Designing Technology to Support Medication Self-Management by Older Adults

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research UNIVERSITY OF WATERLOO talks

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Wellbeing and Health in Rural Communities

- Benefits
  - Space
  - Vast, scenic landscapes
  - Sense of community
  - Slower pace of life
  - Lower cost of living
- Challenges
  - Higher rates of chronic diseases
  - Limited access to healthcare services
    - Shortage of doctors
    - Fewer pharmacies

Rural Ontario Institute, Wellbeing Dashboard, Access to Health Services
National Institute of Health, Health in Rural America

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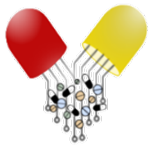
Medication Use Among Older Adults in Rural Locations

- Proportionally, **more older adults in rural locations compared to urban locations**
- Older adults residing in rural communities:
  - Greater odds of taking **riskier medications** compared to urban locations, especially OTC and medications for pain
  - Higher use of **polypharmacy,** especially among those with higher BMI and greater chronic conditions
  - Changing abilities in **vision, hearing, physical and cognition**
- **Self-management of medications is key to independent living**
- Declining **medication management capacity impacts medication adherence and errors**
  - 50% adherence to chronic medications
  - Hospitalization (OR 1.17; 95% CI: 1.12 – 1.21)
  - Mortality (Good adherence: 21% reduction in long-term mortality)
  - Total healthcare cost, pharmacy costs, inpatient costs, ER cost, hospitalization costs
- Telemedicine
- Medication management **technology**
  - Enable self-management
  - Provides clinicians with data and information

Rural Ontario Institute
McDonald HP et al. JAMA 2002; 288: 2868-2879
Cheen MHH et al. Int J Clin Pract 2019; 73: e13350
Briesacher BA et al. Pharmacother 2008; 28: 437 - 443
Walsh CA et al. Br J Pharmacol 2019; 85: 2464-2478
Cutler RL et al. BMJ Open 2018; 8:e016982

Determine…



…how to assess medication management capacity comprehensively (and practically)

1

…medication organization and medication taking-behaviours at home

2

…types of technology available to support medication taking at home

3

…classifying medication storage and dispensing technology

4

…which assistive devices are appropriate for patient-specific challenges

5

…to develop a decision guide to best match medication adherence technology to ability/capacity of older adult

…to measure effectiveness of medication adherence technology on medication adherence of older adult

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Tools to Measure Medication Management Capacity in OA

…how to **assess medication management capacity** comprehensively (and practically)

1

Barriers to medication management capacity

Physical

Grip strength, Speed of performance, Flexibility of joints, Hand-eye coordination, Retention in hand movement

Cognitive

Working memory, Spatial cognition, Selective attention, Semantic fluency, Reasoning, Numeracy and representational fluency

Sensory

Vision: Visual acuity accommodation, Color vision, Contrast detection, Dark adaptation, Glare

Audition: Auditory acuity,

Touch sensation

Motivation

Trust in own ability, Efficiency in seeing benefits, Techno literacy, Health literacy, Self confidence in using wearables, Integration of functions during daily activities

Enviornmental

Social factors, Cost of healthcare, Home environment, Caregiver burden

pharmacy MDPI

Article

Development and Content Validation of an Instrument to Measure Medication Self-Management in Older Adults

Tejal Patel [1,2,3,*], Aidan McDougall [2], Jessica Ivo [1], Jillian Carducci [2], Sarah Pritchard [2], Feng Chang [1], Sadaf Faisal [1] and Catherine Lee [2]

