OREGON HEALTH & SCIENCE UNIVERSITY
SCHOOL OF MEDICINE – GRADUATE STUDIES

POTENTIAL FOR SMARTWATCH DEVICE USE IN THE TREATMENT OF PATIENTS DIAGNOSED WITH SCHIZOPHRENIA OR BIPOLAR I OR II DISORDER

By

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A CAPSTONE

Presented to the Department of Medical Informatics and Clinical Epidemiology and the
Oregon Health & Science University
School of Medicine
in partial fulfillment of
the requirements for the degree of

Master of Science

December 2021

OREGON HEALTH & SCIENCE UNIVERSITY
SCHOOL OF MEDICINE – GRADUATE STUDIES

SCHOOL OF MEDICINE

OREGON HEALTH & SCIENCE UNIVERSITY

CERTIFICATE OF APPROVAL

This is to certify that the Master's Capstone Project of

Katherine L. Millsap

"Potential for Smartwatch Device Use in the Treatment of Patients Diagnosed with Schizophrenia or Bipolar I or II Disorder"

has been approved

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ACKNOWLEDGMENTS

I would like to acknowledge my capstone advisor, Dr. Kristine Alpi, for being generous with her time and guidance throughout my capstone project. The completion of my capstone would not have been possible without the patience, support, and expertise Dr. Alpi provided. I would also like to thank my survey pilot testers for their time and thoroughness in their feedback. It helped me enormously to have their professional and medical input on the survey. I am very appreciative to all the survey participants who took time out of their busy schedules to complete the survey and help add valuable insight into the topic of Severe Mental Illnesses and wearable technologies. And finally, I would like to thank all the professors and advisors in the Department of Medical Informatics and Clinical Epidemiology at Oregon Health & Science University for their support, expertise, and guidance all throughout my master's program.

ABSTRACT

Purpose: The purpose of this research is to add to current knowledge on the potential of leveraging smartwatch device data in the treatment of patients with Severe Mental Illnesses (SMIs), specifically focusing on schizophrenia or bipolar I or II disorder (BPD). The focus of research into the feasibility of using smartwatch device data to augment standard treatment in mental health has primarily been from the technical feasibility of device data integration and patient perspectives on using smartwatches. There is a knowledge gap on the adoptability of this technology from the perspective of the providers who treat patients with SMIs. This research aims to close that gap and provide a more complete understanding of the potential for leveraging data from smartwatch devices and the barriers to providers to use that data for the treatment of patients with SMIs.

Methods: An anonymous online survey of mental health providers was conducted from August 2021 to October 2021. The research was deemed exempt by the Oregon Health & Science University (OHSU) Institutional Review Board. The survey was cross-sectional, taking place at a single point in time, and consisted of 25 open and close-ended questions. The response rate was 5.1% (n=104/2,024). Open-ended responses were thematically analyzed and emotion-coded for positive or negative affect.

Results: Of the 95 providers included in the data analysis, 69.5% (n=66/95) see value in collecting health data from wearable devices for use in patient care, but only 6.3% (n=6/95) reported access to their patient's smartwatch device data. Of the 118 responses selecting from multiple issues identified with accessing patient device data, 16.1% (n=19/118) were technical barriers to integrating data into an Electronic Health Record

(EHR), 13.6%, (n=16/118) additional patient consent to share protected mental health records, 9.3% (n=11/118) outputting data from device to hard copy to integrate into printed health record, 3.4% (n=4/95) data is accessible in an EHR but is inconvenient to access. Data access, smartwatch device features, and privacy and security were the top three themes identified from open-text responses. From emotion coding, positive affect was identified in 75 responses and negative affect in 44 responses.

Discussion and Conclusion: Providers expressed concern about the use of smartwatch devices in SMI clinical care which was centered around the negative impacts and risks associated with introducing new technology to patients with SMIs, especially to their patients with highly symptomatic schizophrenia. There was a subset of respondents who expressed resistance to including their patients in treatment decisions and saw smartwatches as promoting shared decision making. These respondents indicated smartwatch devices are not appropriate for their patients. Informatics professionals should consider the relationship around shared decision making between mental health providers and their patients with SMIs as part of additional research and development of smartwatches for use in SMI clinical care.

INTRODUCTION

Severe mental illnesses (SMIs) have historically been a challenging area of human health to treat and therefore present ample opportunity for research into complementary treatment modalities. As of 2019, mental health illnesses have a prevalence of 51.5 million (20.6%) adults in the United States (U.S.) (1) The most debilitating diagnoses are SMIs such as schizophrenia and bipolar I or II disorder (BPD).(2) The prevalence of SMIs in 2019 was 13.1 million adults in the U.S., accounting for 5.2% of the adult population.(1) Between 2008 and 2019 there was a 40.5% increase (4.8 million adults) in the diagnosis of SMIs.(3,4) According to the March 2021 National Alliance on Mental Illness statistics, the estimated number of adults in the U.S. with a diagnosis of schizophrenia is <1% (1.5 million adults) and a diagnosis of BPD is 2.8% (7 million adults).(5)

Given the challenges in treating this patient population, there is a need for new and innovative treatment modalities that can be applied in conjunction with current treatment standards.(6,7). Smartwatches can be an additional tool for providers to collect important patient data in a continuous and unobtrusive way, allowing them to more closely monitor their patients and reduce the likelihood of severe symptoms becoming psychiatric emergencies.(8) Research into the acceptance of clinical applications of wearable technology such as smartwatches provides an opportunity to explore ways to potentially improve patient outcomes while lowering costs.

This project is exploratory research into the potential of leveraging smartwatch device data in SMI treatment from the perspective of mental health providers who treat

patients with schizophrenia or BPD. By this exploration, hopefully a more complete picture will emerge on the perceived value and feasibility of leveraging smartwatch device data in the clinical care of patients with SMIs.

BACKGROUND

SCHIZOPHRENIA AND BIPOLAR DISORDER DIAGNOSES

To provide a diagnosis of schizophrenia there are five symptom criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM–5) for providers to evaluate, only two of which are required for diagnosis.(9) These five symptoms include "1) delusions, 2) hallucinations, 3) disorganized speech, 4) disorganized or catatonic behavior, and 5) negative symptoms." (9) Negative symptoms refer to cognitive impairments such as blunted or flat emotions or expression, difficulty in relating to others and relationships, and reduced motivation.(10,11) These symptoms can be severely debilitating and make it very difficult for patients to function in society and participate in treatment.(12)

While some symptoms of BPD overlap with schizophrenia, such as delusions and cognitive impairments, the primary symptom used to diagnose BPD in the DSM-5 is a manic state lasting more than one week or a manic episode of any length of time that requires hospitalization.(9) Mania is defined as an abnormally elevated mood and can present with sleeplessness, high irritability, racing thoughts or speech, and high-risk behaviors such as reckless sex or extreme spending.(13,14) While a manic episode is the primary indicator for diagnosing BPD, depressive episodes are also used in conjunction

with mania for diagnosis.(9) During depressive episodes, patients can experience common symptoms with major depressive disorder such as difficulty concentrating, increased sleep, feelings of hopelessness, and decreased interest in activities.(15) As with schizophrenia, symptoms of BPD can lead to difficulties in keeping patients engaged in treatment.(12)

