BIOMARKER, TREATMENT, AND SOCIO-DEMOGRAPHIC FACTORS AFFECTING OPIOID USE DISORDER TREATMENT RETENTION

by

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A dissertation submitted to the Graduate Faculty in Nursing in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

2022

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This manuscript has been read and accepted for the Graduate Faculty in Nursing in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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ABSTRACT

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Increasing mortality from opioid overdose and low treatment engagement are significant public health concerns. Along with increasing health care and criminal justice enforcement costs, there is an urgent need to study the factors associated with treatment retention in opioid use disorder. The study investigated the relative impact of the biomarker cholesterol on treatment retention in an opioid treatment program (OTP) clinic. Further, it examined the medical comorbidities, treatment, and socio-demographic variables that impact opioid use disorder treatment retention. This study was a secondary analysis of patient health records (n=267) in an opioid treatment program clinic. The study employed a hierarchical logistic regression of three models to test the relationship of treatment retention with a cholesterol biomarker, treatment, and socio-demographic factors. This study finds that cholesterol affects positively and significantly

opioid treatment retention across three domains. As a stand-alone independent variable in the biomarker domain, Model I, cholesterol level positively impacts treatment retention (p =0.009). Similarly, an increase in the cholesterol level of patients results in an increase in treatment retention. In the treatment factor domain, Model II, the total cholesterol level (p= 0.025) and medication dosage (p= 0.003) continue to support a significantly positive relation to the dependent variable, treatment retention.

Further, with the third domain's socio-demographic variables, medical comorbidities cease to be statistically significant. Cholesterol level in Model III remains a positive predictor of treatment retention in opioid abuse treatment (p= 0.026). Age and gender are not statistically significant in predicting treatment retention. Regarding ethnicity, this study unequivocally supports that Blacks stay in treatment more than their White counterparts at the study location (p= 0.006; OR= 2.741). This study supports the idea that providing integrated health services in an inclusive OTP clinic promotes the retention of a minority patient population. Additionally, this study supports the extensive use of nursing theories such as the Roy Adaptation Model to generate new knowledge in improving health outcomes, promoting inclusion and equity, and reversing health disparities.

Keywords: opioid use disorder, treatment retention, biomarker, socio-demographic factors

ACKNOWLEDGMENTS

This work was supported in part by the Research Grant from the Alpha Phi Chapter of Sigma Theta Tau International Honor Society of Nursing in Hunter College and the Dean K. Harrison Fellowship at the Graduate Center.

To Dr. Martha Velasco-Whetsell, for the generous support and guidance as chair and mentor. Dr. Whetsell is truly a gift to the nursing profession who keeps on giving. Without her steadfast interest in me, I could not have completed this dissertation.

To Dr. Juan Battle, for his patience in guiding the analytics and system critiques. Dr. Battle's critiques certainly permitted a broader view of the phenomenon under investigation.

To Dr. Steven Baumann for his meticulous attention to this study. Dr. Baumann's critiques and thoughtful reviews made this study clinically relevant.

To Dr. Sister Callista Roy, for her thorough reviews. Sister Callista Roy's insightful comments enabled a comprehensive understanding of her theory as it applies to this study.

To Dr. William Gallo, for his encouragement in pursuing a quantitative study. Dr. Gallo's inspiring guidance and open consultations provided crucial directions.

To Dr. Judith Bennett-Murray for initially serving on my committee. Dr. Bennett-Murray's presence and availability certainly encouraged this study moving beyond the proposal stage.

To the faculty of the Graduate Center Nursing Program: Drs. Eleanor T. Campbell, Elizabeth Capezuti, Barbara DiCicco-Bloom, Cassandra Dobson, Arlene Farren, Catherine Alicia Georges, Eileen Gigliotti, Marianne Jeffreys, Donna Nickitas, Anita Nirenberg, and Linda Scheetz for unselfishly sharing their wisdom and knowledge.

To the management and staff of the Addiction Institute of Mount Sinai and the Psychiatry and Behavioral Health Service of the Mount Sinai Health System: Dr. Yasmin Hurd, Dr. Timothy Rice, Dr. Anne Levesque, Dr. Marilyn Hammer, Ms. Anna Oprescu, Ms. Ingrid Pascali, and Ms. Ruth Williams for facilitating the IRB approval, mentorship and data gathering.

To the providers of scholarship and tuition reimbursement during my stint at the Graduate Center: the NYSNA Secor Scholarship, the Philippine Nurses Association of America (PNAA), Philippine Nurses Association of New Jersey (PNANJ), the Mount Sinai Morningside Hospital and Eastwick College.

To my colleagues at the Graduate Center for bonding and bearing with me all these years.

To my children, Katrina, and Timothy, may this work encourage them to achieve the best possible outcomes in the nursing profession.

Finally, to my wife Ardea for her unconditional love and unswerving support. I must admit that I could not have gone this far without my wife.

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Chapter 1: Introduction and Background

The topic of this dissertation examines specific factors associated with opioid abuse treatment retention among adults in an opioid treatment program (OTP) clinic. Specifically, the study aims to validate a previous analysis of the factors associated with opioid abuse treatment retention and expand the science in opioid abuse treatment retention. This study seeks to achieve these research objectives by including predictive models that explore other predictive variables that use a Roy Adaptation Model (RAM) lens. The basic question investigates whether a biomarker and other factors affect opioid abuse treatment retention.

Background and Statement of the Problem

The increasing mortality from opioid overdose from 1999 to 2015 has been alarming. Opioid overdose-related deaths increased from 0.7 in 2002 to 2.7 per 100,000 people in 2013 (CDC, 2015). Equally disturbing is the low percentage of adults who are in treatment. Out of the 20.4 million adults with opioid addictions aged 18 and older, only 3.5 million have received treatment (Park-Lee et al., 2016). Among adults requiring treatment, only 4.8 percent felt that they needed follow-up (Park-Lee et al., 2016). Low treatment engagement and mortality resulting from opioid overdoses was 3.5 times higher during periods of out-of-treatment making opioid use disorder treatment retention a prime public health concern (Degenhardt et al., 2011).

The widespread effects of opioid overdoses are a significant public health concern, including growing fiscal and economic costs. According to the National Center for Injury Prevention and Control, estimated annual costs to insurers have reached $72.5 billion (CDC,

2015). The amount represents direct health care costs for the non-medical use of prescription painkillers. In the case of private insurers, the mean annual health care costs among opioid abusers ranged from $14,054 to $20,546 per person. For opioid abusers covered by Medicaid, the mean annual health care costs ranged from $5,874 to $15,183 (Meyer et al., 2014).

In addition, illegal drug trafficking and solicitation of opiates have significantly contributed to crime rates in this country. New York is the most affected state in the country. Approximately 20% of the heroin seized nationwide since 2010 has been confiscated in New York State. The massive amounts of heroin and prescription opioids available have contributed to the growth of overdose death. The rate of overdose deaths from prescription opioid overdoses increased 256% from 2000 to 2013, and heroin overdoses doubled between 2000-2013 (New York City Office of the Special Narcotics Prosecutor, 2016).

Despite the importance of tracking treatment among the opioid-dependent patient population, limited knowledge exists about the treatment-seeking behavior among individuals with opioid use disorders (Blanco et al., 2013). Descriptive data on the reasons for non-accession of treatment are available, but gaps exist regarding the analysis of factors associated with treatment. The impact of ethnic subgroups, housing, and employment status on treatment needs further study. Thus, more research is imperative given the limited knowledge of the effects of gender identity, race and ethnicity, sexual orientation, economic status, community resources, faith beliefs, and comorbid psychiatric disorders on treatment engagement (Department of Health and Human Services, 2016).

Significance of the Study

Operational proposals are necessary to combat the growing scourge of opioid misuse and

abuse. Lives lost and the socio-economic costs of opioid abuse call for workable alternatives to mitigate the problem of increased mortality from overdoses. Given the need to minimize the effects of opioid abuse, it is highly desirable for individuals with opioid use disorders to engage in treatment.

The increasing mortality from opiate overdose, health care costs, and associated criminal justice enforcement costs (Florence et al., 2016) pointedly justify the need to study the factors associated with adults seeking first-time treatment for opioid abuse. Filling the knowledge gap in treatment-seeking behaviors is an essential step in moving towards effective interventions in reversing the tide of the opioid epidemic. Given the escalating mortality, this research aims to study the factors associated with opioid abuse treatment retention among the adult population.

Purpose of the Study

This study examines specific factors associated with opioid abuse treatment retention among adults in an opioid treatment program clinic. Table 1 presents the aims and parallel hypotheses. Individually, the purposes of the study are:

Validate previous analysis on the factors associated with opioid abuse treatment retention. Expand the science in opioid abuse treatment retention by including predictive models that explore other predictive variables with the use of the Roy Adaptation Model; and Investigate whether a biomarker affects treatment retention and other factors associated with opioid abuse treatment retention.

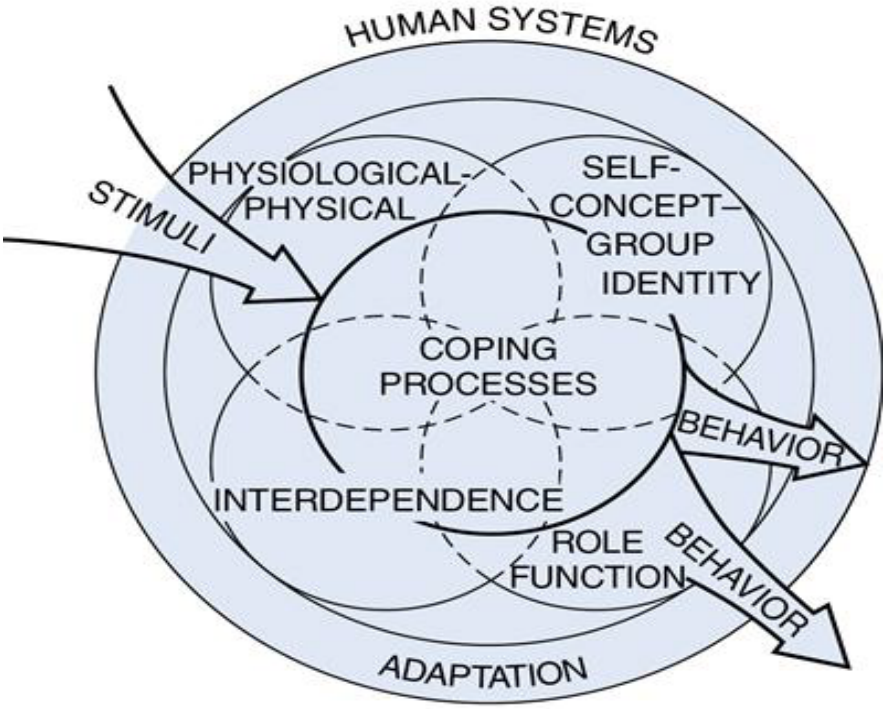
Table 1. Aims and Hypotheses

Purpose and Aims	Hypotheses
Aim 1. Validate the previous analysis on the factors associated with opioid abuse treatment retention.	
Aim 2. Expand the science in opioid abuse treatment retention by using predictive models that explore predictive variables with the Roy Adaptation Model.	1. Socio-demographic factors such as insurance payment plan and housing status are positively associated with opioid abuse treatment retention among adults.
Aim 3. Investigate a biomarker of whether it affects treatment retention and other factors associated with opioid abuse treatment retention.	2. Biomarkers are associated with opioid abuse treatment retention among adults.

Theoretical Frameworks

The increasing concern about the widespread effects of the opioid addiction epidemic requires an operational framework to guide research and the implementation of workable interventions. The Roy Adaptation Model (RAM) offers a framework for research on mitigating the opioid crisis to advance the science of opioid abuse treatment. Given RAM's central feature of adaptation, it is an appropriate framework to study adaptation among the opioid-dependent adult population that continually responds and interacts with external and internal environments (Figure 1).

Figure 1. The Roy Adaptation Model



Source: Roy, C. (2009). *The Roy Adaptation Model* (3rd ed.). Upper Saddle River, NJ: Pearson Education, Inc. Copyright 2009 by Pearson Education, Inc.

The Roy Adaptation Model identifies significant elements: adaptation, person, environment, health, and goal of nursing (Roy, 2009).

Adaptation is the process and outcome whereby thinking and feeling persons, as individuals and groups, use conscious awareness and choice to create human and environmental integration. A person, as defined, is an adaptive system described comprised of parts that function as a unit for some purpose. A person includes people as individuals or groups. The environment is every condition, circumstance and influence surrounding and within affecting the development of the behavior of persons and groups. Health is a state and a process of being and becoming a whole integrated person. The goal of nursing is to promote adaptation and, therefore,

enhance individual and society's health. It is also important to emphasize that the RAM identifies among individuals four adaptive modes: physiological, self- concept, role function, and interdependence (Roy, 2009). Roy (2009) defines the concept as follows: The physiological mode is an adaptive component that reflects a person's interaction with the stimuli in the environment to maintain bodily integrity. The physiological mode maintains physiologic integrity from the cellular level to the organs and system level. As Roy (2009) identified, the physiologic mode has nine components consisting of five basic needs and four processes. The five basic needs are oxygenation, nutrition, elimination, activity and rest, and protection. The other four components are senses, fluid and electrolyte balance, neurological function, and endocrine function. The physical mode refers to the way the group human adaptive system adapts relative to the fundamental operating resources and maintain systems integrity.

Self-concept/group identity mode. The self-concept is the composite of beliefs and feelings that an individual holds about him or herself in a given time. Two components identified for the self-concept mode are the physical and personal selves, including the moral-ethical-spiritual self. On the other hand, the group identity mode reflects group aspects of behavior. Its four sub-dimensions are interpersonal relationships, group self-image, social milieu, and group culture.

Role function mode relates to the individual or group responsibility in society. Group application refers to roles within a group and is the vehicle for accomplishing the goals of the social systems. For example, the group role functions include the administrative and staff services and the management of information systems for decision-making and maintaining order.

The categories for interdependence mode are individual and group interactions. A single application of nurturing relational integrity consists of giving and receiving love, respect, and

value. Group application includes social context, infrastructure, and member capability.

Coping capacity is an essential stimulus to enhance adaptation among groups and individuals. These include a regulator and cognator coping subsystem (Whetsell, Gonzalez & Moreno-Fergusson, 2015). While the central feature of RAM is an adaptation, the coping processes are innate and acquired ways of interacting with the changing environment (Roy, 2009). The coping methods include cognator, regulator, stabilizer, and innovator coping processes. The regulator subsystem refers to the neurochemical and endocrine responses. In contrast, the cognator subsystem refers to the coping process interacting with the four cognitive-emotive channels: perceptual and information processing, learning, judgment, and emotion (Roy, 2009).

In the case of groups, the stabilizer and control subsystems are involved. As Roy (2009) defined, the stabilizer subsystem for groups is a control process involving structures, values, and daily activities associated with systems maintenance. In contrast, the innovator subsystem relates to the group's methods for change. The same subsystem defined in RAM includes structural change associated with group change and growth within social systems (Roy, 2009).

Contribution to the Field

In this dissertation, the author utilizes the Roy Adaptation Model to investigate specific factors associated with opioid abuse treatment retention among adults in an OTP clinic. Specifically, the study aims to validate previous analyses of the factors associated with opioid use disorder treatment retention.

Additionally, the study seeks to expand the science in opioid abuse treatment retention using predictive models that explore other predictive variables. In this case, the Roy Adaptation

Model serves as the framework to investigate whether a biomarker and other factors associated with opioid abuse treatment affects treatment retention. This dissertation will contribute to the following areas:

Patient support training – This research helps reshape healthcare provider training to raise awareness of social determinants directly impacting patient outcomes. The study can likewise identify critical healthcare provider support to improve treatment retention among patients with opioid use disorder. In addition, the research results can improve and enhance current approaches that foster inclusion and diversity.

Health care provider pre-service training – This research can enhance the design and delivery of health care providers entering the service of medication-assisted treatment (MAT) programs that serve patients from diverse socio-cultural backgrounds. The health care providers entering the service can engage a diverse group of patients appropriately.

Health care provider in-service training – This dissertation addresses the tasks of health care providers collaborating with patients from diverse backgrounds. Patients need personalized care and treatment plans that address their needs. The provision of relevant in-service training can certainly increase treatment retention, given healthcare providers' improved understanding of patient needs.

Professional development training – Aside from the pre-service and in-service training, clinical assessment improvement is possible among healthcare providers who lead a team of medication-assisted treatment programs. Physicians, nurses, social workers, counselors, and therapists need awareness of appropriate engagement to enhance patient experience and overall satisfaction. Appropriate approaches to patient engagement derived from this dissertation can rethink how health systems support the improvement of patient outcomes and improve treatment

retention that will lower the mortality from opioid abuse.

Health care policy modification -Health system and structural factors need extensive study. In this dissertation, the author explores workable models of office-based opioid treatment programs. Likewise, this research can modify or validate appropriate implementation models for health insurance access that are relevant and adaptable to opioid abuse treatment.

