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Attrition and Telehealth Utilization for Primary Care Services among Veterans by Substance Use  
Disorder and Housing Instability

A dissertation submitted in partial satisfaction of the  
requirements for the degree Doctor of Philosophy  
in Health Policy and Management

by

Caroline Kim Yoo

2024

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## ABSTRACT OF THE DISSERTATION

Attrition and Telehealth Utilization for Primary Care Services among Veterans by Substance Use  
Disorder and Housing Instability

by

Caroline Kim Yoo

Doctor of Philosophy in Health Policy and Management

University of California, Los Angeles, 2024

Professor Jack Needleman, Chair

Substance use disorder (SUD) among the US Veterans has increased. SUD is also highly prevalent among the homeless and housing unstable Veterans. Despite the importance of primary care at the VA as the gateway to other services, the effect of SUD and housing instability on several areas of Veteran's primary care experience has not been widely explored.

Using a nationwide retrospective cohort of Veterans in primary care between 2019 and 2022, this dissertation examines telehealth use and attrition from primary care services among Veterans with and without SUD and housing instability. SUD and housing instability were identified through ICD-10 coding from VA administrative data.

In Chapter Two, we compare patterns of Veteran telehealth and video use before and after the onset of COVID-19 by SUD diagnosis. In adjusted analyses, we find slightly higher rate of telehealth use and lower rates of video use among Veterans with SUD.

In Chapter Three, we compare primary care attrition rates between Veterans with and without SUD between 2020 and 2022. We find a substantially lower attrition among higher users of VA primary care services, but a higher rate of attrition among patients with SUD.

In Chapter Four, we examine the transitions of housing instability states among Veterans in primary care and the combined impact housing instability and SUD on telehealth use and attrition from primary care services. We find high rates of transition from homelessness but Veterans with SUD were more likely to remain homeless. We find higher rate of telehealth use and lower rate of video use among Veterans with SUD and housing instability. We find substantially lower attrition among higher users of primary care services at the VA, but higher rates of attrition among patients with SUD and housing instability.

These findings underscore the importance of maintaining telehealth access for Veterans with vulnerabilities such as SUD and housing instability. SUD and housing instability should remain high priority areas for the VA, and an important focus of primary care activities. Increasing video visits in the VA will require attention to the challenges of video for Veterans with housing instability with and without SUD.

The dissertation of Caroline Kim Yoo is approved.

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## DEDICATION

I dedicate this work to my father and mother for encouraging me to embrace this opportunity and to grow. Their trust, patience, and prayers have provided me with comfort during my studies. I am immensely grateful to my sister for always being my anchor and for her presence and support. I am thankful for my family's encouragement while they awaited the conclusion of my studies.

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### SELECTED PUBLICATIONS

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Leung, L. B., Zhang, E., Chu, K., **Yoo, C.**, Gabrielian, S., & Der-Martirosian, C. (2024). Characteristics of Veterans Experiencing Homelessness using Telehealth for Primary Care Before and After COVID-19 Pandemic Onset. *Journal of General Internal Medicine*, 1-7.

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Mooney, L. J., Zhu, Y., **Yoo, C.**, Valdez, J., Moino, K., Liao, J. Y., & Hser, Y. I. (2018). Reduction in cannabis use and functional status in physical health, mental health, and cognition. *Journal of Neuroimmune Pharmacology*, 13, 479-487.

## PRESENTATIONS

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**Yoo, C.**, Chu, K., Lukowsky, L. R., & Der-Martirosian, C. Clinical Conditions Associated with Video Use in Primary Care at the Veterans Health Administration. AcademyHealth 2024 Annual Research Meeting. June 2024. Baltimore, MD.

**Yoo, C.**, Needleman, J., Chu, K., Leung, L., Chang, E., & Der-Martirosian, C. Telehealth Utilization for Primary Care Services by Substance Use Disorder Diagnosis at the VA. SEARCH 2023 The National Telehealth Research Symposium. November 2023. Philadelphia, PA.

**Yoo, C.**, Der-Martirosian, C., Chu, K., Chang, E., & Leung, L. Telehealth Uptake Among Veterans with Alcohol Use Disorder Before and After COVID-19 Pandemic Onset. American Public Health Association. November 2022. Boston, MA.

**Yoo, C.**, Zhu, Y., & Hser, Y. (2017) Five-year change in the SF-36 scores associated with long-term opioid abstinence after randomization to methadone versus buprenorphine/naloxone in a multi-site trial. 2017 CALDAR Summer Institute & International Conference. Universal City, CA.

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## Chapter 1 : Introduction

Among the US Military Veterans, the diagnosis of substance use disorder (SUD), including alcohol and other drug use disorders, continue to rise, with its prevalence 12% or 2.4 million adult Veterans in 2020.<sup>1</sup> In addition to increased mortality due to substances such as alcohol and opioids and suicide risks, individuals with SUD suffer from legal and employment issues.<sup>2-4</sup>

SUD is highly prevalent among those with homelessness, which is an acute form of housing instability. Veterans are overrepresented among adult homeless population and have additional risk factors specific to their military experience, such as service-connected disability and history of military sexual trauma.<sup>5,6</sup> Both SUD and homelessness have been linked to increased mortality and suicide risk, as well as negative experiences with primary care services.<sup>7-</sup>

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The importance of primary care cannot be overlooked for Veterans with substance use disorder or housing instability. Within the Veteran Health Administration (VA), primary care serves as, not only a gateway to comprehensive health services, but also to specialty care or other supplementary services for patients with special needs, such as housing instability.<sup>10-13</sup> As evidenced by the Behavioral Model for Vulnerable Populations, patient-level factors like substance use and competing priorities may impact healthcare service utilization and outcomes for vulnerable populations, such as those with SUD or housing instability.<sup>14</sup> Given the higher housing instability among Veterans with SUD and higher SUD rates among Veterans experiencing housing instability, it is important to understand how housing instability and SUD interact in use of primary care services. Telehealth, the delivery and treatment of healthcare and



health-related services, is a care delivery method that has potential to increase flexibility and reach of health services.<sup>15</sup>

This dissertation examines and compares the experience of Veterans with SUD and those without treated in the VA healthcare systems in several areas. In the second chapter, we examine patterns of telehealth use for primary care services before and after the onset of COVID-19 between 2019 and 2022 by SUD diagnosis at the VA. Despite the rapid expansion of telehealth in primary care during the COVID-19 pandemic, telehealth in primary care is relatively less studied compared to other specialties prior to the pandemic onset. It is unclear how telehealth has impacted access and use of primary care services among Veterans with a SUD diagnosis compared to those without the diagnosis.

In the third chapter, we compare primary care attrition rates between Veterans with and without a SUD diagnosis between 2020 and 2022. According to the surveys of patient experiences, Veterans with SUD reported lower satisfaction with primary care compared to those without SUD.<sup>16</sup> We hypothesize that patients with any SUD diagnosis will have higher rates of attrition from primary care during this period.

In the fourth chapter, we examine the rate of transition in housing instability states by a SUD diagnosis and the effect of housing instability on the use of telehealth between 2019 and 2022 and primary care attrition between 2020 and 2022 by a SUD diagnosis. We hypothesize that Veterans with SUD are more likely to experience persistent housing instability compared to those without SUD. Additionally, we hypothesize that housing instability is associated with increased telehealth utilization and higher primary care attrition.

The concluding chapter provides an overview of three sets of results and some closing thoughts on implications for practice and policy, and future research.

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## **Chapter 2 : Telehealth utilization for primary care services by substance use disorder diagnosis at the Veterans Health Administration, Prior to and During the COVID-19 Pandemic (2019 - 2022)**

### **Introduction**

Among the US Military Veterans, the diagnosis of substance use disorder (SUD), including alcohol and drug use disorders, has been increasing. According to the National Survey of Drug Use and Health (NSDUH), the prevalence rate of Veterans over aged 18 with SUD increased from 6.2% in 2019 to 12% (2.4 million) in 2020.<sup>1</sup> Mortality due to substances such as alcohol, psychostimulants, and opioids, continue to rise.<sup>2,3</sup>

Veterans have higher prevalence of issues that are related to substance use disorders, such as post-traumatic stress disorder (PTSD) and homelessness.<sup>4,5</sup> Consequences of substance use disorder go beyond medical problems and include legal issues, employment, and suicidal ideation.<sup>6</sup> When SUD co-occurs with mental health conditions, it increases risk for suicide by impacting mood or impulsivity. According to the 2020 National Veteran Suicide Prevention Annual Report, SUD-related conditions have higher rates of suicide than do Veterans with depression.<sup>7</sup>

<sup>8,9</sup>Telehealth, the delivery and treatment of healthcare and health-related services, is a care delivery method that has potential to increase flexibility and reach of health services.<sup>8</sup> It includes secure messages, telephone care, and video-to-home visits. The VHA was a leader in promoting telehealth even before the pandemic onset. With the COVID-19 pandemic onset, VHA leveraged the existing telehealth structure. With policy revisions to facilitate telework, VHA was able to expand telework rapidly.<sup>9</sup>

Telehealth in primary care is relatively less studied compared to other specialties prior to the pandemic onset.<sup>10,11</sup> It has been particularly successful for mental health specialty care where there is no need for physical examinations. It has been studied that telemental health via videoconferencing was satisfactory and effective for both patients and providers for mental health concerns such as PTSD and depression.<sup>12</sup>

Primary care serves as one of the gateways to initiate and engage SUD patients in treatment of substance use disorder and overall care.<sup>13</sup> Within the Veterans Health Administration (VA), however, there are disparities in preventive care quality, lower satisfaction with access to care, communication, and comprehensiveness for primary care services among Veterans with SUD.<sup>14</sup>

## **Objective**

With the rapid expansion of telehealth in primary care during the COVID-19 pandemic, it is unclear how telehealth has impacted access and use of primary care services among Veterans with SUD compared to non-SUD patients. More specifically, this study examined patterns of telehealth use for primary care services before and after the onset of COVID-19 by SUD diagnosis at the VA.

## **Methods**

### *Study design and Sample*

The sample was a nationwide retrospective cohort study of adult (18 years old or older) Veteran patients in primary care during 3/16/2019 and 3/15/2022. The study cohort consisted of Veterans who had at least one primary care visit (either outpatient regular primary care visit or

mental health integrated primary care visit) and categorized based on the presence of at least one substance use disorder (SUD) diagnosis between March 16, 2018, and March 15, 2019. We examined their primary care visits between March 16, 2019, and March 15, 2022. The comparison group consisted of patients with at least one primary care visit but who did not have a SUD diagnosis.

There is some data suggesting that SUD is underdiagnosed in the VA.<sup>15</sup> While underdiagnosis would weaken the results, as patients with SUD are included in the comparison group, the magnitude of underdiagnosis is such that the results of this analysis are potentially still valuable to guide policy and practice. This is discussed further in the discussion section.

#### *Data Sources*

We used the VHA administrative electronic health record. Patient-level demographic and clinical characteristics, and outpatient visit modality and its dates were extracted from the Corporate Data Warehouse (CDW).<sup>16</sup> The CDW is a national data repository of VHA electronic health records from the Veterans Affairs (VA) administrative and clinical systems. All data management and analyses were conducted within a secure research environment known as the VA Informatics and Computing Infrastructure (VINCI).

#### *Measures*

The main outcome variables were telehealth and video visit counts. Primary care visits were identified using stop code and included both regular primary care and mental health integrated primary care visits (PCMHI). Once primary care visits were identified, they were

categorized by mutually exclusive modalities: in-person visits and telehealth visits (video-to-home, video-to-clinic, phone, and secure message encounters).

A SUD diagnosis was defined as 2 outpatient diagnoses or 1 inpatient diagnosis of F10.x-F19.x (F10.x alcohol, F11.x opioid, F12.x cannabis, F13.x, sedative/hypnotic, anxiolytic, F14.x cocaine, F15.x other stimulant, F16.x hallucinogen, F17.x nicotine, F18.x inhalant, F19.x other psychoactive substance related disorders) in 12 months.

To understand the impact of SUD on use of primary care telehealth visits among Veterans, we controlled for various covariates. Covariates included patient-level demographic and clinical characteristics at baseline. They included age at the end of baseline period, birth sex, race/ethnicity, marital status, and non-VA insurance status. We also included the Charlson Comorbidity Index (CCI)<sup>17</sup>, which is a summary score of medical chronic conditions, categorized into no comorbidity, one comorbidity, and two or more comorbidities. In addition, mental health conditions (depression, anxiety, post-traumatic stress disorder (PTSD), serious mental illness (SMI), and other mental health conditions) were included since they were previously found to be associated with telehealth utilization.

### *Statistical Analyses*

Based on the distinct pattern in monthly telehealth use, the study period was divided into four segments: 1) Pre-pandemic period (March 16, 2019 – February 15, 2020), 2) early pandemic period (February 16, 2020 – July 15, 2020), 3) intermediate pandemic period (July 16, 2020 – December 15, 2020), and 4) late pandemic period (December 16, 2020 – March 15, 2022).

In bivariate analyses, the demographic and clinical characteristics of Veterans were compared by SUD diagnosis. Next, we examined unadjusted percentages of telehealth and video use by demographic and clinical characteristics across the study period by SUD diagnosis.

In multivariable analyses, the outcome was person-level visit counts for each segment. Multivariable negative binomial regression models were used to examine association between SUD diagnosis and telehealth use in three steps. The first model included only SUD diagnosis, segment, and an interaction term between SUD diagnosis and segment. In the second model, patient-level covariates were added. In the third model, an interaction term between patient age and segment was tested. We reported the adjusted odds ratios of telehealth visits overall and specifically for video visits (video-to-home) use and calculated predicted counts of telehealth and video visits per person during each segment. All statistical tests were two-sided at the significance threshold of  $p < 0.05$ . Data were analyzed using Stata 17.0 (StataCorp, College Stations, TX).

## **Results**

The cohort includes 5,249,930 Veteran patients and their visits between March 16th, 2019, and March 15th, 2022: 466,013 (8.9%) with a substance use disorder and 4,783,917 (91.1%) without a SUD diagnosis. Demographic characteristics of the Veterans were compared by SUD diagnosis (Table 1). Compared to those without SUD, Veterans with SUD were younger (mean (SD) = 57.1 (14.1) vs. 63.4 (16.4);  $p < 0.001$ ), had a higher proportion of males (92.3% vs. 91.2%;  $p < 0.001$ ) and Blacks (24.1% vs 16.6%;  $p < 0.001$ ), and had a lower proportion of married status (36.6% vs 58.6%;  $p < 0.001$ ) and non-VA insurance (58.7% vs 72.8%,  $p < 0.001$ ). They were also sicker based on their mean (SD) Charlson Comorbidity Index (CCI) of 1.9 (2.5) vs 1.3 (1.9);



$p < 0.001$ , or the proportion who had a CCI score greater than 2: 38.3% vs 29.3%;  $p < 0.001$ ). In terms of mental health comorbidities, compared to Veterans without SUD, Veterans with SUD had a higher proportion of anxiety (36.3% vs 4.1%;  $p < 0.001$ ), depression (48.8% vs 17.8%;  $p < 0.001$ ), serious mental illness (33.7% vs 12.1%;  $p < 0.001$ ), psychosis (3.2% vs 0.4%;  $p < 0.001$ ), PTSD (36.9% vs 14.5%;  $p < 0.001$ ), and other mental health conditions (14% vs 2.8%;  $p < 0.001$ ).

In unadjusted analyses, telehealth use was compared between Veterans with and without SUD during the study period. Specifically, the unadjusted percentages of telehealth primary care visits per month was examined for four segments across 1 year prior to and 2 years after COVID-onset (Figure 1). During the year prior to COVID-19 (segment 1; pre-pandemic period), telehealth visits comprised 34.2% of primary care visits, increased to 83.7 % in segment 2, followed by 68.5% in segment 3 and 53.1% in segment 4.

First, we visualized trends for unadjusted percentages of telehealth use per month in each time segment by SUD diagnosis during the study period (Figure 1). For patients with SUD, during the year prior to COVID-19 (segment 1; pre-pandemic period), telehealth visits comprised 34.2% of primary care visits, increased to 83.7 % in segment 2, followed by 68.5% in segment 3 and 53.1% in segment 4. For patients without SUD, the percentages of telehealth visits changed from 31.0% in segment 1, 84.4% in segment 2, 66.1% in segment 3, and 50.0% in segment 4. Overall, for both SUD and non-SUD patient groups, the use of telehealth modalities increased immediately after the pandemic but gradually decreased to a new normal substantially above pre-pandemic levels. Except for segment 2, SUD patients had higher telehealth use compared to non-SUD patients. Immediately after the pandemic onset, telehealth use surged for both groups at a similar level. However, starting in segment 3, the difference by SUD groups widens. In segment 4, the

difference by SUD diagnosis starts to widen again to the level prior to the pandemic onset. Next, we examined the change in unadjusted percentage of telehealth use per month by SUD diagnosis and patient characteristics to observe change in telehealth use pattern by demographic and clinical characteristics (Table 2a and 2b).

In the fully adjusted model, we found increased telehealth visits for patients regardless of their SUD diagnosis. As seen in Figure 1, Veterans with SUD had higher telehealth use prior to the pandemic onset (IRR=1.09, 95% CI: 1.09-1.09) compared to Veterans without the diagnosis (Table 3). The interaction term between SUD and segments shows that the differential effect of segments in telehealth use by SUD. The effect of the pandemic onset on the incidence rate of telehealth visits was lower among Veterans with SUD by 11% in segment 2 (IRR=0.89, 95% CI: 0.88-0.89), followed by 9% in segment 3 (IRR=0.91, 95% CI: 0.91-0.92) and 6% in segment 4 (IRR=0.94, 95% CI: 0.93-0.94). In terms of patient characteristics, lower rate of telehealth visits was associated with being Hispanic (IRR=0.96, 95% CI:0.96-0.97). Higher rate of telehealth visits was associated with higher Charlson Comorbidity Index (IRR=1.14 for CCI of 2 or higher, 95% CI: 1.14-1.14), being diagnosis with mental health conditions such as depression (IRR=1.02, 95% CI:1.02-1.03), anxiety (IRR=1.02, 95% CI:1.02-1.02), and PTSD (IRR=1.01, 95% CI:1.01-1.01). On the other hand, a diagnosis of psychosis was associated with lower rate of telehealth visits (IRR=0.97, 95% CI: 0.97-0.98).

Table 4 and Figure 2 show adjusted predicted count of telehealth primary care visits per person based on the fully adjusted regression (Model 3). Veterans with SUD initially had a significantly higher number of visits per person in segment 1 (Est=0.11, 95% CI: 0.11-0.12) compared to those without SUD. However, Veterans with SUD had 0.13 less visits per person in segment 2 (95% CI: -0.13, -0.12) immediately after the pandemic onset, followed by 0.02 less

visits per person in segment 3 (95% CI: -0.026, -0.014). However, in the late pandemic (segment 4), as the telehealth use stabilizes, SUD patients reverted to having more telehealth visits (Est=0.042, 95% CI: 0.037-0.047) compared to non-SUD patients.

Next, we focus more specifically on video visits, one type of telehealth visits. We examined the unadjusted percentage of video visits per month by SUD diagnosis (Figure 3). In the pre-pandemic period, less than 1% of the primary care visits were delivered via video. For both SUD and non-SUD patient groups, the use of video shows similar pattern. In the early pandemic period (segment 2), the percentage of video visits gradually increased and reached peak use above 7% in the intermediate pandemic period (segment 3). In the late pandemic period (segment 4), the percentage of video visits range between 4% to 7%. However, Veterans with SUD consistently has lower video use during the post-pandemic onset. For patients with SUD, during the year prior to COVID-19 (segment 1; pre-pandemic period), video visits comprised only 0.4% of primary care visits, increased to 4.7 % in segment 2, followed by 6.4% in segment 3 and 5.4% in segment 4. For patient without SUD, the percentages of video visits changed from 0.5% in segment 1, 5.4% in segment 2, 7.1% in segment 3, and 5.7% in segment 4 (Table 5a and 5b).

In the adjusted analyses for video visits, we found lower rates for Veterans with SUD prior to the pandemic onset (IRR=0.78, 95% CI: 0.75-0.80) compared to Veterans without the diagnosis (Table 6). The interaction term between SUD and segments shows that the differential effect of segments in video use by SUD. The effect of the pandemic onset on the incidence rate of video visits was 1.04 times higher among Veterans with SUD in segment 2 (95% CI: 1.00-1.08, p=0.03), followed by 7% in segment 3 (95% CI: 1.03-1.11) and 12% in segment 4 (95% CI: 1.08-1.16). In terms of patient characteristics, higher rate of video visits was associated with being Hispanic (IRR=1.20, 95% CI:.1.19-1.21). Lower rate of video visits were associated with higher Charlson

Comorbidity Index (CCI) (IRR=0.81 for CCI of 2 or higher, 95% CI: 0.80-0.81), whereas being diagnosed with mental health conditions such as depression (IRR=1.04, 95% CI:1.03-1.04), anxiety (IRR=1.12, 95% CI:1.11-1.13), and PTSD (IRR=1.05, 95% CI:1.04-1.05) were associated with higher rates of video visits. Lastly, Veterans with non-VA insurance had increased rates of video visits compared those without non-VA insurance (IRR=1.06, 95% CI: 1.05-1.06).