Mental Health Providers and Treatment Settings

Schizophrenia and BPD are life-long illnesses; the goal of treatment is to manage a patient's symptoms and provide support and resources to enable them to attain more stability in their lives.(16) The primary forms of treatment in this patient population are a combination of therapy or counseling and psychiatric medications.(16) The types of providers who typically treat patients with SMIs are listed in Table 1.(17,18) While the high level of patient monitoring and care coordination from multidisciplinary teams is challenging to implement and maintain, it is effective in engaging young adults in their treatment.(13,19)

Outpatient settings such as mental health clinics or group practices are the most common, cost-effective, and accessible place to provide mental health treatment. While inpatient treatment may be necessary in the case of psychiatric emergencies and in cases where the patient is a danger to themselves or others, outpatient settings allow for patients to develop and practice the skills necessary to manage their illness and function successfully in society.(20) They also provide a cost-effective way for providers to monitor patients for early intervention opportunities such as psychiatric medication changes and identifying other mood, behavior, and stability changes before symptoms

escalate into an emergency psychiatric event.(7) However, even with the benefits of increased access to services and lower treatment costs in outpatient settings, patients with SMIs are very difficult to keep stable and engaged in treatment, and patients with schizophrenia are often hospitalized.(19)

Complexities in Managing Patients with Severe Mental Illnesses

Patients with SMIs are often poorly managed because they are a very complex patient population to treat.(16) The two most frequently identified factors that contribute to their complexity are 1) Co-occurring illnesses or chronic conditions and 2) a lack of patient engagement in treatment. Co-occurring illnesses or chronic conditions cross the domains of physical and mental health, requiring a high level of care coordination between medical specialists, primary care providers, mental health providers, psychiatric medication managers, and social services. (6) Cognitive impairments and/or a lack of friend or family support to help them coordinate and track all their appointments compound this complexity.(10)

In addition to the complexity caused by the need for high levels of care coordination, patients with SMIs frequently have low engagement rates in treatment.(6) Patients with low engagement have more severe and frequent symptoms than those who actively participate, thereby increasing the challenges to patient adherence and active involvement in their treatment. (7) Low engagement rates have been linked to patient frustrations around medication management. As most psychiatric medications have severe side effects, constantly changing medications is exhausting and confusing for patients, leading to low medication adherence.(16)

Provider and Patient Relationships

To effectively treat patients with SMIs, providers need to develop a relationship with their patients based on trust and shared decision making.(10,13,19) Shared decision making from patient-centered care models has been shown to help make the patient feel more connected to treatment and therefore more likely to stay engaged.(13) Patients with schizophrenia or BPD can have a difficult time relating to others and identifying and regulating their emotions. Therefore, having feedback from a provider in a safe space can support them in developing and maintaining self-management and social skills. (10,19–22)

Patient Monitoring Tools

The most common ways providers monitor patients with SMIs are through conducting clinical interviews and assessments during appointments and reviewing paper or electronic questionnaires and mood logs completed by the patient.(12,23) Assessments during appointments rely on a provider's training and experience. However, it can be difficult for patients with schizophrenia or BPD to accurately and reliably report the types of emotion and mood longitudinal data that their providers need to understand their illness state outside of the artificial environment of an appointment.(24,25) The level of cognitive functioning required for patients to identify and recall their moods, emotions, behaviors, or activities is unlikely during highly symptomatic periods.(24,25) As a result, the information providers are able to use to assess their patient's functioning outside what they are able to discover during appointments is, at best, incomplete.(25,26)

Embedded sensors in smartphones that track movement and location data when combined with patient self-reported mood tracking have successfully identified early warning signs of behavior pattern changes in patients with SMIs.(12) Apps that are used in tandem with treatment from a mental health provider, both clinically developed with restricted access and 'over the counter,' tend to fall into one of the following categories: encouraging medication adherence, tracking symptoms, moods, and behaviors, and as a tool for patients to communicate with their provider.(12)

In addition to smartphone apps, providers see value in using different types of digital tools for clinical assessments and interventions.(12) Digital tools used in conjunction with mental health treatment include online Artificial Intelligence(AI)/chatbots, questionnaires or other assessments administered through a patient portal, and digital educational materials and resources.(12,13,27,28) Two different studies on digital tool use in SMI treatment reported that mental health providers and patients with schizophrenia had positive feedback on digital tools and the patients were able to successfully navigate them.(27,28) However, even with these available digital tools, Tazawa et al.(29) found that:

> "…a lack of biomarkers that directly reflect illness severity is still a major obstacle that psychiatrists face in clinical settings. Thus, the noninvasive collection of biometric parameters for measuring the severity of mental disorders…will greatly contribute to evaluations and treatment response assessments for psychiatric diseases."(29) (p.258)

There is a gap between the digital tools currently in widespread use for mental health treatment purposes and providers' need for more accurate, objective data for patient monitoring.

Smartwatch Device Applications

The primary use of smartwatches is to monitor one's health, including exercise, movement throughout the day, and sleep.(30) In 2020 an estimated 97% of adults in the U.S. own a smartphone and 21% own a smartwatch.(31,32) Examples of sensor-enabled features that provide users with their health data include the duration and effort expended during activity, time and quality of sleep, and time standing and sitting.

The types of sensors embedded in smartwatches include accelerometers, gyroscopes, GPS, magnetometer, actimetry, and optical sensors.(8) Table 2 provides example combinations of sensors used to generate biometric data and what smartwatch features that data populates.

Table 2. Smartwatch Embedded Sensors

Sensor Combinations	**Uses**	**Feature Examples**
Accelerometer, gyroscope, and actimetry sensors	Movement, motion, and sleep patterns and changes	Sleep quality analysis, reminders to stand throughout the day, step counts
GPS (Global Positioning System), magnetometer, and optical sensor	Speed of movement, location, and heart rate	Running and other exercise metrics such as speed, heart rate, and distance

Smartwatch-Identifiable Symptoms of Schizophrenia and Bipolar Disorder

Leveraging biometric data collected through smartwatches by users with schizophrenia or BPD has potential to augment patient self-reported data, increasing both the objectivity of the data and the likelihood of early interventions before symptoms become severe.(8,12). This data provides an opportunity for providers to identify their patient's functioning and mood state changes more accurately than relying on their patient's self-reported data.(22,29,33,34)

In patients with SMIs, substantial changes in sleep patterns are a strong indicator of illness instability.(29) By leveraging data collected from a patient's smartwatch, providers can assess if a patient is sleeping more or less than their baseline, if there are changes in how long it takes them to fall asleep, or any other insomnia indicators related to movement and motion.(29,35) Using BPD as an example, patients who have sleep pattern changes where they are sleeping significantly less than their baseline or experiencing highly disrupted sleep may be moving towards a manic episode.(42)

In addition to sleep patterns, awake time movements and motion are closely linked with changes in illness state in this patient population.(19) Jerky or disorganized movements identified through smartwatch gyroscopic sensors that measure angular velocity can indicate catatonia in patients with schizophrenia.(9,19) Smartwatch sensors can also indicate when a patient with BPD is cycling into a depressive episode by identifying a slowing or lethargy in movements over a set period of time.(29) As with catatonia and depressive episodes, smartwatch sensors can be used to identify when a patient is entering a manic episode by sharp increases in activity and speed of motion, as

well as an elevated heart rate for a longer period of time than would be likely with exercising or other daily activities such as cleaning.(29)

