THE CORRELATION BETWEEN RURAL RESIDENCE AND CLINICAL OUTCOMES IN HIV-POSITIVE PATIENTS

by

Kathryn H. Stanley

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CERTIFICATE OF APPROVAL

This is to certify that the Master's thesis of

Kathryn H. Stanley

has been approved

Donald Austin, MD, MPH

Dawn Peters, PhD

Sean Schafer, MD

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AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
AZT	Zidovudine
CAPI	Computer-assisted personal interview
CDC	Centers for Disease Control and Prevention
FDA	Food and Drug Administration
GED	General Education Diploma
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
MHP	Medical History Period
MMP	Medical Monitoring Project
RUCA	Rural-Urban commuting area code
SP	Surveillance Period

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ABSTRACT

Background-

HIV is a complex disease that affects a large number of people throughout the world. HIV care is improving, and physicians are becoming specialized in this area. HIV care requires knowledge of complex medication regimens as well as simultaneous management of co-morbidities. Patients in rural areas may be less likely to receive this type of specialized care. It is currently unknown whether rural residence affects clinical outcomes in HIV-positive patients.

Objectives-

The goal of this study was to determine if rural residence or time for a patient to reach their main HIV care provider adversely affects CD4 count.

Methods-

To assess the effect of living in a rural area on health outcomes, a cross-sectional study was employed using information from the Center for Disease Control's Medical Monitoring Project. Personal interviews and chart abstractions were done for 296 patients in Oregon who were sampled between January 1st and April 30th, 2007. Patients were selected through a two-stage sampling scheme and additional patients were over-sampled from rural areas. Odds of having a CD4 count $\geq$ 350 cells/mm^3 were compared among patients living in rural and non-rural areas. Additionally, the relationship between the time it takes to reach the HIV care provider, as defined as greater than 1 hour or less than or equal to 1 hour, and having a CD4 count $\geq$ 350 cells/mm^3 were assessed. Univariate and multivariate logistic regression were used to examine these relationships.

Results-

There was a significant difference between the odds ratios for having a high CD4 count of women and men when comparing rural to non-rural. The odds of having a higher CD4 count was 51.2% less in rural men compared with non-rural men, though only significantly at the $p<.10$ level ($p=.067$). Women in rural areas had an increased odds of having a higher CD4 count than those in non-rural areas. The odds for women in rural areas was 10.163 times that of those living in non-rural areas ($p=0.020$). There was a moderately significant interaction between lowest ever CD4 count and time to provider ($p=0.077$). Patients living within an hour of their provider had an increased odds (by 41.9%) of having a CD4 count greater than or equal to 350 cells/μL when the lowest CD4 count increased by 50 cells/μL. This odds ratio was significant ($p<.001$). Patients living greater than an hour from their provider had an increased odds (by 10.5%) of having a CD4 count greater than or equal to 350 cells/μL when the lowest CD4 count increased by 50 cells/μL, though this was not significant ($p=0.231$).

Conclusion-

In this study, rural residence had a complex effect on magnitude of recent CD4. There is a trend for men who live in rural areas to have a CD4 count below 350 cells/μL. The trend for women is to have a CD4 count ≥ 350 cells/μL in rural areas. Patients had an increased odds of having a CD4 count ≥ 350 cells/μL if they had a greater lowest ever CD4 count. The odds of having a CD4 count ≥ 350 cells/μL was increased less for patients living more than an hour away than for those living less than or equal to an hour away.

INTRODUCTION

At the end of 2003, approximately one million (1,039,000–1,185,000) people were living with human immunodeficiency virus (HIV) or Acquired Immune Deficiency Syndrome (AIDS) in the United States.[1] Approximately 56,000 new cases occurred in the United States in 2006.[2] At that time, 51,146 people had been diagnosed with AIDS in rural areas[3]HIV becomes AIDS when the CD4-positive T-lymphocyte cell count drops below 200 cells/μL or when an HIV-positive patient develops one of a list of opportunistic infections.[4] In 2006, close to 15,000 people died of AIDS. [5]
AIDS is a fatal disease without treatment.[6] From the 1989 Centers for Disease Control and Prevention (CDC) report, HIV/AIDS case fatality rate ranged from 79.5% to 92.0% for patients diagnosed in the first half of 1981.[7,8]

In 1987 the first antiretroviral medicine, Zidovudine (AZT) was produced to help control HIV and AIDS. [9] By 1996, more antiretrovirals had been created and a combination regimen was determined to prolong survival. The three-drug "cocktail" consisted of two nucleoside reverse transcriptase inhibitors, combined with a protease inhibitor.[10,11] Therapeutic options quickly grew and because treatment became more complicated, doctors began specializing in HIV care.[12] AIDS-related deaths rapidly declined, mostly due to combination, highly active antiretroviral therapy (HAART). As of 2008, 25 different antiretrovirals had been approved by the Food and Drug Administration (FDA) within five different classes– Protease Inhibitors, Nucleoside/Nucleotide Reverse Transcriptase Inhibitors, Non-nucleoside Reverse Transcriptase Inhibitors, Fusion or Entry Inhibitors, and Integrase Inhibitors.[13] With help

from these drugs the life spans of HIV-positive patients are often similar or the same as those without HIV now. [14] Patients with HIV often die of unrelated causes.[14]

One important role of HIV specialists is to help their patients adhere to the strict and complicated antiretroviral regimens. Adherence to these medications is vital because drug resistance emerges with incomplete or intermittent adherence.[15,16] Many things affect patient adherence. Some of these include patients' perception of the value of therapy, remembering to take medication, complexity of treatment regimen, decreased social support, and depression.[17] HIV care providers can help through frequent contact and support. Further, it has been shown that a poor patient-clinician relationship is detrimental to adherence to HIV medications.[9] Clinicians often find it difficult to build positive relationships with their patients due to the severity and prognosis of HIV, concern about its contagion, homophobia, drug and alcohol abuse, and the stigma that comes with the disease.[9] These issues may be even more magnified in rural areas, particularly because these areas often lack specialists.[18]

Auchincloss and Hadden found that people living in rural areas have more health problems than people living in urban areas.[19] Though HIV incidence is typically lower in rural areas, if someone who lives in a rural area does become infected, he or she might find it more difficult to obtain appropriate care.[5] Some nurses and other medical staff in rural areas lack knowledge and skills necessary to care for patients with HIV/AIDS, perhaps leading to lower quality of care when compared to their urban counterparts.[17] In addition, people living in rural areas might be less likely to know about HIV and to seek HIV testing. If so, that may delay diagnosis and care for those infected, leading to higher morbidity and mortality.

Case managers in rural areas note that long travel for care is a major problem for rural residents with HIV. They also note that a lack of HIV-trained medical practitioners and a lack of transportation added to the various obstacles that made getting care difficult.[20] Rural residents identify more barriers to care than urban patients. These include long distances to medical facilities and personnel, lack of transportation to access needed services, lack of health care professionals who are adequately trained and competent in HIV/AIDS care, the shortage of mental health professionals who can assist them with their mental health needs and community residents' stigma towards people living with HIV/AIDS. [5] Some HIV patients report delaying care due to the inability to reach their HIV provider.[8] Lack of public transportation in rural areas as well as fewer local health care professionals increases the difficulty for patients to find appropriate care.[21]

Many rural HIV positive patients travel to urban areas to obtain care.[5] Some of them travel because they have concerns about confidentiality in rural areas.[22] Some patients express concern that physicians in rural areas are less capable of managing HIV care.[22] With these barriers to accessing care, many patients may be going without treatment. Rural areas are often lower-income areas as well.[23] These areas have been shown to have higher mortality rates in HIV positive patients.[24,25]

At this point, there is very little information on how living in rural areas affects HIV outcomes. There is some research on African Americans living in rural areas, but close to no information on general rural living's affect on clinical outcomes.[26] Rural-living African American women who are HIV positive are more likely to have contracted it in rural areas than while in urban areas.[27] This means that rural care is not the only

concern, but also prevention of the spread of HIV in rural areas. Race was also found to be a predictor of the quality of HIV care. Latinos and blacks often get poorer care, as well as those less educated. [28] Therefore, it is important to know how rural living affects the care of Oregon HIV patients, and their prognosis.

The goal of this study is to explore the relationship between living in a rural area and clinical health outcomes, as measured by most recent CD4 count. This study will contribute to a better assessment of factors determining HIV outcomes among rural patients. It will give information to find better approaches to improving HIV treatment services for this population.

RESEARCH QUESTION

Does living in a rural area or a further distance from the HIV care provider adversely affect severity of HIV/AIDS disease as measured by recent CD4 counts?