Table 7 and Figure 3 show adjusted predicted count of primary care video visits per person based on the fully adjusted regression (Model 3). Veterans with SUD had less video visits per person for all segments, changing from 0.005 in segment 1 (Est=-0.005, 95% CI: -0.005, -0.004) compared to those without SUD to 0.04 less visits in segment 2 (95% CI: -0.05, -0.04) immediately after the pandemic onset, followed by 0.05 less visits per person in segment 3 (95% CI: -0.05, -0.05) and 0.03 visits per person in segment 4 (95% CI: -0.03, -0.03).

## **Discussion**

This retrospective study of VHA patients and their primary care telehealth utilization during 2019-2022 examined patterns of telehealth and video use before and after the onset of COVID-19 by SUD diagnosis at the VA. Even in the post-pandemic onset, we found stable telehealth and video utilization for Veterans regardless of their SUD diagnosis. For Veterans with SUD, telehealth visit rate initially lagged Veterans without SUD, but eventually stabilized to a similar level. Both Veterans without SUD and with SUD diagnoses participated in the substantial surge of telehealth visits immediately after the onset of COVID-19, and settled in to the newer, higher level of telehealth use after the initial surge had receded.

Video visit rates, a specific type of telehealth visit, were consistently lower among Veterans with SUD compared to those without the diagnosis. Also, patients who are typically

considered vulnerable to the digital divide, such as minorities and sicker patients<sup>18</sup>, maintained similar level of primary care telehealth visits throughout the study period after the pandemic onset.

To our knowledge, this is the first nationwide cohort study of Veterans with substance use disorder and their use of telehealth including video visits for primary care services. The study included over 460,000 Veterans with substance use disorder. There are studies looking at the effect of telehealth-related intervention on substance use disorder, or for the treatment of substance use disorder, but not for use of telehealth services for patients with SUD in their primary care visits. Some studies of telehealth stratified their analysis by chronic diseases, such as cardiovascular,<sup>19</sup> cancer,<sup>20</sup> or homelessness,<sup>21</sup> or grouped with other mental health conditions, but not substance use disorder separately.

Telehealth, mostly comprised of phone visits, showed different patterns compared to video visits. Veterans with SUD had higher use of telehealth visits overall compared to primary care patients without SUD, but lagged behind other patients in video visit use. The discrepancy in the pattern of telehealth use by telehealth modality may vary depending on the purpose of their primary care visit.

Vulnerable populations are less likely to use video visits. Veterans with SUD generally receive fewer video visits than those with other types of mental health disorders,<sup>22</sup> which is consistent with our finding. We also found that the gap in video use by SUD diagnosis does not decrease over time, which may be an area of future research. It has been reported that primary care clinicians prefer phone visits or have no preference, citing video visit challenges.<sup>22</sup> Prior research has shown that telemental health is well received by patients with mental health visits.

High telehealth use among SUD patients, driven by phone visits, may be associated with prior telehealth use,<sup>23</sup> leading to lower technological barriers for its use.

One limitation of this study is the reliance on administrative data to identify patients with SUD diagnoses. As noted above, Williams et al.<sup>15</sup> found that, based on a survey-based assessment of substance use disorder prevalence rates, SUD identification based on electronic health records underestimated SUD by approximately one-third. This would lead to lower estimates in this study of the differences between Veterans with and without SUD in telemedicine use, where we found small differences. Williams and her colleagues also found, however, that the differences in prevalence rates were attenuated when analysis focused on patients with moderate to severe disorders, those most likely to be in treatment. Improved diagnostic accuracy would benefit and bring into treatment those undiagnosed. Given the small differences in telemedicine use by those with and without SUD, the underestimate of the Veterans with SUD and resulting attenuation of estimates associated with telemedicine would not be expected to have a large impact.

This study contributes to the understanding of telehealth use for primary care services among Veterans with a substance use disorder. For both SUD and non-SUD patient groups, the use of telehealth modalities increased immediately after the pandemic but gradually decreased to a new normal substantially above pre-pandemic levels. Therefore, like non-SUD patients, use of telehealth services in primary care continued to provide a viable modality for Veterans with SUD. This highlights the need for sustaining accessibility of telehealth services for all patients, including patients diagnosed with SUD. Additional research is needed to better understand the effect of telehealth use on care quality, patient experience, and outcomes among Veterans with SUD.

## Tables and Figures

Table 1. Demographic and Clinical Characteristics of Veteran in Primary Care by SUD Diagnosis, 2019 –2020

		<b>SUD</b> N=466,013	<b>Non-SUD</b> N=4,783,917	<b>Total</b>	<b>p-value</b>
Age, mean(SD)		57.1 (14.1)	63.4 (16.4)	62.9 (16.3)	<.0001
Age group, n(%)	18-44	99,137 (21.3)	750,960 (15.7)	850,097 (16.2)	<.0001
	45-64	201,430 (43.2)	1,339,109 (28)	1,540,539 (29.3)	
	65-74	137,794 (29.6)	1,569,206 (32.8)	1,707,000 (32.5)	
	75+	27,650 (5.9)	1,124,632 (23.5)	1,152,282 (21.9)	
Gender, n(%)	Male	430,332 (92.3)	4,363,341 (91.2)	4,793,673 (91.3)	<.0001
	Female	35,681 (7.7)	420,576 (8.8)	456,257 (8.7)	
Race/Ethnicity, n(%)	Black	112,530 (24.1)	793,358 (16.6)	905,888 (17.3)	<.0001
	Hispanic	29,647 (6.4)	310,072 (6.5)	339,719 (6.5)	
	Other Minority	9,671 (2.1)	115,813 (2.4)	125,484 (2.4)	
	Unknown	18,998 (4.1)	268,465 (5.6)	287,463 (5.5)	
	White	295,167 (63.3)	3,296,209 (68.9)	3,591,376 (68.4)	
Marital Status, n(%)	Married	169,162 (36.6)	2,765,194 (58.6)	2,934,356 (56.7)	<.0001
	Divorced/Widowed	171,560 (37.2)	1,223,811 (25.9)	1,395,371 (26.9)	
	Never Married/Separated	120,959 (26.2)	729,078 (15.5)	850,037 (16.4)	
Outside Insurance, n(%)	No	192,600 (41.3)	1,299,536 (27.2)	1,492,136 (28.4)	<.0001
	Yes	273,413 (58.7)	3,484,381 (72.8)	3,757,794 (71.6)	
Charlson Comorbidity Index ,mean(SD)		1.9 (2.5)	1.3 (1.9)	1.3 (2)	<.0001
Charlson Comorbidity Index ,n(%)	0	186,690 (40.1)	2,336,710 (48.8)	2,523,400 (48.1)	<.0001
	1	100,911 (21.7)	1,046,474 (21.9)	1,147,385 (21.9)	
	2+	178,412 (38.3)	1,400,733 (29.3)	1,579,145 (30.1)	
Anxiety, n(%)		169,038 (36.3)	675,774 (14.1)	844,812 (16.1)	<.0001
Depression, n(%)		227,185 (48.8)	850,300 (17.8)	1,077,485 (20.5)	<.0001
Serious Mental Illness, n(%)		157,026 (33.7)	580,782 (12.1)	737,808 (14.1)	<.0001
Psychosis, n(%)		14,793 (3.2)	18,307 (0.4)	33,100 (0.6)	<.0001
PTSD, n(%)		171,761 (36.9)	694,720 (14.5)	866,481 (16.5)	<.0001
Other Mental Health Conditions, n(%)		65,351 (14)	131,601 (2.8)	196,952 (3.8)	<.0001

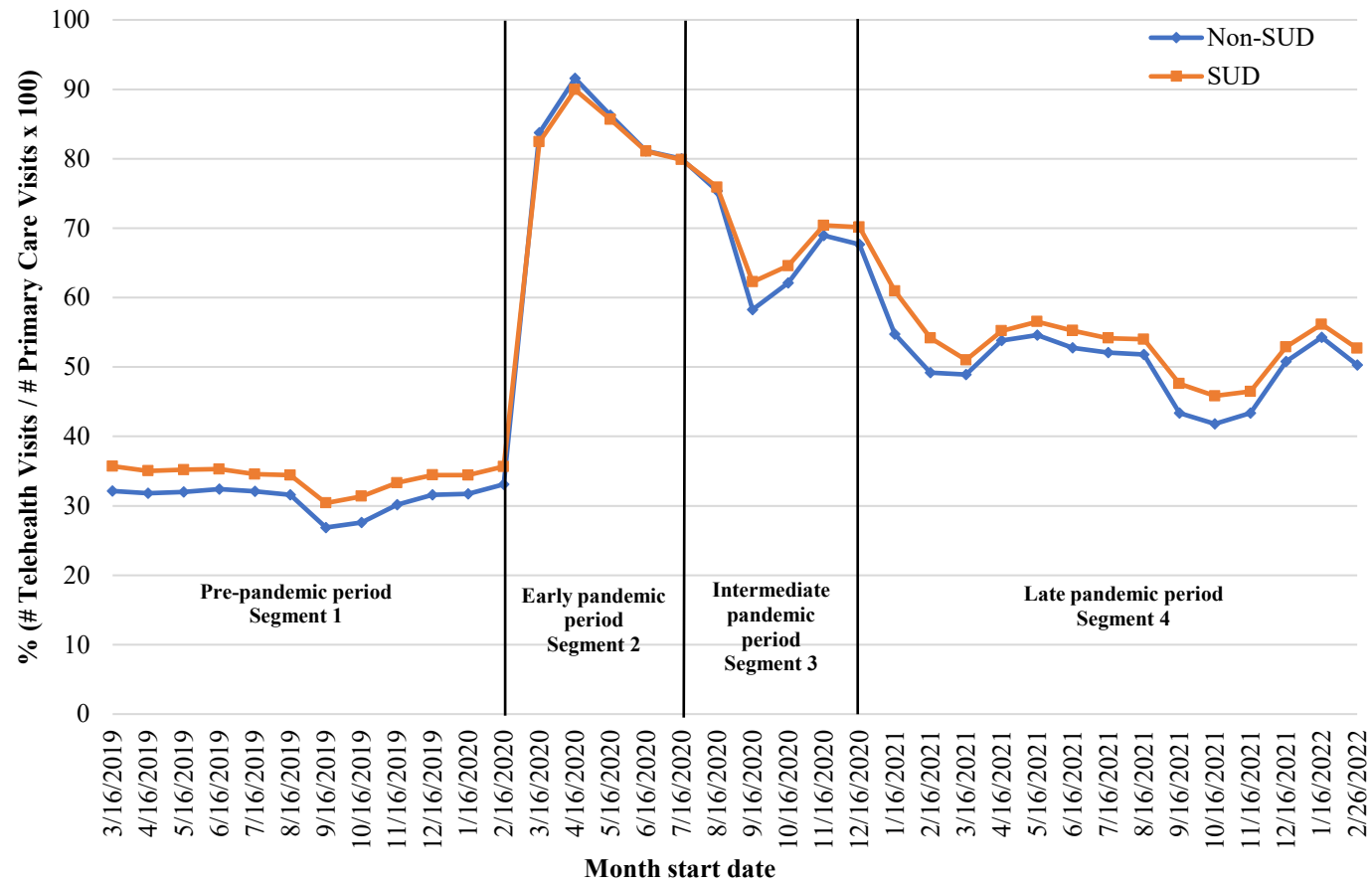


Figure 1. Unadjusted Percentages of Telehealth Primary Care Visits Per Month



Table 2a. Unadjusted Percentages of Telehealth Visits (i.e. Sum of Telehealth Visits / Sum of Primary Care Visits by All Patients within Each Segment) among Veterans with SUD

	<b>Segment 1 (n=409,552)</b>	<b>Segment 2 (n=293,233)</b>	<b>Segment 3 (n=298,811)</b>	<b>Segment 4 (n=368,137)</b>
<b>Overall</b>	34.2	83.7	68.5	53.1
<b>Baseline Age category (n, %)</b>				
18-44	30.8	83.2	71.1	55.1
45-64	33.8	83.8	68.9	53.4
65-74	35.7	84.0	66.9	52.0
75+	37.2	83.3	66.5	51.8
Unknown				
<b>Baseline Birth Sex (n, %)</b>				
Male	34.2	83.6	68.2	52.7
Female	34.9	84.5	71.1	57.1
<b>Baseline Race/Ethnicity (n, %)</b>				
NH Black	30.7	84.5	70.4	53.4
Hispanic	26.9	83.1	70.5	51.3
NH Other	31.2	81.8	68.2	53.8
Unknown	32.7	83.5	68.2	53.2
White	36.5	83.6	67.5	53.2
<b>Charlson Comorbidity Index</b>				
0	29.5	82.9	67.6	50.8
1	32.7	83.7	67.8	52.4
2+	37.8	84.3	69.4	55.3
<b>Comorbidities (%)</b>				
Depression				
No	34.3	83.8	67.5	52.0
Yes	34.1	83.7	69.3	54.2
Anxiety				
No	33.9	83.8	67.8	52.2
Yes	34.7	83.7	69.6	54.6
PTSD				
No	34.9	83.8	68.1	52.6
Yes	33.1	83.6	69.1	54.0
SMI				
No	34.3	84.1	68.5	53.1
Yes	33.7	81.7	68.3	53.5
<b>Marital Status</b>				
Divorced	35.1	83.5	68.6	53.5
Married	34.9	84.8	68.4	53.1
Never Married	31.3	81.9	68.0	52.4
Separated	33.2	84.1	69.5	53.9
Widowed	36.4	84.1	67.5	52.9
<b>Has insurance</b>				
No	32.5	83.3	68.9	53.6
Yes	35.2	84.0	68.2	52.9

Table 2b. Unadjusted Percentages of Telehealth Visits (i.e. Sum of Telehealth Visits / Sum of Primary Care Visits by All Patients within Each Segment) among Veterans without SUD

	<b>Segment 1 (n=4,203,378)</b>	<b>Segment 2 (n=2,790,665)</b>	<b>Segment 3 (n=2,978,294)</b>	<b>Segment 4 (n=3,828,726)</b>
<b>Overall</b>	31.0	84.4	66.1	50.0
<b>Baseline Age category (n, %)</b>				
18-44	28.2	85.5	72.6	55.5
45-64	30.7	85.1	68.3	51.5
65-74	31.5	83.9	63.9	48.3
75+	31.9	83.7	63.1	47.3
Unknown				
<b>Baseline Birth Sex (n, %)</b>				
Male	30.9	84.4	65.7	49.3
Female	31.9	85.0	70.3	55.6
<b>Baseline Race/Ethnicity (n, %)</b>				
NH Black	28.6	86.4	70.7	52.3
Hispanic	24.6	85.9	70.9	49.8
NH Other	28.2	83.9	67.1	51.8
Unknown	29.7	83.7	64.8	49.3
White	32.4	83.8	64.5	49.4
<b>Charlson Comorbidity Index</b>				
0	27.2	83.9	65.1	47.6
1	30.6	84.7	66.3	50.2
2+	34.9	84.8	67.2	52.6
<b>Comorbidities (%)</b>				
Depression				
No	30.6	84.3	65.3	49.0
Yes	32.1	85.0	69.2	53.5
Anxiety				
No	30.8	84.3	65.5	49.2
Yes	31.9	85.0	69.4	53.7
PTSD				
No	31.1	84.3	65.7	49.5
Yes	30.6	84.9	68.4	52.6
SMI				
No	30.9	84.5	66.1	49.9
Yes	31.8	83.0	68.1	52.8
<b>Marital Status</b>				
Divorced	32.0	84.1	66.6	50.9
Married	30.9	84.8	65.6	49.3
Never Married	28.6	83.5	67.5	51.0
Separated	31.2	84.9	69.4	52.7
Widowed	33.1	84.0	64.8	49.2
<b>Has insurance</b>				
No	29.5	84.5	68.9	52.3
Yes	31.5	84.4	65.2	49.2

Table 3. Incidence Rate Ratios and 95% Confidence Interval for Telehealth Visits in Primary Care from Multivariable Negative Binomial Regressions

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
	<b>IRR (95% CI)</b>	<b>IRR (95% CI)</b>	<b>IRR (95% CI)</b>
SUD Diagnosis	1.11 (1.11, 1.11)	1.07 (1.07, 1.07)	1.09 (1.09,1.09)
Segment (ref: Segment 1 Pre-pandemic)			
Segment 2 (Early)	2.79 (2.78, 2.79)	2.78 (2.78, 2.79)	2.69 (2.68,2.69)
Segment 3 (Intermediate)	2.17 (2.16, 2.17)	2.17 (2.17, 2.17)	2.02 (2.01,2.02)
Segment 4 (Late)	1.61 (1.61, 1.62)	1.62 (1.62, 1.62)	1.49 (1.49,1.50)
Interaction of SUD x Segment			
SUD x Segment 2	0.89 (0.89, 0.90)	0.90 (0.89, 0.90)	0.89 (0.88,0.89)
SUD x Segment 3	0.93 (0.93, 0.94)	0.93 (0.93, 0.94)	0.91 (0.91,0.92)
SUD x Segment 4	0.96 (0.96, 0.97)	0.96 (0.96, 0.97)	0.94 (0.93,0.94)
Age (ref: 75+)			
18-44		1.12 (1.12,1.12)	0.94 (0.93,0.94)
45-64		1.06 (1.05,1.06)	0.98 (0.97,0.98)
65-74		1.01 (1.00,1.01)	0.99 (0.99,0.99)
Interaction of Age x Segment			
18-44 x Segment 2			1.14 (1.14,1.15)
18-44 x Segment 3			1.28 (1.28,1.29)
18-44 x Segment 4			1.31 (1.30,1.32)
45-64 x Segment 2			1.05 (1.05,1.06)
45-64 x Segment 3			1.12 (1.12,1.12)
45-64 x Segment 4			1.13 (1.12,1.13)
65-74 x Segment 2			1.01 (1.01,1.02)
65-74 x Segment 3			1.02 (1.02,1.03)
65-74 x Segment 4			1.03 (1.03,1.03)
Female (ref: Male)		1.05 (1.05,1.05)	1.05 (1.05,1.05)
Race/ethnicity (ref: White)			
Black		1.00 (1.00,1.00)	1.00 (1.00,1.00)
Hispanic		0.96 (0.96,0.96)	0.96 (0.96,0.97)
Other minority		0.99 (0.98,0.99)	0.99 (0.98,0.99)
Unknown		0.98 (0.98,0.99)	0.98 (0.98,0.99)
CCI (ref: 0)			
1		1.07 (1.07,1.07)	1.07 (1.07,1.07)
2+		1.14 (1.14,1.14)	1.14 (1.14,1.14)
Marital status (ref: Married)			
Divorced/Widowed		1.01 (1.01,1.01)	1.01 (1.01,1.01)
Never Married/Separated		0.99 (0.99,0.99)	0.99 (0.99,0.99)
Depression		1.02 (1.02,1.02)	1.02 (1.02,1.03)
Anxiety		1.02 (1.02,1.02)	1.02 (1.02,1.02)
PTSD		1.01 (1.00,1.01)	1.01 (1.01,1.01)
Psychosis		0.97 (0.97,0.98)	0.97 (0.97,0.98)
Other mental health condition		1.01 (1.01,1.01)	1.01 (1.01,1.01)
Serious mental illness		1.00 (1.00,1.00)	1.00 (1.00,1.01)
Have insurance outside VA		1.00 (1.00,1.00)	1.00 (1.00,1.00)

Note: All coefficients are statistically significant (p<0.001)

Table 4. Predicted Count of Telehealth Primary Care Visits per Person based on Multivariable Negative Binomial Regression Models

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
<b>Predicted count of visits</b>			
SUD x Segment 1	1.40 (1.40, 1.40)	1.36 (1.36, 1.36)	1.38 (1.37,1.38)
SUD x Segment 2	3.50 (3.49, 3.50)	3.39 (3.38, 3.39)	3.40 (3.40,3.41)
SUD x Segment 3	2.84 (2.83, 2.84)	2.76 (2.75, 2.76)	2.74 (2.73,2.74)
SUD x Segment 4	2.17 (2.17, 2.18)	2.12 (2.11, 2.12)	2.10 (2.09,2.10)
Non-SUD x Segment 1	1.26 (1.26, 1.26)	1.27 (1.27, 1.27)	1.27 (1.27,1.27)
Non-SUD x Segment 2	3.52 (3.51, 3.52)	3.53 (3.53, 3.54)	3.53 (3.53,3.53)
Non-SUD x Segment 3	2.73 (2.73, 2.74)	2.75 (2.75, 2.76)	2.76 (2.76,2.76)
Non-SUD x Segment 4	2.04 (2.03, 2.04)	2.06 (2.05, 2.06)	2.06 (2.06,2.06)
<b>Difference by SUD diagnosis</b>			
(SUD vs Non-SUD) in Segment 1	0.14 (0.13,0.14)	0.090 (0.085,0.094)	0.11 (0.11,0.12)
(SUD vs Non-SUD) in Segment 2	-0.025 (-0.029,-0.020)	-0.15 (-0.15,-0.14)	-0.13 (-0.13,-0.12)
(SUD vs Non-SUD) in Segment 3	0.10 (0.10,0.11)	0.002 (-0.003,0.008) <sup>a</sup>	-0.020 (-0.026,-0.014)
(SUD vs Non-SUD) in Segment 4	0.14 (0.13,0.14)	0.061 (0.058, 0.066)	0.042 (0.037,0.047)

