A Simple Model for Estimating Prevention Impact and Efficiency

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Presented at:
American College of Epidemiology
Annual Meeting 2013, Louisville KY
9/23/13
Acknowledgements

• Co-authors:
  – Mike Pignone at UNC
  – Tom Newman at UCSF

• Grant funding
  – NIH Economics of Prevention Common Fund Initiative, R21 HL112256

• No conflicts of interest to disclose
How to meet public health goals?

• Healthy People 2020
  – A model for public health policy

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But there’s still a gap!!

How to meet public health goals?

• Healthy People 2020

– The Gap:
  • Will these interventions get us to our goals?
  • **Impact**: What theoretical health impact might we expect from implementation of an intervention?
  • **Efficiency**: How many people need to be exposed?
The Prevention Impact Model

• A simple, population-based model designed to estimate theoretical health impact and efficiency
  – % reduction in disease events
  – Number needed to treat (NNT) to prevent a single event

• Designed to be generalizable to different conditions
Specific Research Question

• What is the theoretical health impact and efficiency of statin therapy?
  – % reduction in CHD events at 10 years
  – NNT to prevent 1 CHD event

• 3 basic ways of increasing impact:
  – Lower treatment threshold
  – Increase efficacy
  – Improve risk prediction accuracy
Methods

• National Health and Nutrition Examination Survey (NHANES) 2009-2010
  – Representative sample of US population
    • Limit to adults age 20+
    • Use sampling weights for all analyses
Methods

• Estimate 10-year CHD risk
  – Framingham equation (ATPIII version) for non-diabetics without CHD
    • Age/sex/total & HDL cholesterol/SBP/BP meds/Smoking
    • Adjust for diabetes (RR=1.5 in men, 1.8 in women)
  – Alternate equation if already has CHD, extrapolate to 10 years

Methods

• Statin assumptions

  – Standard dose statins $\rightarrow$ RRR = 21% from a 38 mg/dl reduction in LDL cholesterol
  • RR = 0.79 if not already on a statin

Mihaylova et al; Lancet. 2012;380(9841):581-590
Methods

• Statin assumptions

  – Standard dose statins → RRR = 21% from a 38 mg/dl reduction in LDL cholesterol
    • RR = 0.79 if not already on a statin

  – High dose statins → RRR = 38% from a 76 mg/dl reduction in LDL cholesterol
    • RR = .62 if not already on a statin
    • RR = .79 if already on a statin (?dose)

Methods

• Calculate impact and efficiency for each possible treatment threshold:
  – % reduction in population-averaged risk
  – Estimate efficiency = NNT
    • Threshold NNT = 1/(risk difference)
    • Average NNT = population-averaged NTT above threshold
Methods

• Plots to illustrate tradeoffs
• Hypothetical scenarios
  – Perfect efficacy (RRR=100%)
  – Perfect risk stratification accuracy
• (extra slide about the Prevention Paradox)
### Results

- 5458 adults with complete data
- Nearly 10% with pre-existing CHD

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No CHD</th>
<th>CHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median 10-yr risk</td>
<td>1.5%</td>
<td>32%</td>
</tr>
<tr>
<td>Statin use</td>
<td>13%</td>
<td>55%</td>
</tr>
</tbody>
</table>
The graph illustrates the proportion of CHD events preventable against various treatment threshold levels (10-year CHD risk, %) for different treatment scenarios:

- **Standard dose statins (RRR=21%)**
- **High dose statins (RRR=38%)**
- **Absolute protection (RRR=100%)**

Each treatment threshold level is represented by different markers:

- **Treat>20%**
- **Treat>10%**
- **Treat>5%**
- **Treat>3%**
- **Treat All**

The Healthy People 2020 Goal is indicated with a dashed line, showing the proportion of CHD events preventable at that threshold level.
Threshold NNT = 26
Average NNT = 21
Proportion of CHD events preventable vs. NNT to prevent 1 CHD event at threshold.

- Standard dose statins (RRR=21%*): Black curve.
- High dose statins (RRR=38%*): Gray dashed curve.
- Absolute protection (RRR=100%*): Light gray dotted curve.
- Different thresholds for treatment:
  - Treat > 20% (black circle).
  - Treat > 10% (gray filled triangle).
  - Treat > 5% (gray star).
  - Treat > 3% (gray filled triangle).
- Perfect risk prediction & RRR=21%* (black filled triangle).
- Perfect risk prediction & RRR=38%* (gray filled triangle).
- Perfect risk prediction & RRR=100%* (gray filled triangle).
- Healthy People 2020 Goal: Dotted line at the bottom.

* Denotes risk reduction.
Results Summary

• Treatment with standard dose statins will not get us to Healthy People 2020 goals

• High dose statins produce more impact more efficiently

• Better risk stratification helps efficiency but not with maximum attainable impact
Caveats

- Statin prescribing guidelines and other interventions are complex
- RRR may not be constant
- Health impact is theoretical
- Acceptable NNT differs for different interventions
Conclusions

• A simple model can provide useful insight
  – Clarify tradeoffs
  – Compare interventions
  – Help us meet public health goals

• Simple modeling should be a routine part of guideline publications
Thank you!

• Questions?
A “Prevention Paradox Threshold”

50% of events

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50% of events