

April 2013

# VA Mental Health Integration

Christine Kha Tang  
*Worcester Polytechnic Institute*

Evren Simsek  
*Worcester Polytechnic Institute*

Lazaro Antonio Rodriguez  
*Worcester Polytechnic Institute*

Sett Paing Oo  
*Worcester Polytechnic Institute*

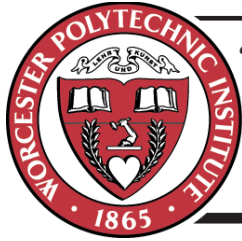
Follow this and additional works at: <https://digitalcommons.wpi.edu/mqp-all>

---

## Repository Citation

Tang, C. K., Simsek, E., Rodriguez, L. A., & Oo, S. P. (2013). *VA Mental Health Integration*. Retrieved from <https://digitalcommons.wpi.edu/mqp-all/4132>

This Unrestricted is brought to you for free and open access by the Major Qualifying Projects at Digital WPI. It has been accepted for inclusion in Major Qualifying Projects (All Years) by an authorized administrator of Digital WPI. For more information, please contact [digitalwpi@wpi.edu](mailto:digitalwpi@wpi.edu).



# WPI



Worcester Polytechnic Institute

# VA Mental Health Integration

Sponsored by the United States Department of Veterans Affairs

*Submitted to:*  
*Professor Isa Bar-On*  
*Professor Andrew Trapp*

*Submitted by:*  
*Sett Paing Oo*  
*Lazaro Rodriguez*  
*Evren Simsek*  
*Christine Tang*

## Table of Contents

|   |    |
|---|----|
| List of Tables and Figures.....                                 | 3  |
| Abstract.....   | 4  |
| Acknowledgements.....   | 5  |
| Authorship .....  | 6  |
| Problem Statement.....  | 7  |
| Goal Statement.....   | 8  |
| 1. Introduction.....  | 9  |
| 2. Background.....  | 11 |
| 2.1 Primary Care .....  | 11 |
| 2.2 Primary Care Mental Health Integration.....                 | 11 |
| 2.3 Mental Health.....  | 12 |
| 2.4 Simulation Modeling Literature Review .....                 | 13 |
| 3. Methodology .....  | 14 |
| 3.1 Clinic Observation .....                                    | 14 |
| 3.2 Data Retrieval .....  | 15 |
| 3.3 Data Analysis.....  | 16 |
| 3.3.1 Data Cleansing .....                                      | 16 |
| 3.3.2 Data Security.....  | 16 |
| 3.3.3 Identifying Target Population .....                       | 17 |
| 3.3.4 Quality Scales for Medication and Psychotherapy .....     | 18 |
| 3.3.7 Descriptive Statistics.....                               | 22 |
| 3.4 Simulation.....   | 22 |
| 4. Results and Analysis .....                                   | 25 |
| 4.1 Target Population.....                                      | 25 |
| 4.2 Relationship between Quality Ratings and Care Settings..... | 28 |
| Medication Quality Ratings .....                                | 29 |
| Psychotherapy Quality Ratings.....                              | 32 |
| Medication and Psychotherapy Combined Quality Ratings .....     | 35 |
| 4.3 Simulation Results .....                                    | 37 |

|  |    |
|--|----|
| 5. Discussion.....                                       | 41 |
| 5.1 Quality Scale.....                                   | 41 |
| 5.2 Simulation.....                                      | 41 |
| 6. Recommendations.....                                  | 43 |
| 6.1 Assessment of the Severity of Health Conditions..... | 43 |
| 6.2 Quality Scale.....                                   | 43 |
| Industrial Engineering MQP Design Component .....        | 45 |
| Design .....   | 45 |
| Life-Long Learning.....                                  | 47 |
| 7. Conclusions.....                                      | 49 |
| References.....  | 50 |
| Appendix A: Summary of Raw Data Tables .....             | 52 |
| Appendix B: Mental Health Medications .....              | 54 |
| Appendix C: Logic for Assigning Quality Scores .....     | 55 |
| Appendix D: Patient arrival rates to PMHC in FY 12 ..... | 56 |
| Appendix E: Simulation Model Screenshots .....           | 57 |

## List of Tables and Figures

|   |    |
|---|----|
| Table 1: Medication Quality Rating Criteria .....   | 18 |
| Table 2: Medications Rating 2 Criteria for MDD, PTSD and Alcohol Abuse patients .....     | 19 |
| Table 3: Medications Rating 3 Criteria for MDD, PTSD and Alcohol Abuse patients .....     | 20 |
| Table 4: Psychotherapy Rating Criteria for MDD and PTSD Patients .....                    | 21 |
| Table 5: Four Different Scenarios in Simulation .....                                     | 23 |
| Table 6: Simplified Reference for Patients by their Care Settings .....                   | 28 |
| Table 7: MDD Medication Quality Ratings by Highest Level of Care Received.....            | 29 |
| Table 8: PTSD Medication Quality Ratings by Highest Level of Care Received .....          | 30 |
| Table 9: Alcohol Abuse Medication Quality Ratings by Highest Level of Care Received.....  | 31 |
| Table 10: MDD Psychotherapy Quality Ratings by Highest Level of Care Received .....       | 33 |
| Table 11: PTSD Psychotherapy Quality Ratings by Highest Level of Care Received.....       | 34 |
| Table 12: MDD Quality Ratings by Highest Level of Care Received.....                      | 35 |
| Table 13: PTSD Quality Ratings by Highest Level of Care Received .....                    | 37 |
| Table 14: Patient Wait Times (in minutes) for different resources of PMHC .....           | 38 |
| Table 15: Utilization of PMHC Resources for Patient Treatment .....                       | 39 |
| Table 16: List of Psychiatric Medications (Medication Rating 1 Criteria).....             | 54 |
|   |    |
| Figure 1: Logic Diagram for Identifying Target Population.....                            | 17 |
| Figure 2: Age Range of Target Population .....  | 25 |
| Figure 3: Target Population by Gender.....  | 25 |
| Figure 4: Target Population by Marital Status.....  | 26 |
| Figure 5: Target Population by Service Era.....   | 27 |
| Figure 6: MDD Medication Quality Ratings by Highest Level of Care Received .....          | 29 |
| Figure 7: PTSD Medication Quality Ratings by Highest Level of Care Received.....          | 31 |
| Figure 8: Alcohol Abuse Medication Quality Ratings by Highest Level of Care Received..... | 32 |
| Figure 9: MDD Psychotherapy Quality Ratings by Highest Level of Care Received.....        | 33 |
| Figure 10: PTSD Psychotherapy Quality Ratings by Highest Level of Care Received .....     | 35 |
| Figure 11: MDD Quality Ratings by Highest Level of Care Received .....                    | 36 |
| Figure 12: PTSD Quality Ratings by Highest Level of Care Received.....                    | 37 |
| Figure 13: Patient Wait Times (in minutes) to see Prescriber and Therapist.....           | 38 |
| Figure 14: Utilization of Prescriber .....  | 39 |
| Figure 15: Utilization of Therapist.....  | 40 |

## Abstract

Veterans at the White River Junction Veterans Affairs Medical Center (WRJVAMC) are screened annually for mental health disorders. Depending upon the severity, patients who screen positive may be treated in up to 3 settings: Primary Care (PC), Primary Mental Health Care (PMHC) clinic and/or Specialized Mental Health Care (SMHC) clinic. PMHC is an innovative clinical setting at the WRJVAMC that integrates mental health with primary care. The particular subset of patients we consider are those newly identified with Major Depressive Disorder (MDD), Post-Traumatic Stress Disorder (PTSD), or Alcohol Abuse through a yearly screening program in PC. This project assesses care for this subset of patients across two dimensions: receipt of any mental health care and how care setting influences the quality of care.

For patients who screen positive, the VA currently needs an established standard to evaluate whether patients subsequently receive an effective course of treatment with medication and/or psychotherapy. The target population consists of veterans who screened positive in Fiscal Year (FY) 2011 and received treatments in (1) PC only, (2) PC and PMHC only, or (3) PC, PMHC and SMHC. We used administrative and pharmacy data from the VA over FY 2010, FY 2011, and FY 2012 to develop and implement a quality scale (rated 0 to 5) to track treatment quality for patients in our target population. According to our analyses, patients who utilized the PMHC or SMHC had higher quality ratings. The majority of patients did not receive treatment, and were seen only in PC and did not receive treatment.

It appears that obtaining mental health services in the PMHC or SMHC increases the quality of mental health treatment. Patients seeking treatment from specialty mental health providers enter treatment through the PMHC and progress to the SMHC if needed. Because so few patients received treatment in these settings, we used a discrete-event simulation model of the PMHC to estimate workforce requirements to see all patients in the PMHC while minimizing impact on patient wait times and staff utilization.

## Acknowledgements

We would like to thank the following people for their guidance and work in this project:

Professor Isa Bar-On – Faculty Advisor (WPI)

Kristine Desotto – New England Veterans Engineering Resource Center, Industrial Engineer for collaborating with us to query the data

Dr. Alicia M. Groft – White River Junction Medical Center, Medical Director, Inpatient Psychiatry and ECT Services, for opening up her home to us during our visit

Dr. Anne Leeson-Jones – White River Junction Medical Center, Primary Care Physician for educating us on primary care and the Patient-Aligned Care Team initiative, and for allowing us to shadow her during her clinic time

Professor Renata Konrad – Project Coordinator (WPI), for establishing the project and guiding us in building and improving the simulation model

Bernard Spence – New England Veterans Engineering Resource Center, Program Specialist for his patience and training in order for us to obtain accounts to access data

Professor Andrew Trapp – Faculty Advisor (WPI)

Dr. Bradley V. Watts – White River Junction Medical Center, Director, VA patient Safety Fellowship

White River Junction Medical Center Staff and New England VERC Staff

Special thanks to:

Dr. Brian Shiner – White River Junction Medical Center, Staff Psychiatrist and Associate Investigator for defining the project on the VA side, developing the quality scales, and answering our mental health related questions.

## **Authorship**

Sett Paing Oo was in charge the simulation data analysis, model changes, and results analysis. He assisted in determining which patients fit into which the quality rating.

Lazaro Rodriguez was in charge of the presentation and poster. Laz assisted Sett in the simulation analysis data.

Evren Simsek was in charge of the report and assisted Christine in analyzing quality scale data.

Christine Tang was in charge of determining patient quality ratings.

All team members contributed to various aspects of the projects but these were the primary tasks for each person.



## **Problem Statement**

Veterans at the White River Junction Veterans Affairs Medical Center are screened annually for Major Depressive Disorder (MDD), Post-Traumatic Stress Disorder (PTSD), and Alcohol Abuse. Patients who screen positive may be treated in Primary Care (PC), Primary Mental Health Care (PMHC) clinic, the Specialized Mental Health Care (SMHC) clinic, or not at all. Our goal was to establish a method to determine whether patients with positive mental health screens receive treatment and whether receiving care from mental health clinicians results in improved treatment quality. Patients obtain care from a mental health clinician by presenting to the PMHC. We provided estimates of the workforce needed to see all patients with a new positive mental health screen in the PMHC clinic.

## Goal Statement

Our goal is to aid the VA on improving operations of mental health services by ensuring that adequate treatment is provided to patients with acceptable clinic access. In order to tackle this goal, we concentrate on assessing the quality of treatment provided to mental health patients. We utilize a scale where mental health patients are categorized into different quality levels depending on the duration and type of treatment provided. We aim to determine which clinic setting has the most patients with the highest quality ratings for each type of treatment (i.e. the setting that provides the highest level of care to the mental health patients for a specific disorder).

Our secondary focus is to determine the staffing levels needed at the Primary Mental Health Care (PMHC) clinic to provide treatment to a larger patient population while preserving current performance of the clinic. We utilize a simulation model to recommend the optimal level of workforce required for the PMHC clinic if patients currently not receiving treatment and patients receiving treatment in only Primary Care were to receive treatment in the PMHC clinic.

## 1. Introduction

A significant number of veterans experience mental health disorders as a result of a high-stress atmosphere associated with military service and combat. It is estimated that more than 1.5 million out of 5.5 million veterans seen in 2009 had a mental health diagnosis [1]. The impact of a high-stress environment usually remains even after a tour of service. Psychological conditions such as post-traumatic stress disorder (PTSD), alcohol abuse and depression are common mental health problems observed within the veteran population. As many veterans need support and treatment to recover, the Veterans Health Administration (VHA) provides them with primary care and mental care services.

The VHA functions within the United States Department of Veteran Affairs and provides veterans with services in facilities such as clinics, medical centers, hospitals, and nursing homes. Services commonly offered at medical centers include surgeries, orthopedics, mental health, and many other forms of health care. These facilities as well as other clinics, community living centers, and independently licensed health care practitioners provide care to over five million veterans each year [1].

The New England VA Healthcare System is a network of services which consists of various medical centers around six New England states. One of these medical centers is the White River Junction VA Medical Center, which was awarded the American Psychiatric Association's gold achievement award and the Secretary of Veterans Affairs Advanced Clinical Access notation champion award due to implementing outstanding and innovative mental health programs to provide better treatment opportunities to its patients [2]. The medical center is well known for the implementation of the "Primary Mental Health Care (PMHC)" model, which was initiated in 2004. This model concentrates on treating patients with mental health conditions within primary care settings in order to conserve scarce mental health treatment resources [2]. The model consists of an integrated clinic which functions within primary care and offers care management, specialty expertise and chronic disease management. Partly due to the success of the PMHC model, VA medical centers began to receive additional funding in 2007 to implement and maintain integrated care models.

In order to fully satisfy the mental health needs of primary care patients, the White River Junction Medical Center places mental health clinicians in the primary care setting. VA primary care staff are organized in groups called Patient Aligned Care Teams (PACT). PACTs

concentrate on providing comprehensive and continuous care to veterans in order to address all of the medical, behavioral and psychosocial issues faced by these patients. The patients are first examined and treated by primary care providers (PCP) who later collaborate with experts in other health units to provide additional expertise [3]. This area is the focus of our work, namely the screening processes that assist the clinic in identifying and addressing needs of primary care patients. Adequate screening and treatment techniques are fundamental to the effectiveness of the VA Medical Center at White River Junction.

## **2. Background**

### **2.1 Primary Care**

Primary care pilot programs began at VA medical centers in the 1980s and early 1990s [4]. Primary care is widely seen as the anchor for integrating and coordinating care delivery [4]. It is the first source of contact for patients and provides continuity of care; however, only approximately 10% of VA health care users were enrolled in primary care at the end of fiscal year (FY) 1994 [4]. Implementation of primary care faced opposition from the specialist-dominated culture of many VA hospitals. The VA went through major reengineering during the 1990s [4] to focus on one of its biggest problems—fragmentation, which is why the VA launched a primary care initiative in FY 1995 to focus on the patient and coordinate better use of the VA healthcare system for the patient [4]. Implementation of primary care is one of the three factors most linked with improved service satisfaction (the other two factors being reduced waiting times and improved access to care through Community Based Outpatient Clinics—CBOCs) [4].

Today, primary care is the cornerstone of VA care and almost all VA users are assigned to a primary care clinician. The VA is redesigning primary care into interdisciplinary teams that will focus on veteran-centered care. This Patient Aligned Care Team initiative aims to provide better care for patients by having specialists and primary care physicians collaborate to provide whole, non-fragmented care. The Core PACTs include the PCP, a Registered Nurse (RN), Care Manager, Clinical Associate, and Clerk [5]. The Expanded Team includes different specialties including mental health (MH) professionals. Patients are screened yearly for depression, suicidal tendencies, PTSD, alcohol abuse, and traumatic brain injury [2]. A parallel initiative the VA has been undertaking is the integration of primary care and mental health services. The Primary Care-Mental Health Integration initiative aims to improve patients' access to care and improve quality of patient care.

### **2.2 Primary Care Mental Health Integration**

Treating mental health problems solely in the primary care setting has become a popular practice since the development of new psychotropic medications [6]. Approximately 42% of the 25,658 mental health diagnoses for Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF) veterans were first made in primary care settings. Detecting mental health disorders in early stages and intervening in primary care can prevent chronic mental illnesses and disabilities

[7], which is one reason why the integration of mental health care into primary care is increasingly important. Two other reasons why primary care and mental health care should be integrated are that (1) primary care detection and treatment may be inaccurate or insufficient and (2) patients receive better treatment in a co-located health care setting.

Primary care may fail to detect mental health problems in patients or may misattribute mental health problems as physical illnesses [8]. Having an integrated clinic will increase detection and diagnostic accuracy [8]. Patients with mental health disorders can be treated in just primary care; however, for certain patients that may not be effective. Studies have shown that care for depression in primary care is no longer acceptable [9]. Primary care physicians do not have sufficient time to treat patients in the acute phase of depression. The use of a care manager along with consultation or co-treatment with a mental health specialist allows the PCP “to fulfill depression screening recommendations more comfortably, formulate depressive diagnoses more aggressively, and manage depressive episodes more effectively” [9].

Integration of primary care and mental health provides better care than treatment in separate settings. Patients prefer to receive mental health care in the primary care setting so integrating mental health services in primary care results in patients being more compliant to mental health treatment. Receiving care in the primary care context enables better integration of care, in which the primary care provider and the mental health provider(s) can share diagnostic information, collaborate on treatment plans, and follow the overall health and well-being of the patient [8]. Clinics worldwide can potentially provide better care for their patients if they integrate mental health specialists into their primary care.

### **2.3 Mental Health**

Studies have shown that there are high rates of mental health disorders – such as PTSD, depression, and alcohol use – among active duty military personnel and veterans of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) [10-13]. Between 2002 and 2008, sixty-two percent of veterans who were screened for mental health issues were diagnosed with PTSD which was the most common disorder [13].

To promote early identification of mental health disorders among all service members returning from deployment, the Department of Defense initiated population-level screening at two points in time: immediately on a veteran’s return to the US, and 3 to 6 months after the

return [12, 14]. Among the veterans whose responses resulted in a positive screen, only 23 to 40% actually received treatment [10, 15].