SPECIFIC AIMS

It is my aim to determine whether there is an association between living in a rural area and clinical outcomes as described by CD4 count. The primary objective of this study was to test the following hypotheses:

1. HIV positive patients living in rural areas have increased odds of having a recent CD4 count <350 cells/µL.
2. Increasing length of time to reach one's HIV care provider is associated with greater odds of having a recent CD4 count <350 cells/µL.

If these hypotheses are supported, additional research will be required to explain differences in clinical severity and better address the needs of rural populations. As the prevalence of HIV in rural areas grows, this information will be increasingly necessary. Additionally, if rural living has an independent effect on disease severity, then this covariate should be measured and included in future studies of HIV/AIDS outcomes.

METHODS

A. Overview

I employed a cross-sectional survey study design. The data come from medical record abstractions and in-person interviews, gathered for the Oregon portion of the Medical Monitoring Project (MMP) in conjunction with the Centers for Disease Control and Prevention (CDC). MMP is a supplemental HIV/AIDS surveillance project to track the occurrence and care for HIV positive people in twenty-six state and city health departments across the United States.

B. Sampling Methodology

HIV positive patients, aged 18 and older receiving care from known HIV care providers in the United States were sampled for MMP. Data analyzed for this study consisted of interviews and medical record data for patients sampled from January 1st through April 30th, 2007 in Oregon only. Sampling of patients was done in two stages. First, all Oregon HIV care facilities were enumerated. To meet the definition of HIV care facility, the facility must have included at least one doctor or other clinician who reported overseeing blood testing for CD4 counts and/or viral loads and making significant treatment decisions based on these results, or served as the principal prescriber of

antiretroviral therapy for at least one patient with HIV/AIDS. Facilities were then selected randomly for participation from the list of all facilities probability proportional to size.

Next, within participating facilities, all patients seen from January 1 through April 30, 2007 were listed if they were HIV-positive and at least 18 years old. From these lists of patients seen in participating facilities, patients were sampled randomly with probability inversely proportional to the facility sampling probability such that all HIV patients in care had equivalent net sampling probability. A total of 400 patients were sampled.

Additionally, in Oregon, 127 patients were over-sampled from rural facilities to facilitate analyses of rural-urban differences in HIV care. All patients seen in facilities located within rural and frontier counties were invited to participate. Rural and frontier counties were defined according to a definition provided by the Oregon Office for Rural Health. Counties were categorized as urban, mixed, rural or frontier based upon the average population density, the size of any discrete cities, and the proximity to cities with >30,000 people. (Appendix A)

Patients were eligible for the study if the patient had a medical record, was not incarcerated, was alive and was able to be contacted. This left a total of 347 participants. Of these, 86 refused interview and medical record review and 10 were too sick to participate. After removing these, 251 participants remained.

C. Data Collection

The data were collected through personal interviews (some of these questions can be found in Appendix B) and medical record abstraction. Personal interviews were collected by trained interviewers. Interviewers were generally aware of whether the patient lived in a rural or urban area but were unaware that a rural urban comparison would later be undertaken. The interviews lasted approximately 45 minutes each. Interview responses were recorded electronically using a computer-assisted personal interview (CAPI). Participants received $25 compensation for their time. To ensure accuracy, approximately 10% of interviews were observed by the project coordinator.

Medical record abstractions were conducted by trained staff for the MMP using CDC exercises and practice abstractions. Abstractors then accompanied an experienced abstractor and completed abstractions under their guidance. Abstractions were conducted at the primary source of HIV care for each patient. Medical history forms were filled out to document care from the first date of HIV care, defined as an office visit addressing HIV needs with a provider, forward until one year prior to the interview date. Surveillance period visit forms were abstracted for each visit during the year prior to the interview date. Additionally, surveillance period inpatient forms were completed for each inpatient visit during the year prior to the interview date. One surveillance period summary form for each patient documented overall information for the year prior to the interview date.

Approximately 5% of abstractions were re-abstracted by a second reviewer. 95% of abstractions were identical, and among abstractions that did differ, none of the

differences were among variables used in this study. Each patient had both an interview and abstraction done at least at the provider from which they were sampled.

The Medical History Period (MHP) was defined as the time beginning at entry into care until the day one year prior to the interview date. The Surveillance Period (SP) was defined as the 12 month period immediately preceding the date of the interview.

A subset of the overall data was entered into a spreadsheet. All variables for 25% of the participants in the data set were re-entered for accuracy. Zero errors were found in the 59 participants that were re-entered. After calculating a one-sided confidence interval for the true error proportion based on our point estimate of zero errors, we are 95% confident that there are no more than 4.96% errors for each variable in my overall sample.

D. **Variables**

Outcome Variables

The outcome variable for this study was CD4 count (cells/μL). CD4 count has been shown to be a strong measure of HIV outcome and possibility of virological failure.[29] A lower CD4 count indicates a higher probability that the patient will contract opportunistic infections, which causes the decline in health of the patient.[4] Pain, symptoms, disability, general health, and social functioning often decline with a decreased CD4 count.[30]

The CD4 cell count was obtained from chart abstractions. This variable was then dichotomized as either being greater than or equal to 350 cells/μL or less than 350 cells/μL. Patients with increased duration of CD4 counts below 350 cells/μL have an

increased risk of mortality. This is also the point at which antiretroviral therapy initiation is recommended. [31] AIDS and non-AIDS diseases are also more common in those with CD4 counts less than 350 cells/μL.[32] Thirteen participants did not have any CD4 counts, and were eliminated from the study (n=238). 61.5% of those were considered rural and 38.5% were categorized as non-rural. The CD4 counts were recoded as "0=less than 350 cells/μL" and "1=greater than or equal to 350 cells/μL" for analysis. For patients who had more than one CD4 count during the surveillance period, the count that was used was the value recorded in the medical record that had the date closest to the interview.

Primary Predictor Variables

Rural residence and time from patients' residence to primary HIV doctor were used as the primary predictor variables in this study. Rural residence was determined from the Rural-Urban Commuting Area Code (RUCA) by applying the United States Department of Agriculture's Economic Research Service definition (definition number 8) of rural as all census tracts with RUCA codes 4 through 10. This defines 20% of the United States population as rural.[33] The zip code of each participant's residence was used to determine their RUCA code and this variable was recoded as rural or non-rural. The data were complete for this variable.

The second predictor variable was travel time from a patient's residence to their HIV care provider's office. During the personal interview, each participant was asked "In the last 12 months, typically how long does a <u>one-way trip</u> take you to get to your <u>usual</u> doctor's office or clinic <u>for HIV treatment</u>?" Responses were categorized as 'less than 15 minutes,' '15-30 minutes,' '31-60 minutes,' '61-90 minutes,' '91-120 minutes,' or 'more

than 120 minutes.' 237 of 238 participants responded to this question. The categories were then collapsed into "greater than 1 hour" and "less than or equal to 1 hour" because there were few participants in the categories greater than 1 hour.

Covariates

Potential covariates were selected based on other previous studies.[5,15,34] After obtaining frequency distributions, some variables were re-coded based on a small numbers of participants in some categories. Histories of bipolar disorder or of psychosis were combined into one variable due to the small number of individuals with each disorder. This new variable was coded as "1=yes (history of psychosis and/or bipolar disorder)" or "0=no." Participants were asked "What is the highest level of education you completed?" and responses were categorized as: never attended school, grades 1 through 8, grades 9 through 11, grade 12 or GED, some college, associate's degree, or technical degree, bachelor's degree, or any post-graduate studies. Some categories were collapsed and the final categorization that was used was: grade 11 or under; grade 12 or GED; some college or associate's degree or technical degree; or bachelor's degree or post-graduate studies. Use of alcohol or use of non-IV drugs during the surveillance period were combined into one variable. Age was initially coded as a continuous variable in years, but was categorized as 18-34, 35-49, and 50 or older based on previous studies.[8,19 22]Other health conditions that were recorded were myocardial infarction, chronic liver disease or hepatitis (alcohol or drug-induced), stroke, renal failure, chronic kidney disease, and diabetes (type 1 or type 2). These conditions were combined into one variable and each participant received a score of 0 through 6 based on how many of the other conditions

they had. Due to the small number of participants with more than 1 other condition, the variable was recoded as 0 conditions or 1 or more conditions. There were a very small number of non-white participants, so races other than white were combined into one category. The length of time that a participant has been HIV-positive was calculated by subtraction of the year of diagnosis from the year of interview. Table 1 shows the final categorization of all variables.

