Company Logo

Ensuring Organizational Readiness for Care Delivery to the Marginalized Patients with Chronic and Mental Health Conditions

Final Internship Report

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Contents

[1. Executive Summary 2](#_Toc103595798)

[2. Introduction 3](#_Toc103595799)

[2.1. Study Objectives 3](#_Toc103595800)

[2.2. Business Problem 3](#_Toc103595801)

[2.3. Background 3](#_Toc103595802)

[3. Methods 4](#_Toc103595803)

[3.1. Barriers 5](#_Toc103595804)

[3.2. Mentor’s Role 5](#_Toc103595805)

[4. Results and Interpretation 5](#_Toc103595806)

[4.1. Causes of patient encounters 5](#_Toc103595807)

[4.2. Predicting co-occurrences of target conditions 6](#_Toc103595808)

[4.3. Gap Analysis 8](#_Toc103595809)

[4.4. Organization Readiness Plan 8](#_Toc103595810)

[5. Discussion and Conclusion 9](#_Toc103595811)

[6. Appendix 10](#_Toc103595812)

[6.1. Internship Experience 10](#_Toc103595813)

[6.2. References 11](#_Toc103595814)

# Executive Summary

This report reflects the tasks accomplished during the internship period between January 20xx to May 20xx at Company A. Company A is a not-for-profit organization that works to provide quality healthcare services for the uninsured and underinsured population, so it becomes crucial to understand the care delivery process. The organization provides these services through a clinic and the Physician Reach Out (PRO) network. After an initial in-person briefing, the internship was completed remotely. The internship aimed to ensure the organization readiness to provide quality care to patients with chronic illnesses and mental health issues. Often chronic diseases are associated with co-occurring disease conditions and social determinants of health, but patients' mental health is ignored. This study establishes an association between chronic diseases, particularly diabetes and hypertension, with depression. The study examined clinical outcomes with a rigorous view of co-occurring conditions. The organization focuses on maximizing its staff resources and addressing the complex needs of patients. The timing of this study has been critical, as the communities the organization serves have been disproportionally affected by profound physical health, mental health, and economic impacts.

The internship facilitated putting theory into practice by exploring and applying analytical tools learned during the Health Informatics and Analytics (HIA) program.

# Introduction

## Study Objectives

The study accomplished the following objectives:

* Identified the major causes of patient encounters with the clinic in 20xx.
* Conducted a predictive analysis of patient visits with chronic and mental health illnesses.
* Conducted gap analysis on the status of available resources within the organization to treat and care for patients.

## Business Problem

This project aims to ensure organizational readiness to provide quality care to marginalized patients with chronic illnesses and mental health issues. Additionally, the resources within the organization are limited, so it is critical to maximize them and be prepared to handle the incoming workload.

## Background

The health system in the United States (U.S.) is the most advanced in the world but is fragmented. Shortage of providers, inadequate primary care, rising health care costs, and an uninsured population undermines the system. As the healthcare system in the United States works on a market justice system, there exists a gap in access to quality care for the uninsured. The marginalized population is often at risk of not seeking care and having severe health outcomes. According to the North Carolina Institute of Medicine (NCIOM), 13.3% of the adult population were uninsured in 2015, reflecting a 4.7 percentage point decrease from 2013 [1]. Past years have contributed to limited access and care. Uninsurance has increased as the pandemic caused jobs and employment-based coverage loss, resulting in increased uncompensated healthcare costs [2]. The expenses incurred due to uninsurance get spillover to those covered by insurance [3].

Equal access to healthcare becomes critical for the marginalized with severe health conditions like chronic and mental illnesses. Chronic diseases are prolonged conditions often considered incurable with uncertain outcomes, hence causing mental distress [4]. Patients with chronic conditions are more likely to develop mental health conditions [5]. Depression and anxiety aggravate these conditions, and uninsurance worsens the situation for the marginalized [6,7].

Accountable Care Organizations (ACOs) are models to improve healthcare delivery and reduce healthcare costs, increasingly implemented by private and public sectors [8]. Many physicians and hospitals work with not-for-profit organizations and offer their services to patients who cannot afford healthcare costs. Company A’s Physicians Reach Out (PRO) connects patients with a network of such healthcare providers and organizations.

# Methods

Deidentified data for specific variables were obtained in two datasets from Electronic Health Records (EHR). Primary data cleaning such as renaming variables, correcting spellings, and removing unnecessary special characters was performed using Microsoft (MS) excel. The data was imported onto Statistical Analysis System (SAS). Two different datasets were merged. Null values missing at random for categorical variables were removed; values representing similar categories, such as for the variable ‘race’ the values like ‘Indian’, ‘Chinese’, ‘Asian’ were merged as ‘Asian’; continuous variables were imputed using mean values. New variables were defined; a variable ‘age’ was calculated from ‘date of birth’; finally, the data was filtered for unique patient visits in 20xx. The final dataset contains 5035 observations.

