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# Predictors of Poor Glycemic Control in Diabetic Clients with Mental Health Illness, Community Alliance, Omaha, Nebraska

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**Predictors of poor glycemic control in diabetic clients with mental health illness, Community Alliance, Omaha, Nebraska**

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# Abstract

People with severe mental illness tend to die 10-25 years earlier than the general population (WHO). Main contributors to these premature deaths include comorbidities such as hypertension, cardiovascular disease, and diabetes. Diabetes prevalence in mentally ill people is 2 times higher than the general population (WHO). The World Health Organization is taking action to improve the health of people with severe mental illness. These efforts include creating protocols of prevention, identification, assessment, and treatment for mentally ill people, as well as improving access to general health services through the integration of physical and mental health services. Community Alliance, located in Omaha, Nebraska (https://community-alliance.org/), is an integrated mental and physical health facility that aims to fulfill this goal. The purpose of this project was to analyze the Diabetes Registry database at Community Alliance in an effort to help their organization monitor health outcomes of diabetic clients. This observational, retrospective study began with descriptive analysis of the primary outcome variable, glycemic control, and demographic factors including sex, race, ethnicity, insurance, smoking status, comorbidity, medication management, antipsychotic medication use, and primary care provider. Cumulative and binary logistic regression was used to estimate the predictors of poor glycemic control. Effects were interpreted using adjusted odds ratios. Both models were multivariate and adjusted for all variables. Findings indicate that while no significant p-values were reported, Hispanic ethnicity (adjOR 2.24; 95% CI .7-29.32), medication management (adjOR 2.5; 95% CI .45-13.96), and Medicaid insurance (adjOR 1.94; 95% CI .26-14.65) were most strongly associated with higher odds of poor glycemic control in both models. Statistical analysis revealed important relationships that may guide Community Alliance in their effort to evaluate and improve Diabetes patient outcomes.

# Chapter 1: Introduction

Community Alliance (https://community-alliance.org/) is an integrated health care organization located in Omaha, Nebraska, that offers psychiatric services, mental health and substance use counseling, primary medical care, rehabilitation, employment, community supports, and family and peer support. The Mission of Community Alliance is to "help individuals with mental illness reach their potential and to live, work, learn, and contribute to the community" (Who We Are). As an integrated health facility, part of its primary care includes maintaining registry data for clients suffering from both mental health illness and other comorbidities such as hypertension, diabetes, and hyperlipidemia.

This project aimed to characterize, analyze, and interpret findings of the diabetes registry data managed by Community Alliance. This report addressed three specific aims: 1. Conduct statistical analysis of the diabetes registry data 2. Identify predictors of poor glycemic control in Diabetic patients suffering from mental illness, and 3. Determine if there is a significant association between client demographics and poor glycemic control. This information serves to help Community Alliance understand predictors of Diabetic complications at their organization and aid them in assessing Diabetes outcomes. Understanding what drives diabetes outcomes will guide Community Alliance in program intervention and contribute to their overall goal of helping people with mental illness achieve their potential and to live, work, learn and contribute in a community of mutual support.

# Specific Aims

There were three specific aims of this project.

Specific Aim #1: To conduct statistical analysis of the diabetes registry data and gain insight into the relationship between covariates in the model. This will help Community Alliance to understand diabetes outcomes at their mental health facility.

Specific Aim #2: To identify predictors of poor glycemic control in Diabetic patients suffering from mental illness at Community Alliance

Specific Aim #3: To determine if there an association between client demographics and poor glycemic control at Community Alliance.

## Significance

The life expectancy of people suffering from mental illness is 10-25 years below the general population (WHO). Mortality rates among people with schizophrenia is 2 to 2.5 times higher than the general population- and people with bipolar mood disorders have mortality rates ranging from 35% to 2 times as high as the general population. There is a 1.8 times higher risk of dying associated with depression (WHO). The reason for premature deaths among those suffering from mental illness is two-fold: first, people with mental illness receive lower quality physical health care than the general population, primarily due to stigma and discrimination associated with mental health. Lower quality health care reduces life expectancy (WHO). Secondly, mental health and chronic physical conditions go hand in hand. The World Health Organization recognizes that people suffering from mental health illness are more susceptible to develop chronic diseases such as cardiovascular diseases, hypertension, and

diabetes. These comorbidities reduce life expectancy (WHO). The relationship between mental illness and diabetes is well-suppported and discussed in the following section.

# Chapter 2- Background/ Literature Review

## Severe Mental Illness and Diabetes

People suffering form Severe Mental Illness (SMI) are more likely to develop chronic physical conditions such as diabetes, cardiovascular disease, and hypertension (WHO), all of which contribute to premature death. The relationship between SMI and Diabetes is largely explored and well-documented.

Some studies attribute the high risk of diabetes among people with SMI to depression. Depression often leads us to unhealthy eating habits, cigarette, and alcohol use (Balhara, 2011)(Chacon, 2011). This unhealthy lifestyle contributes to heightened risk for diabetes. Other authors argue that a relationship exisits between schizophrenia, bipolar disorder, and diabetes. There is reason to believe that treatment with first- and second-generation antipsychotics affect weight gain, leading to increased risk of diabetes (Mangurian et al, 2018). Regardless of the reasoning, multiple studies confirm higher prevalence of diabetes among those with a major mental disorder (Jackson et al, 2019)(Lean et al, 2003). The reported prevalence of people with both SMI and Diabetes range from 15-28% - more than twice that of the general population (Mangurian et al, 2019).

