Preparing for Emergencies and Every Day: Planning with Computer Models

Montgomery County, MD,
Advanced Practice Center
for Public Health Emergency
Preparedness and Response and
University of Maryland
February 18, 2009
San Diego, California

Introduction: APCs

- ☑ The NACCHO Advanced Practice Centers (APC) Program is a network of local health departments that exist to serve the public health community, developing resources and training materials.
- ☑ The program’s mission is to promote innovative and practical solutions that enhance the capabilities of all local health departments and the public health system to prepare for, respond to, and recover from public health emergencies.

Montgomery County, MD APC for Public Health Emergency Preparedness and Response

- ☑ To be a resource in emergency response capabilities for local public health agencies, especially those who are also planning on a multi-jurisdictional area;
- ☑ To collect appropriate tools that other local public health agencies in the National Capital Region have developed for dissemination; and
- ☑ To create and develop toolkits, technologies, and other materials that have been evaluated and tested in Montgomery County, into formats that can be easily replicated and used by other local public health agencies.

Overview of Workshop

- ☑ Introduce Computer Modeling
- ☑ Introduce CRI Scenario
  - Build Clinic Planning Model
- ☑ Continue CRI Scenario
  - Plan medication distribution
  - Use electronic screening
- ☑ Other uses of models
- ☑ Concluding remarks

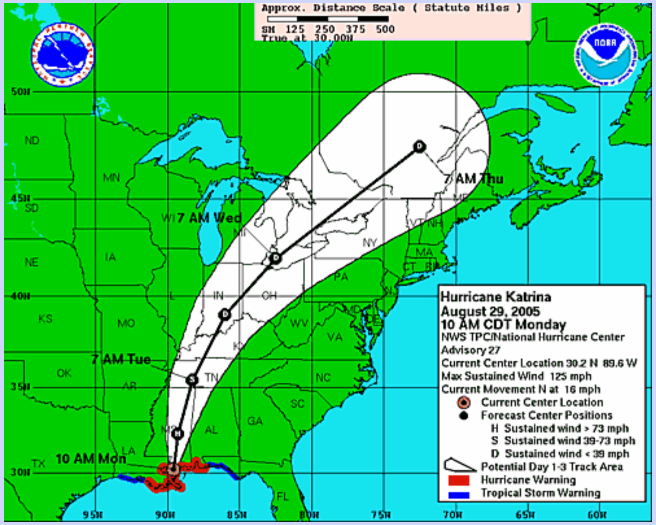
Objectives

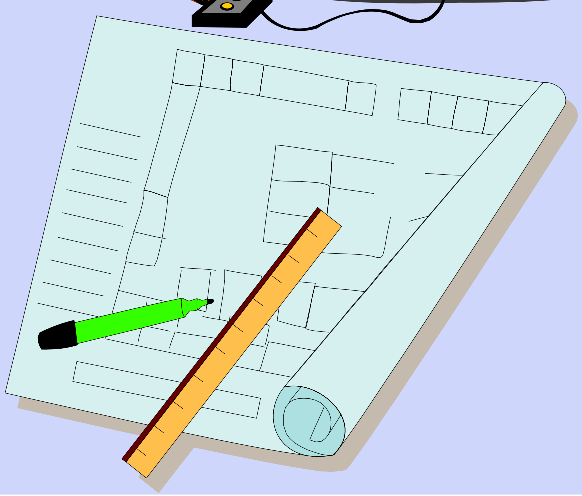
At the end of this session, participants will be able to:

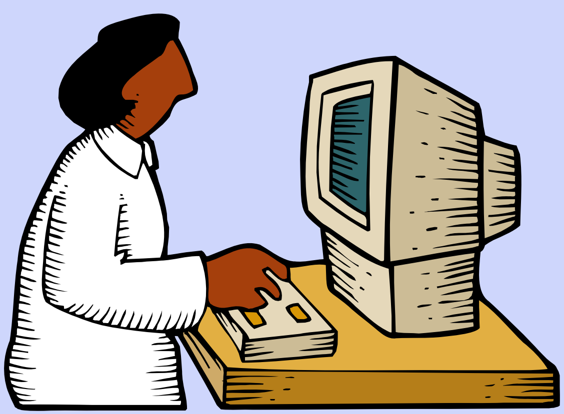
1. Define the term “computer models.”
2. Identify strengths and challenges to using computer models for local public health departments.
3. Describe at least two examples of how computer models can be integrated into local public health.

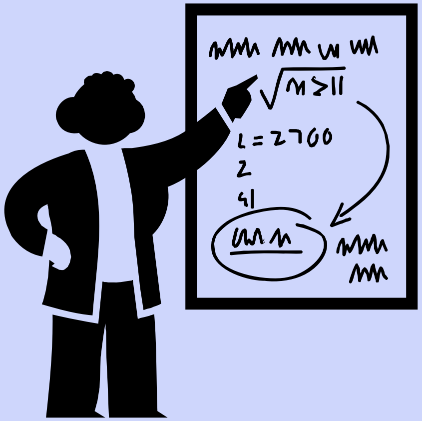
Introduction: Computer Modeling

Models come in many varieties.









Defining “Model”

- ☑ A model represents a system or process.
- ☑ A computer model is a computer program that evaluates the performance of a given system based on data about that system.
  - Includes spreadsheets, specialized software, simulation programs, web-based applications, and others.

Planning with Computer Models . . .

☑. . . is like using tax preparation software:

- Requires collecting important data
- Evaluates your specific situation
- Automates calculation of critical values
- Allows rapid recalculation after changes and corrections
- Requires some time to learn it

Models for POD planning

- ☑ Operational Assessments for SNS Readiness suggest using a POD planning model.
  - RAND working paper 571,

    http://www.bt.cdc.gov/cotper/coopagreement/08/pdf/WorkingPaper-Drills.pdf
- ☑ Available models:
  - BERM
  - RealOPT
  - Clinic Planning Model Generator

Model comparison

Model:	BERM	RealOpt	CPMG
Platform:	Web browser	Java program	Excel spreadsheet
Model type:	Simulation	Simulation, optimization	Mathematical equations
POD design:	Fixed	Flexible	Flexible
Access:	Go to URL	Request from developers	Download from website

Weill Cornell Bioterrorism and Epidemic Outbreak Response Model (BERM)

- ☑ Developed by the Cornell Institute for Disease and Disaster Preparedness (available at www.simfluenza.org)
- ☑ Features:
  - Estimates staffing needed to meet dispensing requirements
  - Uses simulation to determine and graph queue lengths at each station (greeting, triage, evaluation, dispensing)
  - Web-based tool

RealOPT

- ☑ Available from the Center for Operations Research in Medicine and Health Care at Georgia Tech
- ☑ Features:
  - Includes simulation and optimization modules to determine staffing that optimizes performance in user-defined scenarios
  - Includes graph drawing tool for layout
  - Implemented in Java

Clinic Planning Model Generator (CPMG)

- ☑ Collaboration between University of Maryland and Montgomery County, Maryland
- ☑ Features:
  - Spreadsheet-based program that builds a customized POD planning spreadsheet model
  - Estimates POD capacity and queueing
  - Requires Microsoft Excel 2003

CPMG Development

- ☑ The planning models use data collected from time studies of mass dispensing and vaccination exercises in Maryland, Virginia, and New Jersey
- ☑ We developed the spreadsheets based on input from public health planners around the country.

Personal Testimony

- ☑ How many patients per hour?
- ☑ How large of a facility is needed?
- ☑ How much staff is needed?
- ☑ How do you determine most efficient flow pattern for your POD?
- ☑ Needed another planning tool that engaged technology in a efficient way
- ☑ Time Study ➨ Baseline data ➨ Creation of Model

Viewing and editing the model

Model Scope

- ☑ Planning, not a training tool
- ☑ Only takes into account essential station staff
- ☑ Included, but not predicted:
  - Security
  - Runners
  - Translators
  - Data Entry
  - Logistics

Model Scope

- ☑ One of many tools for planning
  - Not the *silver bullet* of POD planning
- ☑ Basic computer skills needed
  - Microsoft Office Excel
- ☑ Unexpected situations
  - Lost children, media, health emergencies
- ☑ Human factor
- ☑ Doesn’t predict supplies needed
- ☑ Numbers in model based on a limited data set

How can the model help you?

- ☑ ***Self-select stations***
- ☑ Decrease bottlenecks/congestion
- ☑ Predicts essential staffing
- ☑ Compare arrival patterns
  - Buses vs. individual
- ☑ Pre-Event and during an event
- ☑ User-friendly

How can the model help you?

- ☑ Evaluation tool of POD plans
- ☑ Cost-effective
- ☑ Versatility of model
  - Seasonal flu clinics-not always for a crisis
- ☑ Field tested and research based

User Guide Information

- ☑ User Guide can be used for single use or “Train the Trainer” presentation
- ☑ For the most updated version of the User Guide and Model go to:

Institute for Systems Research, University of Maryland

www.isr.umd.edu/Labs/CIM/projects/clinic/

Patient Waiting in PODs

- ☑ Waiting occurs when systems with variability operate near capacity.
- ☑ Excessive waiting provides an opportunity to improve POD design.

