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)

McClure JB. Are biomarkers useful treatment aids for promoting health behavior change? An empirical review. *Am J Prev Med.* 2002 Apr; 22(3):200-7.

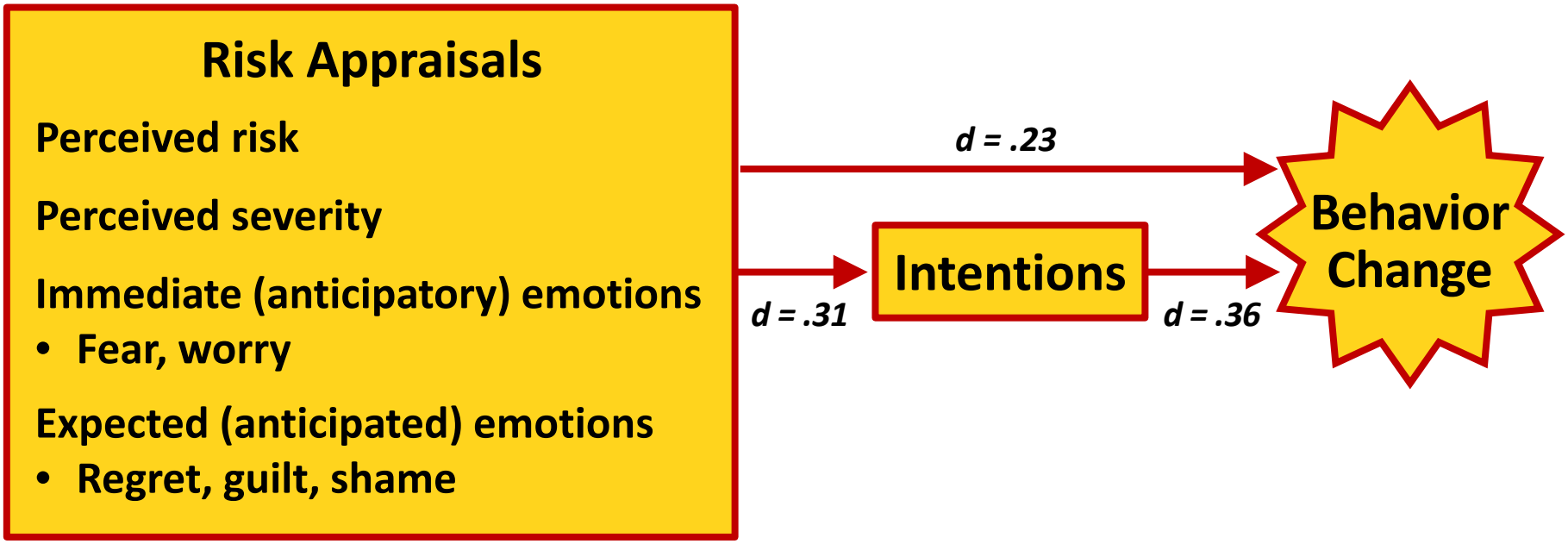
Risk Communication and Biomarkers

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



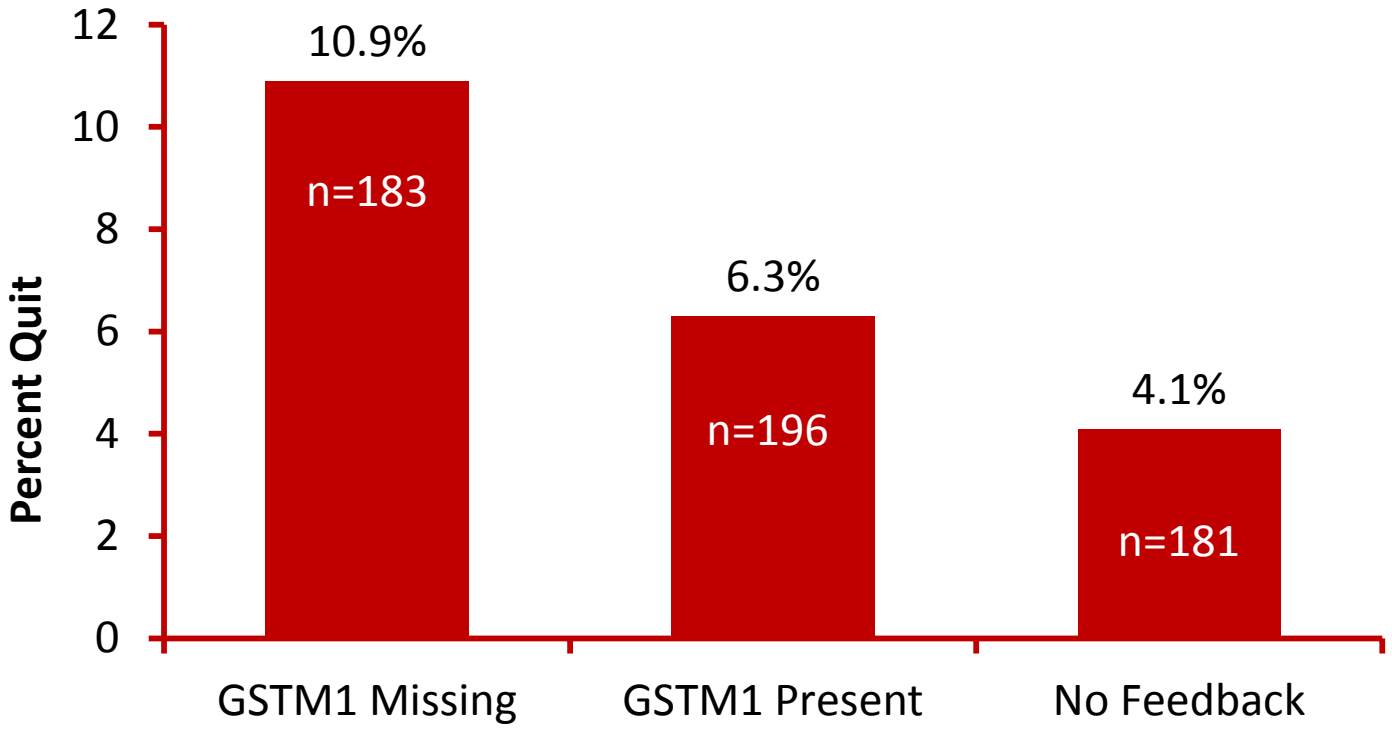