Informatics Implications for the Clinical Use of Smartwatch Device Data

Providers who treat patients with SMIs are generally interested in utilizing wearable device data in their practice.(35) The benefit of having a large set of objective data is well understood by providers; it is appealing to have access to data that can reduce the uncertainty and complexity of treating this patient population.(36) However, providers feel there are too many unaddressed questions around the impact to their workload and potentially serious clinical implications that need to be addressed first.(36)

Electronic Health Records (EHRs) and analytic tools, such as interactive dashboards, are the preferred sources by providers to access and analyze patient data Of the several conditions specific to the electronic transfer of patient smartwatch device data have been identified as limiting factors; the two primary conditions are: 1) that the vast majority of smartwatch device vendors and manufacturers use proprietary data formats in their Application Programming Interfaces (APIs) and 2) the lack of data standards in smartwatch devices makes the transfer of data complex.(35,37)

Despite the limitations caused by proprietary data formats and a lack of data standards, some smartwatch device companies and health systems are working to support the integration of smartwatch device data into EHR software systems.(35,37–39) One example is Fitbit, which has been working with EPIC Systems on integrating device data from their smartwatch products into EPIC's EHRs.(37,39) Health systems such as

Oshsner Health, covering the southern U.S., are investigating the feasibility of integrating smartwatch device data into their EPIC EHR for clinical use.(37,38)

Training and support for interpreting smartwatch device data for clinical purposes is needed by providers.(35) Without training on the clinical applications of smartwatch device data, providers feel there is a high risk to patients and increased provider liability associated with using that data to draw clinical insights or conclusions and apply them in patient treatment.(35) In addition, providers have expressed concerns about the large amount of data smartwatch devices produce. Continuous data collected over an extended period of time can lead to providers being inundated with an overwhelming amount of data that without proper training, they are not confident in using. Algorithms applied to patient smartwatch device data have been suggested as a way to support providers concerned about the increased demand on their time and uncertainty in data interpretation.(35)

Multiple studies have found that while providers are interested in using smartwatch device data in clinical care, they want security and privacy risks to be addressed before they feel comfortable using that data in clinical decision making.(8,12,35,36,40) Developing smartwatches as medical devices, and therefore under the regulatory oversight of the U.S. Food and Drug Administration (FDA), may address provider's concerns.(35) In addition, confidence in the use of this data as covered Protected Health Information (PHI), and therefore subject to privacy regulations to security and privacy concerns, may help providers feel more comfortable leveraging the data in their clinical practice. One requirement for a smartwatch to be approved as a medical device is that the device is able to be integrated and have secure data exchange

with a healthcare system's middleware.(37) By resolving integration barriers as well, promoting the development of smartwatches as medical devices may increase providers' interest in leveraging smartwatch devices.(37)

RESEARCH PURPOSE

This research is exploratory in nature with the primary objective being to increase knowledge and understanding of smartwatch device potential in SMI clinical care and in particular, the treatment of schizophrenia and BPD. Research has primarily focused on perspectives of patients with SMIs and their adoption of devices such as smartwatches. There is a gap in understanding the perspective of the providers who treat this patient population.

MATERIALS AND METHODS

STATED AIMS

The intent of the survey was to explore mental health professionals' perspectives on the potential for leveraging patient health data from smartwatches in the treatment of patients with schizophrenia and BPD. The specific aims were to investigate: 1) mental health professionals' awareness of patient use of wearable devices to record health data, 2) professionals' attitudes and/or experiences with using data from these devices in patient care, and 3) potential adoptability of devices for clinical purposes.

Study Population

The study population recruited for the survey consisted of licensed mental health professionals. Table 1 lists the categories and licenses I focused on recruiting. My primary interest was to recruit participants who treat patients with schizophrenia or BPD. As it was not possible to ascertain from the email lists whether the potential participants treat these patients, I used survey question #4 "How many years have you been treating and/or counseling patients with schizophrenia or bipolar I or II disorder?" including a "not applicable" selection option to filter by those providers for data analysis.

I chose to recruit participants from Oregon and Washington State as both states have a higher prevalence of adults with SMIs than the national average.(41) As of 2017, Washington had an SMI prevalence of 5.3% and Oregon an SMI prevalence of 5.1%, with the U.S. national average prevalence being 4.1%.(41,42) To determine the population size of potential participants I reviewed mental healthcare provider workforce analyses in Oregon from 2018 and Washington from 2017 then identified the total number of mental health professionals licensed in each state.(41,42) Table 3 contains the counts of potential participants by state and by license type. I estimated acquiring email addresses for 50% of this population, or 13,374 potential survey participants. I anticipated a response rate between 5-15% based on other survey research involving mental health professionals, thus hoped to recruit between 669 to 2,006 participating mental health professionals.(43,44)

PROCEDURES

A low barrier way to quickly and efficiently elicit candid opinions from mental health professionals while the pandemic was placing tremendous demands on these professions was key to meeting my research aims. To ensure the questions were clear, I conducted a pilot test with three testers- a physician scientist in psychiatry, a healthcare consumer qualitative researcher, and a medical director at a healthcare company. Requests were sent out and responses collected via email between November and December 2020. All three testers provided feedback, including reporting that the survey took between four to ten minutes to complete.

In the final survey there were an additional six questions based on the pilot testers' feedback. Reviewing the online consent and agreeing to participate were added to the final survey; I anticipated the survey would take an additional ten minutes to complete from what the test pilot reported, estimating about 20 minutes for competition.

The survey was cross-sectional, taking place at a single point in time. I chose to make the survey anonymous as participants may have professional relationships with other participants and mental health is of a sensitive nature. There were 25 closed and open-ended questions. Six questions contained skip logic to move the participant past questions that did not apply to them based on their previous answer. Due to the skip logic, there were between 17 and 26 questions in the survey. The only required questions were indicating if they provided consent to participate in the study and a question asking the participant to identify what type of provider they are. All other questions were optional. See the Appendix A for the consent and Appendix B for the survey.

The study protocol, recruitment materials, and survey text were reviewed and the research was deemed exempt by the OHSU Institutional Review Board on 7/6/2021 (Study ID- STUDY00023192). All data collection and storage were on OHSU-secure cloud services and available only to myself and my capstone mentor Dr. Kristine Alpi, who was the named Principal Investigator.

For recruitment, I emailed state licensing boards and professional organizations for mental health professionals in Oregon and Washington to ask how to obtain names and email address lists or for the organization to distribute the survey link to their members. In addition, I contacted a behavioral health services group of clinics with multiple locations in both Oregon and Washington. Table 4 provides details on sources used for participant recruitment.

The survey was distributed on different dates as contact mechanisms became available with it first opening on 8/27/2021 and closing on 11/18/2021, with participants potentially receiving one reminder two weeks after the initial request. After the survey closed, I exported the response data from the secure OHSU Qualtrics system into OHSU's secure Box system to conduct my analysis. I reviewed the responses to all open-ended questions and redacted identifying information prior to analysis.