Table 1. Summary of Independent Variables

Variable	Source	Possible Responses	Coding for Analysis
CD4 Count	Abstraction	< 350 ≥ 350	0= <350 1= ≥350
Rural Living	By RUCA	Non-Rural Rural	0=Non-Rural 1=Rural
Time to provider	Interview	Less than 15 minutes 15-30 minutes 31-60 minutes 61-90 minutes 91-120 minutes More than 120 minutes	0=Less than 1 hour 1=More than 1 hour
Gender	Interview	Male Female	0=Male 1=Female
Age	Interview	Continuous values reported, generated from birth date	1=18-34 2=35-49 3=50 or greater
Education	Interview	Never attended School Grades 1-8 Grades 9-11 Grade 12 or GED Some college, assoc degree or tech degree Bachelor's Degree Any Post-Graduate Studies	1=Grade 11 or Less 2=HS garduate 3=Some college 4=College grad or post
Race		White Asian or Hawaiian/ Pacific Islander Amer. Indian/Alaska Native Black Hispanic Multi-Racial	0=White 1-Non-White
AIDS Diagnosis	Abstraction	No Yes	0=No 1=Yes
Depression	Abstraction	No Yes	0=No 1=Yes
Bipolar Disorder or Psychosis	Abstraction	Created from 2 questions about bipolar and Psychosis	0=No 1=Yes
Homeless in surveillance Period	Interview	No Yes	0=No 1=Yes
Had Health Insurance during SP	Interview	No Yes	0=No 1=Yes
Any time without insurance during SP	Interview	No Yes	0=No 1=Yes
Ever taken antiretrovirals	Interview	No Yes	0=No 1=Yes

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Table 1. *continued*

Variable	Source	Possible Responses	Coding for Analysis
Currently taking ARTs	Interview	No	0=No
		Yes	1=Yes
Non-IV Drug Use or Alcohol Abuse	Interview	No	0=No
		Yes	1=Yes
IV Drug Abuse	Interview	No	0=No
		Yes	1=Yes
Consistency in following med schedule	Interview	Never	1=Never
		Rarely	2=Rarely
		About half the time	3=About half
		Most of the time	4=Most of the time
		Always	5=Always
Other Conditions	Abstraction	Myocardial Infarction	0=None
		Chronic liver disease or hep.	1=1 or more conditions
		Stroke	
		Renal Failure	
		Chronic kidney disease	
		Diabetes (type 1 or 2)	
Time since diagnosis	Interview	Continuous	Continuous
Time between last cd4 count and interview date	Abstraction	Continuous	Continuous
Number of CD4 counts in 1 year	Abstraction	Continuous	Continuous
Lowest CD4 Count ever	Abstraction	Continuous	Continuous

*SP=Surveillance Period

D. Statistical Analysis

All statistical analyses were conducted using SPSS Version 16.0. Both univariate and multivariate logistic regression were used to analyze the relationship between the independent variables and CD4 count (<350 cells/μL or ≥350 cells/μL). Sampling weights were not available for use in this study.

Descriptive Analysis:

Frequencies were initially calculated for each outcome and categorical predictor variable. Means, histograms, and descriptive statistics were calculated for each

continuous variable. Cross-tabulations were examined for each independent variables and both rural residence and time to provider. Differences between proportions were determined with χ^2 statistics. Frequencies, and cross-tabulations were used to determine whether variables needed to be recoded based on the number of participants in each category.

Univariate Analysis:

Univariate logistic regression models were built for each primary predictor variable and possible covariates with CD4 count as a dichotomous outcome variable. Wald F statistics and their associated p-values were used to determine statistical significance. Covariates were included in building multivariate regression models if their significance was $p<0.25$.

Multivariate Logistic Regression Analysis:

Rural residence and time to provider were included in the multivariate logistic regression analysis as they were the primary predictors that were of greatest interest. Age, race, and gender were determined *a priori* to be included in multivariate analysis regardless of their statistical significance because they are socially significant and have often been correlated with HIV outcomes.[35] Other variables with a significance level of $p<0.25$ were also initially included. Independent variables were then eliminated one by one beginning with the least significant until all variables that were not chosen *a priori* had a significance of $p<.05$.

Once a preliminary model was constructed, each variable that had been removed was re-entered into the model to assure that they were not significant in the model and that there was no confounding. With both rural and time to provider in the model, each

covariate was added individually. If the odds ratio of rural residence or time to provider changed by more than 15% when they were entered into the multivariate model, the variable was considered to be a confounder and was retained in the model.

I then assessed interactions between each remaining variable and both the rural and time to provider variables. Each predictor variable was entered into a model with only rural or time to provider and the first-order interaction term. Interactions were added to the model if they had a significance of $p<0.10$. The interactions were removed one by one beginning with the least significant until only interactions with a significance level of $p<0.10$ remained in the model.

The Hosmer and Lemeshow goodness-of-fit test statistic was used to assess the fit of the final model.

Secondary analysis

A second model was also constructed with the travel time to provider as a single main predictor of the dichotomous CD4 count. The same procedure as listed above was followed to produce a final model without rural residence as a predictor. The Hosmer and Lemeshow goodness-of-fit test statistic was used to assess the fit of this model as well.

RESULTS

Sample Characteristics

A total of 238 HIV-positive patients were included in this study. 60 (25.2%) were categorized as living in a rural area and 178 (74.8%) were non-rural. The majority of the sample was male (86.5%), had been diagnosed with depression (65.1%), was older (11.8% under 35), and white (78.4%). The majority of participants traveled less than one hour to their HIV provider (81.9%). Most participants had taken antiretroviral

medications in the past (95.8%) and most were also currently taking these medications (93.4%). Histograms for CD4 counts and for CD4 count by rural residence are presented in Appendix C. The counts and percentages of all categorical characteristics are shown in Table 2. Descriptive statistics were calculated for continuous variables. These data are shown in Table 3.

Table 2. Distribution of variables

Characteristic	Categories	n	Percentage
Gender (n=237)	Male	205	86.5%
	Female	32	13.5%
Age (n=237)	18 thru 34	28	11.8%
	35-49	117	49.4%
	≥50	92	38.8%
Education (n=237)	Grade 11 or Under	28	11.8%
	High School Grad or Equiv.	55	23.2%
	Some College	114	48.1%
	Bachelor's or Post-Grad	40	16.9%
Race (n=236)	White	185	78.4%
	Non-White	51	21.6%
AIDS diagnosis (n=236)	No	97	41.1%
	Yes	139	58.9%
Depression (n=235)	No	82	34.9%
	Yes	153	65.1%
Bipolar Disorder or Psychosis	No	198	84.3%
(n=235)	Yes	37	15.7%
Travel Time to HIV Doctor	Less than 1 hour	194	81.9%
(n=237)	Greater than 1 hour	43	18.1%
Homeless during SP	No	218	92.0%
(n=237)	Yes	19	8.02%
Had Health Insurance During SP	No	2	0.85%
(n=236)	Yes	234	99.2%
No Health Insurance at Any Point During SP	No	217	92.7%
(n=234)	Yes	17	7.3%
Ever Taken ARTs (n=237)	No	10	4.2%
	Yes	227	95.8%
Currently Taking ARTs	No	15	6.6%
(n=227)	Yes	212	93.4%
Alcohol or Non-IV Drug Abuse (n=237)	No	84	35.4%
	Yes	153	64.6%

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Table 2. *continued*

Characteristic	Categories	n	Percentage
IV Drug Abuse (n=238)	No	224	94.10%
	Yes	14	5.90%
How closely followed Med Schedule (n=212)	Not Always	41	19.30%
	Always	171	80.70%
CD4 Cell Count (n=238)	Less than 350	75	31.50%
	≥ to 350	163	68.50%
Other Conditions (n=232)	None	178	76.70%
	1 or More	54	23.30%
Rural Status (n=238)	Non-Rural	178	74.80%
	Rural	60	25.20%

Table 3. Continuous Participant Characteristics

Characteristic	Minimum	Maximum	Mean	Standard Dev.
Lowest ever CD4 count (n=231)	1	1083	234.85	188.5
Number of CD4s in 1 year (n=238)	1	11	2.82	1.4
Length of time since HIV diagnosis (years) (n=231)	1	23	12.23	6.4
Time from CD4 to Interview (days) (n=238)	0	329	82.56	76.4

Age was highly significantly different between rural and non-rural patients ($p<0.001$). Gender, education, having had health insurance during the surveillance period, having ever taken antiretrovirals, alcohol or non-iv drug abuse, and IV drug abuse were all significantly different between rural and non-rural participants. As expected, travel time from the participant's residence to their main HIV care provider was significantly different for rural and non-rural participants. A greater proportion of rural patients traveled greater than an hour to reach their provider.

The respective counts and percentages are shown in Table 4. The p-values from the Pearson's χ^2 are also shown in this table.

Continuous variables were also grouped by rural residence and two-sample t-tests were performed. Their means, mean difference, and associated p-values are shown in Table 5. There was a trend for rural patients to have fewer CD4 counts (2.53) than non-rural patients (2.91), ($p=0.066$).

