Design and Tradeoff Analysis of a Health Insurance Consumer-Based Decision Support System

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1 December 2010

With support from Dr. Glenn Ackerman of the Center for Naval Analyses
Agenda

- Context
- Need and Problem
- Value Hierarchy
- Design Alternatives
- Method of Analysis
- Design of Experiment
- Schedule
- Risk Management
- Budget and EVMS
Context

- Lifestyle Behaviors
- Pharmaceuticals
- Medical Technology

Demographics

Increased health care costs

- Decreased Employer Contributions
- New regulations

Increased health insurance premiums

Increased number of uninsured

Unhealthy Population

Reduced Economic Performance
# Stakeholders

<table>
<thead>
<tr>
<th>Primary Stakeholder</th>
<th>Greatest Perceived Problem/Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Makers</td>
<td>Uninsured lead to a higher cost to taxpayer provide care</td>
</tr>
<tr>
<td>Society</td>
<td>High cost of health insurance</td>
</tr>
<tr>
<td>Health Care Providers</td>
<td>Malpractice costs</td>
</tr>
<tr>
<td>Health Insurance Providers</td>
<td>Risk of paying out more than pooled</td>
</tr>
<tr>
<td>Lifestyle Decision Information Technology Vendors</td>
<td>Potential profits as result of reducing poor lifestyle choices</td>
</tr>
<tr>
<td>Employers</td>
<td>Unhealthy work force, resulting in reduced productivity</td>
</tr>
<tr>
<td>Medical Goods and Service Providers</td>
<td>Regulations reducing profitability</td>
</tr>
</tbody>
</table>

**Secondary Stakeholders**

Commercial food industry, gym equipment providers, tobacco industry

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**Conflicting Stakeholder Objectives Result in No Change to Current System**
Increased Health Care Costs

Lifestyle Choices

Overutilization

Decreased Employer Contribution

Physician Compensation

Regulations

Demographics

Pharmaceuticals

Misdiagnosis and medical errors

Health Insurance Administration and Marketing

Chronic Illnesses and Morbidity

Lifetime Limits and Deductibles

Malpractice Lawsuits

Health Insurance Affordability

Uninsured Americans
Health Care Costs Increasing

National Health Care Expenditures

Runaway Costs: Pharmaceuticals

Percent Price Increase Above Inflation

- 2007:
  - All Medications: 2.95%
  - Speciality Medications: 5.35%
  - Brand Name Medications: 4.75%

- 2008:
  - All Medications: 4.25%
  - Speciality Medications: 7.45%
  - Brand Name Medications: 9.55%

- 2009:
  - All Medications: 9.14%
  - Speciality Medications: 10.24%
  - Brand Name Medications: 11.64%

Percent increase well above inflation rate.
Runaway Costs: Medical Technologies

- Account for 40–50% of annual health care cost increases

### Incremental Cost Increase

<table>
<thead>
<tr>
<th>Year</th>
<th>Millions USD</th>
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</thead>
<tbody>
<tr>
<td>2001</td>
<td>700</td>
</tr>
<tr>
<td>2002</td>
<td>1000</td>
</tr>
<tr>
<td>2003</td>
<td>1500</td>
</tr>
<tr>
<td>2004</td>
<td>2000</td>
</tr>
<tr>
<td>2005</td>
<td>2500</td>
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</tbody>
</table>

Sources:
Runaway Costs: Lifestyle Behavior Related Costs

Personal Decisions Concerning
- Tobacco Use
- Diet
- Physical Activity

Actual Causes of Death
- Smoking and Other Tobacco use
- Being Overweight

Unhealthy lifestyle choices lead to:
- A rise in health care costs
  - Tobacco Use: 14.5% increase
  - Obesity: 21.4% increase
  - Lack of Physical Activity: 10.4% increase
- A rise in health insurance costs
  - Due to higher risk to insurer

Highly Correlated Outcomes
- Heart Disease
- Cancer
- Stroke
- Chronic lower respiratory disease
- Diabetes
- Influenza and pneumonia
- Unintended injuries