Methodology

The cross-sectional study covers three years, from January 2015 to December 2017. The study's prospective data source and location is a detailed chart review of patients at the OTP clinic at Mount Sinai West Hospital Center. The data come from the Addiction Institute of New York's (AINY) OTP patient database in the Mount Sinai West Hospital Center. The patient population consists of adult OTP clinic patients aged 18 to 65.

Data Collection Plan

Subsequently, after the approval from the Institutional Review Board (IRB) of the Mount Sinai Health System, the researcher collected de-identified data of the patients at the OTP clinic at Mount Sinai West Hospital Center from its Medical Records Division. The de-identified patients' data covers three years. The three-year patient data correspond to patients' socio-demographic information, lipid panel data, and appropriate dosage levels of methadone or buprenorphine.

Data Analysis Plan

In this study, descriptive and inferential statistical analysis are the two primary data analysis methods. The data management and analytics software used was SAS version 9.4 for Windows 10. SPSS version 25 served as backup software. The program's output summarized the

means, medians, standard deviations, and other appropriate descriptive statistics.

Measures

Outcome Variable

The outcome variable in this three-year longitudinal study was the opioid abuse treatment retention period, which corresponds to the survival variable from treatment induction until the time to relapse or withdrawal from treatment or the time-to-dropout event variable.

Operationally, the treatment retention period, in this case, was defined as continued participation in the opioid treatment program (OTP). Measurement of treatment retention among study participants began during the prescribed retrospective three-year period.

Treatment retention among study participants varied from one point to another. Thus, a broader trend of a covariate was captured by measuring treatment retention at any point within three years. As a result, the likelihood of a more inclusive outcome analysis was probable.

All OTP patients in the study location were followed and observed in the longitudinal study. The study population consisted of all OTP patients regardless of continuous or intermittent treatment participation. This study measured each participant's entry and treatment periods at all treatment induction times. Data censoring accounted for OTP patients who dropped out or began treatment at different periods.

Explanatory Variables

Explanatory variables included in this study consist of biomarker and socio-demographic factors. The discrete and categorical variables are:

Biomarker represents patients' cholesterol level discretely expressed as mg/dl as a unit of measurement. During treatment induction, the researcher records the patient's cholesterol level.

Gender denotes biological association among patients where Males was coded as 1 and 0 for Females.

Age refers to the chronological age at the treatment program induction. The study treats age as a continuous variable.

Ethnicity refers to specific cultural or national group identified by the patient (Code 1= White, Code 2 = African American, Code 3 = Hispanic, Code 4 = Asian). Ethnicity is a categorical variable dummied to three variables with a referent variable.

Medical Co-morbidities are a coexisting medical diagnosis of patients (Code 1 = presence and Code 0 = absence of comorbid medical conditions such as hypertension, hyperlipidemia, hypercholesterolemia, diabetes mellitus, HIV/AIDS).

Opioid Treatment Plan refers to opioid treatment of patients (Code 1 = methadone and Code 0 = buprenorphine)

Treatment dosage denotes a specific dosage of methadone or buprenorphine expressed in milligrams.

Assumptions and Limitations

Assumptions: The data set for the epidemiological study will consist of a few missing data to permit appropriate survival data analysis using Cox proportional hazards.

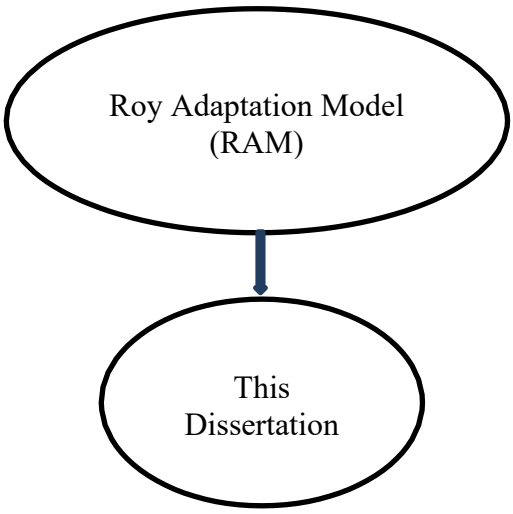
Limitations: A limitation of this study is that it uses an entire group of patients in an OTP clinic. Another limitation is the restricted study location in an urban area. In addition, the fixed study location may also limit the generalizability of the study.

Delimitations: The study participants are in an outpatient OTP clinic located at the Mount Sinai West Hospital Center.

Chapter 2: Literature Review

In this chapter, the author reviews relevant literature about treatment retention among individuals with opioid use disorder. The integrative literature review identifies the barriers and facilitators associated with opioid abuse treatment among adults. Following the theoretical framework, this chapter presents the method used in reviewing relevant literature. Subsequently, the review highlights the following: patient factors, provider factors, system and structural factors, and the biomarker factors associated with opioid abuse treatment retention.

Figure 2: Theoretical Model



Lives lost and the socio-economic costs of opioid abuse call for workable alternatives to reverse the surge. The adult population serves as the focus of analysis to identify research gaps, thereby distinguishing areas for future intervention work that can effectively mitigate the mortality from an opioid overdose.

Method of Review

The review included studies from 2000 to 2016 using MEDLINE Complete, CINAHL, and PsycInfo. Using three databases ensures a contemporary and broad review of barriers and facilitators of opioid treatment. Broad search categories used were barriers, facilitators, treatment, and opioid treatment. The Boolean operators OR and AND were utilized separately and combined with the keywords to broaden the categories. As an additional search strategy, an individual review of the most relevant literature followed the database search.
Inclusion criteria were peer-reviewed articles reporting qualitative and quantitative research of barriers and facilitators to opioid abuse treatment, published from January 2000 to September 2017, a time when data on opioid overdose mortality were available from the Centers for Disease Control and Prevention.

Consistent with the review focus, this review includes only studies that targeted adult participants. Excluded articles included: non-opioid (cannabis, methamphetamine, and benzodiazepine) abuse-related treatment and research of barriers and facilitators of treatment to medical conditions with non-opioid abuse co-morbidity. The review also excluded discussion papers, editorials, and inaccessible dissertations.

The search initially resulted in 276 potentially relevant papers. Guided by the Preferred Reporting Item for Systematic Reviews and Meta-Analyses statement (Figure 2), a review of titles and abstracts eliminated 220 articles leaving a remainder of 52 studies. A second review of the 52 full-text studies excluded 27 studies related to medical conditions with non-opioid abuse co-morbidity. The final set of 25 papers includes one mixed-method, nine quantitative, and 15 qualitative studies.

The review used an appraisal checklist for each qualitative and quantitative research article.

Bowling's 2009 checklist assessed the quantitative journal articles. Bowling (2009) provides 20 comprehensive evaluation criteria for evaluating the quality of studies. The Pearson (2004) Qualitative Assessment and Review Instrument (QUARI) was used to assess qualitative studies. Lastly, the Bowling (2009) and Pearson (2004) checklists appraised mixed-method research.

Results

Bowling's 2009 checklist includes a risk of bias in appraisal. In this regard, the risk of bias appraisal of the nine (9) quantitative studies met most of the 20 criteria in the Bowling checklist (Appendix Table 1). Limitations of quantitative studies included the absence of a pilot study, non-generalizability, and data inaccessibility. The 15 qualitative studies satisfied eight of the ten critical standards.

Following Pearson's 2004 checklist, the papers included in the review were medium to high-quality studies (Appendix Table 2). During the evaluation, there were two items in the QUARI checklist that none of the studies satisfied. These were: locating the research culturally or theoretically and addressing the researcher's influence on the investigation.

Finally, four international studies are in the review. There were quantitative studies whose participants were in Canada, Sweden, and Thailand. In the case of the qualitative studies, 13 studies were conducted in the United States and one in Tanzania. The mixed-method study location was in Thailand.

Data Evaluation

The primary integrative review objective is to identify the state of the science and highlight research gaps. A review of the 25 papers categorized the barriers and facilitators to opioid abuse treatment as demographic, patient, provider, or system factors. The study likewise investigated using a biomarker as a barrier or facilitator of opioid abuse treatment among the adult population.

Patient Factors

Patient demographic factors described the characteristics of the study participants and included age, gender, ethnicity, education, type of residence, and residential density. Two studies explored demographic factors and clinical performance measures. Adults were more likely to continue with opioid treatment in Vancouver, Canada (n=438, mean age of 44) (Hayashi et al., 2016) and Massachusetts (Alford et al., 2011). A study conducted in Sweden indicated a similar trend that being younger (Median age=33; $p<0.05$) predicts discharge from treatment (Davstad et al. 2007). Similar findings have shown that older persons who were employed and used illicit buprenorphine have higher odds of treatment success (OR= 1.40, $p<.01$; OR=2.24, $p<.01$; OR=3.01, $p<.01$) (Alford et al., 2011).

Only one study examined the impact of ethnic subgroups on opioid treatment. African American or Hispanic race had lower odds of treatment success (Alford et al., 2011) (n=382, OR=0.45, $p<0.05$). The same was true regarding studies investigating the impact on opioid treatment performance. One study found opioid treatment success among employed patients (Alford et al., 2011). A study highlighting the odds of non-medical prescription opioid use recommended the investigation of determinants of prescription substance abuse (Perimutter et

al., 2017). Given the limited research, future investigations need to focus on socio-demographic factors such as ethnic subgroups and employment status.

Patients with comorbid drug-induced psychosis or chronic pain diagnosis are more likely toreceive buprenorphine treatment (Murphy et al., 2014). Interestingly, HIV positivity in one study is a treatment facilitator (Callon et al., 2006). Two studies likewise indicated that the provision of HIV specialty care was a treatment engagement facilitator (Turner et al., 2017). Regarding barriers to treatment, alcohol dependence had mixed results among patients. Two studies indicated alcohol dependence as a barrier to treatment (Murphy et al., 2014; Hayashi et al., 2016). In contrast, ethanol or alcohol use was a facilitator of buprenorphine treatment (Murphy et al., 2014). Another interesting note is that comorbid drug-induced psychosis increased the odds of accessing buprenorphine treatment (Murphy et al., 2014). Recent incarceration likewise decreases the likelihood of treatment access (Hayashi et al., 2016; Fox et al., 2015. The absence of a family and personal support system increases the barrier to treatment (Frank et al., 2016; Hewell, Vasquez, & Rivkin, 2017). Difficult adjustment to post-incarceration status exacerbates the barriers to treatment. One key finding in a qualitative study, however, indicates buprenorphine maintenance treatment (BMT) as a treatment facilitator to prevent re-incarceration (Fox et al., 2014).

Social support is another critical treatment facilitator. Social isolation and lack of community re-entry programs complicate treatment access (Fox et al., 2015). Therefore, it is understandable that another qualitative study indicated social support as a favorable treatment facilitator (Frank et al., 2016). Furthermore, two qualitative studies highlight the perceived lack of need and stigma as a barrier to opioid use disorder treatment in two qualitative studies (Hewell, Vasquez, & Rivkin, 2017; Gordon et al., 2011; McMurphy et al., 2016). In another

qualitative study, Teruya, and associates (2014) identified patient factors such as personal determination and commitment as facilitators of opioid abuse treatment. Based on the findings, patient perceptions of treatment impact affected decisions to engage in opioid treatment.

The factors facilitating treatment, improved quality of life, and related positive patient outcomes were revealed in negative toxicology results as treatment facilitators in one qualitative study and one quantitative study (Gordon et al., 2011; Teruya et al., 2014; Frank et al., 2016).

Patients cited positive provider support as treatment facilitators (Frank et al., 2016; Hewell, Vasquez, & Rivkin, 2017). It was unclear, however, what specific support facilitated positive reinforcement among patients. Future studies, therefore, need to investigate the specifics of providing support. Precise patient-centered communication, cultural competence, and staff efficacy may need further assessment. How staff-related factors impact treatment maintenance is vital to keeping patients in the treatment program. In the review, there were no studies on health literacy aspects related to opioid treatment. Therefore, operational teaching-learning methods specific to the patient population require further investigation.

Provider Factors

Healthcare providers play essential roles in mitigating the problem of increased mortality from opioid abuse. Training and lack of expertise are critical factors in providing opioid use disorder treatments (Aletraris et al., 2017; Barry et al., 2010; Green et al., 2014; McMurphy et al., 2006; Storholm et al., 2017). The same concern related to lack of training, particularly for buprenorphine, was similarly captured in the qualitative evaluation study conducted in 17 Veterans Administration facilities (Gordon et al., 2011). Conversely, among substance abuse counselors, buprenorphine specific training was associated with positive attitudes toward

pharmacotherapies for opioid use disorder (Aletraris et al., 2017)

In addition, one quantitative study and two qualitative studies indicated that staff transition and shortage, financial costs, and stigma toward the patient population were barriers to adopting opioid treatment among healthcare providers (Storholm et al., 2017; Hewell, Vasquez, & Rivkin, 2017; McMurphy et al., 2011). Conflicts with staff were another factor for dropping out of treatment. Twenty-four percent of the respondents endorsed disagreement with the treatment team (Gryczynski et al., 2014).

Among advance practice nurses (APNs), barriers identified in a qualitative narrative study included difficulty assessing non-medical modalities for pain management and insurance coverage. On the other hand, using caution on prescriptions and holistic caring and teamwork were facilitators in treatment engagements among APNs (St. Marie, 2016).

A quantitative study among 200 emergency department physicians identified barriers to opioid treatment provision: time, training, and lack of institutional support (Samuels et al., 2016). Regulatory audits and mixing patients were additional concerns in two studies (Barry et al., 2010; and Gordon et al., 2011; McClure et al., 2014; Storholm et al., 2017).

Conversely, four studies identify treatment facilitators among providers. Ease of buprenorphine administration, favorable patient outcomes, social services, and harm reduction philosophy were positive enablers (Barry et al., 2008; McMurphy et al., 2011; Teruya et al., 2014; Thomas et al., 2008). Availability of urine drug screens was likewise indicated as another positive enabler for clinicians to accommodate new patients, particularly in the Veterans Administration health system (Gordon et al., 2011). Specific factors that impact positive patient-provider relationships need investigation (Hewell, 2016). How patient-centered communication and technical and cultural competence affect treatment induction and maintenance warrant

further examination. Both patient and provider perspectives on functional relationships require intensive research focus.

System and Structural Factors

System and related structural factors represent cost considerations, access, and operational aspects affecting opioid treatment (Gellad, Grenard, & McGlynn, 2009). Regarding patient housing conditions, a qualitative study indicated that structured residential facilities were facilitators for opioid abuse treatment retention (Harawa et al., 2017). In a mixed-method qualitative and bivariate study conducted in Thailand, the socio-cultural barriers identified included intense police surveillance, frequent incarceration, and lack of methadone access (Hayashi et al., 2017).

Insurance coverage was also a limiting barrier (St. Marie, 2016; Murphy et al., 2014). With regards to insurance or patient payment plans, individuals treated with buprenorphine were less likely insured in a commercial insurance plan or Medicaid (61% compared to 73% among non- buprenorphine consumers) (Murphy et al., 2014). However, it is not clear how types of insurance were associated with opioid treatment. In the same study by Murphy and colleagues (2014), a non- restrictive insurance plan had higher odds of facilitating opioid abuse treatment. Descriptive reports from the Veterans Health Administration (VHA) system indicated that pilot testing of buprenorphine implementation hastened the adoption of office-based opioid agonist treatment programs (Gordon et al., 2011). With training and resources as barriers, clear policy directives and the availability of providers were the top facilitators for program implementation at the VHA sites. A qualitative summative evaluation, however, indicated that further investigations must examine different implementation models for buprenorphine programs at

VHA centers (Gordon et al., 2011).

Biomarker Factor

As indicated in the data evaluation, the review also investigated using a biomarker as a barrier or facilitator of opioid abuse treatment among the adult population. None of the included studies examined a biological marker as an explanatory factor associated with opioid abuse treatment retention.

In contrast, a recent study among veterans indicated cholesterol levels and suicidal behavior (Reuter, Caldwell, & Basehore, 2017) were biomarkers. Lower serum lipid levels indicated a higher risk for suicidality (Gorwood, 2001; Reuter, Caldwell & Basehore, 2017; Seo, Patrick, & Kennealy, 2008; Wu et al., 2016), but there were conflicting results on the association between cholesterol levels and suicidality. Serum cholesterol levels had no association with suicidality in patients with psychiatric disorders such as schizophrenia, bipolar affective disorder, and major depressive disorder (Park et al., 2013; Pompili et al., 2010). Cholesterol levels were non-predictors of suicide attempts in two different studies among patients with psychiatric illnesses (Fiedorowicz & Coryell, 2007; & Papadopoulou et al., 2013).

While there were conflicting results on cholesterol levels and suicidality, it is essential to consider that there were no studies included in the review that investigated the association between serum cholesterol levels and opioid abuse treatment retention. Given the magnitude of opioid addiction effects, the benefits of examining cholesterol as a biomarker associated with opioid abuse treatment retention outweigh the costs.

This integrative review highlighted the patient, provider, system, and biomarker factors impacting opioid treatment. Patient factors indicated conflicting results on the effect of treatment

duration on treatment maintenance. Such a situation suggests highlighting the impact of treatment duration in future studies. Evidence-based treatment duration needs pilot studies for future replication. Similarly, research needs to investigate specific barriers to patient conflict with staff. How staff-related factors impact treatment maintenance is vital to keeping patients in the treatment regime.