Firstly, the workload for the clinic was determined by calculating the (a) frequency (frequency procedure) of patient visits for unique primary diagnoses; (b) calculating the number of total patient visits for each month using SQL procedure. A bar graph and a line chart were created to visualize the results.

Secondly, some adjustments were made for conducting additional analyses to predict the co-occurrence of chronic and mental health conditions in a patient: (a) the two most common causes of patient encounters identified as diabetes and hypertension, were grouped as ‘chronic health conditions’ (CHC); (b) mental issues including depression and anxiety were grouped as ‘mental health conditions’ (MHC); (c) patients with a diabetes diagnosis were flagged to the diabetes registry, and hypertension diagnosis was labeled to the hypertension registry; (d) the patient health questionnaire (PHQ) scores for mild to severe depression were grouped as a binary variable that describes a positive or negative diagnosis of depression; (e) patients with the identified chronic conditions diagnosed with depression were identified as the ‘target group’, and these disease conditions (CHC and MHC) together were referred to as ‘target conditions’.

Thirdly, the proportion of the population with diabetes and hypertension was explored. Also, the proportion of patients diagnosed with either of these conditions and co-occurring depression were identified. A logistic regression analysis was performed to estimate the possibility of depression diagnosis in patients with CHC.

Fourthly, visualizations were created to demonstrate the association of the target conditions, the most preferred method of contact, the distribution of these conditions among age groups and races, and the utilization of PRO along with other charity groups was explored for the target group.

Lastly, an analysis was performed using the Structured Query Language (SQL) procedure in SAS to identify cases seen by the mental health providers and find gaps in the service delivery process.

## Barriers

Some barriers to achieving the study objectives are listed below, along with the strategies adopted to overcome them:

* The small data size was a limitation in getting statistically significant results for specific analyses such as correlation and t-test. In order to provide strong evidence to the organization and enable them to make better decisions, alternate analyses were conducted.
* The organization provides healthcare services to the uninsured and underinsured (marginalized). A comparison of risks of co-occurring conditions for both groups (uninsured and insured) cannot be made because of the unavailability of data for the insured (general population).
* The organization does not bill its services but instead provides them as a charity. Therefore, as an alternative for the cost of care estimation, an analysis was performed to estimate the utilization of patient coverage options through the Physician’s Reach Out (PRO) network and other charity services. This analysis also helped the organization measure the effectiveness of the PRO network and make decisions on its expansion.

## Mentor’s Role

Mentor’s role was pivotal throughout the internship. Firstly, a detailed discussion with the mentor helped identify the variables needed for the study. The mentor provided all the required data. Detailed feedback and suggestions for analyses aided in structuring the overall internship. Periodic meetings with the mentor helped establish effective communication and understanding of the clinic's and organization’s workflow.

# Results and Interpretation

## Causes of patient encounters

There were 5035 unique patient visits to the clinic in 20xx. The bar chart (Figure 1) indicates the frequency of encounters for the identified conditions. The major causes (primary diagnosis) of patient encounters at the clinic were diabetes (n=742, 14.74%), hypertension (n=482, 9.57%), and mental disorders (n=241, 4.79%).

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*Figure 1: Unique patient visits to the clinic in 20xx. The number of visits is plotted on the y axis. DM stands for diabetes mellitus, the primary diagnoses are plotted on the x axis.*

Figure 2 shows the number of patient visits to the clinic per month, the highest being in October (n=488) and the lowest in December (n=288). Some seasonal variation was observed in the monthly visit pattern.

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*Figure 2: The number of visits is plotted on the y axis, months are plotted on x axis, 21-01 represents January 20xx and so on until 21-12 for December 20xx.*

## Predicting co-occurrences of target conditions

Figure 3 below shows the association between PHQ scores and chronic disease, diabetes and hypertension. Panel 3(a) reflects the increase in depression with the increase in HbA1C levels. Similarly, panel 3(b) depicts high PHQ score readings in patients with hypertension.

|  |  |
| --- | --- |
|  |  |
| (a) | (b) |

*Figure 3: Association between depression and chronic disease conditions. Figure 3(a) shows a scatter plot, where HbA1C values are plotted on the x-axis, and PHQ scores are on the y-axis. A regression line was added to visualize the trend. Figure 3(b) depicts a dot plot where BP readings are plotted on the x-axis, and PHQ scores are on the y-axis. A reference line was added to visualize average PHQ scores.*

Figure 4 below shows the method of patients' encounters at the clinic. Figure 4(a) visualizes all (total) encounters in 20xx. It was observed that most of the patients came for an office visit. Figure 4(b) represents patients diagnosed with target conditions and who had a positive depression screen. A significant increase in the utilization of telemedicine services was seen. This result may indicate the stigma associated with mental illnesses. There exists an opportunity to strengthen telemedicine services to provide continued care for such patients.

|  |  |
| --- | --- |
|  |  |
| (a) | (b) |

*Figure 4: The bar graphs have appointment type on the x-axis and frequency of patient visits on the y-axis. Panel(b) filters patients with diabetes, hypertension, mental issues, and a positive depression screen.*

Upon positive diagnosis of a disease condition, a disease registry was made. The proportion of the population (p= 0.20) was estimated with active diabetes and hypertension disease registry. It was observed that 28.58% of the patients had an active diabetes registry. Also, 39.50% of patients had an active hypertension registry. However, 17.62% of patients had a positive depression screening and active disease registry for both chronic conditions. The patients with CHC were at a 19% higher risk of having a positive depression screen. All the above analyses were statistically significant, with an observed p-value of less than 0.05.

