HIV patients in the case management program can lead to adverse outcomes for the patient and his/her community. Thus, these programs seem to be critical for reducing co-morbidities and improving survival for patients infected with HIV. This study defines the HIV case-managed population in Nebraska and describes any existing variation of viral load outcomes between different clients' groups based on their demographic characteristics, such as (race/ethnicity, gender, housing status, etc.).

Goals and Objectives

Aim #1 Define HIV Case Management clients' characteristics in Nebraska

Objective: Provide a descriptive analysis of HIV case-managed individuals in Nebraska.

> *Activity1:* retrieve the data from the Ryan White Provide© Case Management
>
> Software.
>
> *Activity2:* provide a descriptive analysis of included subjects

Aim #2: To determine whether the viral load of HIV case-managed patients has changed after the enrollment.

Objective: Examine the patterns and the variations of viral load changes according to clients' demographic characteristics.

Activity1: retrieve the data from the Ryan White Provide© Case Management

Software.

Activity3: identify viral load variations between subjects' groups

Activity4: identify risk factors associated with the un-improved viral load.

Methods

Research question

Do viral loads change in HIV/AIDS patients who are enrolled in the Ryan White case

management program? And are there any risk factors associated with having unimproved viral

load?

Study Design and Data source

A retrospective cohort study of people living with HIV/AIDS in Nebraska, who have

been served by the Ryan White program, and have a viral load records in the Ryan White

database. In this study, a de-identified secondary dataset is used, and it was requested through the

Ryan White Part B program case manager, Mr. Stephen Jackson, M.P.H. All participating HIV

clinics are required to report updated demographics and lab results for their clients in a secure

connected-network, which is linked to the Ryan White Provide© Case Management Software.

Viral load tests are required for all clients at least once a year in order to continue

receiving case management services. Other clients' information reported in this database was

obtained by case managers, a trained professional who manages and coordinates care with

providers. Patients' information collected strating from their enrollment and updated whenever

there are cgange in thier information. The enrollment application composes questions about

clients' demographic information (race, ethnicity, age, gender, marital status, household income,

education level, home address, and prefered contact information), health status (HIV diagnosis

year, infection transmission route, substance use, mental health, any disability or developmental

issues, primary care source, health insurance coverage and overall health status), and living

condition (homelessness, housing type, transportation access, and employment status).

Study Population and Study sample

The study population is Nebraska residents living with HIV/AIDS with the following

criteria: 1) were Nebraska residents at enrollment, and 2) have at least two viral load test results

documented in the Ryan White Provide© Case Management database. 3) and the last viral load

result reported in the last three years (2016-2018). We found information for 1774 unique

HIV/AIDS clients enrolled in the program, however only 936 (53%) of the cases had viral load

test results (the outcome measurement). To study the impact of the program on HIV outcomes,

we included 385 (41%) of the subjects who had at least 2 viral load results and the last results

must have been reported in the last three years 2016-2018. (Figure 1).
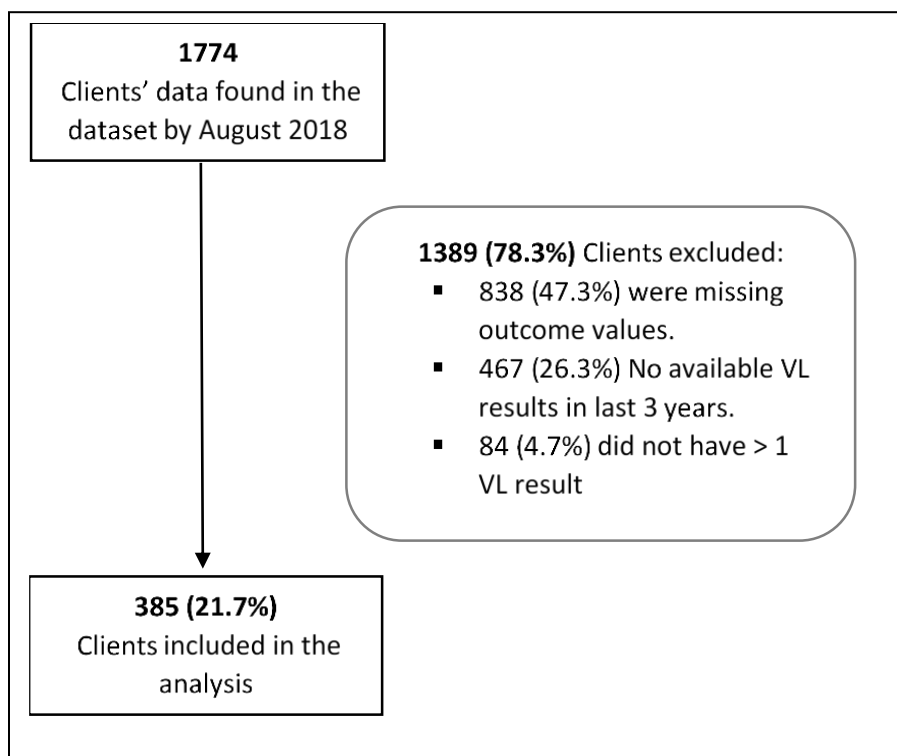
Figure 1. Sample population selection (Ryan White Part B clients in Nebraska)

