Secondary Prevention of Heart Disease: A Focus on Journey through Socioeconomic Status & Smoking

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Disclosures

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• The content is solely the responsibility of the author and does not necessarily represent the official views of the NIH/FDA

• No other conflicts to disclose
Terms to be Familiar With

• Socioeconomic status
  – Educational attainment
  – Income
  – Insurance status/type
  – Occupation

• Smoking
  – Combusted tobacco use, generally cigarettes

• Secondary prevention
  – Improve health-related behaviors
  – Cardiac rehabilitation
Where I Started:
Cardiac Rehabilitation Participation and High School Graduation Rates

Gaalema et al., 2014
Socioeconomic Disparities in Cardiac Disease

• Disparities in development of disease\textsuperscript{1-3}
  – Higher risk cardiac profiles
  – Smoking, diabetes, physical inactivity

• Disparities in outcomes\textsuperscript{3-7}
  – Worse prognosis following a cardiac event
  – 1-year mortality rate more than double that of more affluent patients

• Disparities in secondary prevention

Increasing Disparities?

Fig 1 - Hypothetical trajectories of participation in preventive health behaviors over time in which reduced response to a major health event in lower-SES populations would predict an increasing divergence in health disparities.
Cardiac Rehabilitation

- Cardiac rehabilitation (CR) is a medically supervised, structured program
  - Used to improve health following a cardiac event
    - Recent MI, CABG, PCI, or heart valve replacement or repair, chronic systolic heart failure

- Outpatient rehabilitation program
  - 1-3 visits per week over about 4-6 months
  - Most insurance covers 36 sessions

- Supervised progressive exercise
  - Symptom monitoring
  - Classes on medications, diet, physical activity, stress
Cardiac Rehabilitation

• CR is highly effective at reducing morbidity and mortality rates\(^1,2\)
  - 26% decrease in cardiac mortality over 3 years
  - 31% reduction in cardiac re-hospitalizations over a 12-month period

• CR attendance rates are not ideal
  - Less than half of eligible candidates in the U.S. and Canada participate\(^3-5\)
  - Dropout also a problem and benefits dose dependent\(^6-7\)

CR Participation in Disadvantaged Populations

- Attendance issues even more pronounced in those with lower-SES
  - Medicare patients
    - Only 18% attended CR
    - Only 3-5% of those with dual Medicare/Medicaid status did so\(^1,2\)
  - Washington State Medicaid patients discharged following an MI in 2004
    - Of 322 only two (< 1%) attended CR within the year following their MI\(^3\)
  - Nationally, those with lower levels of educational attainment
    - At least a third less likely to attend CR\(^4\)
  - Problem locally as well\(^5\)

<table>
<thead>
<tr>
<th>Medicaid/ State agencies</th>
<th>Total Eligible</th>
<th>Number in CR</th>
<th>Percent Participation</th>
<th>Percent Completing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>114</td>
<td>28</td>
<td>24%</td>
<td>8%</td>
</tr>
<tr>
<td>Commercial/ Medicare</td>
<td>518</td>
<td>236</td>
<td>46%</td>
<td>35%</td>
</tr>
</tbody>
</table>

Contingency Management/Financial Incentives

• Promote behavior change by immediately reinforcing objectively verified behaviors
  • Gift cards
  • Incentives can be used to further treatment goals
• Incentive-based treatments effective in disadvantaged populations
  • For pregnant smokers incentives significantly more effective (RR 0.76) than other behavioral or pharmacological treatments\(^1\)
• Incentives can increase completion and adherence rates
  • Doubled treatment completion rates\(^2\)
• Randomized 130 CR-eligible Medicaid-insured participants\(^3\)
  • Earn incentives on escalating scale for completion of 36 CR sessions
  • Non-incentive control

Primary Outcomes

- Participants in the incentive condition
  - Earned ~$716
  - Completed significantly more CR sessions
    - 22.4 vs. 14.7 (p = 0.013)
  - Were almost twice as likely to complete CR
    - 55.4% vs. 29.2% (p = 0.002)
Hospital Outcomes

Cumulative ED visits

WEEKS

Cumulative Hospitalizations

Weeks

Emergency Department Visits

# of events

0 5 10 15 20 25 30 35

# of ED visits

Cardiac Disorders Musculoskeletal/Connective Tissue Disorders Respiratory, Thoracic and Mediastinal Disorders GI Disorders Everything Else