Patel T et al. Pharmacy 2021; 9:78

Lynn MR et al. Nurs Res 1986; 35: 382 – 385

Tools - Single Barrier

Tools - Single Barrier	Cognitive: Working Memory	Cognitive: Spatial cognition	Cognitive: Dynamic /selective attention	Cognitive: Phonemic/semantic fluency	Cognitive: Reasoning	Cognitive: Numeracy and representational fluency	Sensory: Vision	Sensory: Visual acuity/accommodation	Sensory: Color Vision	Sensory: Contrast detection	Sensory: Dark adaptation	Sensory: Glare	Sensory: Audition	Sensory: Auditory acuity	Sensory: Touch sensation	Motivation: Trust in own ability	Motivation: Efficiency in seeing benefits	Motivation: Techno literacy	Motivation: Health literacy	Motivation: Self confidence in using wearable	Motivation: Shift in responsibilities from provider to patient not preferred	Motivation: Integration of activities during daily activities	Environmental: Social factors	Environmental: Cost of medication adherence technologies	Environmental: Home environment
Mini-Mental State Examination (MMSE)	✓	✓	✓	✓	✓	✓																			
Wisconsin Card Sorting Test (WCST)	✓																								
Digit span backward (DSB)	✓																								
California Verbal Learning Test (CVLT)	✓																								
Mini-Cog	✓	✓	✓																						
Medi-Cog	✓	✓	✓																						
Medication-transfer screen (MTS)	✓	✓	✓	✓																					
Montreal Cognitive Assessment (MOCA)	✓	✓	✓	✓	✓	✓																			
Short Blessed Test (SBT)	✓	✓	✓	✓																					
Trail-Making Test (TMT)	✓																								
Measure of Drug Self-Management (MeDS)	✓																								
Fuld Object-Memory Evaluation (FOME)	✓			✓																					
National Eye Institute Visual Function Questionnaire-25 (NEI VFQ–25)							✓		✓																
Daily Living Tasks associated with Vision (DLTV)							✓	✓	✓	✓	✓	✓													
Pelli–Robson test (PR test)										✓															
Randot Circles																									
Early Treatment Diabetic Retinopathy Study eye chart (ETDRS)							✓	✓																	
Whisper test													✓	✓											
The Newest Vital Sign (NVS)																			✓						
Rapid Estimate of Adult Literacy in Medicine (REALM)																			✓						
Medication Administration Self-Efficacy Scale (MASES)																✓									
Martin and Park Environmental Demands Questionnaire(MPED)																						✓			
Medication-Specific Social Support Questionnaire (MSSS)																							✓		
Multidimensional Scale of Perceived Social Support (MSPSS)																							✓		
Perceived Social Support from Friends and the Perceived Social Support from Family (PSS-Fr& PSS-Fa)																							✓		

Tools - Combination of Barriers

Tools - Combination of Barriers	Physical: Speed of performance	Physical: Flexibility of joints	Physical: Hand-eye coordination	Physical: Retention in hand movement	Physical: Grip strength	Cognitive: Working Memory	Cognitive: Spatial cognition	Cognitive: Dynamic /selective attention	Cognitive: Phonemic/semantic fluency	Cognitive: Reasoning	Cognitive: Numeracy and representational fluency	Sensory: Vision	Sensory: Visual acuity/accommodation	Sensory: Color Vision	Sensory: Contrast detection	Sensory: Dark adaptation	Sensory: Glare	Sensory: Audition	Sensory: Auditory acuity	Sensory: Touch sensation	Motivation: Trust in own ability	Motivation: Efficiency in seeing benefits	Motivation: Techno literacy	Motivation: Health literacy	Motivation: Self confidence in using wearable	Motivation: Shift in responsibilities from provider to patient not preferred	Motivation: Integration of activities during daily activities	Environmental: Social factors	Environmental: Cost of medication adherence technologies	Environmental: Home environment
ManageMed Screening (MMS)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓							✓	✓		✓						
Self-medication Risk Assessment Tool (RAT)		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓								✓	✓								
Cognitive Screen for Medication Self-Management (CSMS)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										✓						
Medication Management Ability Assessment (MMAA)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓														✓		
Self-medication Assessment Tool (SMAT)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓										✓		
HOME-Rx revised		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										✓									✓
Medication Management Instrument for Deficiencies in the Elderly (MedMaIDE)		✓	✓	✓	✓	✓	✓	✓		✓	✓													✓				✓		
Show Back		✓	✓	✓	✓	✓	✓	✓																✓						
MedTake test	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓													✓						
HOME-Rx		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										✓									
Hopkins Medication Schedule (HMS)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓													✓						
Performance Assessment of Self-care Skills (PASS-IADL)						✓	✓	✓				✓						✓						✓						
Drug Regimen Unassisted Grading Scale (DRUGS)					✓	✓	✓	✓	✓	✓	✓																			
Short Test of Functional Health Literacy in Adults (S-TOFHLA)						✓		✓	✓															✓						
Test of Functional Health Literacy in Adults-Revised (TOFHLA-R)						✓					✓													✓						
Comprehensive Health Activities Scale (CHAS)						✓	✓	✓		✓	✓												✓	✓						
Functional, Communicative and Critical Health Literacy scale (FCCHL)						✓	✓	✓		✓	✓											✓		✓						
Long-Term Medication Behavior Self-Efficacy Scale (LTMBSES)																					✓						✓	✓		
Self-efficacy for appropriate medication use scale (SEAMS)																					✓			✓		✓		✓		