Outcome measurement

In this study, the primary outcome is viral load test results, which are measured with

$CD4^+$ T-cell counts to determine a person's HIV status, the progression of the disease, response

to prescribed treatment, and the health of individual's immune system. The case management

program intends to reduce HIV viral load (VL) to the suppression level, thus, VL test results is

our primary outcome measurement. A large number of the subjects were missing the CD4+ cell counts, so they were not included in the analysis.

All viral load test results were categorized into suppressed result vs. not suppressed result based on the CDC Viral Load suppression definition (< 200 copies/ml of blood sample). And since there are at least two viral load test results for each included subject, a dichotomous outcome variable (Not improved/Declined vs. Improved) was computed based on the baseline and most recent VL results. Improved group included; 1) those who had suppressed viral load when entered into the CM and continue to be virally suppressed, and 2) those who entered with unsuppressed viral but developed suppression while they were in the CM program. (Figure 2).
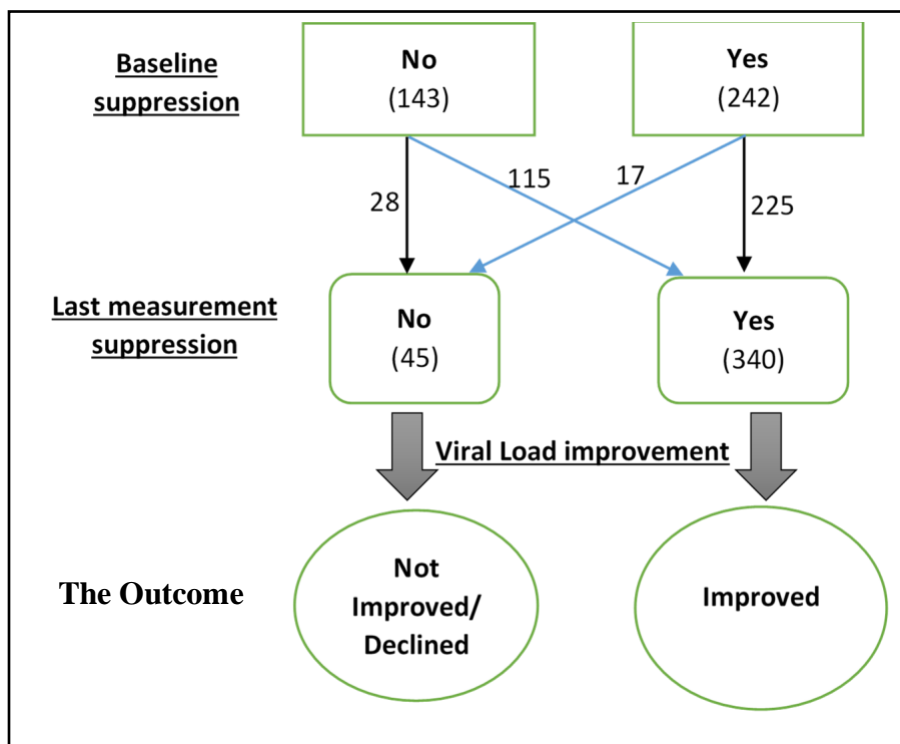
Figure 2. Demonstration of how the outcome variable computed

Descriptive data (independent variables)

These variables were retrieved for each subject: patient Unique ID number, date of birth, race, ethnicity, gender, housing status, homelessness status, diagnosis year, health insurance coverage, transportation access, sexual orientation, primary language spoken, citizenship, HIV transmission mode, mental health, physical and developmental disabilities, marital status, housing type, employment status, education, poverty level, health insurance coverage, medication adherence, care adherence, substance use, primary care source, incarceration history, and CD4+ cell counts.