At the completion of my research, this capstone paper and the aggregated capstone project results will be deposited in the OHSU Digital Collections repository (https://digitalcollections.ohsu.edu/) and a brief summary of my findings with a link to the project report will be shared with the same contacts used to recruit participants.

Consent Process

The consent form was presented to participants on the first screen of the Qualtrics survey after they clicked the survey link in the recruitment email. If a participant selected "No, I would not like to participate in the study" they were not presented with further questions. The complete consent text appears in Appendix A. As the survey was anonymous, the IRB waived signing of a consent form and allowed the online consent process to avoid capturing contact information and further protect participant privacy.

Data Analysis

To analyze data collected from survey responses, I generated descriptive statistics for all closed-ended questions. For all open-ended questions and the narrative responses to "other" on the closed-ended questions, I first inductively generated codes from analyzing the participant written texts, then used these codes and others derived from the literature review to deductively assign codes, many of which became themes based on constant comparative methods. (45) Secondarily, I coded for emotional affect and emotion magnitude in nine of the open-ended questions.(45)

RESULTS

Recruitment and Demographics

There were 104 survey responses of which 95 (91.3%) were included in data analysis. Those not included were four respondents who did not consent and five respondents who did not complete the survey. One respondent that did not complete the

survey was left in data analysis for demographics. The response rate from emails sent via a Qualtrics-provided email link to those licensed by the Oregon Board of Licensed Professional Counselors and Therapists was 4% (n=79/1,957). The remaining 16 (16.8%) responses were received through the anonymous link shared with Western Psychological Services and OHSU Psychiatry Faculty. The number of OHSU Psychiatry Faculty emailed was known (n=67), but not the number at Western Psychological Services as it was put into the clinic newsletter by management. Thus, the response rate from Western Psychological Services or OHSU Psychiatry Faculty cannot be discerned. Provider demographics included the type of provider, the setting(s) in which they practice, and how many years they have been working with patients with mental health disorders, including specifically their years treating patients with schizophrenia and/or BPD. Out of 95 respondents, 76.8% (n=73/95) were Licensed Professional Counselors, 16.8% (n=16/95) were Licensed Marriage and Family Therapists, 2.1% (n=2/95) were Psychologists, and 1 respondent (1.0%, n=1/95) each of the following provider types: Licensed Clinical Social Worker, Licensed Professional Counselor Intern, Doctoral Level LPC, Professional Licensed Counselor, and Psychiatric Registered Nurse.

Of the 107 practice settings, solo private practices accounted for 51.4% (n=55/107) of settings. The other practice settings reported were group private practice (22.4%, n=24/107), publicly funded clinic or mental health center (11.2%, n=12/107), integrated healthcare system (2.8%, n=3/107), psychiatric outpatient treatment center (2.8%, n=3/107), academic medical center (1.9%, n=2/107), and one reported (0.9%, n=1) practice setting each of an agency, association for hospitals, community mental health agency, dual diagnosis intensive outpatient treatment center, group not private

practice, non-profit social services, private company hybrid of private practice and agency, and a substance abuse residential treatment program. Multiple practice locations were reported by 11.2% (n=12/107).

Table 5 displays the number of years providers have been treating general mental health patients and patients with schizophrenia and/or BPD specifically.

Table 5. Years treating mental health diagnoses patient population, N=96

Years Treating Patients	**Schizophrenia and/or BPD Diagnoses**		**Other Mental Health Diagnoses**	
	Count	%	Count	%
0-4 years	20	20.8%	8	8.3%
5-9 years	29	30.2%	27	28.1%
10-14 years	8	8.3%	24	25.0%
15-19 years	12	12.5%	15	15.6%
20+ years	9	9.4%	22	22.9%
N/A- Have not treated this patient population	18	18.8%	-	-
N=	96	-	96	-

Smartwatches: Providers, Patients, and Data

Personal use of smartwatches was reported by 71.6% (n=68/95) of providers. The 28.4% (n=27) who do not select multiple reasons (N=47) for their lack of use: they are cost prohibitive (28.3%, n=13/47), data security concerns (21.7%, n=11), uncomfortable or unfamiliar with technology (17.4%, n=8), uncomfortable to wear (10.9%, n=5), and 21.7% (n=10) indicated "other." Providers who are very comfortable with smartwatches were 51.6% (n=49) and 28.1% (n=27) are moderately comfortable with smartwatch

technology, with 20.0% (n=19) are uncomfortable with this technology. Smartwatch features used were biometric sensors (42.3%, n=58/95), movement sensors (46.0%, n=63/95), and 11.7% (n=16/95) listed other features. Multiple features were used by 76.8% of smartwatch users, with the majority 56.8% (n=54/95) using two, 10.5% (n=10/95) using three, 4.2% (n=4/95) using four, or 5.2% (n=5/95).

Most providers, 90.5% (n=86/95) had observed patients wearing smartwatches, with only 5.3% (n=5/95) never having observed patient use and 4.2% (n=4/95) unsure if they have. Over half (55.8%, n=53/95) of providers had conversation with their patients about smartwatches in general. Conversation specifically about sharing their device data was reported by 20.8% (n=11/53) while the majority (79.3%, n=42/53) have not had these conversations. From the list of potential barriers for their patients with schizophrenia and/or BPD to adopting smartwatches, respondents made 226 selections: financial barriers (24.8%, n=56/226), mistrust of technology (23.5%, n=53/226), unsure how to operate devices (19.5%, n=44/226), lack of buy-in on the positive effects of wearable technology (12.8%, n=29/226), and 12.4% (n=15/226) listing other barriers.

Questions concerning provider's experiences and perceptions with their patient's smartwatch device data covered their access or potential access to this data and their perspectives on barriers to patients sharing their data with them for treatment purposes. Only six providers (6.3%) reported having access to their patient's smartwatch device data, while 89 (93.7%) have not. For those providers who had access through multiple mechanisms, all six had experienced being provided the data directly by their patient, three also having patients report their device data prior to their session, and three reported during their session. Only two reported that device data was entered by the patient into a

patient portal, and one accessed data through their patient's EHR. Additionally, one was invited to share access to data through Fitbit Friend, and one received data emailed from their patient. Providers perceived barriers to patients consenting to share their wearable device data were personal health information security concerns (32.4%; n=67/207), concerns around device data being shared without their consent (30.9%; n=64/207), lack of patient buy-in on the value of sharing their device data (26.6%; n=55/207), other barriers (6.8%; n=14/207), and 6.4% (n=7/207) perceived no barriers.

Providers who see value in collecting health data from wearable devices for use in patient care either agree (38.9%; n=37/95) or moderately agree (30.5%; n=29/95), with 21% (n=20/95) neutral on the value. Smaller numbers of providers either disagree (5.3%; n=5/95) or moderately disagree (4.2%; n=4/95) that this is valuable. Of the six providers who accessed patient smartwatch device data for one or more clinical purposes, 45.5% (n=5/11) purposes were for treatment plan creation, 18.2% (n=2/11) for treatment adherence monitoring, 18.2% (n=2/11), 9.1% (n=1/11) for clinical diagnoses, and 9.1% (n=1/11) for other reasons. Table 6 displays respondents' selections of who on the patient's care team should have access to their wearable device data. While 3.9% (n=9/229) selected the response that they don't believe anyone from a patient's care team should have access to their smartwatch data, an additional three respondents expressed that in the open-text field only.