Note: All numbers are statistically significant (p<0.001) except for <sup>a</sup>(p=0.44)

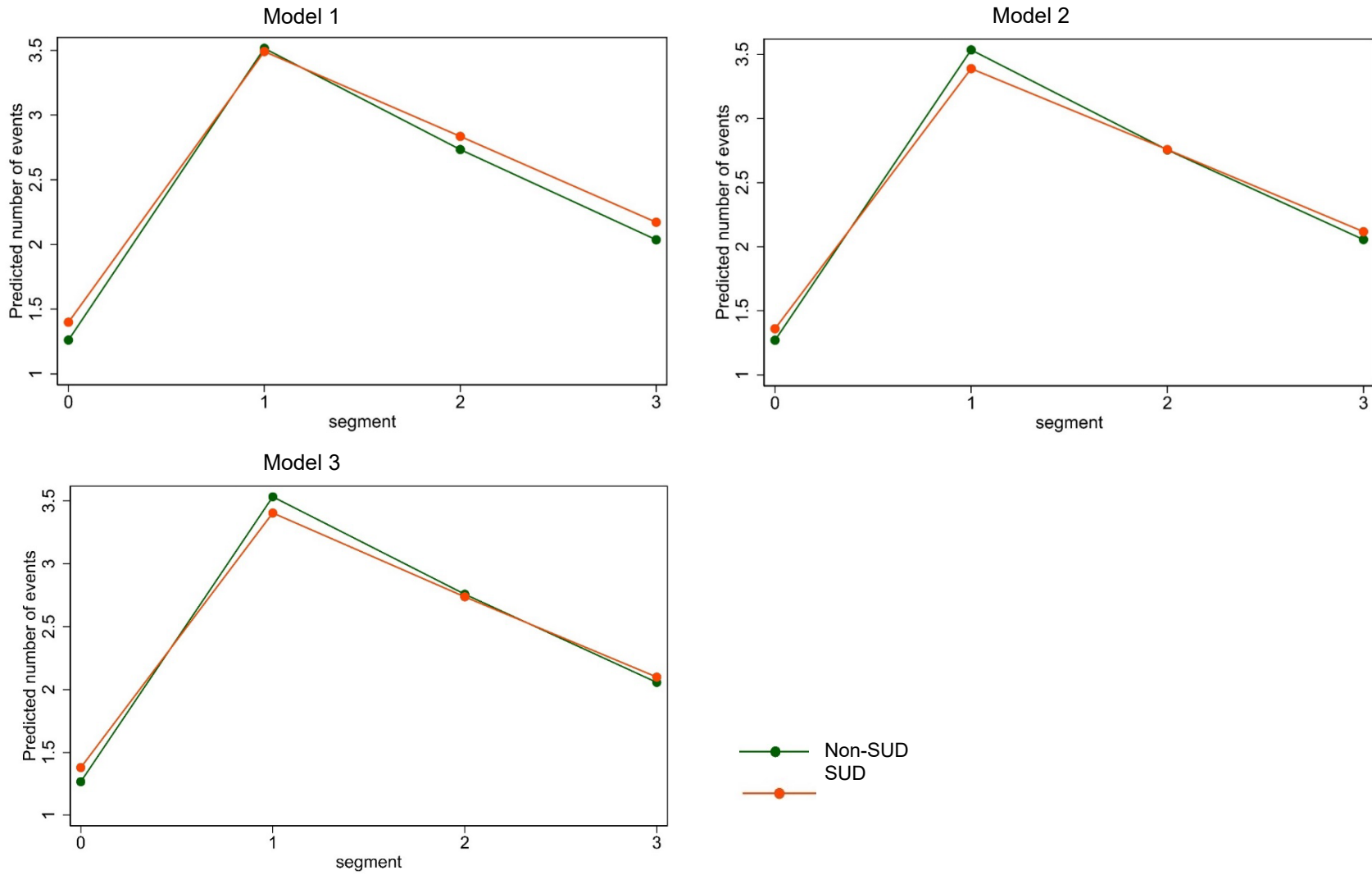


Figure 2. Predicted Count of Telehealth Primary Care Visits per Person based on Multivariable Negative Binomial Regression Models

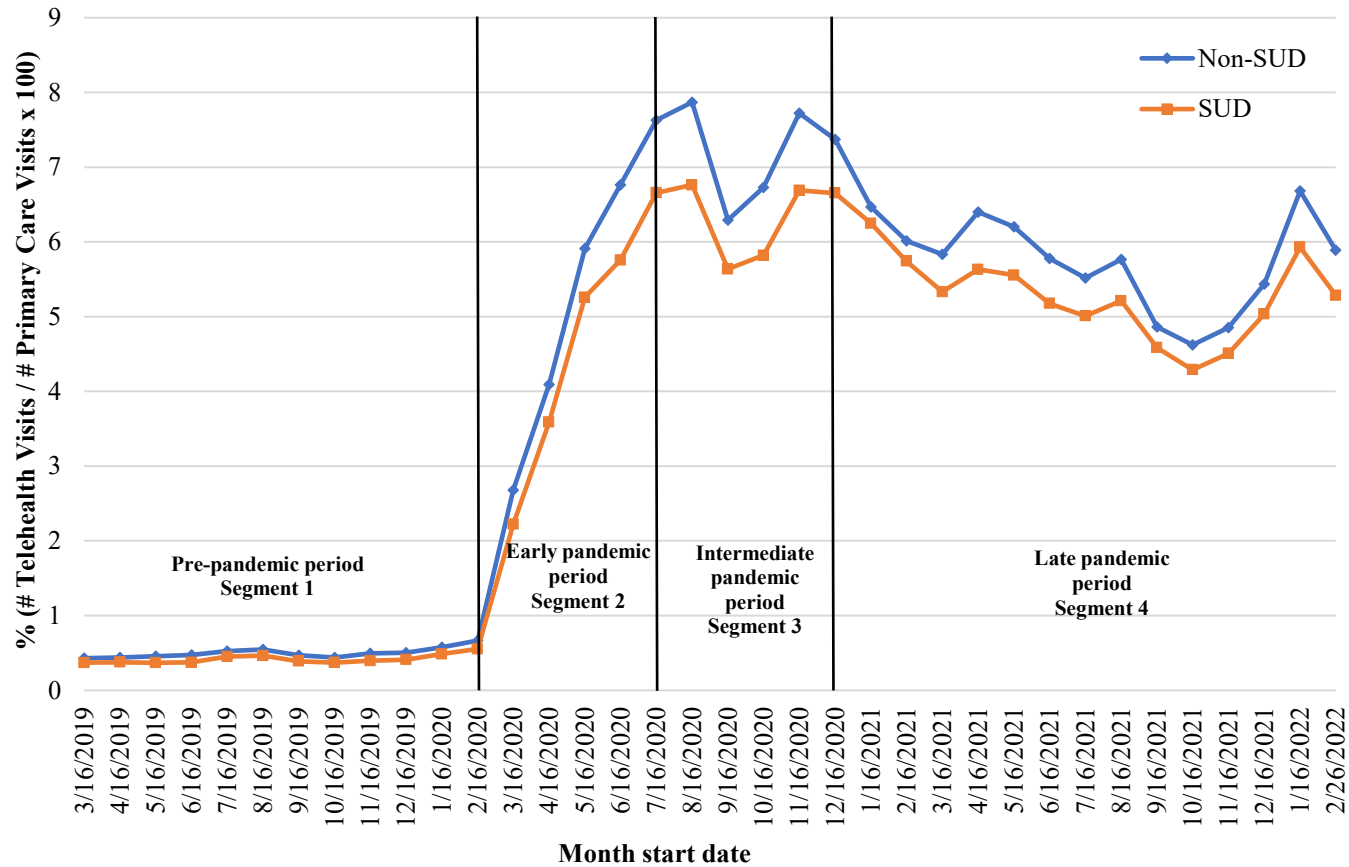


Figure 3. Unadjusted Percentages of Video-to-Home Primary Care Visits Per Month

Table 5a. Unadjusted Percentages of Video-to-Home Visits (i.e. Sum of Video-to-Home Visits / Sum of Primary Care Visits by All Patients within Each Segment) among Veterans with SUD

	Segment 1 (n=409,552)	Segment 2 (n=293,233)	Segment 3 (n=298,811)	Segment 4 (n=368,137)
<b>Overall</b>	0.4	4.7	6.4	5.4
<b>Baseline Age category (n, %)</b>				
18-44	0.7	8.1	11.2	9.7
45-64	0.4	4.9	6.6	5.5
65-74	0.3	3.3	4.3	3.5
75+	0.3	2.8	3.8	2.9
Unknown				
<b>Baseline Birth Sex (n, %)</b>				
Male	0.4	4.4	6.1	5.1
Female	0.6	7.5	9.5	8.4
<b>Baseline Race/Ethnicity (n, %)</b>				
NH Black	0.2	4.3	6.4	5.7
Hispanic	0.4	6.3	9.0	7.1
NH Other	0.7	6.0	7.5	6.6
Unknown	0.5	5.0	6.5	5.7
White	0.5	4.6	6.0	5.0
<b>Charlson Comorbidity Index</b>				
0	0.6	6.5	8.7	7.2
1	0.4	4.6	6.2	5.2
2+	0.3	3.6	4.8	4.1
<b>Comorbidities (%)</b>				
Depression				
No	0.4	4.3	5.8	4.7
Yes	0.4	5.1	6.9	6.0
Anxiety				
No	0.4	4.3	5.8	4.8
Yes	0.4	5.3	7.4	6.3
PTSD				
No	0.4	4.2	5.7	4.7
Yes	0.5	5.5	7.5	6.4
SMI				
No	0.4	4.8	6.4	5.4
Yes	0.3	4.3	6.2	5.3
<b>Marital Status</b>				
Divorced	0.4	4.2	5.7	4.9
Married	0.5	5.2	6.8	5.6
Never Married	0.4	5.1	7.0	6.1
Separated	0.3	4.5	6.4	5.5
Widowed	0.3	3.4	4.4	3.7
<b>Has insurance</b>				
No	0.4	5.3	7.3	6.3
Yes	0.4	4.3	5.8	4.8

Table 5b. Unadjusted Percentages of Video-to-Home Primary Care Visits (i.e. Sum of Video-to-Home Visits / Sum of Primary Care Visits by All Patients within Each Segment) among Veterans without SUD

	<b>Segment 1 (n=4,203,378)</b>	<b>Segment 2 (n=2,790,665)</b>	<b>Segment 3 (n=2,978,294)</b>	<b>Segment 4 (n=3,828,726)</b>
<b>Overall</b>	0.5	5.4	7.1	5.7
<b>Baseline Age category (n, %)</b>				
18-44	0.9	10.3	14.2	12.3
45-64	0.6	6.6	8.7	7.0
65-74	0.4	4.4	5.2	3.9
75+	0.3	3.1	4.0	3.0
Unknown				
<b>Baseline Birth Sex (n, %)</b>				
Male	0.5	5.0	6.6	5.2
Female	0.8	9.0	11.5	10.1
<b>Baseline Race/Ethnicity (n, %)</b>				
NH Black	0.4	6.2	8.7	7.5
Hispanic	0.5	7.0	10.2	7.6
NH Other	0.6	6.5	8.6	7.1
Unknown	0.6	5.3	7.0	5.8
White	0.5	5.0	6.3	4.9
<b>Charlson Comorbidity Index</b>				
0	0.6	7.1	9.2	7.4
1	0.5	5.0	6.6	5.2
2+	0.4	3.9	5.1	4.0
<b>Comorbidities (%)</b>				
Depression				
No	0.5	5.1	6.7	5.3
Yes	0.6	6.4	8.6	7.2
Anxiety				
No	0.5	5.1	6.7	5.3
Yes	0.6	6.9	9.3	7.8
PTSD				
No	0.5	5.2	6.8	5.4
Yes	0.6	6.4	8.5	7.1
SMI				
No	0.5	5.4	7.1	5.7
Yes	0.4	5.1	7.0	5.8
<b>Marital Status</b>				
Divorced	0.5	5.0	6.6	5.4
Married	0.5	5.4	7.0	5.5
Never Married	0.5	6.7	9.1	7.6
Separated	0.4	5.6	7.6	6.4
Widowed	0.3	3.4	4.5	3.5
<b>Has insurance</b>				
No	0.6	7.0	9.5	7.9
Yes	0.5	4.8	6.3	4.9



Table 6. Incident Rate Ratios and 95% Confidence Interval for Video-to-Home Visits in Primary Care from Multivariable Negative Binomial Regressions

	Model 1	Model 2	Model 3
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
SUD Diagnosis	0.81 (0.78, 0.84)	0.75 (0.72, 0.77)	0.78 (0.75, 0.80)
Segment (ref: Segment 1 Pre-pandemic)			
Segment 2 (Early)	11.2 (11.0, 11.3)	10.9 (10.8, 11.1)	9.3 (9.1, 9.6)
Segment 3 (Intermediate)	14.8 (14.6, 15.0)	14.5 (14.3, 14.6)	12.1 (11.8, 12.4)
Segment 4 (Late)	11.6 (11.5, 11.7)	11.0 (10.9, 11.1)	8.9 (8.7, 9.1)
Interaction of SUD x Segment			
SUD x Segment 2	1.07 (1.03, 1.11)	1.07 (1.03, 1.11)	1.04 (1.00, 1.08) <sup>a</sup>
SUD x Segment 3	1.11 (1.07, 1.15)	1.10 (1.06, 1.15)	1.07 (1.03, 1.11)
SUD x Segment 4	1.17 (1.13, 1.22)	1.17 (1.13, 1.22)	1.12 (1.08, 1.16)
Age (ref: 75+)			
18-44		2.91 (2.89, 2.94)	2.16 (2.09, 2.23)
45-64		1.97 (1.95, 1.98)	1.53 (1.49, 1.58)
65-74		1.26 (1.25, 1.27)	1.14 (1.11, 1.18)
Interaction of Age x Segment			
18-44 x Segment 2			1.22 (1.18, 1.26)
18-44 x Segment 3			1.33 (1.29, 1.38)
18-44 x Segment 4			1.49 (1.44, 1.54)
45-64 x Segment 2			1.25 (1.22, 1.29)
45-64 x Segment 3			1.29 (1.25, 1.33)
45-64 x Segment 4			1.33 (1.29, 1.37)
65-74 x Segment 2			1.13 (1.10, 1.17)
65-74 x Segment 3			1.11 (1.08, 1.15)
65-74 x Segment 4			1.09 (1.06, 1.13)
Female (ref: Male)		1.25 (1.24, 1.25)	1.25 (1.24, 1.26)
Race/ethnicity (ref: White)			
Black		1.12 (1.12, 1.13)	1.12 (1.12, 1.13)
Hispanic		1.20 (1.19, 1.21)	1.20 (1.19, 1.21)
Other minority		1.12 (1.11, 1.13)	1.12 (1.11, 1.14)
Unknown		1.07 (1.06, 1.07)	1.07 (1.06, 1.07)
CCI (ref: 0)			
1		0.89 (0.88, 0.89)	0.89 (0.88, 0.89)
2+		0.81 (0.80, 0.81)	0.81 (0.80, 0.81)
Marital status (ref: Married)			
Divorced/Widowed		0.86 (0.85, 0.86)	0.86 (0.85, 0.86)
Never Married/Separated		0.88 (0.88, 0.88)	0.88 (0.87, 0.88)
Depression		1.04 (1.03, 1.04)	1.04 (1.03, 1.04)
Anxiety		1.12 (1.11, 1.12)	1.12 (1.11, 1.13)
PTSD		1.05 (1.04, 1.05)	1.05 (1.04, 1.05)
Psychosis		0.81 (0.79, 0.83)	0.81 (0.79, 0.83)
Other mental health condition		0.98 (0.97, 0.98)	0.98 (0.97, 0.98)
Serious mental illness		0.87 (0.86, 0.88)	0.87 (0.87, 0.88)
Have insurance outside VA		1.06 (1.05, 1.06)	1.06 (1.05, 1.06)

Note: All coefficients are statistically significant ( $p < 0.001$  except for <sup>a</sup> ( $p = 0.03$ ))

Table 7. Predicted Count of Video-to-Home Primary Care Visits per Person based on Multivariable Negative Binomial Regression Models

	Model 1	Model 2	Model 3
<b>Predicted count of visits</b>			
SUD x Segment 1	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
SUD x Segment 2	0.20 (0.20, 0.20)	0.18 (0.18, 0.18)	0.18 (0.18, 0.18)
SUD x Segment 3	0.27 (0.27, 0.28)	0.25 (0.25, 0.25)	0.25 (0.25, 0.25)
SUD x Segment 4	0.23 (0.22, 0.23)	0.20 (0.20, 0.20)	0.20 (0.20, 0.20)
Non-SUD x Segment 1	0.020 (0.020, 0.021)	0.021 (0.021, 0.021)	0.021 (0.020, 0.021)
Non-SUD x Segment 2	0.23 (0.23, 0.23)	0.23 (0.23, 0.23)	0.23 (0.23, 0.23)
Non-SUD x Segment 3	0.30 (0.30, 0.30)	0.30 (0.30, 0.30)	0.30 (0.30, 0.30)
Non-SUD x Segment 4	0.24 (0.24, 0.24)	0.23 (0.23, 0.23)	0.23 (0.23, 0.23)
<b>Difference by SUD diagnosis</b>			
(SUD vs Non-SUD) in Segment 1	-0.004 (-0.004, -0.003)	-0.005 (-0.006, -0.005)	-0.005 (-0.005, -0.004)
(SUD vs Non-SUD) in Segment 2	-0.03 (-0.03, -0.03)	-0.04 (-0.05, -0.04)	-0.04 (-0.05, -0.04)
(SUD vs Non-SUD) in Segment 3	-0.03 (-0.03, -0.03)	-0.05 (-0.05, -0.05)	-0.05 (-0.05, -0.05)
(SUD vs Non-SUD) in Segment 4	-0.01 (-0.01, -0.01)	-0.03 (-0.03, -0.03)	-0.03 (-0.03, -0.03)

Note: All numbers are statistically significant (p<0.001)

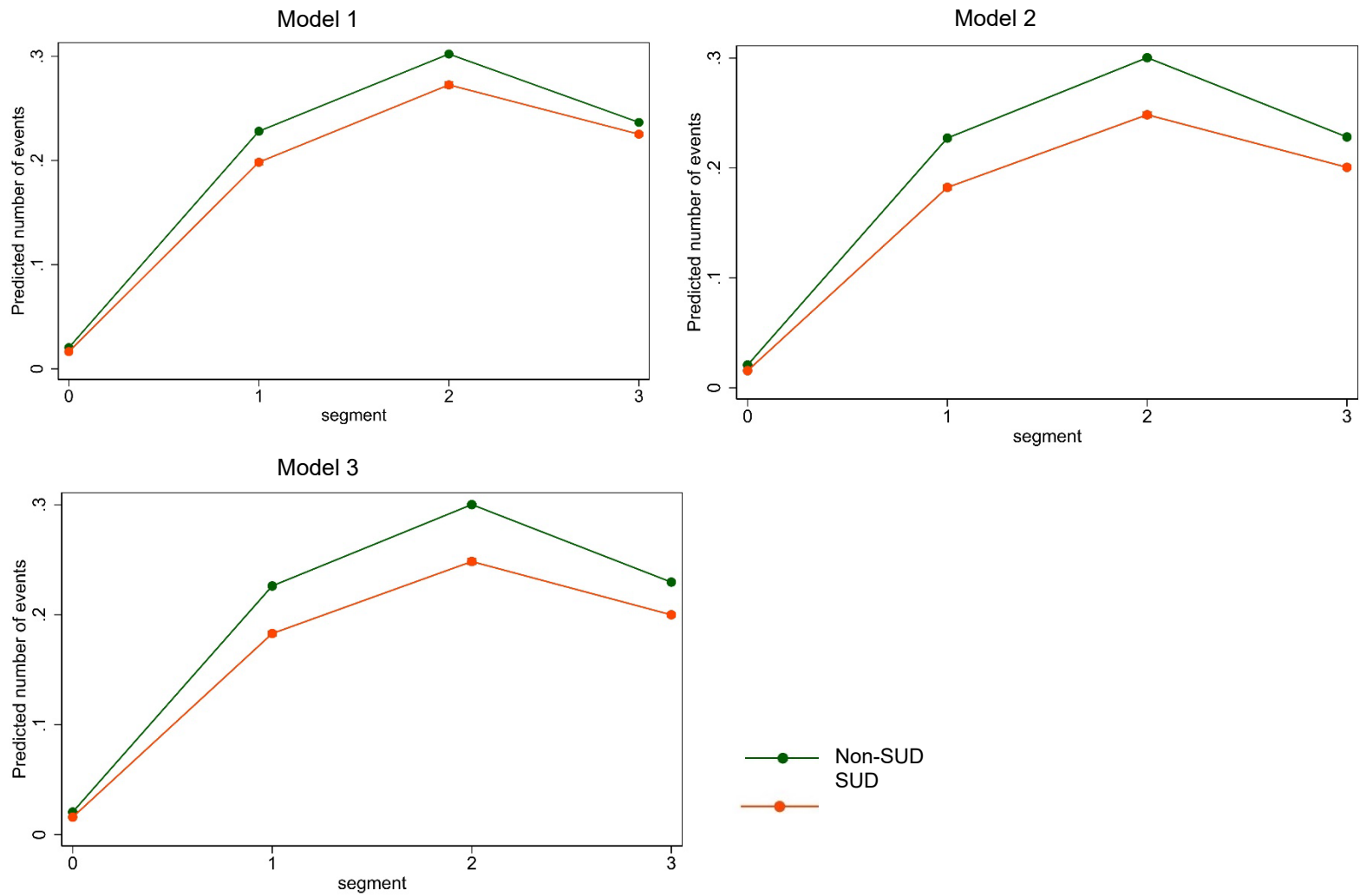


Figure 4. Predicted Count of Video-to-Home Primary Care Visits per Person based on Multivariable Negative Binomial Regression Models