The main independent variables were race/ethnicity, gender, age at enrollmet, diagnosis year, health insurance coverage, transmission route, federal poverty level, housing type, marital status, medication adherence, primary care source and test frequency. No identifier information was retrieved or used in this study. All variables were treated as binary except race/ethnicity, marital status, sexual orientation, transmission route, and health insurance coverage were categorized into three levels to minimize unbalanced groups.

An additional binary variable was created to show whether the client was newly diagnosed or previously diagnosed by computing diagnosis year and enrollment year. If a client was diagnosed within one year of enrollment, then they were classified as newly diagnosed otherwise they were considered prevalent cases or previously diagnosed.

Statistical approach

Data cleaning and data analysis were performed using the IBM SPSS version 22. First, a descriptive analysis was conducted to describe the study sample. Table 1 provides demographic characteristics including frequencies, proportions, means, and standard deviations as appropriate.

(Table1). Second, univariate analysis was conducted to determine the association between the dichotomous outcome (Viral Load improvement) and the covariates using Chi-square test for categorical variables and independent sample t-test for scale variables with significant level at P-value ≤ 0.2 or Odds $\neq 1$. Third, then I conducted Breslow-Day tests to assess the interaction effects between the covariates and the outcome. Collinearity was assessed by measuring the variance inflation factor (VIF). Finally, a multivariate logistic regression model with stepwise method was performed including all significant independent variables in step two.

Ethics

The study utilized de-identified secondary data, and it was approved by the Institutional Review Board (IRB) at the University of Nebraska Medical Center.

Results

Sample characteristics

Using the data retrieved from the Provide Case Management database for the Ryan White clients diagnosed with HIV/AIDS in Nebraska as of the August 2018, we identified 385 (21.7%) of the cases to be eligible for inclusion in our analytic sample. The majority of included subjects were male 280 (72.7%), Non-Hispanic White 172 (44.7%), single marital status 222 (57.7), and over 40 years of age 197 (51.2%) at baseline. The majority or 362 (94%) of the clients were on HIV medications and based on the case managers' reports, 96% were very or somewhat adherent to the prescribed treatments.

Male who have sex with male (MSM) and heterosexual contacts were the highly represented transmission risk factors. Among males, 163 (58.4%) were infected through MSM contacts while among females 95 (91.3%) were infected through heterosexual contacts. The greater portion of the clients or 333 (86.5%) reported they were stably housed, 205 (54.2%) have high school degree or been to high school, and 228 (59.2%) disclosed that they are not working due to disabilities or other unspecified reasons.

Out of the included subjects, 67 (17.7%) reported inadequate health insurance status, while the majority indicated carrying either private 173 (45.8%) or public 138 (36.5%) health insurance. Almost half of the sample reported that they have mental health issues 181(47.4%), and about 27 (7.1%) stated lack of personal primary care providers or alternatively they are relying on emergency departments as the primary care source. Nearly half of the clients, 162 (42.3%) reported unstable transportation access, thus they are utilizing others or friends' car to reach the HIV clinics.

The average enrollment duration in the program was (6.2 ± 3.8) years. Non-Hispanic White (NHW) clients seem to stay in the program longer than Non-Hispanic Black (NHB) clients with an average of (6.9 ± 4 vs. 5.2 ± 3) years.

The number of tests performed during the time the clients been in the CM differs significantly by clients' race/ethnicity, housing types and transportation access. On average, 10.8 ± 8 tests recorded for NHW clients compared to 7.2 ± 4 tests for NHB clients. Stably housed clients seem to have a higher number of tests reported, compared to unstably housed individuals (10.5 ± 8.3 vs. 4.9 ± 3.3 tests). Having a stable transportation access such as owning a car showed a significant relationship with the number of performed tests. For instance, clients who

own a car have been tested more frequently compared to clients with unstable transportation access (11.3 ± 8.8 vs. 7.6 ± 6.2 tests).