Table 4. Categorical Participant Characteristics by Rural/Non-Rural Residence

		Rural		*Non-Rural*		
Characteristic		N	Percent	n	Percent	p-value
Total Sample						
Gender (n=237)						p<0.001
	Male	44	73.30%	161	91.00%	
	Female	16	26.70%	16	9.00%	
Age (n=237)						p=0.062
	18 thru 34	2	3.30%	26	14.70%	
	35 thru 49	33	55.00%	84	47.50%	
	≥50	25	41.70%	67	37.90%	
Education (n=237)						p=0.048
	Grade 11 or less	5	8.30%	23	13.00%	
	H. S. Grad or Equ	20	33.30%	35	19.80%	
	Some College	30	50.00%	84	47.50%	
	Bachelor's/Post	5	8.30%	35	19.80%	
Race (n=236)						p=0.726
	White	48	80.00%	137	77.80%	
	Asian or Hawaiian	12	20.00%	39	22.20%	
AIDS diagnosis (n=236)						p=0.419
	No	22	36.70%	75	42.60%	
	Yes	38	63.30%	101	57.40%	
Depression (n=235)						p=0.336
	No	24	40.00%	58	33.10%	
	Yes	36	60.00%	117	66.90%	
Bipolar Disorder or Psychosis						p=0.315
(n=235)	No	53	88.30%	145	82.90%	
	Yes	7	11.70%	30	17.10%	
Travel Time to HIV Doctor						p<0.001
(n=237)	Less than 1 hour	35	59.30%	159	89.30%	
	Greater than 1 hr	24	40.70%	19	10.70%	
Homeless during SP						p=0.788*
(n=237)	No	56	93.30%	162	91.50%	
	Yes	4	6.70%	15	8.50%	
Had Health Insurance During SP						p=0.064*
(n=236)	No	2	3.30%	0	0.00%	
	Yes	58	96.70%	176	100.00%	

Continued, next page

Table 4. *continued*

Characteristic		*Rural* N	*Rural* Percent	*Non-Rural* n	*Non-Rural* Percent	p-value
No Health Insurance at Any Point during SP(n=234)	No	53	91.40%	164	93.20%	p=0.770*
	Yes	5	8.60%	12	6.80%	
Ever Taken ARTs (n=237)						p=0.069*
	No	0	0.00%	10	5.60%	
	Yes	60	100.00%	167	94.40%	
Currently Taking ARTs (n=227)						p=1.000*
	No	4	6.70%	11	6.60%	
	Yes	56	93.30%	156	93.40%	
Alcohol or Non-IV Drug Abuse (n=237)						p=0.035
	No	28	46.70%	56	31.60%	
	Yes	32	53.30%	121	68.40%	
IV Drug Abuse (n=238)						p=0.024*
	No	60	100.00%	164	92.10%	
	Yes	0	0.00%	14	7.90%	
How closely followed Med Schedule (n=212)						p=0.264
	Not Always	8	14.30%	33	21.20%	
	Always	48	85.70%	123	78.80%	
CD4 in Groups						p=0.320
	less than 350	22	36.70%	53	29.80%	
	350 or greater	38	63.30%	125	70.20%	
Other Conditions (n=232)						p=0.183
	0	49	83.10%	129	74.60%	
	1 or More	10	16.90%	44	25.40%	

SP=Surveillance Period
P-values marked with a * were computed with Fisher's exact test due to expected cell counts of less than 5.

Table 5. Continuous Participant Characteristics by Rural/Non-Rural Residence

Characteristic	*Rural* Mean	*Non-Rural* Mean	Mean Difference	p-value
Lowest ever CD4 count (n=231)	207.78	244.13	36.33	p=0.202
Number of CD4s in 1 year (n=238)	2.53	2.91	0.377	p=0.066
Length of time since HIV diagnosis (years) (n=231)	11.44	12.49	1.054	p=0.273
Time from CD4 to Interview (days) (n=238)	94.63	78.49	-16.14	p=0.157

Rural residence was the only significantly different variable between long and short time to provider. The respective counts and percentages for the differences as well as the p-values from the Pearson's χ^2 tests are shown in Table 6.

Means, mean differences, and associated p-values for continuous variables are shown in Table 7.

Table 6. Categorical Participant Characteristics by Travel Time to Provider

Characteristic		*Travel time less than 1 hour* n	Percent	*Travel time greater than 1 hour* n	Percent	p-value
Total Sample						
Gender (n=236)						p=0.500
	Male	169	87.60%	36	83.70%	
	Female	24	12.40%	7	16.30%	
Age (n=236)						p=0.545
	18 thru 34	25	13.00%	3	7.00%	
	35 thru 49	94	48.70%	22	51.20%	
	50 or greater	74	38.30%	18	41.90%	
Education (n=236)						p=0.407
	≤ Grade 11	22	11.40%	5	11.60%	
	H. S. Grad	42	21.80%	13	30.20%	
	Some College	93	48.20%	21	48.80%	
	Bachelor's/Post	36	18.70%	4	9.30%	
Race (n=235)						p=0.240
	White	154	80.20%	31	72.10%	
	Non-White	38	19.80%	12	27.90%	
AIDS diagnosis (n=235)						p=0.591
	No	80	41.70%	16	37.20%	
	Yes	112	58.30%	27	62.80%	

Continued, next page

Table 6. *continued*

Characteristic		*Travel time less than 1 hour* n	Percent	*Travel time greater than 1 hour* n	Percent	p-value
Depression (n=234)						p=0.692
	No	65	34.00%	16	37.20%	
	Yes	126	66.00%	27	62.80%	
Bipolar Disorder or Psychosis (n=234)						p=0.405
	No	159	83.20%	38	88.40%	
	Yes	32	16.80%	5	11.60%	
Rural (n=237)						p<0.001
	No	159	82.00%	19	44.20%	
	Yes	35	18.00%	24	55.80%	
Homeless during SP (n=236)						p=1.000*
	No	177	91.70%	40	93.00%	
	Yes	16	8.30%	3	7.00%	
Had Health Insurance During SP (n=235)						p=1.000*
	No	2	1.00%	0	0.00%	
	Yes	190	99.00%	43	100.00%	
No Health Insurance at Any Point during SP (n=233)						p=1.000*
	No	176	92.60%	40	93.00%	
	Yes	14	7.40%	3	7.00%	
Ever Taken ARTs (n=236)						p=0.215*
	No	10	5.20%	0	0.00%	
	Yes	183	94.80%	43	100.00%	
Currently Taking ARTs (n=226)						p=0.733*
	No	11	6.00%	3	7.00%	
	Yes	172	94.00%	40	93.00%	
Alcohol or Non-IV Drug Abuse (n=236)						p=0.757
	No	67	34.70%	16	37.20%	
	Yes	126	65.30%	27	62.80%	
IV Drug Abuse (n=237)						p=0.475*
	No	181	93.30%	42	97.70%	
	Yes	13	6.70%	1	2.30%	
How closely followed Med Schedule (n=212)						p=0.314
	Not Always	31	18.00%	10	25.00%	
	Always	141	82.00%	30	75.00%	
CD4 in Groups						p=0.219
	less than 350	58	29.90%	17	39.50%	
	350 or greater	136	70.10%	26	60.50%	
Other Conditions (n=232)						p=0.412
	0	142	75.50%	35	81.40%	
	1 or more	46	24.50%	8	18.60%	

SP=Surveillance Period

P-values marked with a * were computed with Fisher's exact test due to expected cell counts of less than 5.

Table 7. Continuous Participant Characteristics by Time to Provider

	Time to provider ≤ 1 hour	*Time to provider > 1 hour*		
Characteristic	Mean	Mean	Mean Difference	p-value
Lowest ever CD4 count (n=231)	239.06	213.33	25.73	p=0.421
Number of CD4s in 1 year (n=238)	2.85	2.67	0.171	p=0.462
Length of time since HIV diagnosis (years) (n=231)	12.11	12.76	-0.65	p=0.554
Time from CD4 to Interview (days) (n=238)	80.38	94.12	-13.74	p=0.287

Logistic Regression Analysis

Univariate Regression

AIDS diagnosis and lowest ever CD4 count were both highly significantly related to CD4 count ($p<0.001$). Race, travel time to HIV provider, having no health insurance at any point during the surveillance period, self-reported medication adherence, other co-morbidities, and the number of CD4 counts during the surveillance period were all significant at the $p<0.25$ level. Having an AIDS diagnosis was associated with a greater odds of having a CD4 count less than 350 when individually analyzed. The lowest ever CD4 count was associated with an increased odds of having a CD4 count greater than or equal to 350 cells/μL when lowest ever CD4 count increased. Distribution of variables by CD4 count (≥350 cells/μL), odds ratios, and p-values are reported for all categorical variables in Table 8. Means of continuous variables as well as odds ratios and p-values are presented in Table 9.