Even though there is still a significant percentage of veterans that are not receiving treatment, VHA specialty mental health contact has been growing approximately 9% per year on average since 1997 [16]. Around 41% of the 837,458 eligible OIF and OEF veterans have been enrolled in the VA since 2002 – a historically high rate compared to the 10% of Vietnam veterans – and the percentage of OIF and OEF veterans enrolled has been increasing ever since. [13].

As the rate of mental health diagnoses increases and veterans utilize mental health services more, the VA will likely face logistical and financial challenges if new cases emerge and unresolved disorders become chronic [16, 17]. To treat chronic mental health disorders and to accommodate every veteran seeking mental health treatment, the VA needs to adjust its workforce size as well as improve the efficiency and quality of existing workforce in both primary care and mental health care settings.

## **2.4 Simulation Modeling Literature Review**

Discrete-event simulation is one of the many tools used for analyzing and improving healthcare systems. It allows the modeling of complex processes or systems over time. As applied to health care, simulation provides a way to see how changes to a hospital (e.g. changes in layout, resources, work schedules, etc.) will affect the flow of patients. In the 2000's, there have been over 100 papers in healthcare simulation each year - with over 500 in both 2005 and 2007 [18]. Although there have been many simulation studies of Emergency Departments (ED) (including those that use simulation to address different levels of urgency of a patient visit) [19, 20], despite proliferation of this method in healthcare, there are limited simulations and related studies based on mental health clinics.

### **3. Methodology**

We assessed the quality level of mental health treatment by developing and following a set of methods. In order to identify the current conditions and collect relevant data, we observed the daily mental health operations at the VA White River Junction Medical Center for three days. Our observations during the clinic visit and discussions with the project sponsors helped us determine which data should be pulled from the VA data depository. This data was cleansed to get rid of inconsistent or irrelevant records. During our data collection and organization, we referred to the data security training we received from the VA to ensure that there was no violation of mishandling patient or clinic data. Applying the above mentioned steps sequentially allowed us to obtain a clean dataset to identify the target patient population.

By following the guidelines provided to us by our project sponsors, we determined the target patient population which was the initial step for implementing quality assessment. We assigned quality ratings to all the patients in the target population by utilizing quality scales that have varying criteria depending on the type of mental health disorder. The patients were categorized by the care setting they received treatment at as well as the mental health condition(s) they screened positive for. We reflected the data obtained from the quality assessment in descriptive tables and diagrams in order to illustrate the results more effectively.

In order to satisfy our second project goal which is to identify the changes needed at the PMHC clinic, we utilized a previously created simulation model to test various scenarios. By doing so, we identified the optimal number of staff needed to provide treatment to more patients while preserving the performance of the clinic.

#### **3.1 Clinic Observation**

Before conducting extensive data analysis, we observed the White River Junction Medical Center clinics for three days. We examined the daily operations for mental health services in different care settings. This allowed us to evaluate the current conditions and identify the data relevant for our analysis. The two psychiatrists, Dr. Brian Shiner and Dr. Bradley V. Watts, and a primary care physician named Dr. Anne Jones-Leeson provided us with overviews for PMHC clinic and PACT teams in PC, respectively.

During the primary care clinic visit, we accompanied two PACT teams who explained to us how to interpret the mental health screening results. We noted that some screenings resulted in



false positives (when a patient tests positively although they do not actually have a mental health disorder).

During the PMHC clinic visit, we observed clerk and physicians in the clinic and accompanied some patients, with their consent. During our time at the clinic, the therapist and prescriber interviewed most of the new patients simultaneously before the patient would meet with the prescriber separately. However, this case is not typical in a normal workday and not reflected in our simulation model.

### **3.2 Data Retrieval**

We collaborated with engineers at the New England Veterans Engineering Resource Center (VERC) to obtain data from the Corporate Data Warehouse (CDW) which is a repository for VA data. The initial list of data fields was established by Dr. Brian Shiner and expanded upon by our team and the VERC engineers. After initial queries of the tables for patient demographics and pharmacy data, the following data acquisitions were specified to obtain only patients who:

- Tested for at least one mental health assessment
- Were veterans (patients could potentially also be family members of veterans)
- Were not test patients (these are dummy records created during training)
- Had a visit at WRJ or one of its CBOCs
- Did not expire during the timeframe of the study.

The list of tables created (which data fields were used in our analyses and what the tables were used for) can be found in Appendix A. Constraints were included in queries to obtain the data of only the patients who met the criteria listed above. Additional constraints were included to obtain only patient records that meet other specifications such as the visit had to have certain Current Procedural Terminology (CPT) codes or certain medications (See Appendix B).

### **3.3 Data Analysis**

#### **3.3.1 Data Cleansing**

We removed data that were inaccurate, inconsistent, incomplete, or duplicated. We also standardized the data to have the same vocabulary (e.g. transforming the text fields in the pharmacy data). We did not distinguish the specific times of the day when the patients should have taken their medication; only the amount of medication recommended per day was taken into consideration. Some of the data entered in the system was not clear due to entry errors.

We eliminated:

- patients who died during the timeframe of our data analysis
- duplicate data records
- test (fake records created for teaching purposes) patients

Much of the data cleansing we intended to do was done through our data request.

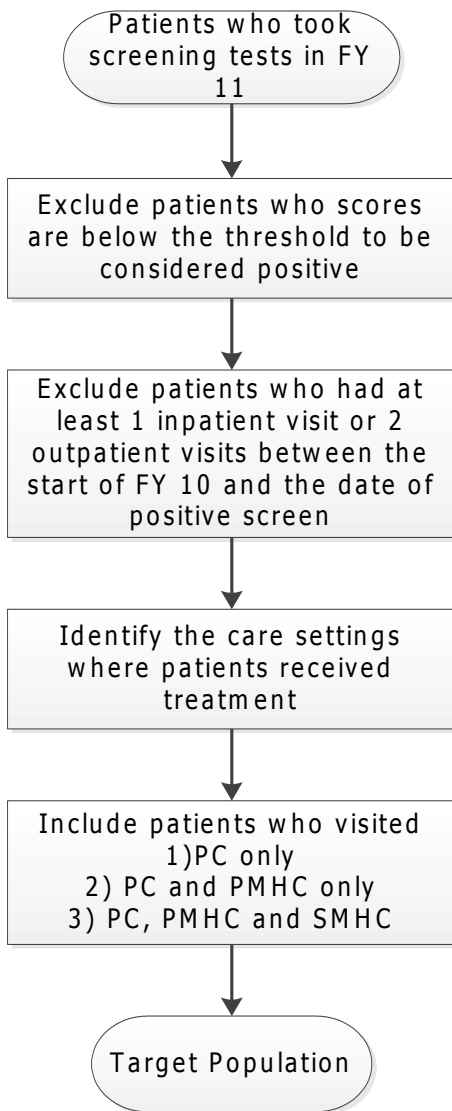
The types and amount of drugs were determined through text analysis of the signa (SIG field)—directions on how to take medication. We determined the daily dose by manually parsing the SIGs and recording the number of drugs taken daily, the frequency (times per day) the drug is taken, whether the prescription requires the patient to take the drug or not (drugs to be taken as needed were not considered for the quality scale) and whether the prescription is a titration (changes in dosages by time) or not.

#### **3.3.2 Data Security**

After receiving encrypted de-identified data from the VA, we decrypted and stored these files on WPI's secure research server and analyzed the data using WPI-owned computers. Upon completion of our data analyses, we permanently deleted the files from the secure WPI server in order to prevent any unauthorized parties from accessing the data in the future.

### 3.3.3 Identifying Target Population

The target population consists of patients who screened positive in fiscal year 2011, but did not receive the adequate amount of mental health treatment (1 inpatient encounter or 2 outpatient encounters) in fiscal year 2010. These patients are also distributed into three different categories depending on the clinics they visited. In order to identify the target population, the



team determined all the patients who took at least one of the following mental health screening tests: PHQ-2 for MDD, PC-PTSD for PTSD and AUDIT-C for alcohol abuse in fiscal year 2011. Patients whose scores were lower than a certain threshold, which is different for each test, were excluded. Patients who were not excluded—those who tested positive—were checked for whether they received any treatment prior to the date of the positive screen. Any patient who had at least one inpatient visit or 2 outpatient visits related to mental health between the start of fiscal year 2010 and the date of the positive screen were excluded. Remaining patients either received treatment in different care settings—PC, PMHC, and SMHC—or did not receive any treatment at all after the date of positive screen. Patients of interest were the ones who visited 1) PC only, 2) PC and PMHC only, 3) PC, PMHC, and SMHC. These patients make up the target population. The logic for identifying the target patient population is illustrated with the flowchart in Figure 1.

**Figure 1: Logic Diagram for Identifying Target Population**

### 3.3.4 Quality Scales for Medication and Psychotherapy

We used a quality scale for mental health treatment created by our sponsor Dr. Brian Shiner to assign quality ratings to patients on a scale of 0 to 5. The criteria for the quality scale vary depending on the type of mental health disorder—MDD, PTSD, and Alcohol Abuse—and the type of treatment—medication and psychotherapy.

#### 3.3.4.1 Medication Quality Ratings

The medication quality scale assesses whether patients received guideline recommended medication and whether patients were prescribed the minimum suggested dosage of medication for an adequate duration. Patients commonly try several medications, which is accounted for in the quality scale. We utilized pharmacy data that belongs to our target population in order to assign quality ratings. We only used records from the date of a patient’s positive screen to the end of FY 2012. The data showed the dates the drugs were issued and dispensed, as well as days of supply, dosage, dispense unit, SIGs and strength. Prescriptions for each patient prior to the date of positive screen were excluded.

| Rating | Definition                                   |
|--------|--|
| 0      | No Treatment                                 |
| 1      | Any Psychiatric Medication                   |
| 2      | Guideline-Recommended Psychiatric Medication |
| 3      | Adequate Total Daily Dose                    |
| 4      | Adequate Duration                            |
| 5      | 2 or More Trials Rated 4 or Higher           |

**Table 1: Medication Quality Rating Criteria**

Patients who received any psychiatric medication were assigned quality rating 1. The data for all the psychiatric medication prescribed were derived from the pharmacy data workbook which was provided to us by our VA project sponsors and listed in the table in Appendix B.

The rest of the patients were assigned rating 0 which means they did not receive any mental health medication although they screened positive. If patients with quality rating of 1 received medication recommended by VA guidelines irrespective of the dosage, they were assigned a quality rating of 2. The list of guideline—recommended medication is different for each mental health disorder as listed in the tables below.

| <b>MEDICATIONS RANK 2 RATING CRITERIA</b>                                  |              |               |               |             |
|--|--------------|---------------|---------------|-------------|
| <b>PTSD Guideline-Recommended<br/>Psychiatric Medication</b>               | Citalopram   | Escitalopram  | Fluvoxamine   | Sertraline  |
|  | Duloxetine   | Fluoxetine    | Paroxetine    | Venlafaxine |
| <b>MDD Guideline-Recommended<br/>Psychiatric Medication</b>                | Amitryptline | Escitalopram  | Nortriptyline | Trazodone   |
|  | Bupropion    | Fluoxetine    | Fluvoxamine   | Venlafaxine |
|  | Citalopram   | Imipramine    | Paroxetine    |             |
|  | Desipramine  | Isocarboxazid | Phenelzine    |             |
|  | Doxepin      | Mirtazepine   | Selegiline    |             |
|  | Duloxetine   | Nefazedone    | Sertraline    |             |
| <b>Alcohol Abuse Guideline-<br/>Recommended Psychiatric<br/>Medication</b> | Naltrexone   |               |               |             |
|  | Acamprosate  |               |               |             |

**Table 2: Medications Rating 2 Criteria for MDD, PTSD and Alcohol Abuse patients**

In order to analyze the medication data, three quality scale tables were created, one for each mental health disorder—MDD, PTSD, and Alcohol Abuse. Patients who tested positive for multiple disorders were included in more than one table. We utilized a specific set of criteria for each mental health disorder. In order to do so, we filtered out the medications that were not used to treat the specified mental health disorder. To determine the patients from the target population who should be assigned a quality rating of 3, Adequate Total Daily Dose, we transformed the SIGs to the number of drugs taken per day, Thus we were able to see if the daily doses prescribed were sufficient to categorize patients for a rating of 3. We determined which records were titrations (different amounts to be taken after a certain amount of days) and dealt with them separately. In order to incorporate the prescriber notes, we filtered the data and found 529 unique notes in the data set, 179 of which were titrations. We utilized the notes to determine the daily number of pills taken for each unique note. We multiplied the strength values of each drug prescribed, in milligrams, with daily number of pills taken and acquired the values for daily doses. Patients who received adequate total daily doses were assigned a quality rating of 3.

Although it was not in our data sets (after separating the patients and filtering for disorder specific medication), Selegiline would have been an exception in the data analysis due to the

nature of the way it is prescribed. Selegiline is a drug that could be prescribed in patches because it can be taken transdermally. Another medication that would have been an exception was Fluoxetine which could be prescribed either as 20 milligrams per day or 90 milligrams per week. If a patient was prescribed 90 milligrams per week which is the suggested minimum dosage, then the patient qualified and was placed under quality rating of 3—Adequate Daily Dosage. All of the patients who were taking Fluoxetine received the required daily dose; therefore, there was no need to check for the required weekly dosage.

| <b>MEDICATIONS RANK 3 RATING CRITERIA</b>  |  |   |                     |
|--|--|---|---------------------|
| <b>PTSD Medications</b><br><br><b>Adequate Total</b><br><br><b>Daily Dose</b>                        | Citalopram 20 mg                               | Escitalopram 10 mg                                  | Fluvoxamine 150 mg  |
|  | Duloxetine 60 mg                               | Fluoxetine 20 mg                                    | Paroxetine 20 mg    |
|  | Sertraline 100 mg                              | Venlafaxine 150 mg                                  |                     |
| <b>MDD Medications</b><br><br><b>Adequate Total</b><br><br><b>Daily Dose</b>                         | Amitryptline 200 mg                            | Doxepin 200 mg                                      | Imipramine 200 mg   |
|  | Bupropion 300 mg                               | Duloxetine 60 mg                                    | Isocarboxazid 41 mg |
|  | Citalopram 20 mg                               | Escitalopram 10 mg                                  | Mirtazepine 30 mg   |
|  | Desipramine 200 mg                             | Fluoxetine 20 mg daily<br><b>or 90 mg weekly</b>    | Nefazedone 300 mg   |
|  | Nortriptyline 76 mg                            | Fluvoxamine 200 mg                                  | Paroxetine 20 mg    |
|  | Phenelzine 61 mg                               | Selegiline 41 mg oral<br><b>or 6 mg transdermal</b> | Sertraline 100 mg   |
|  | Trazodone 400 mg                               | Venlafaxine 225 mg                                  |                     |
| <b>Alcohol Abuse</b><br><br><b>Medications</b><br><br><b>Adequate Total</b><br><br><b>Daily Dose</b> | Naltrexone 50 mg oral daily                    |   |                     |
|  | Naltrexone 380 mg <b>intramuscular monthly</b> |   |                     |
|  | Acamprosate 1998 mg                            |   |                     |

**Table 3: Medications Rating 3 Criteria for MDD, PTSD and Alcohol Abuse patients**

Patients who were assigned a quality rating of 4 were determined by examining the duration of treatments provided to rating 3 patients. The treatment duration should be 8 weeks or more for PTSD and 4 weeks or more for MDD and alcohol abuse. We examined the daily supply of medication as well as the duration of prescription to determine if the total medication received matches the required amount. Patients for whom these values match were assigned a quality rating of 4. Patients who received different amounts of the same medication during different

timeframes—titrations—and refills were examined more carefully. We analyzed the prescription information for rating 4 patients. If a patient refilled a prescription that met the adequate dosage and duration, then that patient was assigned a quality rating of 5. The refill was counted as a second trial.

### 3.3.4.2 Psychotherapy Quality Ratings

| <b>MDD or PTSD PSYCHOTHERAPY RATING CRITERIA</b> |  |  |
|--|--|--|
| <b>Rating</b>                                    | <b>Definition</b>                                | <b>Use</b>   |
| <b>0</b>   | No Treatment                                     | No Treatment   |
| <b>1</b>   | Any Individual Psychotherapy CPT Code            | 90804, 90806, 90808, 90810, 90812, 90814, 90845, 90875, 90876, 96152 |
| <b>2</b>   | Any Psychotherapy CPT Code 45 minutes or Greater | 90806, 90808, 90812, 90814   |
| <b>3</b>   | 8 or more sessions with the same provider        | Use Provider ID  |
| <b>4</b>   | 8 or more sessions over a 14-week period         | Earliest 98-day period   |
| <b>5</b>   | 2 or more trials rated 4 or higher               |  |

**Table 4: Psychotherapy Rating Criteria for MDD and PTSD Patients**

Quality ratings for psychotherapy were assigned only to patients with PTSD or MDD because those with Alcohol Abuse did not receive psychotherapy treatment. In assigning the psychotherapy ratings, we used outpatient visits data which showed the dates of each patient’s visits and the CPT codes for procedures that he or she received during each visit.

Patients who had visits with any psychotherapy CPT code were assigned a quality rating of 1; the rest were assigned 0 which means they did not receive any psychotherapy treatment. Those who received psychotherapy treatment 45 minutes or more were assigned a rating of 2. We analyzed Provider SIDs (Provider ID) to count the number of times each patient visited the same provider. Patients with a quality rating of 2 who received treatment with the same provider for 8 or more times were assigned a quality rating of 3. Patients with a quality rating of 3 who received treatment for 8 or more times within a 14-week period were assigned a rating of 4. We used visit dates to determine whether a patient meets this criterion. If rating 4 patients had 2 or

more trials of such rating (i.e. if there were 2 or more instances where they received 8 or more psychotherapy treatments of at least 45 minutes within 14 weeks), they were assigned a rating of 4.

The logic behind these analyses for assigning medications and psychotherapy ratings to mental health patients is explained in the logic chart presented in Appendix B.

### **3.3.7 Descriptive Statistics**

We calculated descriptive statistics (mean, median, mode, standard deviation, and other measures that explain our data) that described the patients in our target population using Microsoft Excel.

To determine the numbers that describe the medication ratings for each patient disorder type (MDD only, PTSD only, Alcohol Abuse only, MDD & PTSD, MDD & Alcohol, PTSD & Alcohol, and MDD & PTSD & Alcohol), we used the Descriptive Statistics procedure in the Excel Analysis ToolPack.

