

# DIGITAL HEALTH TOOLS TO MONITOR MEDICATION ADHERENCE AMONG BIPOLAR DISORDER, MAJOR DEPRESSIVE DISORDER AND SCHIZOPHRENIA

• FELICIA FORMA, BSC<sup>1</sup>, KEVIN CHIU, PHD<sup>2</sup> • JASON SHAFRIN, PHD<sup>2</sup> • DUSICA HADZI BOSKOVIC, MS<sup>1</sup> • PHANI VEERANKI, MD, DRPH<sup>2</sup>  
 1. OTSUKA PHARMACEUTICAL DEVELOPMENT & COMMERCIALIZATION, INC. PRINCETON, NJ. 2. PRECISIONheor, LOS ANGELES, CA.

Presenting Author: Kevin Chiu  
 Questions E-Mail: dusica.hadziboskovic@otsuka-us.com

## BACKGROUND

- Serious mental illness (SMI) including bipolar disorder (BPD), major depressive disorder (MDD) and schizophrenia (SCZ) contribute to significant healthcare and economic burden in the United States (U.S).
- BPD, MDD and SCZ are estimated to affect 2.8%, 9% and 1.1% of U.S. adults and contribute to an annual burden of >\$195 billion, \$210 billion and \$63 billion in healthcare costs, respectively.<sup>1, 2, 3</sup>
- Poor adherence to antipsychotic medications is a major obstacle to management of patients with BPD, MDD or SCZ and is associated with poor health outcomes (relapse and recurrence cases) and high direct and indirect medical costs.<sup>4</sup>

## OBJECTIVES

- To assess caregivers' preferences and willingness to pay (WTP) for health technology tools that measure medication adherence and general health among family caregivers of patients with BPD, MDD or SCZ.

## METHODS

- Study Design**
  - Web-based survey administered to family caregivers caring for adult patients with BPD, MDD, and SCZ
  - Discrete Choice Experiment (DCE) was used to estimate preference weights and caregivers' WTP
  - DCE choice sets (Figure 1) were administered to 208 caregivers
- Study Population and Criteria**
  - Age ≥ 18 years at the time of survey
  - Family caregiver of a patient diagnosed with BPD, MDD or SCZ
  - Family caregiver of a patient receiving 2<sup>nd</sup> generation oral atypical antipsychotics
  - Family caregiver reported that patient had medication adherence issue
  - Proficient in English
- Study Outcome(s)**
  - Preference weights for different health technology tools
  - WTP for different health technology tools
- Study Covariate(s)**
  - Attributes representing specific tools, and presented in the same way each time
  - Attributes grouped into two bundles-
    - Device attributes' bundle (information about medication adherence, accessing information about medication adherence, frequency of information updates, physical activity, mood, and rest information)
    - Cost bundle (Monthly out of pocket cost to the caregiver to assist the patient in acquiring the technology)
  - Four comparative tools were developed using the device attributes' bundle:
    - Pill embedded with ingestible event marker (IEM) sensor- website access of information, with information updated within every 2 hours, device tracked adherence, physical and rest, and self-reported mood
    - Mobile app -access through a mobile app, with daily updated information on self-reported medication adherence and physical activity information, no mood or rest information
    - Smart pill bottles/dispenser- website access of information, with device tracked information updated every week on medication adherence, no physical activity, mood or rest information
    - Non-digital pill organizer- requires physically examining the device, which provides daily updated information on medication adherence, no physical activity, mood or rest information

## METHODS (continued)

- Statistical Analysis**
  - Random utility models were conducted to estimate caregivers' preferences and WTP for health technology tools

Figure 1. Example of DCE choice set presented to study participants

Features	Device A	Device B
Information about medication adherence	Patient-reported	Device-tracked
Accessing information about medication adherence	Mobile application	website
Frequency of information updates	Daily	Weekly
Physical activity information	Patient-reported	No information reported
Mood information	No information reported	No information reported
Rest information	Device-tracked	No information reported
Caregiver contribution (cost/month)	\$40.00	\$10.00
Which device do you prefer?	<input type="checkbox"/>	<input type="checkbox"/>