Table 8. Unadjusted associations between CD4 count high/low for independent categorical variables

Characteristic	CD4 Count (n, % ≥350)	Odds Ratio (95% CI)	p-value
Gender (n=237)			p=0.387
Male	138 (67.3%)	Referent	
Female	24 (75.0%)	1.46 (0.62-3.41)	
Age (n=237)			p=0.844
18 thru 34	20 (71.4%)	Referent	
35 thru 49	78 (66.7%)	0.80 (0.32-1.98)	
≥50	64 (69.6%)	0.91 (0.36-2.32)	
Education (n=237)			p=0.295
Grade 11 or less	18 (64.3%)	0.45 (0.15-1.34)	
H. S. Grad or Equiv.	34 (61.8%)	0.41 (0.16-1.04)	
Some College	78 (68.4%)	0.54 (0.23-1.29)	
Bachelor's/Post	32 (80.0%)	Referent	
Race (n=236)			p=0.106
White	131 (70.8%)	Referent	
Non-White	30 (58.8%)	0.59 (0.31-1.12)	
AIDS diagnosis (n=236)			p<0.001
No	81 (83.5%)	Referent	
Yes	81 (58.3%)	0.28 (0.15-0.52)	
Depression (n=235)			p=0.465
No	59 (72.0%)	Referent	
Yes	103 (67.3%)	0.80 (0.45-1.45)	
Bipolar Disorder or Psychosis (n=235)			p=0.337
No	134 (67.7%)	Referent	
Yes	28 (75.7%)	1.49 (0.66-3.33)	
Travel Time to HIV Doctor (n=237)			p=0.221
Less than 1 hour	136 (70.1%)	Referent	
Greater than 1 hour	26 (60.5%)	0.65 (0.33-1.29)	
Homeless during SP (n=237)			p=0.603
No	148 (67.9%)	Referent	
Yes	14 (73.7%)	1.32 (0.46-3.82)	
Had Health Insur. During SP (n=236)			p=0.587
No	1 (50.0%)	Referent	
Yes	160 (68.4%)	2.16 (0.13-35.04)	
No Health Insurance at any Point During SP (n=234)			p=0.057
No	152 (70.0%)	Referent	
Yes	8 (47.1%)	0.38 (0.14-1.03)	
Ever Taken ARTs (n=237)			
No	8 (80%)	Referent	p=0.426
Yes	154 (67.8%)	0.53 (0.11-2.55)	
Currently Taking ARTs (n=227)			p=0.305
No	12 (80.0%)	Referent	
Yes	142 (67.0%)	0.51 (0.14-1.86)	

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Table 8. *continued*

Characteristic	CD4 Count (n, % ≥350)	Odds Ratio (95% CI)	p-value
Alcohol or Non-IV Drug Abuse (n=237)			p=0.903
No	57 (67.9%)	Referent	
Yes	105 (68.6%)	1.04 (0.59-1.83)	
IV Drug Abuse (n=238)			p=0.807
No	153 (68.3%)	Referent	
Yes	10 (71.4%)	1.16 (0.35-3.83)	
How closely followed Med Schedule (n=212)			p=0.203
Not Always	24 (58.5%)	Referent	
Always	118 (69.0%)	1.58 (0.78-3.18)	
Rural (n=238)			p=0.321
Non-Rural	125 (70.2%)	Referent	
Rural	38 (63.3%)	0.73 (0.40-1.36)	
Other Conditions (n=232)			p=0.211
0	128 (71.9%)	Referent	
1 or more	34 (63.0%)	0.66 (0.35-1.26)	

Table 9. Unadjusted associations between CD4 count high/low for independent continuous variables

Characteristic	**Mean for those with CD4< 350**	**Mean for those with CD4≥ 350**	**Odds Ratio (95% CI)**	p-value
Lowest Ever CD4 Count	143.4	276.26	1.006 (1.003-1.008)	p<0.001
Number of CD4s in 1 Year	3.03	2.72	0.85 (0.70-1.04)	p=0.112
Time since HIV diag. (yrs)	12.63	12.04	0.99 (0.94-1.03)	p=0.514
Time: CD4 to Interview (days)	78.64	8.36	1.001 (0.997-1.005)	p=0.591

Multivariate Regression

Gender, age, and race were forced into the model because they are considered socially important and may have a combined effect in our study. Prior to evaluation of the interaction, the first preliminary model contained rural residence (p=0.668), age (p=0.753), race (p=0.434), gender (p=0.368), time to provider (p=0.404), and lowest CD4 count ever (p<0.001). The only significant variable was lowest CD4 count. It was

associated with an increased odds of having a higher CD4 count as the lowest ever CD4 count rises. The results of the preliminary model are described in Table 10.

Table 10. Preliminary multivariable logistic regression results for rural/non-rural model

Characteristic	Odds Ratio (95% CI)	p-value
Gender		p=0.368
Male	Referent	
Female	1.565 (0.59-4.149)	
Age		p=0.753
18 thru 34	Referent	
34 thru 49	1.047 (0.363-3.020)	
50 or greater	1.321 (0.442-3.950)	
Race		p=0.434
White	Referent	
Non-White	0.752 (0.368-1.536)	
Lowest CD4 Count Ever	1.005 (1.003-1.008)	p<.001
Rural		p=0.668
Non-Rural	Referent	
Rural	0.849 (0.402-1.794)	
Time to Provider		p=0.404
Short	Referent	
Long	0.713 (0.323-1.577)	

**Equation: log(odds) of CD4 count=0.448(female) + 0.046(age 35-49) + 0.278 (age 50+) -0.285 (non-white) + 0.005 (lowest ever CD4 count) – 0.164(rural) – 0.338 (long time to provider) – 0.310*

I found a significant interaction between gender and rural residence (p=0.029) and a moderately significant interaction between time to provider and lowest ever CD4 count (p=0.075). After adding these to the model, time to provider (p=0.558) and the term for its interaction with lowest CD4 count (p=0.151) were not significant in the multivariate model and were removed. The effect of rural residence on CD4 count was significantly different for men and women.

The results of the final model, including this interaction are shown in Table 11. Odds of having a CD4 count above 350 cells/µL among rural men are about half the odds of having a high CD4 count among non-rural men. In contrast, the odds of having a CD4 count above 350 cells/µL for rural women is over 10 times the odds for non-rural women. The Hosmer and Lemeshow goodness-of-fit test gives a χ^2=14.470 (p=0.070).

Table 11. Adjusted Odds of Recent CD4 Count ≥350 (cells/µL)

Characteristic	Odds Ratio (95% CI)	p-value
Gender		p=0.172
Male	Referent	
Female	0.423 (0.123-1.454)	
Age		p=0.715
18 thru 34	Referent	
35 thru 49	0.980 (0.331-2.898)	
50 or greater	1.287 (0.417-3.971)	
Race		p=0.388
White	Referent	
Non-White	0.726 (0.351-1.501)	
Lowest CD4 Count Ever	1.006 (1.003-1.008)	p<.001
Rural		p=0.067
Non-Rural	Referent	
Rural	0.488 (0.227-1.051)	
Gender and Rural Interaction		p=0.005
Rural for Women	10.163 (1.437-71.852)	p=0.020
Rural for Men	0.488 (0.227-1.051)	p=0.067

**Equation: log(odds) of CD4 count = -0.861(female) – 0.020(age 35-49) + 0.252(age 50+) - 0.320(non-white) + 0.006(lowest ever CD4) – 0.717(rural) + 3.036(rural*female) – 0.273*

Secondary Analysis: Time to Provider

Time to provider was not significant in our main model even after adding the interaction between time to provider and lowest ever CD4 count. Additionally, removing time to provider from the model increased the significance of rural residence. There was

concern about collinearity between time to provider and rural residence so a secondary model was built with the time to provider as the main predictor. The model contained travel time to HIV provider (p=0.303), age (p=0.764), race (p=0.442), gender (p=0.410), and lowest CD4 count ever (p<0.001). The preliminary model is shown in Table 12.

Table 12. Preliminary logistic regression results for time to provider model

Characteristic	Odds Ratio (95% CI)	p-value
Gender		p=0.410
Male	Referent	
Female	1.488 (0.578-3.830)	
Age		p=0.764
18 thru 34	Referent	
35 thru 49	1.006 (0.354-2.855)	
50 or greater	1.270 (0.431-3.742)	
Race		p=0.442
White	Referent	
Non-White	0.756 (0.371-1.542)	
Lowest CD4 Count Ever	1.005 (1.003-1.008)	p<.001
Travel time to provider		p=0.303
1 hour or less	Referent	
More than 1 hour	0.674 (0.318-1.428)	

**Equation: log(odds) of CD4 count = 0.398(female) + 0.006(age 35-49) + 0.239(age 50+) – 0.280(non-white) + 0.005(lowest ever CD4 count) – 0.394(long time to provider) – 0.303*

I found a moderately significant interaction between time to provider and lowest ever CD4 count (p=0.075). Upon inclusion in the multivariate model, it remained moderately significant (p=0.077). The final model is shown in Table 13.