Waiting for screening station
June 21, 2004

Clinic Planning Model Generator Demonstration

(CRI Scenario)

CRI Background

- ☑ The Cities Readiness Initiative (CRI) is a federally funded effort to prepare major US cities and metropolitan areas to effectively respond to a large scale bioterrorism event by dispensing antibiotics to their entire identified population within 48 hours of the decision to do so.

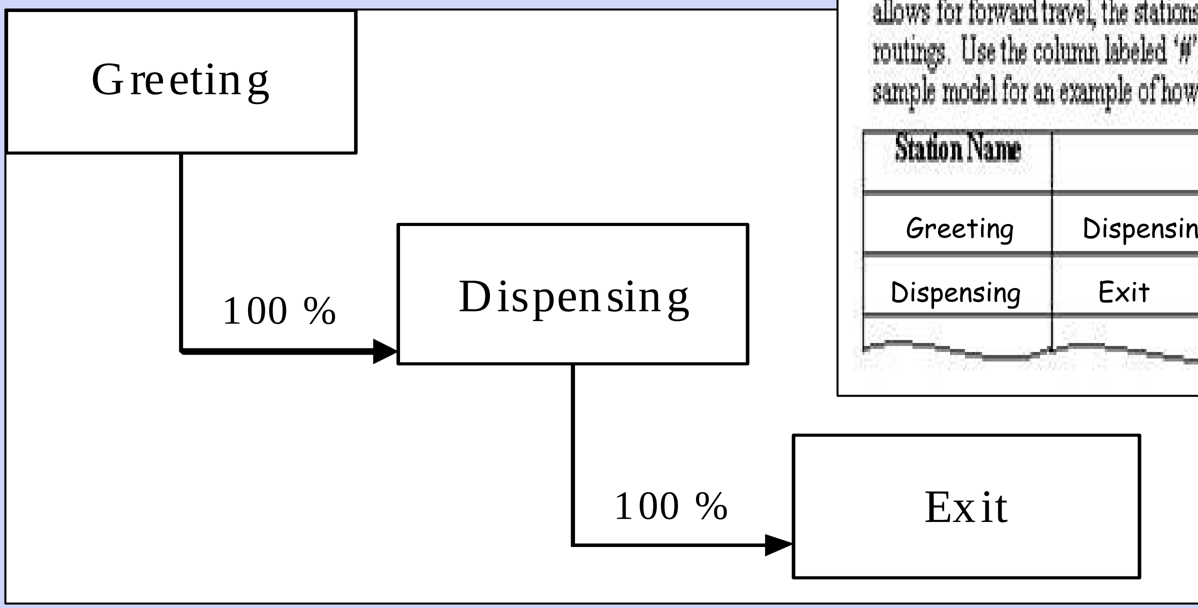
CRI Scenario

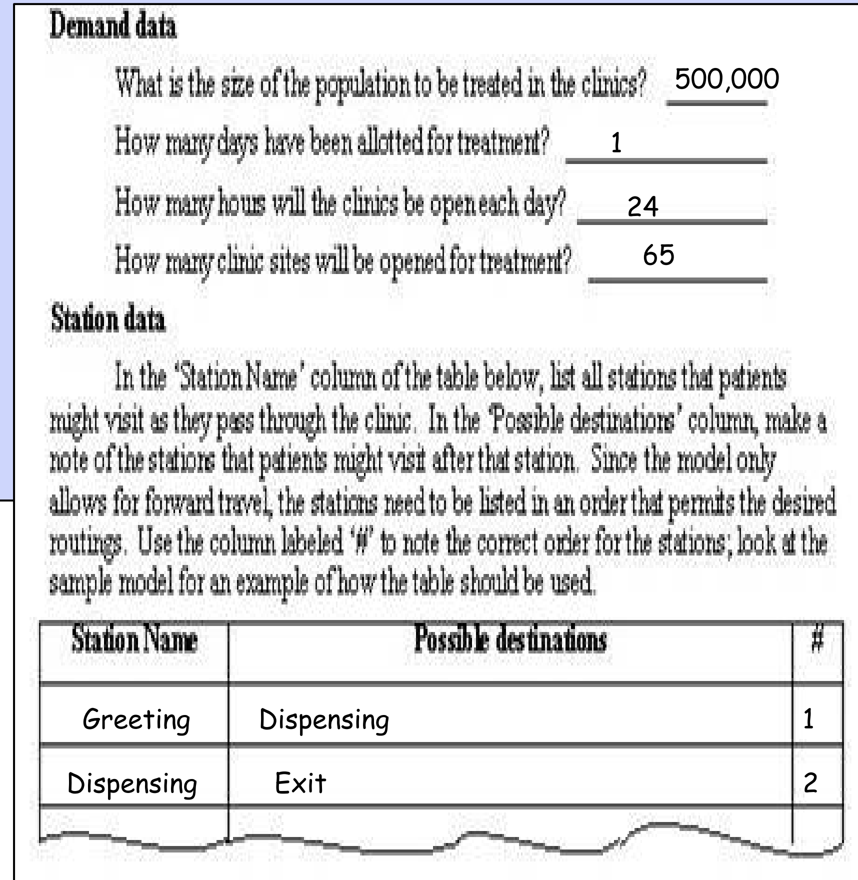
- ☑ There has been an aerosolized Anthrax attack in Anywhere, USA. It has a population of 500,000 residents. There are 65 elementary schools that will be used to distribute oral medication. Household Representatives will be asked to walk to the nearest elementary school. Anywhere's Local Health Department is given 24 hours to distribute the medication, requiring two 12 hour shifts.
- ☑ Problem: Determine the number of staff needed to deliver medications to 500,000. Use two stations *Greeting* and *Delivery*.
- ☑ Go to CPMG

Example: Input Data

Size of population to be treated:	500,000
Time for treatment (days):	1
Hours of operation per day:	24
Number of PODs:	65

Worksheets





Demand data

What is the size of the population to be treated in the clinics? 500,000

How many days have been allotted for treatment? 1

How many hours will the clinics be open each day? 24

How many clinic sites will be opened for treatment? 65

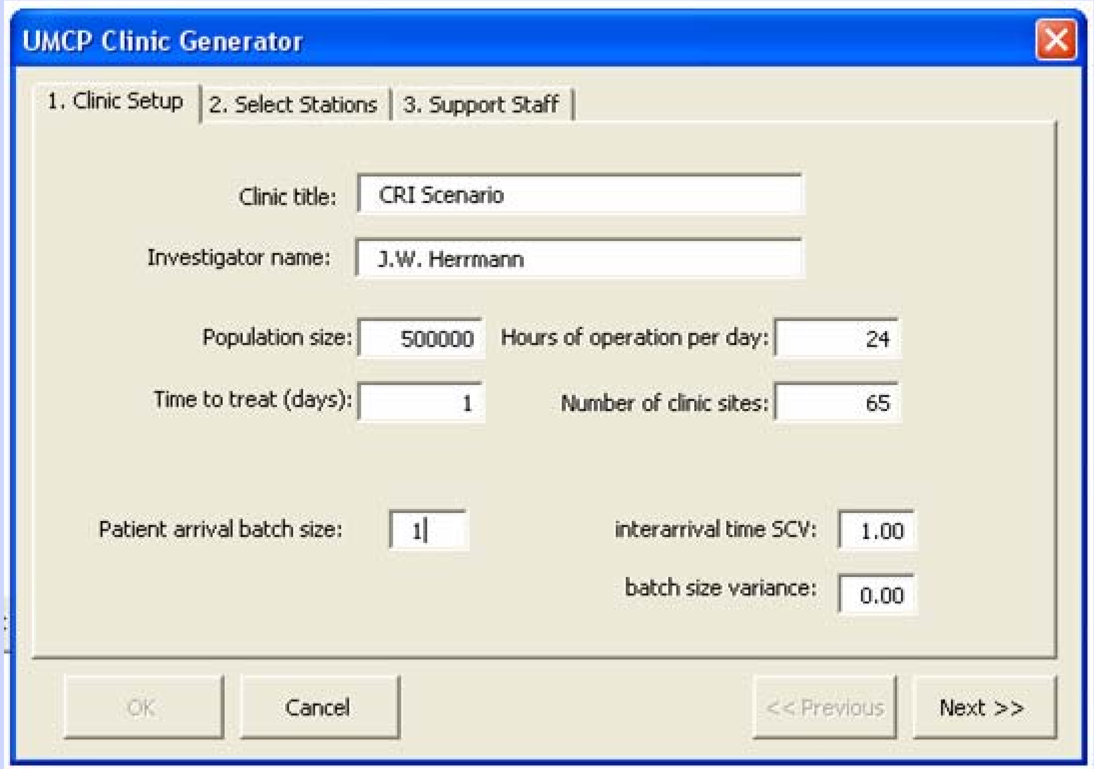
Station data

In the 'Station Name' column of the table below, list all stations that patients might visit as they pass through the clinic. In the 'Possible destinations' column, make a note of the stations that patients might visit after that station. Since the model only allows for forward travel, the stations need to be listed in an order that permits the desired routings. Use the column labeled '#' to note the correct order for the stations; look at the sample model for an example of how the table should be used.