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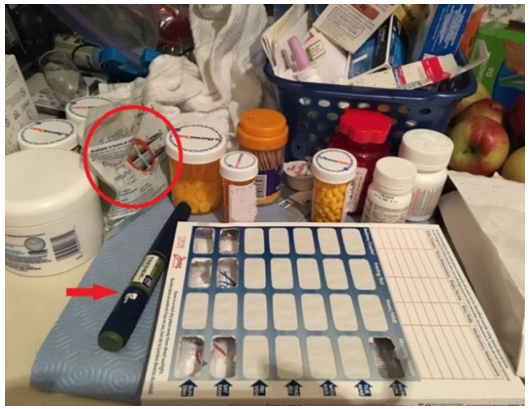
Medication Organization and Taking Behaviour

…medication organization and medication taking-behaviours at home

2

In-home medication management by older adults: a modified ethnography study using digital photography walkabouts

Sadaf Faisal[1], Jessica Ivo[1], Colleen McMillan[3,4], Kelly Grindrod[1], Tejal Patel[1,2,3]



Faisal S et al. Age and Ageing 2022; 55: 1 - 11

Classification of Medication Adherence Products Based on Characteristics

…identifying and classifying types of technology available to support medication taking at home

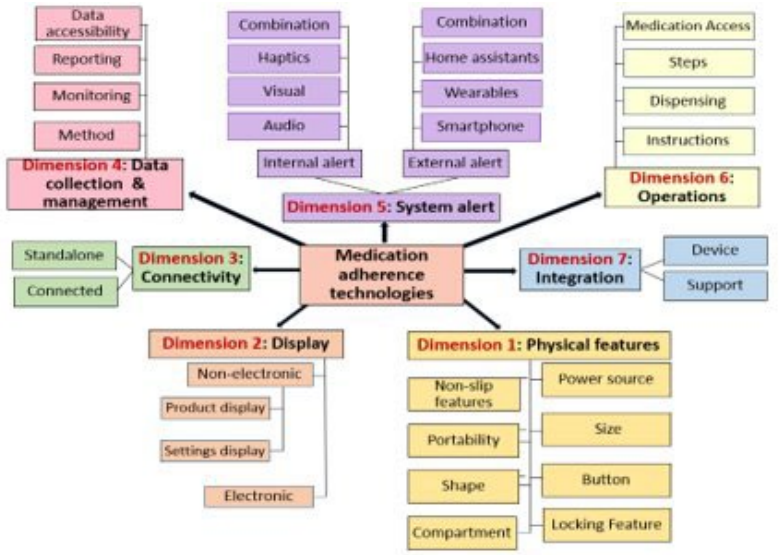
3 and 4

A review of features and characteristics of smart medication adherence products

Sadaf Faisal, BPharm, BCGP; Jessica Ivo, BSc; Tejal Patel, PharmD

Literature review (published and grey)

- Automated/"smart" in-home medication dispensing/adherence technology.
  - Real-time monitoring and reporting of drug intake behaviour
  - 110 available products worldwide; 77 commercially available, 33 prototypes
  - 23 marketed in Canada



Faisal S et al. CPJ 2021; 154: 312 - 323
Treskes RW et.al. *Expert Rev Med Devices*. 2018;15(2):119-126.
Granger BB, Bosworth HB. *Curr Opin Cardiol.* 2011;26(4):279-287.

