# Introduction to Computer Planning Models
# Module I


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# Outline

- What are computer planning models?
- Types of computer planning models
- Computer planning models during H1N1

# Module One Objectives

- Describe how computer planning models can help plan for large public health events.
- List at least three types of computer planning models.
- Describe how computer planning models assisted local public health planners during the 2009-2010 H1N1 influenza outbreak.

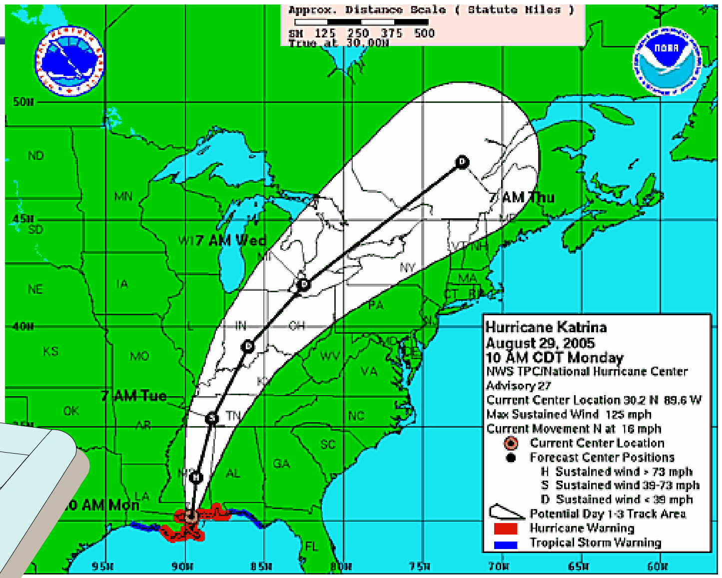
# History of Our Collaboration

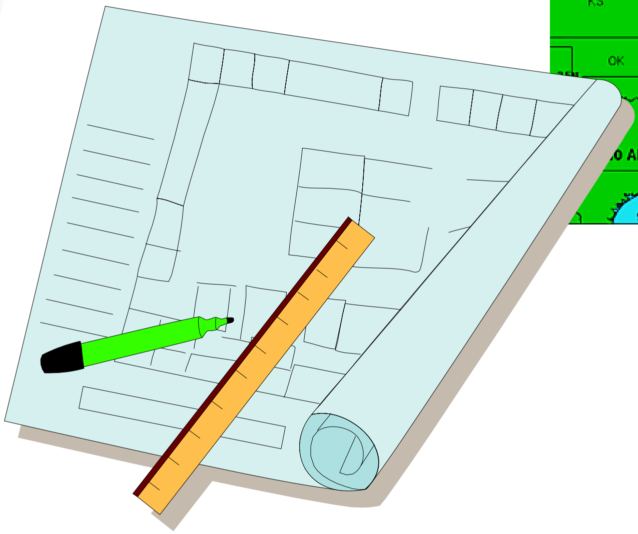
- Funding through APC

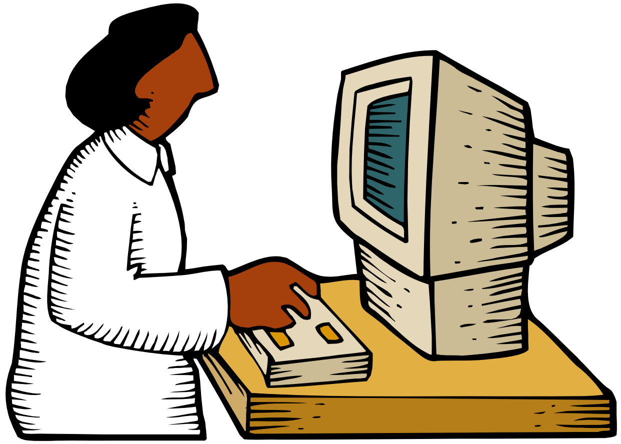
- We needed to answer the following questions:
  - How many patients per hour?
  - How large of a facility is needed?
  - How much staff is needed?
  - How do you determine most efficient flow pattern for your POD?