Of the 118 responses selecting from multiple issues identified with accessing patient device data, 16.1% (n=19/118) were technical barriers to integrating data into an EHR, 13.6%, (n=16/118) additional patient consent to share protected mental health records, 9.3% (n=11/118) outputting data from device to hard copy to integrate into

printed health record, 3.4% (n=4/118) data is accessible in an EHR but is inconvenient to access. No issues were experienced or known of by 35.6% (n=42/118), and 22.0%, (n=26/118) were other barriers. Barriers to using patient data from wearables in clinical practice listed in Table 7.

Open-text Analysis

Themes

There were ten open-ended text responses analyzed. From a high-level categorization of the technical components, there were 104 comments around device data from smartwatches, 82 comments on devices in general, and 21 comments on device features. Table 8 offers insight into the frequency of themes from open-text fields where there were four or more comments and includes sample quotes from providers on these themes.

Table 8. Themes appearing four or more times in open-text fields

Theme	**Count**	**Sample Quotes Around Theme**
Data Access	22	“[patient] Fear of more information is being shared than they can control. Like voice.”
Device Features	21	“Smart watches and the like are too focused on meeting a set number of steps, or calories burned. Does not allow for movement such as chair yoga, dance, stretching to be "counted”
Privacy & Security	13	“data privacy, meaning just because a device has some relvant [sic] data, it can be very hard to validate that other revealing data is scrubbed from that sharing of it. E.g [sic], GPS coordinates attached to fitness data”
Data Interpretation	11	“I do not believe a mental health provider is trained to interpret results that occurred outside of the clinic.”

Theme	Count	Sample Quotes Around Theme
Data Collection Consistency	10	"While symptomatic, these client populations may struggle with consistently wearing devices, hence skewing data."
Physical Device (theft, loss, charging)	7	"Patient would likely lose/damage the device more than likely"
Data Sharing	5	"I think this [data sharing] should be determined by the patient's comfort level. It would be important for them to have agency over who gets to see the data and when. Maybe no one have automatic access to the data. Instead the patient shares the data with the provider during an appointment."
Clinical Efficacy	4	"Would love a training on how wearables can be effective in a therapeutic setting." "I am also not certain of the efficacy of these devices in reporting data…"
Insurance and Billing	4	"…I also wonder and question whether or not the data would be used by an insurance carrier to deny care to patients for a variety of reasons."

In addition to the themes listed in Table 8 above, there was a theme of smartwatches exacerbating patient symptoms. Several respondents offered similar or common thoughts on working with schizophrenic patients, Table 9 highlights responses from three providers.

Table 9. Exemplar quotes for the theme of smartwatches exacerbating patient symptoms

"Increased potential for delusional content to be centered around device"
"…some who do not wear them [smartwatches] have fears about being tracked/listened to on them"
"They may feel tracked and that they are being medically violated. This could lead to self harm and an escalation in paranoia…"

Emotions

All open-text responses were reviewed for emotion coding. Of these, 22 responses could not be classified (such as "no comment," "N/A," or "nothing to add") and 50 responses carried no codable emotional affect. Positive affect was identified in 75 responses, negative affect in 44 responses, with only six responses offered as uncertain or neutral. Responses could include multiple examples of positive or negative emotion. Table 10 shows the seven positive emotion codes found across 57 comments, and Table 11 shows the eleven negative emotions coded across 72 comments.

Table 10. Positive emotion categories expressed in comments, N=57

Positive Emotions Expressed	**Patient and/or Provider Focused**	**Count**
Helpful	Patient and Provider	27
Patient controls access to their data	Patient	13
Useful	Patient and Provider	6
Valuable	Patient and Provider	4
Interested/curious	Provider	3
Motivating	Patient and Provider	2
Beneficial	Patient and Provider	2

Table 11. Negative emotion categories expressed in comments, N=72

Negative Emotions Expressed	**Patient and/or Provider Focused**	**Count**
Mentally/emotionally harmful	Patient and Provider	13
Not trained	Provider	11
Fear/mistrust/paranoia	Patient	10
Privacy concerns	Patient and Provider	11

Negative Emotions Expressed	Patient and/or Provider Focused	Count
Physical device issues (theft/loss/charging)	Patient	7
Inconsistent use	Patient	5
Lack of device/data efficacy	Patient and Provider	4
Intrusive	Patient and Provider	3
Security concerns	Patient and Provider	3
Lack of buy-in	Patient and Provider	3
Limited device features/functions	Patient and Provider	2

Emotion Magnitude Coding was conducted on all questions with open-text fields where a perspective, value, or experience was expressed; see Table 12 for the complete list. Open-text fields that contained responses such as the brand of a smartwatch or the type of features used were not coded. Table 13 shows how the magnitude of emotion was coded as strong, moderate or neutral based on the provider response.

Table 13. Examples of emotion magnitude coding

Question	Answer	Magnitude Code Assigned
From the point of view from your patients with schizophrenia or bipolar I or II disorder, what, if any, barrier(s) do you believe there are to the adoption of wearable devices?	"it could interfere with the fragile rapports that providers spend a lot of time reinforcing"	Strong
	"Patient would likely lose/damage the device more than likely"	Moderate
	"They may not be interested."	Neutral

Questions regarding perceived barriers received responses as 57.1% (n=36/63) moderate and 19.0% (n=12/63) strong, with 23.8% (n=15/63) neutral. As the questions

were based on barriers, I anticipated the comments to all be negative responses. Table 14 below contains the count of each emotion magnitude coded by question.

Table 14. Negative emotion magnitude coding, N=63

Barrier Questions	**Strong**	**Moderate**	**Neutral**
Provider specific reasons not to use smartwatches	2	2	4
Have you experienced or are you aware of any issues with accessing a patient's wearable device data?	3	6	2
From the point of view from your patients with schizophrenia or bipolar I or II disorder, what, if any, barrier(s) do you believe there are to the adoption of wearable devices?	1	12	7
What, if any, barrier(s) do you perceive to patients consenting to share their wearable device data?	3	9	0
What, if any, barrier(s) do you perceive to using patient data from wearables in your clinical practice?	3	7	2

Questions that were informational in nature are in Table 15 below with moderately positive as the most frequent emotional content (33.6%; n=46/137). As the questions listed were informational they were first coded as either positive or negative, then coded based on the emotion magnitude of their response.

Table 15. Emotion magnitude on information seeking questions, N=137	Positive			Negative	
Information Seeking Questions	**Strong**	**Moderate**	**Neutral**	**Strong**	**Moderate**
Please share any comments on your perceived value score from question 9	8	12	8	3	12
Patient perspective(s) on wearable devices	7	27	7	5	3
Who do you believe on the patient's care team should have access to patient data from wearable devices?	0	2	15	1	2
Please add any additional thoughts on the topic of wearables device use with patients with schizophrenia or bipolar I or II disorder.	6	5	0	5	9

DISCUSSION

The themes identified in the results overlap with themes discussed in previous research on the feasibility of using smartwatch device data for clinical purposes, such as the need for provider training and privacy and security risks. As multiple studies on smartphone mental health apps designed specifically for use in clinical settings uncovered psychosocial, privacy, and technical implementation barriers (8,12,35–37,40), it was anticipated that providers would express concerns around similar themes with smartwatch device data use. However, providers seemed to be less concerned than expected about the technical barriers to accessing or utilizing patient device data.