Sources:
R.L. Keeney, Operations Research, Personal Decisions are the Leading Cause of Death
R. Sturn, Health Affairs, The Effects of Obesity, Smoking, and Drinking on the Medical Problems and Costs
## Solutions to Runaway Costs

<table>
<thead>
<tr>
<th>Runaway Cost</th>
<th>Means to Reduce</th>
<th>Impact of Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmaceuticals</td>
<td>Limit price of pharmaceuticals</td>
<td>Vendors - LosePatients - Win/Lose</td>
</tr>
<tr>
<td>Medical Technologies</td>
<td>Limit price of medical technologies</td>
<td>Vendors - LosePatients - Win/Lose</td>
</tr>
<tr>
<td>Lifestyle Choice Impacted Costs</td>
<td>Provide information on impact of lifestyle choice on behavior and cost</td>
<td>Patients, HC Providers, Insurers - Win</td>
</tr>
</tbody>
</table>

Reducing the impact of lifestyle choices on health care costs a win-win
Agenda

- Context
- Need and Problem
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Need and Problem Statement

There is a need to:
• Control runaway health care costs to promote health insurance affordability
  • Focus on unhealthy lifestyle choices

Problem:
• Unhealthy lifestyle choices result in high health care costs
  • As a result health insurance rates are increasing
  • The number of uninsured are also increasing
• Require a means to inform consumers of the impact of lifestyle behaviors on overall health care outcomes and costs
Health Care

Propose decision support system to provide additional information to consumers

Provides information on the impact of lifestyle behavior on quality of life and health care costs

Consumers provided little to no information to make informed choices
Mission Requirements

- **MR-1**: The System shall increase the number of insured Americans from 83.3% to 90% (1970 rate) by reducing health care costs related to lifestyle behaviors.

- **MR-2**: The System shall provide consumers information on the impact of lifestyle choices on health care outcomes and costs.

- **MR-3**: The System shall have an implementation timeline of less than three (3) months.

- **MR-4**: The System shall limit the cost of implementation and operation of the selected alternative.
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Value Hierarchy

Cost versus Utility

- Political Acceptance (Subjective)
- Effectiveness
  - % Insured
  - Likelihood to Change (Subjective)
- Usability
  - Participation Time (minutes)
  - Participation Effort (Subjective)
- Cost
  - Implementation (Dollars)
  - Operation (Dollars, Annual)

Value obtained via simulation

Weights obtained through surveys of stakeholders
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Design Alternatives

<table>
<thead>
<tr>
<th>Design Alternatives</th>
<th>Implementation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Focuses on educating society regarding nutrition, exercise, tobacco use, and the health care costs associated</td>
</tr>
<tr>
<td>Incentives/Disincentives</td>
<td>Focuses on adjustment of lifestyle choices through incentives and institutional nutrition programs</td>
</tr>
<tr>
<td>Personalized Risk Profile</td>
<td>Focuses on informing society by analyzing health assessments, genetic testing, family history, and the personal choices that influence health care costs</td>
</tr>
</tbody>
</table>
Design Alternative 1: Education

- Teaching adults impact of lifestyle choices on health outcomes and associated costs
- Often community-based programs
- Example Programs
  - Nutrition and physical activity: ALIVE!
  - Smoking cessation
    - Self-help program: Four step “Quit kit”
    - Cessation class: Stanford Five City program

Source: Research-tested Intervention Programs, National Institutes of Health
Design Alternative 2: Incentives

- Financial benefit received in exchange for improved lifestyle behavior choices
- Incentive versus disincentive (carrot versus stick)
- Example programs:
  - Discount on health insurance premium in exchange for lifestyle change (i.e. reduce Body Mass Index, join gym, stop smoking)
  - Rewards program: receive points in exchange for good behavior
Design Alternative 3: Personalized Risk Profile

- Consumers provide personal information and receive information regarding quality of life and health care costs
- Obtain personal information via
  - Health assessments: series of questions related to lifestyle behaviors
  - Family medical history: series of questions related to incidences of common chronic diseases
  - Medical testing: genetic and medical screenings to determine current and possible future medical conditions
- Outputs:
  - Receive personalized statement including probability of obtaining chronic diseases, projected health care costs
  - Specific recommendations for improving health outcomes

