

## 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/>



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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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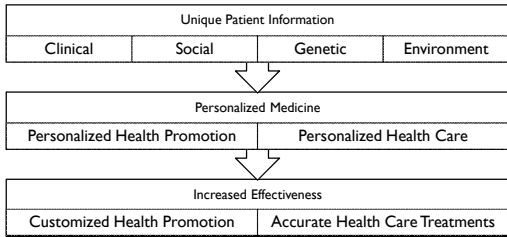
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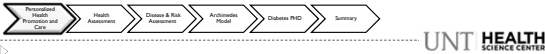
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### Personalized Health Promotion & Care



(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

- Patient Information**
  - Personal, genetic & environmental information
- Personalized Risk Factors**
  - Individualized risk factors (diet, exercise, smoking, alcohol consumption, family history, DNA, and biomarkers)
- Risk Assessment Score**
  - Reveals likelihood of individuals encountering different disease states

(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

(Duke University Health System, 2010)

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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



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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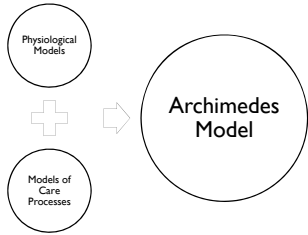
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### Derivation of Archimedes



(Schlessinger & Eddy, 2001)



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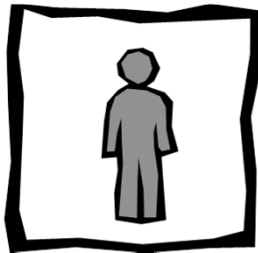
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### Derivation of the Archimedes Physiological Model

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



(Schlessinger & Eddy, 2001)



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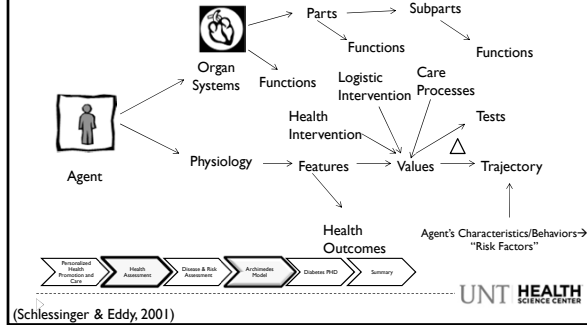
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### Derivation of Archimedes Physiological Model




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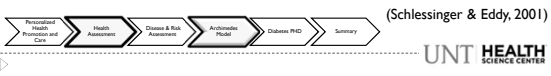
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### Archimedes Equations

- ▶ 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




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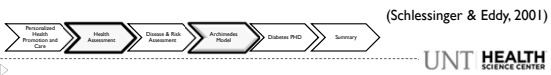
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### Archimedes Trajectory

- ▶ 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.




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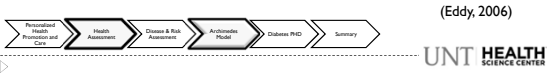
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### How Accurate is Archimedes?

- ▶ 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.




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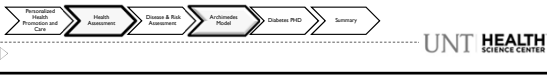
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### Applying Archimedes

- ▶ 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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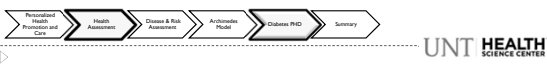
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### Diabetes PHD

- ▶ 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](#)




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### Diabetes PHD Example: Homer Simpson



▶ [http://www.diabetesarchiv  
e.net/phd/results/v  
iew-  
results.jsp?jobid=2567  
29](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: 195 pounds	LDL: I don't know
Year of birth: 1960	HDL: I don't know
Ethnicity: Hispaniolatino	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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**DIABETES PHD** PERSONAL HEALTH DECISIONS American Diabetes Association

Profile Name: HomerSimpson Get A Save / Update profile / Check another profile / Print this report / Email this report

**VIEW RESULTS**

Your results have been calculated and can be viewed in the chart below. You can adjust the health factors to see how changes in lifestyle might affect your results. Select the factor(s) below after adjusting the health factors to observe the new results. To view one of the graphs in more detail, select the relevant tab above the graph on this page. See the text below the graphs for information on your health profile and to show you can take to improve your health.

**Health Factors**

- Adjust Weight: 195  Save / View Report
- Increase Cholesterol (LDL): 145
- Increase Glucose Control (A1C): 9
- Lower Systolic Blood Pressure: 145
- Not Smoking
- Regular Foot Exams
- Regular Eye Exams
- Taking Aspirin
- Taking Beta Blockers
- Taking ACE Inhibitors

**CURRENT 30-YEAR RISK**

This chart shows your 30 year risk for developing diabetes and its complications if a people over the age of 65. The risk is through age 95.

**Weight**

Your height and weight indicate that you have a body mass index (BMI) above 25, in the overweight range. It's important to remember that eating even a relatively small amount of weight can make a real improvement in improving your diabetes control and reducing your risk for other diseases including heart disease, stroke, and some forms of cancer. Exercise and other forms of physical activity can help you lose weight by burning calories and building muscle. The Association has information on [weight loss](#).

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**DIABETES PHD**  
PERSONAL HEALTH DECISIONS  
*ACHILLES*

American Diabetes Association  
Care • Care • Commitment<sup>SM</sup>

Refer A Friend | Edit Account | Sign Out | Help

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**VIEW RESULTS**      [Quit & Save](#) | [Update profile](#) | [Pick another profile](#) | [Print this report](#) | [Email this report](#)

Profile Name: HomeroSimpson

Your results have been calculated and can be viewed in the chart below. You can adjust the health factors to see how changes in lifestyle might affect your results. Send the Rebuildables button after adjusting the health factors to observe the new results. To view one of the graphs in more detail, send the request box below the graph on this page. See the text below the graph for information on your health profile and for steps you can take to improve your health risks.

[Give Us Your Feedback!](#)  
Click here to take a short survey about Diabetes PHD

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Health Overview	Diabetes	Heart Attack	Stroke	Kidney Failure	Eye Problems	Foot Problems
Risk of Amputation						

**Health Factors**  
Adjust these factors to recalculate your risk  
5 Help    Average Value Assigned

- Adjust Weight: 165
- Improve Cholesterol (LDL): 147
- Improve Glucose Control (A1C): 9
- Lower Systolic Blood Pressure: 145
- Not Smoking:
- Regular Foot Exams:
- Regular Eye Exams:
- Taking Aspirin:
- Taking Beta Blockers:
- Taking ACE Inhibitors:

**RISK, %**

**AGE**

**Foot Ulcers**  
This chart shows your risk of developing diabetes-related foot ulcers. Diabetes can cause damage to the nerves and the blood vessels in the feet. Changes to the nerves, called peripheral neuropathy, can lead to numbness in the feet. The numbness can then keep you from realizing that you have a small cut or wound, which can develop into a foot ulcer if untreated. Damage to the blood vessels in the feet can mean that any wound heals more slowly, increasing the risk of a serious infection that can lead to amputation. If caught early, many foot ulcers can be successfully treated, which is why you and your health care provider should be examining your feet on a regular basis. The American Diabetes Association has additional information on foot ulcers, amputation, and foot care for your feet to prevent these problems.

[Click here for a list of scientific references related to foot complications.](#)

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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).




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### 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).



(Eddy et al. ,2011).

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### 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.




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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](http://www.dukepersonalizedmedicine.org/what_is_personalized_medicine).
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