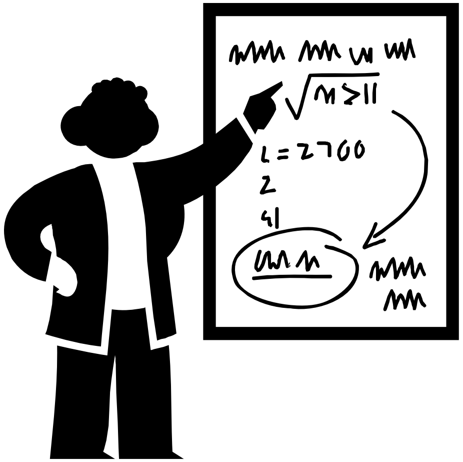
- Needed to effectively measure POD plans
- Developed several computer models to solve different problems

# Models


Approx. Distance Scale ( Statute Miles )
Hurricane Katrina
August 29, 2005
10 AM CDT Monday
NWS TPC/National Hurricane Center
Advisory 27
Current Center Location 30.2 N 89.6 W
Max Sustained Wind 125 mph
Current Movement N at 16 mph
Current Center Location
Forecast Center Positions
H Sustained wind > 73 mph
S Sustained wind 39-73 mph
D Sustained wind < 39 mph
Potential Day 1-3 Track Area
Hurricane Warning
Tropical Storm Warning
7 AM Tue
7 AM Wed
7 AM Thu





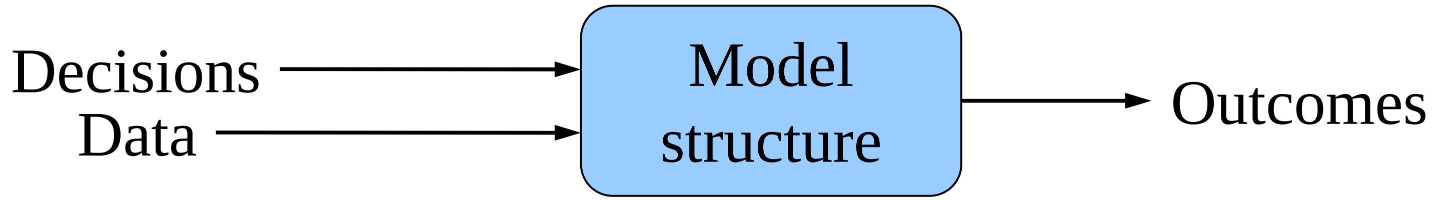


# Computer Modeling

- “Formal, quantitative representation of a real world phenomenon that allows users to do one or more of the following:
- define problems and negotiate boundaries around a system of interest;
- better understand changes within the system over time;
- anticipate the likely consequences of particular conditions; and
- estimate the relative leverage of and trade-offs associated with different action scenarios.”
  - Frumkin, 2007; Rosenfeld *et al*., 2009

# Model Features
## (Powell and Baker, 2004)

- Decisions
  - Choices, things that we control.
- Outcomes
  - Consequences, performance.
- Structure
  - Relationships between decisions and outcomes.
- Data
  - Actual observations of the real world;
  - Estimates of key variables.