Incident disparities between people with and without major mental illness appear to be widening. Diabetes incidence in 2015 was 1.5 to 2.5 percent higher in people with versus without a major mental disorder, having slightly increased over time. Diabetes incidence were greater among women than men for schizophrenia (Jackson et al, 2019).

Part of treating diabetic patients with SMI involves monitoring patient glycemic control, indicated by the HbA1c test. The A1c test measures the percentage of red blood cells that have sugar-coated hemoglobin. A level of 6.5% or more indicates Diabetes. Levels of glycemic control for diabetic patients are as follows:

**Well-controlled**: HbA1c <7%

**Moderately-controlled**: HbA1c 7-9%

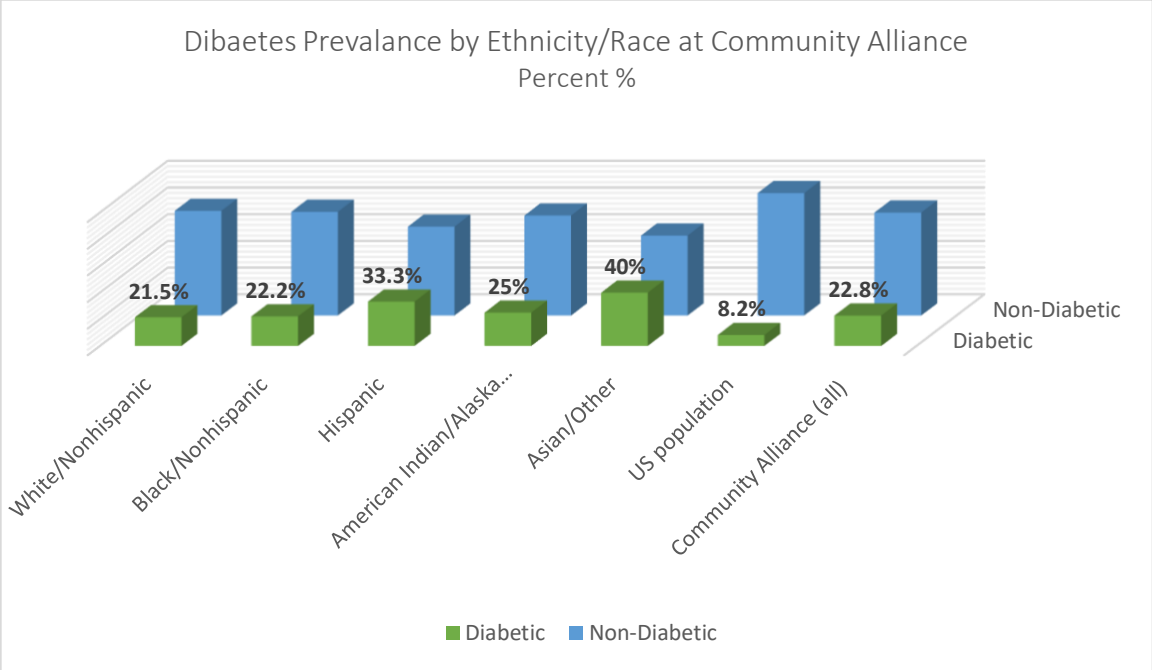
**Poorly-controlled**: HbA1c>9%

Predictors of poor glycemic control in Diabetic patients with SMI have been identified by previous studies. Frequently cited is younger age, medication aherence, ethnic minorities, and last primary care visit as significant predictors of poor glucose control (Mangurian et al, 2018) (Feldman et al, 2014).

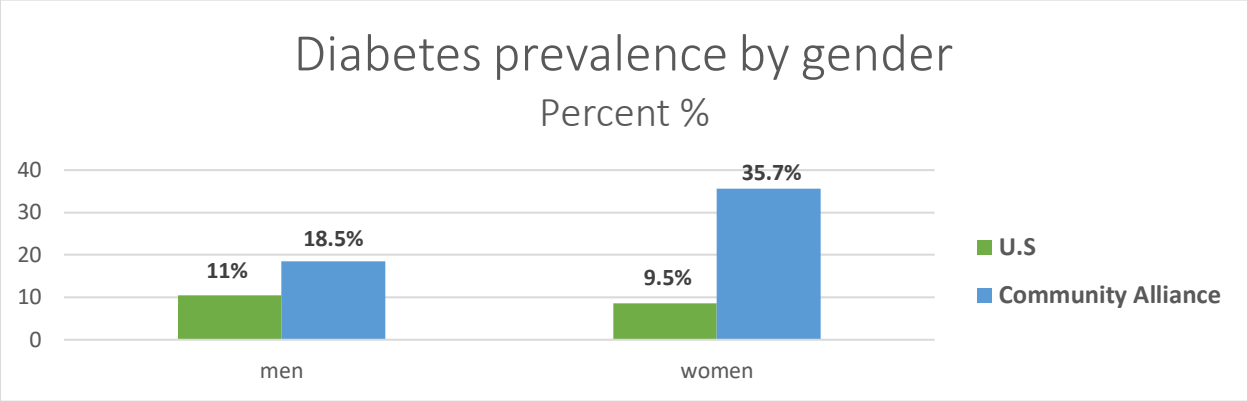
Despite recognition of these associations, diabetic complications among patients with SMI remain a major concern in health care management and clinical practice, with many patients unable to achieve target glycemic levels. Reasons for this include poor medication adherence and socioeconomic inequalities. Those who do not take prescribed anti-diabetic medication as recommended are less likely to reach target glycemic levels (Feldman et al, 2014) (Mangurian et al, 2018). The World Health Organization recognizes a crucial need for increased access to integrated mental and physical health care for patients with severe mental disorders, and to improve the diagnosis, treatment, and follow-up of coexisting psychological and physical conditions.