Table 13. Final logistic regression results for time to provider model

Characteristic	Odds Ratio (95% CI)	p-value
Gender		p=0.506
Male	Referent	
Female	1.380 (0.534-3.564)	
Age		p=0.676
18 thru 34	Referent	
35 thru 49	1.120 (0.387-3.243)	
50 or greater	1.453 (0.481-4.390)	
Race		p=0.431
White	Referent	
Asian or Hawaiian	0.750 (0.367-1.533)	
Lowest CD4 Count Ever	1.007 (1.004-1.010)	p<.001
Travel time to provider		p=0.511
1 hour or less	Referent	
More than 1 hour	1.470 (0.465-4.644)	
Travel time and Lowest CD4 Count Interaction	0.996 (0.991-1.000)	p=0.077
Lowest CD4 Count for travel time ≤1 hour	1.007 (1.004-1.010)	p<0.001
Lowest CD4 count for travel time >1 hour	1.002 (0.998-1.006)	p=0.231

**Equation: log(odds) of CD4 count= 0.322(female) + 0.113(age 35-49) + 0.374(age 50+) – 0.287(non-white) + 0.007(lowest ever CD4 count) + 0.385(long travel time) – 0.004(long travel time* lowest ever CD4 count) – 0.626*

Conclusions

A. Discussion

The results from this study show that there is a significant difference between the odds ratios for women and men when comparing rural versus non-rural (gender*rural interaction p-value: p=0.005). There was a trend indicating that men were less likely to have a CD4 count greater than 350 cells/μL in rural areas than in non-rural areas. This was significant at the p=0.10 level though not significant at the p=0.05 level (OR=0.49, p=0.067). There was also a trend indicating that women were more likely to have a CD4 count greater than 350 cells/μL in rural areas than in non-rural areas (OR=10.16, p=0.020). However, we have a small sample size for women (n=32), so this result may

not be generalizable. With only 32 female patients, if only two with CD4 counts greater than or equal to 350 cells/μL were miscategorized as rural rather than non-rural, the odds ratio would be one.

The only variable significant in the rural residence model was lowest CD4 count ever. The odds ratio was 1.006 (95% CI: 1.003-1.008). I determined that this odds ratio indicates that an increase in lowest ever CD4 count of 50 cells/μL increases the odds of having a CD4 count above 350 cells/μL by 35.0% ($e^{50(0.006)}$). An increase in lowest ever CD4 count of 100 cells/μL increases the odds of having a CD4 count above 350 cells/μL by 82.2% ($e^{100(0.006)}$).

Travel time to provider was not significant when it was entered in multivariate logistic regression with rural residence. Time to provider and the interaction between time to provider and lowest ever CD4 count were entered into the final model. Because neither time to provider alone or the interaction between time to provider and lowest ever CD4 count were significant in this model, they were removed. I considered whether time to provider would have a different association with CD4 count than did rural residence. A long time to provider does not always indicate living in a rural area because public transportation in urban areas is often slow, and increases travel time. As shown in Table 6, only 55.8% of participants travelling more than 1 hour to reach their care provider resided in rural areas. Therefore, a secondary model was built to examine this predictor.

There was an interaction between lowest ever CD4 count and time to provider. It was moderately significant (p=0.077). When the travel time to provider is 1 hour or less, an increase in lowest ever CD4 count of 50 units increases the odds of having a CD4 count greater than 350 by 41.9% ($e^{0.007(50)}$) When the travel time to provider is greater

than 1 hour, an increase in lowest ever CD4 count by 50 units increases the odds of having a CD4 count greater than 350 by 10.5% ($e^{0.002(50)}$).

B. Strengths and Limitations

This project is the first to this investigator's knowledge that examines the relationship between rural living and CD4 count. This study used data from a variety of different health care providers located throughout the state of Oregon to address the question. Personal interviews were used, but chart reviews supplement this material to provide objective information. A strength of this project is the vast amount of information available for each individual patient, covering the entire duration of their illness.

There were many limitations associated with this study. This is a cross-sectional study and thus temporality is unavailable. From the data we have available, it is impossible to know whether patients' outcomes were due to living in a rural area or whether patients moved to a rural area following poor outcomes.

There is no information regarding the migration of patients. The only variable that existed within the data set asked if the patient had ever moved within the state of Oregon. Because our study focuses on the one-year period prior to the interview, those data are not helpful. Patients who felt that they were in worse health may have moved to urban areas to have a greater range of options for obtaining specialized care. This would minimize the difference seen between clinical outcomes. It is also possible that patients who felt that they were stable in their health moved to rural areas to be with family.

Interviewers were not blinded to status of rural living or time to provider. However, this study was not initially intended to be used to assess correlations between rurality and clinical outcomes. Therefore, this should not affect our results.

All patients who participated in this study were obtaining care. So results from this study only pertain to those who see a HIV care provider at least once in a four-month period. Additionally, it is unknown what the characteristics were of patients who refused to participate, were unable to be contacted, and those with no CD4 counts. Additionally, there were 10 patients who were not included because they were too sick to be interviewed. There are no data on whether these patients were rural or non-rural, and so it is impossible to determine how this would affect the study. However, it is possible that this response bias could potentially change the results in either direction.

Many of the variables used in this study were based on self-report and I must consider possible response bias. However, clinical outcomes and rural status were based solely on medical record abstractions. This also provides some cause for concern. Although abstractions were done at HIV care providers and primary care providers' offices, there may be missing data due to archival of records or data kept at other facilities. This missing data could have skewed our results if there was an uneven amount of missing data in rural and urban areas. No data were available on HIV/AIDS status at diagnosis. This may be a predictor of later CD4 count.

The sample size of women was very small. The odds ratio for women was 10.16 though the 95% confidence interval was 1.44-71.85. This indicates that there was a large variability as there were only 16 women in both rural and non-rural groups. Though the odds ratio is large, there is poor precision in the estimate, and the true odds ratio may be smaller.

C. Public Health Significance

This research adds a new source of information to the field of rural health research. It seems, from this study, that rural residence is an independent factor affecting CD4 count, and therefore clinical health outcomes in HIV positive patients. This may be an indication that rural residence also influences the outcomes of other chronic diseases. Rural residence needs to be taken into account as a potential confounder in other studies which do not primarily examine residential status.

It is hoped that discovering that CD4 counts are lower in men living in rural areas than non-rural areas will promote exploration as to the cause of this decline, and improved clinical care. Inequity in health outcomes implies an inequality of care practices and social services surrounding HIV care. More research is necessary to understand how best to approach improving these services.

Additionally, this research is the beginning of information that could influence policy changes and funding allocation to encourage communication between rural and non-rural providers and additional education to providers practicing in rural areas.

D. Future Research

Future research with larger samples on the same subject will enhance our understanding of the influence of rural residence. A cohort study could help to give information regarding temporality. Further research is necessary to determine what factors are associated with the barrier of rural residence. We have little information currently on the characteristics of rurality. Increased stigma and decreased understanding of HIV in rural areas may be a component. Less specialization of providers and lack of knowledge of the complexities and most current practices may be another factor. More

research on reasons for migration and timing of migration in relationship to diagnosis and disease progression may increase our understanding of the influence of location of residence.

Types of facilities in rural areas are also important variables that need to be researched in relationship to rural care. Determination of the proportion of HIV specialists, infectious disease specialists, and other types of facilities may influence the outcomes of HIV-positive patients.

Human Subjects

The human contact involved in this study was done by staff prior to completion of this research. Prior to data analysis, all patient identifying information was be removed from the data. Consent for collection of data was received from every participant who was involved in the Medical Monitoring Project. All data was kept on a secure password-protect network drive in a secure password-protected folder.

This project was determined to be exempt for review by the OHSU Institutional Review Board on January 8, 2009.