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User Experience with Medication Adherence Technology

…which assistive devices are appropriate for patient-specific challenges

5

Review Article

The Usability, Acceptability, and Functionality of Smart Oral Multidose Dispensing Systems for Medication Adherence: A Scoping Review

Journal of Pharmacy Practice
1-14
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Sadaf Faisal, B Pharm, BCGP[1], Jessica Ivo, BSc[1], Catherine Lee, BSc[1], Caitlin Carter, MLIS[1], and Tejal Patel, Pharm D[1,2]

JMIR FORMATIVE RESEARCH Patel et al

Original Paper

An In-Home Medication Dispensing System to Support Medication Adherence for Patients With Chronic Conditions in the Community Setting: Prospective Observational Pilot Study

Tejal Patel[1,2], PharmD; Jessica Ivo[1], MHI; Teresa Pitre[3], BSc, BScPharm; Sadaf Faisal[1], BPharm, PhD; Kristen Antunes[4], BSP; Kasumi Oda[4], BSc

JOURNAL OF MEDICAL INTERNET RESEARCH Patel et al

Original Paper

A Prospective Study of Usability and Workload of Electronic Medication Adherence Products by Older Adults, Caregivers, and Health Care Providers

Tejal Patel[1,2,3,4], PharmD; Jessica Ivo[1], BSc; Sadaf Faisal[1], BPharm; Aidan McDougall[2], BSc; Jillian Carducci[2], PharmD; Sarah Pritchard[2], MScOT; Feng Chang[1], PharmD

Article

Implementation of a Real-Time Medication Intake Monitoring Technology Intervention in Community Pharmacy Settings: A Mixed-Method Pilot Study

Sadaf Faisal [1], Jessica Ivo [1], Ryan Tennant [2], Kelsey-Ann Prior [1], Kelly Grindrod [1], Colleen McMillan [3] and Tejal Patel [1,4,*]

RESEARCH ARTICLE

Integration of a smart multidose blister package for medication intake: A mixed method ethnographic informed study of older adults with chronic diseases

Sadaf Faisal[1], Jessica Ivo[1], Ryan Tennant[2], Kelsey-Ann Prior[1], Kelly Grindrod[1], Colleen McMillan[3,4], Tejal Patel[1,3,5]*

JOURNAL OF MEDICAL INTERNET RESEARCH Faisal et al

Original Paper

Stakeholder Feedback of Electronic Medication Adherence Products: Qualitative Analysis

Sadaf Faisal[1], BPharm; Jessica Ivo[1], BSc; Aidan McDougall[2], BSc; Tejal Patel[1,2,3], PharmD

Faisal S et al. J Pharm Prac 2020; 1:14
Faisal S et al. PLOS One 2022; 17(1): e0262012
Patel T et al. JMIR 2020; 22: 618073
Faisal S et al. Pharmacy 2021; 9:105
Faisal S et al. JMIR 2020; 22(12); e18074
Patel T et al. JMIR Formative Res 2022; 6(5):e34906

