Traditional and New Technologies for Medication Adherence: Can Smartphones Help In Transitions of Care?

Seth Heldenbrand, Pharm.D.
Associate Professor
University of Arkansas for Medical Sciences
Disclosure

• Financial disclosures
  – I have no financial conflicts to disclose

Affiliation disclosures
  – www.medappfinder.com

Semantics disclosures
  – Transitions of care…
Objectives

1. Summarize adherence terminology/epidemiology
2. Identify risk factors for non-adherence and tools to measure it
3. Evaluate traditional methods used to improve/monitor medication adherence
4. Review current and emerging technologies for improving/monitoring medication adherence
5. Discuss how to incorporate using technology to improve health-system pharmacists address non-adherence
Definition of Adherence

• Compliance
  – “the extent to which a patient’s behavior matches the prescriber’s recommendation”

• Adherence
  – “the extent to which the patient’s behavior matches the agreed upon prescriber’s recommendation”

So What Is Adherence?

• “the extent to which a person’s behavior corresponds with agreed recommendations from a health care provider.”
  – taking medication, following a diet, appointments, and/or executing lifestyle changes

WHO 2003: Adherence to long-term therapies.
Medication Adherence

- Adherence for chronic diseases averages – 50%

www.pharmsolutions.org
WHO and Adherence

• Poor adherence grows with disease burden
• Improving adherence improves
  – health outcomes
  – patients’ safety
• Health systems must evolve to meet these challenges

WHO 2003: Adherence to long-term therapies.
NA In the U.S.

- Adversely affects health
- Negative impact on relationship with health care provider
- Skew results of clinical trials
- Increases health resource consumption
Epidemiology of NA

• General population
  – 33-69% of medication related hospitalizations
  – $100 billion annually
  – Adherence to chronic medications is approximately 50%

Measurement of Adherence

• Direct
  – Observation of ingestion
    • Physical or electronic

• Indirect
  – Patient self-reports
  – Pill counts
  – Refill rates
  – Blood monitoring
  – Electronic monitoring

What are the drawbacks to these indirect methods?
Types of NA

• Intentional
  – Rational decision
    • Beliefs/feelings/economic

• Unintentional
  – Intending to take the medication
    • Forgetfulness
    • Carelessness
    • Unexpected financial burdens

Risk Factors for NA

- History of NA
- Psychiatric illness
- Personality disorders
- Substance abuse
- Chronic illness
- Physician communication
- Illiteracy
- Low self efficacy

- Side effects
- Cost
- Complex regimen
- Poor aftercare/discharge
- Negative beliefs in medications
- Socioeconomic status
- History of abuse
- Race/culture

Methods to Improve Adherence

- Behavioral
  - Reminder systems

- Educational
  - Counseling reinforcement

- Organizational
  - Decreasing regimen complexity

- Removing barriers
  - $$$
  - Patient beliefs

Medication Adherence Aids

• Traditional
  – For unintentional NA
    • Pill boxes, unit-of-use packaging, alarms
  – Minimally involves patient in the process
  – Provide no adherence data
  – Many are passive systems

Behavioral Interventions

• Patient counseling/education
  – Most effective method to improve adherence
    • Especially for those taking more than six medications

• Emotional intelligence

• Motivational interviewing

New and Emerging Adherence Technologies

• Mobile Adherence Applications “Apps”
• Internet-connected adherence monitoring technologies
• Electronic and biometric ingestion confirming technologies

Improving Adherence In Your Patients

1. NA is multifactorial
2. Interventions should be customized for each patient and pattern of NA
3. Foundation should be educational and behavior modifying
4. Multiple approaches should be used simultaneously
Traditional Adherence Tools
Traditional Adherence Tools

1. Counseling/Education
2. Regimen books “black books”
3. Regimen print outs
4. Administration check lists
5. Pill boxes (and other pill reminder tools)
Counseling/Education

• Most effective method to improve adherence
• Time intensive
• Health literacy concerns
• Pharmacist role
“Black Books”

1. Contact info
2. Brand/Generic
3. Each med is a card
4. Pencil
5. Patient’s responsibility
Medication Regimens

www.medactionplan.com

<table>
<thead>
<tr>
<th>Take These Medications</th>
<th>At These Times</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9am</td>
<td>3pm</td>
</tr>
<tr>
<td>Prograf® (Tacrolimus) 1mg Capsule(s)</td>
<td>3 Capsule(s)</td>
<td>3 Capsule(s)</td>
</tr>
<tr>
<td>CellCept® (Mycophenolate mofetil) 250 mg Capsule(s) By mouth</td>
<td>4 Capsule(s)</td>
<td>4 Capsule(s)</td>
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<tr>
<td>Prednisone 5mg Tablet(s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valcyte® (Valganciclovir Hydrochloride) 450 mg Tablet(s) By mouth</td>
<td>1 Tablet(s)</td>
<td>1 Tablet(s)</td>
</tr>
<tr>
<td>Bactrim® (Sulfamethoxazole; Trimethoprim) SS = 400mg/80mg Tablet(s)</td>
<td></td>
<td></td>
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<tr>
<td>Nystatin 100,000 units/mL</td>
<td>5 mL(s)</td>
<td>5 mL(s)</td>
</tr>
<tr>
<td>Metoprolol Tartrate 50 mg Tablet(s) By mouth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Brand and generic names
2. Pictures of the meds
3. Drug, strength, dose, time
4. Contact information