Incentive Control

Vermont Center on Behavior & Health
The University of Vermont
Next Study

• Recruiting 200 lower-SES patients eligible for CR (114 so far)
• Inclusion criteria
  – CR qualifying diagnosis (MI, CABG, PCI, valve surgery, CHF)
  – Insured through Medicaid/ Less than HS education
• Randomized into one of four conditions
  – Usual Care
  – Incentives only
  – Case Management only
  – Incentives + Case Management
• Why case management?
  – Initial needs assessment
    • Medical
    • Social
    • Psychological
    • Practical
  – Available as needed to answer acute needs
  – Weekly encouragement to reach goals
But Attending CR is Not the Only Secondary Preventive Behavior
Post-MI Behavior Change by SES

- Systemized review
- 44 studies
  - Behavior change following MI
  - Measure of SES
- 5 behaviors
  - CR attendance
  - Medication adherence
  - Change in diet
  - Change in physical activity
  - Smoking cessation

Gaalema et al., 2017
Behavior Following Myocardial Infarction

Gaalema et al., 2017
Behavior Following Myocardial Infarction

Gaalema et al., 2017
On to Smoking
Risks of Smoking in Those with Coronary Heart Disease

• Dangers of combusted tobacco use
  – Endothelial dysfunction
  – Blood vessel constriction
  – Platelet activation
  – Chronic inflammatory state
  – Dyslipidemia

• Outcomes
  – Accelerate atherosclerosis
  – Destabilize coronary artery plaques
  – Precipitate acute coronary events

1. Barura et al., 2018
Tobacco and Heart Disease

• 50 years of smoking has led to 7,787,000 premature deaths due to cardiovascular and metabolic diseases\(^1\)

• Multivariate-adjusted RR for CHD mortality
  – Men 2.50 (95% CI, 2.34–2.66)
  – Women, 2.86 (95% CI, 2.65–3.08)

1. USDHHS, 2014
Secondary Prevention - Smoking

• Continued smoking number one predictor of a subsequent event

• Those with cardiac disease well aware of the dangers of continued smoking

• Most recognized modifiable risk factor
  – General public
  – Patients

1. Beatty et al., 2015; 2. Fernandez et al., 2008; 3. McDonnel et al., 2014
Smoking Cessation

• Quitting smoking provides immediate cardiovascular health benefits\(^1\)
  – Reduce recurrence of coronary events to that of a non-smoker within 3 years\(^2\)
  – Reducing mortality following a MI by half over 3 to 5 years\(^3\)

• Yet successful cessation difficult
  – Relapse rates 75-85% after 6-12 months, even with treatment\(^4,5\)

1. USDHHS 2014; 2. Critchley et al., 2003; 3. Gerber et al., 2009; 4. Rigotti et al., 2014; 5. Rigotti et al., 2010
Epidemiological - PATH

• Longitudinal, national level data set
  – Focus on tobacco/nicotine use
• Initial data: 23,282 who could be characterized by health status
  – No major health event
  – Life time MI
• Tobacco use
• Attitudes towards products

Gaalema et al., 2018
Use and Attitudes about Tobacco

• Initial data

• Those who reported lifetime MI
  – More likely to have been a current or former combusted tobacco user (OR 3.2, 95%CI 2.0, 5.0; OR 2.4, 95%CI 1.6, 3.8)
  – More likely to believe that smoking/using tobacco is causing/worsening a health problem (OR 2.6, 95%CI: 2.0, 3.3)

Gaalema et al., 2018
Effects of a New MI

- Follow-up data
  - Longitudinal design unique opportunity
  - Those who report having a MI during last 12 months
- No change in condition (n = 13,028)
- New MI (n = 240)
  - Changes in tobacco use
Effects of a New MI

• Individuals with new MI
  – Higher odds (2.1, 95% CI 1.4–3.2) of attempting to quit/reduce combusted

• However, recent MI not a significant predictor of:
  – Cessation
  – Change in CPD

Gaalema et al., 2018
Current Smoking and Other Health-related Behaviors
Back to the Epidemiological Data