## Community Alliance

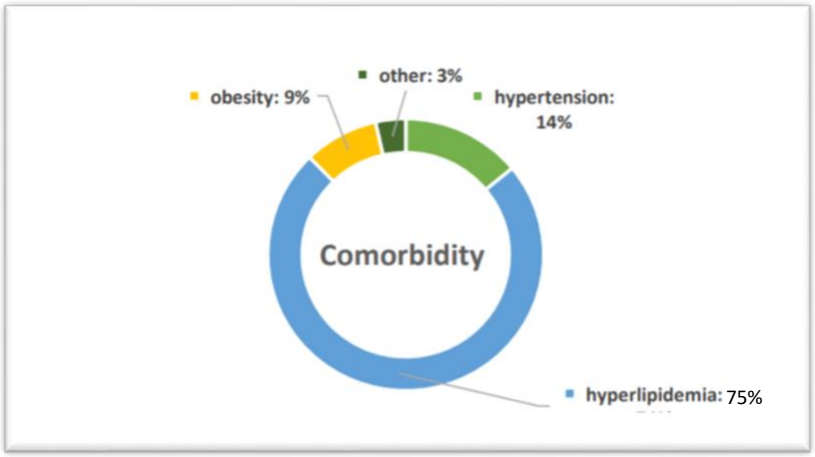
The prevalence of diabetes among clients suffering from severe mental illness at Community Alliance (CA), Omaha, Nebraska is 22.8%. This is approximately 2.5 times that of the general population (8.2%). Diabetes prevalence is higher among women (35.7%) than men (18.5%). Of those diabetic patients with severe mental illness, 100% have at least one comorbidity (75% hyperlipidemia, 15% hypertension, 7% obesity, 3% other), and 39% of diabetic clients are on antipsychotic medication. Representations of this data continue on the following page.




*Diabetes prevalence is significantly higher at Community Alliance than the general population (p=.0001)*




*Diabetes prevalence is higher among women (35.7%) than men (18.5%) at Community Alliance and almost 4 times that of women in the general population.*




*100% of clients have at least one comorbidity (75% hyperlipidemia, 15% hypertension, 7% obesity, 3% other).*


*39% of diabetic clients at Commmunity Alliance are on antipsychotic medication.*

Diabetes prevalence by race/ethnicity at Community Alliance, in comparison with national averages, is shown above. Non-Hispanic Whites have the lowest prevalence percent (7.5% national, 21.5% Community Alliance). Asian/other, Hispanics, and American Indian/Alaska Native have the highest prevalence of diabetes at Community Alliance (40%, 33.3%, and 25% respectively).

Diabetes is more prevalent among women (35.7%) than men (18.5%) at Community Alliance. The odds that a female will have diabetes is 2.5 times that of a male. Hyperlipidemia (75%) is the most prevalent comorbidity, followed by hypertension (14%), and obesity (9%). Approximately 39% of diabetic clients are on anti-psychotic medication.

While the number of minority clients at Community Alliance provides a small sample size for analysis, the demographics at Community Alliance reflects that of Omaha, Nebraska, with a higher percentage of Black/non-Hispanics and American Indian/ Alaska Natives- and lower percentage of Hispanics and Asian/Other races.

| Race | Omaha, NE | Community Alliance |
|---|---|---|
| White/non-Hispanic | 65.7% | 66.7% |
| Black/non-Hispanic | 12.1% | 22.8.% |
| Hispanic | 11.3% | 5% |
| Asian/other | 6.6% | 2.1% |
| American Indian/Alaska native | .6% | 3.4% |

*Omaha, NE demographic data provided by DataUSA (https://datausa.io/profile/geo/omaha-ne/)*

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Baseline calculations of Diabetic clients with SMI at Community Alliance resemble observations made by prior studies analyzing SMI and Diabetes. However, unlike other electronic data registry studies, this report aims to offer analysis of potential relationships between covariates at this particular organization, which has not been examined by any past study. The variables to be considered differ from those included in other diabetes registry analysis.

As noted earlier, diabetic complications among patients with SMI remain a major concern in health care management and clinical practice. People with mental health illness continually receive lower quality health care than the general population (WHO).This report will help Community Alliance understand Diabetes outcomes at their organization, and aid them in helping individuals with mental illness achieve their potential and to live, work, learn and contribute in a community of mutual support.