In the case of provider factors, research gaps were evident as well. Specific factors that impacted positive patient-provider relationships need investigation. The integrative review provided no answers on how patient-centered communication technical and cultural competence affected treatment induction and opioid treatment maintenance. Both patient and provider perspectives on functional ties require intensive research focus.

Health-system-related studies need not focus on VHA sites alone. Workable models of office- based opioid treatment programs need further investigation for functional adaptability. Also, it is important to explore which insurance delivery model enables access to opioid treatment. Studies reviewed have not highlighted any community involvement in opioid treatment. No studies highlighted community-based opioid prevention and treatment referral programs.

Review Limitations

The main limitation of this review was the evident heterogeneity in the sample population of studies. Despite the limitation, this review identified specific barriers and facilitators in opioid abuse treatment in the adult patient population. Integrative research identified research gaps for future research with such a focus.

Summary and Conclusion

Two research questions stood out concerning the public health problem of increasing mortality from opioid overdoses: What were the barriers and facilitators of opioid treatment in the adult population? What specific factors influenced health-seeking behavior among opioid-dependent patients? Articulating the question requires a research approach that provides directions for shaping policies to reverse the problem of increased mortality from an opioid overdose.

Research has focused primarily on patient factors affecting opioid treatment in 14 out of the 25 studies included in the review. While there were 12 studies investigating provider impact, the studies were among physicians. Two separate studies included addiction counselors and advanced practice nurses. Seven studies highlighted the health system or structural factors as themes in opioid abuse treatment retention.

This integrative review found that patient, provider, and system factors influenced opioid treatment. Patient factors included the presence of occurring and co-occurring dependencies, recent incarceration, social support systems, and limited access to social services that served as barriers to treatment. In contrast, patients cited excellent patient outcomes and improved quality of life as facilitators of opioid therapy. Likewise, age, housing situation, and employed versus unemployed status positively affected opioid treatment retention.

Regarding demographic factors, no studies examined the impact of ethnic subgroups on opioid treatment. Besides, no studies investigated the effect of employment status on opioid treatment performance and the health literacy aspects of the patient population. Both factors need to be a focus of future investigations.

Health system and structural factors need extensive study. Aside from insurance, housing,

and employment, the treatment delivery model is another area requiring investigation, especially, workable models of office-based opioid treatment programs. Implementation models need research for functional adaptability to opioid abuse treatment, including examining which insurance delivery model enables broader access to opioid abuse treatment.

Further, investigating viable screening tools for treatment retention motivated the inclusion of biomarkers in this research. Given the indicative association of serum cholesterol levels to suicidality and mood regulation, this study explored the association of patient cholesterol levels in treatment as a factor in opioid abuse treatment retention.

Lives lost and the socio-economic costs of opioid abuse call for mitigating the problem of increased mortality from opioid overdoses. Future studies need to investigate specific barriers to patient conflict with staff.

Contribution to the Field

In this dissertation, the author investigates specific factors associated with opioid use disorder treatment retention among adults in an opioid treatment program (OTP) clinic utilizing the Roy Adaptation Model (RAM). Specifically, this study aimed to validate previous analysis of the factors associated with opioid abuse treatment retention and expand the science in opioid abuse treatment retention. The study investigates whether a biomarker affects treatment retention and other factors associated with opioid abuse treatment retention by including predictive models that explore other predictive variables using the Roy Adaptation Model. This dissertation will contribute in the following areas:

Patient support training – This research can reshape healthcare provider training to raise awareness of social determinants directly impacting patient outcomes. The study benefits critical

healthcare provider support by improving strategies for treatment retention among patients with opioid use disorder. In addition, the research results can improve and enhance current approaches that foster inclusion and diversity.

Health care provider pre-service training – This research can enhance the design and delivery of health care providers entering the service of medication-assisted treatment programs that serve patients with diverse socio-cultural backgrounds. Healthcare providers can therefore engage the diverse group of patients appropriately.

Health care provider in-service training – This dissertation addresses health care provider collaboration with patients from diverse backgrounds. Individual patients need personalized care and treatment plans that address their needs. The provision of relevant in-service training can increase treatment retention with an improved understanding of patient needs.

Professional development training – Aside from pre-service and in-service training, healthcare providers who lead teams of medication-assisted treatment programs can benefit from the study results. Physicians, nurses, social workers, counselors, and therapists need awareness of appropriate engagement to enhance patient experience and overall satisfaction. Appropriate approaches to patient engagement derived from this dissertation can provide information to rethink how health systems support the improvement of patient outcomes and improve treatment retention that will lower opioid abuse mortality.

Health care policy modification -Health system and structural factors need extensive study. This dissertation explores workable models of office-based opioid treatment programs. Likewise, this research can modify or validate an appropriate implementation model on health insurance access that is relevant and adaptable to opioid abuse treatment.

Chapter 3: Methods

This chapter presents the dissertation's methodology. First, an overview is given of the methods employed, followed by a description of the dataset and the specific patient population used for the investigation. Subsequently, this chapter presents the variables within each domain and the study's analytic strategy. This chapter also introduces the operational description and the rationale or justification for selecting the variables. In addition, the discussion presents the predicted outcome of each variable in the analysis.

The primary goal of this study was to investigate the relative impact of biomarkers such as cholesterol on treatment retention in an opioid treatment program clinic. Further, the study investigated three domains: biomarkers, treatment factors, and socio-demographic variables impacting opioid abuse treatment retention. In other words, the study sought to answer the question of the relative impact of cholesterol on staying in a methadone clinic. Further, how did medical comorbidities, treatment factors, and socio-demographic variables impact that relationship?

The study analyzed three distinct phases. The data analysis began with an exploration of the descriptive statistics to characterize the patient population in the data set. The second phase involved the use of Pearson's correlation matrices to explore potential pair-wise relationships between continuous variables within the three conceptual models. Figure 2 presents the logic model of the study. Note that for this study, the three conceptual models or the domains of this study were: Domain 1, Cholesterol as a Biomarker Factor; Domain 2, Comorbidities and

Treatment Factors; Domain 3, Socio-demographic Factors.

Finally, the third phase involved using hierarchical logistic regression on three models. The logistic regression sought to test whether a biomarker variable, treatment variables, and socio- demographic variables significantly explained variances in the retention of patients in the opioid treatment program clinic.

Figure 3: The Logic Model

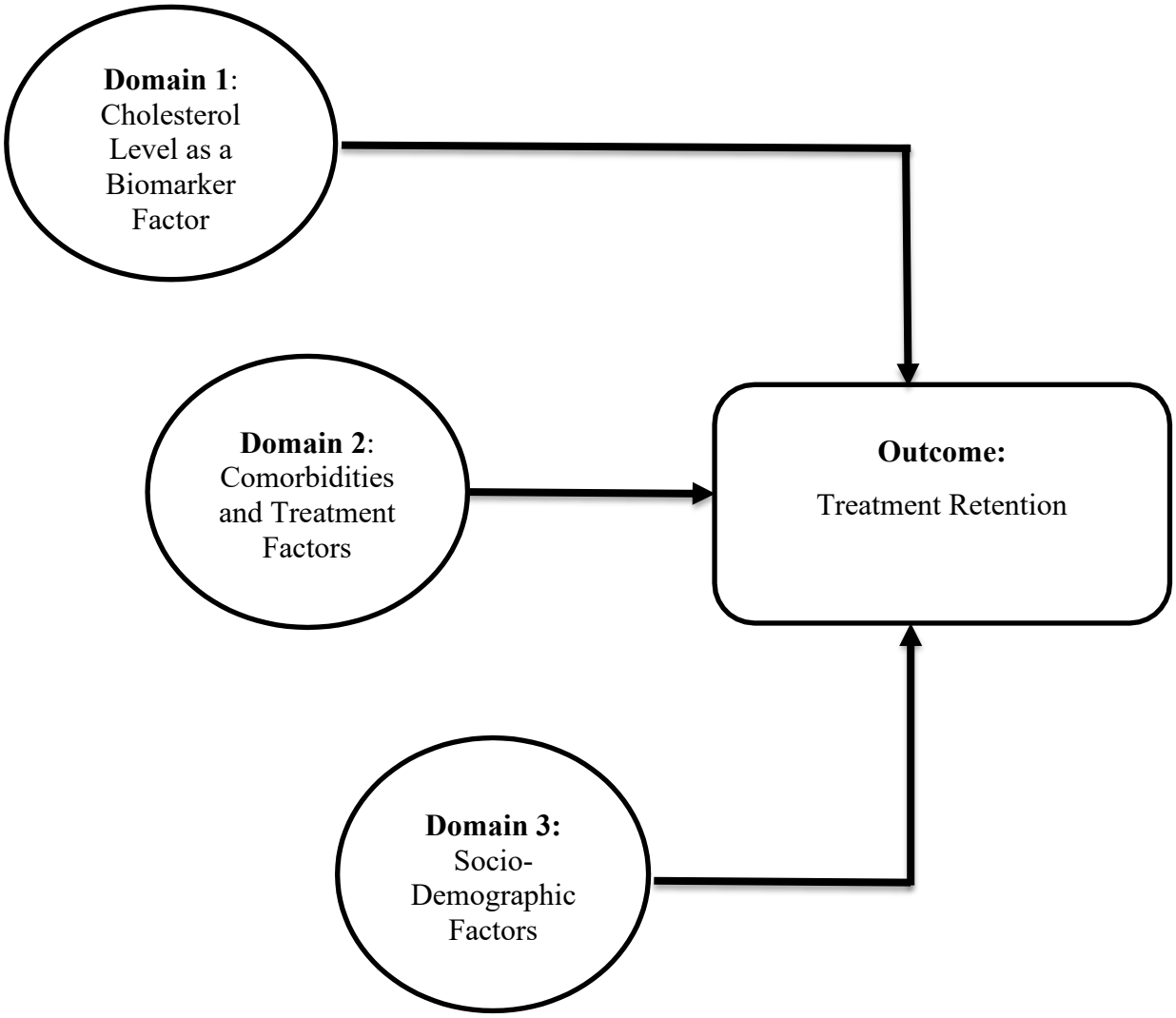


Figure 4: Hierarchical Regression Model

Dependent Variable: Patient Retention

	Model I	Model II	Model III
Biomarker Variable	√	√	√
Comorbidities and Treatment Variables		√	√
Socio-Demographic Variables			√

The subsequent section in this chapter presents the development, rationale, and purpose for selecting the data set and the data collection procedure. The succeeding sections discuss the analytic sample, the dependent variable, and the independent variables used within the regression models. The chapter also summarizes the analytic strategy to answer the research question.

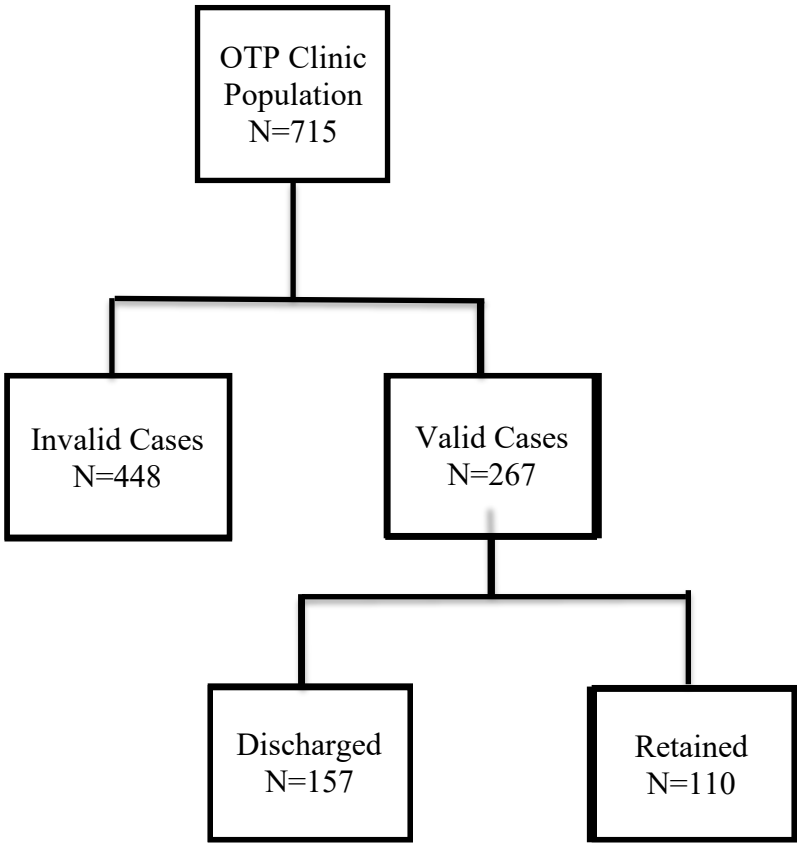
Dataset and Study Location

The present study analyzed the data gathered from patients' medical records covering three years, from January 1, 2015, to December 31, 2017. The study's primary data source was a detailed chart review of patients at the OTP clinic in Mount Sinai West Hospital Center. The data came from the OTP patient database of the Addiction Institute of Mount Sinai (AIMS), located in the Mount Sinai West Hospital Center. The patient population consisted of OTP clinic patients aged 18 to 65 years of age.

The study consisted of a complete review of all patients admitted to the OTP clinic. Seven hundred and fifteen patient records incorporated 519 patients on methadone and 217 on suboxone or buprenorphine. The review included both discharged and retained patients. Given

the missing information on 448 patient records, there were 267 cases included in the logistic regression analysis. Figure 5 presents the schematic sampling process for this study.

Figure 5. Schematic Sampling Process



Following approval from the Institutional Review Board (IRB) of the City University of New York (CUNY) and the Mount Sinai Health Systems (MSHS), data were gathered. Direct patient consent was not needed since the data came from medical records. All patient data were de- identified. Participant data was also de-identified. To ensure anonymity, security codes were assigned for encrypted data.

Subsequently, after the approval from the IRB of the Mount Sinai Health System, the researcher collected de-identified data of the patients at the OTP clinic at Mount Sinai West

Hospital Center from its Medical Records Division. The de-identified patient data at the OTP clinic at the Mount Sinai West Hospital Center covered a three-year period. The three-year patient data corresponded to the patients' socio-demographic information, lipid panel data, and dosage levels of methadone and buprenorphine.

The OTP clinic was formerly known as the Methadone Maintenance Treatment Program Clinic under the Addiction Institute of New York (AINY) before the merger of the hospital with the Mount Sinai Hospital System. The OTP clinic under study was one of the two hospital-based outpatient services for opioid use disorder treatment under the banner of the Addiction Institute of Mount Sinai (AIMS).

The OTP Clinic at Mount Sinai West offered office-based medication-assisted treatment (MAT). The clinic primarily administers methadone and buprenorphine using the current evidence- based practice in a non-stigmatized manner (AIMS, 2022). Aside from the office-based medication- assisted treatment, the same study likewise provided an ideal location for those seeking inpatient services when managing withdrawal symptoms was necessary.

The OTP Clinic consisted of physicians, social workers, registered nurses, and nurse practitioners. The treatment team at Mount Sinai West's OTP Clinic collaborated with the patient and their families for sustained recovery. Doing so gave individual attention to suit each patient's needs.

On principle, clinic staff refused to turn away anyone. Likewise, the clinics and AIMS did not remove patients from their programs when they could not maintain sobriety (AIMS, 2022).

The exact study location was one of the seven AIMS-supervised MAT clinics in New York City. The network of AIMS-supervised clinics offered a variety of services:

- Group counseling
- One-on-one therapy
- Case management
- Educational and vocational counseling
- Annual physicals
- General medical care
- Art therapy
- Psychiatric evaluation
- HIV counseling and testing
- Peer counseling
- Hepatitis C testing and telemedicine
- Women-only clinic

Unit staff nurses conducted a weekly group session with OTP patients. The weekly group session “Health Talk” was an open forum where staff nurses took turns serving as resource persons on chronic disease management. The Health Talk sessions also discussed stress and anxiety coping strategies in the same meetings. Aside from the unit staff nurses, external resource persons were facilitators of the weekly forum.

Overall, the study location integrated services beyond opioid use disorder treatment. Treatment plans included therapy, medication, and a combination of both. In addition, the Mount Sinai West hospital provided detox and urgent care services to patients. Patients who missed their medication doses during the day could take them at the nearby emergency department of the Mount Sinai West Hospital Center.

Measures

This study employed two primary data analysis methods. The two were descriptive and inferential statistical analyses. The data management and analytics software were SPSS version 28 for Windows 10. The program's output summarizes the means, medians, standard deviations, and other proper descriptive statistics.

All OTP patients in the study location were followed and seen in the longitudinal study. The study population was composed of all OTP patients regardless of continuous or intermittent treatment participation. This study measured participants' entry and treatment periods at all treatment induction times.