T. Patel, PharmD uW SoP

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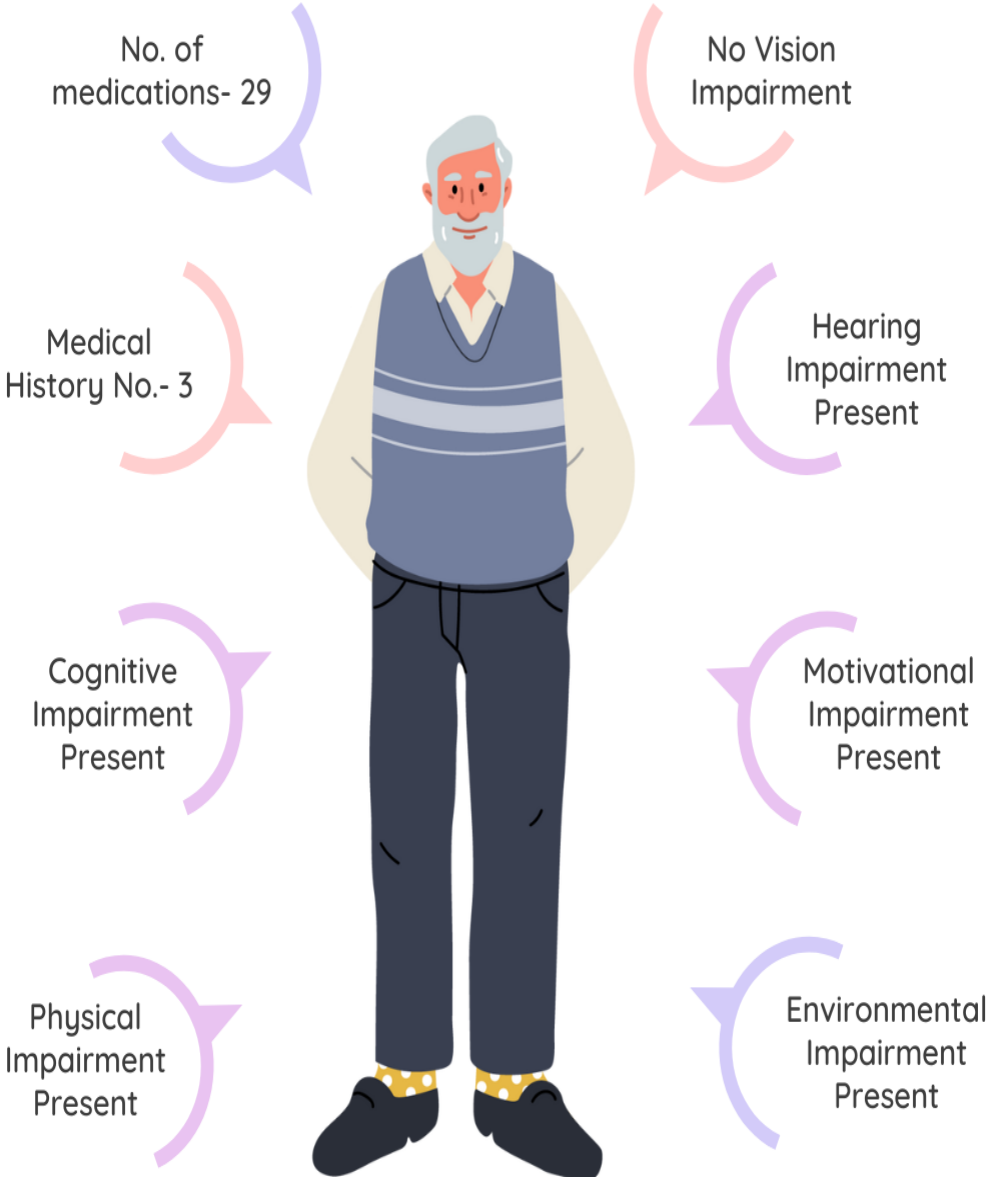

Subtasks with High Probability of Success	
92 %	Align and insert cartridge into the designated slot
90 %	Enter/type any data in an app/screen
88 %	Pull the blister packs away from the device
88 %	Pinch number printed on card and pull out
87 %	Grab/hold the device

Subtasks with Low Probability of Success	
53 %	Press and hold a button on a device
52 %	Tear the package
50 %	Slide a tab/button
44 %	Press and rotate the lid
38 %	Align connectors to one another and gently push card into the device

…to develop a decision guide to best match medication adherence technology to ability/capacity of older adult

Development of a clinician guide for electronic medication adherence products in older adults

Tejal Patel, PharmD; Jessica Ivo, BSc; Aidan McDougall, BSc; Catherine Lee, BSc; Feng Chang, PharmD; Jillian Bauer, PharmD; Sarah Pritchard, MScOT

