Using Health & Risk Assessment Tools for Personalized Health Promotion and Care

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Objectives
1. Define personalized medicine and understand why it is beneficial
2. Explain what a risk assessment calculator can perform
3. Conceptualize the basics of how one risk assessment calculator derives its numbers
4. Recognize how an individual can utilize a risk assessment calculator personally for their own educational benefit

Usual Health Education Programs
- Focus on specific populations (e.g., youth, older adults, African Americans, Latinos/as).
- Pros: Evidence-based and cost effective.
- Cons: Not targeted to specific individual needs.
- Example (publications available from the National Diabetes Education Program):
  http://ndep.nih.gov/publications/
Typical Clinical Guidelines

- Assist physician decision-making by reducing complex problems to a few rules or steps.
- Recommend antihypertensive treatment if BP>140/90 or if BP>130/80 for diabetes patients.
- Pros: Simplicity.
- Cons: Potential for misclassification due to sharp cutoff points (e.g., a person with several high risk factors but systolic BP=138 would not be treated).

Personalized Health Promotion & Care

- Unique Patient Information
  - Clinical
  - Social
  - Genetic
  - Environment

- Personalized Medicine
  - Personalized Health Promotion
  - Personalized Health Care

- Increased Effectiveness
  - Customized Health Promotion
  - Accurate Health Care Treatments

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Health Assessment

- Health assessments calculate individual's well being as measured by:
  - Quality of life
  - Health goals
  - Health change intentions
  - Functional status
  - Do not calculate disease specific risk

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Disease Risk Assessment

- Personal, genetic & environmental information
- Individualized risk factors (diet, exercise, smoking, alcohol consumption, family history, DNA, and biomarkers)
- Reveals likelihood of individuals encountering different disease states

Types of Disease Risk Calculators

- Biosignia’s Know Your Number
- Diabetes Risk Test & Diabetes PHD
- FRAX

Where do these risk calculators get their numbers?

Disease Risk Assessment Calculation

- Disease risk assessment calculators build their predictions based on statistical models
- Biosignia’s Know Your Number is derived from Synthesis Analysis
- FRAX is derived from developed FRAX Models
- Diabetes PHD is derived from the Archimedes Model

How are these statistical models derived? Let’s look at The Archimedes Model
Individualized Guidelines: The Potential for Increasing Quality and Reducing Costs

- Eddy et al. (Ann Intern Med. May 2011) compared current blood pressure management guidelines (JNC 7) with individualized guidelines (i.e., using characteristics from each person to calculate risk reductions).
- N=2,710 adults from the Atherosclerosis Risk in Communities Study (no preexisting cardiovascular disease or treatment).
- Individualized guidelines could prevent the same number of myocardial infarctions and strokes as JNC 7 guidelines but with 67% savings (or for the same cost, individualized guidelines could prevent 43% more MIs and strokes than JNC 7 guidelines).
- How does it work? By better stratifying patients into high and low risk groups.

The Archimedes Model Goal

"Our objective was to design a very broad, deep and realistic model that could be used to address a wide range of clinical, administrative, and financial decisions in health care at the level of detail in which real decisions are made" (Schlessinger & Eddy, 2001).
Alternative Models to Archimedes

- Markov models are often used to predict health care outcomes.
- Markov models have strengths over other modeling options such as decision trees and regression equations.
- Markov models use discrete states to identify health care outcomes.
- Health is dynamic and changing rather than discrete.
- Unlike Markov models, the Archimedes model is continuous and dynamic.

(Dedy, 2006)

Derivation of Archimedes

In the model, individuals are represented as agents.
Each agent has:
- Physiology
- Organ systems
- Names
- Education levels
- Locations
- Behaviors

(Schlessinger & Dedy, 2001)
Derivation of Archimedes Physiological Model

Archimedes Equations

- The model creates a trajectory based on equations derived from:
  - Natural trajectories of features
  - Reactions between features
  - Effects of risk factors
  - Clinical events resulting from features
  - The effects of interventions
  - Organ’s functions

Archimedes Trajectory

- The model then uses the trajectory of the simulated agents in order to attempt to create a statistically similar trajectory to what would result using a real study with real individuals.
How Accurate is Archimedes?

- The Archimedes Model has been validated against 28 clinical trials.
- When modeled against more than 40 independent trials, a correlation coefficient of 96 was obtained.

(Eddy, 2006)

Applying Archimedes

- Archimedes can be used to calculate health outcomes, health care costs, program effectiveness, and individual risks.
- Archimedes is the modeling tool behind Diabetes PHD which is a risk assessment calculator.

Diabetes PHD

- Diabetes PHD (Personal Health Decisions) is a tool created by the American Diabetes Association to allow individuals to see how different health decisions or interventions will affect them individually.
- The following Introduction explains how Diabetes PHD is used: Diabetes PHD Overview.
Diabetes PHD Example: Homer Simpson

http://www.diabetesarchive.net/phd/results/view-results.jsp?jobid=256729

Personalized Health Promotion and Care
Health Assessment
Disease & Risk Assessment
Archimedes Model
Diabetes PHD
Summary
Summary

- Health and risk assessment tools can be used to show individuals the effect of lifestyle choices and interventions on their health outcomes.
- Risk assessment tools can also be used to develop individualized guidelines (as in the study by Eddy et al. (2011)).
- Additionally, the Archimedes model can be used to assess the effectiveness of health promotion programs (e.g., by evaluating program benefits and cost effectiveness).

Extensions

- Once participants/patients have been ranked by risk then the ranked list can be used to prioritize health education or disease management programs.
- Thresholds can be used to achieve desired objectives (e.g., same benefit of diabetes management guidelines but at minimum cost; maximizing benefits while breaking even on program cost).

Implementation

- Displays risk of heart attack, stroke or diabetes onset.
- Suggests medications and/or lifestyle interventions that have the greatest impact on reducing risk.
- Data comes from electronic health records or disease registries.
True/False Summary Question

1. Health assessments are designed to calculate disease specific risks.

2. The Archimedes Model uses Markov models to derive health statistics.
True/False Summary Questions

3. Diabetes PHD is a specific disease risk calculator which allows individuals to see how different health decisions or interventions will affect them.

4. Risk assessment tools can be used to develop individualized guidelines.

References