Mental Health Care Provider's Perspectives Toward Adopting a Novel Technology to Improve Medication Adherence

Joshua N. Liberman, Ph.D., Tigwa Davis, Ph.D., Dawn Velligan, Ph.D., Delbert Robinson, M.D., William Carpenter, M.D., Chris Jaeger, M.D., Heidi Waters, Ph.D., Charles Ruetsch, Ph.D., Felicia Forma, B.Sc.

Objective: To understand perspectives of mental health care providers regarding barriers and drivers of adopting a medication ingestible event monitoring (IEM) system in clinical practice.

Methods: Between April and October 2019, a cross-sectional, online survey was conducted among 131 prescribing clinicians and 119 non-prescribing clinicians providing care to patients with major depressive disorder, bipolar disorder, and schizophrenia.

Results: Most prescribing clinicians were physicians (79.4%) while most non-prescribing clinicians (52.9%) were licensed clinical social workers, followed by counselors (30.8%), clinical psychologists (13.4%), and case managers (2.5%). Most respondents (93.2%) reported that clinicians can influence adherence, that the IEM technology was in their patients' best interest (63.6%), and a willingness to beta test the technology (54.8%). Support was positively associated with prescribing clinicians (OR: 2.2; 95% CI: 1.1, 4.5), belief that antipsychotics reduce the health, social, or financial consequences of the condition (OR: 3.8; 95% CI: 1.3, 11.0), concern for patients' well-being without monitoring (OR: 3.3; 95% CI: 1.2, 8.7), and belief the technology will enhance clinical alliance (OR: 3.1; 95% CI: 1.5, 6.3) or improve patient engagement (OR: 3.0; 95% CI: 1.5, 6.2). Support was inversely related to concerns about appropriate follow-up actions (OR: 0.4; 95% CI: 0.2, 0.9) and responsibilities (OR: 0.3; 95% CI: 0.1, 0.8) when using the technology.

Conclusions: Our results suggest that IEM sensor technology adoption will depend upon additional evidence that patients will actively engage in the use of the technology, will benefit from the technology through improved outcomes, and that the additional burden placed upon providers is minimal compared to the potential benefit.

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Affecting nearly one in five US adults (1), serious mental illnesses are diagnosable mental, behavioral, or emotional disorders that include major depressive disorder (MDD), bipolar I disorder, and the schizophrenia spectrum of disorders (1). These disorders can profoundly disrupt personal and family relationships, often lead to lost worktime and reduced productivity, and, if severe, can interfere with basic activities of daily living (1–3).

These disorders are often difficult to treat (4,5), and a major driver of relapse is medication non-adherence (6,7). Because pharmacotherapeutic effectiveness depends upon consistent medication use, an accurate and timely assessment of medication non-adherence is beneficial to clinicians (8). However, the primary method of assessment, patient self-report in combination with observed symptom control, confound the clinician's ability to discern between medication non-effectiveness and poor medication adherence.

Digital medicine platforms that capture and report real-time medication ingestion data are among the first technologies to make these data available as decision support

KEY POINTS

- Among clinicians with prescribing authority, 91.6% are concerned about the quality of self-reported medication adherence and 75.6% reported that the IEM sensor technology would be in their patients' "best interest".
- Most prescribing (85.5%) and non-prescribing (74.0%) clinicians believe that the IEM sensor technology will either improve patient outcomes or practice efficiency.
- A key barrier to adoption appears to be concern about how to incorporate these data into practice.

for prescribers and those in treatment to use in planning treatment modifications (9). Ingestible event monitoring (IEM) systems include a sensor embedded within oral medication that sends a signal upon digestion to a wearable sensor (patch). The sensor, in turn, sends a secure, wireless signal to a smart phone that communicates with a cloud-based application that records the date and time of ingestion. The data are then available for viewing by the prescribing provider and others approved by the patient. In addition, data recording activity, rest, and self-reported mood can also be recorded. The IEM system is safe, effective, accurate, specific, and protects patient confidentiality (10,11).