Sheeran P, Harris PR, Epton T. Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychol Bull.* 2014; 140(2): 511-43.

Webb TL, Sheeran P. Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol Bull.* 2006; 132(2): 249–68.

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

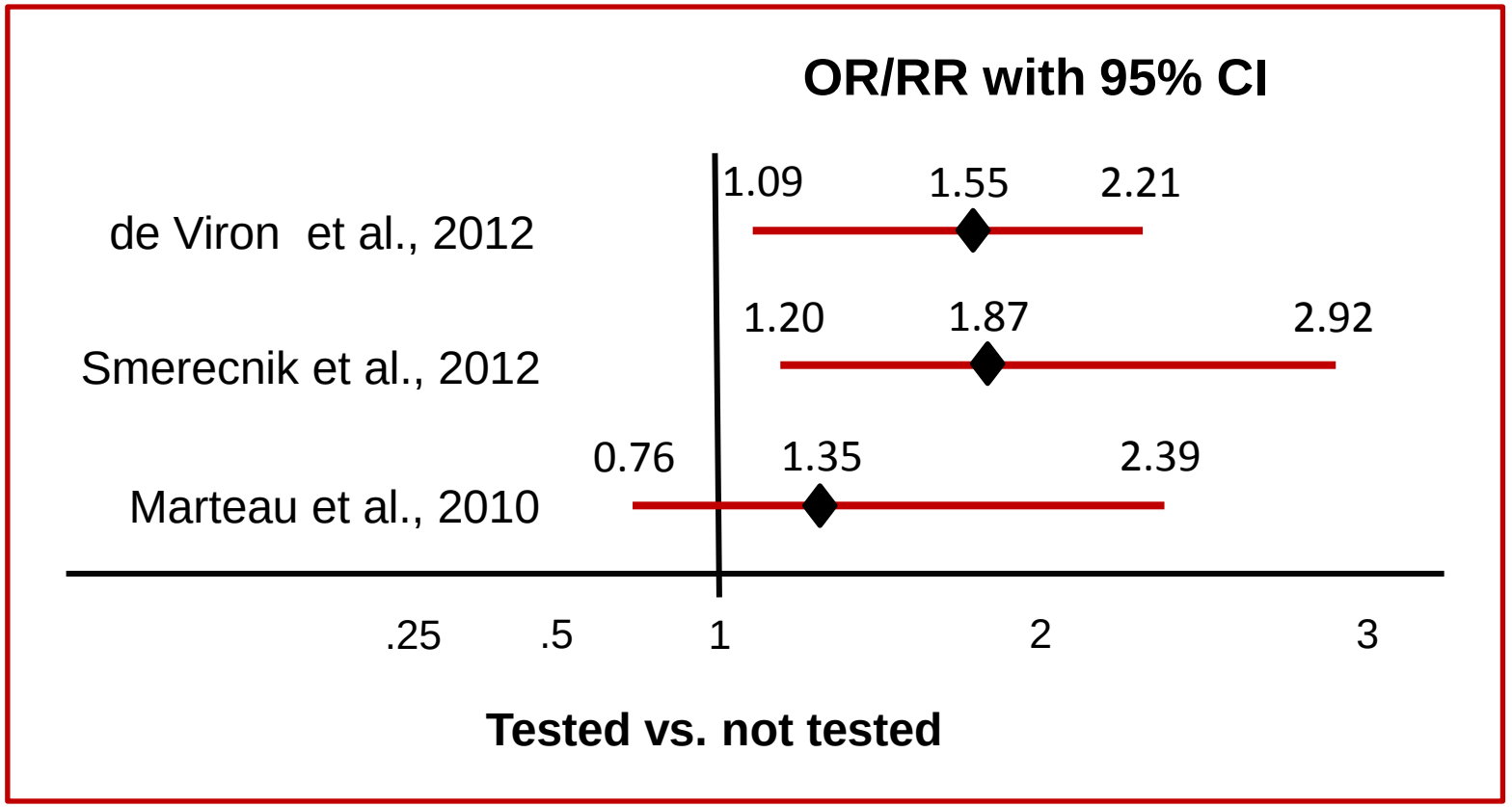
Effects of Lung Cancer Genetic Susceptibility Feedback (GSTM1) on 7-day quit rates among college smokers