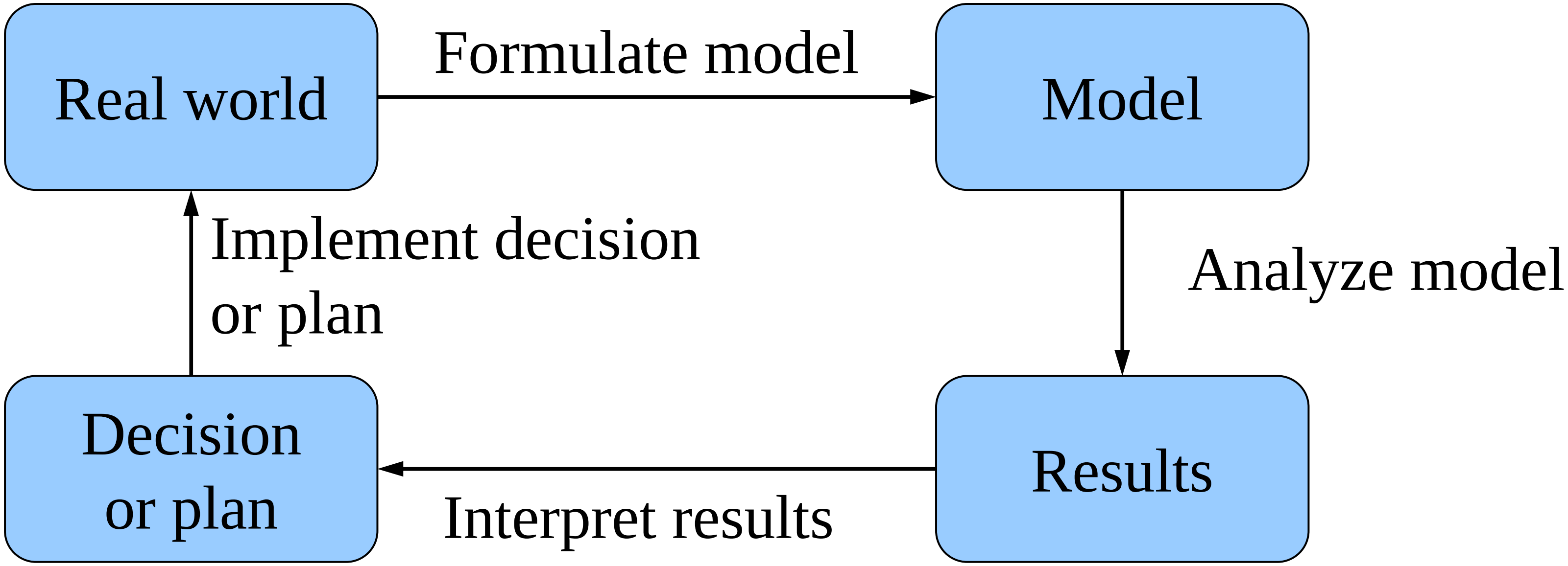


# Modeling and Decision-Making

- Modeling is a tool to improve decision-making.
- Answers questions about possible outcomes:
  - "What if we do this?"
  - "What if this happens?"
- Helps find good solutions:
  - "What is the best alternative?"

# Models and the Real World

- A model is an abstraction of the real-world; it simplifies things.
- Because it is simpler, we can test alternatives and consider different scenarios.



# Model Tradeoffs

| | |
|---|---|
| More realistic | More abstract |
| More complex | Simpler |
| More costly | Less costly |
| Slower | Faster |

# Factors affecting use of computer models for preparedness functions

- Validity: Credible and “valid” assumptions that are used to create the model
- Reliability: Confidence that the model is tested
- Authorship: Source of the model
- Accessibility: Ability to download model software
- Scalability: Capable of making adjustments to local setting
- Relevance: Current with mandates from state and federal initiatives
- Capacity: Qualified and trained staff to run models
- Applicability: To specific hazards, response functions, and/or populations
  – Rosenfeld *et al*., 2009