Station Name	Possible destinations	#
Greeting	Dispensing	1
Dispensing	Exit	2

Model creation

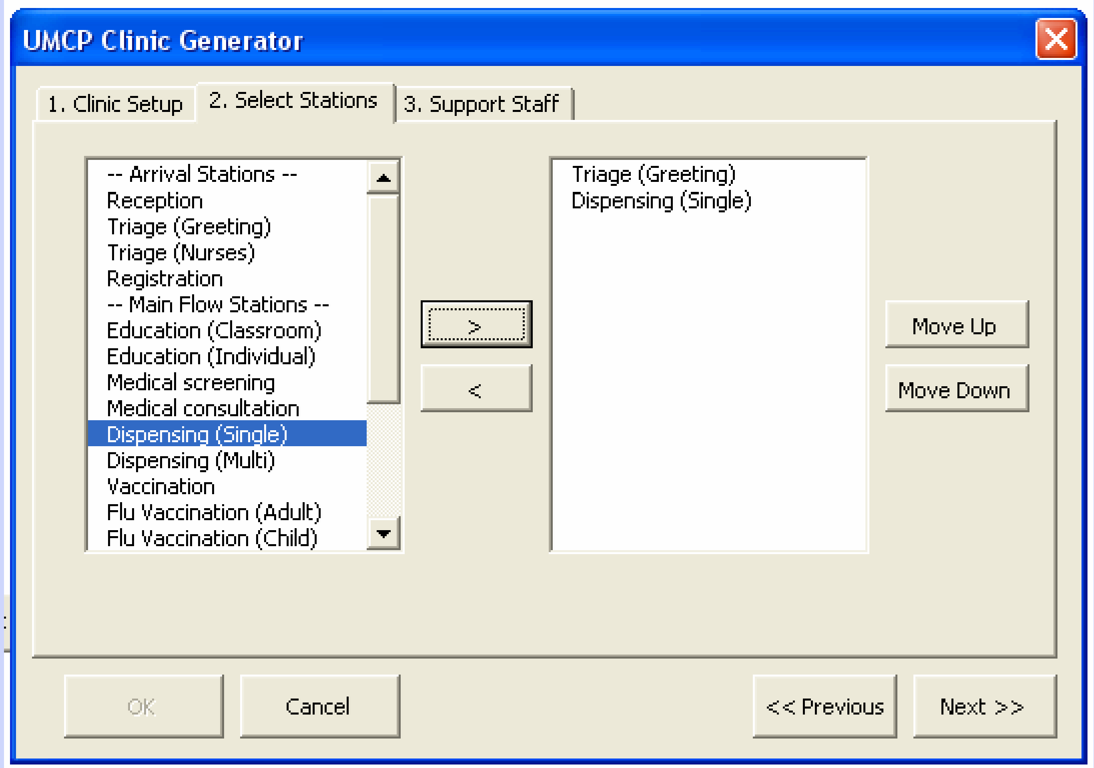
☑ Launch the CPMG (enable macros) and enter setup information