The focus of provider concerns in this research was on the negative impacts and risks associated with introducing new technology to patients with SMIs. The emotional affect and emotion magnitude coding serves as a preliminary attempt to characterize provider feelings. Concerns about smartwatch device use centered around the risks to patients with highly symptomatic schizophrenia in particular. By introducing this new technology to their patients, providers feared it would fuel episodes of paranoia, delusions, and mistrust of providers and authority. The increase in severity of schizophrenia symptoms would then damage their effectiveness with their patients, disrupting the carefully crafted patient-provider relationship.

Confirming prior research in the context of using digital tools in mental health treatment, providers preferred to continue using strategies that they are familiar and most comfortable with--their education, training, and experience. These survey results identify the potential that providers' fear of increasing risks specific to patients with SMIs keeps them continuing to rely on approaches familiar to them.

Despite the concerns around increased risk to patients, many of the responding Licensed Professional Counselors and Licensed Marriage and Family Therapists believe there is clinical value in collecting health data from patient smartwatches and that patients tracking their own health biometric data through these devices is clinically appropriate and potentially beneficial. However, this perceived value and appropriateness by providers applied only to their general mental health patient population. In patients with SMIs, the concerns expressed about the appropriateness of smartwatch device use seemed to outweigh the agreement with the value statement they had indicated. When commenting on patient smartwatch device use specifically by their patients with SMIs, a

majority of provider respondents considered it at best unwise, and at worst life-threatening. Patients with SMIs were referred to in ways that clearly communicated providers believe these patients need to be treated much more carefully.

Another finding not anticipated from my literature review was that providers are considering the implications to health insurance coverage that could come from collecting patient wearable data. Provider's concerns were mostly around their patients being denied coverage. There was only one comment on their own ability to bill the extra time required to analyze device data. Uncovering provider concerns that health insurance companies may deny coverage provides more insight into the impacts on patient care. The friction and interplay between the types of mental health services that health insurance companies will cover and what treatment providers believe their patients need is a source of contention. There seemed to be some resentment from providers that those in the healthcare informatics, technology, and research fields push new technology into patient care without considering how it might exacerbate the friction between providers and insurance companies.

Implications for Future Research

Provider's perceptions that patients with SMIs are differently vulnerable than patients with other mental health disorders indicates that research into technology-enabled mental health treatment needs to become more specialized by either illness or symptom grouping. In addition, there is a need for informatics research focused on developing smartwatches or other wearable devices that can play a more specific role beyond general health self-monitoring in the clinical care of patients with SMIs.

LIMITATIONS

Most of the limitations relate to the small number of respondents. Participation of 95 providers was much less than the anticipated 669 minimum number. Additionally, the respondents were not as varied in provider type as the recruitment plan intended. Most of the respondents were LPCs or LMFTs and therefore there is likely a bias in the results towards the issues, concerns, and priorities of those provider types. These may not be the same as other provider types, and therefore future studies may need different recruitment approaches to engage those providers.

SUMMARY AND CONCLUSIONS

The intent of focusing this research specifically on mental health providers' experiences, attitudes, and beliefs offered an opportunity for a different perspective than prior research has provided, thereby adding insights into the feasibility of leveraging smartwatch device data in the treatment of patients with Severe Mental Illnesses. This research represents a first step in understanding how providers view this technology and provides a foundation to build on in future research.

Threaded throughout the findings of this research was a sense from providers that patients with SMIs should not be active participants in their treatment, including utilizing wearable technology such as smartwatches that could help generate data for their treatment. Although evidence from prior research has shown that including these patients in shared decision making increases their engagement and improves patient outcomes,

this research uncovered concerns from a majority of providers towards their patients' abilities to participate and contribute to their own treatment.

To date, informatics professionals have focused their research primarily on improving smartwatch technology and increasing data exchange between wearable devices and EHRs. Given the findings from this research, there first must be a deeper understanding of the attitudes and beliefs of the mental health clinicians they hope will leverage this technology in their practice. Without this understanding, the successful introduction of smartwatches as a treatment aid for these patients will not be possible.

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APPENDIX A

SURVEY CONSENT

CONSENT INFORMATION

TITLE: Mental health provider survey about wearable device use.

PRINCIPAL INVESTIGATOR: Kristine Alpi, MLS, MPH, PhD, (503) 494-0455

CO-INVESTIGATORS: Katherine Millsap, (206) 830-0249

WHY IS THIS STUDY BEING DONE?

You have been invited to be in this research study because you are a mental health professional. The purpose of this study is to investigate mental health professionals' awareness of patient use of wearable devices to record health data, as well as their attitudes and experiences with using the data from these devices in patient care. We hope to combine the perspective of various provider types to better understand the practical applications of leveraging wearable devices in the treatment of this patient population.

WHAT EXAMS, TESTS OR PROCEDURES ARE INVOLVED IN THIS STUDY?

This study is a 25-question anonymous survey. Participating in this study takes approximately 20 minutes including the consent process. In the future, your anonymous survey responses will be available for other research studies. The information will be labeled as described in the WHO WILL SEE MY PERSONAL INFORMATION? section. If you have any questions, concerns, or complaints regarding this study now or in the future, or you think you may have been injured or harmed by the study, contact Katherine Millsap, kate.millsap@yahoo.com, 206-830-0249 or Kristine Alpi, alpi@ohsu.edu, 503-494-0455.

WHAT RISKS CAN I EXPECT FROM TAKING PART IN THIS STUDY?

It may be inconvenient to take the time to complete the survey. Some of these questions we ask may seem personal to yourself or to your patients. There is only one required question on your focus area of practice, you may refuse to answer any of the other questions in the survey if you do not wish to answer. Although we have made efforts to protect your identity, there is a small risk of loss of confidentiality.

WHAT ARE THE BENEFITS OF TAKING PART IN THIS STUDY?

You will not directly benefit from taking part in this research. If you are interested in wearables devices, or developing surveys, participating may provide you familiarity with these devices and clinical use.

WHAT ARE THE ALTERNATIVES TO TAKING PART IN THIS STUDY?

You may choose not to participate in this study.

WILL I RECEIVE RESULTS FROM THIS STUDY?

We will make all published research outputs (e.g. peer-reviewed conference presentations, articles, etc.) open access, so you will be able to access and read these materials.

WHO WILL SEE MY PERSONAL INFORMATION?

We will take steps to keep your personal information confidential, but we cannot guarantee total privacy. Participants are advised not to include any identifiable information. Only the research team will have access to your survey answers and demographic responses and they will be anonymized. Your anonymized survey may be made publicly available through the OHSU Institutional Repository. However, the

demographics data will only be summarized in aggregate in publications or the repository.

We may release this information to others outside of OHSU who are involved in conducting or overseeing research, including:

- The Office for Human Research Protections, a federal agency that oversees research involving humans.

WILL ANY OF MY INFORMATION OR SAMPLES FROM THIS STUDY BE USED FOR ANY COMMERCIAL PROFIT?