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)



Smerecnik C, et al. Effectiveness of testing for genetic susceptibility to smoking-related diseases on smoking cessation outcomes: a systematic review and meta-analysis.Tob Control. 2012 May;21(3):347-54.

de Viron S, et al. Impact of genetic notification on smoking cessation: systematic review and pooled-analysis. PLoS One. 2012;7(7).

Marteau TM, et al. Effects of communicating DNA-based disease risk estimates on risk-reducing behaviours. Cochrane Database Syst Rev. 2010 Oct 6;(10):CD007275.

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

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

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

Wilt TJ, Niewoehner D, Kane RL, MacDonald R, Joseph AM. Spirometry as a motivational tool to improve smoking cessation rates: a systematic review of the literature. *Nicotine Tob Res.* 2007; 9(1): 21-32.

Evidence on Visualization of Harm

Biomarkers of Harm / Exposure (UV Exposure Harm)

Photography (no UV)

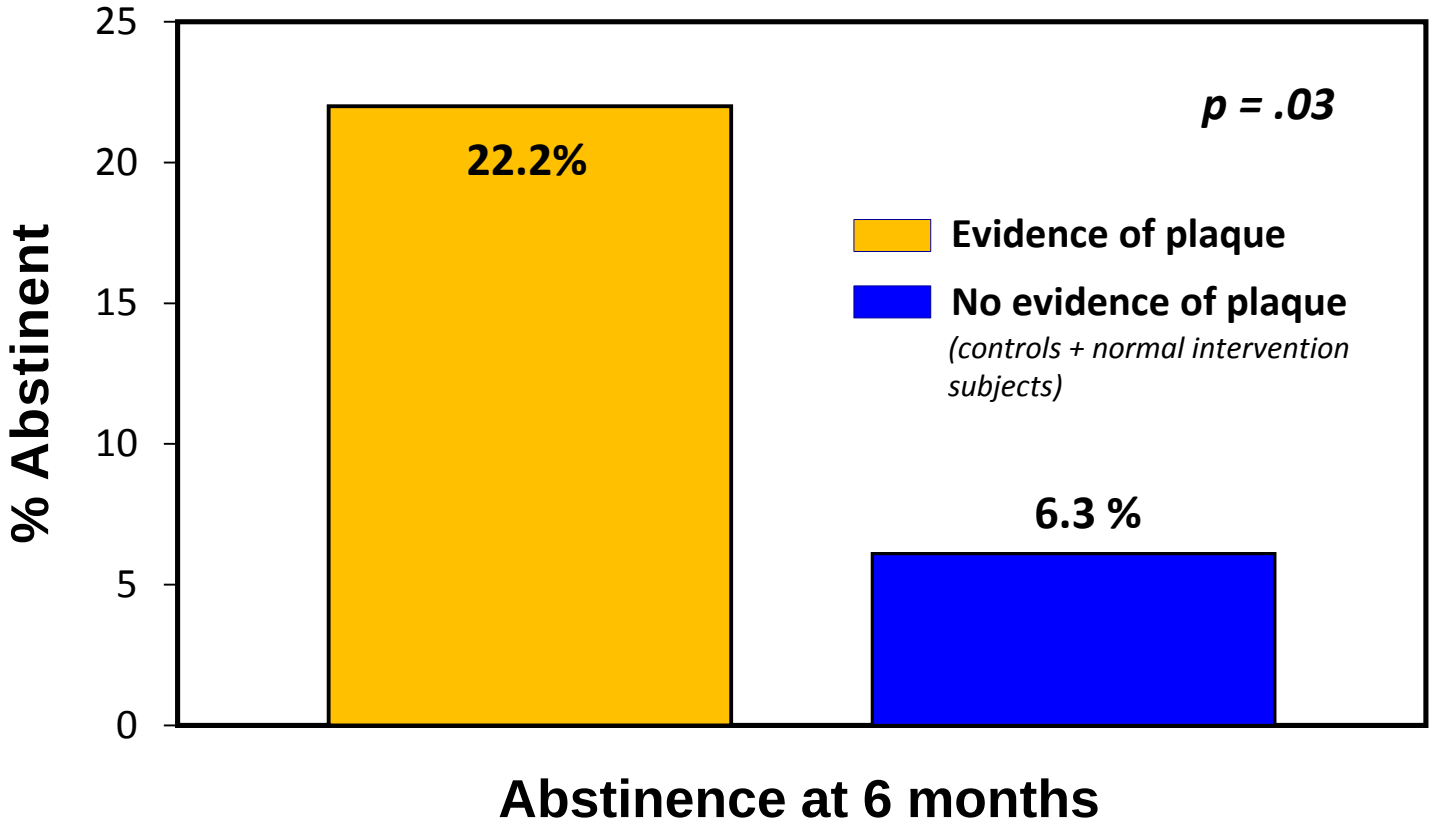
UV photography showing skin damage

Reference	Comparisons	Outcome	Result	p-value
Gibbon et al. (2005)	No UV photo of harm to face *vs.* UV photo of harm to face (2 studies)	Time spent in tanning booths 1 month post-intervention	23% 46%	**>.002***
Oliveria et al. (2004)	Pamphlet on how to perform skin exams + diary, *vs.* Above, with full body photobook	Self skin exams 4 months post-intervention	17.6% 51.0%	**>.0001**

Image of Calcium in Arteries