## RESULTS

Table 1. Demographic Characteristics of Study Participants

Age of Respondent, mean (SD)	42.2 (±12.9)
Gender, n (%)	
Female	108 (58.7%)
Race, n (%)	
African American	39 (21.2%)
Caucasian	126 (68.5%)
Ethnicity, n (%)	
Hispanic	25 (13.6%)
Education, n (%)	
At least some high school or high school degree	21 (11.4%)
Some college or college degree	133 (72.3%)
Some graduate school or graduate degree	30 (16.3%)
Marital Status, n (%)	
Currently married	104 (56.5%)
Living with partner	23 (12.5%)
Widowed	5 (2.7%)
Divorced	20 (10.8%)
Single	32 (17.5%)

## RESULTS (continued)

- Study Population**
  - Of 208 caregivers who initiated the survey, 24 were excluded for taking too much or too little time to complete the survey, or because they cared for patients using long-acting antipsychotic injections.
  - 57, 61 and 66 caregivers provided care to patients diagnosed with BPD, MDD or SCZ respectively
  - Average age of the caregivers was 42.2 (±12.9) years (Table 1)
  - A majority of caregivers were female (58.7%)
  - 68.5% were Caucasian (68.5%) followed by African American (21.2%)
  - A majority of caregivers had at least some college educated (72.3%)
- Preferences and WTP among caregivers of patients with BPD**
  - Caregivers of patients with BPD reported 7.74 (95% confidence interval (CI): 3.81-14.65) and 2.60 (95% CI:1.46-4.62) times higher preference weight for a pill embedded with IEM sensor and the mobile app compared to non-digital pill organizer (Figure 2).
  - Caregiver WTP was \$197.48/month (95% CI: \$50.91-\$344.04) and \$93.72/month (95% CI: \$8.45-\$178.99) more for the pill embedded with IEM sensor and the mobile app compared to a non-digital pill organizer (Figure 3).

Figure 2: Caregiver Preference Weights for Health Technology Tools by Disease State (Reference: non-digital pill organizer)