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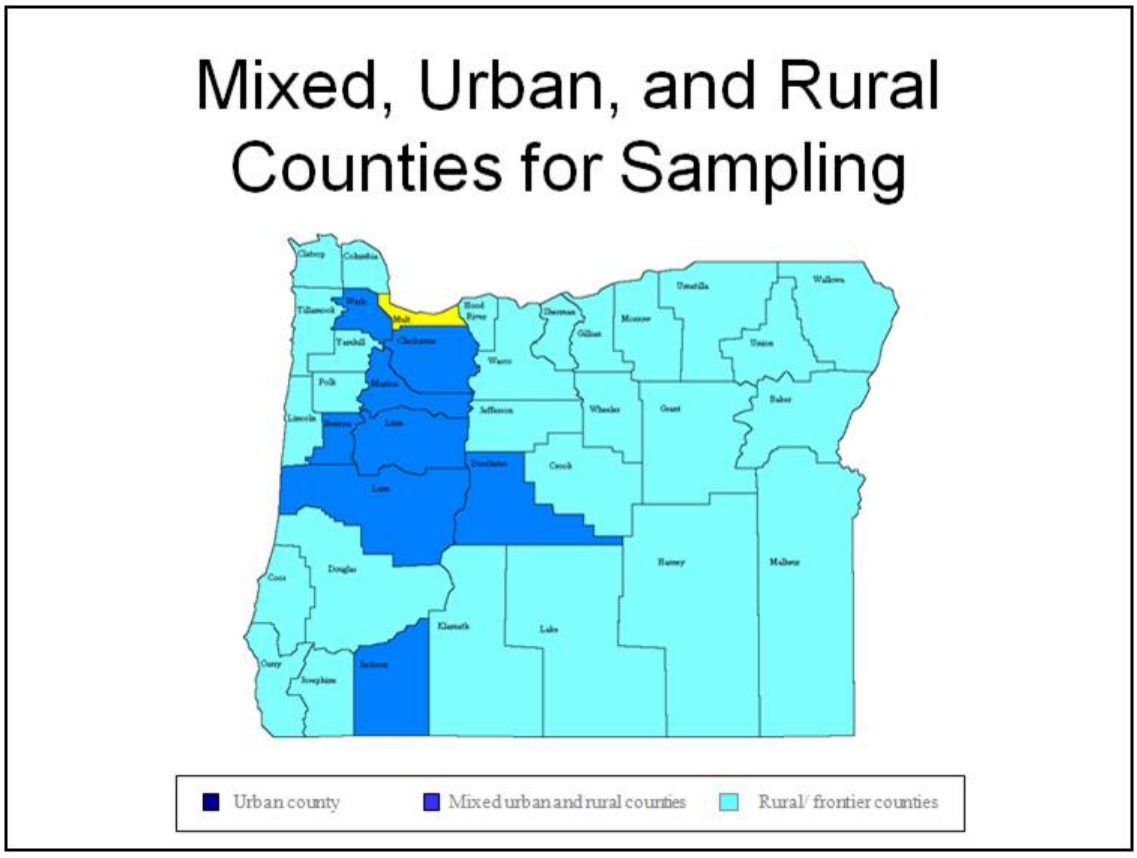
Appendix A: Rural Sampling Scheme



Appendix B: Selected Interview Questions

OMB Number: 0920-0740

Expiration Date: 06/30/2010

2007 Standard Questionnaire for Medical Monitoring Project (MMP)

VERSION 3.3.0

Public reporting burden of this collection of information is estimated to average 45 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to: CDC, Project Clearance Officer, 1600 Clifton Road, MS D-24, Atlanta, GA 30333, ATTN: PRA (0920-0011). Do not send the completed form to this address.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
Atlanta, GA 30333

CENTERS FOR DISEASE CONTROL AND PREVENTION

Demographics

***SAY*:** "I'd like to thank you for taking part in this survey. Remember that all the information you give me will be confidential and your name will **not** be recorded anywhere on this paper (computer). To begin, I would like to ask you some questions about your background. The answers to some questions may seem obvious to you, but I need to ask you all of the questions."

D1. Have you **ever** participated in the MMP interview?

No	❑ 0 →	***Skip to D2***
Yes	❑ 1	
Refused to answer	❑ 7 }	***Skip to D2***
Don't know	❑ 8 }	

D1a. What month and year did you participate in the MMP interview?

(M M / Y Y Y Y)

[Month: 77 = Refused to answer, 88= Don't know;
Year: 7777 = Refused to answer, 8888 = Don't know]

D1b. Where were you interviewed?

_____ (City)

_____ (State)

[7 = Refused, 8 = Don't know]

Interviewer instructions: If the patient was previously interviewed during the 2007 data collection cycle, go to Say box before D2. Otherwise, skip to D2.

SAY*:** "We are only interviewing people this year who haven't already been interviewed during 2007 (2008). Thank you very much for your time." ***[DISCONTINUE INTERVIEW AND GO TO INTERVIEW COMPLETION MODULE.]

D2. What is your date of birth?

(M M / D D / Y Y Y Y)

D2a. So, you were _____ *[AGE]* years old on _____/ _____ *[BEGINNING OF THE PDP]*. Is that correct?

No ..... ❑ 0 → *SAY: "Please tell me your date of birth again," and return to D2*

Yes ..... ❑ 1

Interviewer instructions: If respondent was less than 18 years of age on PDP start date, go to Say box before D3; otherwise, skip to D3.

SAY: "We are only interviewing people who were 18 years or older on _____/ _____ ***[BEGINNING OF THE PDP]***. Thank you very much for your time." ***[DISCONTINUE INTERVIEW AND GO TO INTERVIEW COMPLETION MODULE.]***

D3. What is the highest level of education you completed? ***[CHECK ONLY ONE RESPONSE. DON'T READ CHOICES.]***

Never attended school ..... ❑ 1

Grades 1 through 8 ..... ❑ 2

Grades 9 through 11 ..... ❑ 3

Grade 12 or GED ..... ❑ 4

Some college, associate's degree, or technical degree ..... ❑ 5

Bachelor's degree ..... ❑ 6

Any post-graduate studies ..... ❑ 7

Refused to answer ..... ❑ 77

Don't know ..... ❑ 88

D4. Do you consider yourself to be Hispanic or Latino/a?

No ..... ❑ 0 → ***Skip to D5***

Yes ..... ❑ 1

Refused to answer ..... ❑ 7 } ***Skip to D5***

Don't know ..... ❑ 8

D4a. What best describes your Hispanic ancestry? ***[CHECK ALL THAT APPLY. DON'T READ CHOICES.]***

Mexican ..... ❑ 1

Puerto Rico ..... ❑ 2

Cuban ..... ❑ 3

Dominican ..... ❑ 4

Other 1 *(Specify:*_____*)* ..... ❑ 5

Other 2 *(Specify:* _____*)* ..... ❑ 6
Other 3 *(Specify:* _____*)* ..... ❑ 7
Other 4 *(Specify:* _____*)* ..... ❑ 8
Refused to answer ..... ❑ 77
Don't know ..... ❑ 99

D5. Which racial group or groups do you consider yourself to be in? You may choose more than one option. ***[CHECK ALL THAT APPLY. READ CHOICES.]***

Asian ..... ❑ 1
Black or African American ..... ❑ 2
American Indian or Alaska Native ..... ❑ 3
Native Hawaiian or other Pacific Islander ..... ❑ 4
White ..... ❑ 5
Other 1 ***(Specify:*** _____***)*** ..... ❑ 6
Other 2 *(Specify:* _____*)* ..... ❑ 7
Other 3 *(Specify:* _____*)* ..... ❑ 8
Other 4 *(Specify:* _____*)* ..... ❑ 9
Refused to answer ..... ❑ 77

D6. In what country or territory were you born? ***[CHECK ONLY ONE RESPONSE. DON'T READ CHOICES.]***

United States ..... ❑ 1 } ***Skip to D7***
Puerto Rico ..... ❑ 2
Mexico ..... ❑ 3
Cuba ..... ❑ 4
Other *(Specify:* _____*)* ❑ 5
Refused to answer ..... ❑ 7 } ***Skip to D7***
Don't Know ..... ❑ 8

D6a. How many years have you been living in the United States?

___ ___ ___ years *[777 = Refused, 888 = Don't know]*

D7. In the **past 12 months**, have you been homeless at any time? By homeless, I mean you were living on the street, in a shelter, a Single Room Occupancy (SRO) hotel, temporarily staying with friends/family, or living in a car.

No ..... ❑ 0
Yes ..... ❑ 1
Refused to answer ..... ❑ 7
Don't know ..... ❑ 8

D8. In the **past 12 months,** have you been arrested and put in jail, detention, or prison for longer than 24 hours?

No ..... ❑ 0
Yes ..... ❑ 1
Refused to answer ..... ❑ 7
Don't know ..... ❑ 8

D9. In the **past 12 months**, have you had any kind of health insurance or coverage? I am not referring to coverage for medicines only.

No ..... ❑ 0 → ***Skip to D10***
Yes ..... ❑ 1
Refused to answer ..... ❑ 7 } ***Skip to D10***
Don't know ..... ❑ 8

D9a. What are all the kinds of health insurance or coverage you have had in the **past 12 months**? ***[CHECK ALL THAT APPLY. DON'T READ CHOICES.]***

Private health insurance or HMO ..... ❑ 1
Medicaid ..... ❑ 2
Medicare ..... ❑ 3
Tricare/Champus ..... ❑ 4
Veterans Administration coverage ..... ❑ 5
Other 1 ***(Specify:_____)*** ..... ❑ 6
Other 2 ***(Specify:_____)*** ..... ❑ 7
Other 3 ***(Specify:_____)*** ..... ❑ 8
Other 4 ***(Specify:_____)*** ..... ❑ 9
Refused to answer ..... ❑ 77
Don't know ..... ❑ 88

D9b. Was there a time in the **past 12 months** that you **didn't** have any insurance coverage?