Dependent variable

The outcome variable in this three-year longitudinal study was opioid abuse treatment retention (TXRET). The opioid abuse treatment retention period corresponded to whether the patient stayed or retained in the program from treatment induction until relapse or discharge from treatment or the time-to-dropout event variable. Operationally, the treatment retention period, in this case, was continued participation in the opioid treatment program (OTP). The code was 0 for those discharged and 1 for those who stayed or were retained in the opioid treatment program.

Independent variables

Three domains grouped the independent variables in this study. The first domain incorporated the biomarker. In this case, the patient's cholesterol level was the biomarker variable. Second, the second domain consisted of medical comorbidities and treatment variables.

In addition, the treatment variables included the medication prescribed and the corresponding dosage. Lastly, the third domain combined the variables in the first and second domains. Treatment retention among study participants that began during the prescribed retrospective three-year period.

Biomarker variable

CHOLESTEROL was the patient's cholesterol level in mg/dl, the unit of measurement used in the study. During treatment induction, the researcher recorded the patient's cholesterol level. Aside from social determinants and treatment factors, intrinsic factors required investigation. Based on the Roy Adaptation Model, a person's physiology is one of its adaptive modes for the individual (Roy, 2009). The physiological mode shows the maintenance of physiologic integrity from the cellular to the organs and body systems. The physical mode, on the other hand, refers to the way the group human adaptive system adapts relative to the fundamental operating resources and maintain systems integrity (Andrews, H. & Roy, C., 1986). The two modes are adaptive components that reflect a person's interaction with the environment to support bodily and systems integrity. For this study, the patient's total cholesterol level was the primary biomarker of interest to determine its impact on opioid use disorder treatment retention. The total cholesterol level likewise represents the physiological mode in the theoretical framework of this study.

The selection of cholesterol as a biomarker affecting opioid abuse treatment retention stemmed from the link between serotonin and its metabolite 5-hydroxyindoleacetic acid (5-HIAA) in emotion regulation and impulse control (Seo, Patrick, Kennealy, 2008). A study on biological markers for suicidal behavior in alcohol dependence (Gorwood, 2001) indicated that

cholesterol level appeared to impact 5-HIAA and the dopamine metabolite homovanillic acid (HVA). Given the close relation of serotonin and dopamine systems at the neurophysiological level, changes in either system altered the other (Reuter, Caldwell & Basehore, 2017). As a result, this study investigated the cholesterol level's impact on the patient's decision to stay in treatment for opioid use disorder.

Cholesterol measurement is straightforward. Total cholesterol level data come from a person's serum lipid panel. Below 200 mg/dL shows a normal or desirable level. Above 200 mg/dL needs proper attention from a primary healthcare provider (Mayo Clinic, 2022). As previously noted in the literature review section, a study among veterans shows cholesterol levels and suicidal behavior were associated (Reuter, Caldwell, & Basehore, 2017). Lower serum lipid levels suggested a higher risk for suicidality (Gorwood, 2001; Reuter, Caldwell, & Basehore, 2017; Seo, Patrick, & Kennealy, 2008; Wu et al., 2016).

Yet conflicting results exist on the association between cholesterol levels and suicidality. Serum cholesterol levels had no association with suicidality in patients with psychiatric disorders such as schizophrenia, bipolar affective disorder, and major depressive disorder (Park et al., 2013; Pompili et al., 2010). In two different studies among patients with psychiatric illnesses researchers found that cholesterol levels were non-predictors of suicide attempts (Fiedorowicz & Coryell, 2007; Papadopoulou et al., 2013).

This study predicted that the cholesterol level positively influenced the patient's retention in the opioid treatment program. The prediction assumes that patients with comorbidities can access allied services at the opioid treatment program clinic.

Comorbidities and Treatment Variables

Medical comorbidities (MEDCOMORB) were co-existing medical diagnoses of patients. Code 1 = presence and Code 0 = absence of comorbid medical conditions such as hypertension, hyperlipidemia, hypercholesterolemia, diabetes mellitus, HIV/AIDS, and hepatitis C. Operationally, medical comorbidity is a disease existing simultaneously with another disease. The comorbid disorder is also independent of another medical condition (Merriam-Webster, 2022). It means a patient has a concurrent disease other than the primary disease of interest, such as hypercholesterolemia.

Previous research highlighted the importance of studying the impact of medical comorbidities as facilitators of treatment retention. Patients with comorbid drug-induced psychosis or chronic pain are more likely to receive buprenorphine treatment (Murphy et al., 2014).

Interestingly, HIV positivity in one study was a treatment facilitator (Callon et al., 2006). Two studies likewise showed that providing HIV specialty care was a treatment engagement facilitator (Turner et al., 2017).

While earlier studies found medical service integration with methadone treatment as a treatment retention factor, a French trial proved otherwise. The French research (Carrieri et al., 2014) found no statistical difference in retention at 12 months ($p=0.13$ at $n=195$). Likewise, a more extensive study in the US with a sample size of 316 found no difference in retention at 12 months, $p=0.96$ (Brooner et al., 2013). A smaller study consisting of 94 respondents, however, reported improved retention ($p=0.05$) at 20 weeks (about four and a half months) for both methadone and buprenorphine treatment groups (Miotto et al. 2012).

This study predicted that medical comorbidities could improve treatment retention by

incorporating medical services in outpatient clinics. This prediction was predicated on the AIMS opioid treatment program clinic integrating allied primary care services in its medication-assisted treatment.

Opioid Treatment Plan Variables

Opioid treatment plan (OTPLAN) in this study referred to opioid treatment of patients. The categorical code 1 stood for methadone and Code 0 for buprenorphine. The comparative analysis of which opioid treatment plan works better requires continued research focused on different treatment settings.

Operationally, methadone and buprenorphine were the primary opioid use disorder treatment medications. The World Health Organization (WHO) considers both medications essential for medication-assisted treatment (WHO, 2006). Another medication approved by the Food and Drug Administration (FDA) is the extended-release naltrexone (NIDA & SAMHSA, 2016).

For this study, the inclusion of opioid treatment plans, namely methadone and buprenorphine, was justified, given the need to further investigate which medication improves treatment retention. Note that addiction science literature has presented contrasting results. Among 267 patients with medical toxicology consults on opioid use disorder, methadone was associated with a statistically significant increased probability of retention in outpatient treatment compared to buprenorphine, $p = 0.01$ (Kessler, Schwarz, & Liss, 2021). The same finding confirmed a multisite trial, concluding that provision of methadone was associated with better retention in treatment for opioid dependence than buprenorphine (Hser et al., 2014).

Ease of buprenorphine administration, favorable patient outcomes, social services, and

harm reduction philosophy were positive enablers (Barry et al., 2008; Gordon et al., 2011; McMurphy et al., 2006; Teruya et al., 2014; Thomas et al., 2008). Availability of urine drug screens was likewise shown as another positive enabler for clinicians to accommodate new patients, particularly in the Veterans Administration health system (Gordon et al., 2011). Based on earlier research, this study predicted no significant difference in treatment retention on opioid use disorder treatment.

Treatment Dosage Variable

Treatment dosage (DOSAGE) denoted a specific dosage of methadone or buprenorphine expressed in milligrams/dL. Treatment dosage positively affected treatment retention. Adequate dosing of medications for opioid use disorder led to improved treatment retention (Biondi et al., 2022). Lower medication doses led to higher dropouts (Hser et al., 2014; Proctor et al., 2022). Reduced retention with lower methadone doses was the main finding among patients in opioid substitution treatment (O'Connor et al., 2020; Lin et al., 2015). Conflicting results from prior research merit extensive study on the effect of medication dosage on treatment retention. Analysis-wise, this study provides information on how medication dosage improves retention among those who abuse opioids. This study predicts that medication dosage positively affects treatment retention.

Socio-demographic Variables

This study incorporates essential socio-demographic variables potentially affecting treatment retention. The socio-demographic variables include age, gender, and ethnicity or racial grouping. Gender denoted biological association among patients. In this study, the code for

Males was 1 and 0 for Females. Studies focusing on the impact of gender on opioid use treatment retention have been limited. Gender (GENDER) denotes biological association among patients where Males were coded as 1 and Females 0.

Age referred to the chronological age at the time of treatment program induction. The study treated age as a continuous variable.

Ethnicity referred to specific cultural or racial groups identified by the patient. Code 1 = White, Code 2 = African American, Code 3 = Hispanic, Code 4 = Asian. Ethnicity was a categorical variable dummied to three dummy variables with a referent variable.

The literature review chapter showed that only one study examined the impact of ethnic subgroups on opioid treatment. African American or Hispanic race had lower odds of treatment success (Alford et al., 2011) ($n=382$, $OR=0.45$, $p<0.05$). Treatment retention in a methadone maintenance program for those of Hispanic ethnicity predicted premature discharge (Proctor et al., 2022). Lower retention was not limited only to Hispanic groups but also the Black population (Weinstein et al., 2017).

In contrast, medications for opioid use disorder treatment in a residential setting enhanced the retention of Blacks and Hispanics, as opposed to the White group (Stahler, Mennis, & Baron, 2021). It is evident from the literature review that little research has been conducted regarding the effects of racial and ethnic groupings on treatment retention. Given the limited research and contrasting findings from previous studies, this study predicted that African Americans would have higher odds of retention in opioid use disorder treatment.

With regards to age, a recent study on treatment retention in older versus younger adults concluded that older adults were more likely to remain in the program ($OR=1.73$, {1.02, 2.96}, $p=0.04$) (Francis et al., 2021). A recent systematic review had the same finding on the retention

of older patients (O'Connor et al., 2020; Proctor et al., 2022). Given these findings, it was necessary to investigate further the impact of age on treatment retention. Looking at the profile of OTP patients in this study, the prediction was that age does not significantly affect treatment retention.

Gender, being female predicted early treatment dropout (Lin et al., 2015). Contrasting findings indicate that the male gender predicts early dropout (Proctor et al., 2022). A meta-analysis, however, found similar treatment retention for all gender and racial/ethnic groups (Hochhemer & Unick, 2021). Given the conflicting findings from previous studies, this research predicted no significant difference between males and females.

Analytic strategy

The study employs several stages of analysis. The primary purpose of several steps is to investigate the relative impact of a biomarker such as cholesterol on treatment retention in an OTP clinic. Specifically, the analysis sought to find the relative effect of biomarker, treatment, and socio- demographic variables on the retention of patients in the OTP. Note that the first stage began with an exploration of the descriptive statistics of each of the variables. The second phase involved Pearson's correlation matrices exploring potential pair-wise relationships between continuous variables within the three conceptual models. Finally, the third phase involved using three logistic regression models. The logistic regressions tested whether the biomarker variable, treatment, and socio-demographic variable significantly explained variances in the retention of patients in the OTP clinic.

This research used a univariate analysis to provide descriptive statistics for all variables considered in the study. A multivariate analysis determined the strength, direction, and significance

of the association among independent variables with the dependent variable, treatment retention. Finally, the Pearson product-moment correction coefficient showed the relationship between continuous independent variables and the dependent variable.

In summary, this chapter discussed the dataset, study location, and the independent and dependent variables in the statistical analysis. This chapter likewise highlighted each domain's operationalization and rationale for variable selection. In addition, this chapter presented the prediction of the statistical outcome for each independent variable. Lastly, the chapter also highlights the analytical strategy employed to determine the impact of each variable on opioid use disorder treatment retention

Chapter 4: Results

This dissertation utilized the data set from a patient chart review. A total of 715 patient charts from between January 1, 2015, through December 31, 2017, were reviewed retrospectively for the 18- to 65-year-old group. The patient charts from the opioid treatment program clinic located in the Addiction Institute of Mount Sinai West made up the data set. The total number of charts represented all patient admission who were later categorized as retained and discharged in the program. Out of the 715 cases, 267 cases were selected in the analysis.

The primary goal of this study was to investigate the relative impact of the biomarker cholesterol on treatment retention in an opioid treatment program (OTP) clinic. Further, the study investigated the comorbidities, treatment factors, and sociodemographic variables that impact opioid abuse treatment retention. In other words, the study seeks to answer the question what was the relative impact of cholesterol on staying in a methadone clinic? Further, how did comorbidities and treatment factors as well as sociodemographic variables impact that relationship?

Three distinct phases were analyzed. To characterize the patient population in the data set, data analysis began with an exploration of the descriptive statistics of each of the variables. The second phase involved using the Pearson's correlation matrices to explore potential pair-wise relationships between continuous variables within the three conceptual models.

Note that for this study the three conceptual models or the domains of this study are as follows: Domain (1) Cholesterol as a Biomarker Factor; Domain (2) Comorbidities and Treatment Factors; Domain (3) Socio-demographic Factors.

Finally, the third phase involved using three logistic regression models to test whether biomarker variable, comorbidities and treatment variables, and socio-demographic variable significantly explained variances in the retention of patients in the opioid treatment program clinic. Regression analysis was performed for the entire patient population of the OTP clinic for a three- year period.

Univariate Analysis

Table 2 presents descriptive statistics of means, standard deviations, ranges, and description of variables used in this dissertation. With Table 2 as a reference, a summary of the univariate results for each of the variables is described in the subsequent subsections

Table 2. Means, Standard Deviations, Ranges and Description of Variables

Variable	N	Mean	S.D.	Range	Description: Variable NAME and Label
			Dependent Variable		
Retained	715	0.287	0.453	0-1	TXRET: Discharged patient is 0 and 1 for retained in treatment
			Independent Variables		
	Biomarker				
Cholesterol	269	178.96	42.85	79-314	BIOMARK: Cholesterol level of patients in mg/dl
	Treatment Factors				
Comorbidity	515	0.55	0.50	0-1	COMORB: Code 1 With Comorbidity and 0 Without
Methadone	715	0.71	0.453	0-1	METHADONE: Methadone is 1 and 0 for Buprenorphine treatment
Dosage	715	48.39	39.80	0-270	DOSAGE: Medication dosage in milligrams
	Socio-Demographic Factors				
Male	715	0.702	0.458	0-1	MALE: Code 1 for Male and Code 0 for females
Age	715	43.77	11.40	20-65	AGE: Discrete chronological age of patients
Black	715	0.152	0.360	0-1	ETHNICITY: Code 2 for African American
Latinx	715	0.313	0.464	0-1	ETHNICITY: Code 3 for Latinx
Asian	715	0.100	0.099	0-1	ETHNICITY: Code 4 for Asian

(Listwise N=267)

Dependent Variable: Retained

The dependent variable in this three-year longitudinal study was opioid abuse treatment retention (TXRET). The opioid abuse treatment retention period corresponded to whether the

patient stayed in the program from treatment induction until relapse or discharge from treatment or the time- to-dropout event variable. Operationally, the treatment retention period, in this case, is defined as continued participation in OTP. The code is 0 for those discharged and 1 for those who stayed in the opioid treatment program.

Table 2 presents the dependent variable as Retained with a variable name TXRET. As a dichotomous variable, the variable has a range of zero or one. The mean of 0.287 represents a proportion of patients retained in the opioid treatment program. Despite obtaining a standard deviation figure for the dependent variable, no consideration was given it since dichotomous variables do not represent a normal distribution.

Independent Variable: Biomarker

The total cholesterol level of patients at the OTP clinic represented the biomarker domain. The CHOLESTEROL variable name stood for the biomarker of patients categorized in the first domain. The patient's cholesterol level in mg/dl is the unit of measurement used in the study. For this study, the patient's total cholesterol level was the primary biomarker of interest to determine its impact on opioid treatment retention.

The patients' cholesterol level ranged from 79-314 mg/dl with a mean of 178.96 mg/dl. A cholesterol figure below 200 mg/dl indicates a healthy level (URMC, 2022). Further, the standard deviation of 42.85 suggests that the cholesterol values tend to cluster closer to the mean of the data set. Recall that the standard deviation measures the dispersion of a set of values (Merriam-Webster, 2022).

Independent Variables: Treatment Factors Comorbidity in Treatment Factor Domain

Medical comorbidities (MEDCOMORB) are co-existing medical diagnoses of patients. Code 1 = presence and Code 0 = absence of comorbid medical conditions such as hypertension, hyperlipidemia, hypercholesterolemia, diabetes mellitus, HIV/AIDS, and hepatitis C, among other medical comorbidities. Operationally, medical comorbidity was a disease existing simultaneously with another disease.

As a dichotomous variable, the number ranged from zero or one. The mean value for the medical comorbidities of patient in the study was 0.55. The 0.55 mean signified that over half of patient cases have co-occurring medical diagnoses. As a dichotomous variable, we did not make any reference to the standard deviation value.

Methadone in Treatment Factor Domain

Opioid Treatment Plan (OTPLAN) referred to opioid treatment of patients. The categorical code of One stood for methadone and Code Zero for buprenorphine. The comparative analysis of which opioid treatment plan worked better continued to focus on different treatment settings.

In Table 2, methadone is the opioid treatment plan in focus. The focus on methadone was reasonable given its dominance, in terms of prescription, in the medication-assisted treatment programs for opioid use disorder. In this study, OTPLAN is a dichotomous variable with Code One for methadone. A mean 0.71 for methadone indicated that almost three-quarters of patients were on methadone treatment.