While use of an IEM technology could be transformational in measuring and reporting adherence, the medical profession, and psychiatry in particular, has historically delayed uptake of digital tools designed to enhance their treatment practices (12,13). As important, patients with chronic mental illness are often supported by both a clinician with medication prescribing authority and an extended care team of allied mental health professionals including social workers, case managers, psychologists, and therapists. These providers are principal points-of-contact for patients, delivering education and encouragement, coordinating care services, and monitoring and managing symptoms and health-related behavior, including medication adherence (14). Little has been reported about the perspectives of extended care team providers for digital health solutions and their willingness and ability to support their use among stakeholders (15). The few insights available suggest these providers recognize the value of digital health solutions in clinical practice but have concerns about the digital divide, ethics including confidentiality and data security, and the impact on care (16,17).

The purpose of this study was to improve understanding of the barriers to and drivers of adoption of this digital medicine technology and to compare the perspectives of prescribing clinicians and non-prescribing care team members regarding the importance of medication adherence, their role in supporting patients' adherence efforts, and the value of this novel technology.

METHODS

The survey research protocol was approved by the Advarra Institutional Review Board.

Study Design

The study was a cross-sectional, online survey conducted between April and October 2019, of clinicians with and without medication prescribing authority, licensed in the United States who provide care to patients with serious mental illness.

Identification and Selection of Study Participants

Potentially eligible participants were identified from national lists of behavioral healthcare providers and invited to participate by email. Eligible participants provided a valid National Provider Registry (NPI) number; and provided care to more than 10 patients with serious mental illness per month. Prescribing clinicians included board-certified US-licensed Doctor Medicine; board-certified Doctors of Osteopathic Medicine; or Advanced Practice Registered Nurse or nurse practitioner or clinical nurse specialist (NPs). Non-prescribing clinicians held a clinical psychology degree, social work license, or case management certification.

Questionnaire Design and Development

The survey questionnaire was developed by a steering committee comprised of experts in psychometrics, psychiatric treatment, psychiatric research and evaluation, and clinical informatics. The following domains were selected for measurement by committee consensus: eligibility, demographics and practice characteristics; beliefs about medication adherence; experience with digital technology in clinical practice; perceived impact of adherence management and technology on practice efficiency; concerns about liability and responsibility; belief about effect of being monitored; and incentives to adoption.

Manifest items for each measurement domain were identified from existing questionnaires and additional items were generated by the steering committee with input from the relevant content expert and the psychometrician. The final list of items was assembled into a pilot questionnaire form with instruction sets and relevant response fields. Endorsement for each driver and barrier to IEM adoption was captured on a four-point Likert scale consisting of "strongly agree", "somewhat agree", "somewhat disagree" and "strongly disagree". For other barriers and drivers, participants rank ordered items based on the importance to their decision making or their possible adoption of the IEM technology. The questionnaire was finalized by the steering committee following pilot tests and cognitive debriefing interviews with five prescribing and five non-prescribing clinicians to assess face validity of instruction sets, items, and responses. Including questions to determine eligibility and to assess provider demographics and practice characteristics, the total questionnaire included 85 items.

Recruitment and Participation

Participants were recruited via email invitation. Eligible participants who completed the survey were remunerated: $175 (prescribing clinicians) or $75 (non-prescribing clinicians). A total of 905 prescribing and 11,919 non-prescribing clinicians were invited to participate in the survey, with a 34.1% and 5.9% participation rate,

respectively. The median time to complete the questionnaire was 23 min.

Statistical Analysis

Support for adoption of the IEM technology (dependent variable) was defined by a "strongly" or "somewhat" agree response to the question, "Using the IEM sensor technology is in my patients' best interest." Independent variables including respondent age, gender, level of clinical experience (years), practice type, and degree type were summarized descriptively for the total population and by support for IEM adoption. Four-point Likert scales were converted to a two-point scale consisting of "agree" and "disagree". Tests of significance for observed differences between groups were conducted using unadjusted Odds Ratios and 95% confidence intervals and confirmed with chi-square tests for categorical variables. Variables identified as significant in the bivariate analysis were added into a backwards elimination stepwise logistic regression model. The threshold for significance was set at 0.05. All analyses were performed with SAS software, v9.4, SAS Institute Inc, Cary, NC, USA.

