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

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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/

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

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Typical Clinical Guidelines

- Assist physician decision-making by reducing complex problems to a few rules or steps.
- Example: Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7) guidelines.
- 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).

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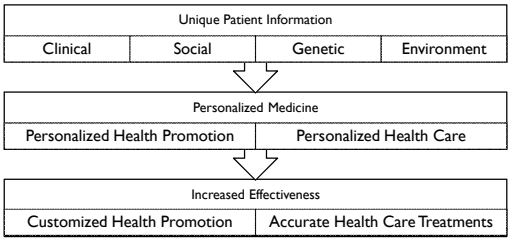
Personalized Health Promotion & Care



(Duke University Health System, 2010)

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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

(Duke University Health System, 2010)

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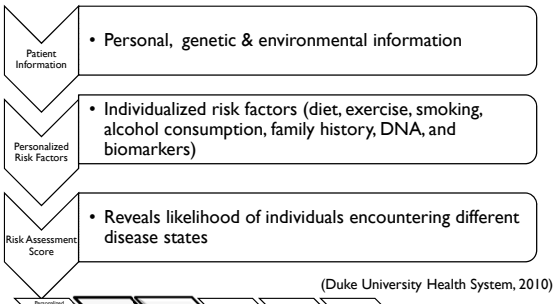
Disease Risk Assessment



(Duke University Health System, 2010)

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Types of Disease Risk Calculators

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

Where do these risk calculators get their numbers?

(Duke University Health System, 2010)

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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

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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.

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The Archimedes Model Goal

ARCHIMEDES
Quantifying Healthcare

Two of the model's creators describe:

"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).

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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.

(Eddy, 2006)

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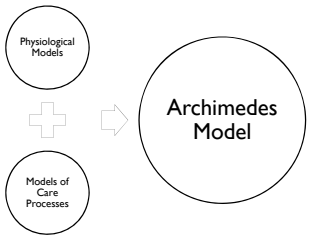
Derivation of Archimedes



(Schlessinger & Eddy, 2001)

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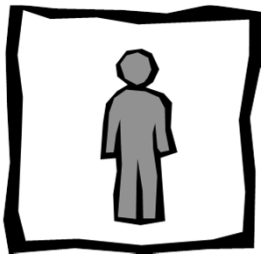
Derivation of the Archimedes Physiological Model

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



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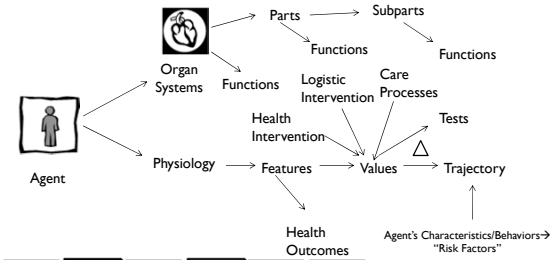
Derivation of Archimedes Physiological Model



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(Schlessinger & Eddy, 2001)

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

(Schlessinger & Eddy, 2001)

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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.

(Schlessinger & Eddy, 2001)

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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)

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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.

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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

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Diabetes PHD Example: Homer Simpson

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

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Your Health Information — Edit

Health Profile Name:	HomerSimpson	Systolic Blood Pressure	145
Gender:	male	Diastolic Blood Pressure	90
Height:	5' 8"	Cholesterol Levels	
Weight:	165 pounds	LDL	I don't know
Year of Birth:	1969	HDL	I don't know
Ethnicity:	Hispanic/Latino	Total Cholesterol	I don't know
Family History			
Diabetes	Yes		
Cardiovascular Disease	No		

Health History — Edit

Smoker:	No	Diagnosed with	
Exercise:	Light	Type 2 Diabetes	

Health Details — Edit

Aspirin Use
Currently not Taking Aspirin

Type 2 Diabetes
Diagnosed at 38 Years Old
Recent A1C is 9

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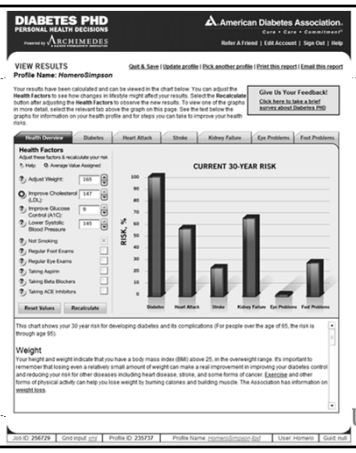