7/2/2013 2:06:00 PM
Revised by: Seth Heldenbrand
Administration Checklists

- Continues inpatient administration procedure as an outpatient
- Not for every patient
- “Type A” comes to mind…

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<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Time</th>
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<tr>
<td>Prograf® (Ticagrelor) 1 mg</td>
<td>3 Capsule(s)</td>
<td>9 am</td>
</tr>
<tr>
<td>CellCept® (Mycophenolate mofetil) 250 mg</td>
<td>4 Capsule(s)</td>
<td>9 pm</td>
</tr>
<tr>
<td>Prednisone 5 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valcyte® (Valganciclovir) 450 mg</td>
<td>1 Tablet(s)</td>
<td>9 am</td>
</tr>
<tr>
<td>Bacitracin® (Sulfamethoxazole; Trimethoprim) SS = 400mg/80mg</td>
<td>Take one tablet every Monday, Wednesday, and Friday x 1 year</td>
<td></td>
</tr>
<tr>
<td>Nystatin 100,000 units/ml</td>
<td>5 mL</td>
<td>9 am</td>
</tr>
<tr>
<td></td>
<td>5 mL</td>
<td>3 pm</td>
</tr>
<tr>
<td></td>
<td>5 mL</td>
<td>9 pm</td>
</tr>
</tbody>
</table>
Traditional Reminders

1. Daily pillbox ($2.49)
2. Weekly pillboxes ($11.24)
3. Electronic pillboxes ($13.99)
4. Wearable digital reminder alarms ($139.95)
Other Adherence Tools

1. Multi-Alarm Pocket ($39.95)
2. Multi-Alarm TimeCap ($29.95)
3. MEDglider 4 Alarm Pillbox ($45.95)
4. CompuMed Automated Dispenser ($895)
Mobile Adherence Technologies
“Apps”
Smartphone medication adherence apps: Potential benefits to patients and providers

Lindsey Dayer, Seth Heldenbrand, Paul Anderson, Paul O. Gubbins, and Bradley C. Martin

Abstract

Objectives: To provide an overview of medication adherence, discuss the potential for smartphone medication adherence applications (adherence apps) to improve medication nonadherence, evaluate features of adherence apps across operating systems (OSs), and identify future opportunities and barriers facing adherence apps.

Practice description: Medication nonadherence is a common, complex, and costly problem that contributes to poor treatment outcomes and con-
Adherence Apps

- Using a smartphone to improve adherence is still a novel approach
  1. Consolidates health information onto one ubiquitous device
  2. Little to no cost to the patient
  3. Simplifies complex regimens
  4. Literature on health and wellness is growing
  5. Adherence data is lacking (although some promising results)

2015 App Study Methods

• Inclusion
  – iOS, Android, Blackberry, Windows
  – English language
  – Designed to generate medication reminders

• Exclusion
  – Designed for one medication type
  – Designed single disease state
  – Lacked description of functionality
2015 App Study
Valuable App Attributes

• Online data entry
• Complex instruction
• Cloud storage
• Med database
• Sync/export/print data
• Tracks doses
• Provider can input

• Multi-platform app
• HIPAA compliant
• Multiple profile
• Multilingual
• Medical social networking
• Health literacy
App Study Results

• Initial scoring from developer descriptions
• Apps user-tested on all platforms
  – 2012: 160 apps (10 tested)
  – 2014: 461 apps (77 tested)
  – 2015: 824 apps (100 tested)
Growth of Adherence Apps by Year

- **2012**: 160 Reviewed, 10 Tested
- **2014**: 461 Reviewed, 77 Tested
- **2015**: 824 Reviewed, 100 Tested

**Reviewed** vs **Tested**

[College of Pharmacy, University of Arkansas for Medical Sciences]
Changes in the Online Marketplaces

- Android
- Blackberry
- iOS
- Windows

<table>
<thead>
<tr>
<th>Year</th>
<th>Android</th>
<th>Blackberry</th>
<th>iOS</th>
<th>Windows</th>
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<tr>
<td>2012</td>
<td>84</td>
<td>15</td>
<td>61</td>
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<td>2014</td>
<td>165</td>
<td>22</td>
<td>180</td>
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<tr>
<td>2015</td>
<td>305</td>
<td>36</td>
<td>378</td>
<td>105</td>
</tr>
</tbody>
</table>
App Marketplace Changes

• What have we learned about the changes in the app marketplaces?
  – Blackberry is dead
  – Explosion in app offerings
  – Extreme variability in quality and functionality
  – It is not always easy locating quality apps when directed by initial search term
Selecting the right app

• Medication Adherence App Website
  – Lets patient or provider select desired functions
  – Ranks apps by our features/testing formula by desired features
  – Eliminates the trial and error approach to medication adherence apps that exists now
Let your phone remind you to take your medications!