Dosage in Treatment Factor Domain

Treatment dosage (DOSAGE) denoted a specific dosage of methadone and buprenorphine expressed in milligrams. Table 2 shows that the mean dosage among patients was 48.39 with a range of 0-270. On the other hand, the standard deviation for treatment dosage stood at 39.80 indicating a relatively low level of dispersion of dosage data in the data set.

Independent Variables: Socio-Demographic Variables

This study incorporated essential socio-demographic variables potentially affecting treatment retention. The socio-demographic variables included age, gender, and ethnicity or racial grouping. The following variable notations operationalized how socio-demographic variables impact treatment retention.

Gender denoted biological association among patients. In this study, the code for males was one and zero for females. Studies focusing on the impact of gender on opioid use treatment retention have been limited, as discussed earlier in the literature review. Gender (GENDER) denotes biological association among patients where males were coded as one and zero for females.

Age referred to the chronological age at the time of treatment program induction. The study treated age as a continuous variable. Ethnicity referred to specific cultural or racial groups identified by the patient. Code 1 = White, Code 2 = African American, Code 3 = Hispanic, Code 4 = Asian.

Ethnicity was a categorical variable dummied to three dummy variables with a reference variable. Most patients were males in the study location. A mean of 0.702 implies that almost three-quarter of the patients were males. On the other hand, the mean age of patients was 43.77

with a standard deviation of 11.40, indicating less dispersion of the chronological age among clinic clients.

With regards to ethnicity or racial groups, mean value for black ethnicity was 0.152 while that of Latinx was 0.313. What these values suggest is that 15.2 and 31.3 per cent of the sample identified as Black and Latinx ethnicity, respectively. A small number of Asians were in the treatment clinic with a proportion of one per cent (see Table 2).

For the second stage of the analysis, the relationship among variables was examined using correlation matrices. Table 3 exhibits the Pearson Correlations results, showing whether the continuous independent variables had a statistically significant association with the dependent variable Treatment Retention (TXRET). The statistical significance in this case was $p < 0.05$.

Table 3. Pearson's Correlations (Significance levels in parentheses)

Variables	**(1)**	**(2)**	**(3)**
(1) Cholesterol	1		
(2) Dosage	0.069 (0.262)	1	
(3) Age	0.114 (0.063)	-0.006 (0.918)	1

* $p \leq 0.05$

Across three variables, cholesterol level (CHOLESTEROL), treatment dosage (DOSAGE) and patient age (AGE), we found no statistical difference at $p < 0.05$. It was between cholesterol

level and age where we found the p value equal to 0.069 closely approaching 0.05. In this case, the relation between cholesterol and age was positive. A patient's cholesterol level increases with age.

With a p = 0.262, there was no statistically significant relationship between the two variables medication dosage (DOSAGE) and cholesterol level (CHOLESTEROL). There was a 0.21% chance of finding it statistically significant if the population correlation were zero. The same was true between treatment dosage (DOSAGE) and age (AGE). There was no statistically significant relationship between the DOSAGE and AGE. We note, however, that DOSAGE decreased with the increase in AGE.

Lastly, in the calculation of Pearson correlation, 267 valid cases were in the data set. Given the use of SPSS version 26.0, there was a pairwise deletion of missing values by default.

Multivariate Analysis

The multivariate analysis involved using three hierarchical logistic regression models to test whether biomarker variable, comorbidities and treatment variables, and socio-demographic variable significantly explain variances in the retention of patients in the opioid treatment program clinic. A total of three hierarchical logistic regression analysis was performed for the entire patient population of the OTP clinic on a three-year period. The three hierarchical logistic regression analyses correspond to the three domains in the study. Table 4 summarizes the result of the logistic regression analysis

Table 4. Logistic Regression Coefficients (Odds Ratio in parentheses) Predicting Patient Retention in Opioid Use Treatment Program (N=267)[a]

Variables	Model 1	Model 2	Model 3
Biomarker Variable			
Cholesterol	0.008* (1.008)	0.007* (1.007)	0.007* (1.007)
Treatment Variables			
Comorbidity	----	0.590 (1.804)	0.368 (1.445)
Methadone	---	0.009 (1.009)	-0.064 (0.938)
Dosage	---	0.012** (1.012)	0.013** (1.013)
Socio-Demographic Variables			
Male	---	---	-0.236 (0.790)
Age	---	---	0.001 (1.001)
Black	---	---	1.008* (2.741)
Latinx	---	---	0.371 (1.448)
Asian	---	---	21.645 (2.5×10^9)
Constant	-1.773*** (0.170)	-2.704*** (0.067)	-2.825*** (0.059)
χ^2 (df)	7.108** (1)	25.964*** (4)	39.143*** (9)
-2 Log likelihood	354.716	335.860	322.681
Nagelkerke R Square	0.035	0.125	0.184

[a] Information above is based on a listwise deletion of cases.
† $p \leq .1$ * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Model I: Biomarker Variable examined the relative impact of cholesterol level with opioid treatment retention. Recall that this study seeks to investigate the relative impact of a biomarker such as cholesterol on treatment retention in an OTP clinic. Based on the Roy Adaptation Model, a person's physiology is one of its adaptive modes (Roy, 2009). Physiological model and physical mode manifest themselves as the maintenance of physiologic integrity from the cellular level to organs and systems. The two modes are adaptive components that reflect a person's interaction with the environment to support bodily integrity. For this study, the patient's total cholesterol level was the biomarker of interest to determine its impact on opioid treatment retention. The cholesterol variable was examined while holding constant other factors known to impact opioid treatment retention.

Model II: Treatment variables suggested the impact of medical comorbidities (MEDCOMORB) on opioid treatment retention. Two additional treatment factors were the medications methadone and buprenorphine and their corresponding dosage. Model II combines the previous Model I biomarker variable, which is CHOLESTEROL. The variables MEDCOMORB, METHADONE, and DOSAGE in combination with CHOLESTEROL were examined while holding constant other factors known to impact opioid treatment retention.

Model III: Model III combines the socio-demographic variables GENDER, AGE, and ETHNICITY with the variables in Models I and Model II. CHOLESTEROL, MEDCOMORB, METHADONE, and DOSAGE were combined with the socio-demographic variable in the hierarchical logistic regression analysis. These variables were examined while holding constant other factors known to impact opioid treatment retention.

Analysis and Interpretation for all OTP Patients

Table 4 summarizes the logistic regression coefficients predicting patient retention in opioid use treatment program. The adjusted odds ratio was for each independent variable against the dependent variable. For the odds ratio, a 95 % confidence interval was set for the odd ratios. The analysis included 275 valid cases. Across the three domains from Model, I to Model III, I found that CHOLESTEROL was statistically significant in relation to opioid treatment retention (TXRET).

In the case of Model I, the overall statistical significance was calculated as $\chi^2 = 7.108$ with p= 0.008. The -2 Log likelihood of the Model was 354.716 with a corresponding Nagelkerke R square of 0.035. Model I explained approximately 3.5% of the variation in the dependent variable, opioid use treatment retention. The single variable, CHOLESTEROL, representing the biomarker, was statistically significant in relation to treatment retention with a p = 0.009.

Model II combines the previous Model I variable which is CHOLESTEROL representing the biomarker variable. Model II investigates the impact of medical comorbidities and two other treatment factors to opioid treatment retention. The other two treatment factors include: medication such as methadone and buprenorphine and their corresponding dosage.

From Model II, the overall significance of the model was calculated as $\chi^2 = 25.964$ with a corresponding p value < 0.001, indicating a goodness of fit for the model. Consistent with Model I, we found that CHOLESTEROL with p = 0.025, significantly affected treatment retention (TXRET). Except for methadone and medical comorbidities, the treatment dosage was statistically significant explanatory variables for treatment retention (TXRET). MEDCOMORB

had a p = 0.087 and medications had a p = 0.980. The medication dosage in the treatment program had p = 0.003 indicating statistical significance in treatment retention.

Note that in Model II, the -2 Log Likelihood improved from Model I. In Model I, the -2 Log Likelihood was 354.716. Model II presents a lower figure of 335.860. There was no general improvement in the model. Further in Table 3, the Nagelkerke R Square of Model II at 0.125 was an improvement from the 0.035 of Model I.

Model III further highlights the statistical significance of CHOLESTEROL as an explanatory variable to the dependent variable TXRET. CHOLESTEROL significantly affected the retention of patient in an opioid treatment program clinic, p = 0.026. The overall statistical significance calculation χ^2 = 39.143 with p < 0.001 indicated goodness of fit for Model III. The χ^2 = 39.143 also showed an improvement from the χ^2 = 7.108 in Model I and the χ^2 of 25.964 in Model II.

Likewise, there was a corresponding improvement in the -2 Log Likelihood value in Model III at 322.681. The -2 Log Likelihood value in Model III decreased from 354.716 in Model I and 335.860 in Model II. The Nagelkerke R Square in Model III improved to 0.184 in comparison to 0.035 and 0.125 in Models I and Model II, respectively.

Model III combined the socio-demographic variables GENDER, AGE, and ETHNICITY with the variables in Models I and Model II. Each of the independent variable such as CHOLESTEROL, MEDCOMORB, METHADONE and DOSAGE combined with the socio-demographic variable in performing the hierarchical logistic regression analysis.

Both CHOLESTEROL, p=0.026, and the treatment dosage (DOSAGE, p = 0.002) significantly affected treatment retention. In Model III, MEDCOMORB, p = 0.314 was not statistically significant nor was METHADONE, p = 0.863, representing the medications in an

opioid treatment program.

Further on Model III, we found that neither GENDER, $p = 0.421$, nor AGE, $p = 0.932$, were statistically significant as predictors of opioid treatment retention. Irrespective of gender and patient age, this study found no statistical significance in patient retention. With regards to racial groups, African Americans (BLACK, $p = 0.006$, $OR = 2.741$) were more likely to stay in treatment than their White, counterparts, the reference variable for patient ethnicity.

In summary, this study supported several significant predictors of retention in an opioid treatment program. As shown in this dissertation, three hierarchical regression models explored the relative impact of cholesterol, treatment factors, and socio-demographic factors on opioid treatment retention. The CHOLESTEROL variable was statistically significant across the three models.

Specifically, among the treatment factors, the treatment dosage (DOSAGE) positively affected patient retention in an OTP clinic. For both treatment and the socio-demographic domain the MEDCOMORB was not statistically significant.

The socio-demographic variables GENDER and AGE were not found statistically significant in predicting treatment retention. African Americans were more likely to stay in treatment than Whites. The likelihood of Latinx and Asians staying in treatment was not found statistically significant. The following chapter will examine the results of the hierarchical logistic regression analyses. The succeeding chapter discusses further the explanatory variables in the context of the theoretical framework and relevant literature in Chapter 2.

Chapter 5: Discussion

In this dissertation, the author utilized three hierarchical logistic regression analyses to explore the relative impact of cholesterol, treatment factors and socio-demographic factors on opioid treatment retention. The presentation of results in the preceding chapter indicates that cholesterol level, comorbidities, treatment factors, and socio-demographic variables were significant predictors of opioid treatment retention in a highly urbanized opioid treatment program clinic.

Domains

In this dissertation, the author examined the relative impact of several independent or explanatory variables based on a review of literature focusing on the barriers and facilitators of treatment retention in an opioid treatment program. There were three domain groups to categorize the independent variables: biomarker, treatment factors, and socio-demographic factors. The biomarker was total patient cholesterol level while medical comorbidities, medication, and treatment dosage represented treatment factors. In addition, gender, age, and racial grouping were the independent variables in the third domain of socio-demographic factors. This chapter presents the discussion on the most significant results of the analyses for each domain as they relate primarily to the literature review in chapter 2.

Biomarker Variable

Cholesterol Level. Across all three domains, from Model I to Model III, we find that cholesterol

levels are statistically significant in relation to opioid treatment retention. The three logistic regression model consistently show the positive impact of cholesterol level to retention in an OTP clinic. Chapter 2 notes that there is a dearth of literature investigating the effects of cholesterol level on opioid treatment retention. None of the studies in the review explored a biological marker as an explanatory factor associated with opioid abuse treatment retention. While the literature review presents little information on the relationship between treatment retention and cholesterol level, there are studies investigating the relationship between cholesterol levels and suicidal behavior (Reuter, Caldwell, & Basehore, 2017). Lower serum lipid levels also indicate a higher risk for suicidality (Gorwood, 2001; Reuter, Caldwell & Basehore, 2017; Seo, Patrick, & Kennealy, 2008; Wu et al., 2016).

In contrast, there are studies presenting no significant relationship between suicidality and cholesterol levels. Serum cholesterol levels has no association with suicidality in patients with psychiatric disorders such as schizophrenia, bipolar affective disorder, and major depressive disorder (Park et al., 2013; Pompili et al., 2010). Cholesterol levels do not predict suicide attempts in two different studies among patients with psychiatric illnesses (Fiedorowicz & Coryell, 2007; Papadopoulou et al., 2013).

For this study, the patient's total cholesterol level is the primary biomarker of interest in opioid treatment retention. The selection of cholesterol as a biomarker affecting opioid abuse treatment retention stems from the link between serotonin and its metabolite 5-hydroxyindoleacetic acid (5-HIAA) in emotion regulation and impulse control (Seo, Patrick, Kennealy, 2008). A study on biological markers for suicidal behavior in alcohol dependence (Gorwood, 2001) indicates that cholesterol level appears to impact 5-HIAA and the dopamine metabolite homovanillic acid (HVA). Given the close relation of serotonin and dopamine

systems at the neurophysiological level, changes in either system will alter the other (Reuter, Caldwell, & Basehore, 2017). It is on this premise that this study seeks to investigate the impact of cholesterol level on a patient's decision to stay in treatment for opioid use disorder.

Consistent with the prediction in chapter 3, cholesterol level positively influenced the patient retention in the opioid treatment program. Note that across three domains, this study presents significantly positive statistical and consistent results. Corresponding odds ratio and p-values for each model are Model I (OR 1.008, p = .009), Model II (OR 1.007, p = .025 and in Model III (OR 1.007, p = .007).

This study suggests that cholesterol level is a protective factor for opioid treatment retention. It is logical to assume that patients with comorbidities can access allied medical servicesat the opioid treatment program clinic. It therefore makes sense to remain in the opioid treatment program given the availability of complementary medical services in OTP clinics. As patients visit clinics regularly for opioid treatment, the patient can also consult a healthcare provider for wellness visit in the same clinic. Wellness visits involving chronic disease management can include monitoring the patient's lipid profile. The same visit can certainly include refilling appropriate medications to control hypercholesterolemia. In other words, the provision of clinical management services for chronic diseases co-occurring with opioid use disorder is important in preventing untimely patient discharge.

Treatment Variables

Medical Comorbidity

Medical comorbidity is another variable worth investigation. As noted in the literature review, patients with comorbid drug-induced psychoses or chronic pain diagnoses are more

likely to receive buprenorphine treatment (Murphy et al., 2014). Interestingly, HIV positivity in one study was a treatment facilitator (Callon et al., 2006). Two studies likewise showed that providing HIV specialty care was a treatment engagement facilitator (Harawa et al., 2017; Turner et al., 2005).

While earlier studies have found medical service integration with methadone treatment as a treatment retention factor, a French trial suggests otherwise. The French research (Carrieri et al., 2014) found no statistical difference in retention at 12 months (p =.13 at n=195). Likewise, a more extensive study in the US with a sample size of 316 found no difference in retention at 12 months, p= 0.96 (Brooner et al., 2013). However, a smaller study consisting of 94 respondents reported improved retention (p=0.05) at 20 weeks (about four and a half months) for both methadone and buprenorphine treatment groups (Miotto et al. 2012).

In contrast with prior predictions, this study does not support the finding that medical comorbidities positively impact opioid treatment retention as shown in Models II and III results. While the findings present otherwise, it is still logical to incorporate medical services in outpatient clinics. By doing so, patients are motivated to stay in the outpatient treatment program. This assumption is predicated on the integration of allied primary care services in its medication-assisted treatment for opioid use disorders in a highly urbanized setting, such as the Addiction Institute of Mount Sinai.

Model III likewise shows that medical comorbidity has no statistical significance when combined with socio-demographic variables. In Model III, the corresponding odds ratio and p-value are OR 1.445, p = .314.

Findings differ from the French research (Carrieri et al., 2014), which took place over 12 months with a sample, n = 195. A similar study in the United States (Samples et al., 2018) was a

retrospective longitudinal three-year study with n= 17,329 respondents with buprenorphine medication only. The two studies differ significantly with this retrospective investigation in terms of sample size and methodology. This study had 275 valid patient cases that were followed within a three-year period, and they encompassed both methadone and buprenorphine.

Opioid Treatment Plan

The inclusion of methadone and buprenorphine opioid treatment plans is justified by the need to further investigate which medication improves treatment retention. Note that addiction science literature presents contrasting results. In recent research, among 267 patients with medical toxicology consults on opioid use disorder, methadone was associated with a statistically significant increased probability of retention in outpatient treatment compared to buprenorphine, $p = 0.01$ (Kessler, Schwarz, & Liss, 2022). The same finding confirms a multisite trial that concluded the provision of methadone is associated with better retention in treatment for opioid dependence than buprenorphine (Hser et al., 2014).