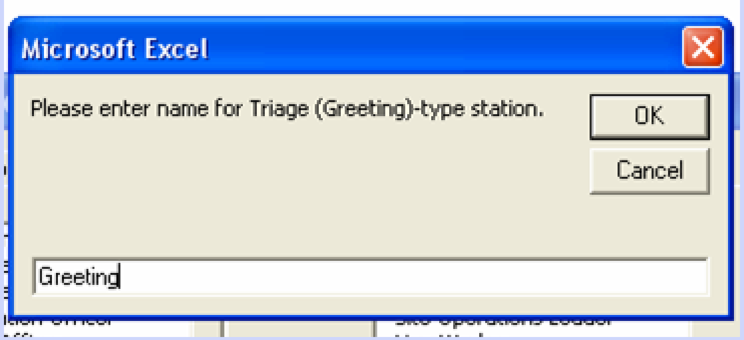
Model creation

☑ Select stations in clinic

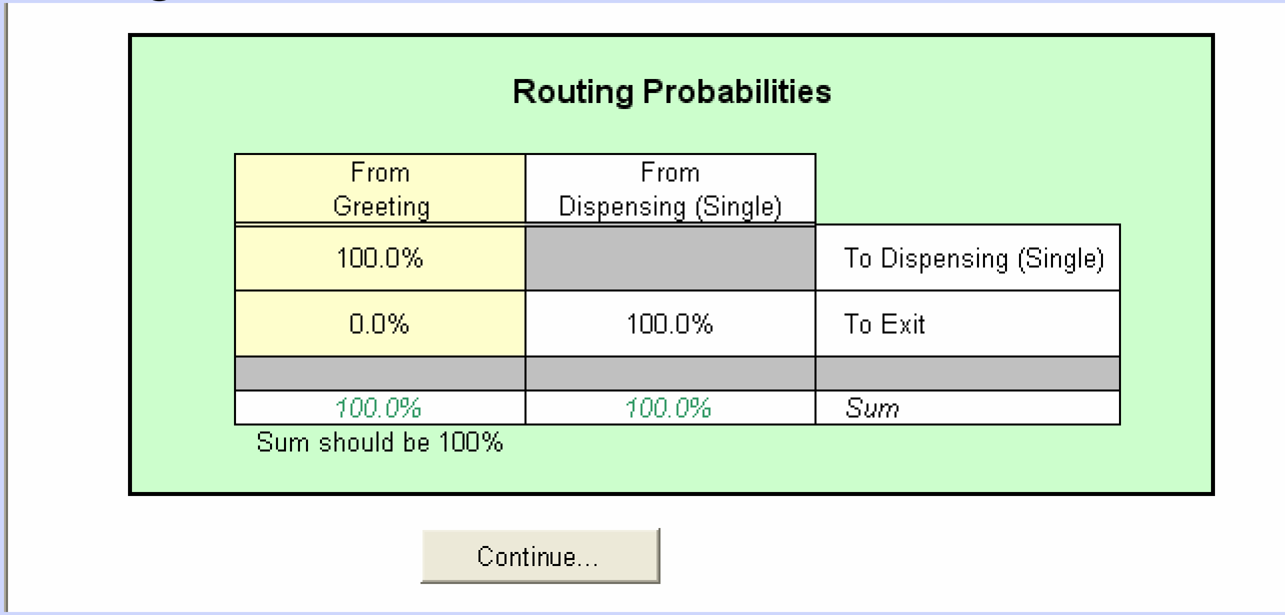
☑ Select ‘OK’ and save clinic



Model creation



- ☑ Enter station names…
- ☑ ….and routing data



Viewing and editing the model

- ☑ Navigate to Main page

Clinic Planning Model

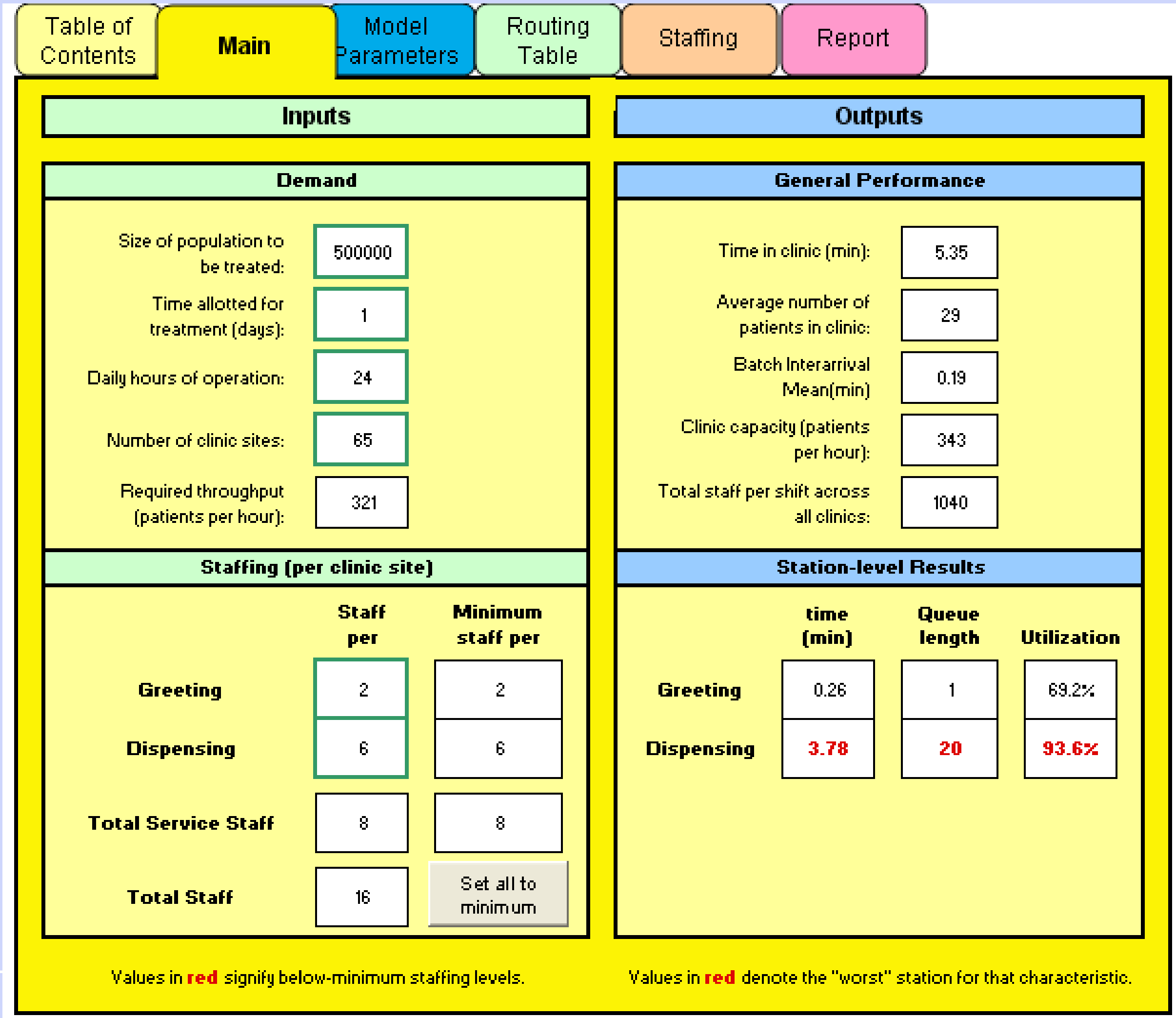
CRI Scenario

Contents

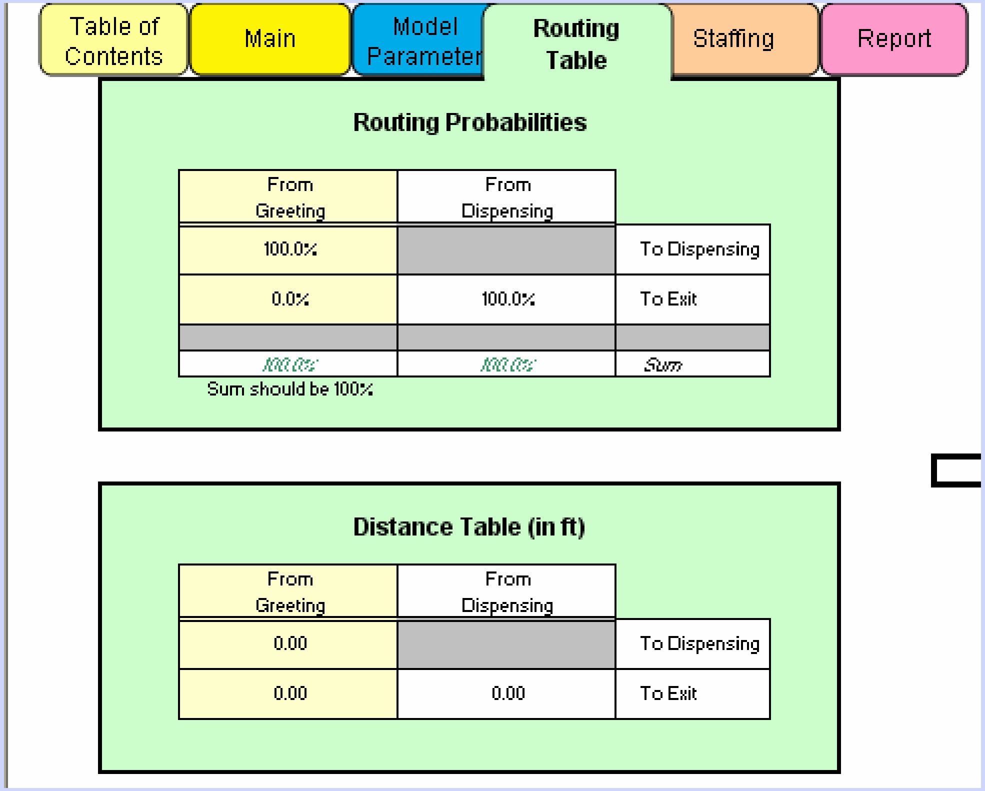
This model is intended for use in advance planning of the response to a biological attack, using mass dispensing clinics or mass vaccination clinics. Calculations are based on the size of the population in question and the timeframe for treatment. Detailed instructions are given below for each portion of the model.

1. Main	Enter the size of the population to be vaccinated and the time allotted for vaccination, then select a staff distribution and view a concise overview of projected clinic performance.
2. Model Parameters	Adjust internal model settings, such as process times, arrival distributions, walking distances, and routing probabilities.
3. Routing Table	Edit patient flow patterns by choosing the proportion of patients to pass through each station.
4. Staffing	Contains support staff counts, such as team leaders, logistics personnel, and site management.
5. Report	See detailed output of clinic performance, including breakdown of cycle times, average queue lengths, and station utilization.
Author Credits	
Startup Screen	

Viewing and editing the model



Viewing and editing the clinic



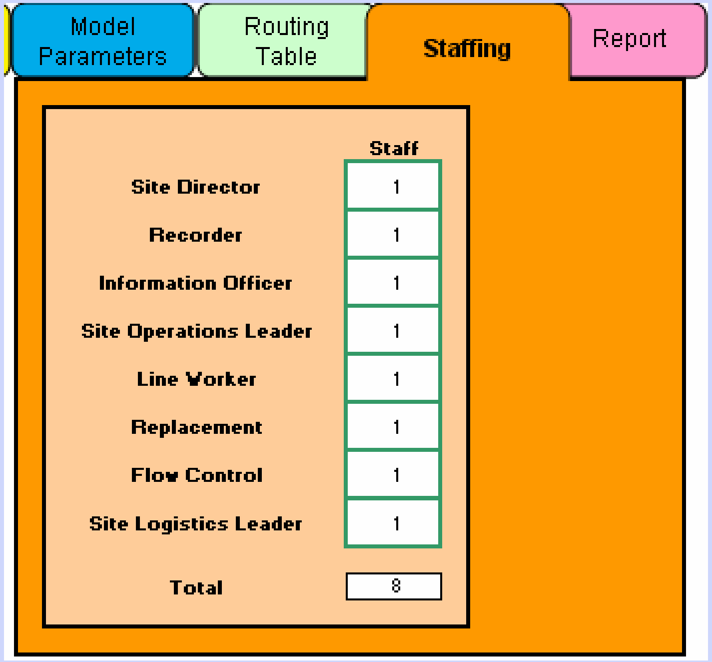
Routing Probabilities

From Greeting	From Dispensing	
100.0%		To Dispensing
0.0%	100.0%	To Exit
100.0%	100.0%	Sum

Sum should be 100%

Distance Table (in ft)

From Greeting	From Dispensing	
0.00		To Dispensing
0.00	0.00	To Exit

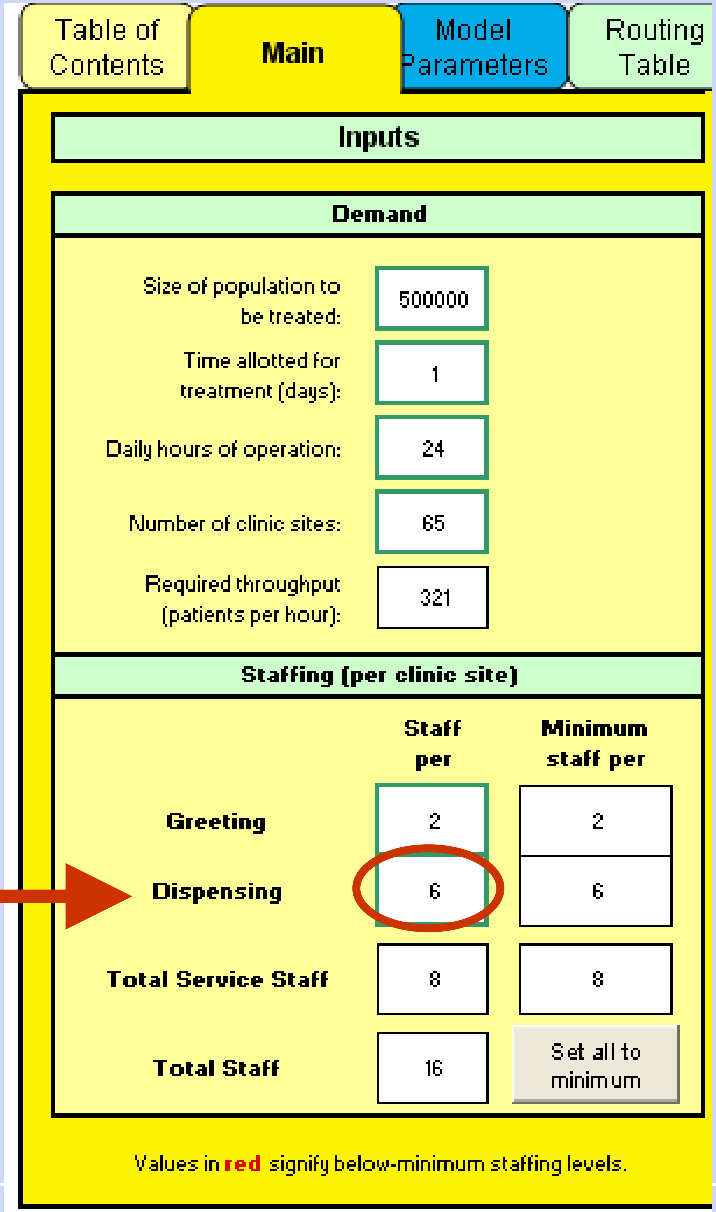


	Staff
Site Director	1
Recorder	1
Information Officer	1
Site Operations Leader	1
Line Worker	1
Replacement	1
Flow Control	1
Site Logistics Leader	1
Total	8

What if?