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## Chapter 3 : Attrition from VA Primary Care by Substance Use Disorder Diagnosis, 2020-2022

### Introduction

Attrition within the healthcare system refers to patients initially accessing and utilizing healthcare services but subsequently discontinuing their use.<sup>1</sup> The attrition, particularly from primary care settings, may signify a lack of receipt of essential and preventive care, dissatisfaction with care, or increased barriers to obtaining care. Within the Veteran Health Administration (VA), primary care serves as, not only a gateway to comprehensive health services, but also to specialty care or other supplementary services for patients with special needs.<sup>2</sup> For individuals with substance use disorder (SUD), especially those with less severe SUD, primary care offers comprehensive and coordinated care to address medical and other SUD-related issues. For example, SUD is known to complicate the management of common chronic conditions, such as hypertension and diabetes. For patients with severe SUDs, primary care can complement treatment offered by specialty addiction care, given the barriers to accessing specialty care due to limited availability and stigma.<sup>3</sup> Particularly, the Patient-Centered Medical Home (PCMH) model has proven beneficial in chronic disease management for vulnerable patients.<sup>4,5</sup> However, according to the surveys of patient experiences, Veterans with SUD reported lower satisfaction with primary care compared to those without SUD.<sup>6</sup>

Our conceptual framework for this study has been influenced by the Behavioral Model for Vulnerable Populations (BMVP)<sup>7</sup>, with its domains of Predisposing (sociodemographic), Enabling (system), Need (clinical), and Health Behavioral characteristics of patients. Patient-level factors like substance use and competing priorities may impact healthcare service

utilization and outcomes for vulnerable populations. While we often examine access and utilization concerning patients who are either new or continued users of healthcare services, less attention has been paid to patients who discontinue use of healthcare. Attrition from a healthcare system may be attributed to barriers to care or receipt of care outside their current healthcare system. Additionally, in capitated managed care systems, such as the VA,<sup>8,9</sup> it is important to track enrollees and maintain systems for comprehensive care.<sup>10</sup>

Previous studies on attrition have been limited to a specific gender, certain medical conditions, single managed care plan, and methodologies with limited sample sizes. Prior studies have revealed that attrition among female Veterans from the VA is associated with negative perceptions of the VA, patient experiences, travel time and distance to VA sites, affordability of VA care, availability of alternative health insurance, and utilization of outpatient community care.<sup>11-14</sup> Factors related to voluntary disenrollment from managed care plans have also been explored. For example, a study of Medicare managed plan patients found increased disenrollment associated with poor physical and mental health and dissatisfaction with provider choices within the network. Another study among Kaiser Permanente patients found a higher likelihood of disenrollment linked to unsatisfactory patient experiences with providers and visits.<sup>15,16</sup> Regarding primary care utilization among patients with substance use disorder, a lower perceived need for preventive care,<sup>17</sup> shame and stigma may lead to patient reluctance in scheduling primary care visits or engaging with providers.<sup>18,19</sup> However, to our knowledge, there is no existing nationwide study focusing on the relationship between attrition and overall SUD using electronic health records (EHR).



## **Objective**

Our study examines how the rates of primary care attrition differ between Veterans with and without a SUD diagnosis between 2020 and 2022. We hypothesize that Veterans with any SUD diagnosis will have higher rates of attrition from primary care during this period.

## **Methods**

### *Study Design and Sample*

This was a nationwide retrospective cohort study of Veteran patients who were continuous users of VA primary care services between March 16, 2018, and March 15, 2020. Initially, we identified Veterans who had at least one primary care visit (either outpatient regular primary care visits or mental health integrated primary care visits)<sup>20</sup> (n=5,249,930) between March 16, 2018, and March 15, 2019. Next, to assess for *continuous* primary care use, we identified primary care users by limiting the initial cohort to those having at least one subsequent primary care visit between March 16, 2019, and March 15, 2020 (n=4,613,830). We included any visit with primary care clinic codes (Appendix 1) between March 16, 2020, and March 15, 2022. Those who were not alive by March 15, 2022, were excluded from the sample (n=4,145,572). The study centered on Veterans diagnosed with any SUD in the VA EHR as the group of interest, while the comparison group consisted of Veterans who did not have any SUD diagnosis.

### *Data Sources*

Patient-level demographic characteristics, comorbidities, and outpatient visits and their dates were extracted from the Corporate Data Warehouse (CDW).<sup>21</sup> The CDW is a national data

repository of EHRs from the Veterans Affairs administrative and clinical systems. Geographic information related to patient residence was obtained from the VA Planning Systems Support Group (PSSG) enrollee files.<sup>22</sup> All data management and analyses were conducted within a secure research environment known as the VA Informatics and Computing Infrastructure (VINCI).

### *Measures*

The main outcome variable was attrition from primary care services at the VA. We defined attrition as not having any primary care visit for two consecutive years (March 16, 2020 – March 15, 2022) based on existing literature on attrition.<sup>13,14</sup> Primary care visits were identified using VA-specific clinic codes and included both regular primary care and mental health integrated primary care visits (PCMHI). We note that attrition from primary care may not mean attrition from all VA care, as some Veterans may have transferred all their care to a specialist or specialist clinic. While this is a possibility, we believe it unlikely that a significant portion of patients in the VA will drop all primary care utilization and make exclusive use of specialists. Future research will test this assumption.

The cohort was categorized based on the presence of at least one SUD diagnosis from March 16, 2018, to March 15, 2019. First, an indicator variable for each type of SUD was created, defined as documentation of either two outpatient diagnoses or one inpatient diagnosis of ICD-10 diagnosis codes F10.x-F19.x (F10.x alcohol, F11.x opioid, F12.x cannabis, F13.x, sedative/hypnotic, anxiolytic, F14.x cocaine, F15.x other stimulant, F16.x Hallucinogen, F17.x Nicotine, F18.x Inhalant, F19.x Other psychoactive substance related disorders) from any visit in the VA, regardless of the visit's purpose or care setting.

There is some data suggesting that SUD is underdiagnosed in the VA.<sup>6</sup> While underdiagnosis would weaken the results, as those with SUD are included in the comparison group, the magnitude of underdiagnosis is such that the results of this analysis are potentially still valuable to guide policy and practice. This is discussed further in the discussion section.

Based on the Behavioral Model for Vulnerable Populations (BMVP)<sup>7</sup>, covariates included Predisposing (sociodemographic), Enabling (system), Need (clinical), and Health Behavioral characteristics of Veterans at baseline. Predisposing factors included age at the beginning of baseline period (March 15<sup>th</sup>, 2019) (18-44, 45-64, 65-74, and 75+), birth sex (male, female), race/ethnicity (Non-Hispanic Black, Hispanic, Non-Hispanic Other, Non-Hispanic Unknown, and Non-Hispanic White), marital status classified as married, divorced/widowed, and never married/separated. Enabling factors included indicators for the 138 VA healthcare systems and the status of non-VA insurance (VA insurance only, non-VA insurance). We also included the VA enrollment priority group, which is an assigned priority for VA healthcare based on service-related disability rating, income level, and eligibility for other benefits. For this study, we created four hierarchical categories: high disability (>50% service-related disability or catastrophically disabled; Group 1 and 4), low to moderate disability (10-40% service-related disability or military exposures; Group 2, 3, and 5), low income (annual income below area-adjusted income threshold; Group 6), and enrollment without special considerations (0% service-related disability and co-pay requirement; Group 7 and 8).<sup>23</sup> As a proxy for barriers to accessing care, we included rurality of patient residence (urban, rural), and driving distance and driving time to the nearest primary care site, which were categorized as greater than 40 miles and greater than or equal to 30 minutes, respectively, which are the VA's eligibility criteria for being able to access non-VA community care.<sup>24</sup> Need factors included Charlson Comorbidity Index (CCI),

which is a summary score of medical chronic conditions predicting risk of mortality, categorized into a score of 0, 1, and 2 or more. A CCI score of 2 or more was chosen to indicate high morbidity and cost, since it has been associated with healthcare utilization, outcome, and clinical relevance.<sup>25-28</sup> All documented diagnoses between March 15, 2018, and March 16, 2019, regardless of the visit's purpose or care setting, were included to calculate CCI. Indicators for mental health conditions included: depression, anxiety, post-traumatic stress disorder (PTSD), serious mental illness (SMI), and other mental health conditions.<sup>23,24</sup> Lastly, the Health Behavior factors included the number of primary care visits at baseline (from March 16, 2019, to March 15, 2020) were included to account for Veterans having varying initial levels of primary care utilization. These counts were categorized based on quartile values (1-2, 3, 4-6, and 7+ visits).

### *Statistical Analyses*

In bivariate analyses, we compared the sociodemographic and clinical characteristics of Veterans by SUD diagnosis with Chi-square tests for categorical and t-tests or Wilcoxon-Mann-Whitney tests for continuous variables. Subsequently, we examined the unadjusted percentages of attrition across the study period between March 16, 2020, and March 15, 2022, organizing the variables in the tables by the domains of the Behavioral Model for Vulnerable Populations, stratified by presence/absence of SUD diagnosis.

For multivariable analyses, the outcome was 2-year attrition from primary care (no primary care visit in the two-year period). A multivariable logistic regression model was used to examine the association between SUD diagnosis and attrition. The model included fixed effects for 138 VA healthcare systems and adjusted for patient covariates, with robust standard errors.

To compare regression coefficients based on SUD diagnosis, we applied regression models in parallel<sup>29,30</sup> by SUD diagnosis by simultaneously specifying two equations: one equation for Veterans with SUD, and another equation for Veterans without SUD. We tested the equality of coefficients between two models using the Wald test.

We calculated predicted probabilities (adjusted percent) of attrition by SUD diagnosis and the level of primary care utilization at baseline. All statistical tests were two-sided at the significance threshold of  $p < 0.05$ . Data were analyzed using Stata 18.0 (StataCorp, College Stations, TX).

### *Human Subjects*

The study was based on an ongoing quality improvement effort approved by the VA Greater Los Angeles Healthcare System's institutional review board. It deemed the study as exempt from full IRB review and therefore exempt from informed consent requirements.

## **Results**

### *Demographic and Clinical Characteristics*

The cohort included 4,145,572 Veteran patients who used primary care at least twice during the baseline two years preceding the study period and were alive at the end of the two-year study period: 360,444 (8.7%) with a substance use disorder and 3,785,128 (91.3%) without a SUD diagnosis. Table 1 compares the demographic and clinical characteristics of Veteran in our cohort. Compared to Veterans without SUD, Veterans with SUD, were younger (22% vs. 16% for the age group 18-44), more likely to be Non-Hispanic Black (25% vs. 17%), less likely to be married (38% vs. 59%), less likely to have health insurance outside the VA (58% vs. 72%)

and had more mental health conditions (50% vs. 19% for depression, 37% vs. 15% for anxiety, and 39% vs. 16% for PTSD), compared to Veterans without SUD. Furthermore, those with SUD were more likely to be categorized as a priority for Veterans Administration enrollment (51% vs. 41% for the high disability group), resided in urban areas (31% vs. 36% for rural residence), had short drive times (<30 minutes) to the nearest primary care sites (18% vs. 22%), and had a higher frequency of primary care visits at baseline (29% vs. 19% for 7+ visits) (All  $p < .001$ ).

### *Descriptive Analysis of Primary Care Attrition*

The percentage of Veterans who discontinued VA primary care (did not have any VA primary care visits during the 2-year follow-up period of March 16, 2020 – March 15, 2022) for the entire sample was 3.2% ( $n=132,448$ ). The attrition rates were 3.3% for Veterans with SUD and 3.2% for those without SUD.

Table 2 presents a comparison of patient demographic and clinical characteristics based on attrition status. There was no significant difference in attrition by SUD diagnosis ( $p=0.065$ ). Comparing patient characteristics, we observed that those who left VA primary care, compared to Veterans who continued with VA primary care, were more likely to be younger (6.7% for the age group 18-44 vs. 3.2% for 75+), Hispanic (3.5% vs. 3.1% for Non-Hispanic White), have only VA insurance (4.6% vs 2.6% for non-VA insurance) , and have fewer comorbidities (4.3% for CCI=0 vs. 1.8% for CCI=2+). They were also less likely to be considered a high priority for VA service enrollment (2.5% for high disability vs. 3.8% enrollment without special consideration). We did not observe a significant difference in drive time to the nearest primary care site by attrition status (3.2% for both categories - drive time <30 minutes, drive time  $\geq$ 30 minutes,  $p=0.320$ ). However, attrition was slightly higher among those with longer driving distances

(3.6% with driving distance  $\leq 40$  miles vs. 3.2% with driving distance  $> 40$  miles). Attritors also had a significantly lower number of primary care visits at baseline compared to non-attritors (attrition was 5.6% for those with 1-2 visits vs. 0.8% for those with 7+ visits). All p-values were  $<.001$  unless stated otherwise.

#### *Effect of Baseline Primary Care Utilization on Attrition*

Table 3 presents results from a multivariable logistic regression model estimating the odds of attrition among Veteran in primary care. The strongest effect in the multivariable model was observed for the primary care visit count in the baseline year. Compared to those with 1-2 visits, Veteran with 3 visits were less likely to leave from VA primary care (OR=0.460, 95% CI: 0.452-0.468), those with 4-6 visits substantially less likely to leave (OR=0.302, 95% CI: 0.297-0.308), and those with 7 or more visits the least likely to leave VA primary care (OR=0.161, 95% CI: 0.157-0.166).

#### *Mediation of Baseline Primary Care Utilization on Attrition*

The adjusted results also show that Veterans with SUD were more likely to leave VA primary care compared to those without SUD, after controlling for demographic and clinical characteristics and site-level clustering effects (OR=1.117, 95% CI: 1.094-1.142,  $p<0.001$ ). However, it must be noted that the odds ratios reported in Table 3 were the marginal effects after controlling for primary care visit counts at baseline, representing the effects in an unmediated relationship. The unadjusted analysis showed that Veterans with SUD are more likely to be high primary care users (29% with 7+ visits among Veterans with SUD vs. 19% without SUD; Table 1). Also, high primary care users were less likely to leave VA primary care (0.8% attrition rate

among Veterans with 7+ visits vs. 5.6% among Veterans with 1-2 visits; Table 2). Without the mediating effect of baseline primary care use in the regression model (Appendix 2), we observed that Veterans with SUD were still more likely to leave VA primary care (OR=1.038, 95% CI: 1.009-1.068,  $p=0.010$ ). However, the magnitude of the odds ratio was reduced, suggesting the presence of the mediating effect of baseline visit counts on attrition. Therefore, the odds ratio of 1.101 in Table 3 overestimates the effect of SUD on attrition by ignoring the mediating effects of higher visit counts at baseline among Veterans with SUD.

As shown in Table 3, anxiety was associated with a higher likelihood of attrition (OR=1.063, 95% CI: 1.033-1.093,  $p<0.001$ ). Depression was also associated with a higher likelihood of attrition, although not significant (OR=1.014, 95% CI: 0.997-1.031,  $p<0.118$ ). However, mental health diagnoses were previously known to be associated with higher number of primary care visits among Veterans, and as a result, the odds ratios reported in Table 3 represent the marginal effects of depression and anxiety on attrition without the mediated pathway. The mediating effect of baseline primary care utilization may also be associated with the increase in attrition associated with anxiety. When the same model was estimated without the baseline visit counts and thereby excluding the mediating effects (Appendix 2), the odds ratios for depression and anxiety were lower than 1 (OR for depression=0.917, 95% CI: 0.897-0.938,  $p<0.001$ ; OR for anxiety=0.979, 95% CI: 0.948-1.012,  $p=0.208$ ). The mediating effect of higher baseline primary care utilization explains the unexpected positive effect of depression and anxiety on attrition and represents the magnitude and direction after mediation by number of visits.

#### *Effect of Covariates on Primary Care Attrition*



Looking at the associations in Table 3 between attrition and other covariates, the age group 18-44 had a higher likelihood of attrition compared to the age group 75+ (OR=1.934, 95% CI: 1.891-1.978). Non-Hispanic Black (OR=0.877, 95% CI: 0.861-0.892) and Hispanic Veterans (OR=0.933, 95% CI: 0.911-0.956) were less likely to leave VA primary care compared to Non-Hispanic White Veterans. Other demographic characteristics, such as being unmarried, were associated with a higher likelihood of attrition (OR=1.105, 95% CI: 1.089-1.121 for Veterans who were divorced or widowed; OR=1.171, 95% CI: 1.153-1.189 for Veterans who were never married or separated) compared to those who were married. Greater comorbidities, as indicated by the Charlson Comorbidity Index (CCI), and certain mental health conditions like PTSD, were associated with a lower likelihood of attrition (OR=0.724, 95% CI: 0.712-0.736 for CCI=2+ vs. CCI=0; OR=0.940, 95% CI: 0.923-0.957 for PTSD vs. no PTSD diagnosis). Attriters were also less likely to reside in rural areas (OR=0.939, 95% CI: 0.924-0.954 vs. urban areas). Veterans who were a high priority for VA service enrollment were less likely to leave VA primary care (OR=0.634, 95% CI: 0.622-0.646 for high disability vs. enrollment without special considerations). Longer drive time and distance to the nearest primary care sites were associated with a higher likelihood of attrition (OR=1.080, 95% CI: 1.060-1.100 for drive time  $\geq 30$  minutes vs.  $< 30$  minutes; OR=1.277, 95% CI: 1.243-1.311 for drive distance  $> 40$  miles vs.  $\leq 40$  miles), with drive distance having a stronger effect than drive time. All p-values were  $< .001$ .

### *Comparison of Regression Coefficients by SUD Diagnosis*

The comparison of the regression coefficients by SUD diagnosis shows some differences in the association of individual covariates and attrition between veterans with and without an SUD diagnosis (Appendix 3). We found that the effect of baseline primary care utilization on

attrition was significantly different only at the highest baseline use category, albeit with a small difference in magnitude; among those with 7 or more visits, Veterans with SUD were less likely to leave VA primary care compared to Veterans without SUD (OR=0.148 vs 0.163,  $p<.001$ ). In terms of demographic characteristics that were risk factors for attrition, their effects were attenuated among Veterans with SUD compared to those without SUD for the youngest age group of 18-44 (OR=1.459 vs. 1.953,  $p<.001$ ). However, the effect of marital status on attrition was stronger for Veterans with SUD (OR=1.229 vs. 1.092 for Veterans who were divorced or widowed; OR =1.299 vs 1.159 for Veterans who were never married or separated; all  $p<.001$ ) compared to those without SUD. There were several protective factors against attrition with stronger effect for Veterans with SUD compared to those without SUD, including age group 45-64 (OR=0.694 vs. 0.860,  $p<.001$ ), being female (OR=0.723 vs. 0.813,  $p=0.004$ ), or Hispanic (OR=0.826 vs 0.943,  $p=0.004$ ). On the other hand, the protective effect of the CCI score  $\geq 2$  on attrition was diminished for Veterans with SUD compared to those without the diagnosis (OR=0.767 vs. 0.717,  $p=0.019$ ). We also observed significant differences in terms of mental health diagnoses, although the difference in magnitude were small. For example, a depression diagnosis increased the likelihood of attrition only for Veterans with SUD (OR=1.098,  $p<.001$ ) but was not a significant factor in explaining the attrition for Veterans without SUD (OR=1.000,  $p=0.969$ ). Also, a PTSD diagnosis was not significantly associated with attrition for Veterans with SUD (OR=1.006,  $p=0.786$ ) but decreased the likelihood of attrition for those without SUD (OR=0.934,  $p<.001$ ). The coefficients for service-connected disability, patient residence rurality, having non-VA insurance, and distance and time to the primary care sites were not significantly different by SUD diagnosis.