• Health-related behaviors predict health related behaviors
  – What about current smoking?
• National level survey - Behavioral Risk Factor Surveillance Survey
• Characterizing 26,000 participants who reported lifetime MI

| Current vs. Former Smokers | Not taking cholesterol med | 16,043 | 1.37 | (1.22, 1.55) |
| Not taking blood pressure med | 18,389 | 1.39 | (1.21, 1.60) |
| Problematic drinking | 24,232 | 1.77 | (1.50, 2.09) |
| Zero minutes physical activity | 23,002 | 1.23 | (1.14, 1.33) |
| Not eating at least one veg daily | 22,788 | 1.25 | (1.14, 1.37) |
| Not attending outpatient CR | 2118 | 1.55 | (1.20, 2.00) |

Gaalema et al., 2020
Back to the Epidemiological Data

• Health-related behaviors predict health related behaviors
  – What about current smoking?
• National level survey - Behavioral Risk Factor Surveillance Survey
• Characterizing 26,000 participants who reported lifetime MI

Gaalema et al., 2020
Clustering of Risk Factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Problematic Drinking</th>
<th>No Physical Activity</th>
<th>Less than One Vegetable/Day</th>
<th>Cluster Frequency</th>
<th>Additional Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never-Smokers</td>
<td></td>
<td></td>
<td>49.2%</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>29.7%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>10.4%</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>8.8%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>1.1%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>0.4%</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Former Smokers</td>
<td></td>
<td></td>
<td>47.4%</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>31.3%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>8.9%</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>8.7%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>1.9%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>1.2%</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Current Smokers</td>
<td></td>
<td></td>
<td>37.5%</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>34.3%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>12.4%</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>8.7%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>3.0%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>2.8%</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Gaalema et al., 2020
Can’t Forget about SES!

Table 7. Sociodemographic characteristics among respondents who experienced a lifetime myocardial infarction by total number of behavioral risks. BRFSS, United States, 2017.

<table>
<thead>
<tr>
<th>Total No. Risks</th>
<th>0 ( (n = 9,723) )</th>
<th>1 ( (n = 9,924) )</th>
<th>2 ( (n = 4,842) )</th>
<th>3+ ( (n = 1,515) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighted %</td>
<td>22.9 (21.2, 24.5)</td>
<td>14.3 (13.0, 15.6)</td>
<td>8.5 (7.3, 9.8)</td>
<td>6.0 (4.4, 7.7)</td>
</tr>
<tr>
<td>Weighted % (95% CI)</td>
<td>22.9 (21.2, 24.5)</td>
<td>14.3 (13.0, 15.6)</td>
<td>8.5 (7.3, 9.8)</td>
<td>6.0 (4.4, 7.7)</td>
</tr>
</tbody>
</table>

Gaalema et al., 2020
Bringing this Back to Cardiac Rehabilitation

• Cardiac rehabilitation (CR) is a medically supervised, structured program
  – Used to improve health following a cardiac event
    • Recent MI, CABG, PCI, or heart valve replacement or repair, chronic systolic heart failure
  – Up to 36 exercise sessions over a 3 to 4 month period
  – Education sessions on medication, diet, stress management

• CR is highly effective at reducing morbidity and mortality rates
  – 26% decrease in cardiac mortality over 3 years
  – 31% reduction in cardiac re-hospitalizations over a 12-month period (Taylor, et al., 2004; Heran, et al., 2011)

• What happens with those who are current smokers?
Smoking and CR
Referral/Attendance/Adherence

• **Systematic review**
  – Effects of smoking on referral/attendance/completion
  – 56 studies included