This website will help you find the best medication reminder/adherence app available for download from the iTunes or Google Play online stores. Scroll down for our Top 10 apps overall, or click one of the green buttons for more detailed search options.

Top Ten Medication Reminder Apps

<table>
<thead>
<tr>
<th>App Name</th>
<th>Apple</th>
<th>Android</th>
<th>Overall Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medisafe</td>
<td>X</td>
<td>X</td>
<td>★★★★★</td>
</tr>
<tr>
<td></td>
<td><a href="#">App Store</a></td>
<td><a href="#">Google Play</a></td>
<td></td>
</tr>
<tr>
<td>MyMeds</td>
<td>X</td>
<td>X</td>
<td>★★★★★</td>
</tr>
<tr>
<td></td>
<td><a href="#">App Store</a></td>
<td><a href="#">Google Play</a></td>
<td></td>
</tr>
<tr>
<td>Care4Today</td>
<td>X</td>
<td>X</td>
<td>★★★★★</td>
</tr>
<tr>
<td></td>
<td><a href="#">App Store</a></td>
<td><a href="#">Google Play</a></td>
<td></td>
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</tbody>
</table>
Medication Reminder App Search

Check the features you would like on your medication reminder app from the list below. Results will be shown on the right.

<table>
<thead>
<tr>
<th>Features</th>
<th>Results</th>
</tr>
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<tbody>
<tr>
<td>Free App</td>
<td><strong>App Name</strong></td>
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<tr>
<td></td>
<td><strong>Apple</strong></td>
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<tr>
<td></td>
<td>Medisafe</td>
</tr>
<tr>
<td></td>
<td>Get at App Store</td>
</tr>
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<td></td>
<td>Care4Today</td>
</tr>
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<td>Get at App Store</td>
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<td>Mango Health</td>
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<td>Get at App Store</td>
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<td>Walgreens</td>
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<td></td>
<td>Get at App Store</td>
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<td></td>
<td>TRxC (Beta)</td>
</tr>
<tr>
<td></td>
<td>Get at App Store</td>
</tr>
<tr>
<td></td>
<td>FZ Pill Reminder</td>
</tr>
</tbody>
</table>
Can Smartphone Apps Help Patients With Transitions of Care?

- EMR integration (www.medactionplan.com)
- Discharge instructions
- Medication regimens
- Medication reminders
- Rx Refills
- Medical Social Networking
- Adherence monitoring
What if your patient does not have a smartphone?
Adherence strategies for someone who can’t use apps

• Dumbphones
• Digital watches
• Sticky notes
• Pill boxes
• Social support systems
• Healthcare providers
Future Directions for Adherence
Apps
Future Directions for Apps

• Growing smartphone use (>60% in US)
  – 14-42% persons age 65 or older
• Companion websites for patients and providers
• Escalating reminder systems
• Tailored reminder systems
  – Motivating reminders
  – Less intrusive reminders for the adherent patient
Future Directions for Apps

- Connectivity: Real-time adherence info
- Interconnectivity: synced hospital info, discharge instructions, pharmacy records
- Medical social networks: patient specified providers apps contact at NA thresholds
- Integration with ingestion sensor systems: the “holy grail” of adherence measurement
Available and Emerging Adherence Technologies
Connected Adherence Technologies
GlowCaps
www.glowcaps.com

- Cellular (AT&T)
- Caps communicate with base to track adherence
- Progressive reminders
  1. Light up (cap)
  2. Light up (base)
  3. Play ringtone
  4. Call/text patient
  5. Requests Rx refills
  6. Weekly adherence report
GlowCaps

- **Cost**
  - $10 per cap
  - $15 per month AT&T

- **Results**
  - Single study
    - Improved adherence from 71% to 98%
  - Other studies pending or unpublished
  - Current trials underway in transplant recipients
• 6 month study randomized (nearing completion and publication hopefully)
• Once a day meds for HTN
• 27% increase in adherence over the control group (early results)
• Funded by GlowCaps
Similar Electronic Cap Technologies