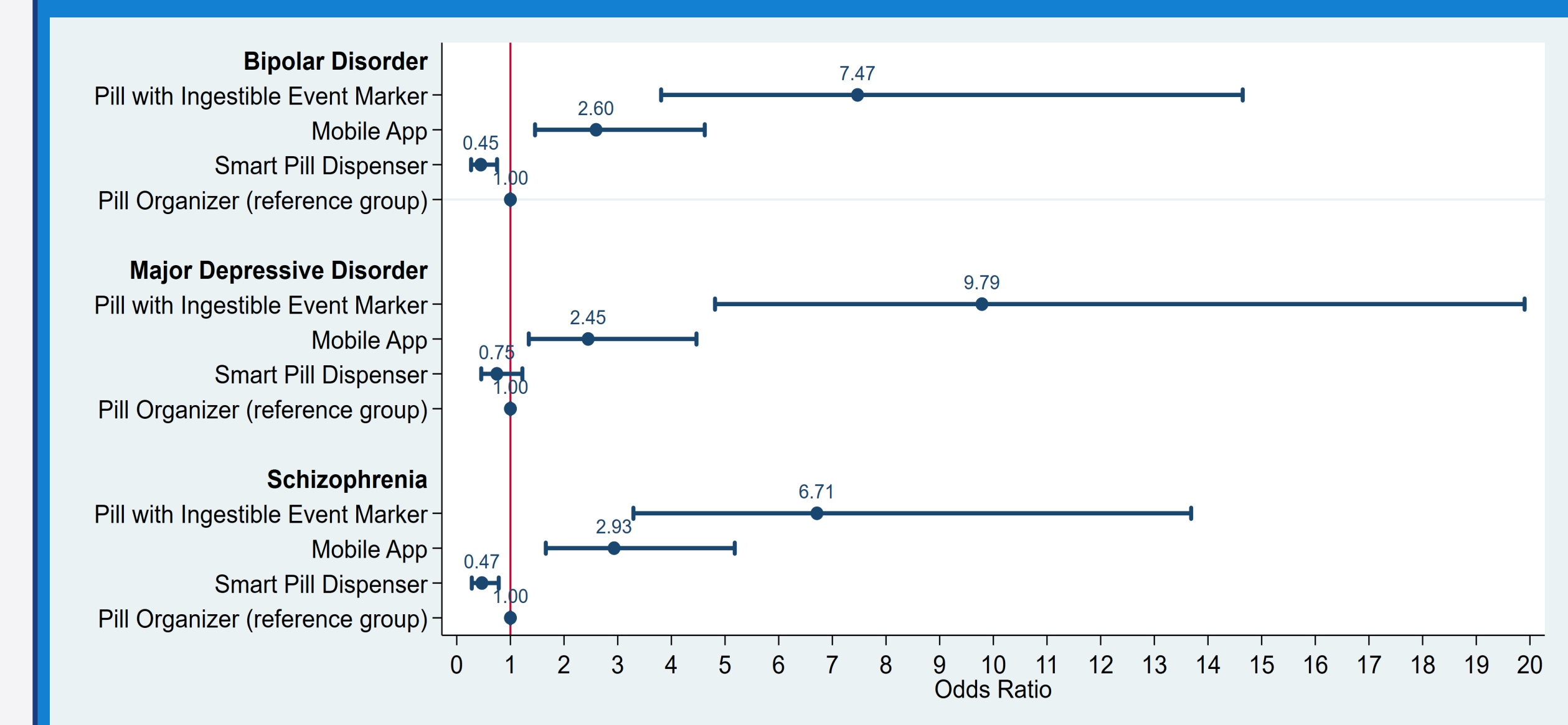
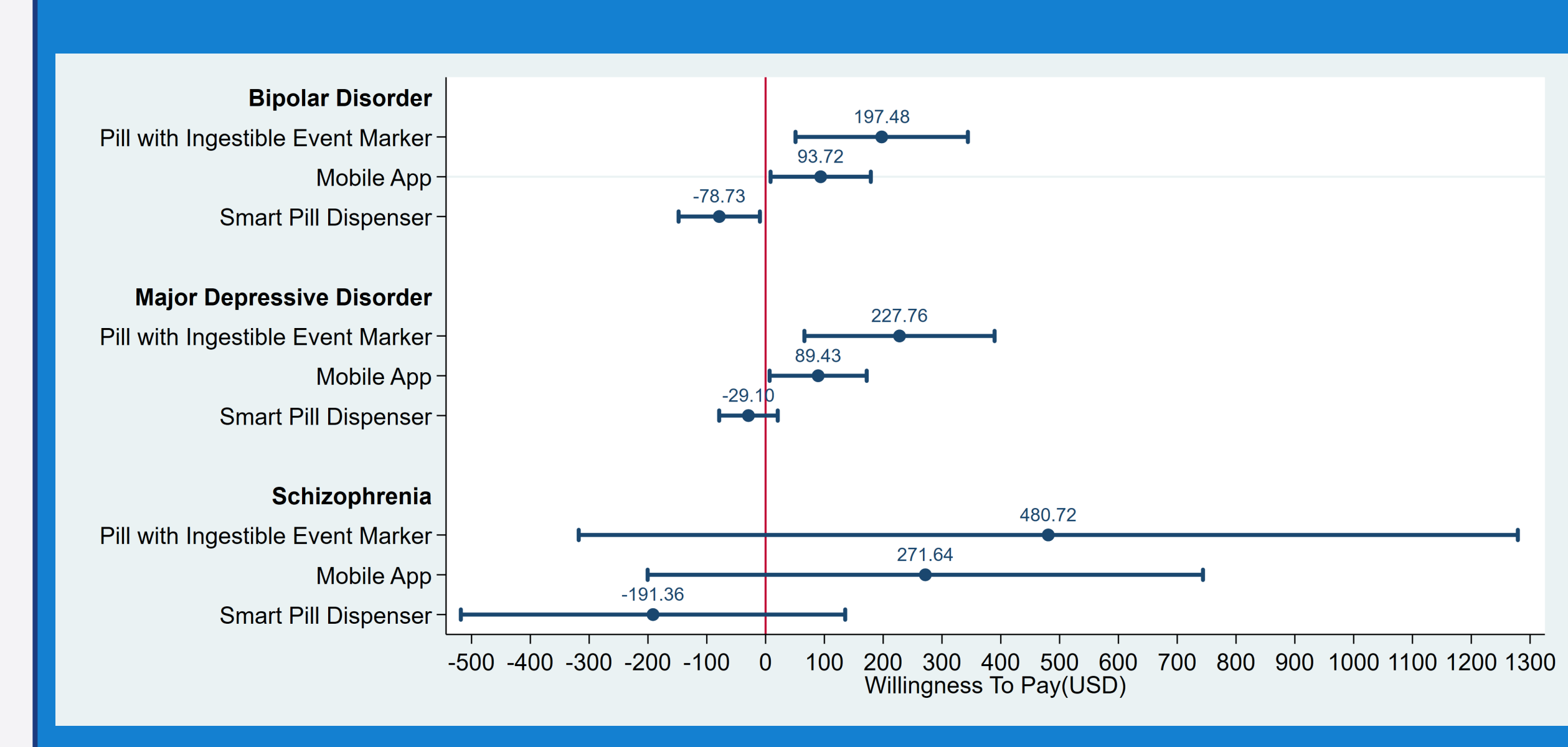