The gaps in time from diagnosis to enrollment ranged considerably between one year and thirty years. Newly diagnosed clients, those who were diagnosed with HIV within the enrollment year, represented 126 (32.7%) of the subjects. The rest of the subjects classified as prevalent cases, those who were diagnosed with HIV at least two years before the enrollment, represented 259 (67.3%) of the total sample.

Interestingly, a large number of the included clients 126 (32.9%) were labeled as closed cases which mean neither further assistance will be provided, nor viral outcomes will be observed mainly due to violation in the program eligibility criteria. Supplementary table 1 provides the proportions and frequencies for the independent covariates. (Table 1)

Table1. Demographic characteristics of Ryan White clients in Nebraska whose recent Viral Load test results were recorded between 2016 and 2018

Demographic Characteristics	No (385)	%
Gender[a]		
Male	280	72.7
Female	105	27.3
Race/Ethnicity[b]		
Non-Hispanic Black	101	26.2
Non-Hispanic White	172	44.7
Other Races/Undetermined	112	29.1
Sexual Orientation[c]		
Heterosexual	191	49.9
Homosexual	164	42.8
Other/Undetermined	28	7.3
Missing=2		

Marital Status		
Divorce/Separated/Widowed	68	17.7
Single/Undetermined	222	57.7
Married/Partnered	95	24.6
Citizenship		
U.S Born	283	77.1
Foreign Born	84	22.9
Missing=18		
Age Group at Baseline[d]		
≤40	188	48.8
40>	197	51.2
Primary Language[e]		
English	302	78.4
Spanish/Other	83	21.6
Homeless		
Yes	25	6.8
No	342	93.2
Missing= 18		
Housing Type[f]		
Unstably housed/Homeless	52	13.5
Stably Housed	333	86.5
Employment Status		
Not working	228	59.2
Working	157	40.8
Education		
≤ High school	205	54.2
College degree/Some college	173	45.8
Missing=7		
Transmission Route[g]		
MSM	163	42.6
Heterosexual Contact	175	45.7
IDU/Other	45	11.7
Missing=2		
Health Insurance Coverage		
Uninsured/Underinsured	67	17.7
Medicaid/Medicare/Other Public insurance	138	36.5
Private	173	45.8
Missing=7		
Medication Adherence		
No	15	4.1
Yes (Very/Some) Adherent	347	95.9

Missing=23		
Mental Health		
No	201	52.6
Yes	181	47.4
Missing=3		
Substance Use		
None	256	67.0
Yes	126	33.0
Missing=3		
Primary care source		
None/ER	27	7.1
Outpatient clinic/Community health centers	353	92.9
Missing=5		
Incarceration History		
No	258	67.0
Yes	127	33.0
Poverty Level		
≤100%	207	53.8
>100%	178	46.2
Transportation access		
Owns car	221	57.7
Utilizes others' car/ No access	162	42.3
Missing=2		
Baseline VL suppression[i]		
No	143	37.1
Yes	242	62.9
Recent VL suppression[j]		
No	45	11.7
Yes	340	88.3
Viral Load Changes[k] (Baseline-recent)		
Not suppressed-Not suppressed	28	7.3
Suppressed-Not suppressed	17	4.4
Suppressed-Suppressed	225	58.4
Not suppressed-Suppressed	115	29.9
Case status		
Closed	126	32.9
open	257	67.1
Missing=2		
	Mean (SD)	

Duration in the CM program[j] **(Year)**	6.2 (3.8)
Test frequency	9.73 (8.0)
Years from diagnosis to enrollment	7.1 (7.4)

a Transgender male to female cases were assigned to the male group.

b Other races include Asian, Hispanic, Native American, or Not determined; were combined because few subjects were in each subgroup.

c Other/Undetermined includes; Bisexual, Lesbian, and undetermined sexual orientation.

d The mean age at the baseline (enrollment) was 40 years, so it was categorized into ≤ 40 years or > 40 years.

e Other languages include; American Sign, Arabic, Burmese, French, and Nuer, but due to very low cell number, it was categorized into two groups.