- Frequency distribution tables
- Mean, median, mode
- Sample standard deviation, range
- Number of patients who screened positive for:
  - Depression Only
  - PTSD Only
  - Substance Abuse Only
  - Depression and PTSD
  - Depression and Substance Abuse
  - PTSD and Substance Abuse
  - Depression, PTSD, and Substance Abuse

### **3.4 Simulation**

Discrete-event simulation is commonly used to model the flow of patients in outpatient clinics as it is a useful tool to analyze scheduling and capacity planning [18]. We utilized a discrete-event simulation model of PMHC clinic at the White River Junction VA Medical Center to estimate how patient-volume changes would affect wait times of patients and utilization of mental health care workforce. Usually, there is a trade-off between wait times and resource utilization. Using too many resources to reduce wait times leads to underutilized resources and



unnecessary costs. Using too few resources increases wait times and keeps resources overly occupied. We used the simulation model to find the optimal level of workforce capable of providing treatment to a larger patient population without having patients wait significantly longer.

The potential increase in patient volume as determined from the screening data serves as the input for the model. From our data analysis, we found that the number of patients with new positive mental health screens who were seen only in PC during FY 2012 was approximately twice the number of patients who visited PMHC clinic. We increased the current patient arrival rates accordingly to predict how clinic performance would be affected if all patients from PC with new positive mental health screens were referred to PMHC. In increasing the arrival rates, we assumed that new patients, on average, would visit the PMHC clinic as frequently as those in FY 2012. We ran a total of four different scenarios as summarized in the table below.

|   | <b>Patient Arrival Rate</b>                        | <b>Resource Capacity</b>                |
|---|--|---|
| <b>Base Scenario</b>                          | Current  | Current                                 |
| <b>Increased Patient Volume</b>               | Increased to approximately 3 times of current rate | Current                                 |
| <b>Additional Prescriber and Therapist I</b>  | Increased to approximately 3 times of current rate | 1 additional prescriber and therapist   |
| <b>Additional Prescriber and Therapist II</b> | Increased to approximately 3 times of current rate | 2 additional prescribers and therapists |

**Table 5: Four Different Scenarios in Simulation**

The Base Scenario was run with patient arrival rates (shown in Appendix) for FY 2012 and current capacity of resources. The resources included in the model are:

1. Clerk, who interacts with patients for registration
2. Tablet, which patients use to take mental health surveys
3. Prescriber, who is responsible for prescribing medication
4. Therapist, who is responsible for psychotherapy treatment
5. Care Manager, who follows up with patients to check their status

Currently, the clinic operates with 1 clerk, 2 tablets, 1 prescriber, 1 therapist, and 1 care manager. The “Base Scenario” uses the same amount of resources and arrival rates to reflect the current situation. In other scenarios, the arrival rate was increased to include patients from PC.

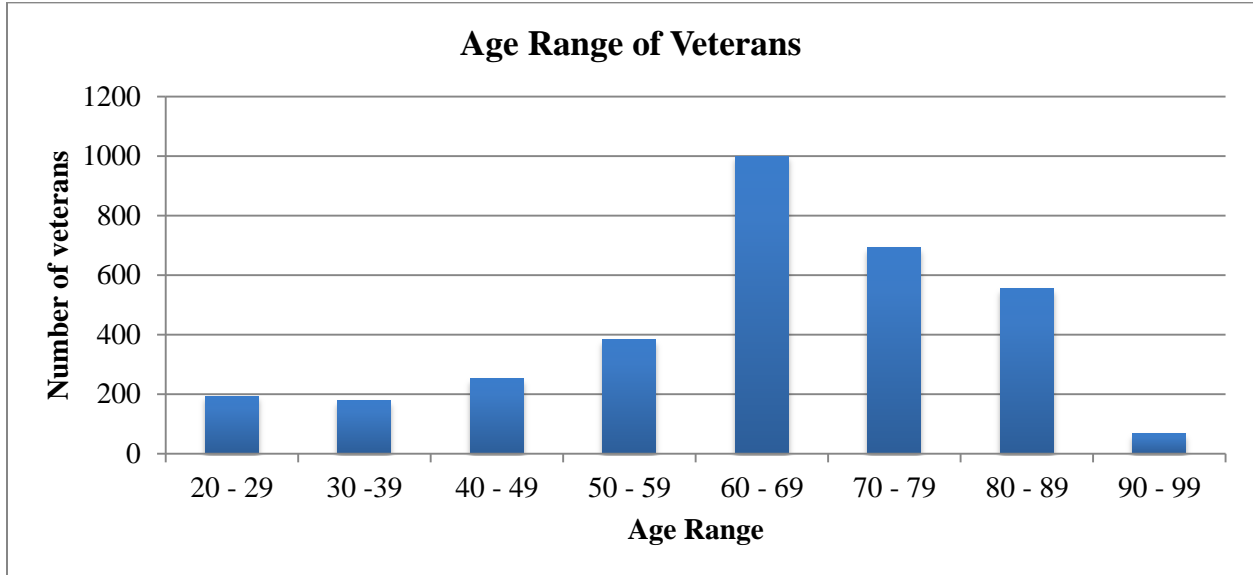
We considered additional scenarios only after analyzing the results of the Base Scenario. Therefore, instead of considering many possible combinations of increased resource capacities, we only considered increasing the capacities of those whose performance was significantly reduced. In the scenarios “Additional Prescriber and Therapist I” and “Additional Prescriber and Therapist II”, the numbers of prescribers and therapists were increased by 1 and 2 respectively.

We initially ran the Base Scenario with 10 replications and observed the results. Using the results of this simulation run, we estimated that 50 replications would reduce the values of the 95% confidence interval to be +/-0.01 (hours) of the average wait times. These 50 replications also would not significantly hinder run time. Each of the replications was run for 130 simulation days to represent 26 work weeks (half a year). Initially, the input data for the model was based on 6 months of data so the initial run-length of the model was set to reflect this. Although we analyzed additional data and used patient arrival rates for the duration of FY 2012, we did not consider it necessary to change the run-length.

## 4. Results and Analysis

### 4.1 Target Population

The following graphs and charts show demographics of our target population.



**Figure 2: Age Range of Target Population**

Figure 2 shows the age distribution of veterans in the target population. The distribution resembles a triangular distribution with the most frequent age range being 60 - 69.

Approximately half of target patient population lies between 60 and 79.

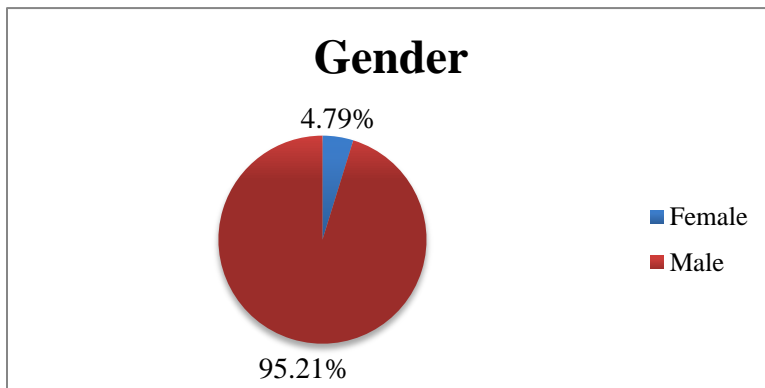


Figure 3 shows the gender distribution of the target population. More than 95% of veterans are male.

**Figure 3: Target Population by Gender**

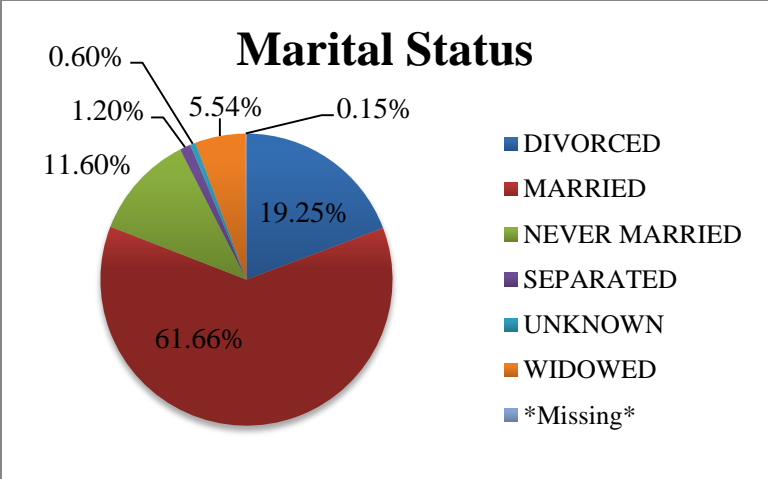
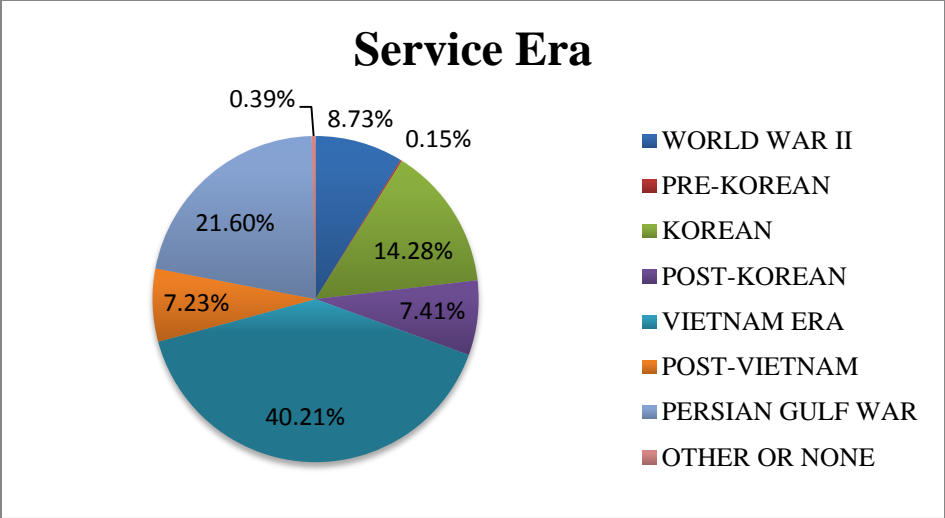


Figure 4 shows marital status of veterans. More than 80% of veterans are either married or divorced while about 11% have never married.

**Figure 4: Target Population by Marital Status**



**Figure 5: Target Population by Service Era**

Figure 5 shows the percentage of veterans that have served in various eras. The majority of our target population served in the Vietnam Era. A smaller percentage of our population served in World War II which makes sense since those veterans would be at least 80 years old.

## 4.2 Relationship between Quality Ratings and Care Settings

Each patient in the target population was categorized by care setting and assigned a quality rating for one or more mental health disorders. Patients with more than one mental health disorder were assigned multiple quality ratings – one for each disorder. For the purpose of simplicity, we will use only one clinic name to refer to each combination of care settings. Patients who are referred to as “PMHC patients” are the ones who received treatment in both primary care and PMHC. Patients who are referred to as “SMHC patients” are the ones who received treatment in all three care settings.

| Care Setting    | Referral      |
|-----------------|---------------|
| PC              | PC patients   |
| PC + PMHC       | PMHC patients |
| PC + PMHC+ SMHC | SMHC patients |

**Table 6: Simplified Reference for Patients by their Care Settings**

Table 7 consists of medication quality rating for MDD patients. Two hundred and fourteen patients (40.2% of MDD patient population) did not receive any mental health medication. On the other hand, 23.1% of the patients have a quality rating of 5 which indicates that these patients received the highest level of care. It can be easily seen that there are no patients with a quality rating of 3. This result shows that all patients who received an adequate daily dose of medication were also treated for at least an adequate duration. These patients were assigned a quality rating of 4.

When the distribution of primary care patients is examined for each quality rating, it is observed that more than half of these patients did not receive appropriate medication. MDD patients with quality ratings of 4 or 5 form only 18.1% of the PC patient population, compared to 45% of PMHC and 60.6% of SMHC MDD patients.

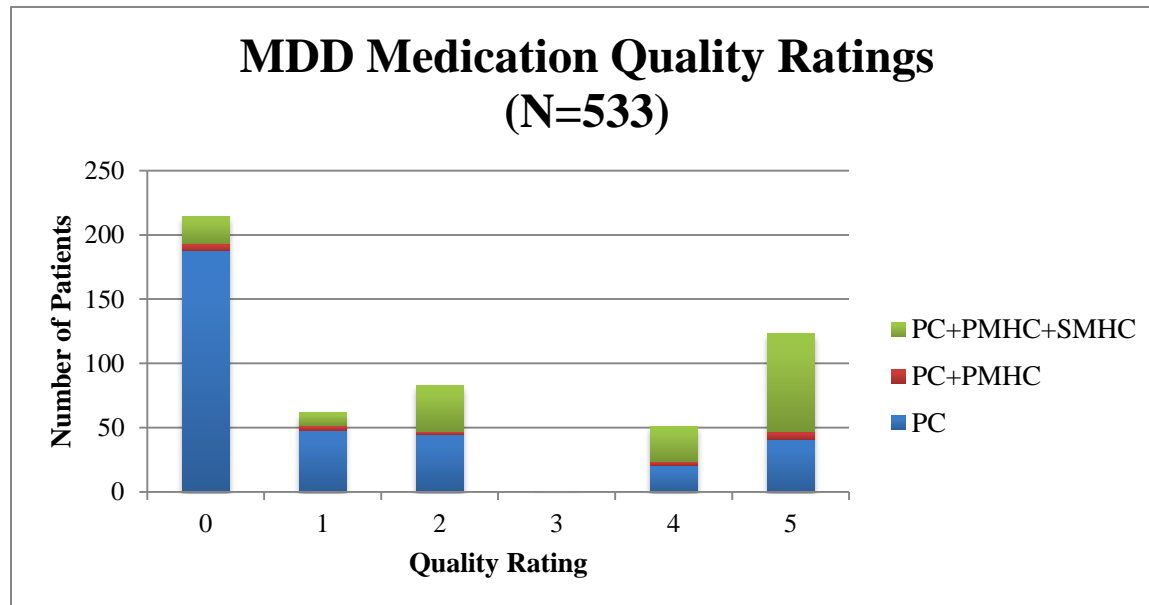
In total, 45% of the MDD patients who are treated in PC and PMHC simultaneously have a quality rating of 4 or 5. Over 60% of the MDD patients who are treated in all three care settings have a quality rating of 4 or 5. This result shows that the services provided by PMHC and SMHC significantly increase the quality of mental health care treatments.

## Medication Quality Ratings

| MDD   | Care Setting |         |         |         |              |         | Total | Total   |
|-------|--------------|---------|---------|---------|--------------|---------|-------|---------|
|       | PC           |         | PC+PMHC |         | PC+PMHC+SMHC |         |       |         |
| 0     | 188          | 54.81%  | 5       | 25.00%  | 21           | 12.35%  | 214   | 40.15%  |
| 1     | 48           | 13.99%  | 4       | 20.00%  | 10           | 5.88%   | 62    | 11.63%  |
| 2     | 45           | 13.12%  | 2       | 10.00%  | 36           | 21.18%  | 83    | 15.57%  |
| 3     | 0            | 0.00%   | 0       | 0.00%   | 0            | 0.00%   | 0     | 0.00%   |
| 4     | 21           | 6.12%   | 3       | 15.00%  | 27           | 15.88%  | 51    | 9.57%   |
| 5     | 41           | 11.95%  | 6       | 30.00%  | 76           | 44.71%  | 123   | 23.08%  |
| Total | 343          | 100.00% | 20      | 100.00% | 170          | 100.00% | 533   | 100.00% |

**Table 7: MDD Medication Quality Ratings by Highest Level of Care Received**

It can be seen in Figure 6 that MDD medication patients with quality ratings of 0 or 1 are less likely to have visited all three care settings. The percentage of patients who have visited all three care settings is higher for patients with quality ratings of 2, 4, and 5. This statistic indicates that combining the resources available at all possible care settings might result in better treatment.



**Figure 6: MDD Medication Quality Ratings by Highest Level of Care Received**

The data analysis of medication quality ratings for PTSD patients provides us with results that parallel the findings for MDD medication patients. Almost 40% of PTSD patients did not receive appropriate medication – similar to the result for the MDD medication patients. Analogous to MDD patients, approximately 30% of the patients are distributed between quality ratings of 1 and 2. In this circumstance, patients with a quality rating of 1 account for 24.6% of

the PTSD patient population. Patients of quality ratings 3 and 4 together account for more than 10% of the PTSD medication patients. It is worth noting that 21.2% of the PTSD patients received the highest level of care for medication. This result aligns with the percentage obtained for MDD medication patients with a quality rating of 5 (23.1%).

As the number of care settings involved in the treatment process increases, a higher number of patients with quality ratings of 4 or 5 is observed. Only 10.6% of the PC patients with PTSD diagnosis have quality ratings of 4 or 5 whereas this percentage increases to 33.3% for PMHC patients. In addition, 45.1% of the SMHC patients have quality ratings of 4 or 5. Thus we can say that for PTSD treatment, the percentage of patients who are provided services with higher quality increases as these patients are treated in higher level care settings. This result aligns with findings for MDD medication patients.

The percentage of PC and PMHC patients with a PTSD diagnosis who did not receive any medication shows us that PTSD is better treated when specialized clinic is involved in the process. The percentage of untreated patients is reduced significantly from 57.5% and 42.9% to 14.8% once the specialized clinic is involved. PTSD patients who receive treatment in PMHC and SMHC clinics in addition to primary care seem to receive a higher quality of treatment.