• **Referral**
  – Current smokers possibly more likely to be referred

• **Attendance**
  – Current smokers less likely to attend CR

• **Completion**
  – Current smokers much less likely to complete CR

Gaalema et al., 2015
### Table 3
The effects of reported smoking status on likelihood of dropping out of a cardiac rehabilitation program.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Location</th>
<th>n</th>
<th>sex</th>
<th>Effect direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oldridge &amp; Streiner</td>
<td>1990</td>
<td>Canada</td>
<td>120</td>
<td>100% M</td>
<td>+</td>
</tr>
<tr>
<td>Oldridge et al.</td>
<td>1983</td>
<td>Canada</td>
<td>733</td>
<td>100% M</td>
<td>+</td>
</tr>
<tr>
<td>Dorn et al.</td>
<td>2001</td>
<td>6 states and DC, USA</td>
<td>931</td>
<td>100% M</td>
<td>+</td>
</tr>
<tr>
<td>Beckie et al.</td>
<td>2010</td>
<td>Southeastern US</td>
<td>252</td>
<td>0% M</td>
<td>+</td>
</tr>
<tr>
<td>Sarrafaezadegan et al.</td>
<td>2007</td>
<td>Iran</td>
<td>1115</td>
<td>77% M</td>
<td>+</td>
</tr>
<tr>
<td>Wittmer et al.</td>
<td>2011</td>
<td>Switzerland</td>
<td>2371</td>
<td>85% M</td>
<td>+</td>
</tr>
<tr>
<td>Marzolini et al.</td>
<td>2008</td>
<td>Toronto, Canada</td>
<td>5922</td>
<td>82% M</td>
<td>+</td>
</tr>
<tr>
<td>Sanderson et al.</td>
<td>2003</td>
<td>Alabama</td>
<td>526</td>
<td>65% M</td>
<td>+</td>
</tr>
<tr>
<td>Digenio et al.</td>
<td>1992</td>
<td>South Africa</td>
<td>711</td>
<td>Unknown</td>
<td>+</td>
</tr>
<tr>
<td>Beauchamp</td>
<td>2013</td>
<td>Melbourne, Australia</td>
<td>281</td>
<td>73% M</td>
<td>+</td>
</tr>
<tr>
<td>Kerins et al.</td>
<td>2011</td>
<td>Ireland</td>
<td>187</td>
<td>71% M</td>
<td>+</td>
</tr>
<tr>
<td>Oldridge et al.</td>
<td>1978</td>
<td>Hamilton, Canada</td>
<td>163</td>
<td>100% M</td>
<td>+</td>
</tr>
<tr>
<td>Waites et al.</td>
<td>1983</td>
<td>Atlanta, Georgia</td>
<td>22</td>
<td>86% M</td>
<td>+</td>
</tr>
<tr>
<td>Eyherabide and Yates</td>
<td>1985</td>
<td>Wisconsin</td>
<td>236</td>
<td>81% M</td>
<td>+</td>
</tr>
<tr>
<td>Worcester et al.</td>
<td>2004</td>
<td>Melbourne, Australia</td>
<td>573</td>
<td>70% M</td>
<td>+</td>
</tr>
<tr>
<td>Sanderson and Bittner</td>
<td>2005</td>
<td>Alabama</td>
<td>228</td>
<td>0% M</td>
<td>=</td>
</tr>
<tr>
<td>Taylor et al.</td>
<td>1988</td>
<td>California</td>
<td>97</td>
<td>100% M</td>
<td>=</td>
</tr>
<tr>
<td>Yohannes et al.</td>
<td>2007</td>
<td>Manchester, UK</td>
<td>189</td>
<td>74% M</td>
<td>=</td>
</tr>
<tr>
<td>Oldridge et al.</td>
<td>1992</td>
<td>Wisconsin</td>
<td>492</td>
<td>68% M</td>
<td>=</td>
</tr>
<tr>
<td>Soleimani et al.</td>
<td>2009</td>
<td>Iran</td>
<td>1986</td>
<td>73% M</td>
<td>=</td>
</tr>
<tr>
<td>Fontana et al.</td>
<td>1986</td>
<td>Connecticut</td>
<td>95</td>
<td>100% M</td>
<td>=</td>
</tr>
</tbody>
</table>

Gaalema et al., 2015
Patient Characteristics and CR Sessions Completed

• Examination of CR program’s prospectively collected database
  – Clinical and demographic characteristics
  – Number of sessions completed
  – CART analysis
    • Which factors explain the most variance
    • Effects of combinations of factors
Predictors of CR Adherence

Complete Sample

<65 years old

65+ years old

Current Smoker

Not Current Smoker

Higher SES

Lower SES

< 65 years old

65+ years old

9 Sessions

27 Sessions

Gaalema et al., 2017
Smoking and Cardiac Rehabilitation

• Smoking is a large driver of cardiac events
• Current smoking risk factor for not attending/completing CR\(^1\)
• Smoking a risk factor addressed in CR
  – But CR programs generally not terribly effective at promoting cessation\(^2\)
• Where can we improve?
  – Currently relying on subjective report/hospital record
  – Objective measurement

1. Gaalema et al., 2015; 2. Taylor et al., 2004
CO Monitoring in Cardiac Rehab

• UVMMC CR Program serves greater Burlington, VT area
  – ~500 patients/year
• Objective CO monitoring
  – CO level (coVita Micro Smokerlyzer®)
  – Implemented in CR Program April 2018
• 853 patients screened
  – Demographics
  – Clinical characteristics
• Outcomes
  – Discrepancies between objective and self-reported smoking status
  – Characteristics by CO level (<4/≥4ppm)