# Chapter 3: Data and Methods

## Study Design, Outcome, and Consent

This retrospective observational study used the data of 45 diabetic patients age 18-85 from the Community Alliance Diabetes electronic data registry. Data has been collected and verified by two clinicians at Community Alliance. Data was provided with no former knowledge of the research question. Data was de-identified and informed client consent was not obtained. Clients were unaware of the research outcome. Study results will be shared only with Community Alliance and the University of Nebraska Medical Center.

## Study Definitions

Indicators for each variable were coded and listed in the table below. A cumulative logit model was fit for 3-level outcome glycemic control; 0 = optimal control (A1c<7%), 1 =moderate control (7%< A1c<9%), and 2 = poor control (AIC>9%). For the binary logit model, outcome A1c was coded as 0= optimal control (A1c<7%), and 1= moderate/poor control (A1c$\geq$ 7%). Categorical covariates considered include sex (male/ female), age, race (white, black/other), ethnicity (Hispanic, not Hispanic), insurance (Medicaid/ other), smoking status (current smoker/nonsmoker), comorbidity (hyperlipidemia/other), med management (yes/no), anti-psychotic med use (yes/no), primary care provider (Community Alliance, other).

| | |
|---|---|
| Gender | 0=female<br>1=male |
| Race | 0=white<br>1=black or other |
| Ethnicity | 0=nonhispanic<br>1=hispanic |
| Age | continuous |
| Smoking Status | 0=never, unknown, or former smoker<br>1= current smoker |
| Insurance | 0=Medicaid<br>1=other |
| Anti-psychotic med use | 0=nonuser<br>1=user |
| Med Management | 0=no<br>1=yes |
| Primary Care Provider | 0=Community Alliance<br>1=other |
| HbA1c<br>(cumulative model) | $0 = < 7\%$ (optimal control)<br>$1 = 7 - 9\%$ (moderate control)<br>$2 = > 9\%$ (poor control) |
| HbA1c<br>(binary logit model) | $0 = < 7\%$ (optimal control)<br>$1 = \geq 7\%$ (moderate to poor control) |
| Comorbidity | 0= Hyperlipidemia<br>1= Other (Hypertension, Obesity) |

### Statistical Analysis

Descriptive statistics, Wald maximum likelihood estimates, and adjusted odds ratios were generated using SAS (Cary, NC). Mutivaritate logistic regression was implemented to analyze associations between covariates and outcome HbA1c. A step-wise selection procedure was administered for model inclusion. Covariates meeting a $p<.05$ significance level according to the Wald-test statistic were included in the final model. A cumulative logit model wascompared to a binary logit model to achieve the best fit of the data.

## Chapter 4: Results

After excluding 9 clients due to missing data for the response variable, the final analysis included 45 diabetic clients ranging in age from 28-97. The mean age of all clients was 56.9 (Sd 11.1)(Median 57.6, IQR 51-62), 24 (54.6%) of which were males and 20 (45.4%) females.

Clinical characteristics and outcomes of all diabetic clients are reported in Table 1. Overall, clients were more likely to be White (72.7%) and Non-hispanic (90%). The mean A1c score of all clients was 7.3% (SD 2.3%). A total of 75% of clients had hyperlipidemia, 13.6% had hypertension, and 11.7% were obese. Demographic variables and comorbidities were compared between those with optimal, moderate, and poor glycemic control. Those with worsening glycemic control were more likely to be female, hispanic, on medication management, and insured by Medicaid. Descriptive statistics of all 45 clients are listed in the table below.

**Table 1**

Clinical features of 45 clients with Diabetes and Mental Health Illness

| Patient Characteristics | All patients (n=45) | A1C | | |
|---|---|---|---|---|
| | # (%) | Optimal control <6% (n=28) | Moderate control 7-9% (n=9) | Poor control >9% (n=7) |
| **Age, years** | | | | |
| Mean (sd)<br>Median (IQR)<br>(range) | 56.9 (11.1)<br>57.5 (51-62)<br>(28-97) | 57.9 (8.3) | 55.9 (11.2) | 54.1 (20.5) |
| **Gender** | | | | |
| Male | 24 (54.6%) | 16 (36.7%) | 5 (11.4%) | 3 (6.8%) |
| Female | 20 (45.5%) | 12 (27.3%) | 4 (9.1%) | 4 (9.1%) |
| **Race** | | | | |
| White | 32 (72.7%) | 19 (43.2%) | 7 (15.9%) | 6 ( 13.6%) |
| Black/Asian/other | 12 (27.3%) | 9 (20.5%) | 2 (4.5%) | 1 (2.27%) |
| **Ethnicity** | | | | |
| Non-Hispanic | 40 (90.9%) | 27 (61.4%) | 8 (18.9%) | 5 (11.4%) |
| Hispanic | 4 (9.1%) | 1 (2.3%) | 1 (2.3%) | 2 (4.6%) |
| **Smoking Status** | | | | |
| Never/unknown/ former | 26 (59.1%) | 19 (43.2%) | 3 (6.8%) | 4 (9.1%) |
| Current | 18 (40.9%) | 9 (20.5%) | 6 (13.6%) | 3 (6.8%) |
| **Comorbidity** | | | | |
| Hyperlipidemia | 33 (75%) | 22 (50%) | 5 (11.4%) | 6 (13.6%) |
| Hypertension | 6 (13.6%) | 3 (6.8%) | 3 (6.8%) | 0 (0.0%) |
| Obesity | 5 (11.7%) | 3 (6.8%) | 1 (2.3%) | 1 (2.3%) |
| **Med Managment** | | | | |
| Yes | 28 (63.6%) | 16 (36.4%) | 7 (15.9%) | 5 (11.4%) |
| No | 16 (36.4%) | 12 (27.8%) | 2 (4.6%) | 2 (4.6%) |
| **Psychotic Med User** | | | | |
| Non-user | 29 (65.9%) | 18 (40.9%) | 6 (13.6%) | 5 (11.4%) |
| User | 15 (34.1%) | 10 (22.7%) | 3 (6.8%) | 2 (4.6%) |
| **Insurance** | | | | |
| Medicaid | 34 (77.3%) | 21 (47.7%) | 6 (13.6%) | 7 (15.9%) |
| Other | 10 (22.7%) | 7 (15.9%) | 3 (6.8%) | 0 (0.0%) |
| **Primary Care Provider** | | | | |
| Community Alliance | 23 (52.3%) | 16 (36.4%) | 5 (11.4%) | 2 (4.6%) |
| Other | 21 (47.7%) | 12 (27.3%) | 4 (9.1%) | 5 (11.4%) |