Ease of buprenorphine administration, favorable patient outcomes, social services, and harm reduction philosophy are positive enablers (Barry et al., 2008; Gordon et al., 2011; McMurphy et al., 2006; Teruya et al., 2014; Thomas et al., 2008). Complementing the medication for opioid treatment, the availability of urine drug screens is likewise shown as another positive enabler for clinicians to accommodate new patients, particularly in the Veterans Administration health system (Gordon et al., 2011).

Consistent with predictions, this study finds no statistical significance between methadone and buprenorphine on the medication use for opioid use disorder treatment retention. For both Models II and Model III, the opioid treatment plan with a variable name,

METHADONE, the p- values were 0.980 and 0.863, respectively. This study differs from two studies (Hser et al., 2014; Kessler, Schwarz, and Liss, 2022) in terms of design and sample size. Both studies use the Cox proportional hazards in data analysis. The first study has 152 respondents in one while the latter is a multi-site study involving 1,267 individuals randomized in nine different locations.

Finding no significant difference between buprenorphine and methadone on treatment retention is important in two aspects. The finding offers both patients and healthcare professionals the reassurance that both are effective in treatment retention. Therefore, there are no discernible differences in using methadone or buprenorphine. Note that the Food and Drug Administration equally recommends both medications for medication-assisted treatment (Azhar, Chockalingam, & Azhar, 2020).

Treatment Dosage

Consistent with predictions, this study confirmed prior findings that treatment dosage positively affects treatment retention. Adequate dosing of medications for opioid use disorder led to improved treatment retention (Biondi et al., 2022). Lower medication doses led to higher dropouts (Hser et al., 2022). Reduced retention with lower methadone doses is the main finding from among patients in opioid substitution treatment (Lin et al., 2015; O'Connor et al., 2020).

This study and Biondi and colleagues' study of 118 participants (2022) both used logistic regression in analyzing data. On the other hand, the finding that lower medication doses lead to higher dropouts (Proctor et al., 2022) used survival analysis on the data of 267 patients. The findings of this study further amplify the finding that there is a positive impact from higher treatment doses, regardless of the prescribed medication for opioid substitution.

Socio-Demographic Variables

Age, Gender, and Ethnicity

This study incorporates essential socio-demographic variables – age, gender, and ethnicity or racial grouping – potentially affecting treatment retention. The following section highlights the discussion of findings resulting from the hierarchical logistic regression on the third domain of this study. Note that Model III incorporates the biomarker, treatment and socio-demographic variables into one domain.

Consistent with my earlier prediction in chapter 3, this study found that age does not significantly affect treatment retention, $p = .932$. Recent studies offer conflicting findings. Younger age predicts premature discharge from the opioid treatment program (Francis et al., 2021; Proctor et al., 2022). A systematic review likewise supports the finding that age negatively impacts opioid treatment retention (O'Connor et al., 2020).

An integrative review of literature further indicates that adults are more likely to continue with opioid treatment in Vancouver, Canada (n=438, mean age of 44) (Hayashi et al., 2016) and Massachusetts (Alford et al., 2011). The Canadian and Massachusetts studies used mixed method design and logistic regression, respectively. A study conducted in Sweden using Poisson regression indicated a similar trend that younger age (Median age =33; $p<0.05$) predicts discharge from treatment (Davstad et al., 2007). Similar findings show that older employed persons and those that use illicit buprenorphine have higher odds of treatment success (OR= 1.40, $p<.01$; OR=2.24, $p<.01$; OR=3.01, $p<.01$) (Alford et al., 2011).

On the assumption that an outpatient opioid treatment program provides inclusive and culturally sensitive patient care, treatment retention need not differ across the lifespan. This study supports the finding that age need not be a significant barrier to treatment retention.

An integrative review of literature indicates that gender matters in treatment retention. Being female predicts early treatment dropout (Lin et al., 2015). Contrasting findings indicate that the male gender predicts early dropout (Proctor et al., 2022). In a study among black individuals, the results disclose that age does not significantly impact treatment retention outcome, n=98, p = .941.

The same study used multivariate logistic and linear regression (Parlier-Ahmad, Pugh, & Martin, 2021). A meta-analysis of 19 articles, however, found similar treatment retention for all gender and racial/ethnic groups (Hochhemer & Unick, 2021).

Ethnicity is another socio-demographic variable of interest. Limited studies exist regarding racial and ethnic groupings on treatment retention. The literature review chapter shows that only one study examined the impact of ethnic subgroups on opioid treatment. African American or Hispanic race had lower odds of treatment success (Alford et al., 2011) (n=382, OR=0.45, $p<0.05$). Treatment retention in a methadone maintenance program for those of Hispanic ethnicity predicts premature discharge (Proctor et al., 2022). Lower retention is not only limited to Hispanic groups but also the Black population (Stahler & Mennis, 2018; Weinstein et al., 2017). A smaller data set, n=98, using logistic and linear regression indicated otherwise. Black adults receiving buprenorphine demonstrated positive retention outcomes where 66 per cent remained in treatment (Parlier-Ahmad, Pugh, & Martin, 2021).

Ethnicity

In contrast, medications for opioid use disorder treatment in a residential setting enhanced the retention of Blacks. Blacks (OR = 1.144) and Hispanics (OR = 1.234) as opposed to the White group (Stahler, Mennis, & Baron, 2021). This study supports the similar finding that

Black individuals are more likely to remain in treatment than Whites or Asians (OR = 2.741, p = .006). The findings of this study are consistent with the prediction that African Americans have higher odds of retention in opioid use disorder treatment.

Theoretical Discussion

In this dissertation, the author examines specific factors associated with opioid use disorder treatment retention among adults in an OTP clinic. Specifically, the study aimed to validate the previous analysis on the factors associated with opioid abuse treatment retention and expand the science in opioid abuse treatment retention. By incorporating predictive models that explore other predictive variables using the Roy Adaptation Model, the study investigated whether a biomarker affects treatment retention and other factors associated with opioid abuse treatment retention.

The Roy Adaptation Model (RAM) shown in Figure 2 served as the theoretical framework on the research mitigating the opioid crisis. With the use of the RAM this study seeks to advance the science of opioid abuse treatment retention. Given RAM's central feature on adaptation, it is an appropriate framework to study the adaptation among the opioid-dependent adult population that continually responds and interacts with the external and internal environments.

The study provided results on the impact of cholesterol levels, treatment factors and socio- demographic factors that impact opioid use treatment retention. Further, this study sought to validate previous analysis on the factors associated with opioid use disorder treatment retention.

In summary, the goal of this study is to investigate the relative impact of a biomarker

such as cholesterol on treatment retention in an opioid treatment program clinic. Further, the study investigates the comorbidities and treatment factors well as sociodemographic variables impact opioid abuse treatment retention. In other words, the study seeks to answer the question what is the relative impact of cholesterol on staying in a methadone clinic? Further, how do comorbidities, treatment factors, and sociodemographic variables impact that relationship?

This study finds that cholesterol affects positively and significantly opioid treatment retention across three domains. As a stand-alone independent variable in the biomarker domain, Model I, cholesterol level positively impacts treatment retention. An increase in cholesterol level of patients, similarly, results to an increase in treatment retention.

In the treatment factor domain, Model II, the total cholesterol level, along with medication dosage, continues to support a significantly positive relation to the dependent variable, treatment retention. This study confirms prior studies that show higher dosages for methadone and buprenorphine positively impacts treatment retention.

The medical comorbidities and the opioid treatment plan, however, were not statistically significant in the treatment factor domain. Regardless of using methadone or buprenorphine, the opioid treatment plan or its modality is not statistically significant. The same is true in the socio-demographic domain in Model III where the biomarker and treatment factor variables are integrated.

Further, with the third domain's socio-demographic variables, medical comorbidities likewise cease to be statistically significant. Cholesterol level, on the other hand, remains a positive predictor of treatment retention in opioid abuse treatment. Age and gender are not statistically significant in predicting treatment retention. With regards to ethnicity, this study unequivocally supports that Blacks stay in treatment more than their White counterparts at the

study location.

The following chapter of this dissertation explores the implications of the research findings in clinical practice and health policy. The concluding chapter likewise presents the limitations of this study and suggestions for further research.

Chapter 6: Conclusion

The topic of this dissertation examined the relative impact of several independent or explanatory variables based on a review of the literature that focuses on the barriers and facilitators of treatment retention in an opioid treatment program. In chapter 5, the discussion focused on the explanatory variables in the context of the literature review and the Roy Adaptation Model (RAM) as the theoretical framework for this study. The following chapter of this dissertation explored the implications of the research findings among patients, healthcare professionals, and health policy. The concluding chapter likewise presented the limitations of this study and suggestions for further research.

The study investigated the relative impact of the biomarker cholesterol on treatment retention in an opioid treatment program (OTP) clinic. Further, the study examined the medical comorbidities, treatment factors, and socio-demographic variables that impact opioid abuse treatment retention. In other words, the study asked, what is the relative impact of cholesterol on staying in a methadone clinic? Further, how do comorbidities, treatment factors, and socio-demographic variables affect methadone clinic retention?

Limitations of the Study

Despite the impact of cholesterol level, treatment factors, and socio-demographic factors on treatment retention, there are limitations to this study's generalizability. These include methodological and data set limitations and data timeliness.

Methodological Limitations

This study's data analysis is primarily quantitative. Discrete and categorical values for treatment retention, cholesterol biomarker, treatment factors, and socio-demographic factors are its primary data. The study's design, however, did not incorporate participant feelings or direct thoughts on treatment retention. Qualitative studies can probe patient perspectives and ideas on treatment retention. Further, a qualitative study provides a deeper understanding of patient preferences. Despite this limitation, a quantitative analysis allows predictions on how the cholesterol biomarker impacts treatment retention. The same is true with the impact of treatment and socio-demographic factors on opioid abuse treatment retention.

The limited number of cases in the logistic regression analyses are another limitation. Given the three years of patient data from January 1, 2015, to December 31, 2017, the review is comprised of 735 records. There were, however, 460 instances of missing data, reducing the number of cases for logistic regression. Missing values were primarily due to unavailable total cholesterol data over the same period. Having more data in a hierarchical logistic regression analysis is highly desirable.

Whenever possible, more data and more cases in a data set are preferable. With more data, the confidence in an estimated increase allows greater precision on the exact estimate (Littler, S., 2022). While there is a reduction in the number of cases for logistic regression in this study, the listwise deletion in the SPSS program offers objective management of the missing data.

Another limitation is the limited number of independent variables. Including relevant independent variables affords a deeper understanding of the phenomena under investigation. In this study, there are seven independent variables. For the biomarker domain, there was one

variable which was the total cholesterol level of the patient. The treatment factor domain has three: medical comorbidities, opioid treatment plan, and the corresponding dosage. There were also three variables in the socio-demographic factors: gender, age, and ethnicity or racial grouping. Addressing the limited number of independent variables is essential to capture the impact of other relevant social determinants in treatment retention. Additional socio-demographic factors can provide a more representative picture of treatment retention factors.

An essential aspect of this study is the inclusion of medical comorbidities as an explanatory variable of treatment retention. The study captures the presence or absence of medical comorbidities in the final cases for hierarchical logistic regression analyses. The study, however, does not control for psychiatric comorbidities. Iindividuals with opioid use disorder have co-occurring psychiatric comorbidities; therefore, it makes sense in future studies to control for psychiatric comorbidities. By doing so, a quantitative study that controls for psychiatric comorbidities can provide a deeper understanding of the interplay of patients' comorbidities from a medical standpoint and for psychiatric and behavioral factors.

Data Set Limitations

This study exclusively utilizes quantitative data, calculating the statistical significance of each independent variable. The quantitative data do not, however, capture exactly why the predictor impacts a positive or negative treatment retention outcome.

In addition, the data set solely comes from a single site in a highly urbanized metropolitan area, New York City. The data set provides no comparative data for another location within or outside New York City. Data across the state or a cross-national data set can provide a deeper understanding of the phenomenon of opioid treatment retention. Time and

logistical constraints preclude this study from covering a comparative approach in quantitative data analysis.

The data set is primarily cross-sectional. While the data set covers three years from 2015-2017, a cross-sectional snapshot describes only the study's independent and dependent variables. A longitudinal study gathers data for a specific independent variable over time (IWH, 2015). As an illustration, longitudinal research captures changes in total cholesterol level data in a period for the same cohort of patients. Despite the limitation, the cross-sectional data set describes population characteristics at a specific time. In this case, the data set enables a study to determine statistically significant factors affecting opioid use treatment retention from 2015 to 2017.

Patient gender in this study is limited to male and female categories. There is no representation for other gender categories, such as non-binary. Notwithstanding the intent to include more representative gender categories, the available data set is limited to cisgender types. The gender identity data in this study reflect only biological sex at birth. Given the diversity of gender representation in the present context, it is critical to include a more diverse gender identification in future studies. Future studies should incorporate more inclusive data from different gender categories.

Timeliness of Data

While the data set provides patient characteristics from January 1, 2015, to December 31, 2017, the period covers pre-pandemic information. The data also provide a cross-sectional snapshot of patient characteristics at a given time. The data snapshot did not cover the outbreak of Covid-19, which may have affected patient characteristics and attributes. It is therefore essential to highlight differences in patient behavior in a pandemic. Capturing the interplay of

patient behavior within a pandemic clarifies how treatment and socio-demographic factors affect treatment retention. Despite such limitations, the data set could still identify statistically significant factors affecting opioid abuse treatment retention.

Implications of the Study

The study's findings contribute to the theory that physiological biomarkers, treatment, and socio-demographic factors impact the retention of patients in an opioid abuse treatment program. Further, the results of this research provide essential information in keeping patients in treatment that lowers the mortality from an opioid overdose. The study has significant implications for the patient, healthcare provider, and health policy levels.

Patient-Level Implications

To increase patient awareness of the importance of cholesterol levels for their healthy being and continuing opioid substitute maintenance, there are several steps patients can adopt to increase their likelihood of retention in the program:

1. Know their lipid profile, which includes their total cholesterol level information.
2. Knowing their lipid profile allows patients to examine themselves for cardiovascular disease risk.
3. Consult with clinic providers about the appropriate prescription to prevent cardiovascular complications. Given a knowledge of their lipid profile, health-seeking behavior can benefit from consultation with the medical provider on the appropriate regimen to manage the existing hypercholesterolemia.
4. Keep regular clinic appointments for methadone or buprenorphine maintenance,

wellness checks, and compliance with clinic protocols. The integrated provision of medical services and medication-assisted treatment for opioid use can motivate patients to stay in treatment. Patient retention is encouraged not only for opioid use treatments but also for hypercholesterolemia.

5. Adhere to individual treatment plans for opioid substitution and total physical wellness that includes management of medical comorbidities such as hypercholesterolemia, hypertension, and related chronic ailments. In conjunction with Item 2, patients are encouraged to remain in treatment at the clinic since the clinic provides integrated medical services. Receiving attention for other co-occurring diseases results in good treatment retention.
6. Maintain open communications with clinic staff, including physicians, nurse practitioners, registered nurses, and addiction counselors; as patients engage with clinic staff, improved rapport results in a better understanding of patient conditions. With improved communications, patients are more likely to stay in treatment at the OTP clinic.

Healthcare Professionals and Patient Retention Implications

Healthcare providers provide a critical link among patients, which spells a substantial difference in patient adherence. Among other measures, healthcare professionals can initiate the following to increase the likelihood of patient retention:

1. Adopt a new indicator for patient screening and assessment, such as monitoring patients' total cholesterol levels. Given the study results on the significant impact of cholesterol levels on patient retention, healthcare providers should recognize the

critical support and provision of medical services in helping manage chronic patient ailments in OTP clinics. Adopting cholesterol levels in patient screening and assessment is a cost-effective strategy for keeping patients in treatment. The positive impact of the same screening indicator can extend to reducing mortality from an opioid overdose.

2. Enhancement of healthcare provider pre-service and in-service training. Aside from awareness of cholesterol screening, the inclusion of cultural sensitivity training in pre- and in-service seminar workshops can foster an inclusive environment in the OTP clinic. Given the diverse background of patients in an OTP clinic, the promotion of cultural sensitivity training can make a difference in retaining patients. A deeper understanding of patients' cultural backgrounds can reduce misconceptions among patients and healthcare providers. With deeper understanding, avoiding miscommunications leads to improved patient satisfaction and longer patient retention in treatment.
3. Professional development training – Aside from pre-service and in-service training, clinical assessment improvement is possible among healthcare providers who lead a team of medication-assisted treatment programs. Physicians, nurses, social workers, counselors, and therapists need awareness of appropriate engagement to enhance patient experience and overall satisfaction. When positive and inclusive approaches are incorporated, underrepresented minorities will stay in treatment at OTP clinics.