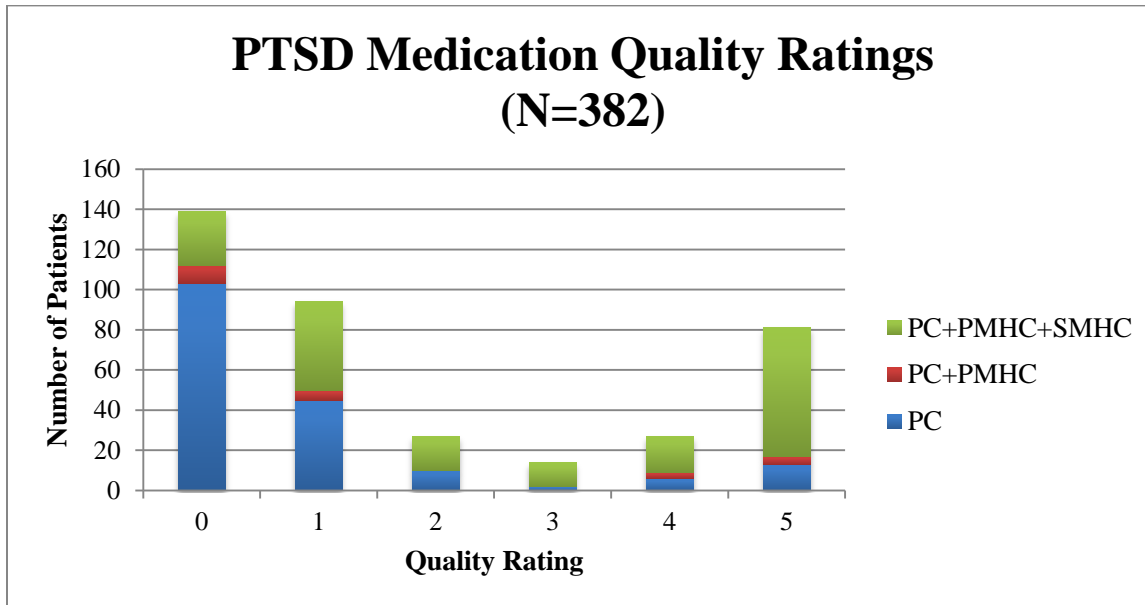
|           |       | Care Setting |         |         |         |              |         | Total |         |
|-----------|-------|--------------|---------|---------|---------|--------------|---------|-------|---------|
|           |       | PC           |         | PC+PMHC |         | PC+PMHC+SMHC |         |       |         |
| TangScale | 0     | 103          | 57.54%  | 9       | 42.86%  | 27           | 14.84%  | 139   | 36.39%  |
|           | 1     | 45           | 25.14%  | 5       | 23.81%  | 44           | 24.18%  | 94    | 24.61%  |
|           | 2     | 10           | 5.59%   | 0       | 0.00%   | 17           | 9.34%   | 27    | 7.07%   |
|           | 3     | 2            | 1.12%   | 0       | 0.00%   | 12           | 6.59%   | 14    | 3.66%   |
|           | 4     | 6            | 3.35%   | 3       | 14.29%  | 18           | 9.89%   | 27    | 7.07%   |
|           | 5     | 13           | 7.26%   | 4       | 19.05%  | 64           | 35.16%  | 81    | 21.20%  |
|           | Total | 179          | 100.00% | 21      | 100.00% | 182          | 100.00% | 382   | 100.00% |

**Table 8: PTSD Medication Quality Ratings by Highest Level of Care Received**

Similar to the result obtained for MDD patients, PMHC patients (indicated by red in the bar graphs) form only a small percentage of the overall PTSD medication patient population. The majority of patients who are treated in primary care do not receive appropriate medication; however the majority of those treated in all three care settings receive at least the adequate amount of medication. Most PTSD medication patients are assigned quality ratings of 0 or 1 and the third largest patient group consists of patients with quality rating of 5. This result shows that



most of the patients are accumulated on either end of the quality rating scale. Figure 7 highlights quality ratings related to PTSD medication.



**Figure 7: PTSD Medication Quality Ratings by Highest Level of Care Received**

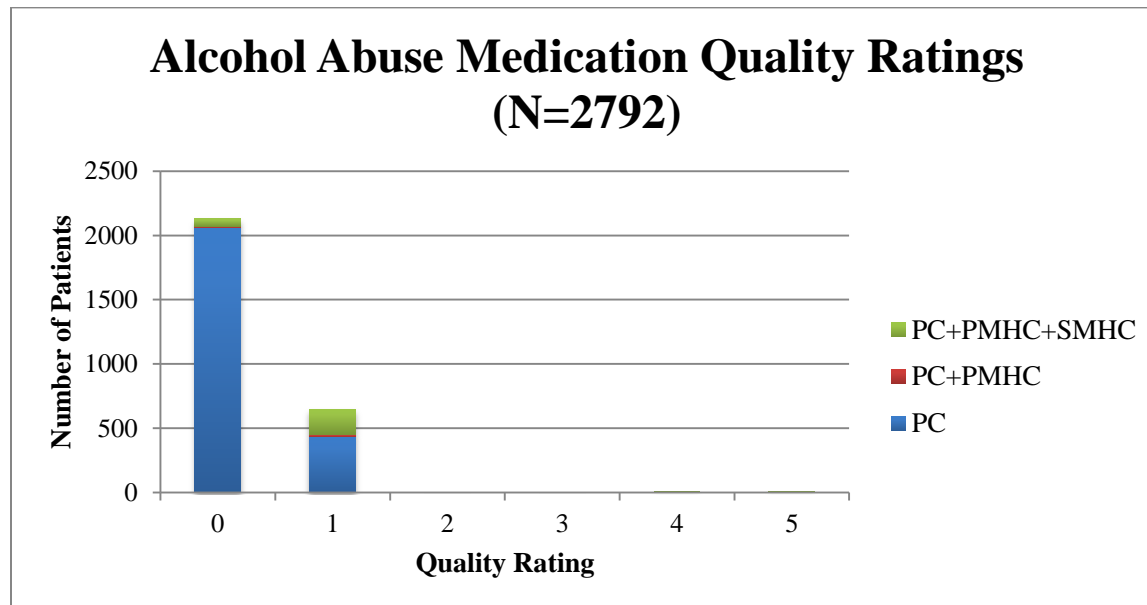
Our analysis for alcohol abuse treatments indicates that 76.4% of the patients did not receive any medication. Even though approximately 90% of all alcohol abuse patients attend solely primary care, more than 80% of those patients did not receive appropriate medication.

|           |      | Care Setting |         |              |        |         | Total  |         |        |
|-----------|------|--------------|---------|--------------|--------|---------|--------|---------|--------|
|           |      | PC           | PC+PMHC | PC+PMHC+SMHC | PC     | PC+PMHC |        |         |        |
| TangScale | AUDC |              |         |              |        |         |        |         |        |
|           | 0    | 2060         | 82.60%  | 13           | 37.14% | 59      | 22.43% | 2132    | 76.36% |
|           | 1    | 433          | 17.36%  | 22           | 62.86% | 194     | 73.76% | 649     | 23.24% |
|           | 2    | 0            | 0.00%   | 0            | 0.00%  | 0       | 0.00%  | 0       | 0.00%  |
|           | 3    | 0            | 0.00%   | 0            | 0.00%  | 0       | 0.00%  | 0       | 0.00%  |
|           | 4    | 1            | 0.04%   | 0            | 0.00%  | 4       | 1.52%  | 5       | 0.18%  |
|           | 5    | 0            | 0.00%   | 0            | 0.00%  | 6       | 2.28%  | 6       | 0.21%  |
| Total     | 2494 | 100.00%      | 35      | 100.00%      | 263    | 100.00% | 2792   | 100.00% |        |

**Table 9: Alcohol Abuse Medication Quality Ratings by Highest Level of Care Received**

The majority of patients (62.9% of the total PMHC and 73.8% of the total SMHC patients) have a quality rating of 1. This result shows that a large percentage of these patients who were treated in PMHC or SMHC received psychiatric medication; however, they did not receive the alcohol abuse medications recommended by VA guidelines. Table 9 shows that 23.2% of the total patient population is composed of patients with a quality rating of 1 and very

few patients received treatments of quality rating 2 or higher. Figure 8 highlights quality ratings related to alcohol abuse medication.



**Figure 8: Alcohol Abuse Medication Quality Ratings by Highest Level of Care Received**  
**Psychotherapy Quality Ratings**

Table 10 shows that the majority of MDD patients, 66.8% of the total population, did not receive any psychotherapy treatment. The remaining 33.2% of the MDD patients received psychotherapy with 26.6% having quality ratings of 2 or higher. This result shows that the majority of the patients who received psychotherapy treatment attended psychotherapy sessions of 45 minutes or longer.

As explained in the methodology section earlier, quality rating 3 stands for receiving 8 or more psychotherapy sessions with the same provider– continuity of care and quality rating 4 stands for receiving these sessions over a 14 week period. In our data analysis, quality ratings of 3 or higher each accounts for only about 2% of the total MDD patient population. For this reason, we can state that only a small percentage of patients received good continuity of care for psychotherapy treatments.

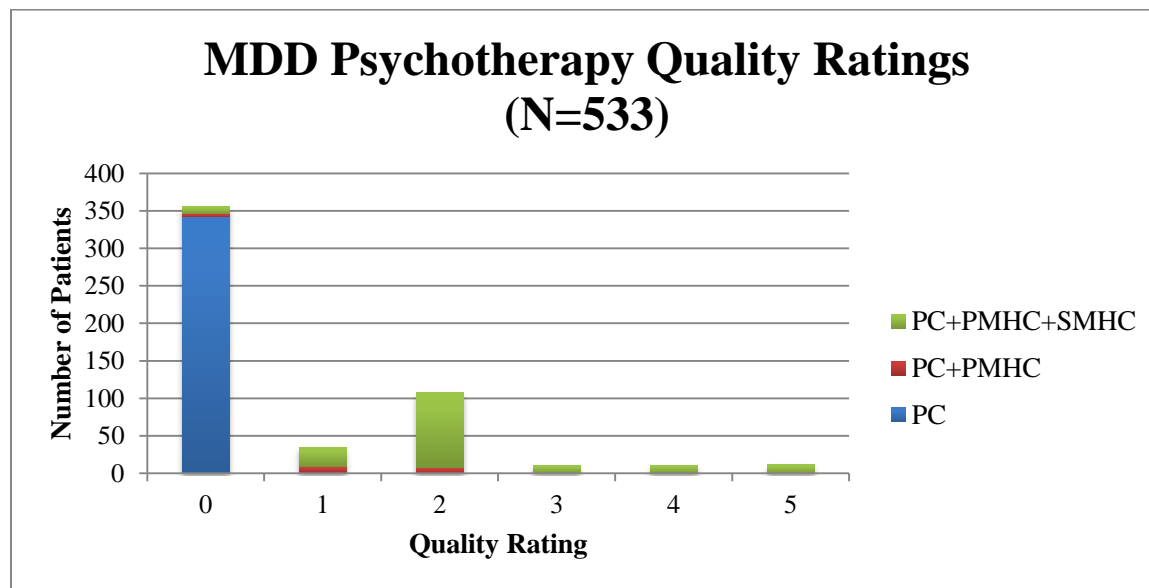
The majority (99.7%) of MDD patients who attended primary care did not receive any psychotherapy treatment. Patients who visited primary care form about 64% of MDD patient population which is a high percentage and them not receiving treatment indicates a possible insufficiency of resources to provide such treatment. On the other hand, roughly 80% of PMHC patients have quality ratings of 1 or 2 and there are no patients with quality ratings of 3 or higher.

This means that PMHC patients received psychotherapy treatment but did not experience continuity of care. SMHC patients yield a similar result where 74.1% of them have quality ratings of 1 or 2 and 20% of the total SMHC patients have quality ratings of 3 or higher. This result indicates that only 20% of the SMHC patients experienced continuity of care.

|           |       | Care Setting |         |         |         |              |         |       |         |
|-----------|-------|--------------|---------|---------|---------|--------------|---------|-------|---------|
| MDD       |       | PC           |         | PC+PMHC |         | PC+PMHC+SMHC |         | Total |         |
| TangScale | 0     | 342          | 99.71%  | 4       | 20.00%  | 10           | 5.88%   | 356   | 66.79%  |
|           | 1     | 1            | 0.29%   | 8       | 40.00%  | 26           | 15.29%  | 35    | 6.57%   |
|           | 2     | 0            | 0.00%   | 8       | 40.00%  | 100          | 58.82%  | 108   | 20.26%  |
|           | 3     | 0            | 0.00%   | 0       | 0.00%   | 11           | 6.47%   | 11    | 2.06%   |
|           | 4     | 0            | 0.00%   | 0       | 0.00%   | 11           | 6.47%   | 11    | 2.06%   |
|           | 5     | 0            | 0.00%   | 0       | 0.00%   | 12           | 7.06%   | 12    | 2.25%   |
|           | Total | 343          | 100.00% | 20      | 100.00% | 170          | 100.00% | 533   | 100.00% |

**Table 10: MDD Psychotherapy Quality Ratings by Highest Level of Care Received**

As it can be seen from Figure 9, the majority of the MDD patients visited the primary care clinic but did not receive psychotherapy treatment. Most of the remaining patients received treatment in all three clinics. This patient group forms approximately 32% of the total MDD psychotherapy patients which is indicated by the green data series on Figure 9.



**Figure 9: MDD Psychotherapy Quality Ratings by Highest Level of Care Received**

Half of the PTSD patient population did not receive any psychotherapy treatment as it can be seen from Table 11. Similarly to the MDD psychotherapy patients, rating 2 patients form the second highest percentage (~30%) of the PTSD psychotherapy patients. All of the higher

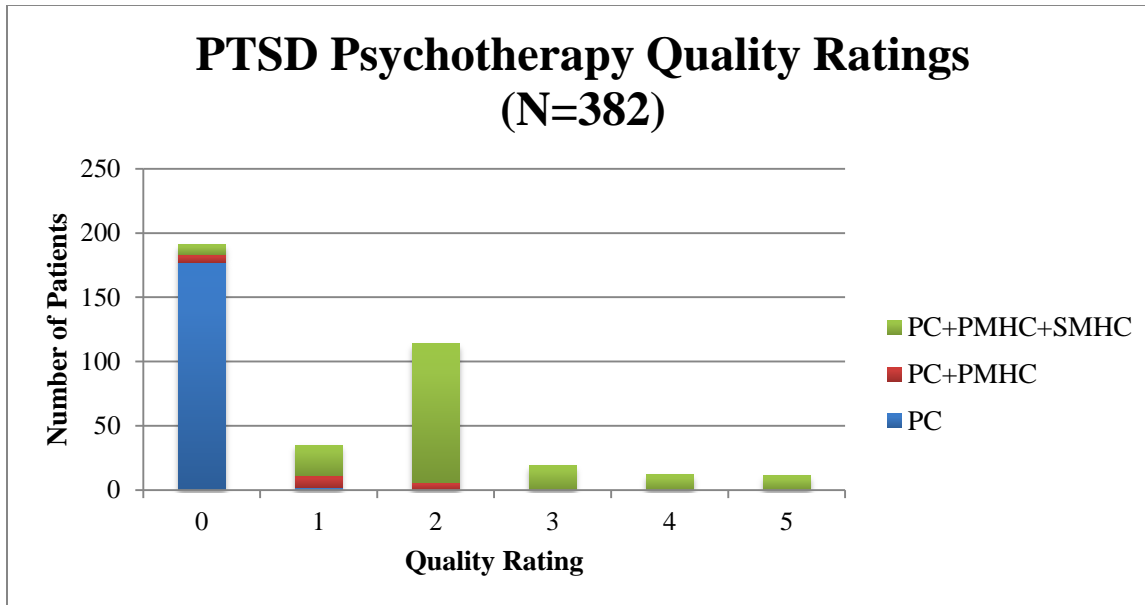
quality ratings each accounts for less than 5% of the total PTSD patients. This result might indicate that only a small percentage of PTSD psychotherapy patients received good continuity of care.

Similar to the MDD patients, almost all of the PTSD patients (98.9%) who visited primary care did not receive psychotherapy treatment. These patients form only about 47% of total patient population which is less than the percentage of MDD patients (~64%) who visited only primary care. The majority of the PTSD patients (71.5%) who attended PMHC received psychotherapy treatment although there are no PMHC patients with quality ratings of 3 or higher. This result indicates that the PMHC patients who receive psychotherapy treatment did not experience good continuity of care. About 60% of the SMHC patients have a quality rating of 2. This demonstrates that the majority of the SMHC patients received psychotherapy treatment for 45 minutes or longer. In addition, 23.1% of the SMHC patients have a quality rating of 3 or higher - an improved result compared to PMHC. This might show that the resources provided by SMHC improve the quality of psychotherapy treatments provided.

|           |       | Care Setting |         |         |         |              |         | Total |         |
|-----------|-------|--------------|---------|---------|---------|--------------|---------|-------|---------|
|           |       | PC           |         | PC+PMHC |         | PC+PMHC+SMHC |         |       |         |
| TangScale | 0     | 177          | 98.88%  | 6       | 28.57%  | 8            | 4.40%   | 191   | 50.00%  |
|           | 1     | 2            | 1.12%   | 9       | 42.86%  | 24           | 13.19%  | 35    | 9.16%   |
|           | 2     | 0            | 0.00%   | 6       | 28.57%  | 108          | 59.34%  | 114   | 29.84%  |
|           | 3     | 0            | 0.00%   | 0       | 0.00%   | 19           | 10.44%  | 19    | 4.97%   |
|           | 4     | 0            | 0.00%   | 0       | 0.00%   | 12           | 6.59%   | 12    | 3.14%   |
|           | 5     | 0            | 0.00%   | 0       | 0.00%   | 11           | 6.04%   | 11    | 2.88%   |
|           | Total | 179          | 100.00% | 21      | 100.00% | 182          | 100.00% | 382   | 100.00% |

**Table 11: PTSD Psychotherapy Quality Ratings by Highest Level of Care Received**

The percentage of patients who visited only primary care (46.8%) and the percentage of the patients who visited all three care settings (47.6%) are approximately the same. This result differs from the MDD patient population who mostly visited primary care for psychotherapy treatments. PMHC patients who are represented by red data series in Figure 10 only form a small percentage of the PTSD patient population. None of these patients have quality ratings higher than 2.