Gaalema et al., currently under review
Smoking Status by Measurement Type

- Current Smoker (self-report)
  - 11
- Former Smoker (self-report)
  - 369
- CO: 4+
  - 51
  - 17
  - 44
Smoking Status by Measurement Type

Current Smoker (self-report)
- 11
- 51
- 17

Former Smoker (self-report)
- 369
- 44

CO: 4+

Gaalema et al., currently under review
### Patient Characteristics, Overall and by Carbon Monoxide Level

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All (n= 853)</th>
<th>CO &lt;4 (n = 741)</th>
<th>CO ≥4 (n = 112)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (M ± SD)</td>
<td>66.9 ± 11.1</td>
<td>67.7 ± 11.0</td>
<td>62.2 ± 11.0*</td>
</tr>
<tr>
<td>Female (%)</td>
<td>229 (26.8)</td>
<td>201 (27.1)</td>
<td>28 (25.0)</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;High School/GED</td>
<td>53 (6.2)</td>
<td>41 (5.8)</td>
<td>12 (12.0)*</td>
</tr>
<tr>
<td>High School</td>
<td>227 (26.6)</td>
<td>180 (25.5)</td>
<td>47 (47.0)</td>
</tr>
<tr>
<td>Some college</td>
<td>182 (21.3)</td>
<td>159 (22.5)</td>
<td>23 (23.0)</td>
</tr>
<tr>
<td>4-year degree</td>
<td>171 (20.0)</td>
<td>160 (22.6)</td>
<td>11 (11.0)</td>
</tr>
<tr>
<td>Greater than 4-year degree</td>
<td>174 (20.4)</td>
<td>167 (23.6)</td>
<td>7 (7.0)</td>
</tr>
<tr>
<td>Smoking status (self-report)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never smoked</td>
<td>380 (44.5)</td>
<td>363 (49.0)</td>
<td>17 (15.2)*</td>
</tr>
<tr>
<td>Formerly smoked</td>
<td>411 (48.2)</td>
<td>367 (49.5)</td>
<td>44 (39.3)</td>
</tr>
<tr>
<td>Currently smoking</td>
<td>62 (7.3)</td>
<td>11 (1.5)</td>
<td>51 (45.5)</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical</td>
<td>195 (22.9)</td>
<td>176 (23.8)</td>
<td>19 (17.0)</td>
</tr>
<tr>
<td>Non-surgical</td>
<td>658 (77.1)</td>
<td>565 (76.2)</td>
<td>93 (83.0)</td>
</tr>
<tr>
<td>Fitness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>METS</td>
<td>6.0 ± 2.1</td>
<td>6.0 ± 2.1</td>
<td>5.9 ± 2.3</td>
</tr>
<tr>
<td>VO2</td>
<td>20.1 ± 6.6</td>
<td>20.2 ± 6.6</td>
<td>20.0 ± 6.7</td>
</tr>
<tr>
<td>BMI</td>
<td>29.7 ± 6.0</td>
<td>29.8 ± 5.9</td>
<td>29.3 ± 6.5</td>
</tr>
<tr>
<td>MOS-36</td>
<td>64.2 ± 26.9</td>
<td>64.3 ± 27.0</td>
<td>63.7 ± 26.1</td>
</tr>
<tr>
<td>PHQ-9</td>
<td>4.0 ± 4.1</td>
<td>3.7 ± 3.9</td>
<td>5.6 ± 4.8*</td>
</tr>
<tr>
<td>Sessions of CR completed</td>
<td>21.3 ± 13.2</td>
<td>21.9 ± 13.1</td>
<td>17.6 ± 13.4*</td>
</tr>
</tbody>
</table>

Gaalema et al., currently under review
## Patient Characteristics, Overall and by Carbon Monoxide Level

