Methods to improve the efficiency of screening for multiple mental disorders

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Hierarchical screening

General psychological distress

Internalizing disorders
- Depression
- Anxiety
  - Social phobia
  - Generalized anxiety
  - Panic disorder

Externalizing disorders
- Alcohol abuse
- Substance abuse
- Adult ADHD
Hierarchical screening

Psychological distress (e.g. K6)

YES

NO

4 disorders, 26 items

GAD (GAD-7)
Depression (PHQ-9)
Social phobia (SOPHS-5)
Panic disorder (PHQPAN-5)

Finish
Hierarchical screening

First-phase screening approaches

1. No hierarchy (control)
2. K6 score
3. Psychological distress decision tree
4. Disorder-specific decision tree
5. Gating items
Method 1: No hierarchy (control)

- Depression (PHQ-9)
- GAD (GAD-7)
- Social phobia (SOPHS-5)
- Panic disorder (PHQ-Panic-5)
Method 2: K6 hierarchy

- **K6 score**
  - <5 → **STOP**
  - ≥5 → Full screen
    - Depression (PHQ-9)
    - GAD (GAD-7)
    - Social phobia (SOPHS-5)
    - Panic disorder (PHQ-Panic-5)
Method 3: Distress decision tree

- Choose distress items that best discriminate absence of disorder
- Subgroups least likely to have disorder escape further screening
- Chi-Square Automatic Interaction Detection (*treedisc* macro in SAS)
Method 3: Distress decision tree

Chi-Square Automatic Interaction Detection (CHAID)

• Divides the sample into subsamples with different risks of outcome
• Diagram with leaves and branches
• Categorical items
• Branching based on item that best differentiates on the basis of the outcome
• Smallest p-value from a chi-square statistic
Method 3: Distress decision tree

Chi-Square Automatic Interaction Detection (CHAID)

• Splitting stops when:
  - There is a small number of observations in a leaf (20 observations)
  - No split would result in a significant $\chi^2$ value ($\alpha = .2$)
  - A specified level of branching is reached (6 levels)
Method 3: Distress decision tree

MWBS9 (close to others)
- K18 (tense/shaky)
  - 2,3,4
  - 0,1
  - STOP (n=95)
  - FULL SCREEN

K11 (good mood)
- MWBS2 (useful)
- 3,4
- FULL SCREEN

K18 (tense/shaky)
- 0,1
- STOP (n=11)
- FULL SCREEN

K1 (so sad...)
- 0
- 1
- 2,3,4
- STOP (n=37)
- FULL SCREEN

MWBS11 (decisive)
- 4
- 0-3
- STOP (n=11)
- FULL SCREEN

K19 (angry)
- 0,1
- 2,3,4
- FULL SCREEN

K8 (restless)
- 0
- STOP (n=23)
- FULL SCREEN

K2 (nervous)
- 2,3,4
- STOP (n=10)
- FULL SCREEN

K7 (depressed)
- 1
- 3,4
- FULL SCREEN

K11 (good mood)
- 0
- 2,3,4
- FULL SCREEN

STOP (n=23)
- 0,1
- 2,3,4
- FULL SCREEN

STOP (n=95)
- 0,1
- 2,3,4
- FULL SCREEN

STOP (n=11)
- 0
- 1
- 2,3,4
- FULL SCREEN

STOP (n=37)
- 4
- 0-3
- FULL SCREEN

STOP (n=10)
- 0
- 2,3,4
- FULL SCREEN

STOP (n=14)
- 1-4
- 0
- FULL SCREEN
Method 4: Disorder decision tree

- **PHQ-2** (down/depressed)
  - 0
    - **SOCPH-4** (suffered social occasions)
      - 1,2
        - **GAD7-1** (nervous/anxious)
          - 0,1
            - **PHQPAN-1** (anxiety attack)
              - No
                - **STOP** (n=425)
              - Yes
                - **FULL SCREEN**
      - 3,4
        - **FULL SCREEN**
  - 1
    - **SOCPH-5** (social fear disruption)
      - 1
        - **GAD7-1** (nervous/anxious)
          - 0,1
            - **PHQ-1** (little interest)
              - Yes
                - **FULL SCREEN**
              - No
                - **GAD7-3** (worrying)
                  - 0,1
                    - **STOP** (n=52)
                  - 2,3
                    - **FULL SCREEN**
        - 3,4
          - **FULL SCREEN**
  - 2,3
    - **FULL SCREEN**

- **PHQPAN-1** (anxiety attack)
  - 2,3
    - **FULL SCREEN**
  - 0,1
    - **FULL SCREEN**
  - 2,3
    - **FULL SCREEN**
  - 0,1
    - **FULL SCREEN**
  - 2,3
    - **FULL SCREEN**
  - 0,1
    - **FULL SCREEN**
  - 2,3
    - **FULL SCREEN**
Method 5: Gating items

PHQ-9
Items 1 & 2

- PHQ1 ≥ 2 or PHQ2 ≥ 2
- PHQ1<2 and PHQ2<2

PHQ-9
Items 3-9

GAD-7
Item 1

GAD-7
Items 2-7

PHQ-panic
Item 1

- PHQ-panic Item 1 = “Yes”
- PHQ-panic Item 1 = “No”