Information about you or obtained from you in this research may be used for commercial purposes, such as making a discovery that could, in the future, be patented or licensed to a company, which could result in a possible financial benefit to that company, OHSU, and its researchers. There are no plans to pay you if this happens. You will not have any property rights or ownership or financial interest in or arising from products or data that may result from your participation in this study. Further, you will have no responsibility or liability for any use that may be made of your information.

WHAT ARE THE COSTS OF TAKING PART IN THIS STUDY?

There will be no cost to you to participate in this study.

WHERE CAN I GET MORE INFORMATION?

If you have any questions, concerns, or complaints regarding this study now or in the future, contact Kristine Alpi (503) 494-0455.

This research has been approved and is overseen by an Institutional Review Board ("IRB"). You may talk to the IRB at (503) 494-7887 or irb@ohsu.edu if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research subject.
- You want to get more information or provide input about this research.

You may also submit a report to the OHSU Integrity Hotline online at https://secure.ethicspoint.com/domain/media/en/gui/18915/index.html or by calling toll-free (877) 733-8313 (anonymous and available 24 hours a day, 7 days a week).

DO I HAVE TO TAKE PART IN THIS STUDY?

Your participation in this study is voluntary. You do not have to join this or any research study. If you do elect to participate in this study, you may withdraw from the study at any time without affecting your relationship with OHSU, the investigator, or the OHSU Library.

HOW DO I TELL YOU IF I WANT TO TAKE PART IN THIS STUDY?

Please indicate whether you provide your consent to participate in this study using the radio buttons below. If you select no, you will exit the survey. After making your selection, click on the blue arrow at the bottom right of the screen to continue.

▢ Yes, I would like to participate in the study

▢ No, I would not like to participate in the study

Skip To: End of Survey If CONSENT INFORMATION = No

APPENDIX B

MENTAL HEALTH PROVIDER SURVEY

Q1 Please indicate your profession [required]:

- ☐ Psychiatrist
- ☐ Psychologist
- ☐ Psychiatric-mental health nurse
- ☐ Licensed clinical social worker
- ☐ Licensed professional counselor
- ☐ Other (please specify) _____

Q2 Where do you practice? Select all that apply

- ☐ Psychiatric inpatient facility
- ☐ Psychiatric outpatient treatment center
- ☐ Solo private practice
- ☐ Group private practice
- ☐ Publicly funded clinic or mental health center
- ☐ Academic medical center
- ☐ Integrated healthcare system
- ☐ Other (please specify) _____

Q3 How many years have you been treating and/or counseling patients with mental health disorders?

- ☐ 0-4 years
- ☐ 5-9 years
- ☐ 10-14 years
- ☐ 15-19 years
- ☐ 20+ years

Q4 How many years have you been treating and/or counseling patients with schizophrenia or bipolar I or II disorder?

- ☐ I have not treated this patient population
- ☐ 0-4 years
- ☐ 5-9 years
- ☐ 10-14 years
- ☐ 15-19 years
- ☐ 20+ years

Q5 How comfortable are you with wearable device technology (e.g. smart watches such as Fitbit or Apple Watch)?

- ☐ Very comfortable; I am able to easily use smart devices, wearables, and/or remote diagnostic devices and explain their purpose and use in-depth to others.
- ☐ Moderately comfortable; I am able to use smart devices, wearables, and/or remote diagnostic devices with moderate proficiency but may not be able to confidently train others in their use.
- ☐ Uncomfortable; I've had some exposure to smart devices, wearables, and/or remote diagnostic devices but not enough to be comfortable with their use.

Q6 Have you personally used a wearable device to track or manage your own health (e.g. tracking sleep via a Fitbit, tracking your heart rate during a workout with Apple watch, etc.)?

- ☐ Yes
- ☐ No
- ☐ Unsure or do not wish to answer

Skip To: Q8 If Q6 = No
Skip To: Q9 If Q6 = Unsure or do not wish to answer

Q7 Which type(s) of features have you used? Select all that apply.

- ☐ Biometric sensors (e.g. heart rate or blood pressure sensors embedded in device)
- ☐ Movement sensors (e.g. pedometer or accelerometer sensors embedded in smart devices)
- ☐ Other wearable device features (please list) _____

Skip To: Q9

Q8 Is there a specific reason(s) why not? Select all that apply.

- ☐ Cost prohibitive
- ☐ Uncomfortable to wear
- ☐ Uncomfortable or unfamiliar with technology
- ☐ Data security concerns
- ☐ Other (please describe) _____

Q9 Please indicate how much you agree or disagree with the following statement:

"I see value in collecting health data from wearable devices for use in patient care."

- ☐ Disagree
- ☐ Moderately disagree
- ☐ Neither agree nor disagree
- ☐ Moderately agree

☐ Agree

Q10 Please share any comments on your perceived value score from question 9

_____

Q11 Have you observed any of your patients using wearables devices (e.g. seen a smart watch on their wrist)?

☐ Yes

☐ No

☐ Unsure

Skip To: Q13 If Q11 = No
Skip To: Q13 If Q11 = Unsure

Q12 Please list which type(s) of device(s) you have seen your patient(s) wearing

_____

Q13 Have you had conversations with any of your patients about wearable devices?

☐ Yes

☐ No

☐ Not applicable

Skip To: Q17 If Q13 = 2
Skip To: Q17 If Q13 = 3

Q14 Please briefly describe their perspective(s) on wearable devices

_____

Q15 Have you had any conversations with your patients about sharing data with you from their wearable devices?

☐ Yes

☐ No

Q16 Please briefly describe their perspective(s) on sharing device data with you

_____

Q17 Have you ever had access to a patient's data from a wearable device?

☐ Yes

☐ No

☐ Unsure

Skip To: Q20 If Q17 = 2
Skip To: Q20 If Q17 = 3

Q18 How have you accessed that data? Select all that apply.

☐ Patient's Electronic Health Record (EHR)

- ☐ Patient reported prior device data directly to me
- ☐ Patient showed me their device data in-person
- ☐ Patient self-reported device data through a patient portal
- ☐ Patient self-reported device data in their online Personal Health Record
- ☐ Patient invited me to "share" access to their data (e.g. Fitbit Friend)
- ☐ Other (please describe) _____

Q19 For what clinical purposes have you accessed their data? Select all that apply.

- ☐ Clinical diagnoses
- ☐ Treatment plan creation
- ☐ Treatment adherence monitoring
- ☐ Care coordination
- ☐ Other (please describe) _____

Q20 Have you experienced or are you aware of any issues with accessing a patient's wearable device data? Select all that apply.

- ☐ Outputting data from device to hard copy to integrate into printed health record
- ☐ Technical barriers to integrating data into EHR
- ☐ Data is accessible in the EHR but is inconvenient to access
- ☐ Issues with additional patient consent to share protected mental health records
- ☐ Other (please describe) _____
- ☐ No issues

Q21 From the point of view from your patients with schizophrenia or bipolar I or II disorder, what, if any, barrier(s) do you believe there are to the adoption of wearable devices? Select all that apply.

- ☐ Financial barriers to patient
- ☐ Patient mistrust of technology
- ☐ Lack of patient buy-in on the positive effects of wearable technology
- ☐ Patient unsure how to operate devices
- ☐ Other (please describe) _____
- ☐ No barriers
- ☐ Not applicable, I do not treat this patient population

Q22 What, if any, barrier(s) do you perceive to patients consenting to share their wearable device data? Select all that apply.