Sd: Standard Deviation; A1C (%): percentage of how much sugar is attached to the blood's hemoglobin protein

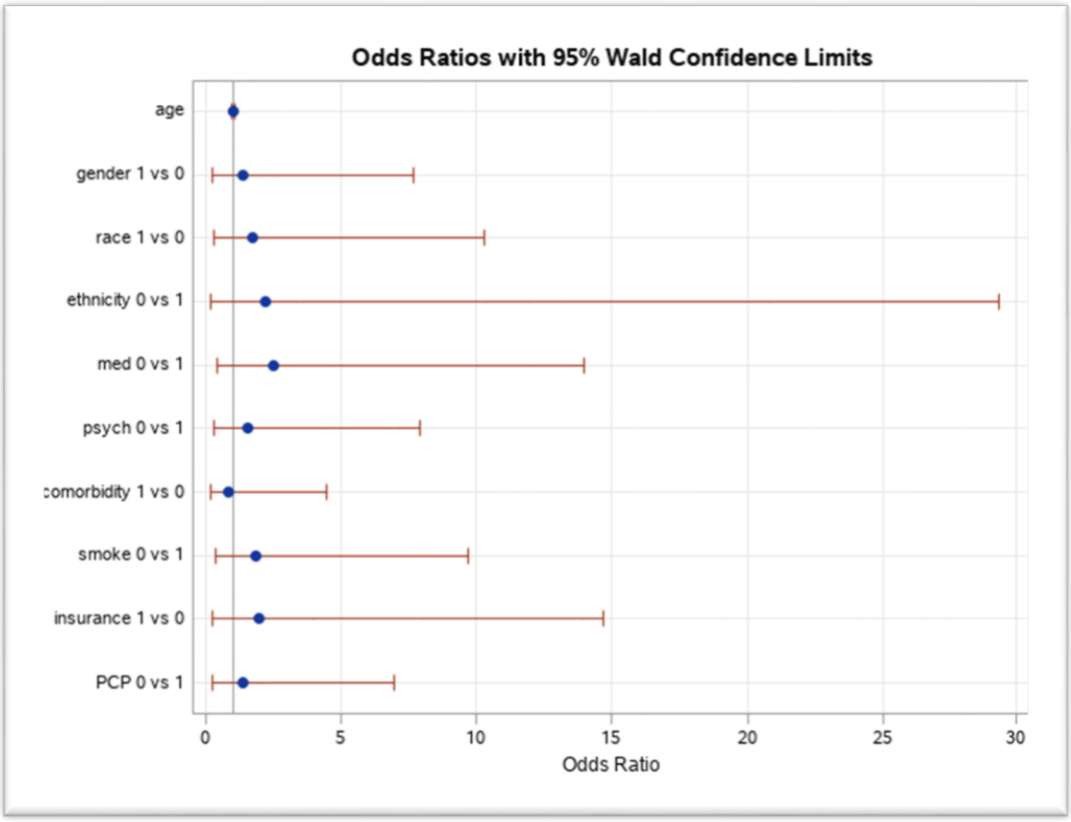
**Table 2 (Cumulative Logit Model)**

Multivariate Logistic Regression Analysis of the likelihood of poorer glycemic control in 45 Diabetic clients with mental health illness.