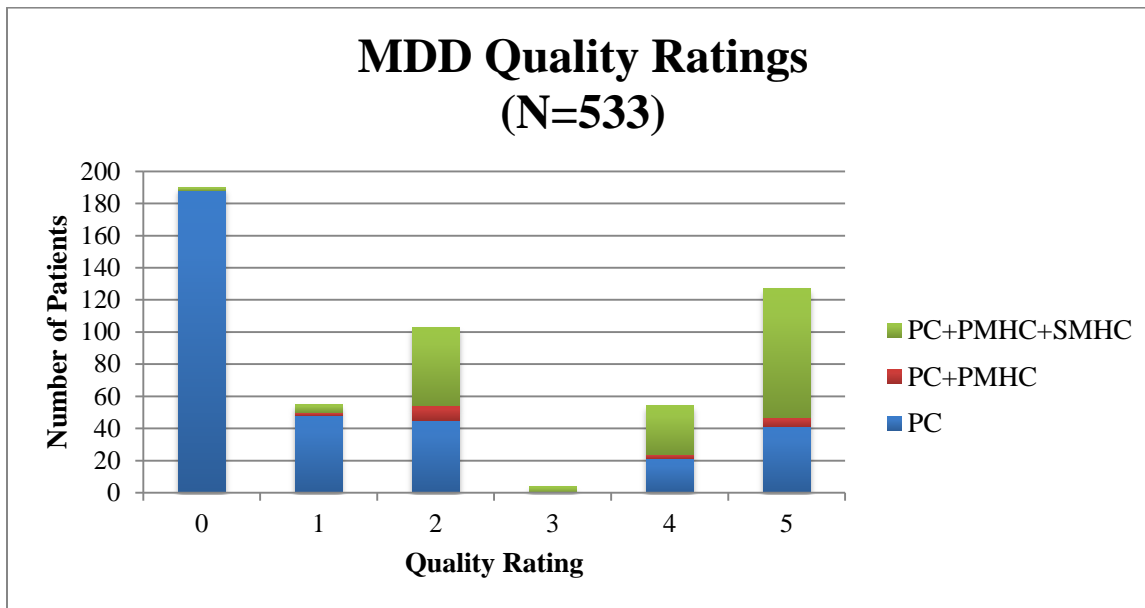
**Figure 10: PTSD Psychotherapy Quality Ratings by Highest Level of Care Received**  
**Medication and Psychotherapy Combined Quality Ratings**

To determine the overall quality of mental health treatments, we combined the quality ratings for medication and psychotherapy treatments and analyzed them separately for MDD and PTSD patient populations. Alcohol abuse does not need psychotherapy treatment; therefore, no combined quality rating analyses exist for alcohol abuse. For MDD patients, the data showed that 64.4% of them attended only primary care and only 3.8% of them visited both primary care and PMHC. This result clearly shows that the majority of the MDD patients attended primary care to utilize mental health services; however 54.8% of these attendants did not receive any mental health treatment. The twenty PMHC patients seem to receive better care since 45% of them are assigned quality ratings of 4 or 5. For SMHC, the data yields even better results where 64.7% of the patients had a quality rating of 4 or 5 and only 1.2% of the patients were untreated.

|           | MDD   | Care Setting |         |              |         |     | Total   |     |         |
|-----------|-------|--------------|---------|--------------|---------|-----|---------|-----|---------|
|           |       | PC           | PC+PMHC | PC+PMHC+SMHC |         |     |         |     |         |
| TangScale | 0     | 188          | 54.81%  | 0            | 0.00%   | 2   | 1.18%   | 190 | 35.65%  |
|           | 1     | 48           | 13.99%  | 2            | 10.00%  | 5   | 2.94%   | 55  | 10.32%  |
|           | 2     | 45           | 13.12%  | 9            | 45.00%  | 49  | 28.82%  | 103 | 19.32%  |
|           | 3     | 0            | 0.00%   | 0            | 0.00%   | 4   | 2.35%   | 4   | 0.75%   |
|           | 4     | 21           | 6.12%   | 3            | 15.00%  | 30  | 17.65%  | 54  | 10.13%  |
|           | 5     | 41           | 11.95%  | 6            | 30.00%  | 80  | 47.06%  | 127 | 23.83%  |
|           | Total | 343          | 100.00% | 20           | 100.00% | 170 | 100.00% | 533 | 100.00% |

**Table 12: MDD Quality Ratings by Highest Level of Care Received**

As it can be clearly seen from Figure 11, more than half of the patients who attend primary care only are not receiving any treatment after being identified with a new mental health disorder. In addition, the percentage of patients who attended all three clinics significantly grows as the quality ratings increase. Almost no patients have with a quality rating of 3 because they were upgraded to quality rating of 4 or 5. This result shows that the MDD patients who received a sufficient total daily dose of medication were also treated for an adequate duration. In addition, the patients who received psychotherapy with the same provider were also treated over an adequate duration.



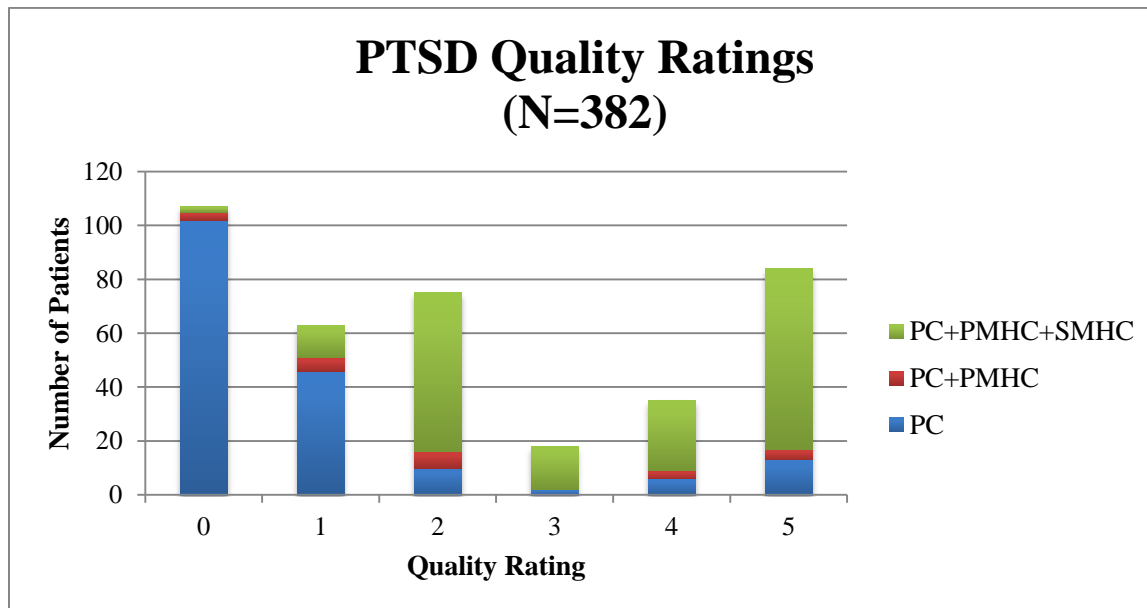
**Figure 11: MDD Quality Ratings by Highest Level of Care Received**

For PTSD patients, 46.8% of the total population attended primary care; however only 10.6% of these patients received treatment with quality rating of 4 or 5. Approximately 57% of the PTSD patients who were seen in primary care were not treated for their condition. Only 5.5% of the PTSD patients attended both primary care and PMHC which is a result similar to that of MDD patients. The patients who attended all three clinics form 47.6% of the PTSD patient population and 51.1% of them received care with a quality rating of 4 or 5. Only 1.1% of the PTSD patients who attended all three clinics did not receive any treatment - significantly lower than the patients who only attended primary care. These results show that as patients received treatments in more care settings the quality of care they received was improved.

| PTSD  | Care Setting |         |         |         |              |         | Total |         |
|-------|--------------|---------|---------|---------|--------------|---------|-------|---------|
|       | PC           |         | PC+PMHC |         | PC+PMHC+SMHC |         |       |         |
| 0     | 102          | 56.98%  | 3       | 14.29%  | 2            | 1.10%   | 107   | 28.01%  |
| 1     | 46           | 25.70%  | 5       | 23.81%  | 12           | 6.59%   | 63    | 16.49%  |
| 2     | 10           | 5.59%   | 6       | 28.57%  | 59           | 32.42%  | 75    | 19.63%  |
| 3     | 2            | 1.12%   | 0       | 0.00%   | 16           | 8.79%   | 18    | 4.71%   |
| 4     | 6            | 3.35%   | 3       | 14.29%  | 26           | 14.29%  | 35    | 9.16%   |
| 5     | 13           | 7.26%   | 4       | 19.05%  | 67           | 36.81%  | 84    | 21.99%  |
| Total | 179          | 100.00% | 21      | 100.00% | 182          | 100.00% | 382   | 100.00% |

**Table 13: PTSD Quality Ratings by Highest Level of Care Received**

Similar to the MDD patients, the majority of the PTSD patients who visited primary care did not receive any treatment as shown by Figure 12. Each quality rating has patients who visited all three clinics as shown by the green data series. Quality ratings of 2 and 5 have the highest percentage of patients who visited all three care settings. In contrast to the MDD patients, there are PTSD patients with quality rating of 3 who were not upgraded to quality rating of 4. This result shows that the suggested treatment durations were not satisfied for these patients.



**Figure 12: PTSD Quality Ratings by Highest Level of Care Received**

### 4.3 Simulation Results

Table 14 highlights the patient wait times generated by the simulation model based on the White River Junction clinic. Comparing the results of Base Scenario and Increased Volume (in Table 18) shows that patients would have to wait less than 5 additional minutes to talk to clerk or use a tablet. In this case, it is unjustifiable to add one more clerk or tablet so we decided not to

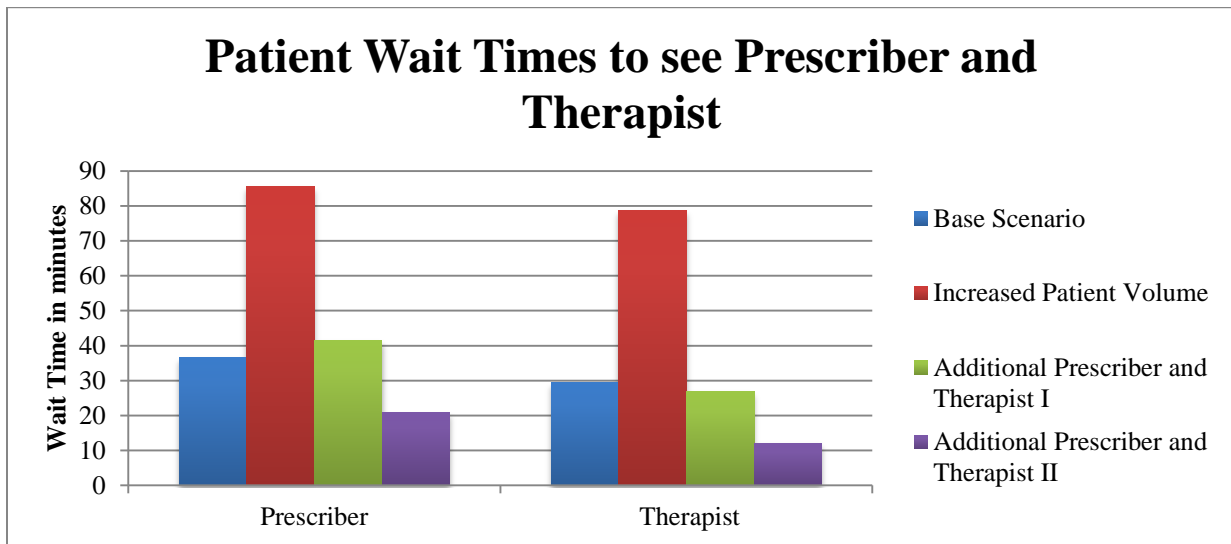
increase the number of clerks and tablets in additional scenarios. The table also shows that the care manager would take approximately 40 more hours to review patient files and follow up with them. Since the care manager usually takes a few weeks before following up a patient and patients do not have to wait physically in the clinic, we also decided to keep the number of care managers the same in other scenarios.

Patient Wait Times (in minutes)

|              | Base Scenario | Increased Patient Volume | Additional Prescriber and Therapist I | Additional Prescriber and Therapist II |
|--------------|---------------|--------------------------|---------------------------------------|--|
| Prescriber   | 36.7 ± 0.6    | 85.6 ± 0.6               | 41.4 ± 0.6                            | 20.9 ± 0.6                             |
| Therapist    | 29.4 ± 0.6    | 78.6 ± 0.6               | 26.7 ± 0.6                            | 12.1 ± 0.0                             |
| Clerk        | 0.9 ± 0.0     | 5.0 ± 0.0                | 4.9 ± 0.0                             | 5.0 ± 0.0                              |
| Tablet       | 0.1 ± 0.0     | 0.3 ± 0.0                | 0.3 ± 0.0                             | 0.3 ± 0.0                              |
| Care Manager | 298.2 ± 3.6   | 339.6 ± 2.4              | 431.4 ± 4.2                           | 556.9 ± 22.2                           |

**Table 14: Patient Wait Times (in minutes) for different resources of PMHC**

Patient wait times for prescribers and therapists increased significantly—more than double of the current wait times; therefore, we ran two scenarios with additional prescribers and therapists. Additional Prescriber and Therapist I has 2 prescribers and 2 therapists while Additional Prescriber and Therapist II has 3 prescribers and 3 therapists (Base Scenario and Increased Patient Volume have only 1 prescriber and 1 therapist.) Patient waiting times for prescribers and therapists in four different scenarios are illustrated in Figure 13 below.



**Figure 13: Patient Wait Times (in minutes) to see Prescriber and Therapist**



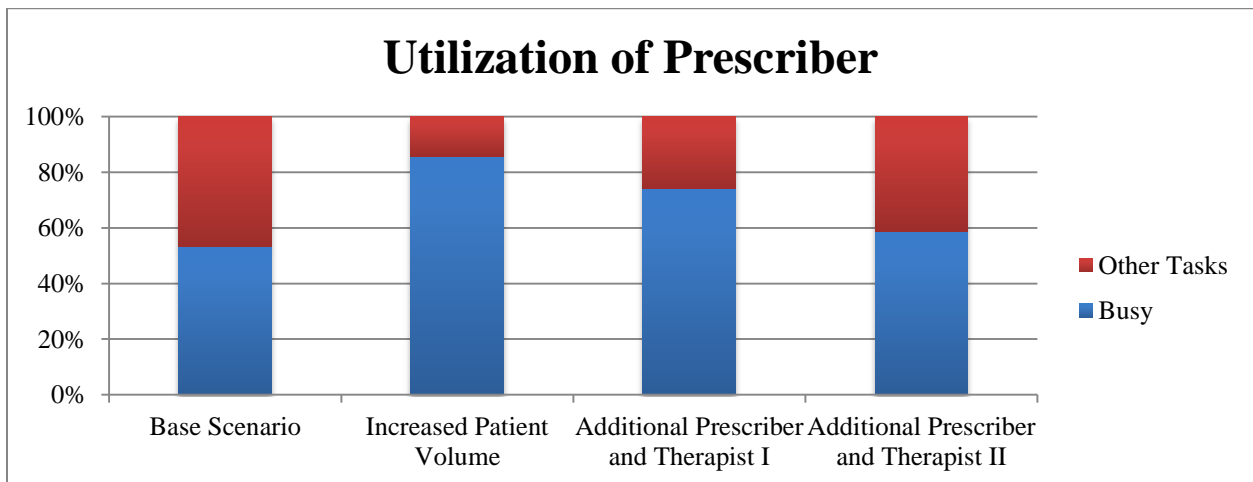
Utilization of PMHC Resources

|              | Base Scenario | Increased Patient Volume | Additional Prescriber and Therapist I | Additional Prescriber and Therapist II |
|--------------|---------------|--------------------------|---------------------------------------|--|
| Prescriber   | 53.23%        | 85.80%                   | 74.09%                                | 58.89%                                 |
| Therapist    | 34.94%        | 80.19%                   | 57.33%                                | 40.11%                                 |
| Clerk        | 15.00%        | 45.62%                   | 45.41%                                | 45.52%                                 |
| Tablet       | 11.37%        | 34.95%                   | 34.77%                                | 34.88%                                 |
| Care Manager | 24.43%        | 48.44%                   | 71.06%                                | 78.64%                                 |

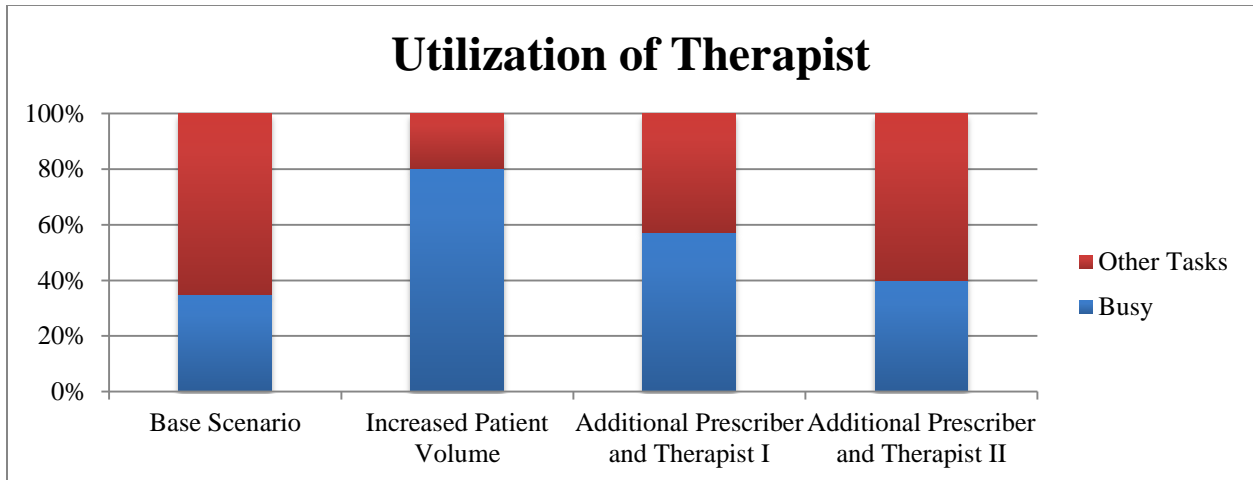
**Table 15: Utilization of PMHC Resources for Patient Treatment**

Table 15 shows the utilization of PMHC resources in different scenarios. With increased patient volume, the clerk, tablets, and care manager would be much busier but these increases would not be an issue since their utilization levels are not concerning. However, the prescriber and therapist would be busy over 80% of the time causing increased wait times for patients.