PHQ-panic
Items 2-5

SOPHS
Item 1

- SOPHS1 ≤ 2
- SOPHS1 > 2

SOPHS
Items 2-5

END
Testing the hierarchies

• Efficiency
  – Mean number of items presented

• Precision
  – Sensitivity relative to control
Validation samples

- Two community-based samples
- $N_1 = 1360; N_2 = 668$
- Recruited through Facebook ads
- Australia-wide, 18+
Sample 2 (N=668)

- Age distribution:
  - 18-24: 10%
  - 25-29: 5%
  - 30-30: 20%
  - 40-49: 30%
  - 50-59: 25%
  - 60 and over: 10%
  - Refused: 0%

- Gender distribution:
  - Male: 50%
  - Female: 50%

- Location distribution:
  - Metropolitan: 40%
  - Regional: 30%
  - Rural: 20%
  - Remote: 5%
  - Refused: 5%
Samples: Psychopathology

N = 1360
None: 63%

MDD 25%
GAD 20%
SP 16%
PD 14%

N = 668
None: 53%

MDD 34%
GAD 26%
SP 7%
PD 22%

(Not to scale)
Results: Efficiency gains

Mean items presented

- No hierarchy: 22.0
- K6 hierarchy: 21.8
- Psychological distress items: 18.4
- Disorder-based items: 14.6
- Gating items: 11.8
Results: Projected efficiency gains

- No hierarchy: 22.0
- K6 hierarchy: 18.2
- Psychological distress items: 16.2
- Disorder-based items: 13.3
- Gating items: 10.1

Efficiency gains:
- 17%
- 26%
- 40%
- 54%
Results: Summary

Sensitivity

- No hierarchy: 90%
- K6 hierarchy: 95.7%
- Psychological distress items: 99.7%
- Disorder-based items: 99.9%
- Gating items: 100.0%
Results: Summary

- Two-phase hierarchical screening was efficient and precise
- Using gating items had most efficiency gain (up to 54%)
- Using decision trees also had large efficiency gains (up to 40%)
- K6 did not improve screening efficiency
Considerations

- The K6/K10 were designed to “rule in” not “rule out”
- Hierarchical screening works better for:
  - Low rates of psychopathology
  - Longer screening scales (60% fewer items)
- Tested with other disorders/outcomes
  - PTSD, adult ADHD, alcohol abuse, suicidality
Considerations

• Purpose of screening
• Brevity vs. need for data
• Ease of implementation vs. efficiency
  – Gating only works for scales with gated scoring criteria
  – Pencil and paper vs. computer-based
Future research: Adaptive screening

• Fully adaptive measures
  – Each response determines next item presented

• PROMIS measures
  – IRT-calibrated item banks
  – PROMIS-depression 5-item adaptive screener more precise than 20-item CES-D
Future research: Adaptive screening