### *Predicted Probabilities of Primary Care Attrition*

Table 4 and Figure 1 show the adjusted attrition rates by SUD diagnosis at various levels of baseline primary care utilization. The adjusted probability of attrition was 3.47% (95% CI: 3.40-3.53) for Veterans with SUD, compared to 3.12% (95% CI: 3.11-3.14) for those without SUD. Additionally, the adjusted probabilities of attrition, stratified by the level of primary care utilization at baseline, are also presented. Notably, the largest difference in the probability of attrition was observed among Veterans with 1-2 visits (difference in predicted probabilities = 0.55, 95% CI: 0.44-0.66), while the smallest difference was among Veterans with 7 or more visits (difference in predicted probabilities = 0.10, 95% CI: 0.08-0.12).

### **Discussion**

To our knowledge, this is the first study focused on the relationship between attrition from primary care services and having any substance use disorder using EHR data in a large integrated delivery system. Our findings suggest a lower overall attrition rate compared to the attrition rates at the VA from previous years.<sup>10</sup> While there was no significant difference in attrition rates between Veterans with and without SUD observed in unadjusted percentages, in our multivariate analysis we find higher attrition rates among Veterans with SUD, particularly among those who are light users of primary care at baseline. This finding persisted even after accounting for various sociodemographic and clinical factors associated with attrition, such as age, marital status, comorbidities, and indicators of better access to care, such as rural residence or drive time and distance to primary care site. The higher attrition rates among Veterans with SUD align with prior research indicating barriers for Veterans with SUD in engaging with treatment<sup>31-33</sup> and lower satisfaction with primary care among vulnerable populations.<sup>34</sup> Previous

research of female Veterans had shown that perceptions of VA, patient experience, and travel time and distance to VA site affected attrition. While our model does not take into account perceptions of VA or patient experience, it showed a significant positive association between attrition and greater drive distance and time to primary care sites. It shows that these barriers were significant factors not only among females but also for the nationwide sample. Also, the effect of time and distance to primary care sites did not affect Veterans with SUD disproportionately. These findings suggest that having SUD negatively affects Veteran patients' continuation of primary care at the VA even after taking all the known predictors of attrition.

Similarly, consistent with an earlier study,<sup>13</sup> we identified a strong association between the extent of primary care utilization at baseline and subsequent attrition. Light primary care users (defined as the lowest quartile values of 1-2 visits), especially within the SUD population, were most likely to discontinue primary care, highlighting the need for targeted intervention strategies to enhance engagement among this subgroup. Also, light primary care users can be either relatively new patients at the VA or patients who have been receiving care at the VA but are light primary care users. Future studies could explore variables indicating patient tenure within the VA system, serving as proxies for established relationships with primary care providers. Other future studies should examine variations in attrition and service use by type of substance use disorder.

Our findings showed a positive association between travel time and distance and attrition rates, as well as lower attrition among rural Veterans. This aligns with previous findings emphasizing the role of geographic factors in attrition.<sup>13</sup> This previous study also identified an interaction effect by other patient covariates, such as whether a patient is new or established patient at the VA. While our analysis did not examine the interaction between SUD diagnosis

and geographic factors, it demonstrated that a SUD diagnosis remains positively associated with attrition, even after accounting for geographic factors.

Our analysis underscores the impact of mental health conditions on primary care attrition among Veterans with and without SUD. Comparison of coefficients showed that depression increased the likelihood of attrition solely among Veterans with SUD, while PTSD decreased the likelihood of attrition exclusively among those without SUD. However, these differences were masked in the regression model for the entire sample, emphasizing the importance of considering differential effects of covariates by SUD diagnosis and conducting further stratified analysis.

Nevertheless, there are limitations to our analysis. It focused solely on attrition from primary care, potentially overlooking care received through other care settings, such as emergency departments or hospitalizations. Stratification based on patient tenure within the VA system could provide valuable insights. Additionally, we did not account for community care provided outside of the VA healthcare systems. Lastly, while we adjusted for healthcare system-level differences, our study did not examine professional or organizational factors, such as characteristics of interdisciplinary care team characteristics or practices, which may influence patient attrition from primary care that were identified as important in caring for vulnerable patients.<sup>35</sup> Measures such as care coordination, communication, comprehensiveness, or facility infrastructure warrant further exploration as potential factors associated with primary care attrition.

One limitation of this study is the reliance on administrative data to identify Veterans with SUD diagnoses. As noted above, Williams et al.<sup>6</sup> found that, based on a survey-based assessment of substance use disorder prevalence rates, SUD identification based on electronic health records underestimated SUD by approximately one-third. This would lead to lower

estimates in this study of the differences between patients in the VA with and without SUD in attrition, where significant differences were observed. Williams and her colleagues also found, however, that the differences in prevalence rates were attenuated when analysis focused on patients with moderate to severe disorders, those most likely to be in treatment. Improved diagnostic accuracy would benefit and bring into treatment those undiagnosed. The underestimate of the Veterans with SUD and resulting attenuation of estimates associated with attrition from primary care in the VA adds to the urgency of addressing these problems in the Veteran population.

To our knowledge, this is the first study to assess the effect of substance use disorder upon primary care attrition among Veterans. The findings highlight the persistent challenge of engaging Veterans with SUD in continuous primary care utilization. Future research should continue to explore approaches to reduce attrition, thereby enhancing the quality and effectiveness of care for Veterans, especially those with SUD.

## Tables and Figures

Table 1. Demographic and Clinical Characteristics of Veteran in Primary Care by SUD Diagnosis between March 2019 and March 2020

Variable	Non-SUD (n= 360,444)	SUD (n= 3,785,128)	Total (N= 4,145,572)	p
<b>Age category, %</b>				
18-44	16%	22%	16%	<.001
45-64	31%	46%	32%	
65-74	35%	28%	34%	
75+	19%	4%	17%	
<b>Gender, %</b>				
Male	90%	91%	90%	<.001
Female	10%	9%	10%	
<b>Race/ethnicity, %</b>				
Non-Hispanic Black	17%	25%	18%	<.001
Hispanic	7%	7%	7%	
Non-Hispanic Other	2%	2%	2%	
Non-Hispanic Unknown	5%	4%	5%	
Non-Hispanic White	68%	62%	68%	
<b>Marital Status, %</b>				
Married	59%	38%	57%	<.001
Divorced/Widowed	25%	36%	26%	
Never Married/Separated	16%	26%	17%	
<b>Insurance, %</b>				
VA insurance only	28%	42%	29%	<.001
Non-VA insurance	72%	58%	71%	
<b>Charlson Comorbidity Index (CCI), mean(SD)</b>				
	1.12 ± 1.65	1.51 ± 2.07	1.15 ± 1.70	<.001
<b>CCI Categories, %</b>				
0	51%	43%	50%	<.001
1	23%	23%	23%	
2+	27%	34%	27%	
<b>Depression, %</b>				
No	81%	50%	79%	<.001
Yes	19%	50%	21%	
<b>Anxiety, %</b>				
No	85%	63%	83%	<.001
Yes	15%	37%	17%	
<b>PTSD, %</b>				
No	84%	61%	82%	<.001
Yes	16%	39%	18%	
<b>Psychosis, %</b>				
No	100%	97%	99%	<.001

Yes	0%	3%	0%	
<b>Other mental health conditions, %</b>				
No	87%	66%	85%	<.001
Yes	13%	34%	15%	
<b>Enrollment Priority Group<sup>a</sup>, %</b>				
High Disability	41%	51%	42%	<.001
Low/Moderate Disability	25%	18%	25%	
Low Income	17%	22%	17%	
Enrolled without special considerations	17%	8%	16%	
<b>Patient Residence, %</b>				
Urban	64%	69%	64%	<.001
Rural	36%	31%	36%	
<b>Drive time to primary care site, mean(SD)</b>	21.3 ± 16.4	19.0 ± 15.3	21.1 ± 16.3	<.001
<b>Drive time to PC, %</b>				
<30min	78%	82%	79%	<.001
≥30min	22%	18%	21%	
<b>Drive distance to primary care site, mean(SD)</b>	15.7 ± 15.1	13.6 ± 14.0	15.5 ± 15.1	<.001
<b>Drive distance to PC, %</b>				
≤40miles	94%	95%	94%	<.001
>40miles	6%	5%	6%	
<b>Baseline primary care visit count<sup>b</sup>, mean(SD)</b>	4.40 ± 4.44	5.74 ± 5.68	4.51 ± 4.58	<.001
<b>Baseline primary care visit count<sup>b</sup>, %</b>				
1-2 visits	42%	29%	40%	<.001
3 visits	15%	14%	15%	
4-6 visits	24%	28%	25%	
7+ visits	19%	29%	20%	

<sup>a</sup> High disability refers to having >50% service-related disability or catastrophically disabled. Low/moderate disability includes 10-40% service-related disability or military exposures. Low income includes Veterans having annual income below area-adjusted income threshold. Enrolled without special considerations refers to 0% service-related disability and co-pay requirement.

<sup>b</sup> March 16<sup>th</sup>, 2019 – March 15<sup>th</sup>, 2020



Table 2. Unadjusted Number and Percentages of Attrition from Primary Care among Veterans by Demographic and Clinical Characteristics

	<b>n(%) of Veterans who Left VA Primary Care within Each Category of Variables</b>	<b>p<sup>a</sup></b>
<b>SUD Diagnosis</b>		
No SUD	120,746 (3.2%)	0.065
SUD	11,702 (3.2%)	
<b>Age category</b>		
18-44	45,861 (6.7%)	<.001
45-64	36,548 (2.7%)	
65-74	27,334 (1.9%)	
75+	22,705 (3.2%)	
<b>Gender</b>		
Male	120,135 (3.2%)	<.001
Female	12,313 (3.1%)	
<b>Race/ethnicity</b>		
Non-Hispanic Black	21,657 (2.9%)	<.001
Hispanic	9,786 (3.5%)	
Non-Hispanic Other	4,167 (4.1%)	
Non-Hispanic Unknown	8,530 (4.0%)	
Non-Hispanic White	88,308 (3.1%)	
<b>Marital Status</b>		
Married	65,061 (2.8%)	<.001
Divorced/Widowed	32,319 (3.0%)	
Never Married/Separated	32,105 (4.7%)	
<b>Insurance</b>		
VA insurance only	56,577 (4.6%)	<.001
Non-VA insurance	75,871 (2.6%)	
<b>Charlson Comorbidity Index (CCI), mean(SD)</b>		
	(132,448) 0.65 ± 1.32	<.001
<b>CCI Categories</b>		
0	90,069 (4.3%)	<.001
1	22,539 (2.4%)	
2+	19,840 (1.8%)	
<b>Depression</b>		
No	106,401 (3.3%)	<.001
Yes	26,047 (2.9%)	
<b>Anxiety</b>		
No	109,526 (3.2%)	<.001
Yes	22,922 (3.3%)	
<b>PTSD</b>		
No	111,427 (3.3%)	<.001
Yes	21,021 (2.9%)	

<b>Psychosis</b>		
No	131,318 (3.2%)	<.001
Yes	1,130 (4.6%)	
<b>Other mental health conditions</b>		
No	112,083 (3.2%)	<.001
Yes	20,365 (3.3%)	
<b>Enrollment Priority Group</b>		
High Disability	44,181 (2.5%)	<.001
Low/Moderate Disability	34,679 (3.4%)	
Low Income	27,893 (3.9%)	
Enrolled without special considerations	25,063 (3.8%)	
<b>Patient Residence</b>		
Urban	88,842 (3.3%)	<.001
Rural	42,685 (2.9%)	
<b>Drive time to primary care site, mean(SD)</b>	(131,407) 21.4 ± 17.6	<.001
<b>Drive time to PC</b>		
<30min	103,599 (3.2%)	0.320
≥30min	27,808 (3.2%)	
<b>Drive distance to primary care site, mean(SD)</b>	(131,407) 15.8 ± 16.3	<.001
<b>Drive distance to PCs</b>		
≤40miles	122,304 (3.2%)	<.001
>40miles	9,103 (3.6%)	
<b>Baseline primary care visit count<sup>b</sup>, mean(SD)</b>	(132,448) 2.37 ± 2.39	<.001
<b>Baseline primary care visit count<sup>b</sup></b>		
1-2 visits	94,014 (5.6%)	<.001
3 visits	15,548 (2.5%)	
4-6 visits	16,338 (1.6%)	
7+ visits	6,548 (0.8%)	

<sup>a</sup> P-value from Chi-square test of attrition status (Veterans who left VA primary care vs. Veterans who did not leave) and each of the variables

<sup>b</sup> March 16<sup>th</sup>, 2019 – March 15<sup>th</sup>, 2020

Table 3. Odds Ratios and 95% Confidence Interval for Attrition from Primary Care among Veterans from Multivariable Logistic Regression Model<sup>a</sup>

<b>Variable</b>	<b>OR (95% CI)</b>	<b>p</b>
SUD diagnosis (ref: Non-SUD)	1.117 (1.094, 1.142)	<.001
Baseline primary care visit counts <sup>b</sup> (ref: 1-2 visits)		
3 visits	0.460 (0.452, 0.468)	<.001
4-6 visits	0.302 (0.297, 0.308)	<.001
7+ visits	0.161 (0.157, 0.166)	<.001
Age (ref: 75+)		
18-44	1.934 (1.891, 1.978)	<.001
45-64	0.859 (0.841, 0.876)	<.001
65-74	0.702 (0.689, 0.715)	<.001
Female (ref: male)	0.807 (0.791, 0.824)	<.001
Race/ethnicity (ref: White)		
Non-Hispanic Black	0.877 (0.861, 0.892)	<.001
Hispanic	0.933 (0.911, 0.956)	<.001
Non-Hispanic Other	1.050 (1.015, 1.088)	0.005
Non-Hispanic Unknown	1.128 (1.101, 1.156)	<.001
Marital status (ref: Married)		
Divorced/Widowed	1.105 (1.089, 1.121)	<.001
Never married/Separated	1.171 (1.153, 1.189)	<.001
Charlson Comorbidity Index (ref: 0)		
1	0.768 (0.756, 0.780)	<.001
2+	0.724 (0.712, 0.736)	<.001
Depression	1.014 (0.997, 1.031)	0.118
Anxiety	1.063 (1.033, 1.093)	<.001
PTSD	0.940 (0.923, 0.957)	<.001
Serious mental illness	1.079 (1.046, 1.113)	<.001
Psychosis	1.439 (1.347, 1.538)	<.001
Other mental health conditions	0.968 (0.940, 0.996)	0.025
Non-VA insurance (ref: VA insurance only)	0.809 (0.797, 0.821)	<.001
Rurality of patient residence (ref: Urban)	0.939 (0.924, 0.954)	<.001
Enrollment priority group (ref: Enrolled without special considerations)		
High Disability	0.634 (0.622, 0.646)	<.001
Low/Moderate Disability	0.873 (0.858, 0.889)	<.001
Low Income	1.193 (1.172, 1.216)	<.001
Drive time to primary care site $\geq$ 30min (ref: <30min)	1.080 (1.060, 1.100)	<.001
Drive distance to PC >40miles (ref: $\leq$ 40 miles)	1.277 (1.243, 1.311)	<.001

<sup>a</sup> Indicators for 138 VA health care systems were included in the regression model as fixed effects but are not shown in the table

<sup>b</sup> March 16<sup>th</sup>, 2019 – March 15<sup>th</sup>, 2020

Table 4. Predicted Probabilities of Attrition from Primary Care among Veterans based on Multivariable Logistic Regression Model

Category	Predicted Probability (95% CI)
Non-SUD	3.12 (3.11-3.14)
SUD	3.47 (3.40-3.53)
(SUD v. Non-SUD) for Baseline primary care visit 1-2	0.55 (0.44-0.66)
(SUD v. Non-SUD) for Baseline primary care visit 3	0.28 (0.11-0.33)
(SUD v. Non-SUD) for Baseline primary care visit 4-6	0.19 (0.15-0.22)
(SUD v. Non-SUD) for Baseline primary care visit 7+	0.10 (0.08-0.12)

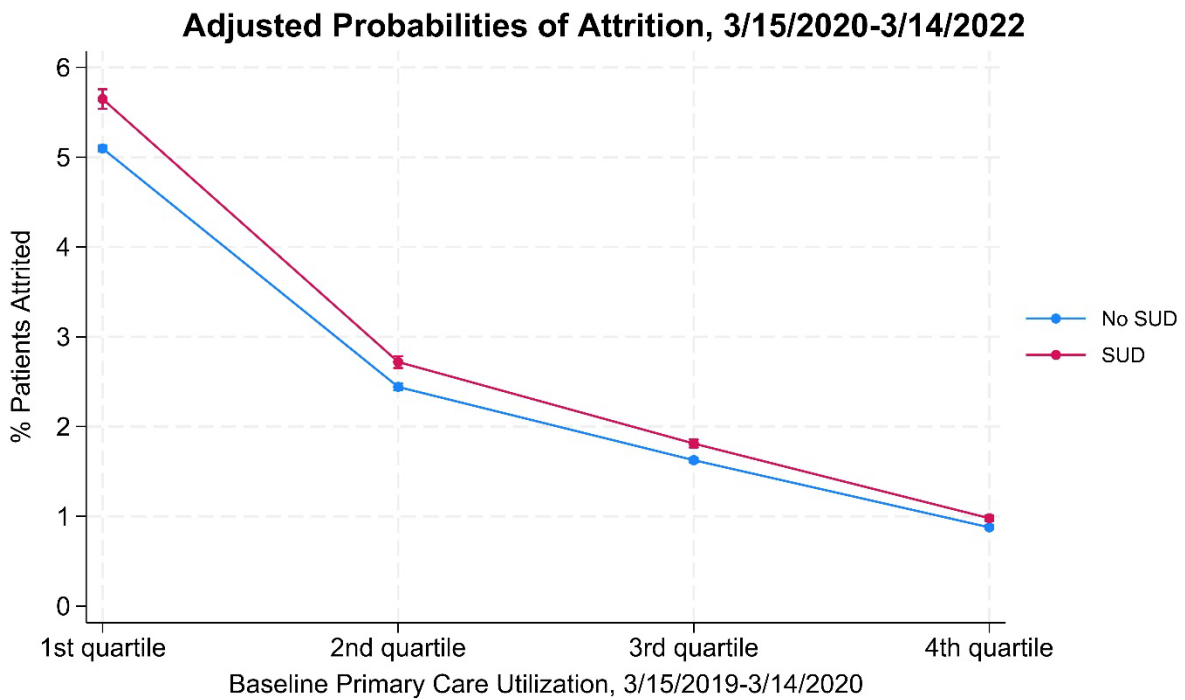


Figure 1. Predicted Probabilities of Attrition from Primary Care among Veterans by SUD Diagnosis based on Multivariable Logistic Regression Model

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## **Chapter 4 : Association between Housing Instability and Primary Care Attrition among Veterans by Substance Use Disorder**

### **Introduction**

Despite efforts and progress in the past decades, homelessness, especially among Veterans, remains a public health challenge.<sup>1,2</sup> Compared to the US population, Veterans are overrepresented among adult homeless population.<sup>3</sup> Risk factors of homelessness include gender, race, unemployment, adverse childhood experience, and mental health and substance use disorders. For Veterans, they are additional risk factors specific to their military experience, such as non-honorable discharge status, service-connected disability rating, and history of military sexual trauma.<sup>4</sup>

Housing instability, which encompasses homelessness and housing insecurity, is linked to adverse outcomes, such as increased mortality, suicide risk, and overdose, increased acute healthcare utilization, reduced utilization of primary care services, and negative experiences with primary.<sup>5-11</sup> Housing instability lacks a standardized definition but includes various dimensions or temporal patterns such as housing quality, risk of loss of housing, recent housing history, financial status, and subjective assessments of housing satisfaction and stability.<sup>12-15</sup> With varying degrees of housing insecurity, the specific impact of each level on primary care utilization remains unclear. In this chapter of the dissertation, I substantially expand the analysis in the prior chapters on telehealth use and attrition among Veterans with and without SUD to examine how homelessness and other housing instability and SUD interact in influencing telehealth use and attrition from primary care. Understanding how housing instability and SUD

interact in use of services is important because of the higher housing instability among Veterans with SUD and higher SUD rates among Veterans experiencing housing instability.<sup>16</sup>

Telehealth, which has grown significantly since the onset of the COVID-19 pandemic, offers a means to enhance patient engagement and reduce attrition from primary care by reducing time and travel costs associated with obtaining.<sup>17</sup> The utilization of telehealth varies across different care settings.<sup>18-20</sup> Barriers to primary care and telehealth use for the homeless and others confronting housing instability include competing priorities, digital divide, travel burden and financial resources.<sup>21-25</sup> Despite concerns about the low adoption of telehealth among vulnerable populations due to the digital divide, prior studies indicate that it is effectively utilized for primary care among these groups, including homeless-experienced Veterans,<sup>26</sup> but these issues need further study, particularly for subpopulations with chronic conditions like substance use disorder (SUD).

Veterans with mental or behavioral health conditions, including SUD, often have more exposure to and familiarity with telehealth due to their engagement in telemental health.<sup>18,27</sup> The prevalence of SUD diagnosis is notably high among the homeless. Yet, comparisons of telehealth usage between those with both homelessness and SUD versus those without have been limited. The analyses in Chapter Two compared telehealth use for primary care services between Veterans with and without SUD. Considering that previous studies have identified homelessness as a significant factor in telehealth use, we revisited the regression model for telehealth use from Chapter Two to include housing instability as a variable.