• eCAP
  – Beeps and flashes
  – RFID communication

• MEMS 6 TrackCap
  – Records
    • bottle openings
    • uploads via reader
MedMinder
www.medminder.com

• 7 day pill box
  – Cellular connectivity
• Lights up and beeps when a dose is due
• Central database records adherence
• Missed doses trigger calls, texts, email
• Social involvement (MD, caregiver, etc)
MedMinder
www.medminder.com

• Cost
  – No upfront costs
  – $39.99 per month (base unit)
  – $44.99 per month (base unit with med alert)
  – $64.95 per month (deluxe lockable unit)

• Results?
  – Customer testimonials only
Cerepak
www.meadwestvaco.com

- RFID chip and sensor
  - Records when pills are punched out
  - Transmits data to CPU and uploads to centralized database
- Reminders: lights up, plays sounds, and vibrates
- Has buttons for patient responses or questions
- Marked towards clinical trials and industry
- Cost: $75 per package; $250 for reader
Technologies for the Visually Impaired

• ScripTalk
  – RFID Rx adhesive tag
  – Pharmacy programs label
  – When placed on the base
  • Reads
    – Drug
    – Strength
    – Dose
    – Frequency
    – Warnings/precautions

www.envisionamerica.com
Technologies for the Visually Impaired

- ScripView
  - Large “flagged” Rx label
  - Booklet-style
  - Large print
  - 2D barcode (QR code)
    - Audible instructions via smartphone
  - Elderly/low vision patients

www.envisionamerica.com

Technologies for the Visually Impaired
Technologies for the Visually Impaired

• BRL
  – Braille Rx labels
  – Embossed Rx data
  – Clear adhesive applied over the Rx label
  – Rx verification friendly for pharmacists
Emerging Technologies

- Proteus Biomedical
  - Recently FDA approved
  - Ingestible chip
  - Battery activates when swallowed
  - Uses human conductivity to transmit RFID ingestion signal to skin sensor worn by patient
  - Sensor forwards ingestions data to mobile device
  - Mobile device forwards to central adherence database
  - FDA approved Abilify (aripiprazole 9/11/2015)
Other Technologies

- **MagneTrace**
  - Not FDA approved
  - Magnet attached to medication
  - Electromagnetic sensors record when the pill is ingested
  - Transmits data to mobile device and central database
  - Also reminds patients of missed doses
Other Available and Future Technologies

• Pill Pets -- electronic dog that reminds you to take your meds
• eCAP – RFID pill bottle cap
• Tatteltale Pill – alerts caregivers when you miss a dose
Addressing Health-System Non-adherence
WHO Changing How We See Adherence

- Support your patients... don’t blame them
- Nonadherence is multifactorial
  - Social, economic, health care team/system, disease, therapies, patient-related factors
- Patient-tailored interventions are required
  - No silver bullet....
- Adherence is dynamic
  - Requires follow up and encouragement
- HCP need training in adherence
- Multidisciplinary approach to adherence is needed

WHO 2003: Adherence to long-term therapies.
Counseling/Education

• Most effective method to improve adherence
• Time intensive
• Health literacy concerns
  – Communication skills (YOURS and theirs)
  – Knowledge of health topics (YOURS and theirs)
  – Culture
  – Barriers to health system/care
  – Education in non-health areas (reading, math, general education level)
Clear Communication

1. Warm greeting
2. Eye contact
3. Plain, non-medical language
4. Slow down
5. Limit content (3-5 points)
6. Repeat key points
7. Graphics (when applicable)
8. Patient participation
9. Teach-back

WHO 2003: Adherence to long-term therapies.
Teach-back Method

• What percentage of medical information is forgotten immediately?
  – 40-80%

• What percentage of information retained is incorrect?
  – Almost 50%

• Teach-back involves asking the patient to repeat what you have just told them.

• Repeat the process until they get it right.

• Confirms patient understanding of instructions.

WHO 2003: Adherence to long-term therapies.
Teach-back Method

- Not a test of the patient knowledge
- Use with everyone
- Should be used by all medical staff

WHO 2003: Adherence to long-term therapies.
Follow-up With Patients Improves Adherence

- Monitoring health (BP, blood sugar, weight)
- Reinforcing action plans
- Assessing/Confirming adherence
- Verifying follow-through on referrals
- Communicating lab results

Adherence Conclusions

- Patient education is still the most effective method
- Physical tools (pillboxes) do improve adherence
- Passive electronic technologies MAY improve adherence
- Smartphone apps offer a new promising tool
- Pill ingestion technologies are the “Holy grail”
- Multi-faceted approach is a MUST
- Customize to the patient
References

1. AHRQ Health Literacy Universal Precautions Toolkit www.ahrq.gov
5. www.medactionplan.com
6. www.envisionamerica.com
7. www.medisafeproject.com
Thank you!
Questions?