RESULTS

Respondent Characteristics

A total of 131 psychiatric prescribers participated in the survey (Table 1). The prescribers were 79.4% physicians, 20.6% NPs, 56.5% female, and an average age of 47.5 years. Fifty-eight percent reported working in private or group practice. Prescribers who predominantly treated patients with schizophrenia were significantly more likely ($p < 0.01$) to practice in hospitals, psychiatric facilities, and settings other than individual or group practice.

A total of 119 non-prescribing clinicians participated (Table 1) and were predominantly female (79.0%), with a mean age of 44.8 years. Most (52.9%) were licensed in social work, followed by licensed counselors (30.8%), clinical psychologists (13.4%), and case managers (2.5%). The most common practice settings were individual or group practice (24.4%), public outpatient clinic (22.7%), and mental health center (17.6%). Respondents who predominantly treated patients with schizophrenia or bipolar disorder worked in mental health centers or clinics (74.3% and 53.9%, respectively) while respondents with a higher proportion of MDD patients worked in office-based practice (61.0%).

TABLE 1. Demographic and practice characteristics of prescribing and non-prescribing clinicians

	Prescribing clinicians				Non-prescribing clinicians					
	Physicians		Nurses		Social work (case mgr)		Counselor		Psychology	
	N = 104		*N* = 27		*N* = 66		*N* = 37		*N* = 16	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
Gender										
Female	52	50.0%	22	81.5%	53[a]	80.3%	32	86.5%	9	56.3%
Male	50	48.1%	3	11.1%	11	16.7%	5	13.5%	7	43.8%
Other/unknown	2	1.9%	2	7.4%	2	3.0%	0	0.0%	0	0.0%
Age (mean)										
18–35	14	13.5%	5	18.5%	20	30.3%	12	32.4%	1	6.3%
36–55	66	63.5%	8	29.6%	31	47.0%	16	43.2%	9	56.3%
56+	24	23.1%	14	51.9%	15	22.7%	9	24.3%	6	37.5%
Years practicing										
≤5 years	4	3.8%	2	7.4%	18	27.3%	11	29.7%	3	18.8%
6–10 years	26	25.0%	11	40.7%	15	22.7%	10	27.0%	4	25.0%
11–20 years	36	34.6%	9	33.3%	15	22.7%	11	29.7%	4	25.0%
21+ years	38	36.5%	5	18.5%	18	27.3%	5	13.5%	5	31.3%
% Of patients on medicaid										
≤25%	57	54.8%	19	70.4%	22	33.3%	13	35.1%	11	68.8%
26–50%	23	22.1%	5	18.5%	10	15.2%	5	13.5%	2	12.5%
>50%	24	23.1%	3	11.1%	34	51.5%	19	51.4%	3	18.8%
Practice setting										
Individual practice	39	37.5%	8	29.6%	8	12.1%	5	13.5%	4	25.0%
Group office practice	19	18.3%	10	37.0%	5	7.6%	3	8.1%	4	25.0%
Public psychiatric hospital	11	10.6%	2	7.4%	4	6.1%	1	2.7%	1	6.3%
Public clinic or outpatient facility	9	8.7%	2	7.4%	18	27.3%	8	21.6%	1	6.3%
Mental health center	7	6.7%	1	3.7%	13	19.7%	7	18.9%	1	6.3%
Private psychiatric hospital	6	5.8%	0	0.0%	1	1.5%	0	0.0%	1	6.3%
Private clinic or outpatient hospital	4	3.8%	2	7.4%	4	6.1%	0	0.0%	1	6.3%
Private, public general hospital					4	6.1%	1	2.7%	0	0.0%
Other work setting	9	8.7%	2	7.4%	9	13.6%	12	32.4%	3	18.8%

[a] Two social workers identified as neither male or female.

Beliefs About Medication Adherence

When uncertain about a patient's adherence, most prescribers (93.9%) reported asking patients about adherence directly, followed by assessing symptomatology (63.4%), asking a collateral (relative, caregiver; 61.1%), or contacting a pharmacy (22.9%). Few prescribers reported counting pills (7.6%), requesting use of a daily logbook (0.7%), or using adherence scales (0.7%).