Cardiovascular Images of Harm

Carotid ultrasound feedback more effective among smokers with arterial plaque



Source: Bovet P, Perret F, Cornuz J, Quilindo J, Paccaud F. Improved smoking cessation in smokers given ultrasound photographs of their own atherosclerotic plaques. *Prev Med.* 2002; 35(2): 215-20.

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)

Hackam DG, Shojania KG, Spence JD, Alter DA, Beanlands RS, Dresser GK, Goela A, Davies AH, Badano LP, Poldermans D, Boersma E, Njike VY. Influence of noninvasive cardiovascular imaging in primary prevention: systematic review and meta-analysis of randomized trials. *Arch Intern Med.* 2011; 171(11): 977-82.

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)

Hollands GJ, Hankins M, Marteau TM. Visual feedback of individuals' medical imaging results for changing health behaviour. *Cochrane Database Syst Rev* 2010 Jan 20; (1): CD007434.

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

Bize R, Burnand B, Mueller Y, Rège-Walther M, Camain JY, Cornuz J. Biomedical risk assessment as an aid for smoking cessation. *Cochrane Database Syst Rev.* 2012 Dec 12; 12:CD004705.

Marteau TM, French DP, Griffin SJ, Prevost AT, Sutton S, Watkinson C, Attwood S, Hollands GJ. Effects of communicating DNA-based disease risk estimates on risk-reducing behaviours. *Cochrane Database Syst Rev.* 2010 Oct 6; (10): CD007275.

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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)

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