f Stably housed assigned if the clients reported living in an owned, rent, private residence or stated stably hosed. Otherwise, it assigned unstably or homeless if the client reported homelessness.

g MSM (male who has sex with male), IDU (Injection drug use), Other includes; female who has sex with female, sexual abuse contact, and undetermined. IDU and Other mode of transmission were combined due to very low cell numbers.

h Yes (Very/some adherent) It means that the client is taking HIV medicines as directed, or attempts to take HIV medications as directed but may miss doses or refills due to barriers and side effects, (No) means that client does not take medications as directed due to various barriers or by informed decision.

i Baseline Viral Load (VL result obtained during the enrollment between 2000 -2018), the viral load suppression is assigned when the VL result is <200 copies/Ml of blood according to the CDC definition.

j Recent Viral Load (the most recent VL result reported in the database between 2016-2018)

k Viral Load Changes were classified into four groups, based on the viral suppression at the first and last tests; 1) Not suppressed-Not suppressed means the result was not-suppressed at enrollment and not suppressed at last test, 2) Suppressed-Not suppressed means suppressed at enrollment and not suppressed at last test, 3) Suppressed-Suppressed means was suppressed both at enrollment and suppressed at last test, 4) Not suppressed-Suppressed means was not suppressed at enrollment but eventually achieved viral suppression at the end.

m Open case status means clients still enrolled in the program and receiving the CM services, otherwise assigned closed due to several reasons related to patients' compliance, HIV status, or living in the state .

n Enrollment duration computed by subtracting the last and first test years.

Viral loads from baseline to recent tests:

The overall viral load suppression rate has increased significantly after the clients are enrolled in the CM program. Only small portion of the subjects 45 (11.7%) did not achieve viral suppression.

At the enrollment 242 (62.9%) of the subjects had suppressed viral load results, which defined by the CDC < 200 copies/mL of blood, of whom, larger portion 225 (93%) were able to successfully be sustained virally suppressed into the last measurement reported. On the other hand, the rest of the cases at enrollment 143 (37.1%) were not virally suppressed, of whom, greater number 115 (80.4%) successfully became virally suppressed at the last recorded measurement. Ultimately, the overall viral-suppression rate seems to be increased among subjects by 25.4% as it was 62.9% at the baseline and it became 88.3% at the most current reported viral result.

When newly diagnosed cases were compared to prevalent cases (≤1 year vs. > 1 year), the newly diagnosed group seemed to have higher increases in their viral suppression rate. For example, at baseline, 38% of the newly diagnosed clients were virally suppressed while by the last test 83% had achieved the viral suppression. On the other hand, among the prevalent cases, 75% were virally suppressed at the enrollment, and ultimately 90% achieved the viral suppression.

Viral load improvement by clients' demographic information

As previously stated, HIV outcomes did not improve for 45 (11.7%) of the total included subjects. Within this group, 68.9% were male, 33.3% were NHW, 60% were single or undetermined marital status, 70.5% were U.S born, 68.9% were ≤ 40 years of age, 28.9% were unstably housed, 66.9% were currently not working, 67.4% had ≤ high school education, 37.2% were uninsured/underinsured, and 51.1% of the male group were infected through male-to-male sexual contacts.

The number of VL tests recorded and the duration in the program differed between the improved vs. not-improved groups. Compared to the improved group, not-improved group had

fewer VL tests (6.5±5 vs. 10.1±8) and stayed less amount of years in the program (5.6±3.6 vs.

6.3±3.8). (Table 2).

Table 2. Demographic Characteristics for Nebraska Ryan White Case Managed clients by the VL improvement.