Most prescribers (84.0%) reported adequate time to assess medication adherence, while only 66.2% reported confidence in accurately estimating adherence (Table 2). Most prescribers (91.6%) reported concern about the validity of self-reported adherence, a concern that was more common among those providing care for patients with bipolar disorder and schizophrenia rather than MDD (95.7% and 97.4% vs. 82.2%; $p < 0.05$). More prescribers treating patients with schizophrenia (84.6%) reported concern about their ability to adequately monitor adherence, followed by those treating bipolar disorder (73.9%) and MDD (44.6%; $p < 0.05$). Most non-prescribing clinicians (89.9%) reported that assessing adherence is an important part of the service provided, and that adherence can be influenced by clinicians (91.6%; Table 2).

Nearly all (95.4%) prescribers believed that oral antipsychotic medication adherence can be influenced by

TABLE 2. Drivers and barriers of technology adoption in clinical practice among prescribing and non-prescribing clinicians

	Prescribing clinicians		Non-prescribing clinicians			
	N = 131		*N* = 119			
Question	*N*	%	*f*	%	Odds ratio	95% CI
Drivers of adoption						
This product is likely to _____						
Increase efficiency	10	7.6%	17	14.3%	2.1	(1.1, 3.9)
Improve outcomes	102	77.9%	71	59.7%		
Have no effect	15	11.5%	21	17.6%		
Decrease efficiency	2	1.5%	5	4.2%		
Decrease outcomes	2	1.5%	5	4.2%		
Using the ingestible event marker sensor technology is in my patient's best interest.						
Agree	99	75.6%	60	50.4%	3.0	(1.8, 5.4)
Disagree	32	24.4%	59	49.6%		
This product is likely to _____ patient engagement with their treatment						
Increase	94	71.8%	59	49.6%	2.6	(1.5, 4.4)
Decrease	13	9.9%	28	23.5%		
Have no effect on	24	18.3%	32	26.9%		
Using this technology will _____ my clinical alliance with patients						
Enhance	85	64.9%	63	52.9%	1.6	(1.0, 2.7)
Erode	46	35.1%	56	47.1%		
This product is likely to decrease inter-visit contacts with patients						
Agree	62	47.3%	49	41.2%	NS	
Disagree	69	52.7%	70	58.8%		
Barriers to adoption						
"I Would not adopt this technology because..."						
It might require 24/7 monitoring						
Agree	39	29.8%	62	52.1%	0.4	(0.2, 0.7)
Disagree	92	70.2%	57	47.9%		
I'm unsure of my responsibility when using it						
Agree	86	65.6%	89	74.8%	NS	
Disagree	45	34.4%	30	25.2%		
It's data I do not normally collect						
Agree	73	55.7%	78	65.5%	NS	
Disagree	58	44.3%	41	34.5%		
I'm unclear on follow-up actions						
Agree	57	43.5%	68	57.1%	0.6	(0.4, 0.9)
Disagree	74	56.5%	51	42.9%		
It might make it difficult to accept new patients						
Agree	38	29.0%	50	42.0%	0.6	(0.3, 0.9)
Disagree	93	71.0%	69	58.0%		
I lack knowledge about adherence drivers						
Agree	28	21.4%	49	41.2%	0.4	(0.2, 0.7)
Disagree	103	78.6%	70	58.8%		
I would like to be a beta site for this technology						
Agree	68	51.9%	59	49.6%		
Disagree	63	48.1%	60	50.4%	NS	

practitioners and the most likely adherence intervention reported was switching the patient to a long-acting injectable (38.9%), followed by cognitive behavioral therapy/motivational interviewing (33.6%), and adherence education (16.9%).

Barriers and Drivers of Support for the IEM Technology

The majority (85.5%) reported having used digital medicine technology with patients and agreed that digital medicine applications improve efficiency (84.0%). Prescribers believed that an IEM solution would be beneficial to their patients: 77.9% agreed that an IEM would improve clinical outcomes and 75.6% agreed that the device was in their patients' best interest (Table 3). Nearly two-thirds of prescribers (64.9%) reported that an IEM solution would "enhance" their clinical alliance with patients. Overall, 71.8% reported the solution would increase patient engagement with their treatment; fewer (47.3%) agreed that it would decrease inter-visit contacts with their patients.

