Real-Time Electronic Diary Reports of
Cue Exposure, Mood, and Drug Use

Kenzie L. Preston, Ph.D.¹
David H. Epstein, Ph.D.¹
Karran Phillips, M.D.¹
Massoud Vahabzadeh, Ph.D.¹
Jia-Ling Lin, Ph.D.¹
Mustapha Mezghanni, M.S.²

¹ DHHS, National Institutes of Health, National Institute on Drug Abuse, Intramural Research Program, ² Johns Hopkins Bayview Medical Center, Baltimore, MD

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Ecological Momentary Assessment - EMA -

- Participants report their moods and behaviors in their daily environments using ELECTRONIC DIARIES (EDs).

- EMA in substance dependence may be valuable for:
  - Prospectively assess the process and precipitants of cravings and use.
  - Assess exposure to psychosocial stress.
  - Distinguish subtypes of relapse - stress-induced, cue-induced.
Real-Time Self Report

PDAs have EMA software with normal features locked out.

Security Features:
- Password protected.
- No link between stored data and questions.

Other Features:
- Demo option to show friends.
- Can briefly suspend random prompts.

Palm Z22
- Cost approx. $100
- Size: 10.3 x 6.9 x 1.3 cm
- Flash memory
- Beep only (no vibrate mode)
- Battery life acceptable

Main screen

Set random prompts

Sample question
Trial Design

- Designed to assess natural history of craving and lapse against a background of methadone maintenance.
- Event-Contingent Entries - activate the ED whenever they used, or were tempted to use, cocaine or heroin.
- Random Time Sampling - prompted by the ED to answer questions at random times during their waking hours (to assess base rates of stress, cue exposure, etc.).
- Comparison data: urine screen results; DSM-IV symptoms of drug abuse and dependence.
EMA Questions

- **Random Prompt Entries**
  - Where are you?
  - Whom are you with?
  - What are you doing?
  - Rate mood
  - Rate craving
  - Exposure to 23 different cues in the past hour.

- **Event Contingent**
  - What happened? (Craved or Used)
  - Which drugs were involved? (heroin, cocaine or both)
  - I think it happened because
Population and Study Site Characteristics

Participants
Treatment seeking heroin users who also use other drugs (cocaine)
60% African American; 70% male
Average age about 40 years
Average education through grade 11
Employment: 1/3 full time, 1/3 part time, 1/3 unemployed

Archway Clinic
Standard treatment: opiate agonist maintenance
& weekly individual counseling
Observed urine collection and self-reported drug use 3 times weekly
Study duration: 6-10 months
Retention in study >80%
Feasibility

- **226 PDAs** were issued - 71 reused for multiple participants
- **114 participants** carried PDAs for a total of **14,918 person-days** (mean 130.9 days/pt, median 162.5, range 6-189)
- **PDA nonrecovery** - one for every 226 person-days of use.
- **Random prompts:**
  - Issued - 34,400, Answered - 26,969 (78%)
- **2,500 event-contingent entries** were initiated per participant - mean 22 (median 14.5, range 0-131) per day - mean 0.2 (median 0.1, range 0-2.2).
Acceptability in our Population

1. Questionnaire administered in clinic at end of study
2. Participants generally reported liking the EDs, sometimes finding them therapeutic, “like a journal,” despite the multiple-choice nature of most of the items.
3. The most common complaint was inaudibility of the random prompts.

**How Easy to Use?**
- Easy: 45%
- Very Easy: 55%

**Number of Beeps per day?**
- Just right: 90%
- A little too much: 5%
- Too much: 5%

1. Very easy
2. Easy
3. Difficult
4. Very difficult
1. Not enough
2. Just right
3. A little too much
4. Too much
Compliance with EMA in our population

Where Are You? At Clinic

With Whom? Clinic Staff or Patients
Real-Time Electronic Diary Reports of Cue Exposure and Mood in the Hours Before Cocaine and Heroin Craving and Use

David H. Epstein, PhD; Jessica Willner-Reid, BSc; Massoud Vahabzadeh, PhD; Mustapha Mezghanni, MS; Jia-Ling Lin, PhD; Kenzie L. Preston, PhD

Archives of General Psychiatry, 66, 88-94, 2009

(83 to 101 datapoints per bar)
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Seeing or being offered cocaine was associated with increasing likelihood of cocaine use.
Do behavior patterns differ during periods of cocaine abstinence versus use?

Random prompt data; N = 112
Abstinence Periods - at least 1 week of consecutive cocaine-negative urines
Using Cocaine Periods - at least 1 week of consecutive positive urines
Tobacco and Cocaine: Craving and Use

Tobacco Craving and Use

Cocaine Abstinence vs. Use

Tobacco and Cocaine

Figure 5a

• Cocaine Using
○ Cocaine Abstinent

Tobacco Smoking
Exposure to Psychosocial Stress and Illicit Substances

Real-time self-report *electronic diaries*

Real-time location *GPS*

Environmental Risk Measures

Exposure Algorithm

- Self report & Location
- Drug use
- Stress Event
- Time spent in high vs. low risk environments

- Crime
- Drugs
- Violence
- Socioeconomic Statistics from public and research databases
Feasibility - Real Time Location

- 29 participants enrolled, 27 received devices
- PDAs and GPS units carried for 2,775 person-days (mean 103 days/pt);
- 64 PDAs issued; 7 broken; nonrecovery: one for every 394 person-days. Random prompts: compliance (80%)
- 62 GPS units issued; 13 broken (largely due to recharging at home), 3 lost; GPS nonrecovery: one for every 173 person-days of use.

