The “Promise” of Biomarker Feedback as a Risk Communication Strategy to Promote Health Behavior Change

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What are Biomarkers?

Biomarkers are physiological indicators of:

- harm/abnormality (e.g., lung damage via spirometry)
- susceptibility to disease (e.g., lung cancer via genetic/genomic test)
- exposure to harmful agents (e.g., carbon monoxide levels via breath test, cholesterol levels via blood test)

Risk Communication and Biomarkers

Do lifestyle behaviors (e.g., smoking, physical activity, diet) change when people are presented with biological risk information pertaining to harm/abnormal results, susceptibility to disease and/or exposure to harmful agents?
Why Use Biomarkers?

- Foundation of etiology of disease
  - Educate public about disease
  - An outcome of intervention

- Used in clinical practice (e.g., blood test results)

- Direct-to-consumer (e.g., genetics, 23andme)

- Theoretical plausibility
  - Teachable moment
  - Risk appraisals
Theoretical Framework

Risk Appraisals
Perceived risk
Perceived severity
Immediate (anticipatory) emotions
  • Fear, worry
Expected (anticipated) emotions
  • Regret, guilt, shame


Empirical Evidence

- Smoking cessation most studied behavior
- Over 30 years of evidence
- Biomarkers / biologically-based feedback studied:
  - Carbon monoxide (CO)
  - Spirometry testing and lung age
  - Genetic susceptibility to disease (e.g., cancer)
  - Arterial imaging (e.g., ultrasound)
  - Spiral CT scan of lungs
Effects of Lung Cancer Genetic Susceptibility Feedback (GSTM1) on 7-day quit rates among college smokers

GSTM1 missing = higher risk, GSMT1 present = lower risk

Source: Lipkus, Shepperd, O’Neil, Sanderson, McBride, unpublished data
Effects on Susceptibility Testing on Short-term Quit Rates (meta-analyses)

OR/RR with 95% CI

- de Viron et al., 2012: 1.09, 1.55, 2.21
- Smercenik et al., 2012: 1.20, 1.87, 2.92
- Marteau et al., 2010: 0.76, 1.35, 2.39


# Studies of Biomarkers of Harm and Exposure (Spirometry, CO): Examples

<table>
<thead>
<tr>
<th>Reference</th>
<th>Comparisons</th>
<th>6 mo.</th>
<th>12 mo.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segnan et al. (1991)</td>
<td>Minimal intervention (advice to quit) vs. Repeated counseling with spirometry</td>
<td>4.8%</td>
<td>4.8%</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.9%</td>
<td>7.5%</td>
<td></td>
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<tr>
<td>McClure et al. (2009)</td>
<td>Control (e.g., risks of smoking, advice to quit) vs. Focus on spirometry + CO + advice to quit</td>
<td>14.1%</td>
<td>14.9%</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.0%</td>
<td>13.1%</td>
<td></td>
</tr>
<tr>
<td>Richmond &amp; Webster (1985)</td>
<td>Two visits with physician vs. 6 visits with physicians, spirometry, blood tests</td>
<td>3.0%</td>
<td>33.0%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Humerfelt et al. (1998)</td>
<td>Control (no intervention) vs. Letter from respiratory physician, pamphlet + spirometry</td>
<td>9.1%</td>
<td>11.4%</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Risser &amp; Beltcher (1991)</td>
<td>50-minute educational intervention vs. Same educational intervention + spirometry, CO, symptom discussion</td>
<td>6.7%</td>
<td>20.0%</td>
<td>&lt;.06</td>
</tr>
<tr>
<td>Parkes et al. (2008)</td>
<td>Advice to quit with links to cessation aids vs. Advice to quit + spirometric lung age</td>
<td>6.4%</td>
<td>13.6%</td>
<td>&lt;.05</td>
</tr>
</tbody>
</table>
Commentary Using Spirometry

“Spirometric values are of limited benefit as a predictor of smoking cessation or as a tool to ‘customize’ smoking strategies”

–Wilt et al. (2007), p. 21

Evidence on Visualization of Harm
## Biomarkers of Harm / Exposure (UV Exposure Harm)

**Photography** (no UV)

**UV photography showing skin damage**

<table>
<thead>
<tr>
<th>Reference</th>
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<th>Outcome</th>
<th>Result</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gibbon et al. (2005)</td>
<td>No UV photo of harm to face vs. UV photo of harm to face (2 studies)</td>
<td>Time spent in tanning booths 1 month post-intervention</td>
<td>23%</td>
<td>&gt;.002*</td>
</tr>
<tr>
<td>Oliveria et al. (2004)</td>
<td>Pamphlet on how to perform skin exams + diary, vs. Above, with full body photobook</td>
<td>Self skin exams 4 months post-intervention</td>
<td>17.6%</td>
<td>&gt;.0001</td>
</tr>
</tbody>
</table>

* Combined results of both studies
Image of Calcium in Arteries
Carotid ultrasound feedback more effective among smokers with arterial plaque

Effects of Cardiovascular Imaging

- Examples of cardiovascular imaging:
  - Computed tomography
  - Ultrasonography

- Review of studies (4) in primary care found no significant effects on smoking cessation (OR: 2.24; 95% CI: 0.97 – 5.19)

- No significant effects of cardiovascular imaging on either dietary improvement or physical activity (1 study)

Commentary on Use of Visuals to Convey Risk

In a Cochrane review, Hollands & colleagues (2010) concluded that:

- “no strong statements can be made about the effectiveness of communicating medical imaging results to change health behaviour.” (p. 2)

- “if taken with caution, there is sufficient evidence to suggest that these types of interventions show promise and merit further research.” (p. 13)

Overall Consensus

- Inconclusive, yet limited, evidence that biologically-based feedback promotes health behavior change

- No evidence that health behavior change is undermined by informing people that:
  - they are at low risk of harm, or
  - they show no evidence of physical harm

- Need for well-designed randomized controlled trials


Reason for Inconclusive Findings

- Different diseases
- Small sample sizes
- Inconsistency in measures and time points
- Different populations and motivation
- Manipulations other than biomarker feedback (e.g., counseling)
- Use of varying biomarkers
- Variations in feedback delivery
Future Directions and Opportunities

- Which biomarkers promote behavior change:
  - For whom?
  - Under what conditions?
  - For which behavior outcomes?
  - ... and why?
Future Directions and Opportunities

- Capitalize on process of testing
- Empower change with low risk feedback
- Captivating graphics/images (sense of coherence)
- Communal effects of biomarker feedback (e.g., second hand smoke).
- Use of new designs
  - Adaptive designs
  - Technology (e.g., ecological momentary assessments, texting)
Acknowledgements

Jennifer McClure, PhD
Meg Gerrard, PhD
Elizabeth P. Flint, PhD
Marilyn Hockenberry, PhD
Beth Merwin, PhD
Chip Bailey, PhD
Bernard Fuemmeler, PhD
Crystal Arthur, BS