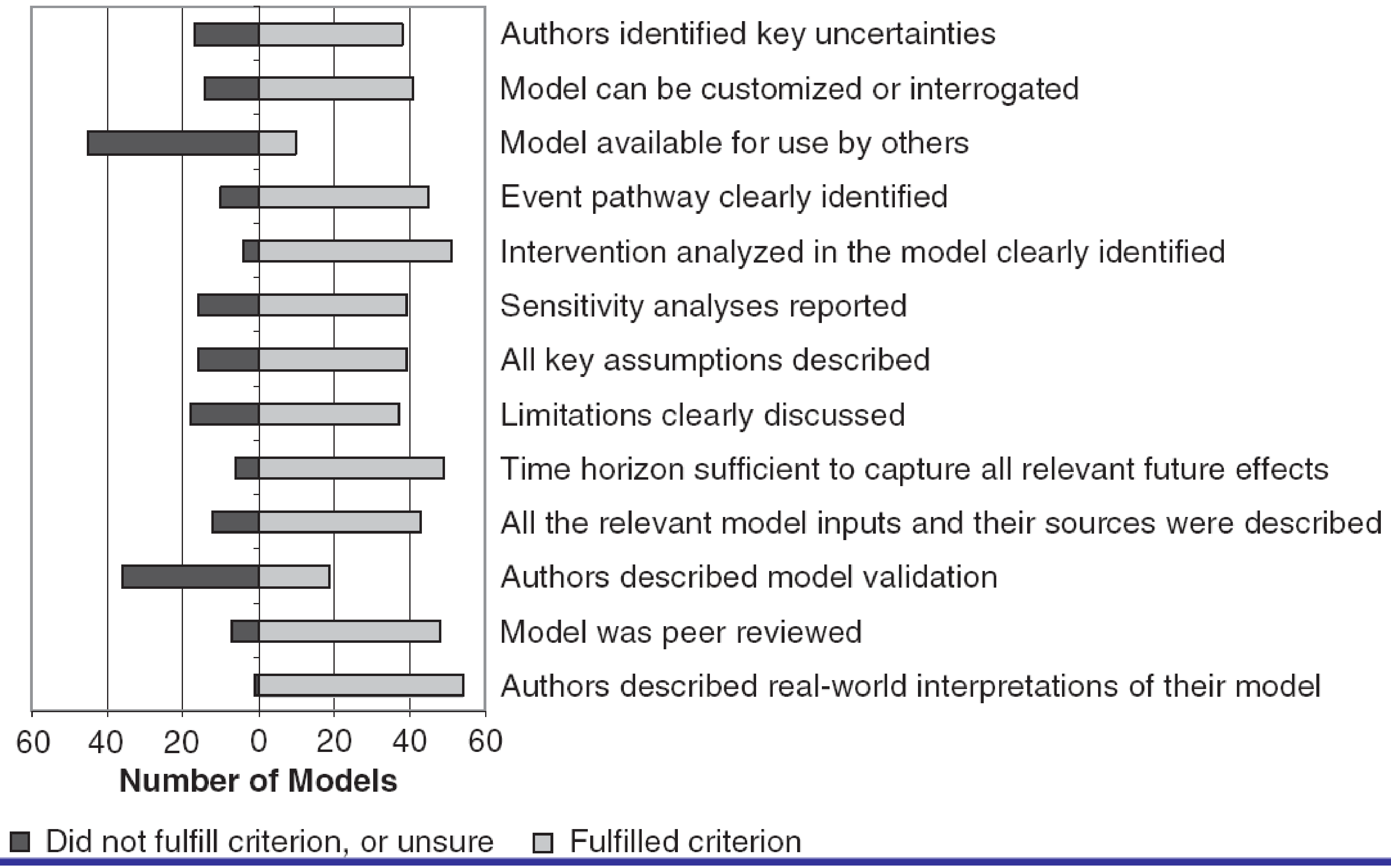
# Challenges in Using Computer Models

- Concerns about validity, reliability, model derivation or source, accessibility, and scalability.
- Insufficient time and funding to train existing staff or hire new staff.
- Difficult to become aware of new models; need better communication and dissemination.
  - Rosenfeld *et al*., 2009

# Recommendations for Modeling Disaster Responses in Public Health and Medicine

- Health sector disaster response models should
  - address real-world problems,
  - be designed for maximum usability by response planners,
  - strike the appropriate balance between simplicity and complexity,
  - include appropriate outcomes that extend beyond those considered in traditional cost-effectiveness analyses,
  - and be designed to evaluate the many uncertainties inherent in disaster response.
- Good model reporting is particularly critical for disaster response models.
  - Brandeau *et al*. (2009)