☑ What happens if we add a person to the station with the highest utilization?

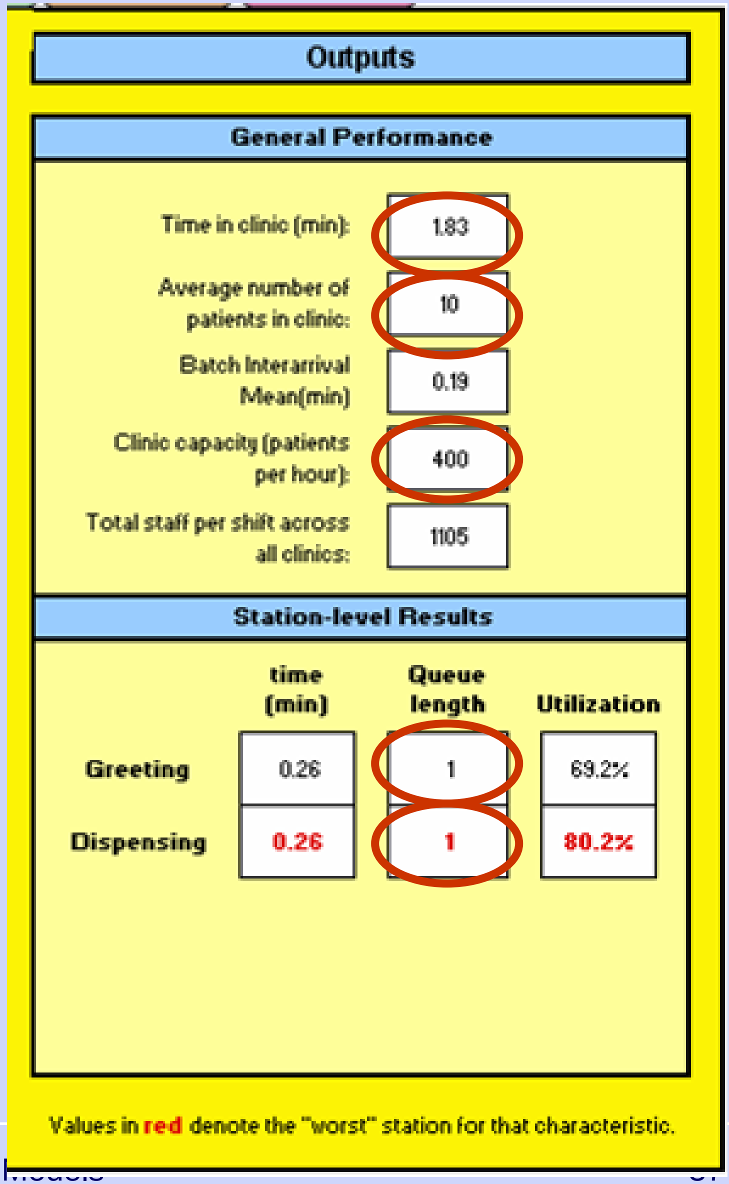
Add 1 to number of dispensing staff:



What if?

☑ Adding 1 to dispensing impacts POD performance:

- POD capacity:
  343 to 400 patients per hour
- Time in POD:
  5.35 mins to 1.83 mins
- Patients in POD:
  29 to 10
- Waiting time at dispensing:
  3.78 mins to 0.26 mins
- Queue length at dispensing:
  20 to 1



Medication Distribution Model

CRI Scenario: Medication Distribution

- ☑ Medication flow:
  - Strategic National Stockpile (SNS) and Vendor Managed Inventory (VMI)
  - State Receipt, Store, and Stage (RSS) facility
  - Local Distribution Center (LDC)
  - Points of Dispensing (PODs)
- ☑ Multiple shipments to RSS require good plans to get medication to PODs on-time

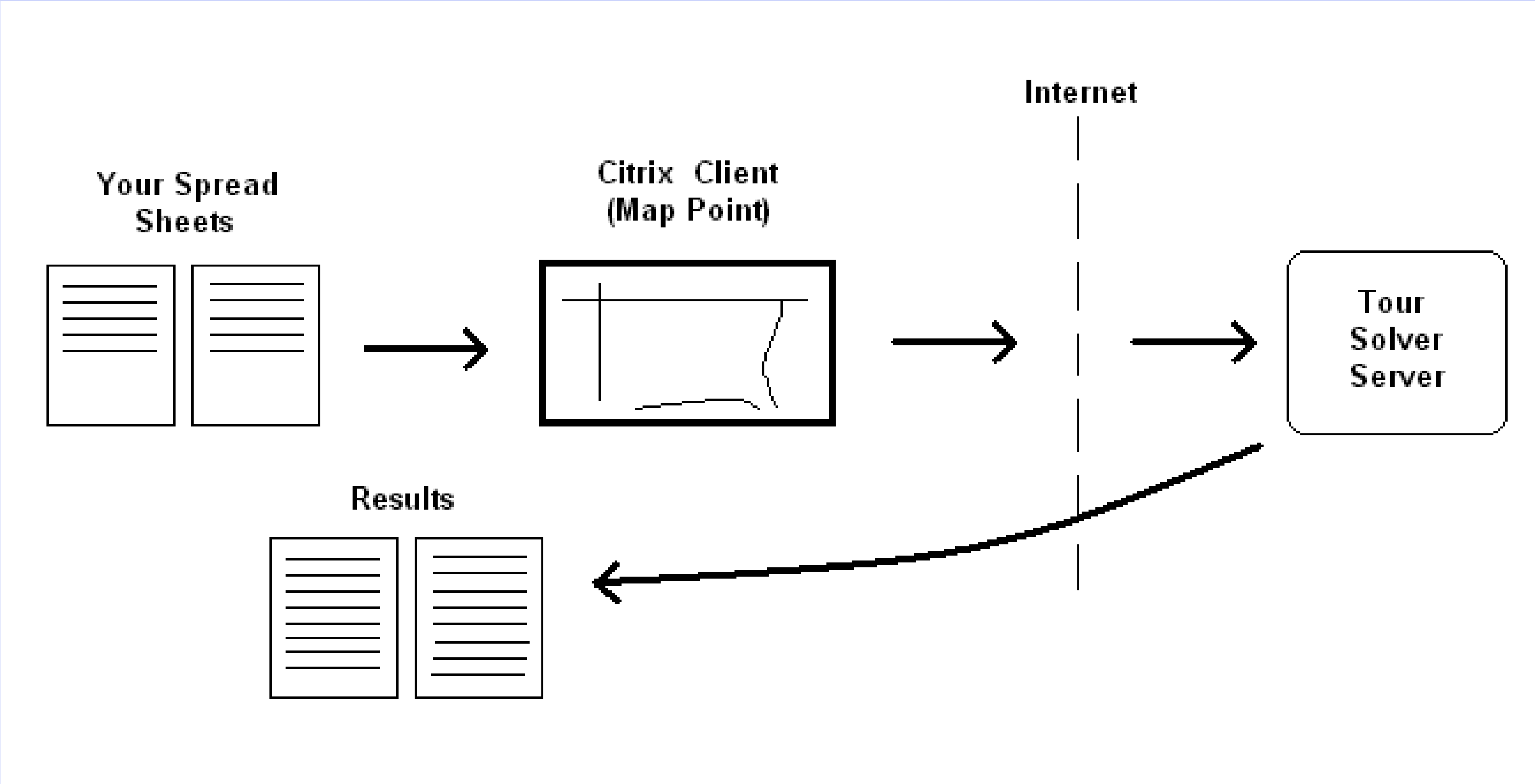
CRI Scenario: Medication Distribution

- ☑ Slack
  = how early are deliveries to PODs?
  - More slack is better: more robust plan that can handle disruptions
- ☑ Synchronizing operations is key to increasing slack.