| Variables | Model 1 (Cumulative Logit) | | | | Model 2 (Binary Logit) | | | |
|---|---|---|---|---|---|---|---|---|
| | Adj(OR) | 95% CI | | P value | Adj(OR) | 95% CI | | P value |
| **Age** | 1.04 | .97 | 1.11 | .328 | 1.03 | .96 | 1.12. | .231 |
| **Gender** Female | 1.40 | .27 | 7.33 | .690 | 1.39 | .25 | 7.68 | .710 |
| **Race** White | 1.88 | .32 | 10.96 | .482 | 1.71 | .28 | 10.26 | .560 |
| **Ethnicity** Hispanic | 4.36 | .37 | 50.97 | .240 | 2.24 | .17 | 29.32 | .540 |
| **Smoking Status** Current | 1.89 | .38 | 9.35 | .434 | 1.86 | .36 | 9.69 | .462 |
| **Comorbidity** Hyperlipidemia | 1.12 | .21 | 5.90 | .895 | .85 | .16 | 4.50 | .846 |
| **Med Managment** Yes | 2.46 | .45 | 13.38 | .297 | 2.50 | .45 | 13.96 | .296 |
| **Psychotic Med User** Non-user | 1.48 | .30 | 7.32 | .631 | 1.50 | .30 | 7.89 | .604 |
| **Insurance** Medicaid | 2.75 | .35 | 21.41 | .334 | 1.94 | .26 | 14.65 | .520 |
| **Primary Care Provider** Other | 1.29 | .27 | 6.09 | .751 | 1.38 | .27 | 6.98 | .694 |

Both the cumulative and binary logistic regression models were adjusted for all variables. There was no statistically significant ($p<.05$) associations between moderate-to-poor or worsening glycemic control and other covariates in the model. While no significant p-values were reported, Hispanic ethnicity (adjOR 2.24; 95% CI .7-29.32), medication management users (adjOR 2.5; 95% CI .45-13.96) , and Medicaid insurance users (adjOR 1.94; 95% CI .26-14.65) were associated with higher odds of poor glycemic control in both models. White race (adjOR 1.71; 95% CI .28-10.26), current smoking status

(adjOR 1.86; 95% CI .36-9.69), and being a non-user of psychotic meds (adjOR 1.50; 95% CI .30-7.89) was also associated with higher odds of moderate to poor glycemic control.




As seen in the Odds Ratio plot above, some variable were given an inverted reference category (i.e ref=1 vs ref=0) in instances where the Odds Ratio was below 1. This was performed in order to compare the odds ratios of different covariates. The OR plot above shows which exposure had the strongest effect on the outcome: medication management, followed by ethnicity and insurance provider.

## Model Selection

Multivariate logistic regression was implemented to model the cumulative and binary logit models separately. After running both analyses, the fit of each model was evaluated by the standards below. Ultimately, the binary logit model was chosen as preferable over the cumulative logit model.

The binary logit model was chosen because it yields an AIC of 57.04 and likelihood ratio test statistic of 6.19 (p=.799). This fit is better that of the cumulative logit model, which yields an AIC of 78.45 and Likelihood Ratio test statistic of 7.57 (p=.671). Both the AIC and Likelihood Ratio is lower in the binary logit model. This model was selected as the superior model, and Odds Ratios reported by this model were preferable.

Binary Logit Model AIC = 57.043; Likelihood Ratio= 6.188

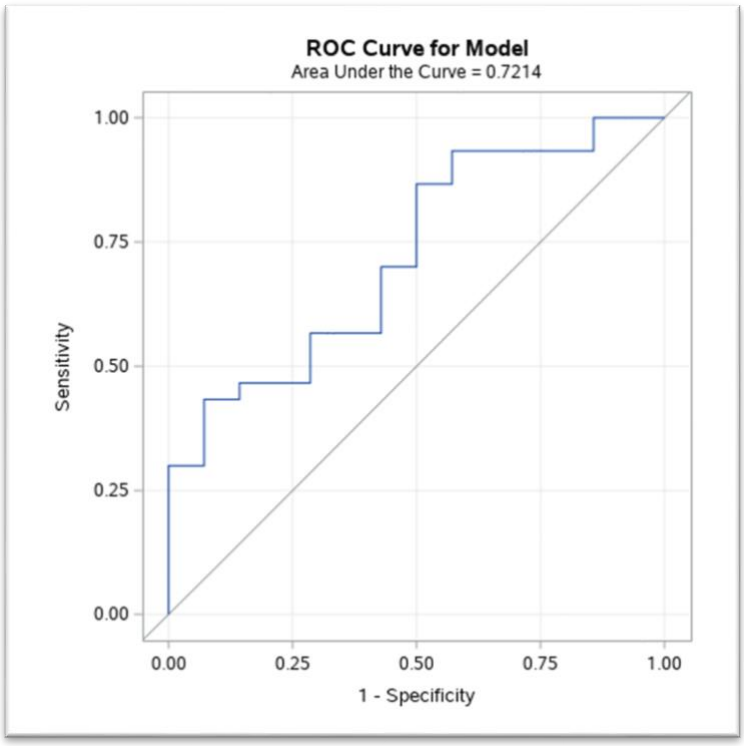
| Model Fit Statistics | | |
|---|---|---|
| Criterion | Intercept Only | Intercept and Covariates |
| AIC | 57.043 | 70.855 |
| SC | 58.827 | 90.481 |
| -2 Log L | 55.043 | 48.855 |

| Testing Global Null Hypothesis: BETA=0 | | | |
|---|---|---|---|
| Test | Chi-Square | DF | Pr > ChiSq |
| Likelihood Ratio | 6.1881 | 10 | 0.7992 |
| Score | 5.7486 | 10 | 0.8359 |
| Wald | 5.0426 | 10 | 0.8883 |