Most (65.6%) prescribers were unsure of their responsibility when using such a device (Table 4), though this issue was a greater concern among NPs than physicians (85.2% vs. 61.2%; $p < 0.05$). Nearly 56% of respondents expressed concern about collecting data they do not normally collect. Few prescribers (29.8%) expressed concern over potentially new patient monitoring responsibilities or impact to their patient panel (29.0%). Finally, 43.5% were unclear about required follow-up actions if they adopted the system, and 21.4% indicated that a lack of knowledge about drivers of medication adherence was a concern.

Of the 119 non-prescribing respondents, 60 (50.4%) agreed that the use of the IEM technology was in their patients' best interest. Support for the technology did not vary by provider age, sex, degree/licensure, practice setting, or years in practice; however, it did vary by disorder, with the highest level of support for patients with bipolar disorder (64.1%), followed by schizophrenia

TABLE 3. Clinician characteristics and perspectives on medication adherence with whether the ingestible event monitoring technology is in patients best interest, by clinical group

		Prescribing clinicians				Non-prescribing clinicians			
Question to prescriber		Best interest 99%	Not best interest 32%	Odds ratio	95% CI	Best interest 60%	Not best interest 59%	Odds ratio	95% CI
Clinician characteristics									
Clinician	Physician	82.8%	68.8%	NS		-	-		
	Nurse	17.2%	31.3%			-	-		
	Psychologist					16.7%	10.2%	NS	
	Social work					50.0%	61.0%		
	Counselor					33.3%	28.8%		
Clinician sex	Female	55.6%	59.4%	NS		75.0%	86.0%	NS	
	Male	41.4%	37.5%			25.0%	14.0%		
Years in practice	0–5 years	4.0%	6.3%	NS		30.0%	23.7%	NS	
	6–10 years	28.3%	28.1%			25.0%	23.7%		
	11–20 years	34.3%	34.4%			26.7%	23.7%		
	21+ years	33.3%	31.3%			18.3%	28.8%		
Condition managed	MDD	31.3%	46.9%	1		25.00%	44.10%	1	
	Bipolar I disorder	34.3%	37.5%	1.4	(0.6, 3.4)	41.70%	23.70%	3.1	(1.2, 7.7)
	Schizophrenia	34.3%	15.6%	3.3	(1.1, 10.1)	33.30%	32.20%	1.8	(0.7, 4.5)
Perspectives on adherence									
Clinicians influence adherence to oral antipsychotic medication?	Agree	96.0%	93.8%	NS		93.3%	88.1%	NS	
	Disagree	4.0%	6.3%			6.7%	10.2%		
Concerned about self-reported adherence	Agree	93.9%	84.4%	NS		93.3%	79.7%	3.6	(1.1, 11.8)
	Disagree	6.1%	15.6%			6.7%	20.3%		
Adherence reduces consequences of the disorder	Agree	89.9%	71.9%	3.5	(1.3, 9.6)	96.7%	79.7%	7.4	(1.6, 34.7)
	Disagree	10.1%	28.1%			3.3%	20.3%		
Adequate time to assess medication adherence	Agree	84.8%	81.3%	NS					
	Disagree	15.2%	18.8%						
Assessing adherence important service provided	Agree					91.7%	88.1%	NS	
	Disagree					8.3%	11.9%		
Concerned about adequately monitor adherence	Agree	72.7%	50.0%	2.7	(1.2, 6.1)	53.3%	50.8%	NS	
	Disagree	27.3%	50.0%			46.7%	49.2%		
Concerned for patients' well-being without adequate monitoring	Agree	97.0%	75.0%	10.7	(2.6, 43.3)	86.7%	67.8%	3.1	(1.2, 7.8)
	Disagree	3.0%	25.0%			13.3%	32.2%		
Confident estimating patient's medication adherence	Agree	64.6%	71.9%	NS		75.0%	64.4%	NS	
	Disagree	35.4%	28.1%			25.0%	35.6%		

TABLE 4. Association of clinical characteristics and perspectives on medication adherence with interest in being a beta test site for ingestible event monitoring technology