Health Policy Implications

As evidenced by the study's findings, state and federal agencies need to support full

reimbursement of comprehensive treatment for OTP clinic services. Aside from dispensing methadone or buprenorphine, appropriate payment for quality treatment, counseling, and chronic disease management at the OTP clinic level needs critical support. Note that the minorities are staying longer in medicine at the OTP clinic study area. Following the model OTP clinic of the Addiction Institute of Mount Sinai at the Mount Sinai West Hospital Center, state and federal policymakers should support holistic comprehensive services, as follows:

1. Group and peer counseling. Recovery involves meeting with peers in a therapeutic milieu such as group and peer counseling. Meeting in groups provides essential pointers for patients to stay on track with their recovery and subsequent retention at the clinic. Therefore, group and peer counseling must be in an OTP clinic that provides a holistic set of services.
2. One-on-one therapy. Not all individuals respond well to group therapy. Confidential therapy sessions promote a better understanding of individual patient conditions. A customized treatment plan can improve patient outcomes when individual patient conditions are known.
3. Case management. Case management not only provides proper care at a particular time. It also affords appropriate referral to resources that a patient needs to meet positive patient outcomes. Case management, therefore, needs a continuous presence in an OTP clinic to advocate for needed medical and community services.
4. Educational and vocational counseling. Patient retention improves with constructive counseling services. Interactive sessions on available resources and community services navigation provide incentives for patients to stay in treatment in a particular OTP clinic. Informative sessions on occupational training further enhance patient

engagement in the clinic. More importantly, when educational and vocational counseling is available, patients are more likely to stay in the clinic since they see it as a vital resource for continuing education and vocational opportunity.

5. Annual physicals. Providing annual physicals motivates patients to stay in treatment at the OTP clinic. Annual physicals afford screening and prevention of emerging health problems. For patients who exhibit health-seeking behavior, such as seeking medication-assisted treatment for opioid use, the annual physicals provide an incentive for patients to stay in treatment in an OTP clinic.
6. General medical care. Patients with opioid use disorder suffer from other co-occurring medical conditions. Therefore, an OTP clinic must provide general medical care to its patients. Providing general medical care in an OTP clinic makes precise chronic disease management accessible to all patients. With improved access to general medical care, patients are more likely to stay in treatment at the same OTP clinic.
7. Art therapy. Patients are more likely to stay engaged when there are activities in their clinic. Creative expression among patients can reduce anxiety and harmful cravings. The provision of art therapy as patient engagement can motivate patients to stay connected with the OTP clinic and staff. With increasing engagement, patients are more likely to stay longer in treatment.
8. Psychiatric evaluation and medication management. Patients with opioid use disorder cope with anxiety, depression, and other mental illness while managing their addiction. Providing psychiatric evaluation services from a qualified professional can motivate patients to continue treatment at the clinic. As the patient continues to seek treatment for behavioral problems and medication management, the patient continues

to stay in treatment at the OTP clinic.

9. HIV counseling and testing. Confidential testing for HIV and appropriate counseling builds trust and confidence between patients and healthcare providers in an OTP clinic. Given the vulnerability of patients with opioid use disorder to HIV infection, patients are more likely to stay in treatment if OTP clinic have HIV testing and counselors with suitable training.
10. Hepatitis C testing and telemedicine. The provision of hepatitis C testing provides another incentive for patients to remain in treatment at the OTP clinic. With the inherent risk for hepatitis C infection among those with opioid use disorder, the availability of testing and flexible telemedicine appointments is another reason for patients to stay in treatment. As the patient moves toward health-seeking behavior, diagnostic testing coupled with offsite healthcare visits can mean a difference among patients who demand flexibility in attending to their medical needs. Flexibility from telemedicine offers convenience and prevents exposure among patients and healthcare providers to infectious diseases.
11. Women-only clinics. The provision of gender-sensitive clinic hours encourages the retention of patients. Patients are more comfortable with healthcare providers with whom they identify and with whom they can confide privately.

Recommendations and Future Research

Notwithstanding this study's limitations, future studies can address gaps in current research. A multi-site study can focus on a larger number of patients. A diverse number of cases can provide reliability and higher statistical power. Multi-site studies offer a better perspective

on patient care systems and procedures. Indeed, sites across states or cross-national levels can provide a comprehensive description of factors affecting treatment retention across regions.

In addition, a longitudinal study complementing multi-site research can better understand specific patient characteristics over time. Over time, data gathering of cholesterol levels in a longitudinal survey addresses the limitation of a cross-sectional investigation. Further, on the design of the longitudinal study, it is essential to include the following:

Broader gender category inclusion such as transgender or non-binary individuals. More comprehensive gender identification can provide better insight into variations among patients who identify differently from their biological identities.

Addition of other independent variables representing relevant social determinants such as housing, patient payment plans, or insurance coverage,

Control for psychiatric comorbidities. This study captures the presence or absence of medical comorbidities in the final cases for hierarchical logistic regression analyses. A better understanding of opioid treatment retention can certainly result when a future study includes psychiatric comorbidities as explanatory variables.

Qualitative research complementing a multi-site longitudinal study can address the whys of treatment retention. Discrete and categorical values for treatment retention, cholesterol biomarker, treatment factors, and socio-demographic factors are the primary data of this study. With the description of direct participants and their feelings, a mixed-method, or a stand-alone qualitative study can certainly disclose the themes and topics of opioid use disorder treatment retention.

Epilogue

The 2021 Morbidity and Mortality Report from the Centers for Disease Prevention and Control indicates a worsening trend in overdose deaths, increasing by 30% from 2019 to 2020 (Kariisa et al., 2022). In addition, the same report highlights that health disparities in overdose rates continue to worsen among Black and American Indians/Alaska Natives, where the respective death rates were 44% and 39%. The trend is worrisome and suggests that the war on the opioid epidemic is far from over.

The troubling situation indicates the need to adopt viable screening tools to help retain patients in treatment for opioid use disorder. The promise of biomarkers such as cholesterol needs further exploration at the clinical practice level. Given the study findings, patients, healthcare providers, and policymakers need to address the necessary steps to increase the likelihood of treatment retention. At all levels, the goal of patient retention as a concrete measure of lowering mortality from opioid overdose needs to guide clinical practice and policy interventions. A step toward treatment retention can start with adopting cholesterol screening among patients on treatment with opioid use disorder.

What is the clinical relevance of total cholesterol level in opioid use disorder treatment retention? From the healthcare providers' perspective, the total cholesterol level becomes a potent talking point among patients in an opioid treatment program (OTP) clinic. Knowing that total cholesterol level is another screening tool for potential patient retention, the healthcare provider can initiate appropriate dialogue and client teaching among those interested in maintaining healthy cholesterol levels. For those with high cholesterol levels, the healthcare provider can offer allied clinical services promoting wellness among patients and cardiovascular

health in conjunction with adaptation to methadone or buprenorphine maintenance. Regular wellness checks and prescription refills for hypercholesterolemia can initiate better rapport between patients and clinicians. As a result, improved communication between patients and healthcare providers improves client satisfaction, achieving the desired outcome of treatment retention.

Even among patients with low cholesterol levels, the healthcare provider can initiate appropriate patient engagement to establish strong communication lines with patients. Knowing that patients with low cholesterol levels are at risk of dropping out, the OTP clinic team can devise relevant patient education sessions on the importance of maintaining cardiovascular health. Again, patient engagement through client education improves rapport between patients and clinicians. Improved communication results in higher client satisfaction that positively impacts treatment retention.

While this study highlights several factors affecting opioid use disorder treatment retention, there is a need to add more independent variables. Note that the Nagelkerke R square in Model III is 0.184. Given the low value, future research needs to add more independent variables in a hierarchical regression model. The variables can include patient body mass index (BMI), housing status, employment status, educational attainment, incarceration history, and health insurance access.

Body mass index is another biomarker candidate worth adding as an independent variable. Body mass index is a measure that uses a person's height and weight to determine if weight is healthy (NHS, 2019). Analogous to total cholesterol level, when found statistically significant, the BMI is another potent talking point among patients to establish and strengthen the rapport between healthcare providers and patients. When a health-seeking patient realizes

the importance of maintaining a healthy BMI, a positive dialogue can result in a potential outcome of retaining patients in an OTP clinic.

Housing status is another crucial independent variable worth adding that is an essential social determinant of health. An investigator can deduce that patients with stable housing are more likely to stay in a treatment program. Program administrators of medication-assisted treatment programs can easily track patients with stable housing conditions. A qualitative study indicates that structured residential facilities facilitate opioid abuse treatment retention (Harawa, Amani, Bowers, Sayles, & Cunningham, 2017). Finding out housing status impacts treatment retention is another phenomenon worth investigating.

Employment status is another variable for inclusion. An investigator can predict that those who are gainfully employed are more likely to stay in a treatment program than those unemployed. Note that in the United States, those who are employed are likely to have health insurance coverage. With health insurance coverage, patients can access services in an OTP clinic.

Educational attainment is another candidate variable for inclusion in future research. A recent study investigating educational attainment's effects on treatment retention point to a negative association with treatment retention (Parlier-Ahmad, Radic, Svikis, & Martin, 2022). As an important social determinant of health, education and related health literacy need investigation on its effect on opioid use disorder treatment retention. Sustained participation in treatment hinges on patients' understanding of their health and the appropriate interventions to keep them on track to wellness.

Incarceration is another variable worth investigating. Patient incarceration is a barrier to sustained treatment engagement (Hayashi, Ti, Ayutthaya, Suwannong, Kaplan, Small & Kerr,

2017; & Russell, Pang, Nafeh, et al., 2022). Given the risks of justice system involvement by patients in an OTP clinic, it is essential to study the impact of incarceration in specific OTP locations. Disruptions from arrests and incarcerations can negatively influence participation in a medication-assisted treatment program. Thus, including incarceration data as an independent variable is a must to understand the phenomenon of treatment retention.

Another variable for inclusion is the patient's health insurance access. As previously cited in the literature review, insurance coverage is a limiting barrier (St. Marie, 2016; Murphy et al., 2014). Regarding insurance or patient payment plans, individuals treated with buprenorphine were less likely insured in a commercial insurance plan or Medicaid (61% compared to 73% among non-buprenorphine consumers) (Murphy et al., 2014). However, it is not clear how types of insurance were associated with opioid treatment. In the same study by Murphy and colleagues (2014), a non-restrictive insurance plan had higher odds of facilitating opioid abuse treatment. Given these findings, it is imperative to investigate the effect of health insurance coverage or payment method in an OTP clinic.

Further on variables and the data set, it is vital to deal with missing data. The study limitation cites the limited number of cases in the hierarchical regression model. In this study, there was a reduction from 715 to 267 cases. The limitation traces the decline from incomplete and missing patient data. Future research can lessen the impact of missing data by employing multiple data imputation methods in SPSS. The purpose of multiple data imputation is to generate data sets for the missing values (IBM, 2022). Multiple imputations are considered a robust replacement for missing data (Papageourgiou, 2018). Note that there are multiple ways of dealing with missing values in a data set. Other methods include meaning, median, mode; linear interpolation; time-series specific method; and linear regression (Swalin, 2018).

Health disparities in overdose rates among Blacks, American Indians, and Alaska Natives call for a more inclusive approach to medication-assisted treatments. Social determinants of health access need aggressive action to reverse the tide of the opioid epidemic among the vulnerable population in the United States. It is crucial to relate the findings of this study to the troubling figures on overdose deaths among the Black population. In this study, Black individuals are more likely to remain in treatment than Whites or Asians. What this finding suggests is that when an inclusive and integrated health service provision is present in an OTP clinic, it is more likely that Black individuals remain in treatment. Treatment retention, in this case, is a desirable precondition to help lower overdose deaths. Overall, future research needs to understand better the barriers to treatment and the factors affecting the retention of patients in an opioid use disorder treatment program.

In this dissertation, the study underscores the importance of a nursing theory as a guiding compass, a GPS, in public health nursing research. Based on the Roy Adaptation Model (RAM), a person's physiology is one of its adaptive modes (Roy, 2009). The physiologic mode manifests the maintenance of physiologic integrity from the cellular to the organ and systems level. The physiologic mode is an adaptive component that reflects a person's interaction with the environment to support bodily integrity. For this study, the patient's total cholesterol level is the primary biomarker of interest in determining its impact on opioid treatment retention. With RAM in this study as a theoretical framework, an obscure biomarker such as cholesterol gained prominence as a screening tool for treatment retention among patients with opioid use disorder. This study supports the extensive use of nursing theories with models such as RAM to generate new knowledge in improving health outcomes, promoting inclusion and equity, and reversing health disparities.

To help vulnerable populations, it is essential to look at them wholistically or holistically. Note that this discussion uses the holistic view. Holistic refers to integrated whole-person nursing care (ANA & AHNA, 2013). Holding a holistic perspective in mitigating the opioid overdose epidemic is critical to understanding the interaction and interdependence of other factors affecting opioid use disorder treatment retention (Schoonover-Shoffner, 2013). This study's findings support the statistical significance of cholesterol level, treatment dosage, and ethnicity with treatment retention. However, an investigator needs to understand and view a bigger picture of the patient and the surrounding human adaptive systems (Roy, 2009). Failing to view the opioid overdose epidemic holistically results in myopic policy and clinical interventions.

The worsening health disparities and escalating mortality from opioid overdose signify a call to action. The expansion of medication-assisted treatment among vulnerable populations must accelerate while addressing social determinants of health to improve access to integrated health services. The time to act is NOW

Appendix Tables and Figures

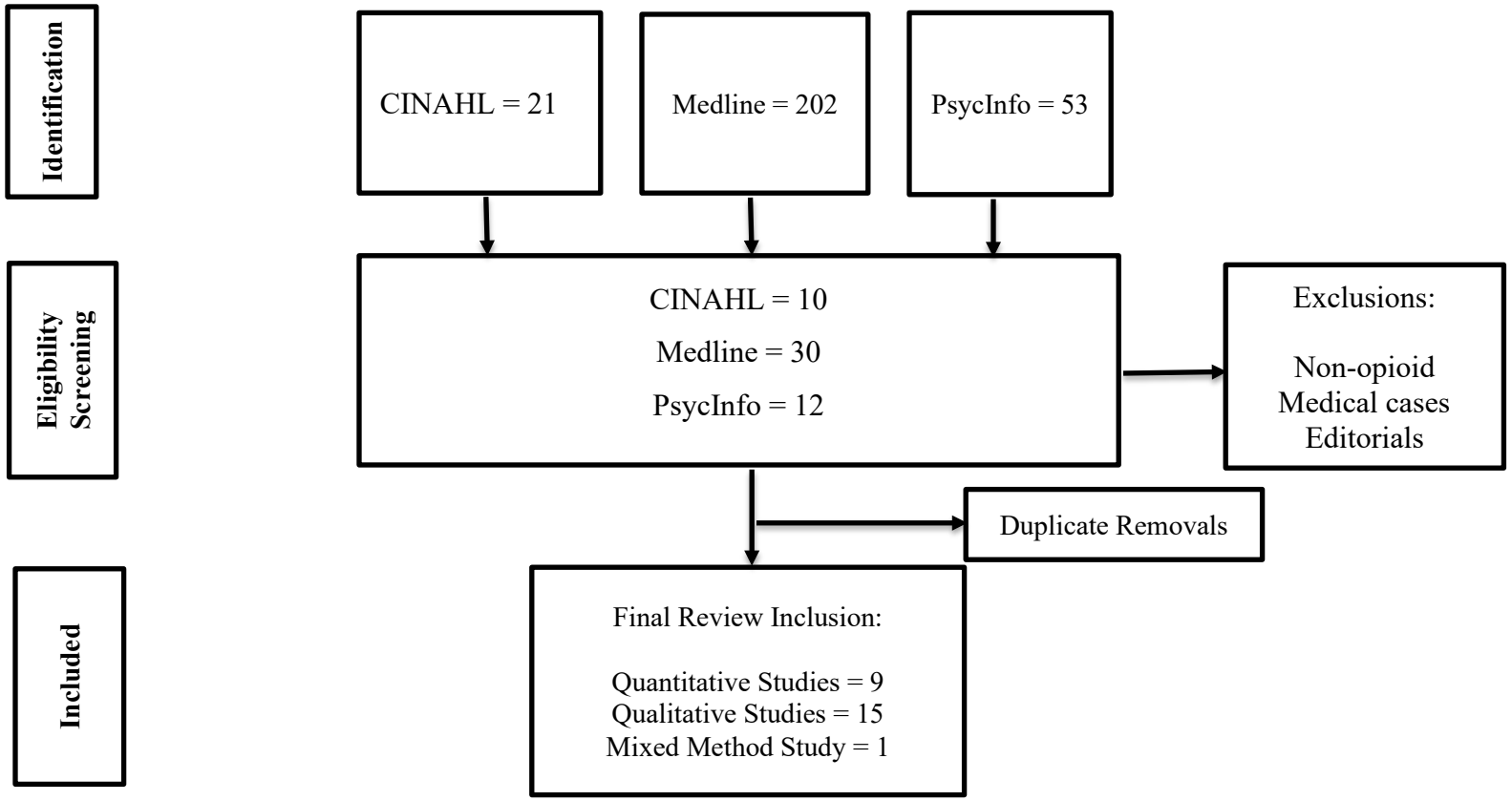
Appendix Table 1. Summary Quantitative studies and critical appraisal checklist (Bowling, 2002)

Criteria	Yes	No
1. Are the aims and objectives of the study clearly stated?	10	0
2. Are the hypotheses and research questions clearly	8	2
3. Are the dependent and independent variables clearly	8	2
4. Have the variables been adequately operationalized?	10	0
5. Is the design of the study adequately described?	10	0
6. Are the research methods appropriate?	10	0
7. Were the instruments used appropriate and adequately	9	1
8. Is there an adequate description of the source of the	10	0
sample, inclusion and exclusion criteria, response rates, and		
(in the case of longitudinal research and post-test in		
9. Was the statistical power of the study to detect or reject	8	2
differences (types I and II error) discussed critically?		
10. Are ethical considerations presented?	10	0
11. Was the study piloted?	2	8
12. Were the statistical analyses appropriate and adequate?	10	0
13. Are the results clear and adequately reported?	10	0
14. Does the discussion of the results report them in the light of the study's		
hypotheses and other relevant literature?		
15. Are the limitations of the research and its design	10	0
16. Does the discussion generalize and conclude the limits of	0	10
the data and the number and type of people studied?		
17. Can the findings be generalized to other relevant	10	0
18. Are the implications-practical or theoretical of the	10	0
19. Who was the study's sponsor, and was there a conflict of	0	10
20. Are the research data held on an accessible database or	0	10
otherwise available for scrutiny and re-analysis?		