Cumulative Logit Model AIC= 78.451; Likelihood Ratio 7.568

| Model Fit Statistics | | |
|---|---|---|
| Criterion | Intercept Only | Intercept and Covariates |
| AIC | 78.451 | 90.883 |
| SC | 82.020 | 112.293 |
| -2 Log L | 74.451 | 66.883 |

| Testing Global Null Hypothesis: BETA=0 | | | |
|---|---|---|---|
| Test | Chi-Square | DF | Pr > ChiSq |
| Likelihood Ratio | 7.5683 | 10 | 0.6709 |
| Score | 6.4223 | 10 | 0.7786 |
| Wald | 6.5098 | 10 | 0.7708 |




To further ensure the fit, an ROC curve was generated. The area under the ROC curve is .721, indicating an acceptable predictive power of the binary logit model. The specificity of the model is 72.1 and the sensitivity is 27.9.

## Chapter 5: Discussion

In this retrospective observational study, we examined the relationship between demographic and factors and glycemic control in 45 diabetic clients with mental health illness at Community Alliance, Omaha, Nebraska. This report details organization-specific predictors of poor glycemic control, such as anti-psychotic med use, insurance provider (Medicaid vs other), and primary care provider (Community Alliance vs other). These covariates combined have not been included by any past study.

Previous studies cite predictors such as age, use of anti-diabetic agents, medication adherence, ethnicity, and frequency of primary care visits as predictive factors of glycemic control in diabetic patients (Mangurian et al, 2018) (Feldman et al, 2014). Fewer studies report indicators of glycemic control in diabetic clients with *mental health illness*. As noted earlier, there is evidence that antipsychotic medication use affects weight gain, increasing the risk of developing Diabetes (Mangurian et all, 2018). While there may be evidence that antipsychotic med use heightens one's risk for contracting type 2 diabetes, no significant effect of antipsychotic med use on poor glycemic control was found in this report. Unexpectedly, results indicate that nonusers of antipsychotic medication were more likely to maintain moderate-to-poor (>7%) glycemic control than users (adjOR 1.50; 95% CI .30-7.89).

These result pose a few questions. Why would nonusers of antipsychotic medication be more likely to have poor glycemic control? And why would medication management users, Medicaid insurance users, and Hispanics be more likely to have poor control?

In reference to the former question, there is evidence that suggests the risk for diabetes is heightened by atypical antipsychotic drugs in patients with Schizophrenia (Arthur et al, 2005). Even prior to the development of antipsychotic drugs, there was evidence that diabetes was more common in patients with schizophrenia (Lean et al, 2003). The effect of antipsychotic drugs on glucose control is observed mainly in the use of clozapine or olanzapin, both of which are known to influence weight gain and induce hyperglycemia (Lean et al, 2003).

With regard to Community Alliance, one explaination for why antipsychotic med users are less likely than nonsusers to have poor glucose control might be that clozapine or olanzapin is being substituted by another antipsychotic drug. Another explaination might be that clients taking antipsychotic drugs are high risk clients, and by nature receive routine quality care at Community Alliance. Patients at this

facility have custom access to a psychiatrist, licensed nursing and therapy staff, substance use and rehabilitation specialists, and peer support staff. The staff at Community Alliance is likely well aware of the relationship between some antipsychotic drugs, diabetes, and glucose control. The condition of psychotic med users may be heavily influenced by the quality of care at the facility.

Another question surfaced by the results is why would medication management users (adjOR 2.5; 95% CI .45-13.96) be more likely to have worse glycemic control? It is my assumption that medication users are more likely to have poor control because poor control prompts the use of medication, and less because medication causes poor control.

The last results under question are the effects of Insurance provider and Ethnicity. Medicaid insurance users were 1.94 times more likely to have moderate-to-poor control. Reasons for this may stem from the fact that Medicaid is designed for low-income households. Those on Medicaid likely cannot afford private health insurance, which arguably increases one's access to higher quality health care (Spencer et al, 2013). Another question surfaced by the results is why would those of Hispanic ethnicity (adjOR 2.24; 95% CI .7-29.32) be more likely to have worse glycemic control? Several studies cite ethnicity as a predictive factor for poor glucose control (Feldman et all, 2014) (Mangurian et all, 2018). Ethnic and Minority research has found that hispanics are less likely to be private insurance users and more likely to be Medicaid insurance users; as a result, they receive poorer quality health care than private insurance users (Bulatao et al., 2004). At Community Alliance, is it possible that those insured by Medicaid receive lower quality care compared to private insurance users of Region 6 and Medicare, which may translate to poorer glucose management of Medicaid insurance users overall.

## Specific Aims

The specific aims of this study are reiterated below followed by an assessement of the fulfillment of that aim.

Specific Aim #1: To conduct statistical analysis of the diabetes registry data and gain insight into the relationship between covariates in the model. This will help Community Alliance to understand diabetes outcomes at their mental health facility.