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All (n= 853)</th>
<th>CO &lt;4 (n = 741)</th>
<th>CO ≥4 (n = 112)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (M ± SD)</td>
<td>66.9 ± 11.1</td>
<td>67.7 ± 11.0</td>
<td>62.2 ± 11.0*</td>
</tr>
<tr>
<td>Female (%)</td>
<td>229 (26.8)</td>
<td>201 (27.1)</td>
<td>28 (25.0)</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;High School/GED</td>
<td>53 (6.2)</td>
<td>41 (5.8)</td>
<td>12 (12.0)*</td>
</tr>
<tr>
<td>High School</td>
<td>227 (26.6)</td>
<td>180 (25.5)</td>
<td>47 (47.0)</td>
</tr>
<tr>
<td>Some college</td>
<td>182 (21.3)</td>
<td>159 (22.5)</td>
<td>23 (23.0)</td>
</tr>
<tr>
<td>4-year degree</td>
<td>171 (20.0)</td>
<td>160 (22.6)</td>
<td>11 (11.0)</td>
</tr>
<tr>
<td>Greater than 4-year degree</td>
<td>174 (20.4)</td>
<td>167 (23.6)</td>
<td>7 (7.0)</td>
</tr>
<tr>
<td>Smoking status (self-report)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never smoked</td>
<td>380 (44.5)</td>
<td>363 (49.0)</td>
<td>17 (15.2)*</td>
</tr>
<tr>
<td>Formerly smoked</td>
<td>411 (48.2)</td>
<td>367 (49.5)</td>
<td>44 (39.3)</td>
</tr>
<tr>
<td>Currently smoking</td>
<td>62 (7.3)</td>
<td>11 (1.5)</td>
<td>51 (45.5)</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical</td>
<td>195 (22.9)</td>
<td>176 (23.8)</td>
<td>19 (17.0)</td>
</tr>
<tr>
<td>Non-surgical</td>
<td>658 (77.1)</td>
<td>565 (76.2)</td>
<td>93 (83.0)</td>
</tr>
<tr>
<td>Fitness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>METS</td>
<td>6.0 ± 2.1</td>
<td>6.0 ± 2.1</td>
<td>5.9 ± 2.3</td>
</tr>
<tr>
<td>VO2</td>
<td>20.1 ± 6.6</td>
<td>20.2 ± 6.6</td>
<td>20.0 ± 6.7</td>
</tr>
<tr>
<td>BMI</td>
<td>29.7 ± 6.0</td>
<td>29.8 ± 5.9</td>
<td>29.3 ± 6.5</td>
</tr>
<tr>
<td>MOS-36</td>
<td>64.2 ± 26.9</td>
<td>64.3 ± 27.0</td>
<td>63.7 ± 26.1</td>
</tr>
<tr>
<td>PHQ-9</td>
<td>4.0 ± 4.1</td>
<td>3.7 ± 3.9</td>
<td>5.6 ± 4.8*</td>
</tr>
<tr>
<td>Sessions of CR completed</td>
<td>21.3 ± 13.2</td>
<td>21.9 ± 13.1</td>
<td>17.6 ± 13.4*</td>
</tr>
</tbody>
</table>

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Objective CO Monitoring Conclusions

• Current smokers are a high-risk group in CR
  – Health effects, depression, impaired fitness
• Screening is low-burden and highly acceptable to patients
• Results suggest that a substantial number of patients are misclassified by relying on self-report alone
• CO measurement also helpful for monitoring, goal setting
Smoking in those with CVD is Challenging

• Continued smoking number one predictor of subsequent events
• Smoking also a huge predictor of not engaging in secondary prevention
• Cessation obviously difficult
• Need for better treatment
Need for Intensive Treatment

• Brief/low touch interventions ineffective\(^1,2\)
  – Advice to quit
  – Provision of self-help quit materials
  – Follow-up at post-hospital visit
  – Short-term benefits on quit attempts
  – 12-month follow-up no different

Successful Approaches to Cessation?

• Behavioral approaches with demonstrated efficacy\(^1\)
• Intense counseling with follow-up
  – Initiated during hospitalization
  – Hour with cessation specialist
  – Regular follow-up by phone for at least one month
  – Increases quit rates
• Problem space
  – Most patients abstinent when in-patient
  – Motivated to quit
  – May not be seen again for 4-6 weeks
  – Median time to relapse 1-2 weeks\(^2\)

1. Rigotti et al., 2012. 2. Riley et al., 2018.
Conclusions

• Disparities in development of and outcomes from cardiac events
  – SES
  – Smoking

• These factors also predict engagement in secondary prevention

• Progress being made in improving engagement in CR among high-risk groups

• Smoking continues to be an issue in need of intense intervention
References


Thank you!

Questions?