Table 2. Calibrated Depression Items

<table>
<thead>
<tr>
<th>Item stem</th>
<th>Slope (discrimination)</th>
<th>Location threshold 1</th>
<th>Location threshold 2</th>
<th>Location threshold 3</th>
<th>Location threshold 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>I felt hopeless*</td>
<td>4.46</td>
<td>0.49</td>
<td>1.00</td>
<td>1.71</td>
<td>2.46</td>
</tr>
<tr>
<td>I felt depressed*</td>
<td>4.35</td>
<td>-0.19</td>
<td>0.53</td>
<td>1.36</td>
<td>2.20</td>
</tr>
<tr>
<td>I felt worthless*</td>
<td>4.27</td>
<td>0.33</td>
<td>0.90</td>
<td>1.62</td>
<td>2.37</td>
</tr>
<tr>
<td>I felt helpless*</td>
<td>4.15</td>
<td>0.29</td>
<td>0.84</td>
<td>1.61</td>
<td>2.40</td>
</tr>
<tr>
<td>I felt like a failure*</td>
<td>3.97</td>
<td>0.13</td>
<td>0.72</td>
<td>1.50</td>
<td>2.22</td>
</tr>
<tr>
<td>I felt that I had nothing to look forward to*</td>
<td>3.94</td>
<td>0.23</td>
<td>0.94</td>
<td>1.52</td>
<td>2.34</td>
</tr>
<tr>
<td>I felt that nothing could cheer me up</td>
<td>3.66</td>
<td>0.24</td>
<td>0.91</td>
<td>1.71</td>
<td>2.50</td>
</tr>
<tr>
<td>I felt unhappy*</td>
<td>3.49</td>
<td>-0.61</td>
<td>0.28</td>
<td>1.27</td>
<td>2.28</td>
</tr>
<tr>
<td>I felt sad*</td>
<td>3.28</td>
<td>-0.57</td>
<td>0.33</td>
<td>1.34</td>
<td>2.30</td>
</tr>
<tr>
<td>I felt that I wanted to give up on everything</td>
<td>3.24</td>
<td>0.39</td>
<td>0.96</td>
<td>1.76</td>
<td>2.44</td>
</tr>
<tr>
<td>I felt that my life was empty</td>
<td>3.19</td>
<td>0.13</td>
<td>0.71</td>
<td>1.45</td>
<td>2.25</td>
</tr>
<tr>
<td>I felt discouraged about the future</td>
<td>3.19</td>
<td>-0.33</td>
<td>0.33</td>
<td>1.23</td>
<td>2.06</td>
</tr>
<tr>
<td>I felt I had no reason for living</td>
<td>3.13</td>
<td>0.85</td>
<td>1.41</td>
<td>2.09</td>
<td>2.78</td>
</tr>
<tr>
<td>I found that things in my life were overwhelming</td>
<td>3.11</td>
<td>-0.03</td>
<td>0.65</td>
<td>1.57</td>
<td>2.40</td>
</tr>
<tr>
<td>I felt disappointed in myself</td>
<td>3.10</td>
<td>-0.43</td>
<td>0.34</td>
<td>1.33</td>
<td>2.15</td>
</tr>
<tr>
<td>I felt that I was not needed</td>
<td>2.92</td>
<td>0.13</td>
<td>0.82</td>
<td>1.58</td>
<td>2.46</td>
</tr>
<tr>
<td>I felt that nothing was interesting</td>
<td>2.84</td>
<td>0.07</td>
<td>0.83</td>
<td>1.77</td>
<td>2.80</td>
</tr>
<tr>
<td>I withdrew from other people</td>
<td>2.80</td>
<td>0.08</td>
<td>0.70</td>
<td>1.53</td>
<td>2.46</td>
</tr>
<tr>
<td>I felt that I was to blame for things</td>
<td>2.74</td>
<td>0.00</td>
<td>0.74</td>
<td>1.73</td>
<td>2.60</td>
</tr>
<tr>
<td>I felt emotionally exhausted</td>
<td>2.69</td>
<td>-0.37</td>
<td>0.35</td>
<td>1.29</td>
<td>2.23</td>
</tr>
<tr>
<td>I had trouble making decisions</td>
<td>2.62</td>
<td>-0.09</td>
<td>0.80</td>
<td>1.79</td>
<td>2.75</td>
</tr>
<tr>
<td>I felt lonely</td>
<td>2.59</td>
<td>-0.15</td>
<td>0.56</td>
<td>1.41</td>
<td>2.25</td>
</tr>
<tr>
<td>I had trouble feeling close to people</td>
<td>2.57</td>
<td>-0.11</td>
<td>0.62</td>
<td>1.58</td>
<td>2.51</td>
</tr>
<tr>
<td>I felt upset for no reason</td>
<td>2.55</td>
<td>0.12</td>
<td>0.94</td>
<td>1.94</td>
<td>3.05</td>
</tr>
<tr>
<td>I felt pessimistic</td>
<td>2.38</td>
<td>-0.53</td>
<td>0.41</td>
<td>1.47</td>
<td>2.56</td>
</tr>
<tr>
<td>I felt ignored by people</td>
<td>2.37</td>
<td>0.14</td>
<td>0.92</td>
<td>1.83</td>
<td>2.86</td>
</tr>
<tr>
<td>I felt that I was not as good as other people</td>
<td>2.34</td>
<td>0.12</td>
<td>0.88</td>
<td>1.66</td>
<td>2.56</td>
</tr>
<tr>
<td>I felt guilty</td>
<td>2.02</td>
<td>-0.12</td>
<td>0.85</td>
<td>1.93</td>
<td>2.89</td>
</tr>
</tbody>
</table>

Note: Items are rank ordered on the basis of their slope (discrimination) parameters. All items are reprinted with the permission of the Patient-Reported Outcomes Measurement Information System (PROMIS®) Health Organization and the PROMIS Cooperative Group. a. Items included in the short form.

Future research: Adaptive screening

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Future research: Adaptive screening

• Assess severity level, not clinical criteria
  → Test against DSM criteria using decision tree approach

• Validated in US
  → Validate internationally

• Limited array of mental health problems
  → Develop item banks for other disorders
Future research: Adaptive screening

Psychological distress

Psychosis
- Depression
- Panic / agoraphobia
- PTSD

Internalising
- Generalised anxiety
- Social phobia
- OCD

Externalising
- Alcohol use/abuse
- Adult ADHD

Suicidality
- Substance use/abuse
- Anger
Future research: Adaptive screening

Adaptive screening tools:
- Anxiety
- Depression
- Suicidality, etc

Assessment:
- Resources
- Context
- Preferences

Ongoing monitoring

VIRTUAL CLINIC

STEPPED CARE SERVICE
- Emergency referral
- Referral to MH professional
- Referral to phone service
- Referral to primary care
- Low intensity online CBT
- Psychoeducation
- Watchful waiting
Conclusions

• Hierarchical screening for multiple disorders can result in large efficiency gains without sacrificing accuracy

• Disorder-specific items more useful than general distress items

• Much promise in adaptive screening
Conclusions

• May be applied to
  – Virtual clinics
  – Primary care screening
  – Research
  – School-based screening
  – Other service contexts
Collaborators

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