Figure 14 illustrates how the utilization of the prescriber and therapist changed in four scenarios.



**Figure 14: Utilization of Prescriber**



**Figure 15: Utilization of Therapist**

As shown in Figure 15, adding 1 additional prescriber and therapist each (Additional Prescriber and Therapist I scenario), the clinic should be able to serve a patient volume which is approximately 3 times that of the current volume without causing patients to wait significantly longer. However, the utilization of prescribers and therapists would increase by slightly more than 20 percent. As another option, adding 2 additional prescribers and therapists each (Additional Prescriber and Therapist II scenario) would keep the utilization near the current level. This scenario also reduces patient wait times to less than the current wait times.

## **5. Discussion**

### **5.1 Quality Scale**

The results of our analyses on the quality scales showed that the majority of patients received care solely in the primary care setting and the second largest group of patients who received care were the ones who attended all three clinics. A very underwhelming number of patients in our target population utilized services offered by primary care and PMHC without subsequently attending SMHC.

While categorizing patients by mental health medication or psychotherapy, specifically for PTSD patients, there are more patients treated in all three care settings. As expected, most of the patients who have a quality rating of 4 or higher are seen in SMHC which provides extensive mental health services. This result aligns with the assumption that patients who benefit from the most extensive mental health services at SMHC would receive the most adequate and highly-qualified mental health treatment.

The results also show that the majority of patients in our target population who test positive for a mental health disorder and receive no treatment are being treated solely in primary care. The reason for this may be that patients are unwilling or not yet willing to seek further treatment. It also may be that the patients are testing positive for certain mental health screens; however, their PCPs do not believe that the patient has a problem and do not refer the patient to PMHC (e.g. 2,060 out of 2,494 patients in our target population were seen solely in primary care and did not receive any mental health medication even though they tested positive for alcohol abuse).

### **5.2 Simulation**

Determining the number of additional staff needed for the PMHC clinic depends on VA Medical Center's approach to improving the mental health services. Adding 1 additional prescriber and therapist each as shown in Additional Prescriber and Therapist I scenario allows the clinic to serve 3 times as many patients. However such a change would increase the utilization of prescribers and therapists and the staff members would need to eliminate non-value added tasks in order to create 20% more time of the work day to treat patients. This change will most likely be difficult to implement until the non-value added, time-consuming tasks are determined and eliminated.

On the other hand, if the PMHC clinic adds 2 new prescribers and 2 therapists as shown in the Additional Prescriber and Therapist II scenario, the utilization of the staff would stay around the current level and the patient wait times would be reduced. Although such a change would improve patient experience, it would also create a significant expense for the clinic due to paying for 4 new employees.

The decision to add 1 prescriber and 1 therapist or 2 prescribers and therapists depends on VA's perspective on the matter. Adding 1 of each specialist may prove to be more cost effective than adding 2 of each. If the officials prioritize expenses as an important factor in the decision making, then selecting Additional Prescriber and Therapist I with 1 additional prescriber and 1 additional therapist would be logical. If they prioritize improving patient experience, Additional Prescriber and Therapist II would be suitable to address the issue.

## **6. Recommendations**

### **6.1 Assessment of the Severity of Health Conditions**

This project did not consider the severity of patients' mental health conditions. As a next step, patients should be grouped by how sick they are, to identify whether patients who need to be treated are being treated and what medication and psychotherapy ratings are. By stratifying patients by severity of their mental health conditions, patients who should but are not meeting the recommended daily doses can be identified. In order to determine how severe patients' health conditions are, there are different scores that can be used.

From the yearly screenings for mental health disorders, patients are assigned a score which may be a proxy for their severity of the specific mental health disorder being tested. Although these tests have specific scales to identify the severity of illnesses, the results are not completely accurate due to the subjectivity incorporated in the tests. Patient demographics, the expertise and approach of the physicians, and the conditions in the medical facilities all impact the scores assigned to patients [21]. The Charlson Comorbidity Index is an objective score that PCPs use to evaluate the severity of illnesses and mortality level in their patients. This index assigns scores to patients for each disease that is likely to reduce their lifetime. Scores are assigned for each chronic disease of the patient such as diabetes, heart failure or metastasis, and they are then added together to obtain a final score that represents the mortality level of a patient. These assessments are crucial for prioritizing patients in receiving treatment when the available resources are not sufficient. If the costs and risks of treatment outweigh the benefit from the treatment, then the resources offered to a patient with severe conditions might be transferred to a patient with a lower mortality score [22].

### **6.2 Quality Scale**

After presenting the results to our sponsor, it became clear that the categorization of patients by highest care setting may not be accurate. Although patients may majority of their care in PMHC, if they went to the SMHC even just once, they were categorized as SMHC. We recommend re-evaluating the SMHC patients to see whether they receive more mental health care in PMHC or SMHC. Further analysis should also be made on the patients who are not receiving any mental health treatment (medication and psychotherapy).

Another recommendation with regards to the quality scale is the use of automated text parsing using tools such as regular expression for future (larger) data sets to convert the SIGs to useful numbers.

## Industrial Engineering MQP Design Component

The section below provides an overview of the design process for our methodology and constraints involved in our project as well as the life-long learning skills we achieved through its duration.

### Design

We identified the problem at the VA mental health services as the lack of an established system that can track the quality of care provided as well as the necessity to identify the workforce needed in order to serve a larger patient population at the PMHC clinic. Our solution to the problem was built upon previous work completed by two of our team members as well as research conducted by our project sponsor Dr. Shiner. We established our objectives as to assist the VA in analyzing their patient population for quality purposes while recommending the workforce needed to maintain a certain quality level at the PMHC clinic to treat more patients.

The methods utilized to address the problem included extensive data analysis and simulation modeling. The first component of our methodology was the quality scale we utilized to categorize VA mental health patients into different quality ratings. In order to do so, we first identified our target population as the patients who screened positive in FY 2011, but did not receive the adequate amount of mental health treatment (1 inpatient encounter or 2 outpatient encounters) in FY 2010. These patients were screened for post-traumatic stress disorder (PTSD), mental depressive disorder (MDD) and alcohol abuse - which are the three most common mental disorders among VA patients. We considered the patients who visited only the following care settings when we formed the target population: PC only, PC and PMHC only, PC, PMHC, and SMHC together. The criteria used for the quality scale varied depending on the type of mental health disorder—MDD, PTSD, and Alcohol Abuse—and the type of treatment—medication and psychotherapy.

The patients in our target population were first examined to determine whether their treatments satisfy the quality rating 1 criteria for medication and psychotherapy separately. As some treatments satisfied the additional criteria for higher quality ratings, the patients who received those treatments were assigned higher ratings. This process was implemented in a fashion similar to climbing up a pyramid where the dataset for each higher quality rating was derived from the quality rating one below.

The second part of our project was focused on modifying a simulation model to analyze the patient wait times and staff utilization at the PMHC clinic. This model was created by two of the team members during the summer of 2012 as part of another VA project. We created four different simulation scenarios to identify the number of extra personnel needed in order to treat more patients while preserving a certain quality level at the clinic. The first scenario was the base scenario which used the current values for patient arrival rate and resource capacity that were observed at the PMHC clinic. The second scenario was named as the ‘Increased Patient Volume’ and reflected the extreme case of having three times as many patient arrivals while maintaining the current staffing level. The third scenario analyzed the impact of adding 1 prescriber and 1 therapist to the clinic in order to serve the incoming patients whose arrival rate was increased to 3 times of the current rate. The last scenario also looked into satisfying increased demand while utilizing 2 additional prescribers and 2 additional therapists. The scenarios were compared and contrasted to analyze their impact on patient wait times and staff utilization.

### **Constraints**

This project required extensive data cleansing, compilation and analysis which was difficult to complete during the available time span. We started working on the project in September 2012 and completed our analysis by the end of March 2013. However, the project goals and objectives constantly evolved and more analysis became necessary during various phases of the project. For this reason, the time available to complete the project and create a valuable end product was a serious constraint. In order to address this difficulty, we had regular conference calls and email contact with our sponsors to discuss progress as well to answer quick questions.

Gathering all the data attributes we needed was a complicated task. We had to compile patient visits, patient demographics and pharmacy data together in a meaningful way by using queries. We first identified which exact data attributes we needed after observing the clinics and having discussions with the project sponsors. We constantly communicated with the New England Veterans Engineering Resource Center (VERC) in order to acquire the necessary data from the central data warehouse of the VA. This procedure slowed down our progress because we could not access and compile the data directly due to privacy constraints. The mental health records of VA patients are confidential; thus all the data attributes that belonged to our patient population had to be de-identified before we ran our analysis.



Another constraint we faced was the reproducibility of our data analysis procedure. This is due to the unique collocated model implemented at the White River Junction Medical Center. Many other VA medical centers treat their patients separately at primary clinic and specialized clinic without utilizing an integrated clinic as a gateway. For this reason, the information flow and the interaction between the clinics differ from how the system works at the WRJ VA Medical Center. This situation contradicts with our initial goal: to design a procedure that was easy to replicate at other VA medical centers. Although the data analysis procedure we used cannot be exactly implemented at other clinics, it can easily be repeated at the VA Medical Center for future analysis.

### **Life-Long Learning**

This project helped our team members to gain certain technical skills as well as leadership and project management skills. As we started the project and were not knowledgeable enough about the VA system, we invested significant time into researching the collocated model and mental health services provided at the VA medical centers. This preliminary phase of the project taught us how to effectively research background information about a system in order to create a problem statement and potential solution path. Doing effective research involved observing the operations at the three clinics within the WRJ Medical Center. During this time, we learned how to ask the right questions, collect relevant information and interpret such information to build a solution.

One important aspect of the life-long improvement process was learning how to manage resources in an efficient way. In order to be resourceful, we identified which individuals have the necessary experience and knowledge to tackle certain tasks. Our sponsor Dr. Shiner who is a researcher psychiatrist knew the VA system very well and therefore guided us through identifying problems as well as leading us in the right direction for designing solutions. We also had two team members who had previous project experience with extensive data analysis and simulation modeling who took a lead on these tasks which were the backbones of the project. This project experience taught us how to identify the individual strengths of team members so they can work together effectively to achieve a common goal.

Another important skill we achieved through this project was being able to develop foresight as to which direction our project should head in. As we continued to analyze data and

communicate with our sponsors, we started to understand how this project fits within the “big picture”: what changes can be implemented at the VA in order to improve the mental health services? Our project provided the VA administration with preliminary information on the quality of mental health care provided.

The VA administration is looking into identifying the roles of different care settings for mental health treatment. For this reason, their focus is on understanding the function of the PMHC clinic within the system. The main question they wish to answer is: Should most mental health patients be treated at the PMHC or should the clinic serve as a gateway between primary care and specialized mental health care? Our project provided the VA officials with a preliminary analysis which will allow them to answer this question in the long-term. We assessed the overall quality of mental health care provided as well as staffing changes needed at the PMHC clinic. Thus, we completed some essential analysis which will assist the VA administration to strategize their mental health services to provide the best care possible.

## 7. Conclusions

This report addresses the need for a quality measure on mental healthcare in the VA. While literature has stated that receiving mental health care in PMHC is better than in solely PC, there are no data driven numbers to support this claim. Although the findings show that most patients who are not receiving care go only to the PMHC, it does show that the PMHC may be a facilitator for patients to be seen and receive better care in SMHC. The former statement is not for certain; we categorized by the highest level of care a patient received. More extensive analysis needs to be done on which care setting is where the majority of individual patients' mental health care is treated. The current numbers are not enough for a conclusive argument about whether patients have higher quality scores if they go to PMHC along with PC.

The report also addresses what would happen if all the patients not currently seen in PMHC visit the PMHC clinic. The team adjusted parameters in the PMHC simulation model that was build prior to the project by two of the team members along with the help of the WRJ doctors and staff, New England VERC engineers and cooperative students from Northeastern University. Using scenario analysis, the team determined that the best scenario to counteract the influx in patient volume is to staff two prescribers and two therapists to keep the wait times for patients to see a provider similar to the times before the increase in patients to the PMHC.

## References

- [1] *Strategic Plan Refresh FY 2011-2015*. United States Department of Veterans Affairs. [PDF Document]. Retrieved from [http://www.va.gov/VA\\_2011-2015\\_Strategic\\_Plan\\_Refresh\\_wv.pdf](http://www.va.gov/VA_2011-2015_Strategic_Plan_Refresh_wv.pdf)
- [2] Pomerantz, Andrew S., et al. "The White River Model of Colocated Collaborative Care: A Platform for Mental and Behavioral Health Care in the Medical Home." *Families, Systems, & Health* 28.2 (2010): 114-29. Web.
- [3] "Patient Aligned Care Team (PACT)." *va.gov*. United States Department of Veterans Affairs, 19 Oct. 2011. Web.
- [4] Kizer, Kenneth W., and R. A. Dudley. "Extreme Makeover: Transformation of the Veterans Health Care System." *Annual Review of Public Health* 30.1 (2009): 313-39. Web.
- [5] Kearney, Lisa, et al. "The Role of Mental and Behavioral Health in the Application of the Patient-Centered Medical Home in the Department of Veterans Affairs." *Translational Behavioral Medicine* 1.4 (2011): 624-8. Web.
- [6] Wang, Philip S., et al. "Changing Profiles of Service Sectors used for Mental Health Care in the United States." *The American Journal of Psychiatry* 163.7 (2006): 1187-98. Web.
- [7] Seal, K. H., et al. "Bringing the War Back Home: Mental Health Disorders among 103 788 US Veterans Returning from Iraq and Afghanistan seen at Department of Veterans Affairs Facilities." *Archives of Internal Medicine* 167.5 (2007): 476. Web.
- [8] Zeiss, Antonette, and Bradley Karlin. "Integrating Mental Health and Primary Care Services in the Department of Veterans Affairs Health Care System." *Journal of Clinical Psychology in Medical Settings* 15.1 (2008): 73-8. Web.
- [9] Oxman, Thomas E., Allen J. Dietrich, and Herbert C. Schulberg. "Evidence-Based Models of Integrated Management of Depression in Primary Care." *Psychiatric Clinics of North America* 28.4 (2005): 1061-77. Web.
- [10] Hoge, C. W., et al. "Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care." *New England Journal of Medicine* 351.1 (2004): 13-22. Web.
- [11] Kang, H. K., and K. C. Hyams. "Mental Health Care Needs among Recent War Veterans." *N Engl J Med* 352.13 (2005): 1289. Web.
- [12] Hoge, C. W., J. L. Auchterlonie, and C. S. Milliken. "Mental Health Problems, use of Mental Health Services, and Attrition from Military Service After Returning from Deployment to Iraq Or Afghanistan." *JAMA: the journal of the American Medical Association* 295.9 (2006): 1023-32. Web.

- [13] Seal, K. H., et al. "Trends and Risk Factors for Mental Health Diagnoses among Iraq and Afghanistan Veterans using Department of Veterans Affairs Health Care, 2002-2008." *American Journal of Public Health* 99.9 (2009): 1651. Web.
- [14] Milliken, C. S., J. L. Auchterlonie, and C. W. Hoge. "Longitudinal Assessment of Mental Health Problems among Active and Reserve Component Soldiers Returning from the Iraq War." *JAMA: the journal of the American Medical Association* 298.18 (2007): 2141-8. Web.
- [15] Burnam, M. A., et al. "Mental Health Care for Iraq and Afghanistan War Veterans." *Health affairs* 28.3 (2009): 771-82. Web.
- [16] Rosenheck, R. A., and A. F. Fontana. "Recent Trends in VA Treatment of Post-Traumatic Stress Disorder and Other Mental Disorders." *Health affairs* 26.6 (2007): 1720-7. Web.
- [17] Seal, K. H., et al. "Getting Beyond "Don't Ask; don't Tell": An Evaluation of US Veterans Administration Postdeployment Mental Health Screening of Veterans Returning from Iraq and Afghanistan." *Journal Information* 98.4 (2008)Web.
- [18] Gunal, MM, and M Pidd. "Discrete event simulation for performance modeling in health care: a review of literature." *Journal of Simulation* 4 (2010): 42-51. Web.
- [19] Price, Devon J. "Managing Variability to Improve Quality, Capacity, and Cost in the Perioperative Process at Massachusetts General Hospital." Diss. Massachusetts Institute of Technology, 2011. *Dissertations and Theses*. Web.
- [20] Zeng, Zhen, et al. "A Simulation Study to Improve Quality of Care in the Emergency Department of a Community Hospital." *Journal of Emergency Nursing* 38.4 (2012): 322-8. Web.
- [21] Aas, IH M. "Guidelines for Rating Global Assessment of Functioning (GAF)." *Annals of General Psychiatry* 10.1 (2011): 2. Web.
- [22] Mishra, S. I., et al. "Adherence to Medication Regimens among Low-Income Patients with Multiple Comorbid Chronic Conditions." *Health & Social Work* 36.4 (2011): 249-58. Web.