GPS - Usability/Acceptability

- How comfortable carrying GPS:
  - Extremely comfortable: 50%
  - Mostly comfortable: 41%
  - Somewhat comfortable: 9%

- How is the size of the GPS:
  - Right size: 95%
  - Too small: 5%
  - Too big: 0%
Density of GPS and EMA Entries

Participant Tracks

Approx 2700 tracks

All EMA Entries

8,000 EMA entries

Event Contingent Entries

360 EMA entries

27 participants; approx. 100 days each
Ecological Momentary Assessment
- EMA -

- Participants report their moods and behaviors in their daily environments using ELECTRONIC DIARIES (EDs).
- EDs in substance dependence may be valuable for:
  - Prospectively assess the process and precipitants of cravings and use.
  - Assess exposure to psychosocial stress.
  - Distinguish subtypes of relapse—stress-induced, cue-induced.
  - Monitor and enhance adherence to treatment.

PDAs to remind patients to complete homework assignments for Cognitive Behavioral Therapy (CBT).
Contingency Management

Behavioral treatment in which a target behavior is increased by providing non-drug reinforcers contingent upon a target behavior, such as drug abstinence or medication adherence.

Consecutive Doses of Naltrexone Taken

<table>
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<tr>
<th>Doses Taken</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
<th>11</th>
<th>13</th>
<th>15</th>
<th>17</th>
<th>19</th>
<th>21</th>
<th>23</th>
<th>25</th>
<th>27</th>
<th>29</th>
<th>31</th>
<th>33</th>
<th>35</th>
</tr>
</thead>
</table>
| Potential Earnings For Each Target Behavior Event | YOU HAVE TAKEN 5 CONSECUTIVE DOSES OF NALTREXONE TODAY'S DOSE ENTITLES KP 129088 TO $8.50 TOWARDS THE PURCHASE OF GOODS AND SERVICES. YOUR ACCOUNT BALANCE AS OF 2/24/2010 IS: $20.50 YOU HAVE EARNED: $37.50

Significantly increased naltrexone adherence

<table>
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<tr>
<th>Doses Taken</th>
<th>00</th>
<th>55</th>
<th>1010</th>
<th>1515</th>
<th>2020</th>
<th>2525</th>
<th>3030</th>
<th>3535</th>
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<tbody>
<tr>
<td>Mean Group</td>
<td>Contingent = 36</td>
<td>Noncontingent = 36</td>
<td>Control = 33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual Subject</td>
<td>Contingent = 36</td>
<td>Non-Contingent = 36</td>
<td>No Voucher = 30</td>
<td></td>
<td></td>
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</table>

* P<.05

**


Significantly increased treatment retention

<table>
<thead>
<tr>
<th>Study Visit</th>
<th>12121111101099887766554433221100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Week</td>
<td>% Patients Remaining In Treatment</td>
</tr>
</tbody>
</table>

NIDA IRP's Automated Contingency Management (ACM) System

- ACM
- Electronic Diary
- LDME
- AE
- MRV
- TQS
- RX
- CRM
- PWS
- DQE
- DSS
- NIDA IRP's Automated Contingency Management (ACM) System
An Internet-based abstinence reinforcement smoking cessation intervention in rural smokers

William W. Stoops\textsuperscript{a, b, *}, Jesse Dallery\textsuperscript{c, d}, Nell M. Fields\textsuperscript{a}, Paul A. Nuzzo\textsuperscript{a}, Nancy E. Schoenberg\textsuperscript{a}, Catherine A. Martin\textsuperscript{a, e}, Baretta Casey\textsuperscript{f}, Conrad J. Wong\textsuperscript{a, b, e}

\textsuperscript{a} University of Kentucky College of Medicine, Department of Behavioral Science, 140 Medical Behavioral Science Building, Lexington, KY 40536, United States
\textsuperscript{b} University of Kentucky, Center on Drug and Alcohol Research, 643 Maxwellton Court, Lexington, KY 40506, United States
\textsuperscript{c} University of Florida, Department of Psychology, Room 114, Psychology Building, Gainesville, FL 32611, United States
\textsuperscript{d} National Development Research Institutes, Center for Technology and Health, 71 West 23rd Street, 8th Floor, New York, NY 10010, United States
\textsuperscript{e} University of Kentucky College of Medicine, Department of Psychiatry, 3470 Blazer Parkway, Lexington, KY 40509, United States
\textsuperscript{f} University of Kentucky College of Medicine, Center for Excellence in Rural Health, 750 Morton Boulevard, Hazard, KY 41701, United States
Conclusions

- Illicit drug users in treatment are willing and able to carry PDAs.
- Illicit drug users in treatment can self-report on mood and behaviors in real time.
- Loss and breakage of electronic devices occur at a relatively low rate.
- Speculation:
  - Electronic devices may be a useful addition to contingency management for remotely monitoring and reinforcing medication adherence.
  - Location data may give additional information on:
    - environmental factors affecting adherence
    - placement of mobile health care services.
Individual Participant

GPS

EMA

GPS plus EMA Entries
Stress Questions - Event Contingent

166 entries from 11 (out of 16) participants

107 stressed, 19 overwhelmed, 19 anxious
8 stressed & other, 2 overwhelmed & anxious

23 conflict, 38 just thinking, 5 legal, 4 money, 10 health, 5 surroundings unsafe, 50 other (all but 2 filled blank; most family-related)

68 passing annoyance/hassle,
48 day spoiler;
41 more than day spoiler