Appendix Table 2. Summary of qualitative studies and critical appraisal checklist inclusive of one in a mixed-method study. (Pearson, 2004)

Criteria	Yes	No
1. Congruity between stated philosophical perspective and research methodology	15	0
2. Congruity between methodology and research question or objectives	15	0
3. Congruity between methodology and methods used to collect data	15	0
4. Congruity between methodology and representation and analysis of data	15	0
5. Congruity between methodology and interpretation of results	15	0
6. There is a statement locating the researcher culturally or theoretically	6	9
7. The influence of the researcher on the research and vice-versa is addressed	4	11
8. Participants and their voices are adequately addressed	15	0
9. Ethical according to current criteria, evidence of ethical approval	15	0
10. Conclusions are drawn flow from analysis or interpretation of data	15	0

Appendix Figure 1. PRISMA Flow Diagram.



Appendix Table 3. Summary table of literature review.

Authors (Year)	Title	Sample size, n	State and Country	Methods	Key Findings	Study Limitations
Aletraris, L., Edmond, M.B., Paino, M., Fields, D. & Roman, P.M. (2017)	Counselor training and attitudes toward pharmacotherapies for opioid use disorder.	725 counselors	Georgia, United States	Ordinary least squares (OLS)	Buprenorphine specific training positively associated with attitudes (b=.251, SE=.037, p<.001) Adaptability positively associated with acceptability (b=.131, SE=.062, p<.05) Advanced degree holders more likely to report buprenorphine acceptability (b=.362, SE=.148, p<.05) Adherence to 12-step orientation negatively associated with acceptability (b=-0.192, SE=.044, p<.001)	Cross-sectional data do not determine causality Self-reported data subject to response bias Subjective counselor ratings on treatment effectiveness Participants may be subject to selection bias

Alford, D.P., LaBelle, C.T., Kretsch, N., Bergeron, A., Winter, M., Botticelli, M. & Samet, J.H. (2011)	Five-year experience with collaborative care of opioid-addicted patients using buprenorphine in primary care	382 patients	Massachusetts, United States	Multiva riate logistic regressi on (MLS)	At least 93% remaining in treatment had negative urine toxicology results in 3, 6, 9, and 12month intervals. Older, employed, and used illicit buprenorphine have higher odds of treatment success (OR= 1.40, p<.01; OR=2.24, p<.01; OR=3.01, p<.01) African American or Hispanic race had lower odds of treatment success (OR= 0.50, p<.05; OR=0.45, p<0.05)	Limited to retrospective data from the clinical program Unavailable follow-up information from departing patients Underestimate of opioid abuse given changes in the toxicology test protocol

Callon, C., Wood, E., Marsh, D., Li, K., Montaner, J.& Kerr, T. (2006)	Barriers and facilitators to methadone therapy use among illicit opiate injection users in Vancouver	1,463 patients	Vancouver	Bivariate and multivariate generalized estimating equation (GEE)	At 95% confidence, negatively association found with methadone maintenance treatment (MMT) male gender (Odds Ratio, OR=0.41); aboriginal ethnicity (OR=0.37); recent incarceration (OR= 0.82) downtown residence (OR=0.86), sex-trade involvement (OR=0.80); syringe lending (OR=0.76; denied treatment (OR=0.81); heroin injection (OR=0.51); nonfatal overdose (OR=0.59); injecting in public (OR=0.75). Positive treatment facilitators include older age (OR= 1.03); HIV positivity (OR=1.89); crack cocaine smoking (OR=1.41)	The measurement timing captured behavioral change only among males, aborigines, and HIV-positive patients. Non-randomized sample Measure of MMT use is limitedwith self-report
Davstad, I., Stenbacka, M., Leifman, A., Beck, O., Korkmaz, S. & Romelsjo, A. (2007)	Patterns of illicit drug use and retention in a methadone program: A longitudinal study	204 patients	Stockhol m, Sweden	Poisson regression Wilcoxon signed-rank test Spearman rank-order bivariate correlation	Discharged patients have more relapsed periods (79%, $p<0.0001$) and have a higher risk of illicit drug use. Low methadone dose ($r=-0.22$; $p<0.05$) and younger age (Median age =33; $p<0.05$) predict discharge from treatment	Limited to methadone programs with less restrictive criteria

Murphy, S.M., Fishman, P.A., McPherson, S., Dyck, D.G. & Roll, J.R. (2014)	Determinants of buprenorphine treatment for opioid dependence.	4,030 patients	Washington and Northern Idaho, United States	Multiple logistic regression	Facilitators include: point of service (non-restrictive) insurance plan (OR=2.63); metropolitan residence (OR=1.62); Co-morbidity from non-opioid use (OR=0.02); ETOH use (OR=0.48); chronic pain (OR=1.82)	Unable to control for the price of buprenorphine and alternative treatment Unable to control for buprenorphine prescribers; Unable to determine if a
						physician with waivers is prescribing buprenorphine
Perimutter, A.S., Conner, S.C., Savone, M., Kim, J.H., Segura, L.E. & Martins, S.S. (2017)	Is employment status in adults over 25 years old associated with non-medical prescription stimulant use?	58,846 patients	United States	Multivariate logistic regression	Unemployed participants have the highest odds of non- medical prescription opioid and stimulant use (aOR=1.45, 95% CI (1.15-1.82)	Cross-sectional design limits inferences

Samuels, E.A., Dwyer, K., Mello, M.J., Baird, J., Kellogg, A.R. & Bernstein, E. (2016)	Emergency department-based opioid harm reduction: Moving physicians from willing to doing	200 physicians	New England States, United States	Stepwise linear regression	Willingness to perform opioid harm reduction (R^2=0.50) Prohibitive barriers identified: time, training, and institutional support. Positive influence on interventions: research evidence, professional organization recommendations, and E.D. leader opinions	Restricted to three academic centers Low response rate at 64.7-71.9% Underestimation of actual naloxone referrals Selection bias among respondents
Thomas, C.P., Reif, S., Haq, S., Wallack, S.S., Hoyt, A. & Ritter, G.A. (2008)	Use of buprenorphine for addiction treatment: Perspectives of addiction specialists and general psychiatrists	271 addiction specialists 224 psychiatrists	Boston, Chicago, San Francisco, Miami, United States	Multivariate logistic regression	Positive predictors: Organizational support (OR=7.75, p<.001); more significant than ten patients in the past month (OR=3.86, p<.01); patient satisfaction (OR=4.37, p<.05); and 50% of group practice clinical time Negative predictors: 50% of clinical in general psychiatry (OR=.22,	Preliminary examination of new treatment Limited to four locations and may not be generalizable

Turner, B.J., Laine, C., Lin, Y. & Lynch, K. (2005)	Barriers and facilitators to primary care or human immunodeficiency virus clinics providing methadone or buprenorphine for the management of opioid dependence	261 directors of primary HIV care clinics	New York, United States	Multivariate logistic regression	Negative factors: administrative burden, lack of social workers, inadequate reimbursement, and legal risks. Potential facilitators: methadone training (AOR=2.06); access to experts (AOR=2.08); HIV specialty care (AOR=2.16), and methadone programs	Single state clinic survey The survey focused on clinics serving Medicaid enrollees. Self-report from clinic directors Uncertain about office-based treatment in resource-constrained
Hayashi, K., Ti, L., Ayutthaya, P.P.N., Suwannawong, P., Kaplan, K., Small, W. & Kerr, T. (2017)	Barriers to retention in methadone therapy among people who inject drugs in Bangkok, Thailand: a mixed-methods study	158 patients	Bangkok, Thailand	Mixed method: qualitative and bivariate analysis	HIV positivity associated with receiving >60mg/day (p=0.015) Younger age is significantly associated with receiving > median dose of 30mg/day. Provider barriers: Bias against methadone treatment in Western medicine, difficulty negotiatin g higher methadone doses, and abrupt dose reductions. socio-structural barriers: intense police surveillance, frequent patient incarceration, and lack of access to methadone during incarceration	Non- random sampling Unaccounted regional differences

Authors (Year)	Title	Sample size, n	State and Country	Methods	Key Findings	Identified Themes
Barry, D., Irwin, K.S., Jones, E.S., Becker, W.C., Tetrault, J, M., Sullivan, L.E., Hansen, H., O'Connor, P.G. Schottenfeld, R.S. & Fiellin, D.A. (2010)	Opioids, chronic pain, and addiction in primary care	23 physicians	New England, United States	Grounded theory	Physician barriers: absence of pain measures, lack of expertise in addiction, coexisting disorders and pain management, aberrant patient behavior, and physician attitude on analgesic prescription. Physician facilitators: promoting continuity of care and use of opioid agreements	Patient factors, physician, and logistical factors
Barry, D., Irwin, K.S., Jones, E.S., Becker, W.C., Tetrault, J, M., Sullivan, L.E., Hansen, H., O'Connor, P.G. Schottenfeld, R.S. & Fiellin, D.A. (2008)	Integrating buprenorphine treatment into office-based practice: a qualitative study	23 physicians	New England, United States	Grounded theory	Physician barriers: competing activities, lack of interest, and lack of expertise in addiction treatment Physician facilitators: continuity of patient care, positive perceptions of the buprenorphine maintenance treatment (BMT), and BMT as a positive alternative to methadone treatment	Patient factors, physician, and logistical factors

Clemans-Cope, L., Wishner, J.B., Allen, E.H., Lallemand, N., Epstein, M. & Spillman, B.C. (2017)	Experiences of three states implementing the Medicaid health home model to address opioid use disorder-Case studies in Maryland, Rhode Island, and Vermont.	70 discussants	Maryland, Rhode Island, and Vermont Unites States	Focus group discussions	Barriers: Shortage of providers, reluctance to treat patients, patient confidentiality regulations, and operational sustainability Facilitators: Collaborative relationships between crucial state agencies, care coordination, and engagement of providers in program planning and design	Patient factors, Provider factors and system/structural factors
Fox, A.D., Maradiaga, J., Weiss, L., Sanchez, J., Starrels, J.L. & Cunningham, C.O. (2015)	Release from incarceration, relapse to opioid use and the potential for buprenorphine treatment: a qualitative study of the perceptions of former inmates with opioid use disorder	21 former inmates	New York, United States	Grounded theory	Barriers: Prior negative experience with buprenorphine and methadone use, such as withdrawal symptoms Facilitators: BMT to prevent re-incarceration and BMT as a better option than methadone maintenance	Reliance on willpower Fear of medication dependency Variable buprenorphine exposure BMT acceptability after relapse

Frank, J.W., Levy, C., Matlock, D.D., Calcaterra, S.L., Mueller, S.R., Koester, S. & Binswanger, IA (2016)	Patient's perspectives on tapering opioid therapy	24 patients	Colorado, United States	Mixed deductive and deductive approach	Barriers: Pessimism about a non-opioid option to manage pain and fear of opioid withdrawal Facilitators: Social support, trusted health care provider, and improved QOL (Quality of Life) after	Risks Barriers Facilitators Benefits
Harawa, N.T., Amani, B., Bowers, J.R., Sayles, J.N., & Cunningham, W. (2017)	Understanding interactions of formerly incarcerated HIV-positive men and transgender women with addiction treatment, medical, and criminal justice systems	19 patients	Los Angeles, United States	Qualitative thematic analysis	Barriers: Economic marginalization and limited access to social services Facilitators: Structured residential facility, substance use facilitated HIV treatment	Autonomy Temporary stabilization Inconsistent treatment approach
Hewell, V.M., Vasquez, A.R., & Rivkin, I.D., (2017)	Systemic and individual factors in buprenorphine treatment-seeking process: a qualitative study	11 participants	Fairbanks, Alaska, United States	Qualitative	Barriers: Limited access to health care, the limited number of providers, travel barriers, and stigma Facilitators: Willpower, self-efficacy, and motivation to change, family support, positive provider support,	Patient factors Contextual factors

McClure, B., Mendoza, S., Duncan, L., Rotrosen, J. & Hansen, H. (2014)	Effects of regulation on methadone and buprenorphine provision in the wake of Hurricane Sandy.	Eight administrators 41 providers One provider/admin	New York, United States	Grounded theory	Barriers: Uncertain state regulation, inflexible DEA regulation, clinic overcrowding, licensure red tape, disruption of provider relationship, lack of emergency preparedness strategies, difficult dosage verification, patient inconvenience, and incorrect dosage risks	System Structural factors
McMurphy, S., Shea, J., Switzer, J. & Turner, B.J. (2006)	Clinic-based treatment for opioid dependence: a qualitative inquiry	27 clinic directors	New York, United States	Grounded theory	Barriers: Stigma and stereotypes, mixing patient populations, financial reimbursements, time-consuming patients, staffing concerns, and training challenges. Facilitators: Financial incentives and training	Patient factors Provider factors System factors

Molfenter, T., Sherbeck, C., Zehner, M., Quanbeck, A., McCarty, D., Kim, J. & Starr, S. (2015)	Implementing buprenorphine in addiction treatment: payer and provider perspectives in Ohio	18 county board participants 36 providers	Ohio, United States	Qualitative	Barriers: Negative attitude toward medication use, lack of awareness among providers, limited physician availability, insufficient funds, and diversion concerns Facilitators: Provider knowledge about buprenorphine, criminal justice system referral,	System factors Provider factors
St. Marie, B. (2016)	The experiences of advanced practice nurses caring for patients with substance use disorder and chronic pain	20 APRNs	United States	Qualitative narrative	Barriers: Difficulty accessing non-medical modalities for pain management, insurance coverage Facilitators: Using caution on prescriptions, holistic caring, teamwork	Provider factors
Storholm, E.D., Ober, A.J., Hunter, S.B., Becker, K.M., Iyiewuare, P.O., Pham, C. & Watkins, K.E. (2017)	Barriers to integrating the continuum of carefor opioid and alcohol use disorders in primary care.	Nine medical providers 26 administrators	California, United States	Qualitative	Barriers: Billing, cost of service, the time required to treat, H.R. and staffing problems, lack of provider knowledge, low motivation, difficulties with registration, clinic hours outside of standard hours, treating significant homeless population, and fear of unsupportive	Structural factors

Teruya, C., Schwartz, R.P., Mitchell, S.G., Hasson, A.L., Thomas, C., Buoncristinai, S.H., Hser, Y., Wiest, K., Cohen, A.J., Glick, N., Jacobs, P., McLaughlin, P. & Ling, W. (2014)	Patient perspectives on buprenorphine/naloxone: A qualitative study of retention during the starting treatment with agonist replacement therapies (START) study	105 patients	California, Connecticut, Oregon, Pennsylvani a, Washington, United States	Qualitative	Barriers: Dosing design, missing days on START trials, switching to methadone treatment, wanted methadone, and use of prescribed methadone during the study. Facilitators: Medication worked well; personal determination and commitment	Structural factors Patient factors
Zamudio-Haas, S., Mahenge, B., Saleem, H., Mbwambo, J. & Lambdin, B.H. (2016)	Generating trust: Programmatic strategies to reach women who inject drugs with harm reduction services in Dar es Salaam, Tanzania	19 patients	Dar es Salaam, Tanzania	Qualitative	Barriers: Stigma and discrimination in the health care setting Facilitators: Direct visitation/outreach and supportive services to reunite with families,	Patient factors Structural factors
Gordon, A.J., Kavanagh, G., Krumm, M., Ramgopal, R., Paidisetty, S., Aghevli, M., Goodman, F., Trafton, J. & Liberto, J. (2011)	Facilitators and barriers to implementing buprenorphine in the Veterans Health Administration	61 V.A. clinicians and administrators in 17 V.A. facilities	United States	Grounded theory	Provider barriers: lack of interest, stigma toward the population, and lack of education about buprenorphine Patient barriers: lack of need and attitudes/stigma associated with opioid dependence	Patient factors Provider factors

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