## Appendix A: Summary of Raw Data Tables

Working with engineers at the VERC, we pulled data that were categorized into the following tables:

| Table Name                   | Relevant Data Fields   | Used For   |
|------------------------------|--|--|
| <b>tblPtDem</b>              | PatientSID (patient identifier)<br>Gender<br>Marital Status<br>Age<br>Race<br>Date of Birth<br>Deceased/Alive<br>DateofDeath<br>Veteran/Non-Vet<br>CurrentMeansTestStatusIEN<br>(financial need indicator)<br>PercentServiceConnect<br>PeriodofService<br>TestPatientFlag (not real patients;<br>used for studies, etc.)<br>County<br>State<br>Sta3n (location of care) <sup>1</sup> | Understanding background information about our target population |
| <b>tblMHAssess_-_PHQ2</b>    | PatientSID<br>SurveyGivenDateTime<br>Raw Score   | Determining which patients tested positive in FY2011             |
| <b>tblMHAssess_-_AUDC</b>    | Same as above  | Determining which patients tested positive in FY2011             |
| <b>tblMHAssess_-_PC_PTSD</b> | Same as above  | Determining which patients tested positive in FY2011             |

<sup>1</sup> Every patient in this study should have Sta3n number 405 for White River Junction and its CBOCs.

|                           |  |  |
|---------------------------|--|--|
| <b>tblMHAssess_-_PCLM</b> | Same as above  | Determining which patients tested positive in FY2011 <sup>2</sup>                      |
| <b>tblMHAssess_-_PHQ9</b> | Same as above  | Determining which patients tested positive in FY2011                                   |
| <b>tblPharmData</b>       | PatientSID<br>RxOutpatSID (visit identifier)<br>MaxRefill<br>IssueDate<br>DispensedDate<br>Quantity<br>SIG (doctors' notes, when/how much to take)<br>DrugNameWithoutDoseSID (drug identifier)<br>NationalFormularyName (drug name)<br>Strength (e.g. milligrams of the tablet)<br>DispenseUnit (e.g. patch, tablet, capsule, injection) | Determining what rating on the Tang Scale patients have for their specific MH disorder |

<sup>2</sup> We included the PCLM and PHQ-9 tests in case there would not be enough patients who tested for the other three mental health (MH) assessments. After analyzing the data, we found that out of the 18,774 patients who took a MH survey in FY2011, 35 took ONLY the PHQ-9, 3 took ONLY the PCLM and 12 took both the PHQ-9 and PCLM and nothing else; therefore, we and our sponsors agreed that it was unnecessary to look at those tests with regards to our target population.

## Appendix B: Mental Health Medications

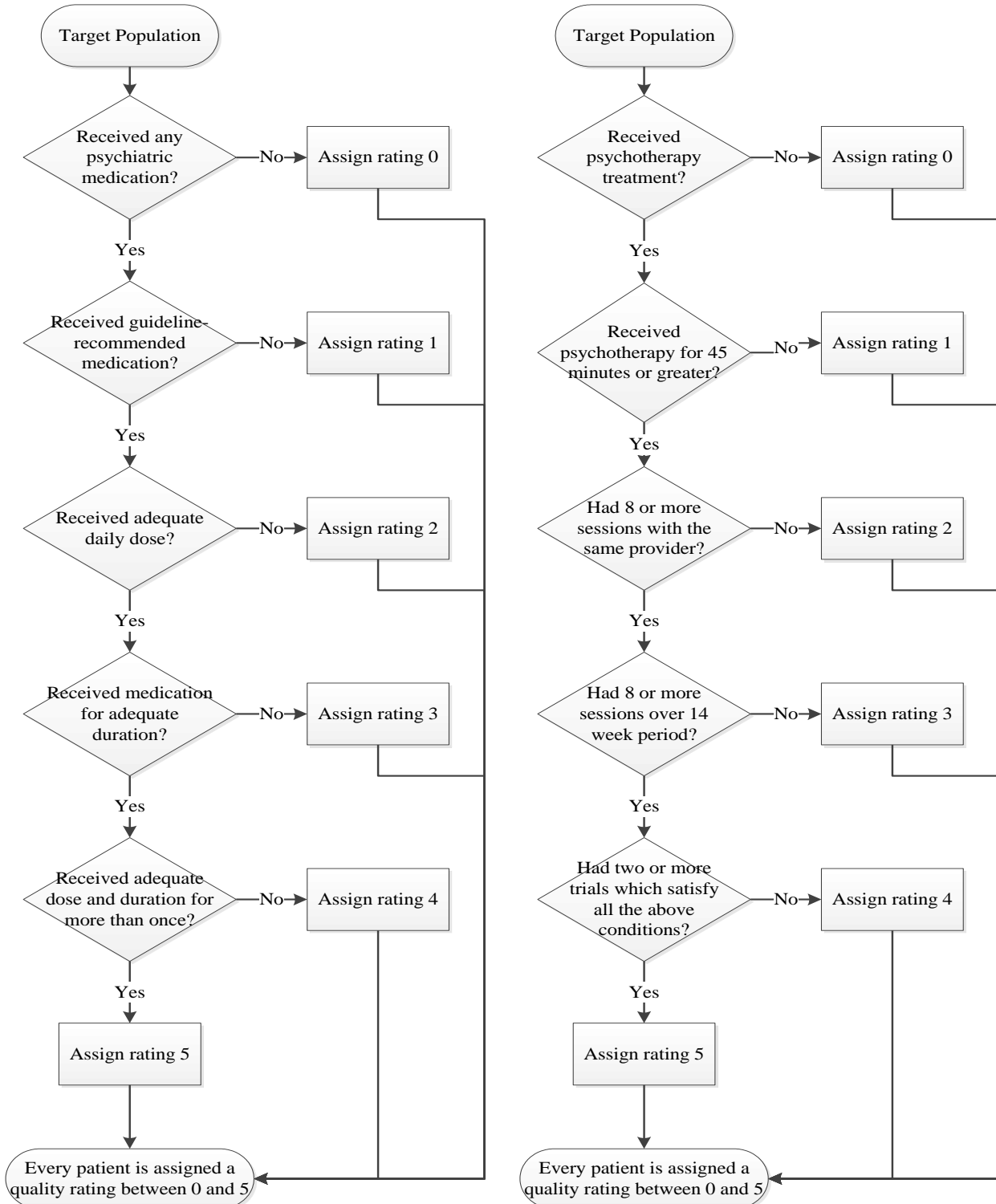
**Table 16: List of Psychiatric Medications (Medication Rating 1 Criteria)**

|                            |                |                    |                  |
|----------------------------|----------------|--------------------|------------------|
| ACAMPROSATE                | DIAZEPAM       | MEMANTINE          | RAMELTEON        |
| ALPRAZOLAM                 | DISULFIRAM     | MEPROBAMATE        | RILUZOLE         |
| AMITRIPTYLINE              | DIVALPROEX     | MIDAZOLAM          | RISPERIDONE      |
| AMITRIPTYLINE/PERPHENAZINE | DONEPEZIL      | MIRTAZAPINE        | RIVASTIGMINE     |
| AMOBARBITAL                | DOXEPIN        | MOLINDONE          | ROPINIROLE       |
| AMOXAPINE                  | DULOXETINE     | NALTREXONE         | SECOBARBITAL     |
| ARIPIRAZOLE                | ESCITALOPRAM   | NEFAZODONE         | SELEGILINE       |
| ATOMOXETINE                | ESZOPICLONE    | NORTRIPTYLINE      | SERTRALINE       |
| BUPROPION                  | FLUOXETINE     | OLANZAPINE         | TEMAZEPAM        |
| BUSPIRONE                  | FLUPHENAZINE   | OXAZEPAM           | THIORIDAZINE     |
| CARBAMAZEPINE              | FLURAZEPAM     | OXCARBAZEPINE      | THIOTHIXENE      |
| CHLORAL HYDRATE            | FLUVOXAMINE    | PALIPERIDONE       | TOPIRAMATE       |
| CHLORDIAZEPOXIDE           | GABAPENTIN     | PAROXETINE         | TRANLYCYPROMINE  |
| CHLORPROMAZINE             | GALANTAMINE    | PENTOBARBITAL      | TRAZODONE        |
| CITALOPRAM                 | GUANFACINE     | PERPHENAZINE       | TRIAZOLAM        |
| CLOMIPRAMINE               | HALOPERIDOL    | PHENELZINE SULFATE | TRIFLUOPERAZINE  |
| CLONAZEPAM                 | IMIPRAMINE     | PHENOBARBITAL      | TRIMIPRAMINE     |
| CLONIDINE                  | ISOCARBOXAZIDE | PHENYTOIN          | VALPROATE SODIUM |
| CLORAZEPATE                | LAMOTRIGINE    | PIMOZIDE           | VALPROIC ACID    |
| CLOZAPINE (CLOZARIL)       | LEVETIRACETAM  | PRAMIPEXOLE        | VENLAFAXINE      |
| CLOZAPINE (MYLAN)          | LITHIUM        | PRAZOSIN           | ZALEPLON         |
| DESIPRAMINE                | LORAZEPAM      | PREGABALIN         | ZIPRASIDONE      |
| DESVENLAFAXINE             | LOXAPINE       | PROTRIPTYLINE      | ZOLPIDEM         |
| DEXMEDETOMIDINE            | MAPROTILINE    | QUETIAPINE         |                  |



## Appendix C: Logic for Assigning Quality Scores

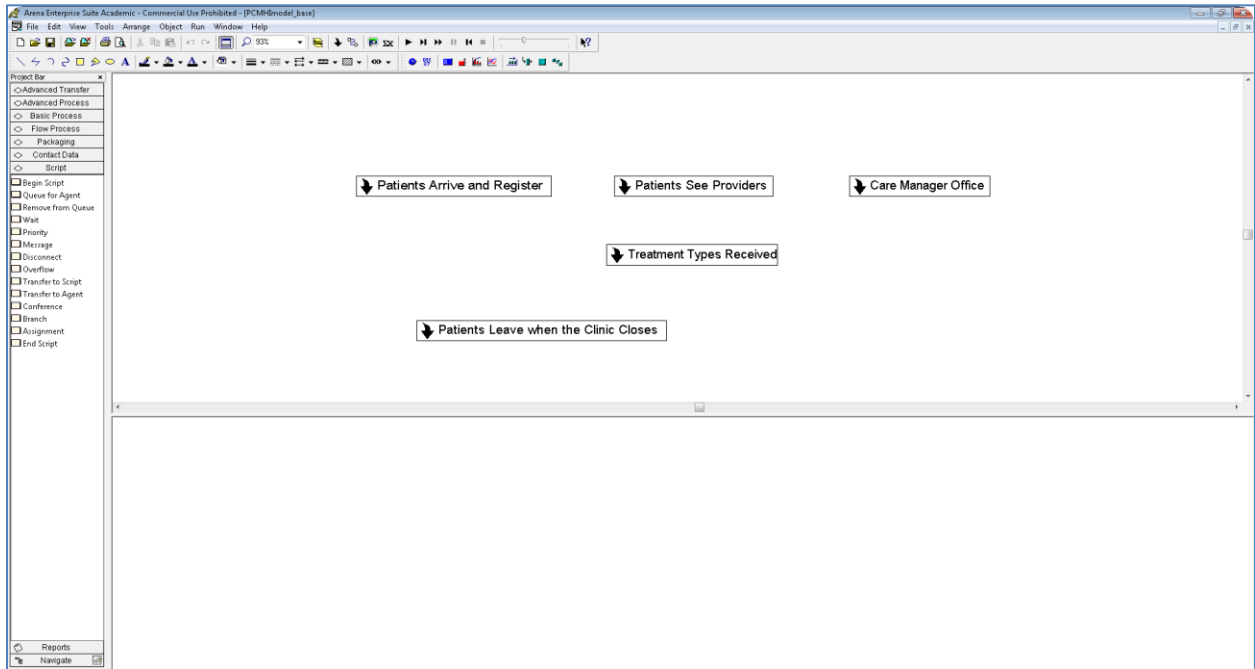
The charts below illustrate the logic behind the analysis to assign quality ratings to mental health patients. The first chart is specialized on medications and the second chart is specialized on psychotherapy which are the two treatment types that provide the criteria for quality ranks.



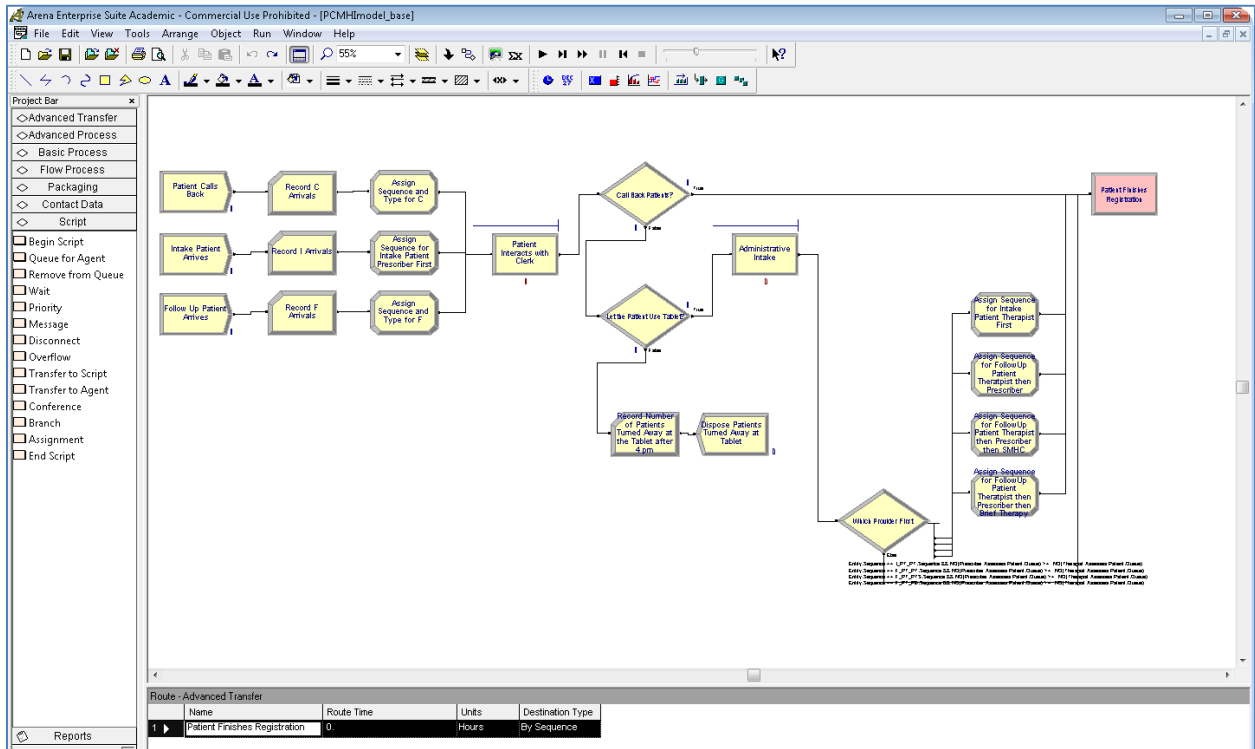
## Appendix D: Patient arrival rates to PMHC in FY 12

| Current   |               | Intake | Follow-up | Call-back |
|-----------|---------------|--------|-----------|-----------|
| Monday    | 7:00 - 8:00   | 0.133  | 0.267     | 0.022     |
|           | 8:00 - 9:00   | 0.289  | 0.711     | 0.067     |
|           | 9:00 - 10:00  | 0.422  | 1.000     | 0.156     |
|           | 10:00 - 11:00 | 0.644  | 1.022     | 0.133     |
|           | 11:00 - 12:00 | 0.533  | 1.356     | 0.178     |
|           | 12:00 - 1:00  | 0.267  | 0.489     | 0.111     |
|           | 1:00 - 2:00   | 0.422  | 0.578     | 0.067     |
|           | 2:00 - 3:00   | 0.356  | 0.489     | 0.111     |
|           | 3:00 - 4:00   | 0.400  | 0.533     | 0.244     |
| Tuesday   | 7:00 - 8:00   | 0.038  | 0.615     | 0.038     |
|           | 8:00 - 9:00   | 0.154  | 0.865     | 0.135     |
|           | 9:00 - 10:00  | 0.365  | 1.096     | 0.096     |
|           | 10:00 - 11:00 | 0.404  | 1.173     | 0.135     |
|           | 11:00 - 12:00 | 0.615  | 0.885     | 0.115     |
|           | 12:00 - 1:00  | 0.212  | 0.500     | 0.154     |
|           | 1:00 - 2:00   | 0.346  | 1.192     | 0.096     |
|           | 2:00 - 3:00   | 0.327  | 1.000     | 0.058     |
|           | 3:00 - 4:00   | 0.231  | 0.635     | 0.173     |
| Wednesday | 7:00 - 8:00   | 0.041  | 0.163     | 0.041     |
|           | 8:00 - 9:00   | 0.184  | 0.429     | 0.020     |
|           | 9:00 - 10:00  | 0.265  | 1.000     | 0.143     |
|           | 10:00 - 11:00 | 0.633  | 1.388     | 0.122     |
|           | 11:00 - 12:00 | 0.592  | 0.796     | 0.082     |
|           | 12:00 - 1:00  | 0.327  | 0.653     | 0.224     |
|           | 1:00 - 2:00   | 0.204  | 1.184     | 0.204     |
|           | 2:00 - 3:00   | 0.265  | 1.000     | 0.041     |
|           | 3:00 - 4:00   | 0.143  | 0.592     | 0.163     |
| Thursday  | 7:00 - 8:00   | 0.059  | 0.216     | 0.000     |
|           | 8:00 - 9:00   | 0.216  | 0.784     | 0.118     |
|           | 9:00 - 10:00  | 0.373  | 0.922     | 0.137     |
|           | 10:00 - 11:00 | 0.392  | 1.039     | 0.157     |
|           | 11:00 - 12:00 | 0.510  | 0.804     | 0.235     |
|           | 12:00 - 1:00  | 0.275  | 0.647     | 0.059     |
|           | 1:00 - 2:00   | 0.314  | 0.627     | 0.157     |
|           | 2:00 - 3:00   | 0.451  | 0.569     | 0.196     |
|           | 3:00 - 4:00   | 0.235  | 0.490     | 0.078     |
| Friday    | 7:00 - 8:00   | 0.098  | 0.275     | 0.039     |
|           | 8:00 - 9:00   | 0.196  | 0.804     | 0.118     |
|           | 9:00 - 10:00  | 0.451  | 0.882     | 0.039     |
|           | 10:00 - 11:00 | 0.529  | 0.941     | 0.137     |
|           | 11:00 - 12:00 | 0.235  | 0.725     | 0.137     |
|           | 12:00 - 1:00  | 0.333  | 0.667     | 0.020     |
|           | 1:00 - 2:00   | 0.216  | 0.745     | 0.059     |
|           | 2:00 - 3:00   | 0.216  | 0.490     | 0.137     |
|           | 3:00 - 4:00   | 0.137  | 0.471     | 0.098     |