- ☐ Personal Health Information security concerns
- ☐ Concerns around device data being shared without their consent
- ☐ Lack of patient buy-in on the value of sharing their device data
- ☐ Other (please describe) ___ _____
- ☐ No barriers

Q23 Who do you believe on the patient's care team should have access to patient data from wearable devices?

- ☐ Therapist or counselor
- ☐ Case manager
- ☐ Medication manager
- ☐ Primary Care Physician
- ☐ Open access to any who have permissions to access the patient's Electronic Health Record
- ☐ Administrative team (e.g. scheduling department)
- ☐ Other (please describe) _____
- ☐ No one should have access

Q24 What, if any, barrier(s) do you perceive to using patient data from wearables in your clinical practice? Select all that apply.

- ☐ Lack of time to access and analyze patient data
- ☐ Uncertainty about accuracy of data
- ☐ No or little guidance on how to effectively use data for mental healthcare purposes
- ☐ Provider's organization does not support use case
- ☐ Provider's organization prohibits the collection and/or use of patient data from wearable devices
- ☐ Security or privacy concerns
- ☐ Other (please describe) _____
- ☐ No barriers

Q25 Please add any additional thoughts on the topic of wearables device use with patients with schizophrenia or bipolar I or II disorder.

_____

TABLES

Table 1. Services, providers, and licenses

Treatment	Providers	Most Common Licenses
Therapy and Counseling	Psychologists	Doctor of Philosophy*
		Doctor of Psychology (Psy.D.)
	Social Workers	Licensed Clinical Social Worker (L.C.S.W.)
		Licensed Independent Clinical Social Worker (L.I.C.S.W.)
		Master's degree in Social Work (M.S.W.)
		Doctorate in Social Work (D.S.W. or Ph.D.)
	Professional Counselors	Licensed Professional Counselor (L.P.C.)
		Licensed Clinical Professional Counselor (L.C.P.C.)
		Licensed Mental Health Counselor (L.M.H.C.)
		Licensed Clinical Mental Health Counselor (L.C.M.H.C.)
		Licensed Mental Health Practitioner (L.M.H.P)
		Licensed Marriage and Family Therapist (L.M.F.T.)
Medication Management	Psychiatrists	Doctor of Medicine (M.D.)*
		Doctor of Osteopathic Medicine (D.O.)*
	Psychiatric Mental Health Nurse	Psychiatric Mental Health Nurse (P.M.H.N., P.M.H.-A.P.R.N.)**
		Clinical Nurse Specialist (C.N.S.)
		Certified Nurse Practitioner (C.N.P)
		Doctorate of Nursing Practice (D.N.P.)

*Specialized in psychiatric disorders

**Can be prescribers of psychiatric and antipsychotic medications depending on their state of licensure.

Table 3. Size of mental health workforce in Oregon and Washington State

Mental Health Professional Categories	Oregon	Washington
Social Workers*	5,123	3,696
Psychologists	1,804	2,295
Psychiatrists (MD and DO)	750	727
Counselors and Therapists*	3,839	7,310
Advanced Practice Providers who are prescribers (NPs, CNSs)	673	530
Total Potential Recruiting Count by State	12,189	14,558
Total Potential Recruiting Count	26,747	

*Mental health professionals with LCSW and CSWA credentials are the only credentials listed in the count of providers from the Oregon Workforce Analysis and LASW and LICSW credentials are the only credentials listed in the count of providers from the Washington State Workforce Analysis.

** Mental health professionals with LPC, LMFT, and LPCLMFT credentials are the only credentials listed in the Oregon Workforce Analysis. Washington State does not list license types in their Workforce Analysis.

Table 4. Recruitment sources

Recruitment Contact	Recruitment Contact Outcome
American Psychiatric Association- Oregon Psychiatric Physicians Association branch	No response to email request
Board of Licensed Professional Counselors and Therapists	Form provided for email list request
Permanente Medicine	No response to email request
Western Psychological Services	Recruitment request provided to management to out in company newsletter
American Counseling Association	No response to email request

Recruitment Contact	Recruitment Contact Outcome
Washington State Psychiatric Association	No response to email request
Washington Mental Health Counselors Association	No response to email request
American Psychiatric Nurses Association	No response to email request
OHSU Psychiatry Faculty Directory	Sent recruitment request email directly to faculty

Table 6. Patient data access, N=229

Who do you believe on the patient's care team should have access to patient data from wearable devices?	%	Count
Therapist or counselor	20.5%	47
Case manager	10.9%	25
Medication manager	21.4%	49
Primary Care Physician	28.4%	65
Open access to any who have permissions to access the patient's Electronic Health Record	5.7%	13
Administrative team (e.g., scheduling department)	0.9%	2
Other (please describe)	8.3%	19
No one should have access	3.9%	9

Table 7. Patient data access barriers, N=230

What, if any, barrier(s) do you perceive to using patient data from wearables in your clinical practice?	%	Count
Lack of time to access and analyze patient data	24.3%	56
Uncertainty about accuracy of data	17.0%	39
No or little guidance on how to effectively use data for mental healthcare purposes	23.9%	55
Provider's organization does not support use case	10.0%	23
Provider's organization prohibits the collection and/or use of patient data from wearable devices	2.2%	5

What, if any, barrier(s) do you perceive to using patient data from wearables in your clinical practice?	%	Count
Other (please describe)	5.2%	12
Security or privacy concerns	16.1%	37
No barriers	1.3%	3

Table 12. Selected questions for emotion magnitude coding

Open-Text Question	Prior Question (if applicable)
Q8 Is there a specific reason(s) why not?	Q6 Have you personally used a wearable device to track or manage your own health (e.g. tracking sleep via a Fitbit, tracking your heart rate during a workout with Apple watch, etc.)?
Q10 Please share any comments on your perceived value score from question 9	Q9 Please indicate how much you agree or disagree with the following statement: "I see value in collecting health data from wearable devices for use in patient care."
Q14 Please briefly describe their perspective(s) on wearable devices	Q13 Have you had conversations with any of your patients about wearable devices?
Q16 Please briefly describe their perspective(s) on sharing device data with you	Q15 Have you had any conversations with your patients about sharing data with you from their wearable devices?
Q20 Have you experienced or are you aware of any issues with accessing a patient's wearable device data? ☐ Other (please describe)	N/A
Q21 From the point of view from your patients with schizophrenia or bipolar I or II disorder, what, if any, barrier(s) do you believe there are to the adoption of wearable devices? ☐ Other (please describe)	N/A

Open-Text Question	Prior Question (if applicable)
Q22 What, if any, barrier(s) do you perceive to patients consenting to share their wearable device data? ☐ Other (please describe)	N/A
Q23 Who do you believe on the patient's care team should have access to patient data from wearable devices? ☐ Other (please describe)	N/A
Q24 What, if any, barrier(s) do you perceive to using patient data from wearables in your clinical practice? ☐ Other (please describe)	N/A
Q25 Please add any additional thoughts on the topic of wearables device use with patients with schizophrenia or bipolar I or II disorder.	N/A