Demographic Characteristics	Viral Load Improvement[a] (385)				P-value
	Not Improved 45 (11.7%)		Improved 340 (88.3%)		
	No.	%	No.	%	
Gender					
Male	31	68.9	249	73.2	0.538
Female	14	31.1	91	26.8	
Race/Ethnicity					
Non-Hispanic Black	13	28.9	88	25.8	0.232
Non-Hispanic White	15	33.3	157	46.2	
Other Races/Undetermined	17	37.8	95	27.9	
Marital Status					
Divorce/Separated/Widowed	11	24.5	57	16.7	0.213
Single/Undetermined	27	60.0	195	57.4	
Married/Partnered	7	15.6	88	25.9	
Sexual Orientation					
Heterosexual	18	40.0	173	51.2	0.295
Homosexual	22	48.9	142	42.0	
Other/Undetermined	5	11.1	23	6.8	
Missing=2					
Citizenship					
U.S Born	31	70.5	252	78.0	0.263
Foreign Born	13	29.5	71	22.0	
Missing=18					
Age Group at Baseline					
≤40	31	68.9	157	46.2	0.004*
>40	14	31.1	183	53.8	
Primary Language					
English	34	75.6	268	78.8	0.616
Other	11	24.4	72	21.2	
Homeless					
No	38	86.4	304	94.1	0.1*
Yes	6	13.6	19	5.9	

Missing= 18

Housing Type					
Unstable/Homeless	13	28.9	39	11.5	0.001*
Stably Housed	32	71.1	301	88.5	
Employment Status					
Not working	31	66.9	197	57.9	0.160*
Working	14	31.1	143	42.1	
Education					
≤ High school	29	67.4	176	52.5	0.065*
College degree/Some college	14	32.6	159	47.5	
Missing=7					
Transmission Route					
MSM	23	51.1	140	41.4	0.344
Heterosexual Contact	19	42.2	156	46.2	
IDU/Other	3	6.7	42	12.4	
Missing=2					
Health Insurance Coverage					
Uninsured/Underinsured	16	37.2	51	15.2	0.001*
Medicaid/Medicare/Other Public insurance	15	34.9	123	36.7	
Private	12	27.9	161	48.1	
Missing=7					
Primary Care Source					
None/ER	6	13.3	21	6.3	0.113*
Outpatient/Community health	39	86.7	314	93.7	
Missing=5					
Medication Adherence					
No	8	19.0	7	2.2	<0.001*
Yes (Very/Some)	34	81.0	313	97.8	
Missing=23					
Mental Health					
No	22	50.0	179	53.0	0.712
Yes	22	50.0	159	47.0	
Missing=3					
Substance Use					
No	31	70.5	225	66.6	0.606
Yes	13	23.5	113	33.4	
Missing=3					
Incarceration History					
No	28	62.2	230	67.6	0.467
Yes	17	37.8	110	32.4	
Poverty Level					

≤100%	29	64.4	178	52.4	0.126*
>100%	16	35.6	162	47.6	
Duration in the CM program (Year)	5.60 (3.66)		6.32 (3.88)		0.239*
Tests frequency	6.53 (5.77)		10.15 (8.19)		<0.001*
Years from diagnosis to enrollment	5.82 (7.8)		7.33 (7.34)		0.200*

a Viral Load Improvement classified into two groups; Improved group included; 1) those who had suppressed viral load when entered into the CM and continue to be virally suppressed, and 2) those who entered with unsuppressed viral but developed suppression while they were in the CM program. All the rest were classified into Not-improved group.
* variables with *P* values of <.25 in the univariate analysis were entered into the logistic regression.

Risk factors associated with VL not improving/declining

Six variables predicted the probability that subjects would have lower improvement rate. These variables were the age groups and viral suppression at enrollment, gender, health insurance coverage, medication adherence, and test frequency.

Logistic regression model:

> Logit (p)= 3.739 – 2.44 (medication adherence) – 0.849 (gender) – 0.879 (age group at enrollment) – 1.66 (health insurance coverage) – 1.399 (baseline suppressed VL) + 0.091 (test frequency)

Clients non-adherent to medication had 11.5 (95% CI 3.1, 42.8) times higher odds to be in the non-improved group compared to adherent clients. Females had 2.33 (95% CI 0.9, 5.6) higher odds than males, those younger than 40 years of age had 2.4 (95% CI 1.04, 5.5) higher odds than the older group, un-insured/underinsured clients had 5.3 (95% CI 1.9, 14.2) higher odds than those with private health-insurance, individuals with non-suppressed VL at baseline had 4.1 (95% CI 1.8, 9.1) higher odds than those with suppressed VL test result, and clients with fewer number of tests performed during their time in the program had 1.1 (95% CI 1.01, 1.16) higher odds compared to a client with higher performed tests to be in the Not-Improved group. (Table 3).