System designed to combine best aspects of existing programs
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Method of Analysis

Modified chronic illness costs

Mortality rate

% Insured Americans

Income Distribution

Cost Threshold

Demographics

Annual Premium

Premium Calculator Model

Modified chronic illness costs

Original chronic illness costs

Modified Lifestyle Behavior

Lifestyle Behavior Effect Model

Consumer Based Decision Support System Impact

Original Lifestyle Behavior
Impact of Lifestyle Behavior

Future Health Care Cost

Cost Without Unhealthy Lifestyle Behaviors

\[ HCC = BC \times [1 + 0.214 \times OB + 0.197 \times PT + 0.145 \times CT + 0.104 \times E] \]

Obesity Impact (21.4% higher health costs)

Pass Tobacco Use Impact

Low Exercise Level Impact

Current Tobacco Use Impact

Source for impact quantities:
Premium Calculation

\[
\text{Premium} = \frac{\sum_{k=0}^{n} \frac{C_p}{(1+m)^k} + \frac{(NI_k - ND_k) \times \frac{C_I}{(1+m)^{n-k}} - \frac{C_h}{(1+i)^{n-k}}}{(1+i)^k} \times \frac{i \times (1+i)^{EPY}}{(1+i)^{EPY} - 1}}{\text{Equivalent Participant Years (EPY)}}
\]

Net Present Value, Cost to Care for Ill
Net Present Value, Annual Preventative Care
Convert to Annual Payment

Premiuns pooled across participants within a given risk group
Individual Choice Model

Cost threshold

Potentially Feasible Region

Infeasible Region

Will not purchase

Cost (% of income)

10%

Potential Solution
Agenda

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### Design of Experiment

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Nature of Alternative</th>
<th>Timeline of Alternative</th>
<th>Premium Incentive</th>
<th>Other Incentive</th>
<th>Intermediate Values</th>
<th>Model Outputs</th>
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</thead>
<tbody>
<tr>
<td><strong>Positive</strong></td>
<td>Near-Term</td>
<td>High</td>
<td>High</td>
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<tr>
<td></td>
<td>Long-Term</td>
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<td></td>
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<tr>
<td></td>
<td>Near-Term</td>
<td>Medium</td>
<td>Medium</td>
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<td></td>
</tr>
<tr>
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<td>Long-Term</td>
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<tr>
<td><strong>Negative</strong></td>
<td>Near-Term</td>
<td>Low</td>
<td>Low</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long-Term</td>
<td>Low</td>
<td>Low</td>
<td></td>
<td></td>
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<tr>
<td>Alternative</td>
<td>Nature of Alternative</td>
<td>Timeline of Alternative</td>
<td>Premium Incentive</td>
<td>Other Incentive</td>
<td>Modified Lifestyle Behavior</td>
<td>Annual Premium</td>
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<tr>
<td>----------------------</td>
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<td>-------------------</td>
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<td>-----------------------------</td>
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<tr>
<td>Education</td>
<td>Positive</td>
<td>N/A</td>
<td>None</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Negative</td>
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<td>None</td>
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<td></td>
<td></td>
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<tr>
<td>Personalized Risk Profile</td>
<td>Positive</td>
<td>N/A</td>
<td>None</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td></td>
<td>None</td>
<td>None</td>
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</table>
Agenda