Primary care attrition, as discussed in Chapter Three, refers to patients initially accessing and utilizing primary care services but subsequently discontinuing their use. Homeless Veterans are a high priority population for the Veterans Health Administration (VA) and the VA has

pursued a variety of initiatives to improve their care. However, previous research on attrition from primary care has not examined housing instability as a risk.<sup>28-31</sup> This chapter addresses this gap, with additional focus on the interaction of SUD and housing instability.

## **Objective**

In this chapter, we examine three questions: 1) what is the rate of transition across housing instability states and how does this vary by SUD status, 2) how is the use of telehealth for primary care services by Veterans with and without SUD influenced by housing instability, and 3) how is attrition from primary care for Veterans with and without SUD influenced by housing instability. We hypothesize that Veterans with SUD are more likely to experience persistent housing instability compared to those without SUD. Additionally, we hypothesize that housing instability is associated with increased telehealth use and higher attrition rates from primary care for both Veterans with and without SUD, but higher use of primary care services for Veterans with SUD reduces the likelihood of attrition.

## **Methods**

### *Study Design and Sample*

This study consisted of two different study designs for telehealth and primary care attrition analyses. Housing status was examined for the retrospective cohort consisting of adult Veteran patients between March 16, 2018, and March 15, 2019, who had at least one primary care visit (either outpatient regular primary care visit or mental health integrated primary care visit). For the telehealth analysis, we followed their primary care visits and telehealth use during the height of the COVID-19 pandemic, between March 16, 2019, and March 15, 2022. For the primary care attrition analysis, we identified continuous users of VA primary care services by

subsetting the initial cohort from March 16, 2018, to March 15, 2019, to those having at least one subsequent primary care visit between March 16, 2019, and March 15, 2020 (n=4,613,830).

### *Data Sources*

Patient-level sociodemographic characteristics, housing instability, comorbidities, and outpatient visits and their dates were extracted from the VA Corporate Data Warehouse (CDW), a depository for a wide range of administrative and electronic health record data for each Veteran in the VHA health system. Geographic information related to patient residence was obtained from the VA Planning Systems Support Group (PSSG) enrollee files, which contains detailed geographic information of the VA enrollees based on their address.<sup>32</sup>

The study was based on an ongoing quality improvement effort approved by the VA Greater Los Angeles Healthcare System's institutional review board. It deemed the study as exempt from full IRB review and therefore exempt from informed consent requirements.

### *Measures*

We determined the housing instability of Veterans using the social determinant of health (SDOH) domains of the International Classification of Diseases, 10<sup>th</sup> Revision, diagnosis codes (ICD-10-CM): Z59.0x Homelessness, Z59.1x Inadequate Housing (e.g. environmental temperature, utilities), Z59.8x Other Problems Related to Housing and Economic Circumstances (e.g. risk of homelessness, transportation, financial insecurity), and Z59.9x Problem Related to Housing and Economic Circumstances, Unspecified. To assess the full spectrum of housing instability (insecurity, quality, and financing), we examined individual aspect of housing instability using a combination of the four ICD-10 codes. We operationalized this by creating a

seven-level measure to indicate housing instability: 1) Homelessness only (Z59.0 only), 2) Homelessness and housing insecurity (Z59.0 and at least one of Z59.1, Z59.8, and Z59.9), 3) Housing insecurity only - poor housing quality (Z59.1 only), 4) Housing insecurity only - economic hardships (Z59.8 only), 5) Housing insecurity only – other (Z59.9 only), 6) Housing insecurity without homelessness (two or more of Z59.1, Z59.8, and Z59.9 but no Z59.0), and 7) Stable housing (No documentation of Z59.0, Z59.1, Z59.8, and Z59.9). We opted for a detailed set of categories to assess whether patterns of transition from housing instability were the same for the homeless with and without other measured housing insecurity, and across different measures of housing insecurity without homelessness. These codes were based on previous studies.<sup>13,33</sup> While they are variation in identifying homelessness among Veterans such as ICD coding, receipt of homelessness services, or inpatient treatment specialties, the use of ICD codes provides the key criteria for identifying Veterans with homelessness that is uniform across VA facilities. The ICD codes were extracted from outpatient and inpatient visit records between March 16, 2019, and March 15, 2022. The measure for the year of the study was determined as follows: year 0 (March 16, 2019 – March 15, 2020), year 1 (March 16, 2020 – March 15, 2021), and year 2 (March 16, 2021 – March 15, 2022) to examine the transition in housing instability across these years and adjust for secular trend in the regression models.

The measures to identify a SUD diagnosis and assess telehealth utilization and time segments based on patterns of telehealth use during the study period (person-level visit counts for each segment) were constructed as described in Chapter Two. The methodology for measuring attrition from primary care – defined as the absence of a primary care visit in two consecutive years – and other patient-level covariates is described in Chapter Three.

## *Statistical Analyses*

We assessed changes in housing instability states during the study period by constructing descriptive transition matrices for the entire cohort. We examined the distribution of Veterans across seven categories of housing status from year 0 to year 1, year 1 to year 2, and year 0 to year 2 by calculating the proportion of Veterans in each category in the first year remaining in the category or transitioning to other categories. All seven categories were retained to explore whether there were differences across categories.

For the adjusted analysis of telehealth and video utilization, the outcome variable was the person-level count of telehealth or video visit per segment. Multivariable negative binomial regression models were used to examine the association between SUD diagnosis, housing status, and telehealth use, as described in Chapter Two. A variable for housing instability during each time segment was incorporated into the model. For the adjusted analysis of primary care attrition, multivariable logistic regression models were used to explore the association between SUD diagnosis, housing status, and attrition, as described in Chapter Three. The housing instability in the baseline year was also added to the model to examine its effect on primary care attrition during the subsequent two years following baseline. Lastly, multicollinearity among covariates were assessed based on variance inflation factor (VIF) values.

## **Results**

### *Housing Instability Among Veterans in Primary Care by SUD Diagnosis*

We examined the distribution of the ICD-10 diagnostic codes related to housing status among Veterans in primary care by SUD diagnosis (Table 1). The percentages of Veterans in the categories for homelessness either with or without other measures of housing instability are

higher among Veterans with SUD compared to those without SUD (4% vs 0% for Homelessness only; 7% vs. 1% for Homelessness and housing insecurity,  $p < .001$ ). For the individual categories of housing insecurity without homelessness, the percentages of Veterans differed 0 to 2% by SUD diagnosis. Among Veterans in primary care with SUD, 84% ( $n=301,162$ ) did not have reported housing instability, compared to 97% ( $n=3,685,873$ ) for those without SUD.

### *Transition of Housing Instability States by SUD Diagnosis and Study Year*

We examined the transition of housing instability states among Veterans in primary care by SUD diagnosis from the baseline year through each of the two subsequent years (Table 2-4). In the text of the chapter, we focus initially on the transitions from year 0 to year 2.

#### Year 0 to Year 2

Among all Veterans in our sample, between the baseline year and two years after baseline, 62% of the Veterans who were homeless and 41% of Veterans who were homeless with other housing insecurity transitioned to stable housing. Thirty percent of homeless Veterans and 35% of homeless Veterans with other housing insecurity remained in one of the two categories of homelessness, with eight percent of the homeless without other housing insecurity moving into varying states of housing insecurity without homelessness and approximately a quarter of those who were homeless with other housing insecurity moving into one of the categories of housing insecurity without homelessness. Among those with one but not multiple categories of housing insecurity without homelessness, there was substantial movement out of housing insecurity (70 to 78%), and 8 to 10% moving into some homeless state. Those with multiple categories of

housing insecurity but not homeless were substantially less likely to move out of a state of housing insecurity and 14% moved into homelessness.

Among those with stable housing, 98% remained in that status. (Table 2c). Veterans with SUD were more likely to remain in a homeless state and less likely to transition to a status of stable housing than those without SUD, although the differences were not large, in the range of 4-13%. Veterans with SUD were also less likely to remain in stable housing compared to those without SUD. (Tables 3c and 4c)

#### Year 0 to Year 1

Among all Veterans in our sample, between the baseline year and one year after baseline, 55% of the Veterans who were homeless and 29% of Veterans who were homeless with other housing insecurity transitioned to stable housing. Forty percent of homeless Veterans and 48% of homeless Veterans with other housing insecurity remained in one of the two categories of homelessness, with five percent of the homeless without other housing insecurity moving into varying states of housing insecurity without homelessness and 23% of those who were homeless with other housing insecurity moving into one of the categories of housing insecurity without homelessness. Among those with one but not multiple categories of housing insecurity without homelessness, there was substantial movement out of housing insecurity (65 to 75%), and 8 to 10% moving into some homeless state. Those with multiple categories of housing insecurity but not homeless were substantially less likely to move out of a state of housing insecurity and 15% moved into homelessness.

Among those with stable housing, 99% remained in that status. (Table 2a). Veterans with SUD were more likely to remain in a homeless state and less likely to transition to a status of



stable housing than those without SUD, although the differences were not large, in the range of 3-13%. Veterans with SUD were also less likely to remain in stable housing compared to those without SUD. (Tables 3a and 4a)

#### Year 1 to Year 2

Among all Veterans in our sample, between one year and two years after the baseline year, 50% of the Veterans who were homeless and 25% of Veterans who were homeless with other housing insecurity transitioned to stable housing. Forty-four percent of homeless Veterans and 50% of homeless Veterans with other housing insecurity remained in one of the two categories of homelessness, with six percent of the homeless without other housing insecurity moving into varying states of housing insecurity without homelessness and a quarter of those who were homeless with other housing insecurity moving into one of the categories of housing insecurity without homelessness. Among those with one but not multiple categories of housing insecurity without homelessness, there was substantial movement out of housing insecurity (61 to 67%), and 9 to 14% moving into some homeless state. Those with multiple categories of housing insecurity but not homeless were substantially less likely to move out of a state of housing insecurity and 16% moved into homelessness.

Among those with stable housing, 99% remained in that status. (Table 2b). Veterans with SUD were more likely to remain in a homeless state and less likely to transition to a status of stable housing than those without SUD, although the differences were not large, in the range of 3-13%. Veterans with SUD were also less likely to remain in stable housing compared to those without SUD. (Tables 3b and 4b)

By study year, we observed transition into worse states, such as a higher percent of homelessness staying in the state of homelessness, higher percent of housing insecurity without homelessness into homelessness, and lower percent of those without housing instability transitioning into stable housing during the period of March 16, 2021-March 15,2022 (years 1 and 2) compared to the period of March 16, 2020-March 15, 2021 (years 0 and 1). By SUD diagnoses, we observed similar level of difference in state transitions between the period of March 16, 2021-March 15,2022 (years 1 and 2) and March 16, 2020-March 15, 2021 (years 0 and 1).

#### *Effect of Housing Instability on Telehealth Use for Primary Care*

Table 5 shows adjusted telehealth use in primary care between March 16, 2019, and March 15, 2022 from multivariable negative binomial regression model after adding the housing instability measure. Looking at the coefficients for housing instability, we observed that homeless Veterans had fewer telehealth visits (IRR=0.973, 95% CI: 0.968-0.977,  $p<.001$  for homelessness; IRR=0.976, 95% CI: 0.972-0.979,  $p<.001$  for homelessness and housing insecurity) compared to Veterans with stable housing, controlling for other variables, including health care use. On the other hand, other categories reflecting housing insecurity without homelessness had more telehealth visits (IRR=1.061, 95% CI: 1.047-1.075 for poor housing quality; IRR=1.074, 95% CI: 1.070-1.077 for economic hardships; IRR=1.083, 95% CI: 1.079-1.087 for other housing insecurity, all  $p<.001$ ).

The coefficients for the impact of SUD diagnosis on telehealth use and the coefficients for all other covariates remained the same even after adding the housing instability measure. The coefficient for SUD diagnosis (IRR=1.089) reflects telehealth use during segment 1 for Veterans

with SUD. The coefficients for segments (IRR=2.688 for segment 2, 2.017 for segment 3, and 1.494 for segment 4) reflect change in telehealth use during each segment compared to the pre-COVID-19 period (segment 1) for Veterans without SUD. Also, the coefficients for the interaction between a SUD diagnosis and segments reflect the relative change in IRR from the coefficients for segments among Veterans without SUD. The IRRs less than one for the interaction terms indicate fewer visits associated with SUD for the post-COVID-19 onset segments compared to Veterans without SUD ( $2.688 \times 0.884 = 2.376$  for segment 2,  $0.911 \times 2.017 = 1.837$  for segment 3, and  $0.937 \times 1.494 = 1.400$  for segment 4).

Table 6 shows adjusted rates of a specific type of telehealth, video use, among Veterans seen in primary care after adding the housing instability measure. All categories of housing instability were associated with fewer video visits compared to Veterans with stable housing, with the homelessness and housing insecurity category associated with the lowest IRR of 0.746 (95% CI: 0.734, 0.758). The addition of housing instability slightly lowered the risk of SUD diagnosis for video use (IRR=0.795, 95% CI: 0.768-0.824 vs. IRR=0.776, 95% CI: 0.749-0.804 before adding housing instability; all  $p < .001$ ).

Similar to the model predicting telehealth use, the coefficients for all other covariates on video use remained the same even after adding the housing instability measure. The coefficients for segments (IRR=9.321 for segment 2, 12.057 for segment 3, and 8.885 for segment 4) reflect video use during each segment compared to the pre-COVID-19 period (segment 1) for Veterans without SUD. Increased likelihood of video use associated with segments are maintained after the addition of housing instability measure. The IRRs greater than one for these interaction terms indicate that the likelihood of increased video use associated a SUD diagnosis are higher during

all segments post-COVID-19 onset for Veterans with SUD ( $9.321 \times 1.036 = 9.657$  for segment 2,  $12.057 \times 1.060 = 12.780$  for segment 3, and  $8.885 \times 1.113 = 9.889$  for segment 4).

### *Effect of Housing Instability on Primary Care Attrition*

Table 7 shows adjusted rates of primary care attrition between March 16, 2019, and March 15, 2022, based on the multivariable logistic regression model after adding housing instability measure. We examined the effect of housing instability on attrition in three steps. The first model describes the association between a SUD diagnosis and attrition without housing instability. The second added housing instability to the first model. The third model additionally incorporated an interaction term between a SUD diagnosis and housing instability.

The first model, without housing instability, shows an estimate of the effects of SUD on attrition without considering housing status. Since Veterans with SUD are likely to have more primary care visits, despite the OR greater than 1 on SUD status, their actual rate of attrition is lower than the rate for patients without SUD after taking different baseline primary care visits into account.

The second model describes the estimated association with SUD with housing instability taken into account. All levels of the housing instability increased the likelihood of attrition from primary care, with homelessness having the strongest effect (OR=1.849, 95% CI: 1.758-1.946) and housing insecurity without homelessness having the weakest effect on (OR=1.209, 95% CI: 1.105-1.323). The effect of SUD on primary care attrition decreased after adding housing instability (OR=1.059, 95% CI: 1.036-1.083) because Veterans with SUD are also more likely to have homelessness or housing insecurity. Even though Veterans with SUD utilize primary care

more compared to those without SUD, we consistently observed an increased risk of attrition with a SUD diagnosis.

The third model tested an interaction term between SUD diagnosis and housing instability. All odds ratios less than one showed that while housing instability increases the likelihood of attrition, the increased attrition risk associated with housing instability is lower for Veterans with a SUD diagnosis. The decrease in the likelihood of attrition among Veterans with SUD diagnosis was the greatest for those with poor housing quality (OR=0.651, 95%CI: 0.405-1.047, p=0.076) and the lowest for those who are homeless (OR=0.986, 95%CI: 0.890-1.093, p=0.793). The coefficients of all other covariates, including the level of baseline primary care visits, remained the same even after adding housing instability or interaction terms. Lastly, our assessment of multicollinearity showed low VIF values less than three, suggesting low collinearity.

## **Discussion**

This study examined the transitions of housing instability among Veterans in primary care and its impact on telehealth use and attrition from primary care services during the height of the COVID-19 pandemic in 2020-2022. Sixteen percent of Veterans with SUD had housing instability at baseline compared to three percent of Veterans without SUD. We found that less than half of the homeless Veterans remained in the same housing status between 2020 and 2022, while a small proportion (1.5%) yet significant number of Veterans (N=78,021) who were not initially homeless transitioned into housing instability. Among Veterans with a SUD diagnosis, a higher proportion (41.8%) remained homeless or moved into housing insecurity status between 2020 and 2022 compared to those without SUD (35.0%).

Veterans facing housing instability, particularly homelessness, represent a priority population at the VA.<sup>1</sup> Even with the addition of housing instability to the attrition model, the risk of attrition remained higher for Veterans with SUD compared to those without SUD. This indicates higher attrition among Veterans with SUD after controlling for demographic and clinical characteristics, baseline level of healthcare utilization, geographic barriers, and housing instability, suggesting the need for greater attention to Veterans with these vulnerabilities. Also, Veterans with housing instability were more likely to discontinue VA primary care, despite being previously regular users of primary care, although the risk associated with housing instability on primary care attrition was slightly lower for Veterans with SUD compared to those without SUD. The protective effect of a SUD diagnosis on attrition among Veterans with housing instability may indicate greater familiarity, established relationship, or higher engagement with VA healthcare systems due to the comorbidity.<sup>34,35</sup> Lastly, while we observed a significantly higher risk of attrition for those with psychosis, as shown in a prior study,<sup>36</sup> in the model with housing instability, the effect of psychosis on attrition became protective with the addition of the interaction between a SUD diagnosis and housing instability.

In addition to a SUD diagnosis, housing instability presents additional risks of attrition from VA primary care utilization, negatively impacting both primary care attrition and telehealth use. This suggests a differential impact of severity of housing instability on telehealth use, underscoring the need for tailored interventions to meet the various needs of these Veterans. While homelessness was negative associated telehealth use for primary care visits among Veterans, housing insecurity showed a positive association with overall telehealth use. All levels of housing instability status decreased the likelihood of video use, with a more pronounced impact on rates of video visits than on overall telehealth utilization. Telehealth, especially phone-

based services, may offer a viable option for Veterans with housing insecurity, though it appears less effective for those who are homeless. Our findings suggest that housing instability, along with SUD, serves as an additional risk factor for primary care attrition, emphasizing the need for greater attention to Veterans with these vulnerabilities.

There are limitations to our study. Housing status was determined using diagnostic codes from administrative data. This approach only includes Veterans who were engaged in the VA system, potentially excluding those who do not use VA services or receive informal care. Without identification using standardized screening, our sample may not fully represent the broader population of Veterans experiencing housing issues. However, previous studies have found that using the administrative diagnostic codes provide the key criteria for identifying Veterans with homelessness that is uniform across VA.<sup>13,33</sup>

Notwithstanding those limitations, we find strong associations of SUD diagnosis with homelessness, and that the two states interact in a complex pattern to influence attrition from primary care in the VA. In general, SUD status is associated with more visits, which are associated with lower attrition rates, but both SUD diagnoses and homelessness increase the risk of attrition when differences in visits are controlled for. SUD and housing instability should remain high priority areas for the VA, and an important focus of primary care activities. The effects of SUD and housing instability are smaller with respect to telehealth, but continued movement toward telehealth and specifically video visits in the VA will require attention to be paid to the challenges of video visits for Veterans with housing instability with and without SUD.