CRI Scenario: Medication Distribution Planning

- ☑ Inputs:
  - Timeframe
  - Shipments to RSS: time, quantity
  - PODs: location, demand
  - Vehicles: number, capacity
- ☑ Output:
  - Routes for vehicles
  - Delivery schedule with quantities

Medication Distribution Planning Process



CRI Scenario: Medication Distribution Planning

☑ Routing:

- Uses TourSolver (cdcstockpilerouting.c2logix.com) to generate vehicle routes

☑ Scheduling:

- Uses tested rules to schedule deliveries and determine best quantities

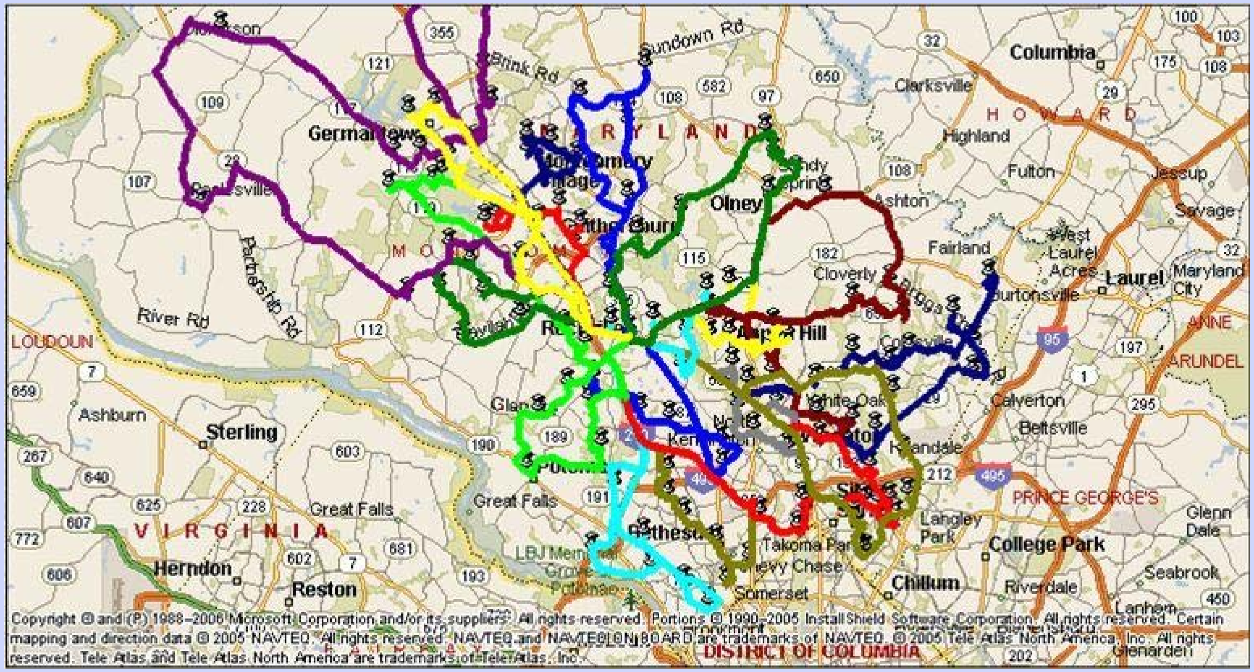
CRI Scenario:
Medication Distribution Planning

Delivery “Waves”

- ☑ Wave: A delivery to depot (RSS) followed by deliveries from depot to PODs.
- ☑ Distribution to PODs is limited by these waves.
- ☑ Our CRI Scenario: 6 waves.
  5 hours between waves.

1. Generate Routes

SNSTourSolver



2. Scheduling

- ☑ Inputs: Supply and Demand
- ☑ Output:
  - Vehicle start times
  - Minimum slack for each wave
- ☑ Assumptions: equal-sized deliveries to depot, all PODs have same dispensing rate, one delivery to each POD each wave, all vehicles start simultaneously.

Inputs

Demand

Number of PODS:	65
Total population:	500,000
Dispensing start (hours):	12
Dispensing duration (hours):	24

Supply

Number of deliveries to depot:	6
Time between deliveries	5:00
Maximum truck route time (hh:mm):	4:35
Max time to POD delivery (hh:mm):	3:52

Outputs

General Performance

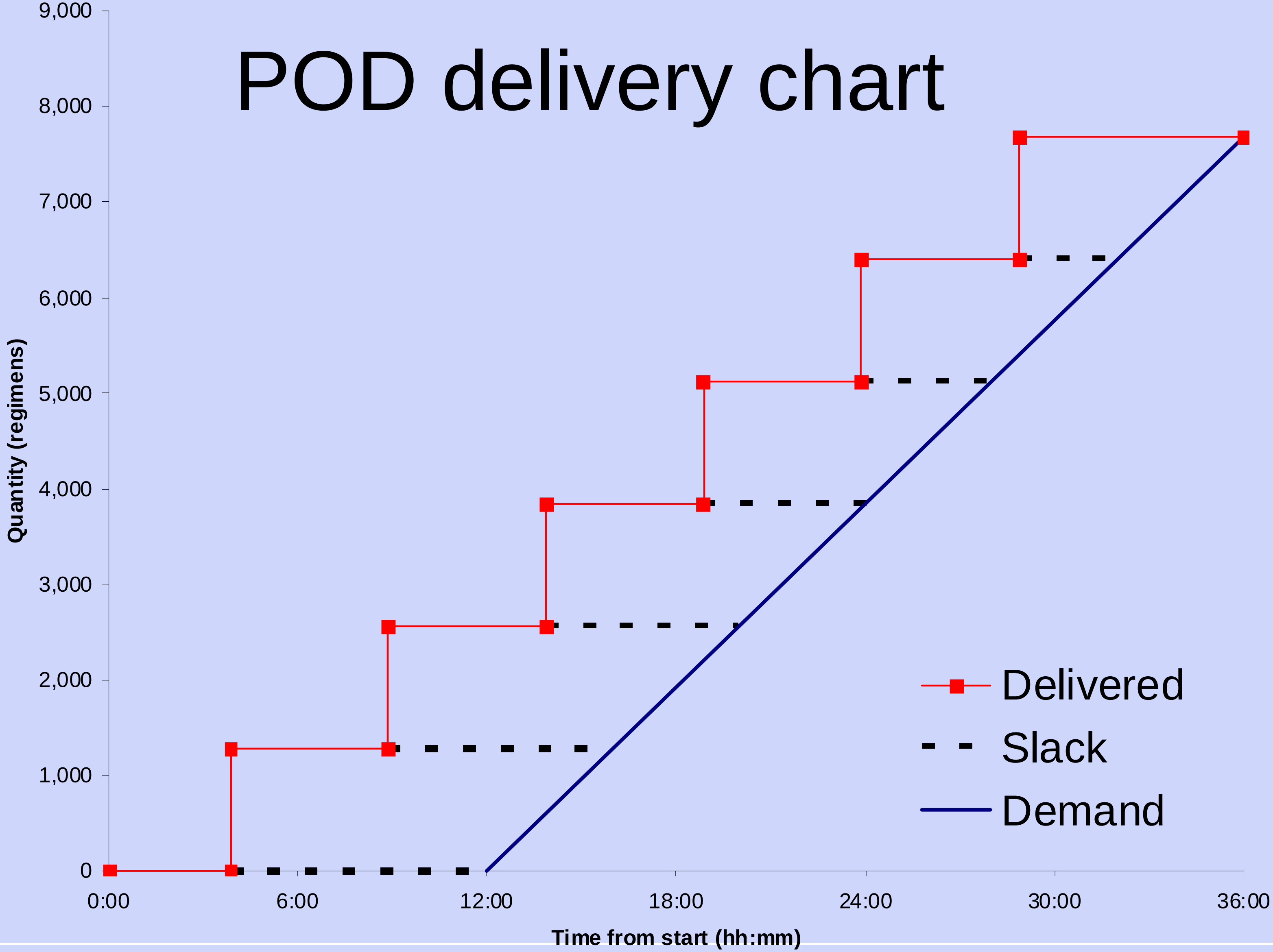
Minimum slack (hh:mm):	3:08
Total quantity needed at each POD:	7,692
Delivery quantity to each POD:	1,282
Dispensing rate (regimens per hour):	321

Results by Wave

Wave	Wave start time (hh:mm)	Minimum slack (hh:mm)
1	0:00	8:08
2	5:00	7:08
3	10:00	6:08
4	15:00	5:08
5	20:00	4:08
6	25:00	3:08

Values in **red** denote the "worst" minimum slack.

POD delivery chart



eMedCheck

Electronic Patient Screening

CRI Scenario: Patient Screening

1	2 FOR **EACH MEMBER** OF YOUR HOUSEHOLD, ANSWER ALL THREE QUESTIONS BELOW:		
	A	B	C
LIST ALL HOUSEHOLD MEMBERS FOR WHOM YOU ARE PICKING UP MEDICATIONS TODAY, INCLUDING YOURSELF	Is household member: • Pregnant • Breast feeding • Under 8 years of age	Is household member allergic to or shouldn't take any of these: • Doxycycline (Vibramycin) • Minocycline • Tetracycline	Is household member allergic to or shouldn't take any of these: • Ciprofloxacin • Levofloxacin (Levaquin) • Ofloxacin • Gatifloxacin • Moxifloxicin

DECISION MATRIX – STAFF USE ONLY

Answer A	Answer B	Answer C	Provide
No	No / DK	No / DK	Doxy
Yes / DK	No / DK	No / DK	Cipro
Yes / DK	No / DK	Yes	Doxy
Yes / DK	Yes	No / DK	Cipro
Yes / DK	Yes	Yes	Refer
No	No / DK	Yes	Doxy
No	Yes	No / DK	Cipro
No	Yes	Yes	Refer

Last name	First Name	Yes, No or Don't Know?	Yes, No or Don't Know?	Yes, No or Don't Know?	CIRCLE MEDICATION TO BE PROVIDED STAFF USE ONLY		
					Doxy	Cipro	Refer
					Doxy	Cipro	Refer
					Doxy	Cipro	Refer
					Doxy	Cipro	Refer
					Doxy	Cipro	Refer
					Doxy	Cipro	Refer
					Doxy	Cipro	Refer
					Doxy	Cipro	Refer
				Add Totals Under Doxy & Cipro Columns:			