		Prescribing clinicians				Non-prescribing clinicians			
Question to prescriber		Yes 68%	No 63%	Odds ratio	95% CI	Yes 59%	No 60%	Odds ratio	95% CI
Clinician characteristics									
Clinician	Physician	79.4%	79.4%	NS		-	-		
	Nurse	20.6%	20.6%			-	-		
	Psychologist					20.3%	6.7%	NS	
	Social work					49.2%	61.7%		
	Counselor					30.5%	31.7%		
Clinician sex	Female	55.9%	57.1%	NS		78.0%	80.0%	NS	
	Male	39.7%	41.3%			22.0%	16.7%		
Years in practice	0 to 5 years	5.9%	3.2%	NS		27.1%	26.7%	NS	
	6 to 10 years	26.5%	30.2%			23.7%	25.0%		
	11 to 20 years	30.9%	38.1%			30.5%	20.0%		
	21+ years	36.8%	28.6%			18.6%	28.3%		
Condition managed	MDD	29.4%	41.3%	NS		27.1%	41.7%	NS	
	Bipolar I disorder	33.8%	36.5%			37.3%	28.3%		
	Schizophrenia	36.8%	22.2%			35.6%	30.0%		
Perspectives on adherence									
Clinicians influence adherence to oral antipsychotic medication?	Agree	95.6%	95.2%	NS		91.5%	91.7%	NS	
	Disagree	4.4%	4.8%			8.5%	8.3%		
Concerned about self-reported adherence	Agree	97.1%	85.7%	5.5	(1.1, 26.5)	94.9%	78.3%	5.2	(1.4, 19.2)
	Disagree	2.9%	14.3%			5.1%	21.7%		
Adherence reduces consequences of the disorder	Agree	88.2%	82.5%	NS		94.9%	81.7%	4.2	(1.1, 15.9)
	Disagree	11.8%	17.5%			5.1%	18.3%		
Adequate time to assess medication adherence	Agree	80.9%	87.3%	NS					
	Disagree	19.1%	12.7%						
Assessing adherence important service provided	Agree					91.5%	88.3%	NS	
	Disagree					8.5%	11.7%		
Concerned about adequately monitor adherence	Agree	79.4%	54.0%	3.3	(1.5, 7.1)	49.2%	55.0%	NS	
	Disagree	20.6%	46.0%			50.8%	45.0%		
Concerned for patients' well-being without adequate monitoring	Agree	95.6%	87.3%	NS		88.1%	66.7%	3.7	(1.4, 9.6)
	Disagree	4.4%	12.7%			11.9%	33.3%		
Confident estimating patient's medication adherence	Agree	60.3%	73.0%	NS		79.7%	60.0%	2.6	(1.2, 5.9)
	Disagree	39.7%	27.0%			20.3%	40.0%		

Abbreviation: MDD, major depressive disorder.

(51.2%) and MDD (36.6%) (Table 1) Support for the IEM sensor technology was associated with concern about the validity of patient self-reported adherence (OR:3.6; 95% CI: 1.1–11.8), with the belief that improving adherence with antipsychotics "reduces the health, social, and financial consequences" of their patient's disorder (OR: 7.4; 95% CI: 1.6–34.7), and with concern for patients' well-being if adherence not adequately monitored (OR: 3.1; 95% CI: 1.2–7.8) (Table 2).

Non-prescribers (73.9%) expected the technology to either improve outcomes or increase practice efficiency. Fewer (52.9%) expected the technology to enhance the clinical alliance with patients, increase patient engagement with treatment (49.6%), or decrease contacts with patients between visits (31.1%). However, supporting the IEM technology was associated with each of the following beliefs: improved outcomes or practice efficiency (OR: 17.2, 95% CI: 4.8, 61.0), enhanced clinical alliance (OR: 6.8; 95% CI: 3.0, 15.3), and fewer contacts between visits (OR: 2.5; 95% CI: 1.1, 5.9). Providers who expected the technology to increase inter-visit contacts were also more supportive of the technology (OR: 3.6, 95% CI: 1.3, 9.9). The most common barrier was unclear responsibility when using the technology (74.8%), which was also associated with support for adopting the IEM technology (OR: 0.3; 95% CI: 0.1, 0.7) followed by unclear follow-up actions (OR: 0.4; 95% CI: 0.2, 0.8) (Table 3).