## Tables and Figures

Table 1. Housing Instability at Baseline by SUD Diagnosis among Veteran Patients in Primary Care

<b>Categories</b>	<b>Non-SUD (n= 3,785,128)</b>	<b>SUD (n=360,444)</b>	<b>Total (N= 4,145,572)</b>	<b>p</b>
1. Homelessness only	(18,113) 0%	(13,865) 4%	(31,978) 1%	<.001
2. Homelessness and housing insecurity	(26,438) 1%	(24,057) 7%	(50,495) 1%	
3. Housing insecurity only – poor housing quality	(1,916) 0%	(640) 0%	(2,556) 0%	
4. Housing insecurity only – economic hardships	(21,289) 1%	(7,350) 2%	(28,639) 1%	
5. Housing insecurity only – other	(21,269) 1%	(7,782) 2%	(29,051) 1%	
6. Housing insecurity without homelessness	(10,230) 0%	(5,588) 2%	(15,818) 0%	
7. Stable housing	(3,685,873) 97%	(301,162) 84%	(3,987,035) 96%	



Table 2a. Transition Matrix of Housing Instability from Study Year 0 to Study Year 1 among Veterans in Primary Care

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2020 – March 15 <sup>th</sup> , 2021 (Year 1)									
ICD-10 Code between March 16 <sup>th</sup> , 2019 – March 15 <sup>th</sup> , 2020 (Year 0)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	9,462	6,674	100	854	818	316	22,102	40,326	
Row %	23.46	16.55	0.25	2.12	2.03	0.78	54.81	100	
<b>2</b>									
N	7,791	21,603	268	4,094	4,189	5,196	17,733	60,874	
Row %	12.8	35.49	0.44	6.73	6.88	8.54	29.13	100	
<b>3</b>									
N	97	223	209	107	80	118	2,439	3,273	
Row %	2.96	6.81	6.39	3.27	2.44	3.61	74.52	100	
<b>4</b>									
N	686	2,082	72	6,750	972	2,077	23,445	36,084	
Row %	1.9	5.77	0.2	18.71	2.69	5.76	64.97	100	
<b>5</b>									
N	714	2,446	70	1,209	5,617	2,244	24,026	36,326	
Row %	1.97	6.73	0.19	3.33	15.46	6.18	66.14	100	
<b>6</b>									
N	307	2,596	121	2,545	2,465	5,217	6,327	19,578	
Row %	1.57	13.26	0.62	13	12.59	26.65	32.32	100	
<b>7</b>									
N	12,315	12,042	1,441	17,955	16,572	4,039	4,989,105	5,053,469	
Row %	0.24	0.24	0.03	0.36	0.33	0.08	98.73	100	
<b>Total</b>									
N	31,372	47,666	2,281	33,514	30,713	19,207	5,085,177	5,249,930	
Row %	0.6	0.91	0.04	0.64	0.59	0.37	96.86	100	

Table 2b. Transition Matrix of Housing Instability from Study Year 1 to Study Year 2 among Veterans in Primary Care

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2021 – March 15 <sup>th</sup> , 2022 (Year 2)									
ICD-10 Code between March 16 <sup>th</sup> , 2020 – March 15 <sup>th</sup> , 2021 (Year 1)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	7,383	6,309	114	700	690	324	15,852	31,372	
Row %	23.53	20.11	0.36	2.23	2.2	1.03	50.53	100	
<b>2</b>									
N	5,216	18,589	248	3,171	3,521	5,013	11,908	47,666	
Row %	10.94	39	0.52	6.65	7.39	10.52	24.98	100	
<b>3</b>									
N	89	220	198	88	55	106	1,525	2,281	
Row %	3.9	9.64	8.68	3.86	2.41	4.65	66.86	100	
<b>4</b>									
N	635	2,321	118	6,418	959	2,689	20,374	33,514	
Row %	1.89	6.93	0.35	19.15	2.86	8.02	60.79	100	
<b>5</b>									
N	680	2,338	75	851	5,814	2,110	18,845	30,713	
Row %	2.21	7.61	0.24	2.77	18.93	6.87	61.36	100	
<b>6</b>									
N	297	2,859	127	2,260	2,548	5,857	5,259	19,207	
Row %	1.55	14.89	0.66	11.77	13.27	30.49	27.38	100	
<b>7</b>									
N	13,263	14,993	1,830	18,513	17,969	4,982	5,013,627	5,085,177	
Row %	0.26	0.29	0.04	0.36	0.35	0.1	98.59	100	
<b>Total</b>									
N	27,563	47,629	2,710	32,001	31,556	21,081	5,087,390	5,249,930	
Row %	0.53	0.91	0.05	0.61	0.6	0.4	96.9	100	

Table 2c. Transition Matrix of Housing Instability from Study Year 0 to Study Year 2 among Veterans in Primary Care

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2021 – March 15 <sup>th</sup> , 2022 (Year 2)									
ICD-10 Code between March 16 <sup>th</sup> , 2019 – March 15 <sup>th</sup> , 2020 (Year 0)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	5,786	6,160	134	1,130	1,104	884	25,128	40,326	
Row %	14.35	15.28	0.33	2.8	2.74	2.19	62.31	100	
<b>2</b>									
N	5,478	15,776	303	4,049	4,507	6,043	24,718	60,874	
Row %	9	25.92	0.5	6.65	7.4	9.93	40.61	100	
<b>3</b>									
N	96	221	121	100	69	113	2,553	3,273	
Row %	2.93	6.75	3.7	3.06	2.11	3.45	78	100	
<b>4</b>									
N	676	2,186	101	4,416	1,108	2,216	25,381	36,084	
Row %	1.87	6.06	0.28	12.24	3.07	6.14	70.34	100	
<b>5</b>									
N	786	2,372	94	1,164	4,068	2,013	25,829	36,326	
Row %	2.16	6.53	0.26	3.2	11.2	5.54	71.1	100	
<b>6</b>									
N	356	2,468	107	2,002	2,308	4,004	8,333	19,578	
Row %	1.82	12.61	0.55	10.23	11.79	20.45	42.56	100	
<b>7</b>									
N	14,385	18,446	1,850	19,140	18,392	5,808	4,975,448	5,053,469	
Row %	0.28	0.37	0.04	0.38	0.36	0.11	98.46	100	
<b>Total</b>									
N	27,563	47,629	2,710	32,001	31,556	21,081	5,087,390	5,249,930	
Row %	0.53	0.91	0.05	0.61	0.6	0.4	96.9	100	

Table 3a. Transition Matrix of Housing Instability from Study Year 0 to Study Year 1 among Veterans in Primary Care with Substance Use Disorder

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2020 – March 15 <sup>th</sup> , 2021 (Year 1)									
ICD-10 Code between March 16 <sup>th</sup> , 2019 – March 15 <sup>th</sup> , 2020 (Year 0)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	3,749	2,697	35	297	277	94	6,716	13,865	
Row %	27.04	19.45	0.25	2.14	2	0.68	48.44	100	
<b>2</b>									
N	3,472	9,982	111	1,502	1,507	2,046	5,437	24,057	
Row %	14.43	41.49	0.46	6.24	6.26	8.5	22.6	100	
<b>3</b>									
N	29	57	54	21	17	21	441	640	
Row %	4.53	8.91	8.44	3.28	2.66	3.28	68.91	100	
<b>4</b>									
N	207	613	20	1,791	231	563	3,925	7,350	
Row %	2.82	8.34	0.27	24.37	3.14	7.66	53.4	100	
<b>5</b>									
N	224	807	13	244	1,608	671	4,215	7,782	
Row %	2.88	10.37	0.17	3.14	20.66	8.62	54.16	100	
<b>6</b>									
N	102	953	34	783	720	1,761	1,235	5,588	
Row %	1.83	17.05	0.61	14.01	12.88	31.51	22.1	100	
<b>7</b>									
N	2,936	2,717	256	2,815	2,611	754	289,073	301,162	
Row %	0.97	0.9	0.09	0.93	0.87	0.25	95.99	100	
<b>Total</b>									
N	10,719	17,826	523	7,453	6,971	5,910	311,042	360,444	
Row %	2.97	4.95	0.15	2.07	1.93	1.64	86.29	100	

Table 3b. Transition Matrix of Housing Instability from Study Year 1 to Study Year 2 among Veterans in Primary Care with Substance Use Disorder

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2021 – March 15 <sup>th</sup> , 2022 (Year 2)									
ICD-10 Code between March 16 <sup>th</sup> , 2020 – March 15 <sup>th</sup> , 2021 (Year 1)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	2,876	2,710	45	266	237	112	4,473	10,719	
Row %	26.83	25.28	0.42	2.48	2.21	1.04	41.73	100	
<b>2</b>									
N	2,146	8,145	91	1,135	1,267	1,869	3,173	17,826	
Row %	12.04	45.69	0.51	6.37	7.11	10.48	17.8	100	
<b>3</b>									
N	28	73	63	30	15	32	282	523	
Row %	5.35	13.96	12.05	5.74	2.87	6.12	53.92	100	
<b>4</b>									
N	228	823	29	1,866	226	903	3,378	7,453	
Row %	3.06	11.04	0.39	25.04	3.03	12.12	45.32	100	
<b>5</b>									
N	206	841	22	214	1,747	703	3,238	6,971	
Row %	2.96	12.06	0.32	3.07	25.06	10.08	46.45	100	
<b>6</b>									
N	96	1,108	34	706	812	2,105	1,049	5,910	
Row %	1.62	18.75	0.58	11.95	13.74	35.62	17.75	100	
<b>7</b>									
N	3,533	3,870	345	3,017	3,046	1,009	296,222	311,042	
Row %	1.14	1.24	0.11	0.97	0.98	0.32	95.24	100	
<b>Total</b>									
N	9,113	17,570	629	7,234	7,350	6,733	311,815	360,444	
Row %	2.53	4.87	0.17	2.01	2.04	1.87	86.51	100	

Table 3c. Transition Matrix of Housing Instability from Study Year 0 to Study Year 2 among Veterans in Primary Care with Substance Use Disorder

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2021 – March 15 <sup>th</sup> , 2022 (Year 2)									
ICD-10 Code between March 16 <sup>th</sup> , 2019 – March 15 <sup>th</sup> , 2020 (Year 0)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	2,434	2,755	41	409	397	301	7,528	13,865	
Row %	17.55	19.87	0.3	2.95	2.86	2.17	54.29	100	
<b>2</b>									
N	2,712	7,950	134	1,596	1,737	2,509	7,419	24,057	
Row %	11.27	33.05	0.56	6.63	7.22	10.43	30.84	100	
<b>3</b>									
N	27	68	31	22	16	33	443	640	
Row %	4.22	10.62	4.84	3.44	2.5	5.16	69.22	100	
<b>4</b>									
N	196	727	29	1,249	268	692	4,189	7,350	
Row %	2.67	9.89	0.39	16.99	3.65	9.41	56.99	100	
<b>5</b>									
N	261	836	31	306	1,224	643	4,481	7,782	
Row %	3.35	10.74	0.4	3.93	15.73	8.26	57.58	100	
<b>6</b>									
N	137	965	30	631	728	1,417	1,680	5,588	
Row %	2.45	17.27	0.54	11.29	13.03	25.36	30.06	100	
<b>7</b>									
N	3,346	4,269	333	3,021	2,980	1,138	286,075	301,162	
Row %	1.11	1.42	0.11	1	0.99	0.38	94.99	100	
<b>Total</b>									
N	9,113	17,570	629	7,234	7,350	6,733	311,815	360,444	
Row %	2.53	4.87	0.17	2.01	2.04	1.87	86.51	100	

Table 4a. Transition Matrix of Housing Instability from Study Year 0 to Study Year 1 among Veterans in Primary Care without Substance Use Disorder

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2020 – March 15 <sup>th</sup> , 2021 (Year 1)									
ICD-10 Code between March 16 <sup>th</sup> , 2019 – March 15 <sup>th</sup> , 2020 (Year 0)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	3,969	2,786	47	418	392	176	10,325	18,113	
Row %	21.91	15.38	0.26	2.31	2.16	0.97	57	100	
<b>2</b>									
N	3,031	8,580	108	1,942	2,006	2,413	8,358	26,438	
Row %	11.46	32.45	0.41	7.35	7.59	9.13	31.61	100	
<b>3</b>									
N	50	123	118	65	51	72	1,437	1,916	
Row %	2.61	6.42	6.16	3.39	2.66	3.76	75	100	
<b>4</b>									
N	362	1,096	40	3,738	582	1,150	14,321	21,289	
Row %	1.7	5.15	0.19	17.56	2.73	5.4	67.27	100	
<b>5</b>									
N	363	1,217	47	793	2,989	1,223	14,637	21,269	
Row %	1.71	5.72	0.22	3.73	14.05	5.75	68.82	100	
<b>6</b>									
N	154	1,175	68	1,312	1,294	2,638	3,589	10,230	
Row %	1.51	11.49	0.66	12.83	12.65	25.79	35.08	100	
<b>7</b>									
N	6,503	6,721	843	11,752	10,977	2,594	3,646,483	3,685,873	
Row %	0.18	0.18	0.02	0.32	0.3	0.07	98.93	100	
<b>Total</b>									
N	14,432	21,698	1,271	20,020	18,291	10,266	3,699,150	3,785,128	
Row %	0.38	0.57	0.03	0.53	0.48	0.27	97.73	100	

Table 4b. Transition Matrix of Housing Instability from Study Year 1 to Study Year 2 among Veterans in Primary Care without Substance Use Disorder

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2021 – March 15 <sup>th</sup> , 2022 (Year 2)									
ICD-10 Code between March 16 <sup>th</sup> , 2020 – March 15 <sup>th</sup> , 2021 (Year 1)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	3,217	2,651	53	336	355	160	7,660	14,432	
Row %	22.29	18.37	0.37	2.33	2.46	1.11	53.08	100	
<b>2</b>									
N	2,175	7,939	128	1,579	1,747	2,538	5,592	21,698	
Row %	10.02	36.59	0.59	7.28	8.05	11.7	25.77	100	
<b>3</b>									
N	41	109	108	49	33	66	865	1,271	
Row %	3.23	8.58	8.5	3.86	2.6	5.19	68.06	100	
<b>4</b>									
N	308	1,191	75	3,629	629	1,464	12,724	20,020	
Row %	1.54	5.95	0.37	18.13	3.14	7.31	63.56	100	
<b>5</b>									
N	362	1,164	47	531	3,329	1,131	11,727	18,291	
Row %	1.98	6.36	0.26	2.9	18.2	6.18	64.11	100	
<b>6</b>									
N	169	1,420	77	1,267	1,398	3,042	2,893	10,266	
Row %	1.65	13.83	0.75	12.34	13.62	29.63	28.18	100	
<b>7</b>									
N	7,324	8,733	1,218	13,125	12,809	3,374	3,652,567	3,699,150	
Row %	0.2	0.24	0.03	0.35	0.35	0.09	98.74	100	
<b>Total</b>									
N	13,596	23,207	1,706	20,516	20,300	11,775	3,694,028	3,785,128	
Row %	0.36	0.61	0.05	0.54	0.54	0.31	97.59	100	



Table 4c. Transition Matrix of Housing Instability from Study Year 0 to Study Year 2 among Veterans in Primary Care without Substance Use Disorder

1. Homelessness only
2. Homelessness and housing insecurity
3. Housing insecurity only – poor housing quality
4. Housing insecurity only – economic hardships
5. Housing insecurity only – other
6. Housing insecurity without homelessness
7. Stable housing

ICD-10 Code between March 16 <sup>th</sup> , 2021 – March 15 <sup>th</sup> , 2022 (Year 2)									
ICD-10 Code between March 16 <sup>th</sup> , 2019 – March 15 <sup>th</sup> , 2020 (Year 0)	1	2	3	4	5	6	7	Total	
<b>1</b>									
N	2,442	2,592	73	580	555	461	11,410	18,113	
Row %	13.48	14.31	0.4	3.2	3.06	2.55	62.99	100	
<b>2</b>									
N	2,037	6,216	142	2,006	2,251	2,916	10,870	26,438	
Row %	7.7	23.51	0.54	7.59	8.51	11.03	41.12	100	
<b>3</b>									
N	55	112	75	68	47	69	1,490	1,916	
Row %	2.87	5.85	3.91	3.55	2.45	3.6	77.77	100	
<b>4</b>									
N	370	1,150	61	2,511	708	1,271	15,218	21,289	
Row %	1.74	5.4	0.29	11.79	3.33	5.97	71.48	100	
<b>5</b>									
N	404	1,198	58	727	2,334	1,102	15,446	21,269	
Row %	1.9	5.63	0.27	3.42	10.97	5.18	72.62	100	
<b>6</b>									
N	175	1,161	64	1,105	1,300	2,078	4,347	10,230	
Row %	1.71	11.35	0.63	10.8	12.71	20.31	42.49	100	
<b>7</b>									
N	8,113	10,778	1,233	13,519	13,105	3,878	3,635,247	3,685,873	
Row %	0.22	0.29	0.03	0.37	0.36	0.11	98.63	100	
<b>Total</b>									
N	13,596	23,207	1,706	20,516	20,300	11,775	3,694,028	3,785,128	
Row %	0.36	0.61	0.05	0.54	0.54	0.31	97.59	100	

Table 5. Incidence Rate Ratios and 95% Confidence Interval for Change in Number of Telehealth Visits in Primary Care, 2019-2022, from Multivariable Negative Binomial Regressions with Housing Instability Measure Added

	Change in the Number of Telehealth Visits	
	Model without Housing Instability IRR (95% CI) <sup>a</sup>	Model with Housing Instability IRR (95% CI) <sup>b</sup>
SUD Diagnosis	1.089 (1.085, 1.092)	1.089 (1.085, 1.092)
Housing Instability (ref: Stable housing)		
Homelessness only	N/A	0.973 (0.968, 0.977)
Homelessness and housing insecurity	N/A	0.976 (0.972, 0.979)
Housing insecurity only – poor housing quality	N/A	1.061 (1.047, 1.075)
Housing insecurity only – economic hardships	N/A	1.074 (1.070, 1.077)
Housing insecurity only – other	N/A	1.083 (1.079, 1.087)
Housing insecurity without homelessness	N/A	1.059 (1.054, 1.064)
Segment (ref: Segment 1 Pre-pandemic)		
Segment 2 (Early)	2.688 (2.681, 2.695)	2.688 (2.681, 2.695)
Segment 3 (Intermediate)	2.017 (2.011, 2.023)	2.017 (2.012, 2.023)
Segment 4 (Late)	1.494 (1.490, 1.499)	1.494 (1.490, 1.499)
Interaction of SUD x Segment		
SUD x Segment 2	0.885 (0.882, 0.888)	0.884 (0.881, 0.888)
SUD x Segment 3	0.912 (0.908, 0.915)	0.911 (0.908, 0.915)
SUD x Segment 4	0.937 (0.934, 0.941)	0.937 (0.933, 0.940)
Age (ref: 75+)		
18-44	0.937 (0.934, 0.941)	0.938 (0.934, 0.941)
45-64	0.978 (0.975, 0.981)	0.978 (0.975, 0.981)
65-74	0.990 (0.987, 0.993)	0.990 (0.987, 0.993)
Interaction of Age x Segment		
18-44 x Segment 2	1.142 (1.137, 1.147)	1.142 (1.137, 1.146)
18-44 x Segment 3	1.284 (1.278, 1.290)	1.284 (1.278, 1.290)
18-44 x Segment 4	1.309 (1.303, 1.315)	1.309 (1.303, 1.315)
45-64 x Segment 2	1.053 (1.049, 1.057)	1.053 (1.049, 1.056)
45-64 x Segment 3	1.121 (1.117, 1.125)	1.121 (1.117, 1.125)
45-64 x Segment 4	1.127 (1.122, 1.131)	1.126 (1.122, 1.131)
65-74 x Segment 2	1.013 (1.009, 1.016)	1.013 (1.009, 1.016)
65-74 x Segment 3	1.023 (1.019, 1.027)	1.023 (1.019, 1.027)

65-74 x Segment 4	1.030 (1.026, 1.034)	1.030 (1.026, 1.034)
Female (ref: Male)	1.051 (1.050, 1.053)	1.051 (1.050, 1.052)
Race/ethnicity (ref: Non-Hispanic White)		
Non-Hispanic Black	0.999 (0.998, 1.000)	0.999 (0.998, 1.000)
Hispanic	0.965 (0.963, 0.966)	0.965 (0.963, 0.966)
Non-Hispanic other minority	0.986 (0.984, 0.989)	0.986 (0.984, 0.988)
Non-Hispanic unknown	0.984 (0.982, 0.985)	0.984 (0.982, 0.985)
Charlson Comorbidity Index (ref: 0)		
1	1.072 (1.071, 1.073)	1.072 (1.071, 1.073)
2+	1.141 (1.140, 1.142)	1.140 (1.139, 1.141)
Marital status (ref: Married)		
Divorced/Widowed	1.010 (1.009, 1.011)	1.009 (1.008, 1.010)
Never Married/Separated	0.986 (0.985, 0.987)	0.985 (0.984, 0.986)
Depression	1.024 (1.023, 1.025)	1.023 (1.022, 1.024)
Anxiety	1.018 (1.016, 1.020)	1.018 (1.016, 1.019)
PTSD	1.006 (1.005, 1.007)	1.006 (1.005, 1.007)
Psychosis	0.972 (0.967, 0.977)	0.973 (0.968, 0.977)
Other mental health condition	1.008 (1.006, 1.010)	1.008 (1.006, 1.010)
Serious mental illness	1.003 (1.001, 1.005)	1.002 (1.000, 1.004)
Have insurance outside VA	0.998 (0.997, 0.999)	0.998 (0.997, 0.999)

<sup>a</sup> All p<.001 except for Black race/ethnicity category (p=0.197)

<sup>b</sup> All p<.001 except for Black race/ethnicity category (p=0.003) and serious mental illness (p=0.033)

Table 6. Incidence Rate Ratios and 95% Confidence Interval for Change in Number of Video-to-Home Visits in Primary Care, 2019-2022, from Multivariable Negative Binomial Regressions with Housing Instability Measure Added

