Using geolocation data in serious mental illness phenotyping

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The Wearable Clinic launch event
05/07/2017
Digital phenotyping*

Why geolocation data to study serious mental illness (SMI)?

- Increasing Smartphone ownership in people living with SMI
- Passive monitoring of important disease indicators (i.e. mobility, rhythmicity and routines)
- Real-time monitoring, as opposed to infrequent visits and questionnaires

To what extent have these opportunities been explored?
Systematic review of the literature

Search on 16/5/2017:
(<smartphone> OR <geolocation>) AND
(<schizophrenia> OR <bipolar disorder>)

<table>
<thead>
<tr>
<th>Search Method</th>
<th>Records Screened (n=641)</th>
<th>Records Excluded (n=586)</th>
<th>Duplicates Removed (n=366)</th>
<th>Studies Included in Synthesis (n=22)</th>
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<tr>
<td>Medline search</td>
<td>(n=267)</td>
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<tr>
<td>PsycInfo search</td>
<td>(n=218)</td>
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<td>Scopus search</td>
<td>(n=522)</td>
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</table>

Full-text articles excluded (n=33):
- Not on SMI (2)
- Not measuring geolocation (18)
- Review (11)
- Other (2)
Preliminary findings

• 15 individual studies, with 6 being feasibility studies
• Mostly density-based methods to process the geolocation data
• Main metrics reported:
  – number of locations visited and distance travelled
  – time spent outdoor or specific location
  – cell tower movements
• Only two studies looking at more complex metrics (i.e. out-of-home behaviours and entropy of life)
• Seven studies reported clinical significance of the geolocation-derived metrics
Monitoring SMI: Social functioning

Withdrawal

Employment

Interpersonal functioning

Independence - performance

Pro-social activities

Independence - competence

Recreational activities
Feasibility study

Research question: To what extent is it feasible to collect the data necessary to validate algorithms inferring daily out-of-home activities?

Methods
• 21 healthy volunteers (7 male:14 female)
• Mix of personal and rental devices
• Measured 10 days over 4 weeks
• Completed feedback questionnaire
GPS Data

- Logging application
- Start on waking, end on sleeping
- Upload to secure server
- Valid if 10+ hours long
Activity diary

- Total time out of home
- Flowchart of activities
- Valid if time out of home clearly stated
## Total number of analysable days

<table>
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<th>GPS Data</th>
<th>Activity Diaries</th>
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<td></td>
<td>Valid</td>
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<td>48</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td>Invalid</td>
<td>24</td>
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<td>Total</td>
<td>138</td>
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</table>
Number of analysible days per participant

- Number of analysable days
Results from feedback questionnaires

- Complicated
  - Smartphone
  - Diary
- Time-consuming
  - Smartphone
  - Diary
- Intrusive
  - Smartphone
  - Diary

[Bar chart showing percentages for each category with different levels of agreement: Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree]
Conclusion

- More GPS files returned than activity diaries
- Smartphones found to be less bothersome
- Results suggest potential
- More studies needed, including participants with mental health issues
- Next step processing the data to infer out-of-home activities
Thanks for listening!