Both the belief that the IEM technology was in patients' best interest and an interest in being a beta test site for the technology were positively associated with a general support for technology to monitor adherence (as measured by support for MEMS), a belief that the IEM technology will increase patient engagement with treatment, and that the technology will enhance the clinical alliance and was inversely associated with concern about clinician responsibility when using the technology (Table 5) Belief

TABLE 5. Logistic regression results[a]: Factors associated with belief that the ingestible event monitoring technology is in the best interest of my patient, prescribing and non-prescribing clinicians

		Patients' best interest		Interest in beta testing	
Question	Response	Odds ratio	95% CI	Odds ratio	95% CI
Clinician type	Non-prescriber	1		NS	
	Prescriber	2.2	(1.1, 4.5)		
MEMS (continuous 1–6 ranking)		0.76	(0.6, 0.9)	0.77	(0.6, 0.9)
Concerned for patients' well-being without adequate monitoring	Disagree	1		NS	
	Agree	3.3	(1.2, 8.7)		
Adherence reduces consequences of the disorder	Disagree	1		NS	
	Agree	3.8	(1.3, 11.0)		
I'm unclear on follow-up actions	Disagree	1		NS	
	Agree	0.4	(0.2, 0.9)		
I'm unsure of my responsibility when using it	Disagree	1		1	
	Agree	0.3	(0.1, 0.8)	0.5	(0.2, 0.9)
This product is likely to decrease inter-visit contacts with patients	Disagree	1		NS	
	Agree	2.07	(1.0, 4.2)		
Using this technology will _____ my clinical alliance with patients	Erode	1		1.0	
	Enhance	3.1	(1.5, 6.3)	6.0	(3.1, 11.6)
Increase patient engagement with treatment	Decrease/no effect	1		1	
	Increase	3.0	(1.5, 6.2)	2.3	(1.2, 4.5)
Concerned about self-reported adherence	Disagree	NS		1	
	Agree			5.5	(1.6, 18.8)

[a] Results obtained using backward elimination logistic regression.

that the technology is in the patients' best interest was also positively associated with being a prescribing clinician (OR: 2.2; 95% CI: 1.1, 4.5), with concern for patients' well-being without adequate adherence monitoring (OR: 3.3; 95% CI: 1.2, 8.7), with the belief that adherence to antipsychotics reduces the health/social/financial consequences of the mental health disorder (OR: 3.8; 95% CI: 1.3, 11.0), and with the belief that the technology will decrease inter-visit contacts with patients (OR: 2.1; 95% CI: 1.0, 4.2) and was inversely associated with concern about appropriate follow-up actions (OR 0.4; 95% CI: 0.2, 0.9). Concern about the validity of self-reported adherence was associated with an interest in being a beta test site (OR: 5.5; 95% CI: 1.6, 18.8) but not that the technology was in the patients' best interest.

DISCUSSION

Nonadherence to antipsychotic medication is common (18–22) and a driver of potentially avoidable health service utilization and costs (23). Yet, assessing medication nonadherence during a clinic visit is a challenge for clinicians (24–27). Due to the lack of efficient, valid alternative data collection methods (28), providers routinely rely on patient or caregiver self-report (29,30) combined with assessment of symptom control for adherence information, and as a result, tend to significantly overestimate their patients' level of adherence to medication (24,31) and confound medication effectiveness with adherence. Currently available alternative approaches to measuring medication adherence, including the use of reports based on pharmacy claims, the administration of standardized questionnaires, or technologies that measure the opening of prescription drug bottles are routine in clinical and epidemiologic research but are not widely adopted in clinical practice (32,33).

Inaccurate assessment of medication adherence leads to uninformed treatment, management, and prescribing decisions having clinical ramifications for patients and financial costs to payers (34).

When reviewing a series of clinical vignettes of patients with schizophrenia, clinicians whose vignettes included digitally captured adherence information (compared to those whose vignettes did not) were more likely to switch non-adherent patients to a long-acting injectable antipsychotic, and more likely to increase the dose of oral antipsychotic medication among patients who were adherent but poorly controlled (35). These results are consistent with an administrative claims analysis of 286,249 patients with serious mental illness which reported that physician awareness of nonadherence was associated with medication switching and dose increases (36).

By recording medication ingestion data and delivering timely reporting to patients and providers, the IEM technology platform provides a promising alternative to traditional methods of medication adherence assessment. Though the design, development, and testing of this novel IEM technology in psychiatry is still evolving (37,38), early studies suggest it meets criteria for usability, patient acceptance, and provider acceptance and utility (39,40).