NCR Medication Screening Form

3 **EACH PERSON SHOULD TAKE THE MEDICINE CIRCLED IN THEIR ROW.**

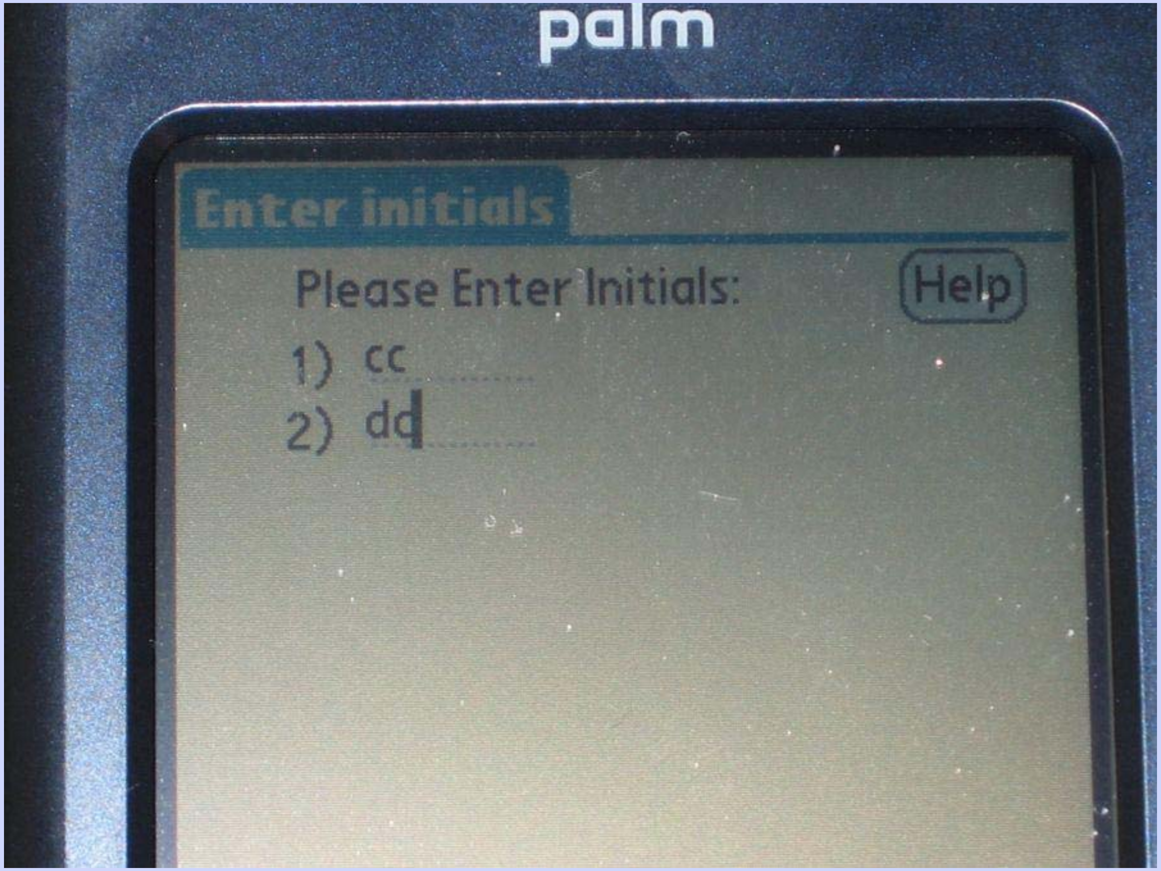
CRI Scenario: Patient Screening

CRI Scenario: Patient Screening

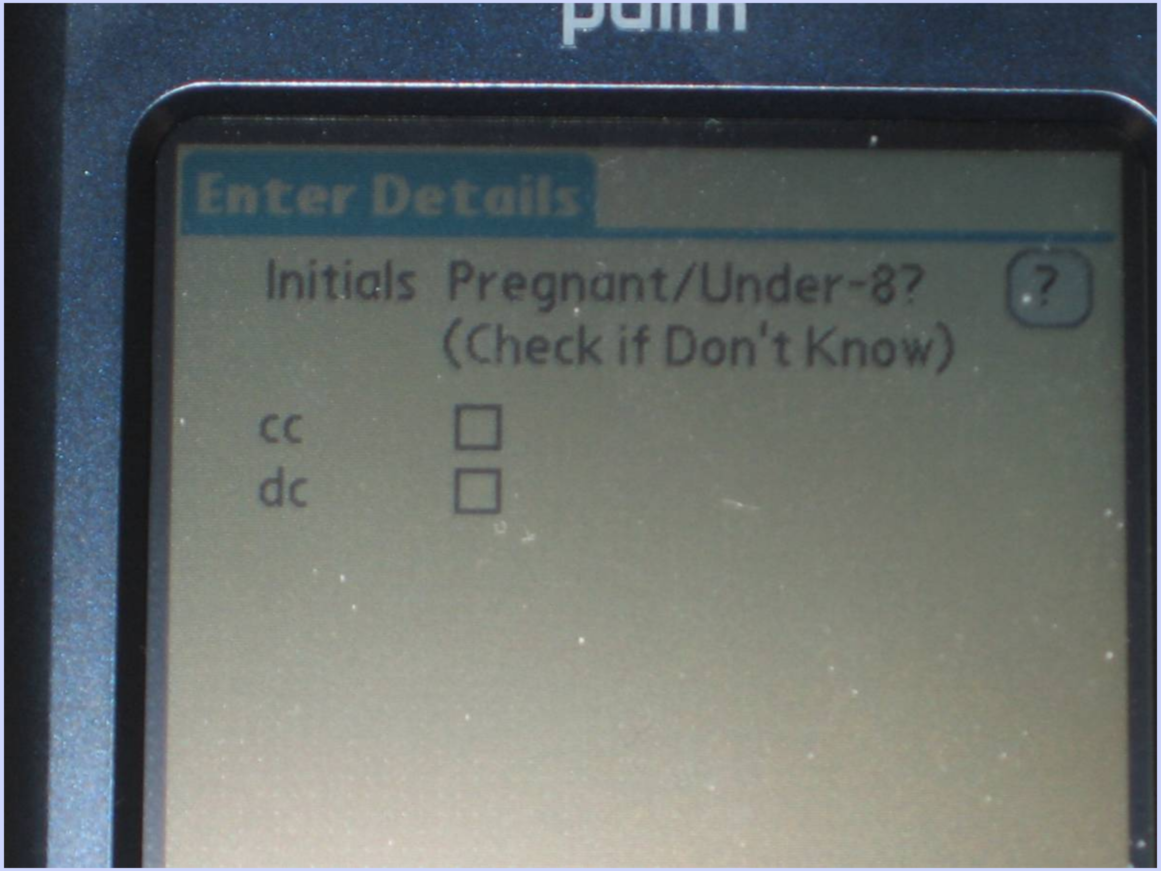
CRI Scenario: Patient Screening

Carla Court is a 55 year old female with allergies to doxycycline and ciprofloxacin. She lives with her 56 year old husband David Court who has no allergies.