The logistic regression analysis was performed to predict the likelihood of depression in patients. The observed p-value for testing the hypothesis and analysis of the effect was 0.0111. The analysis of the maximum likelihood of not having a target condition and not being diagnosed with depression proved significant, with the observed p-value of 0.0113. There were 0.77 less odds (23% times less chances) of diagnosis of depression in case of absence of a target disease condition. The CL does not include 0, which indicates statistically significant test results.

Additional visualizations were performed. Figure 5(a) shows the bar chart for the racial distribution of patients with CHC and MHC by sex. It was observed that the target conditions are more prevalent in white patients. Figure 5(b) indicates observed mean age of patients with MHC was around 40 years.

|  |  |
| --- | --- |
|  |  |
| (a) | (b) |

*Figure 5: Figure 5(a) depicts the panel bar chart. The race was plotted on the y-axis and the frequency of cases on the x-axis of this panel chart. The left panel represents female patients, and the right panel represents male patients. Figure 5(b) visualizes the mean age of patients with target conditions with age on the y-axis and target conditions on the x-axis.*

Figure 6 shows the geographical distribution of patients with target conditions. The dot size represents the number of patients coming from that area. Though the patients visited from all around Mecklenburg County, the higher number of patients belonged to the southern part of the county.

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*Figure 6: The geographical distribution of patients.*

## Gap Analysis

Table 1 represents the distribution of patients per provider/ center. There were 2396 ‘target patients’ and four mental health providers. A gap in the provider-patient ratio was evident, leading to unequal workload distribution.

*Table 1. The names of providers and centers are deidentified. The table below represents the total number of patients each provider/ center has seen.*

|  |  |
| --- | --- |
| Provider | Visits |
| A | 466 |
| B | 27 |
| C | 55 |
| D | 7 |

## Organization Readiness Plan

The above analysis establishes a strong relationship between chronic illnesses and mental health issues. The analysis supports the study's idea that patients with chronic conditions are more prone to depression. It was also observed that a significant number of patients coming to the clinic either have a primary diagnosis of hypertension or diabetes. This trend is expected to continue. Based on these observations, below are the suggestions to prepare the organization for ensuring quality care delivery and support for its patients.

1. Target all new patients diagnosed with chronic conditions (may include those with comorbidities) for depression screening and counseling.
2. Continued counseling of all patients with chronic and mental illnesses.
3. As these patients tend to use telemedicine services often, there is a need to strengthen existing telemedicine. This process may incur additional costs to the organization and needs higher management involvement for other operational decisions.
4. The organization should expand the network of MH providers. The gap in the provider-patient ratio can be filled by hiring support staff who can provide primary screening and counseling services (nurses, counselors, and social workers).
5. As a long-term plan, the clinic can plan to establish a call center within its facility with a trained provider and dedicated support staff.

# Discussion and Conclusion

A similar study by Rhyne et al. found that most patients had chronic medical diseases that included hypertension or diabetes and were inadequately monitored. Moreover, more than half of diabetic patients had hypertension. In addition to this, nearly one-fifth of the patients had a mental health diagnosis [9]. The findings of this study strongly support these analyses and observations. This study successfully establishes a relationship between chronic health conditions and the diagnosis of depression in patients. The stigma associated with mental health issues makes individuals feel uncomfortable discussing their illness. Depression is the most common form of a mental health disorder that is often ignored. It is essential to successfully understand individual behavior and environment to provide care and treatment to the marginalized population.

Company A’s Physician Reach Out program and telemedicine services are especially proven helpful in bridging the gap between demand and supply of healthcare services. Enough statistical evidence is available through this study that emphasizes the need for continuous counselling of patients with chronic conditions. The organization development plan can be a valuable tool for planning future activities. The gap analysis findings suggest a strong need to expand the network of mental health providers. However, the small sample size of the study was a limitation. It is suggested that a complete case analysis be performed by the end of 20xx to get more significant observations of other associated factors.

# Appendix

## Internship Experience

This internship was an opportunity to apply the learnings from the HIA program. In addition, the experience helped in practicing analytical and visualization tools such as SAS, SQL, and Tableau. Besides applying data analytics functions, the internship provided an opportunity to develop project management skills like project planning, need assessment, critical thinking and problem solving, risk management, and effective communication. As most jobs these days function remotely, the virtual nature of the internship provided a first-hand experience in getting used to such work culture. The feedback received from the mentor as well as faculty supervisor on report writing, interpretation, and presentation of results was particularly valuable. The experience contributed to overall professional and personal development. The overall experience was incredibly fulfilling and will definitely be useful in future endeavors.

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