In brief, in addition to not adherence to medication and fewer tests performed, a client who was in the following group: female, un-insured, younger than 40 years of age, or Non-suppressed viral results at baseline seemed to have a higher probability to not get the expected impacts by the program. The CM program primary goal is to improve clients' HIV outcomes which defined by being stably virally suppressed after enrolment.

Table 3. Crude and Adjusted odds of VL Not Improved by independent predictors (n=385)

Independent variables	Estimate[#]	Crude OR (95% CI)	Adjusted OR[a] (95% CI)
Constant	3.739		
Medication Adherence			
Yes		1.00 (reference)	1.00 (reference)
No	-2.44	10.5 (3.6, 30.8)	11.5 (3.1,42.8)
p value	*<0.001*		
Gender			
Male		1.00 (reference)	1.00 (reference)
Female	-0.849	1.23 (0.6, 2.4)	2.33 (0.9, 5.6)
p value	*0.057*		
Age Group at enrollment			
> 40		1.00 (reference)	1.00 (reference)
≤ 40	-0.879	2.58 (1.3, 5.0)	2.4 (1.04, 5.5)
p value	*0.039*		
Health insurance coverage			
Private		1.00 (reference)	1.00 (reference)
Public	-0.893	1.6 (0.7, 3.6)	2.44 (0.8, 6.6)
Uninsured/underinsured	-1.66	4.2 (1.8, 9.5)	5.3 (1.9, 14.2)
p value	*0.005*		
Baseline Suppressed VL			
Yes		1.00 (reference)	1.00 (reference)
No	-1.399	3.22 (1.7, 6.1)	4.1 (1.8, 9.1)
p value	*0.001*		
Test Frequency[#]	0.091		1.1 (1.02, 1.17)
p value	*0.008*		

a Odds Ratios and p-values were adjusted for the significant variables in Table 2.
* Significance observed at *P* values <.05
Depended variable: Viral Load Improvement (improved vs. not-improved)

Stepwise (conditional backward) method was used
Beta coefficient

Discussion

The purpose of this study was to examine the impact of the Medical and Social case management program (CM) on RW clients' HIV outcomes, and to determine the risk factors associated with un-improved viral outcomes. Therefore, a retrospective cohort data for 385 RW clients were retrieved and analyzed. We hypothesized that viral load would change after enrollment in the program and that change would vary based on clients' demographic characteristics. The results indicate that viral suppression rate increased significantly post enrollment, and that VL improvement varied based on several factors, including clients' gender, viral suppression and age at enrollment, treatment adherence, and health insurance status. Thus, our findings provide robust evidence of the positive impact of the Case Management program on improving HIV outcomes, the difference outcomes based on certain clients' demographic characteristics, and it is consistent with other studies conducted nationally.

For example, Irvine et al. (2015) conducted a one-year pre-post study for New York City Ryan White clients and found that short-term CM enrollment was associated with an increase in VL suppression and Engagement in HIV care rates. In this study we found that 83% of newly diagnosed clients and 90.7% of previously diagnosed clients achieved viral suppression by the last VL measurement which is consistent with the Irvine et al. (2015) findings.

Despite the fact that the RW program mainly serves a low socio-economic population, the suppression rates appear to be higher than the overall HIV-infected individual on the state and national level. For instance, over 88% of our sample develop viral suppression according to

the last reported VL tests (2016-2018) compared to 75.4% in Nebraska and 59.9 on the national levels. (NE DHHS, 2016) and (CDC, 2017).

Our analysis indicates there are some groups that may need further attention in order to improve their viral outcomes and achieve the viral suppression after enrollment. Similar to Doshi et al. (2014) findings, we found a higher portion of the not improved group was ≤ 40 years of age at enrollment. Interestingly, we also observed that clients who were older than 40 years of age represent a higher percentage of the improved group, unlike other chronic diseases where the health outcomes worsen as the age increases. (Doshi et al. 2014) This may be explained by HIV medication adherence and test frequency, as older clients were found to be more adherent to medication and had higher number of tests performed compared to younger clients. Thus, it is important to study the factors and motivators that promote the adherence and viral suppression for older clients because it might be applicable to the youth population.