No ..... ❑ 0

Yes ❑ 1
Refused to answer ❑ 7
Don't know ❑ 8

D10. What are the **main ways** your prescription medicines for HIV and related illnesses were paid for in the **past 12 months**? ***[CHECK ALL THAT APPLY. DON'T READ CHOICES.]***

I wasn't taking any prescription medicines for HIV or related illnesses ❑ 1
Private health care coverage ❑ 2
I got my HIV medicines at a public clinic ❑ 3
I paid for my HIV medicines myself ("out of pocket") ❑ 4
AIDS Drug Assistance Program (ADAP) ❑ 5
I participated in a clinical research trial or drug study that provided my medicines ❑ 6
An AIDS service organization provided me my medicines ❑ 7
Medicaid/Medicare ❑ 8
Other 1 ***(Specify:*** _____***)*** ❑ 9
Other 2 ***(Specify:*** _____***)*** ❑ 10
Other 3 ***(Specify:*** _____***)*** ❑ 11
Other 4 ***(Specify:*** _____***)*** ❑ 12
Refused to answer ❑ 77
Don't know ❑ 88

D11. In the **past 12 months**, where did most of your money or financial support come from? ***[CHECK ONLY ONE RESPONSE. DON'T READ CHOICES.]***

Salary or wages ❑ 1
Savings/investments ❑ 2
Pension/retirement fund ❑ 3
Supplemental Security Income (SSI) or Social Security Disability Insurance (SSDI) ❑ 4
Public assistance ("welfare") ❑ 5
Spouse, partner or family ❑ 6
Friends ❑ 7
No income/financial support ❑ 8

Other *(Specify:_____)* ..... ❑ 9

Refused to answer ..... ❑ 77

Don't know ..... ❑ 88

D12. In the **past 12 months** have you **applied for** any form of public assistance or welfare, including Supplemental Security Income (SSI) or Social Security Disability Insurance (SSDI)?

No ..... ❑ 0

Yes ..... ❑ 1

Refused to answer ..... ❑ 7

Don't know ..... ❑ 8

D13. In the **past 12 months** have you **received** any form of public assistance or welfare, including Supplemental Security Income (SSI) or Social Security Disability Insurance (SSDI)?

No ..... ❑ 0

Yes ..... ❑ 1

Refused to answer ..... ❑ 7

Don't know ..... ❑ 8

D14. What was your sex at birth? ***[CHECK ONLY ONE RESPONSE. READ CHOICES EXCEPT "Intersex/ambiguous".]***

Male ..... ❑ 1

Female ..... ❑ 2

Intersex/ambiguous ..... ❑ 3

Refused to answer ..... ❑ 7

Don't know ..... ❑ 8

D15. Do you consider yourself to be male, female, or transgender? ***[CHECK ONLY ONE RESPONSE. READ CHOICES.]***

Male ..... ❑ 1

Female ..... ❑ 2

Transgender ..... ❑ 3

Refused to answer ..... ❑ 7

Don't know ..... ❑ 8

D16. Do you think of yourself as: ***[CHECK ONLY ONE RESPONSE. READ CHOICES.]***

Heterosexual or Straight ..... ❑ 1
Homosexual, Gay, or Lesbian..... ❑ 2
Bisexual..... ❑ 3
Other (Specify_____)..... ❑ 4
Refused to answer..... ❑ 7
Don't know ..... ❑ 8

A34. Most antiretroviral medicines need to be taken on a schedule, such as "2 times a day" or "3 times a day" or "every 8 hours". How often did you follow your specific schedule over the last 2 days? ***[USE RESPONSE CARD C.]***

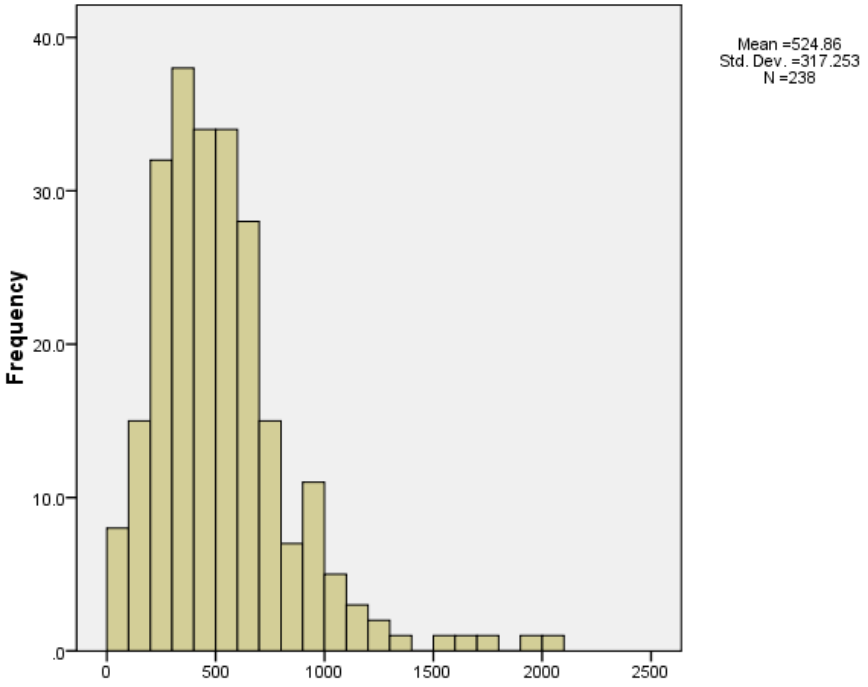
Never..... ❑ 1
Rarely..... ❑ 2
About half of the time..... ❑ 3
Most of the time..... ❑ 4
Always ..... ❑ 5
Refused to answer..... ❑ 7
Don't know..... ❑ 8

Length of time

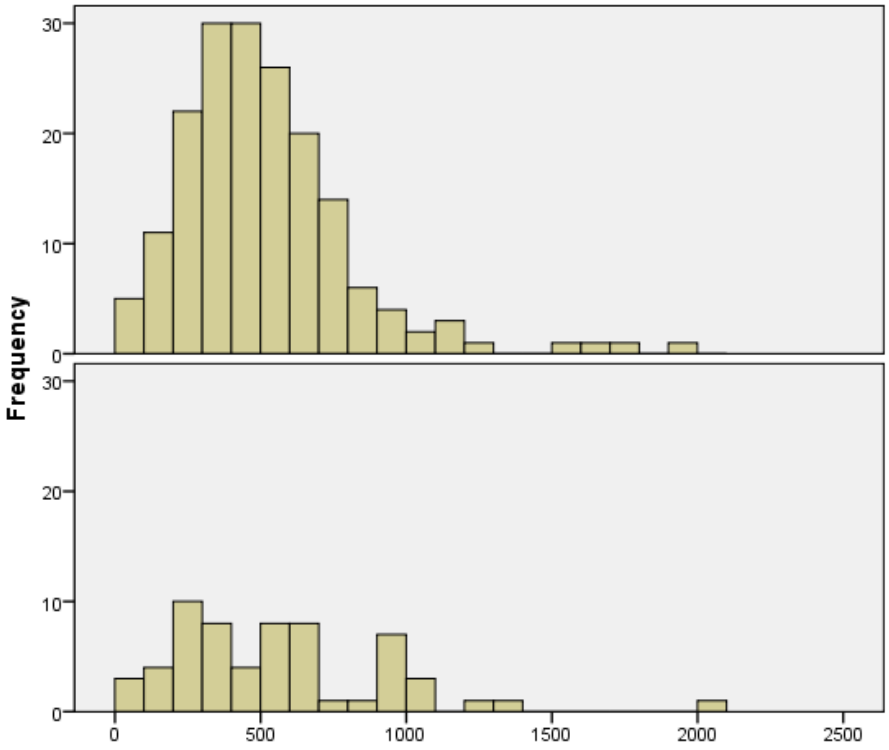
T2. "In the last 12 months, typically how long does a <u>one-way trip</u> take you to get to your <u>usual</u> doctor's office or clinic <u>for HIV treatment</u>?" (Less than 15 minutes, 15-30 minutes, 31-60 minutes (1 hour), 61-90 minutes, 91-120 minutes (2 hours), More than 120 minutes, R, DK) [**Do not read response categories.**]

To obtain the entire interview questionnaire or the medical record abstraction forms, please contact Sean Schafer at 971-673-0153.

Appendix C: Histograms of CD4 count



CD4 count (cells/µL)



CD4 count