	Change in Number of Video-to-Home Visits	
	Model without Housing Instability IRR (95% CI) <sup>a</sup>	Model with Housing Instability IRR (95% CI) <sup>b</sup>
SUD Diagnosis	0.776 (0.749, 0.804)	0.795 (0.768, 0.824)
Housing Instability (ref: Stable housing)		
Homelessness only	N/A	0.784 (0.768, 0.800)
Homelessness and housing insecurity	N/A	0.746 (0.734, 0.758)
Housing insecurity only – poor housing quality	N/A	0.849 (0.792, 0.911)
Housing insecurity only – economic hardships	N/A	0.913 (0.896, 0.929)
Housing insecurity only – other	N/A	0.891 (0.874, 0.909)
Housing insecurity without homelessness	N/A	0.882 (0.861, 0.903)
Segment (ref: Segment 1 Pre-pandemic)		
Segment 2 (Early)	9.325 (9.093, 9.563)	9.321 (9.089, 9.559)
Segment 3 (Intermediate)	12.062 (11.770, 12.362)	12.057 (11.764, 12.356)
Segment 4 (Late)	8.888 (8.675, 9.105)	8.885 (8.673, 9.102)
Interaction of SUD x Segment		
SUD x Segment 2	1.042 (1.003, 1.082)	1.036 (0.998, 1.076)
SUD x Segment 3	1.066 (1.028, 1.107)	1.060 (1.021, 1.100)
SUD x Segment 4	1.122 (1.082, 1.164)	1.113 (1.073, 1.155)
Age (ref: 75+)		
18-44	2.155 (2.087, 2.225)	2.156 (2.088, 2.226)
45-64	1.537 (1.493, 1.582)	1.542 (1.499, 1.587)
65-74	1.144 (1.111, 1.177)	1.143 (1.111, 1.176)
Interaction of Age x Segment		
18-44 x Segment 2	1.220 (1.179, 1.263)	1.218 (1.177, 1.261)
18-44 x Segment 3	1.332 (1.288, 1.378)	1.330 (1.286, 1.375)
18-44 x Segment 4	1.491 (1.443, 1.541)	1.489 (1.440, 1.539)
45-64 x Segment 2	1.254 (1.215, 1.294)	1.252 (1.214, 1.292)
45-64 x Segment 3	1.286 (1.247, 1.326)	1.284 (1.245, 1.323)
45-64 x Segment 4	1.334 (1.295, 1.375)	1.332 (1.292, 1.372)
65-74 x Segment 2	1.131 (1.097, 1.167)	1.131 (1.097, 1.167)
65-74 x Segment 3	1.114 (1.081, 1.149)	1.114 (1.081, 1.149)

65-74 x Segment 4	1.096 (1.064, 1.130)	1.096 (1.064, 1.130)
Female (ref: Male)	1.250 (1.243, 1.256)	1.218 (1.177, 1.261)
Race/ethnicity (ref: Non-Hispanic White)		
Non-Hispanic Black	1.125 (1.120, 1.130)	1.132 (1.127, 1.137)
Hispanic	1.202 (1.194, 1.209)	1.202 (1.195, 1.209)
Non-Hispanic other minority	1.123 (1.112, 1.135)	1.124 (1.113, 1.136)
Non-Hispanic unknown	1.066 (1.057, 1.075)	1.067 (1.058, 1.076)
Charlson Comorbidity Index (ref: 0)		
1	0.886 (0.882, 0.890)	0.887 (0.883, 0.891)
2+	0.806 (0.803, 0.810)	0.808 (0.804, 0.811)
Marital status (ref: Married)		
Divorced/Widowed	0.857 (0.853, 0.860)	0.863 (0.859, 0.867)
Never Married/Separated	0.879 (0.875, 0.883)	0.887 (0.883, 0.891)
Depression	1.037 (1.032, 1.041)	1.041 (1.036, 1.046)
Anxiety	1.117 (1.108, 1.125)	1.118 (1.110, 1.127)
PTSD	1.049 (1.044, 1.053)	1.047 (1.043, 1.052)
Psychosis	0.808 (0.790, 0.826)	0.827 (0.809, 0.846)
Other mental health condition	0.976 (0.969, 0.984)	0.978 (0.970, 0.985)
Serious mental illness	0.873 (0.865, 0.880)	0.884 (0.876, 0.892)
Have insurance outside VA	1.058 (1.053, 1.062)	1.052 (1.048, 1.056)

<sup>a</sup> All p<.001 except for SUD x Segment 2 (p=0.032)

<sup>b</sup> All p<.001 except for SUD x Segment 2 (p=0.065) and SUD x Segment 3 (p=0.002)

Table 7. Odds Ratios and 95% Confidence Interval for Attrition from Primary Care, 2020 - 2022, among Veterans from Multivariable Logistic Regression Models with Housing Instability Measure Added

Variable	Model without Housing Instability		Model with Housing Instability		Model with Interaction Term	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
SUD diagnosis (ref: Non-SUD)	1.117 (1.094, 1.142)	<.001	1.059 (1.036, 1.083)	<.001	1.083 (1.058, 1.109)	<.001
Baseline primary care visit counts (ref: 1-2 visits)						
3 visits	0.460 (0.452, 0.468)	<.001	0.459 (0.451, 0.467)	<.001	0.459 (0.450, 0.467)	<.001
4-6 visits	0.302 (0.297, 0.308)	<.001	0.300 (0.295, 0.305)	<.001	0.300 (0.295, 0.305)	<.001
7+ visits	0.161 (0.157, 0.166)	<.001	0.158 (0.154, 0.162)	<.001	0.158 (0.153, 0.162)	<.001
Housing Instability (ref: Stable housing)						
Homelessness only	N/A		1.849 (1.758, 1.946)	<.001	1.846 (1.728, 1.971)	<.001
Homelessness and housing insecurity	N/A		1.628 (1.555, 1.704)	<.001	1.730 (1.630, 1.835)	<.001
Housing insecurity only – poor housing quality	N/A		1.819 (1.503, 2.202)	<.001	1.999 (1.614, 2.477)	<.001
Housing insecurity only – economic hardships	N/A		1.454 (1.364, 1.551)	<.001	1.524 (1.416, 1.639)	<.001
Housing insecurity only – other	N/A		1.357 (1.272, 1.448)	<.001	1.445 (1.341, 1.557)	<.001
Housing insecurity without homelessness	N/A		1.209 (1.105, 1.323)	<.001	1.303 (1.169, 1.453)	<.001
SUD diagnosis x Housing instability (ref: Non-SUD x Stable housing)						
SUD x Homelessness only	N/A		N/A		0.986 (0.890, 1.093)	0.793
SUD x Homelessness and housing insecurity	N/A		N/A		0.858 (0.784, 0.939)	<.001
SUD x Housing insecurity only – poor housing quality	N/A		N/A		0.651 (0.405, 1.047)	0.076
SUD x Housing insecurity only – economic hardships	N/A		N/A		0.821 (0.707, 0.953)	0.009
SUD x Housing insecurity only – other	N/A		N/A		0.776 (0.668, 0.902)	<.001

SUD x Housing insecurity without homelessness	N/A		N/A		0.787 (0.648, 0.955)	0.015
Age (ref: 75+)						
18-44	1.934 (1.891, 1.978)	<.001	1.935 (1.892, 1.980)	<.001	1.933 (1.890, 1.977)	<.001
45-64	0.859 (0.841, 0.876)	<.001	0.854 (0.836, 0.871)	<.001	0.853 (0.836, 0.871)	<.001
65-74	0.702 (0.689, 0.715)	<.001	0.703 (0.690, 0.717)	<.001	0.703 (0.690, 0.716)	<.001
Female (ref: male)	0.807 (0.791, 0.824)	<.001	0.812 (0.796, 0.829)	<.001	0.812 (0.795, 0.829)	<.001
Race/ethnicity (ref: White)						
Non-Hispanic Black	0.877 (0.861, 0.892)	<.001	0.858 (0.843, 0.873)	<.001	0.857 (0.842, 0.873)	<.001
Hispanic	0.933 (0.911, 0.956)	<.001	0.933 (0.910, 0.956)	<.001	0.933 (0.910, 0.956)	<.001
Non-Hispanic Other	1.050 (1.015, 1.088)	0.005	1.051 (1.016, 1.089)	0.004	1.052 (1.016, 1.089)	0.004
Non-Hispanic Unknown	1.128 (1.101, 1.156)	<.001	1.125 (1.098, 1.153)	<.001	1.125 (1.098, 1.153)	<.001
Marital status (ref: Married)						
Divorced/Widowed	1.105 (1.089, 1.121)	<.001	1.095 (1.079, 1.111)	<.001	1.094 (1.078, 1.110)	<.001
Never married/Separated	1.171 (1.153, 1.189)	<.001	1.157 (1.139, 1.175)	<.001	1.157 (1.139, 1.175)	<.001
CCI (ref: 0)						
1	0.768 (0.756, 0.780)	<.001	0.767 (0.755, 0.779)	<.001	0.767 (0.755, 0.779)	<.001
2+	0.724 (0.712, 0.736)	<.001	0.723 (0.711, 0.736)	<.001	0.723 (0.711, 0.736)	<.001
Depression	1.014 (0.997, 1.031)	0.118	0.999 (0.982, 1.017)	0.937	0.999 (0.982, 1.017)	0.934
Anxiety	1.063 (1.033, 1.093)	<.001	1.055 (1.026, 1.086)	<.001	1.055 (1.026, 1.085)	<.001
PTSD	0.940 (0.923, 0.957)	<.001	0.934 (0.917, 0.951)	<.001	0.933 (0.917, 0.951)	<.001
Serious mental illness	1.079 (1.046, 1.113)	<.001	1.038 (1.005, 1.071)	0.021	1.340 (1.254, 1.433)	<.001
Psychosis	1.439 (1.347, 1.538)	<.001	1.333 (1.247, 1.424)	<.001	0.967 (0.939, 0.995)	0.020
Other mental health conditions	0.968 (0.940, 0.996)	0.025	0.966 (0.939, 0.994)	0.019	1.039 (1.007, 1.072)	0.016
Non-VA insurance (ref: VA insurance only)	0.809 (0.797, 0.821)	<.001	0.817 (0.805, 0.829)	<.001	0.817 (0.805, 0.829)	<.001
Rurality of patient residence (ref: Urban)	0.939 (0.924, 0.954)	<.001	0.945 (0.930, 0.960)	<.001	0.945 (0.930, 0.960)	<.001
Enrollment priority group (ref: Enrolled without special considerations)						
High Disability	0.634 (0.622, 0.646)	<.001	0.637 (0.625, 0.649)	<.001	0.637 (0.625, 0.649)	<.001
Low/Moderate Disability	0.873 (0.858, 0.889)	<.001	0.868 (0.853, 0.884)	<.001	0.869 (0.853, 0.884)	<.001

Low Income	1.193 (1.172, 1.216)	<.001	1.171 (1.149, 1.193)	<.001	1.170 (1.148, 1.192)	<.001
Drive time to primary care site >=30min (ref: <30min)	1.080 (1.060, 1.100)	<.001	1.083 (1.064, 1.104)	<.001	1.083 (1.064, 1.104)	<.001
Drive distance to PC >40miles (ref: <=40 miles)	1.277 (1.243, 1.311)	<.001	1.275 (1.241, 1.310)	<.001	1.275 (1.241, 1.310)	<.001

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<sup>a</sup> Indicators for 138 VA health care systems were included in the regression model as fixed effects but are not shown in the tab



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## Chapter 5 : Conclusion

In this dissertation, Chapters Two, Three, and Four have examined and compared the primary care use and experience of Veterans with and without SUD nationwide in terms of telehealth and video use, primary care attrition, and their association with housing instability. Looking across the full range of analyses, we found Veterans with a SUD diagnosis utilize more telehealth but fewer video visits for primary care services compared to those without SUD. The association between SUD and telehealth use remain the same in the presence of housing instability, and the severity of housing instability differentially affected the use of telehealth. Unadjusted attrition of Veterans with SUD diagnoses was slightly higher than for Veterans without SUD (3.3% versus 3.2%) but the difference higher in adjusted multivariate analysis. Housing instability also significantly increased the risk of primary care attrition, but the increased risk associated with housing instability is lower among Veterans with a SUD diagnosis. Combined together, it provides insights into how different aspect of primary care utilization at the VA, such as telehealth as an alternative way of accessing primary care<sup>1</sup> and attrition, are influenced by vulnerabilities, such as a SUD diagnosis or housing instability.

More specifically, in the second chapter on the study of telehealth use for primary care services among Veterans between 2019 and 2022, we found sustained telehealth utilization, and specifically video modality, even in the post-COVID-19 onset for Veterans with and without a SUD diagnosis. Higher telehealth visit rate among Veterans with SUD were maintained as the overall telehealth use stabilized, whereas video visit rates were lower among Veterans with SUD compared to those without the diagnosis. Lastly, Veterans who are typically considered vulnerable to the digital divide,<sup>2</sup> such as minorities and sicker patients, did not lag in telehealth use after the pandemic onset.

In the third chapter on primary care attrition among Veteran patients between 2020 and 2022, we found higher attrition rates among Veterans with SUD, particularly among those who are light users of primary care. Attrition was substantially lower in Veterans with higher use of primary care services in the VA. The study also showed a significant positive association between attrition and greater drive distance and time to primary care sites, expanding their association not only among female Veterans<sup>3</sup> but also for the nationwide sample, although the geographic barriers did not affect Veterans with SUD disproportionately.

The fourth chapter examined the transitions of housing instability states among Veterans in primary care and its impact on telehealth use and attrition from primary care services. We found that less than half of the homeless Veterans maintained the same status over time, and a small percentage but significant number of Veterans who were not initially homeless transitioned into an insecure housing status the following year. Veterans with a SUD diagnosis were more likely to be homeless and a higher proportion remained homeless or moved into housing insecurity the following year compared to those without SUD. The analysis showed less telehealth use among Veterans with homelessness, greater telehealth use among those with housing insecurity, but less use of video for all types of housing instability. Both SUD and housing instability increased the risk primary care attrition even after taking the differences in baseline visits into account.

The three studies in the dissertation paid attention to the role of vulnerabilities such as SUD and housing instability in primary care utilization at the VA. We found higher telehealth use, lower video use, and increased attrition among those with SUD and housing instability, and but lower attrition among those with SUD and housing instability compared to those with housing instability alone. These findings imply the importance of maintaining telehealth access

for Veterans with vulnerabilities such as SUD and housing instability who previously reported to have negative experience with primary care.<sup>4,5</sup> Also, testing an interaction between SUD and housing instability helped to quantify how they interact in a complex pattern to influence primary care attrition.

The study was dependent on identification of SUD and ICD-10 coding of homelessness and housing insecurity as reported in data from electronic health records in the VA Corporate Data Warehouse. As noted in the individual chapters, there is some evidence of underdiagnosis of SUD and potentially underreporting of measures of social determinants of health, including housing insecurity measures. We do not believe underreporting substantially impacts the conclusions reached in this dissertation, but we would encourage efforts to improve capture of these critical measures of patient need.

From the perspective of policy and practice, the findings on telehealth overall suggest comparable levels of use by Veterans with and without SUD. The findings on video telehealth, likely to increase over time, are more troubling and suggest that VA should identify additional ways to link Veterans with SUD and homelessness to these modalities of care. The findings on attrition associated with SUD and homelessness also suggest continued and increased efforts to keep these Veterans attached to VA services.

In terms of future research, their lower likelihood of using video modality suggests further studies to examine appropriateness of the video modality for primary care and satisfaction among Veterans with SUD and housing instability and look for reasons and ways to improve their video use experience. Also, further research into how telehealth affects other aspect of primary care experience, such as continuity of care, may help the VA to fully understand the long-term effect of promoting virtual care for these population.<sup>6,7</sup> For the attrition

study, future research can strengthen the analysis by examining other patient-level factors such as patient perception and experience as well as organizational factors to fully understand the effect of the vulnerabilities on attrition.<sup>4,8,9</sup> Lastly, more research of the housing instability transitions such as using Markov model can further quantify and identify significant factors associated with the transition of housing instability.<sup>10</sup> This dissertation helps to close the gap on the effect of SUD on telehealth and attrition, as well as the effect of housing instability on primary care attrition.



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## Appendices

### Appendix 1. Clinic Codes Used to Identify Primary Care Visit at the Veterans Health Administration

<b>Clinic Code</b>	<b>Definition</b>
322	Comprehensive Women's Primary Care Clinic
323	Primary Care Medicine
338	Telephone Primary Care
348	Primary Care Shared Appointment
350	Geriatric Patient Aligned Care Team
531	Primary Care for Patients with Serious Mental Illness (SMI)
534	Mental Health Integrated Care - Individual
539	Mental Health Integrated Care - Group
704	Women's Gender-Specific Preventive Care

**Appendix 2.** Odds Ratios and 95% Confidence Interval for Attrition from Primary Care among Veterans from Multivariable Logistic Regression Model<sup>a</sup> after Removing Baseline Primary Care Visit Counts

<b>Variable</b>	<b>OR (95% CI)</b>	<b>p</b>
SUD diagnosis (ref: Non-SUD)	1.038 (1.009, 1.068)	0.010
Age (ref: 75+)		
18-44	2.112 (2.016, 2.211)	<.001
45-64	0.827 (0.795, 0.861)	<.001
65-74	0.673 (0.651, 0.695)	<.001
Female (ref: male)	0.702 (0.678, 0.727)	<.001
Race/ethnicity (ref: White)		
Non-Hispanic Black	0.922 (0.862, 0.986)	0.018
Hispanic	0.923 (0.801, 1.063)	0.264
Non-Hispanic Other	1.162 (1.094, 1.235)	<.001
Non-Hispanic Unknown	1.220 (1.146, 1.298)	<.001
Marital status (ref: Married)		
Divorced/Widowed	1.052 (1.031, 1.074)	<.001
Never married/Separated	1.169 (1.136, 1.204)	<.001
Charlson Comorbidity Index (ref: 0)		
1	0.675 (0.661, 0.689)	<.001
2+	0.543 (0.527, 0.560)	<.001
Depression	0.917 (0.897, 0.938)	<.001
Anxiety	0.979 (0.948, 1.012)	0.208
PTSD	0.932 (0.909, 0.956)	<.001
Serious mental illness	1.003 (0.965, 1.042)	0.886
Psychosis	1.465 (1.371, 1.565)	<.001
Other mental health conditions	0.941 (0.908, 0.975)	<.001
Non-VA insurance (ref: VA insurance only)	0.798 (0.776, 0.821)	<.001
Rurality of patient residence (ref: Urban)	0.846 (0.804, 0.891)	<.001
Enrollment priority group (ref: Enrolled without special considerations)		
High Disability	0.557 (0.535, 0.580)	<.001
Low/Moderate Disability	0.819 (0.797, 0.841)	<.001
Low Income	1.058 (1.027, 1.090)	<.001
Drive time to primary care site $\geq 30$ min (ref: $< 30$ min)	1.107 (1.060, 1.156)	<.001
Drive distance to PC $> 40$ miles (ref: $\leq 40$ miles)	1.294 (1.203, 1.392)	<.001

<sup>a</sup> Indicators for 138 VA health care systems were included in the regression model as fixed effects but are not shown in the table

**Appendix 3.** Comparison of Odds Ratios for Attrition from Primary Care among Veterans by Substance Use Disorder from Multivariable Logistic Regression Model<sup>a</sup>

Variable	OR and Significance from Respective Models <sup>b</sup>		P-value from the Test of Equality of Coefficients <sup>c</sup>
	Veterans with SUD (n=355,323)	Veterans without SUD (n=3,719,108)	
Baseline primary care visit counts <sup>d</sup> (ref: 1-2 visits)			
3 visits	0.480***	0.458***	0.131
4-6 visits	0.302***	0.302***	0.954
7+ visits	0.148***	0.163***	<.001
Age (ref: 75+)			
18-44	1.459***	1.953***	<.001
45-64	0.694***	0.860***	<.001
65-74	0.645***	0.699***	0.159
Female (ref: male)	0.723***	0.813***	0.004
Race/ethnicity (ref: White)			
Non-Hispanic Black	0.859***	0.878***	0.454
Hispanic	0.826***	0.943***	0.004
Non-Hispanic Other	0.968	1.054**	0.207
Non-Hispanic Unknown	1.036	1.135***	0.069
Marital status (ref: Married)			
Divorced/Widowed	1.229***	1.092***	<.001
Never married/Separated	1.299***	1.159***	<.001
Charlson Comorbidity Index (ref: 0)			
1	0.787***	0.766***	0.325
2+	0.767***	0.717***	0.019
Depression	1.098***	1.000	<.001
Anxiety	1.014	1.078***	0.099
PTSD	1.006	0.934***	0.004
Serious mental illness	1.120***	1.071***	0.197
Psychosis	1.340***	1.530***	0.051
Other mental health conditions	1.018	0.954**	0.089
Non-VA insurance (ref: VA insurance only)	0.836***	0.805***	0.110
Rurality of patient residence (ref: Urban)	0.965	0.937***	0.327
Enrollment priority group (ref: Enrolled without special considerations)			
High Disability	0.611***	0.634***	0.333

Low/Moderate Disability	0.870***	0.872***	0.957
Low Income	1.118**	1.199***	0.067
Drive time to primary care site $\geq 30$ min (ref: $< 30$ min)	1.075*	1.080***	0.883
Drive distance to PC $> 40$ miles (ref: $\leq 40$ miles)	1.193***	1.285***	0.159

<sup>a</sup> Indicators for 138 VA health care systems were included in the regression model as fixed effects but are not shown in the table

<sup>b</sup> Significance from regression model with each patient group using seemingly unrelated estimation (SUEST); \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

<sup>c</sup> p-values from the test of equality of coefficients (Wald test), i.e., test whether the effect of  $x_1$  on  $y_1$  is the same as the effect of  $x_2$  on  $y_2$

<sup>d</sup> March 16<sup>th</sup>, 2019 – March 15<sup>th</sup>, 2020