Figure 3: Caregiver Marginal Willingness to Pay for Health Technology Tools by Disease State (Reference: non-digital pill organizer)



## RESULTS (continued)

- Preferences and WTP among caregivers of patients with MDD**
  - Caregivers of patients with MDD reported 9.79 (95% CI:4.81-19.90) and 2.45 (95% CI:1.34-4.47) times higher preference weight for a pill embedded with IEM sensor and the mobile app compared to non-digital pill organizer (Figure 2)
  - Caregivers were willing to pay \$227.48/month (95% CI: \$66.04-\$389.47) and \$89.43/month (95% CI: \$6.84-\$172.03) more for the pill embedded with IEM sensor and the mobile app compared to a non-digital pill organizer (Figure 3)
- Preferences and WTP among caregivers of patients with SCZ**
  - Caregivers of patients with SCZ reported 6.71 (95% CI: 3.29-13.69) and 2.93 (95% CI:1.66-5.18) times higher preference weight for a pill embedded with IEM sensor and mobile app compared to non-digital pill organizer (Figure 2)
  - Caregivers of patients with SCZ did not report statistically significant results for WTP in comparison to non-digital pill organizer (Figure 3)

## LIMITATIONS

- Preferences were stated rather than revealed and it is not clear if these preferences would extend to the real world
- While the study was able to measure preferences across difference adherence tools with sufficient power, by bundling attributes, we were not able to determine which individual attributes were the driving factors of such preferences

## CONCLUSIONS

- Caregivers of patients with BPD and MDD have a stronger preference and are willing to pay more for a pill embedded with an IEM sensor tool that tracks patient medication ingestion and other health information including physical activity, rest and mood.
- Caregivers of patients with SCZ have a strong preference but are not willing to pay more for a pill embedded with an IEM sensor compared to a non-digital pill organizer.
- Caregivers of patients with BPD, MDD or SCZ also preferred the mobile app that helps measure medication adherence and tracks daily physical activity over the non-digital pill organizer.

## REFERENCES

- Bessonova, Leona et al., 2020, "The Economic Burden of Bipolar Disorder in the United States: A Systematic Literature Review," CEOR, 12: 481.
- Amos, Tony B., et al., 2018, "Direct and indirect cost burden and change of employment status in treatment-resistant depression: a matched-cohort study using a US commercial claims database." Journal of Clinical Psychiatry, 79.2: 0-0.
- Zhang, Wenjie, et al., 2018, "A systematic literature review of the clinical and health economic burden of schizophrenia in privately insured patients in the United States," CEOR, 10: 309.
- Kane JM, et al., 2013, "First experience with wireless system incorporating physiologic assessments and direct confirmation of digital tablet ingestions in ambulatory patients with schizophrenia or bipolar disorder." Journal of Clinical Psychiatry, 74(6):e533-540.

## ACKNOWLEDGMENTS

Study was funded by Otsuka Pharmaceutical Development & Commercialization, Inc.

## DISCLOSURES

Kevin Chiu and Phani Veeranki are employees of PRECISIONheor. Jason Shafirin is a former employee of PRECISIONheor. Dusica Hadzi Boskovic is an employee of Otsuka Pharmaceutical Development & Commercialization, Inc. Felicia Forma is a former employee of Otsuka Pharmaceutical Development & Commercialization, Inc