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## Project Schedule

<table>
<thead>
<tr>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
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<tbody>
<tr>
<td><strong>Identification Phase</strong></td>
<td><strong>General and Statistical Research</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Need Statement</strong></td>
<td></td>
<td><strong>Final Presentation and Paper Due Date</strong></td>
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<tr>
<td></td>
<td><strong>Problem Statement</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Stakeholder Analysis</strong></td>
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<td><strong>Originating Requirements</strong></td>
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<td></td>
<td><strong>Vision</strong></td>
<td></td>
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<td></td>
<td><strong>Operational Scenarios/Use Cases/Sequence Diagrams</strong></td>
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<tr>
<td></td>
<td><strong>Requirements Development</strong></td>
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<tr>
<td></td>
<td><strong>Architecture Development</strong></td>
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<td></td>
<td><strong>Initial Model Development</strong></td>
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<tr>
<td></td>
<td><strong>Deliverable #1</strong></td>
<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Deliverable #2</strong></td>
<td></td>
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</tr>
<tr>
<td>January</td>
<td>February</td>
<td>March</td>
<td>April</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Determine effect of alternatives on probability of chronic illness, life expectancy</td>
<td>Develop logic for determining premium</td>
<td><strong>Incorporate effects of alternatives into premium calculation</strong></td>
<td><strong>Implement individual choice model</strong></td>
</tr>
<tr>
<td></td>
<td>Model Verification</td>
<td>Model Validation</td>
<td><strong>Obtain data to use in determining weights</strong></td>
</tr>
<tr>
<td></td>
<td>Model Runs</td>
<td><strong>Calculate weights</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Obtain data to use in determining weights</strong></td>
<td><strong>Calculate weights</strong></td>
<td><strong>Obtain values for non-model items</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Calculate weights</strong></td>
<td><strong>Obtain values for non-model items</strong></td>
<td><strong>Determine which solution to recommend</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Obtain values for non-model items</strong></td>
<td><strong>Determine which solution to recommend</strong></td>
<td><strong>SEIDS Paper Due</strong></td>
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<td><strong>Deliverable #1</strong></td>
<td><strong>Deliverable #2</strong></td>
<td><strong>SEIDS Paper Due</strong></td>
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<tr>
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<td><strong>Deliverable #1</strong></td>
<td><strong>Deliverable #2</strong></td>
<td><strong>SEIDS Paper Due</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Deliverable #2</strong></td>
<td><strong>Deliverable #3</strong></td>
<td><strong>SEIDS Conference</strong></td>
</tr>
</tbody>
</table>
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## Risk Mitigation Plan

<table>
<thead>
<tr>
<th>Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannot obtain accurate effect of lifestyle choices on life expectancy</td>
<td>Use best available data and state possible inaccuracies.</td>
</tr>
<tr>
<td>Cannot obtain effects of lifestyle choices on costs and/or frequency of costs</td>
<td></td>
</tr>
<tr>
<td>Cannot obtain data regarding weights of attributes in value hierarchy</td>
<td></td>
</tr>
<tr>
<td>Cannot obtain values for items not determined via model</td>
<td></td>
</tr>
<tr>
<td>Human resource availability reduced</td>
<td>Identify primary and secondary assignees for each task. Hold status update meetings regularly to ensure situational awareness.</td>
</tr>
</tbody>
</table>
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## Budget

### Level 1 WBS Item

<table>
<thead>
<tr>
<th>Level 1 WBS Item</th>
<th>Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification Phase</td>
<td>1600.00</td>
</tr>
<tr>
<td>Management</td>
<td>11200.00</td>
</tr>
<tr>
<td>Research</td>
<td>17800.00</td>
</tr>
<tr>
<td>Context Analysis</td>
<td>7400.00</td>
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<tr>
<td>Concept of Operations</td>
<td>5400.00</td>
</tr>
<tr>
<td>Design</td>
<td>13600.00</td>
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<tr>
<td>Design Alternatives</td>
<td>12800.00</td>
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<tr>
<td>Presentation Preparations</td>
<td>36000.00</td>
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<tr>
<td>Second Semester Management</td>
<td>4500.00</td>
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<tr>
<td>Second Semester Research</td>
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<tr>
<td>Model Refinement</td>
<td>16,800.00</td>
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<tr>
<td>Verification/Validation of Model</td>
<td>4,000.00</td>
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<tr>
<td>Obtain Results (Run Model)</td>
<td>8,000.00</td>
</tr>
<tr>
<td>Cost-Benefit Analysis</td>
<td>8,200.00</td>
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<tr>
<td>Deliverable Preparations</td>
<td>40,000.00</td>
</tr>
</tbody>
</table>

### Summary

- **Total budget:** $198,800
- **Task-based budget**
- **Assumptions:**
  - $100 / hour loaded rate
  - No work takes place between Dec 20 and Dec 26
  - Work hours limited to 30 hours / week per person
Performance Against Plan – As of 11/24/10

- Total EV
- Total AC
- Total PV

CPI: 0.41
SPI: 1.5
Questions