Our results indicate support for the technology varied by views on medication and adherence, with support highest among respondents who believe that antipsychotics reduce the health, social, and financial consequences of the disorder, who are concerned about the validity of self-reported adherence, and who are concerned about patient well-being if adherence cannot be adequately managed. Further, support was more likely among providers who believed it would improve patient outcomes or increase practice efficiency, including enhanced clinical alliance and patient engagement. In contrast, support was lower among respondents who were unsure about their responsibility if using the technology and who were unclear on appropriate follow-up actions. These perspectives align with the growing body of evidence that medication non-adherence is a complex issue. A recent Cochrane review concluded that providing clinicians with medication adherence information improves the process of care but does not translate into "improved medication adherence, patient outcomes, or health resource use." (41) This finding supports evidence that simple strategies, such as providing pill boxes or educating patient's on the importance of consistency are only modestly effective (42) and that patient's struggling with medication non-adherence are best supported by comprehensive, person-centered approaches (43). However, these approaches are complex, time-consuming to implement, and require additional training for providers and healthcare systems (44).

Support for the technology differed between clinicians who have authority to prescribe medications (75.6%) and extended care team members without prescribing authority (50.4%). Nonetheless, most allied care team members reported that medication adherence is an issue that can be influenced by clinicians and that reporting nonadherence to the prescribing clinician is important. Credible medication adherence data may help improve care coordination between care team members and the prescribing provider. Further, non-prescribing mental health professionals may use these data to employ alternative adherence interventions, approaches that do not involve changes to pharmaceutical treatment (45). For example, psychologists and counselors may integrate adherence information into cognitive-behavioral therapy to address negative perceptions about medication, into motivational interviewing techniques to reinforce the importance of taking medications and improve confidence in the ability to adhere, or into environmental supports such as alarms and checklists to remind individuals when to take medication.

These provider perspectives offer insights that can support the integration of this novel technology in clinical practice. Implementation strategies that identify and address an individual provider's priorities and perspectives will likely achieve the most success. Future research should focus on provider-centered approaches that integrate the value of objective medication adherence data and the methods for translating these results into effective interventions. Given the importance of extended care teams in mental health care (psychotherapists, social workers, case managers, etc.), future research should also focus on understanding their support for new approaches to adherence, psychosocial, and cognitive behavioral interventions.

Study limitations

A modest sample size recruited from a convenience sample limit the generalizability of results as participants may represent a select sub-group of care providers. Respondents did not have an ability to interact directly with the IEM sensor technology, rather, a description of the device was introduced as text within the questionnaire. Further, our study was focused on barriers and drivers of adopting this technology and did not explore how these data might be used in everyday practice, an important topic for future research. Finally, the survey focused only on the provider perspective and did not include the patient perspective, which should be investigated in future studies.

CONCLUSIONS

Mental health care providers are concerned about medication adherence, perceive current monitoring tools as problematic, and are open to using digital medicine technologies to improve accuracy of adherence assessment. Successful adoption of the IEM sensor technology will depend upon additional evidence that patients will benefit from the technology through improved outcomes and that the additional burden placed upon providers is minimal compared to the potential benefit. Given the importance of allied health professionals in mental health care, future research should focus on how this technology supports care coordination with prescribing clinicians and on empowering clinicians with tools to translate insights into impactful adherence interventions.

AUTHOR AND ARTICLE INFORMATION

Health Analytics LLC, Columbia, MD (Liberman, Davis, Ruetsch); University of Texas Health Science Center, San Antonio, TX (Velligan); Northwell Health, Feinstein Institutes for Medical Research, Hempstead, NY (Robinson); School of Medicine, University of Maryland, Baltimore, MD (Carpenter); JHC Solutions LLC, San Francisco, CA (Jaeger); Otsuka Pharmaceutical Development & Commercialization Inc, Princeton, NJ (Waters, Forma).

Send correspondence to Dr. Liberman (j.liberman@healthanalytics.com).

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ENDNOTE

[1]Substance Abuse and Mental Health services Administration (www.samhsa.gov/dbhis-collections/smi) accessed July 7, 2020.

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