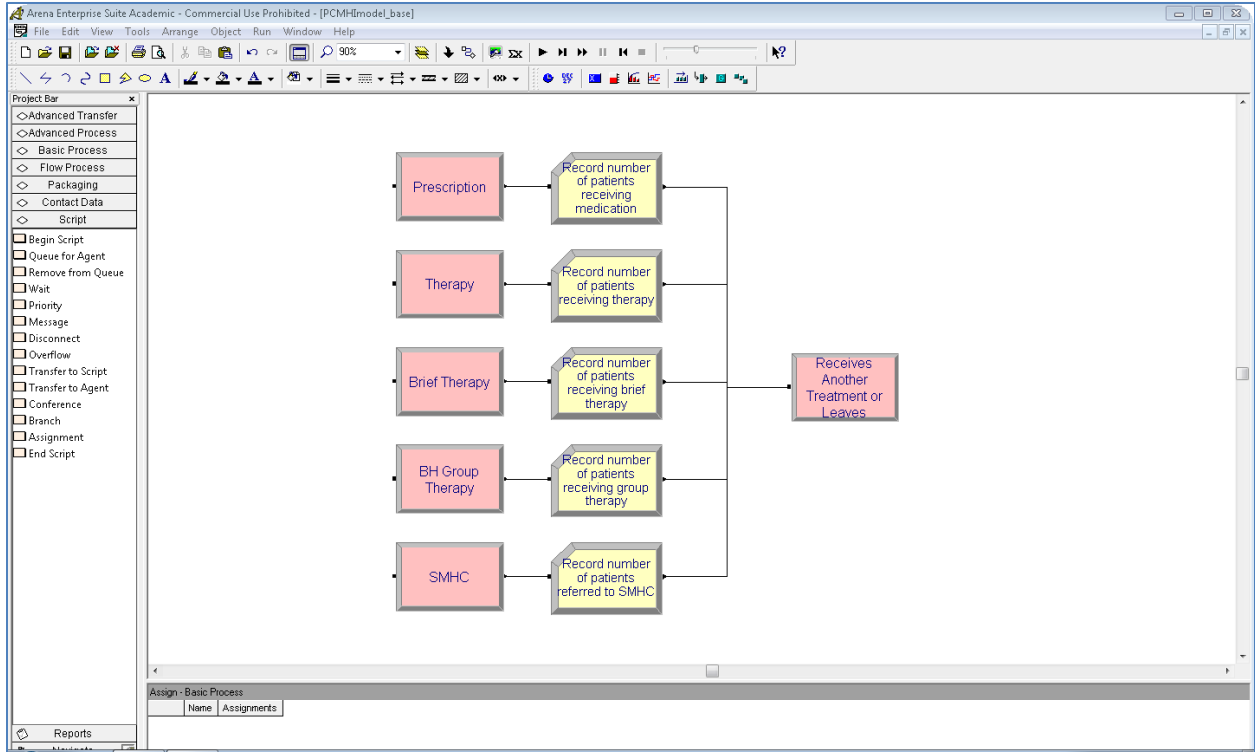
# Appendix E: Simulation Model Screenshots



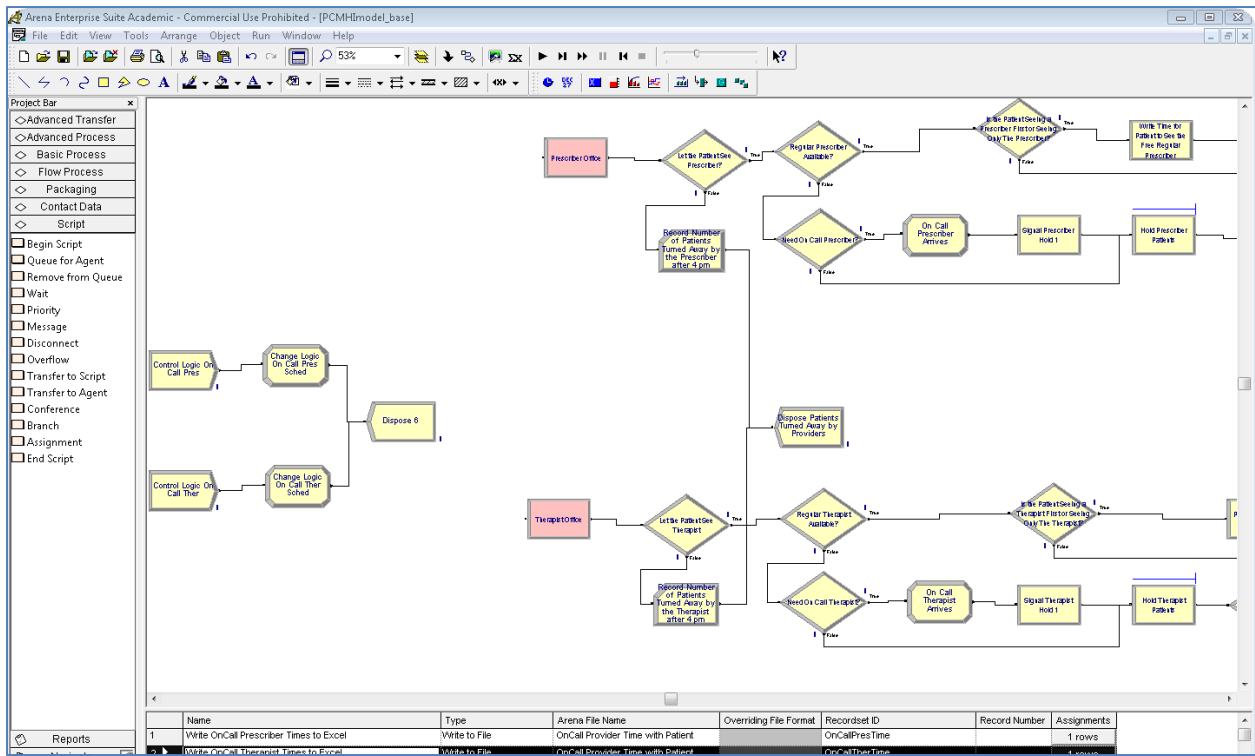
## Simulation Submodels



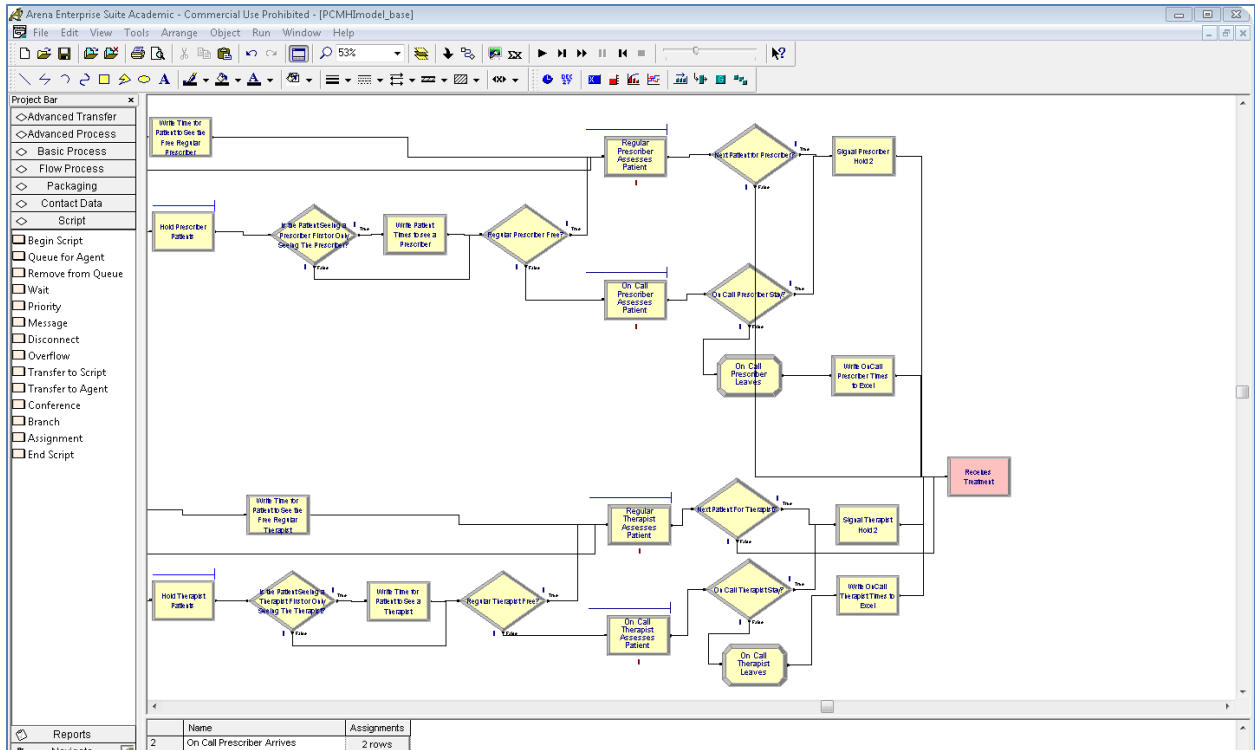
Patient Arrive and Register Submodel



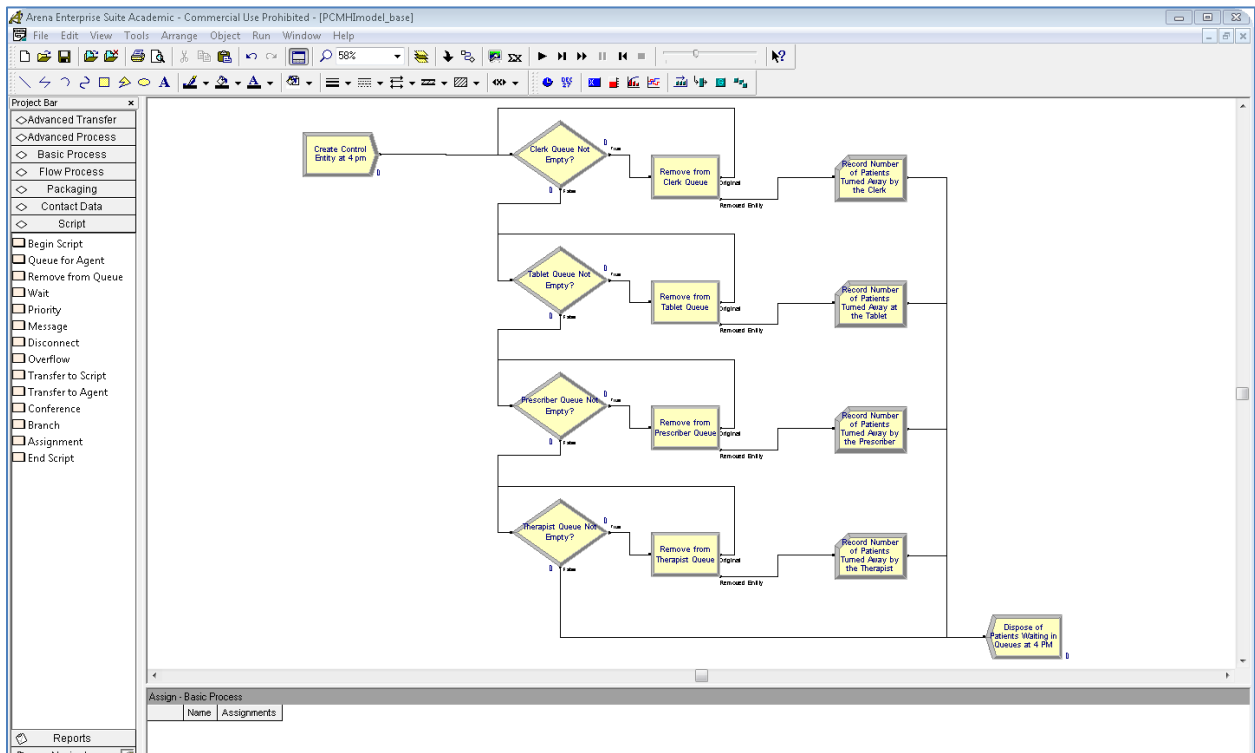
Treatment Types Received Submodel



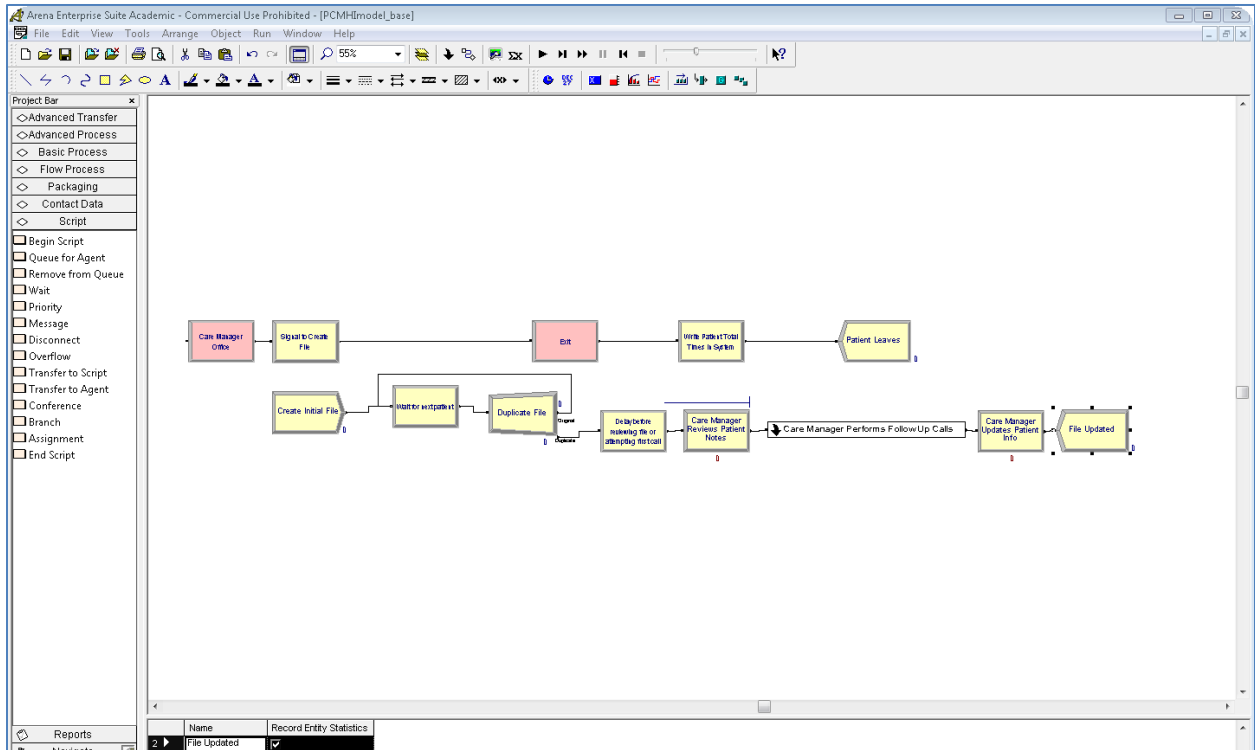
Patients See Providers Submodel Part 1



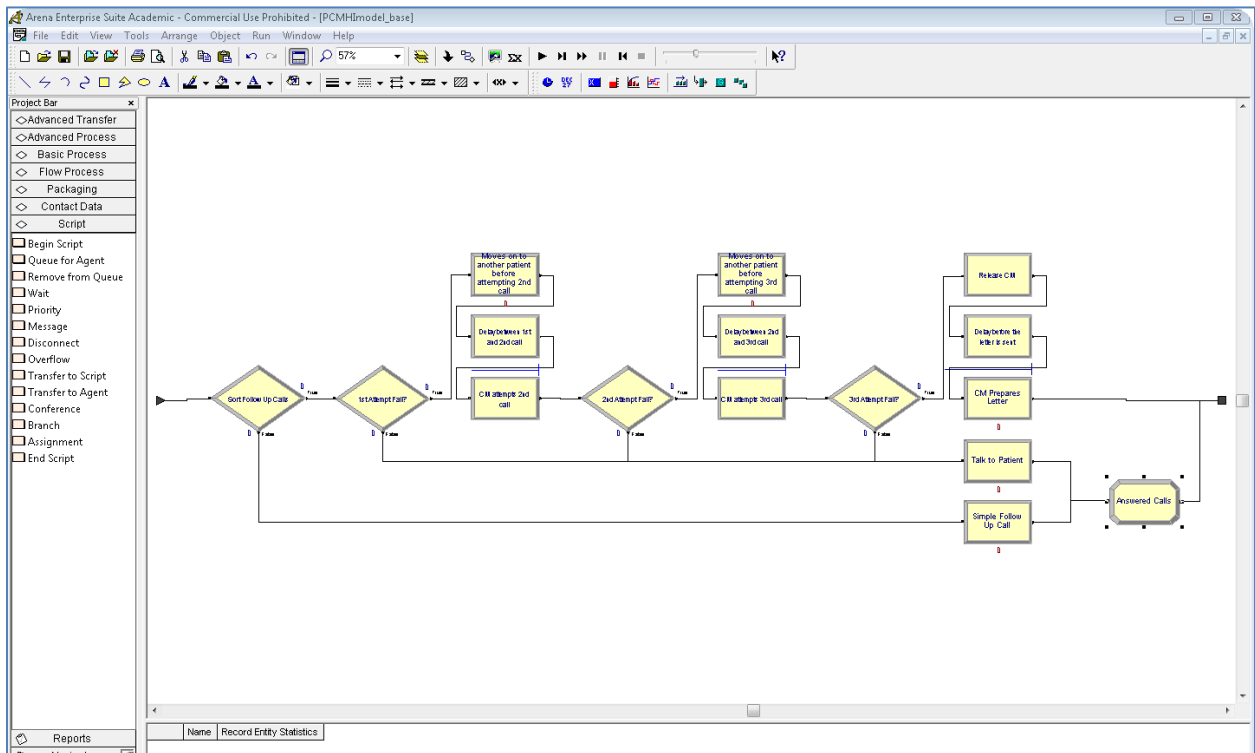
## Patients See Providers Submodel Part 2



## Patients Leave and Clinic Closes Submodel



Care Manager Office Submodel



Care Manager Follow Up Calls Submodel