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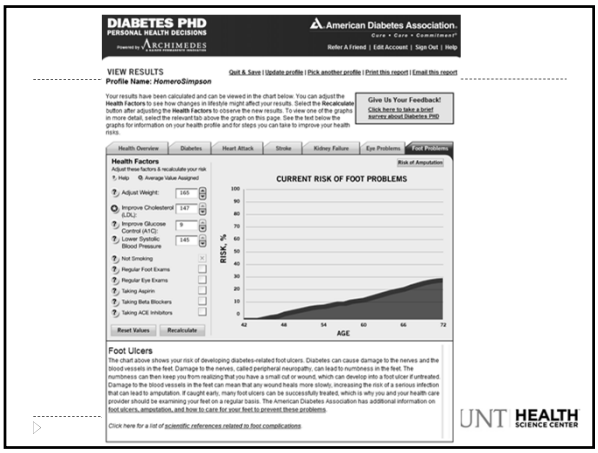
DIABETES PHD
PERSONAL HEALTH DECISIONS
American Diabetes Association.
Cure • Care • Commitment
Refer A Friend | Edit Account | Sign Out | Help
VIEW RESULTS
Quit & Save | Update profile | Pick another profile | Print this report | Email this report
Profile Name: HomeroSimpson
Give Us Your Feedback!
Click here to take a brief survey about Diabetes PHD
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Heart Attack
Stroke
Kidney Failure
Eye Problems
Foot Problems
Health Factors
Risk of Amputation
CURRENT RISK OF FOOT PROBLEMS
RISK, %
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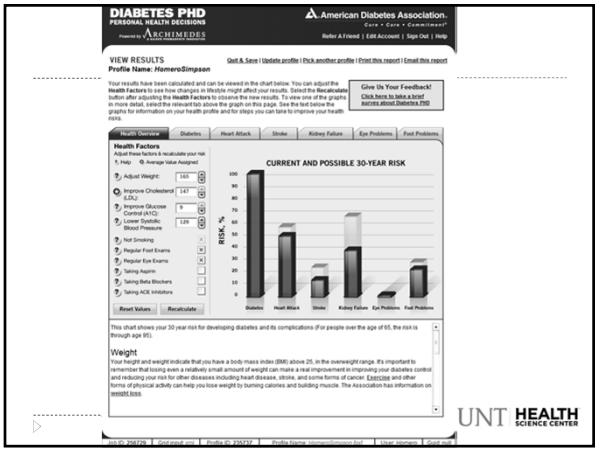
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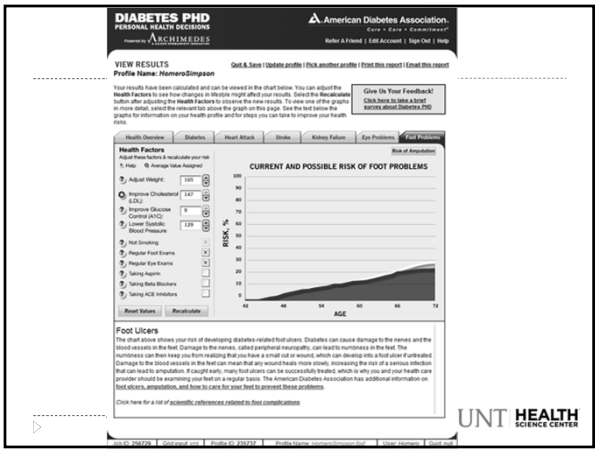
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Summary

- 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 the 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).

(Eddy et al. ,2011).

Implementation

IndiGO™ Individualized Guidelines and Outcomes

- 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.

Thanks!

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True/False Summary Question

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

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True/False Summary Question

- 2. The Archimedes Model uses Markov models to derive health statistics.

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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.

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True/False Summary Questions

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

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References

- Duke University Health System (2010). What is personalized medicine? Retrieved from: http://www.dukepersonalizedmedicine.org/what_is_personalized_medicine.
- Duke University Health System (2010). Patient care: assessing your health. Retrieved from: http://www.dukepersonalizedmedicine.org/patient_care/prevention_wellness/health_risk_assessment.
- Eddy, D. (2006). Bringing health economic modeling to the 21st century. *Value in Health, 9(3),* 168-178.
- Eddy, et al. (2011). Individualized guidelines: the potential for increasing quality and reducing costs. *Annals of Internal Medicine 154(9),* 627-W-232.
- Schlessinger, L & Eddy, D. (2001). Archimedes: a new model for simulating health care systems—the mathematical formulation. *Journal of Biomedical Informatics 35 (2002).* 37-50.

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