Compared to males, females had a higher probability to be in the non-improved group, which is similar to Doshi et al. (2014) findings. However, neither medication adherence nor number of tests differed significantly by gender. Therefore, we expect the type of Anti-Retroviral Therapy (ART) prescribed may have a role in the observed variations of viral improvement between males and females. However, typically type of ART regimens is not reported in this database, so we were unable to study the effect of ART on HIV outcomes based on gender factor.

Similar to Irvine et al. (2015), we observed that clients who were uninsured or had non-suppressed VL at baseline seem to have a lower rate of viral improvement, which suggests a gap in ART prescribed or adherence. A study conducted by Bradley et al. (2016) may support our explanation as they found only 48% of uninsured individuals were prescribed ART;

consequently, they had lower viral suppression rates compared to insured patients. Additionally, Diepstra et al. (2017) concluded that insurance provision is beneficial for persons living with chronic diseases as well, as it is associated with a higher probability of achieving viral suppression for HIV-infected individuals.

Collectively, our findings and the literature demonstrate the critical role of the Case Management assistance that provided through the RW program in achieving viral suppression. This achievement is likely attributable to the various forms of assistance provided, such as providing medications, housing support, offering transportation services, and/or coordinating medical care visits.

Limitations

Through our work, we identified certain possible limitations.   First, the dataset used in this study only includes HIV persons served by RW program in Nebraska, thus our findings need to be carefully interpreted and might not be generalized to other HIV populations in the US. Second, we excluded over 50% of the cases from the database due to missing the outcome values or the subjects had no up-to-date records. Third, the dataset did not include information regarding clinical visits, the type of services provided, or the type of treatment prescribed, which might have been helpful in the interpretation of the outcomes. Fourth, almost third of our sample was labeled as closed cases, and no reasons were reported for case closure. However, we did not find any significant demographic differences when we compared closed with open cases. Additionally, case mangers follow the RW protocols and instructions in order to close any cases which mainly due to violations in the program eligibility criteria. Fifth, we were unable to include a control group such as comparing RW clients to HIV-infected individuals not served by the RW program. However, we compared the last VL outcomes to the baseline results in which

the cases served as their own control. Finally, some patients may have received medical case management services from other providers that were not documented in this dataset, but this rarely happens according to the Case managers, and it usually occurs when the clients are relocated out of the state.

Recommendations

Through our analysis we identified certain areas for potential improvements and venues for future research.

1. Literature reviews indicated that clinical information obtained from doctor visits, and the type of support patients received are associated with HIV outcomes. However, the data we used did not include this information. Thus, we highly recommend documenting these data as it would allow to find out if the improvement is attributable to specific services or combinations of support the patients received. Additionally, further studies can be done using clinical information to study the role of engagement in care on viral load outcomes. Thus, we recommend linking the Provide Case Management database with the State HIV surveillance data, which has updated medical records.

2. Finding that around 33% of the cases were labeled as closed cases, raises a necessity to identify what led to this decision and whether it is an issue related to the clients or to the program process. Therefore, it is recommended to provide a short note in the database indicating the reasons for a case closure.

3. We observed that about 50% of the clients experienced mental health issues which point out to the importance of providing mental health care through a licensed psychiatrist. However, no significant differences were found between clients with or without mental health illnesses in term of viral improved vs. not improved.

4. In our sample, uninsured clients had the lowest improvement rate, which suggests existing gaps in medication adherence, treatment use, and overall health status, according to the literature. Thus, future research can build on this fact to study the impact of providing this population with a health insurance on their HIV outcomes.

5. Although unstably-housed clients only represent 13.5% of the total sample, our analysis indicated they had lower VL improvement rate compared to stably housed individuals. In fact, Kushel et al. (2006), found a positive relationship between case management and improvement of health outcomes for HIV-infected homeless and marginally-housed individuals. Based on these facts, this population needs further housing support in order to increase their treatment adherence and subsequently improve their biological outcomes.

Conclusion

Case management programs serve predominantly low-economic population, yet we found the viral suppression rate increased significantly among the CM clients after enrollment and it is relatively high compared to the national and state rates. However, in order to improve community's health through increasing viral suppression rates, few groups need dedicated and additional support toward improving their HIV outcomes.

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