	Device Name	Maximum Number of Alarms	Compartments Once Daily Regimen	Compartments 2x Daily Regimen	Compartments 3x Daily Regimen	Compartments 4x Daily Regimen	Price of Device (USD)	Monthly Subscription	Allows for Personalization	Locking Feature	Average Time to Set Device	Number of Steps to Set Device	Unassisted Completion	Average Usability	Average Workload
Automatic Pill Dispenser	GMS Med-e-lert Automatic Pill Dispenser	6	28	14	7*	7	$$$	No	No	Yes	17:30	18	13%		
	LiveFine Automatic Pill Dispenser and Reminder	6	28	14	7*	7	$$$	No	No	Yes	18:30	18	25%		
	MedReady 1700 Automated Medication Dispenser	4	28	14	7*	7	$$$$	No	No	Yes	26:30	16	50%		
	MedSmart Med-Reminder and Dispensing System	6	29	14	7*	7	$$$$	No	Yes	Yes	25:30	20	33%		
	e-pill MedTime Station Automatic Pill Dispenser with Tipper	6	28	14	7*	7	$$$$	No	No	Yes	31:00	17	25%		
Clock Cap	TimerCap Travel Size	N/A	1	∞	∞	∞	$	No	Yes	No	5:30	5	100%		
	TimerCap Universal Size	N/A	1	∞	∞	∞	$	No	Yes	No	5:30	5	100%		
eBlister Pack	Jones Medication Adherence System	∞	14	7	N/A	N/A	N/A	Yes	Yes	No	15:30	13	29%		
Pill Box with Alarm	Reizen Vibrating Pill Box	5	5	2	1	1	$	No	Yes	No	15:30	10	67%		
	VitaCarry Advanced Pill Case	7	7	3	2	1	$$	No	Yes	No	15:00	10	67%		
	Nishiki Round Pill Box with Alarm	5	7	3	2	1	$	No	Yes	No	15:00	10	67%		
	MedGlider System 1 with Talking Reminder	4	4	2	1	1	$$	No	Yes	No	16:30	11	90%		
	Patterson Medical TabTime Super 8	8	8	4	2	2	$$	No	Yes	No	12:30	12	44%		
	100-Hour Pill Reminder	∞	3	1	1	N/A	$	No	Yes	No	9:30	10	89%		
	MedQ Smart PillBox	2	14	7	N/A	N/A	$$$	No	Yes	No	12:30	12	70%		
	e-pill MedGlider Home Medication Management System	4	7	7	7	7	$$$	No	Yes	No	10:00	14	78%		
	MedCentre System	4	30	30	30	30	$$$	No	Yes	No	16:30	8	38%		
	eNNOVEA Weekly Planner with Advanced Auto Reminder	4	14	14	14	14	$$$	No	Yes	No	15:30	14	63%		
	e-pill Multi-Alarm Pocket XL	37	7	3	2	1	$$	No	Yes	No	11:30	12	56%		
	6 Grid Pill Storage Case with Alarm	5	6	3	2	1	$	No	Yes	No	15:30	12	44%		
Reminder Alarm	Itzbeen Pocket Doctor	4	0	0	0	0	$	No	Yes	No	15:00	17	11%		
	e-pill Accutab Weekly Pill Dispenser	N/A	7	7	7	N/A	$$	No	No	No	9:00	5	33%		

* Value has been rounded down to the nearest week
∞ No restrictions to the amount of times a device can perform a particular task
* Device was advertised as an electronic product; however, it does not have any electronic components.
N/A: Not Applicable

Electronic Medication Adherence Product Decision Aid — About Us

Background

Making the right decision is important when it comes to medication adherence technologies. Whether it's a weekly pill organizer, an alarm system or an automated dispenser, a medication adherence device helps you stay on track with your medications.
This decision aid is designed to help users navigate their abilities & personal preferences to identify suitable features of such products.

Read

Upload Data

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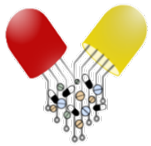

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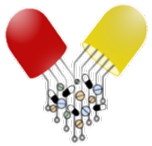
Ongoing and Future Studies…



Ongoing

- Decision aid development, validation and evaluation
- Caregiver burden

Future

- Cost/subscription prices/cost effectiveness
- Real-time monitoring
  - Who (caregivers, physicians?, pharmacists?)
  - How to respond to concerns
  - When to monitor
- Pharmacist integration
- Decision Aid
- Examine impact on adherence and health outcomes

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Barriers to Use of Medication Management Technology

- Older Adults
  - Usability, learnability, familiarity
  - Confidence
  - Trust/reliability
  - Changing medication management capacity over time and age
  - Caregiver/family Support
  - Design of device

- Healthcare Professionals
  - Measuring capacity limitations
  - Determining most optimal device
  - Pharmacy operations and buy-in
  - Reliability
  - Monitoring
  - Payment
  - Legal obligations
  - Measuring adherence

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