This study offers insight into the relationship between covariates in the model. Provided are descriptive statistics of the study population in terms of the three-level outcome: optimal, moderate, and poor glycemic control. Multivariate logistic regression analysis also indicated which factors are associated with poor glycemic control. This which will help Community Alliance understand which exposures are are influencing glycemic control at their mental health facility.

Specific Aim #2: To identify predictors of poor glycemic control in Diabetic patients suffering from mental illness at Community Alliance

This study identified medication management-Yes (adjOR 2.5; 95% CI .45-13.96), Ethnicity-Hispanic (OR 2.24; 95% CI .7-29.32), and insurance provider-Medicaid (adjOR 1.94; 95% CI .26-14.65) as the top three predictors of moderate to poor glyecmic control. Clients on medication management are 2.5 times more likely to experience moderate to poor glycemic control than clients not on medication management. Hispanic clients are 2.24 times more likely to experience moderate to poor control, and clients insured by Medicaid are 1.94 times more likely to experience moderate to poor control.

Specific Aim #3: To determine if there an association between client demographics and poor glycemic control at Community Alliance.

No significant association (p-value <.05) between client demographics and poor glycemic control was supported by this study. The cumulative and binary logit models yield odds ratios that identify which variables are associated with a stronger likelihood of the outcome. In addition to medication users, Hispanics, and those insured by medicaid, this study found that females were more likely than males to experience moderate to poor control (adjOR 1.39; CI .25-7.68). Current smokers (adjOR 1.86; 95% CI .36-9.69) and clients with a primary care provider outside Community Alliance (adjOR 1.38; 95% CI .27-6.98) were more likely to experience moderate to poor control than non-smokers and clients attending Community Alliance for primary care. Whites were 1.71 times more likely than Black/Asian/ Other races to experience moderate to poor control.

## Strengths/Limitations

The limitations of this study involve sample size, data quality, and access to comparative data from other mental health facilities. A multi-center observational study would provide a larger study population and may yield statistically significant associations between exposure variables and the response.

Increasing the sample size may strengthen the statistical power and accuracy in measuring significant effects. For example, one would assume that because there are 4 Hispanic clients with Diabetes, and 2 of them have poor glycemic control, Hispanic would have a significant effect on the outcome. Ethnicity (Hispanic) did have the lowest p-value, however it was not <.05. Reasons for this might be that the sample size of Hispanics (n=4) is not large enough to accurately predict association. There may be other reasons why 2 of the 4 Hispanic clients have poor glycemic control aside from being Hispanic. The odds

of poor glycemic control is 2.24 times higher for Hispanics- however the confidence interval for this calculation is .7-29.32. This is considerably wide and indicative of high uncertainty. Conversely, if 20 Hispanics were enrolled, and 10 of them had poor glycemic control, the statistical power increases and we would be able to say more confidentally that Ethnicity has a significant effect on poor glycemic control at Community Alliance.

Another reason for lack of significant associations may be that too many variables were included in the model. It is possible that by adjusting for too many covariates, individual effects were undetectable.

Additional weaknesses  of this study include its exclusion of 9 diabetic patients due to unreported A1c sores. Recovery of the missing values was attempted by using the multiple imputation method in SAS. This recovery resulted in a reduced fit of the model and did not provide any significant associations. Therefore the missing entries were removed.

Future studies involving diabetic clients with mental health illness may benefit from including a larger sample size, with fewer covariates,  involving multiple integrated health facilities like Community Alliance.

## Interpretation/ Generalizability

This study aimed to idenfity the predictors of poor glycemic control in a a small population of individuals suffering from menal health illness and diabetes at Community Alliance. Results indicate that certain demographic factors may be associated with glycemic control at Community Alliance. It is possible that these predictors influence glycemic control in other study populations as well. However this information is for use of Community Alliance and the University of Nebraska Medical Center alone.

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# Application of public health competencies

### *Foundational Competency:*

- MPHF3-Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate

I analyzed quantitative data using biostatistical methods generated by SAS statistical software. Logistic regression was administered to evaluate the association between categorical and continuous predictors and the cumulative and binary outcome variable, HbA1c. Descriptive statistics and odds ratios were interprete accordingly.

### *Concentration Competencies:*

- BIOSMPH2- Apply appropriate statistical methods for estimation and inference, using a software package for data management, statistical analyses, and data presentation.

I applied Multivariate logistic regression anlysis using SAS statistical software. In conducting exploratory analysis, Proc logistic was applied for the estimative and inference of odds ratios. Proc freq and Proc means were used to yield descriptive statistics for summary data and graphical presentations.

- BIOSMPH3- Apply statistical methods for quality control and data cleaning to already collected data, verify assumptions of statistical tests and models, and implement appropriate methods to address any issues discovered

I administered quality control measures and data cleaning methods to the already collected Diabetes Registry data. This included assessing data completeness, identifying variables with too many missing values, and determining appropriate methods to accommodate incomplete observations. I will verified the assumptions of logistic regression and compare goodness of fit between models using the likelihood ratio test statistic and AIC.

## Supervision and Facilities

This project took place virtually under the supervision of UNMC and Community Alliance. No physical facility was used.

## Human Subjects

This project is a retrospective analysis of clients with de-identified registry data and did not require IRB approval.