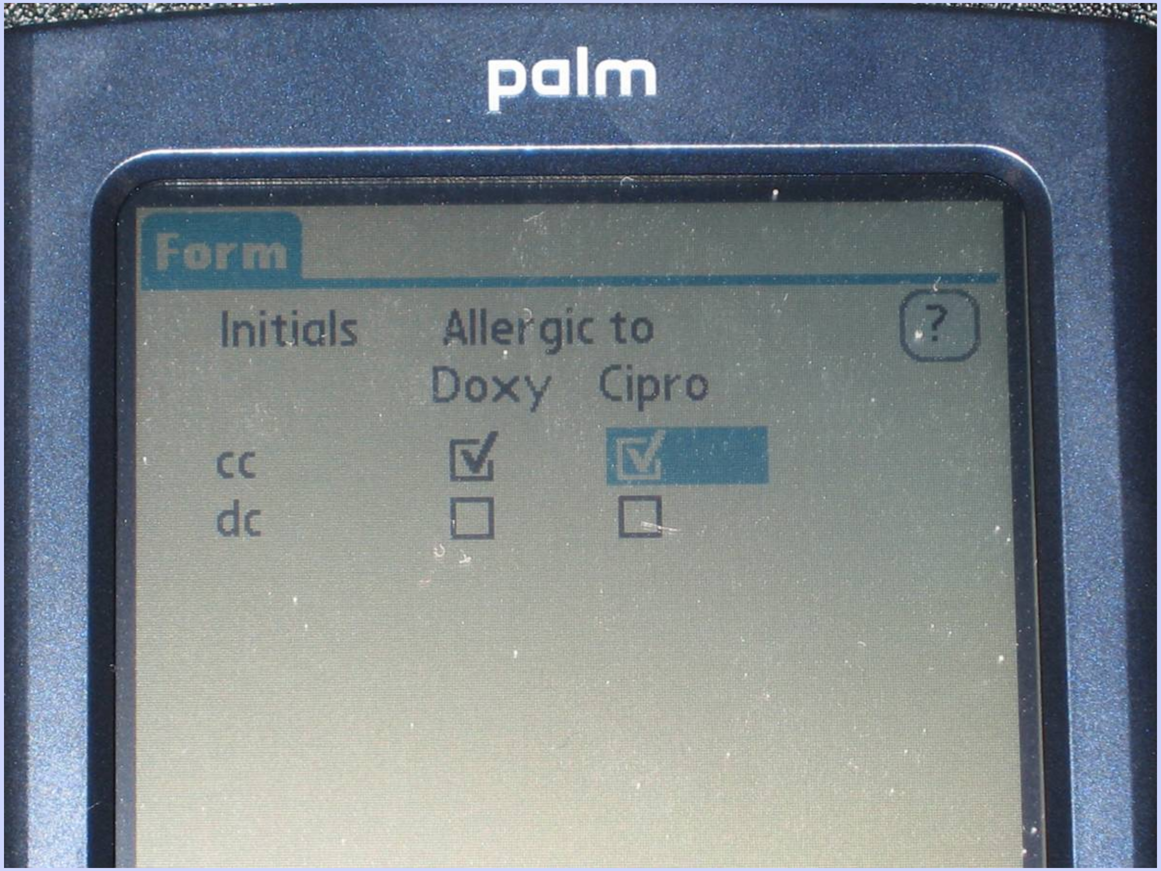
Patient Screening
Step One



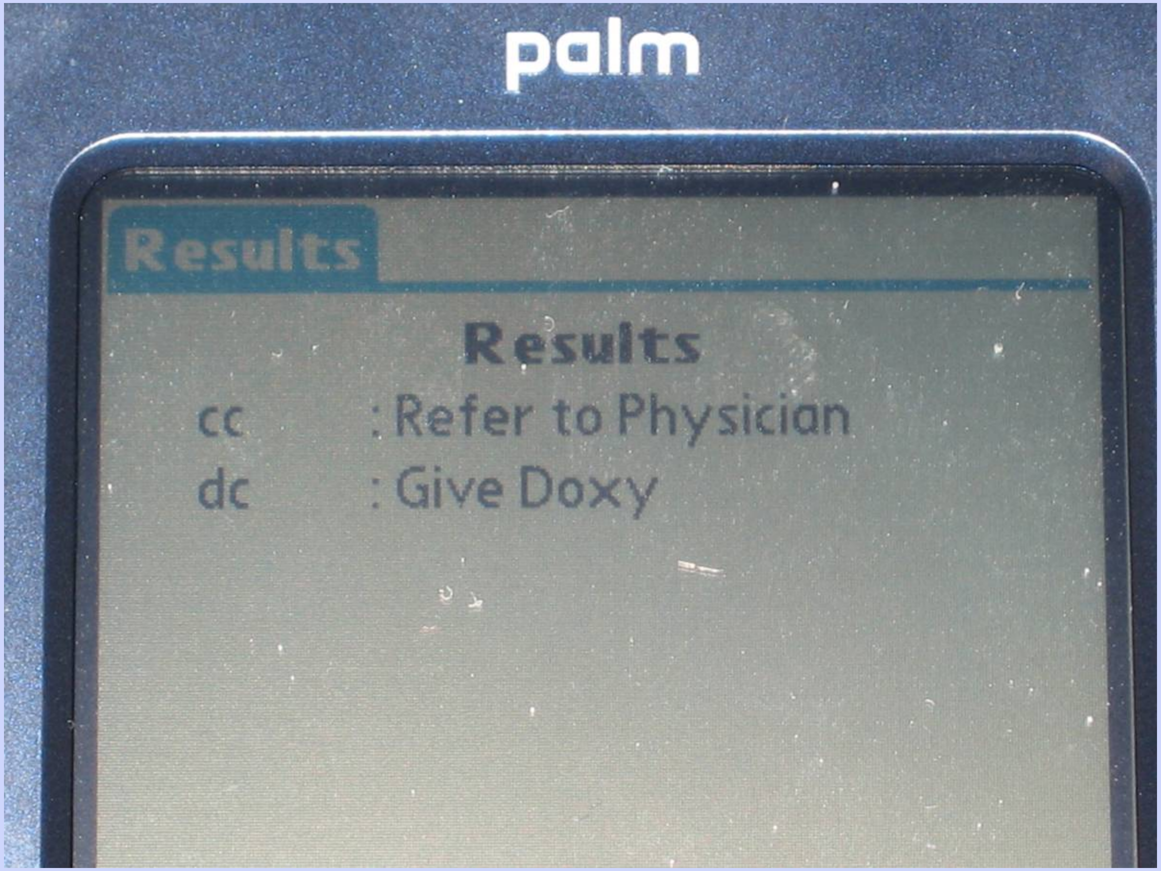
Patient Screening Step Two



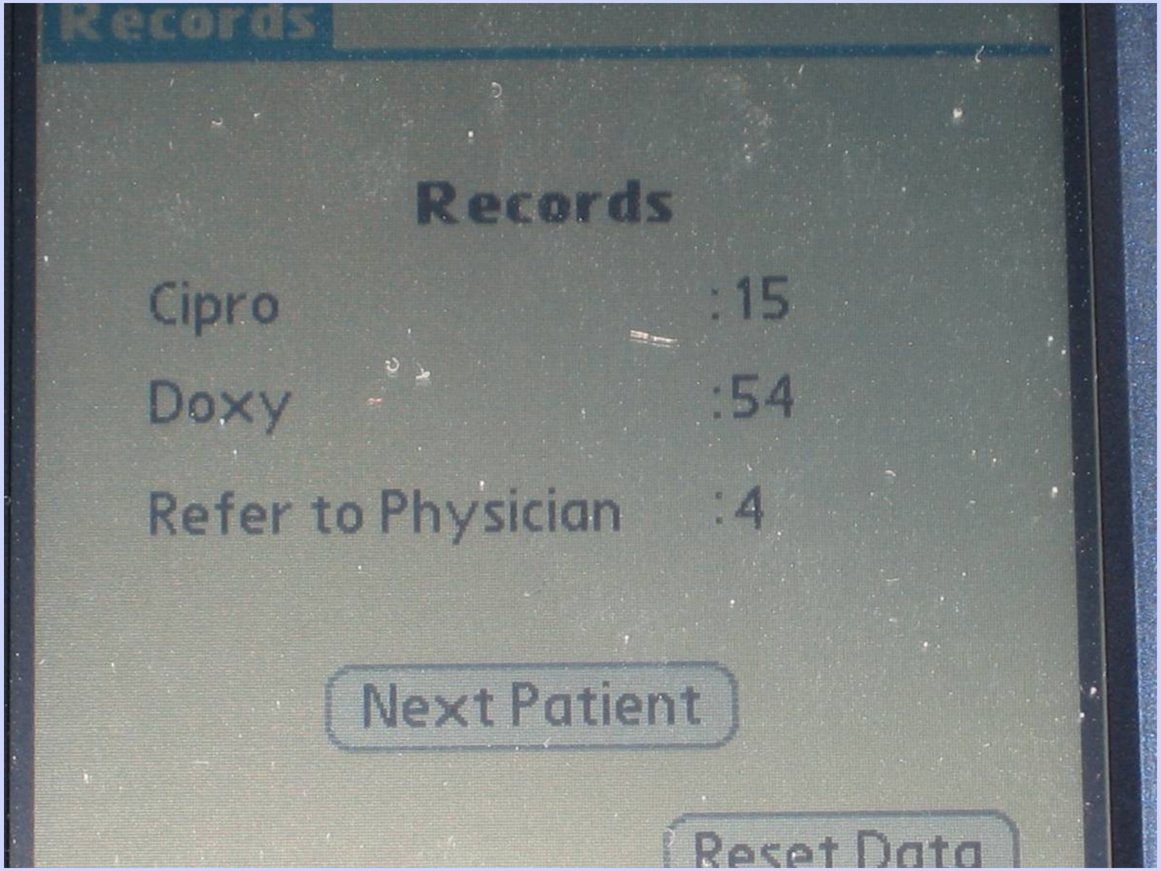
Patient Screening
Step Three



Patient Screening
Step Four



Patient Screening Next Person



Planning with Computer Models . . .

- ☑ . . . can be used for more routine operations:
  - Tuberculosis screening at high schools
  - Seasonal flu clinics
  - Other immunization clinics

Objectives

At the end of this session, participants will be able to:

1. Define the term “computer models.”
2. Identify strengths and challenges to using computer models for local public health departments.
3. Describe at least two examples of how computer models can be integrated into local public health.

Concluding Remarks

☑ We encourage you to use these tools and provide feedback to use so that we can continue to improve them and develop useful new ones.

A Final Thought

☑ Modeling should create a conversation, not answer a question.

Contact Information

- ☑ For more information about the Montgomery County Advanced Practice Center (APC) and tools please refer to the following website:

http://www.montgomerycountymd.gov/apc

- ☑ Or contact:

Kay Aaby, APC Program Manager
kay.aaby@montgomerycountymd.gov
Dr. Jeffrey Herrmann, University of Maryland
jwh2@umd.edu

☑Questions??