# Key quality criteria for reporting
## (Brandeau *et al.*, 2009)



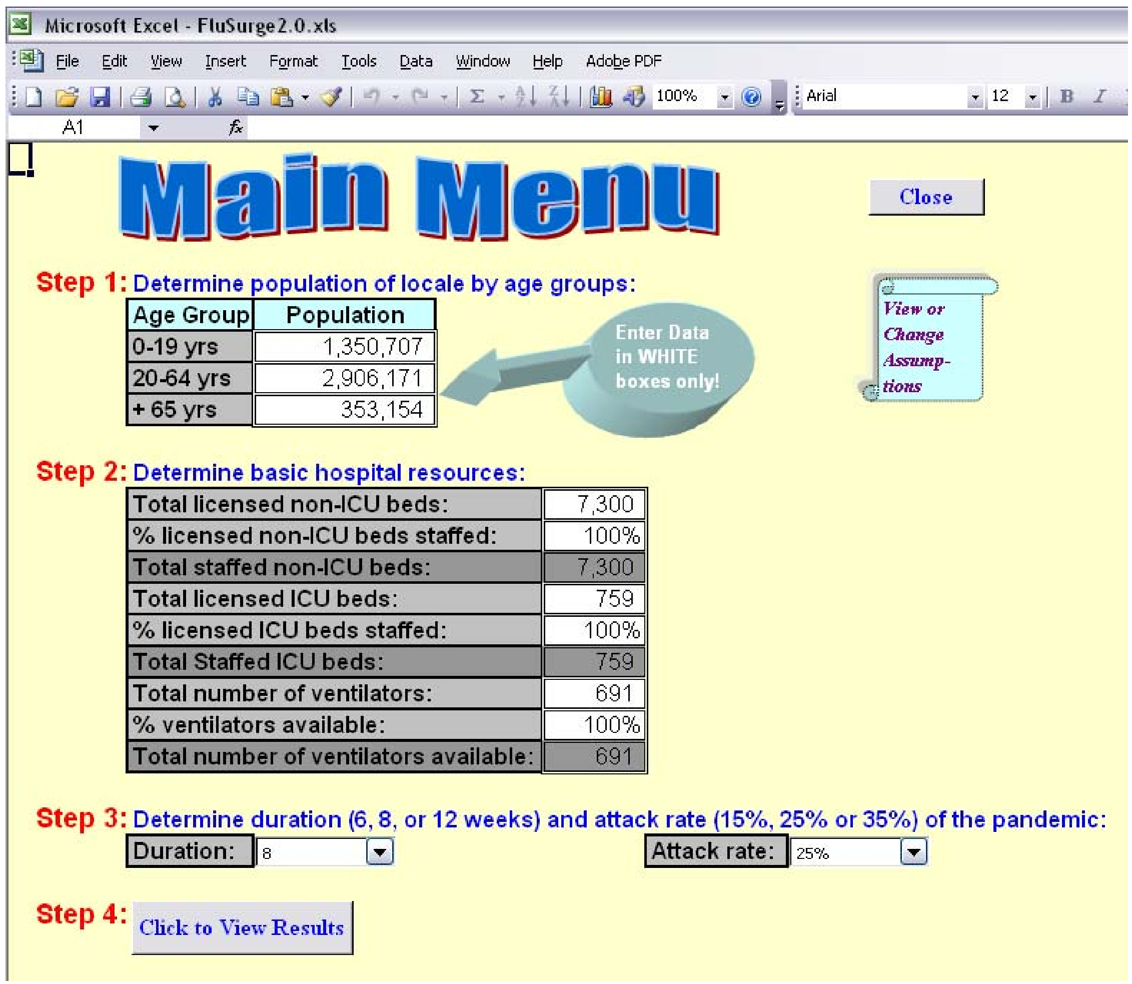
# Pandemic Flu

- FluAid 2.0: provides a range of estimates of impact in terms of deaths, hospitalizations, and outpatients visits due to pandemic influenza.
- FluSurge: estimates the number of hospitalizations and deaths of an influenza pandemic (whose length and virulence are determined by the user) and compares the number of persons hospitalized, the number of persons requiring ICU care, and the number of persons requiring ventilator support during a pandemic with existing hospital capacity.
- FluLabSurge: predicts demand for specimen testing.
- FluWorkLoss: estimates the potential number of days lost from work due to an influenza pandemic.
- InfluSim 2.1: predicts the course of an influenza epidemic in a fully susceptible population.
- Vaccine Allocation Model is a Microsoft Excel workbook that can determine how many persons in different target groups can receive treatment if the number of vaccinations available is limited.

# FluSurge 2.0

- Estimates the number of hospitalizations and deaths of an influenza pandemic;
- Compares the number of persons hospitalized, the number of persons requiring ICU care, and the number of persons requiring ventilator support during a pandemic with existing hospital capacity.
- Users can change some assumptions:
  – the average length of hospital stay for an influenza-related illness
  – the percentage of influenza-related hospital admits that will require a bed in an Intensive Care Unit (ICU)

# FluSurge 2.0


Microsoft Excel - FluSurge2.0.xls
File Edit View Insert Format Tools Data Window Help Adobe PDF
100%
Arial
12
A1
Main Menu
Close
Step 1: Determine population of locale by age groups:
Age Group | Population
0-19 yrs | 1,350,707
20-64 yrs | 2,906,171
+ 65 yrs | 353,154
Enter Data in WHITE boxes only!
View or Change Assump-tions
Step 2: Determine basic hospital resources:
Total licensed non-ICU beds: 7,300
% licensed non-ICU beds staffed: 100%
Total staffed non-ICU beds: 7,300
Total licensed ICU beds: 759
% licensed ICU beds staffed: 100%
Total Staffed ICU beds: 759
Total number of ventilators: 691
% ventilators available: 100%
Total number of ventilators available: 691
Step 3: Determine duration (6, 8, or 12 weeks) and attack rate (15%, 25% or 35%) of the pandemic:
Duration: 8
Attack rate: 25%
Step 4:
Click to View Results

# POD Planning Models

- Bioterrorism and Epidemic Outbreak Response Model (BERM): allows planners to formulate realistic mass antibiotic dispensing and vaccination contingency plans for their target populations.
- Clinic Planning Model Generator: evaluates plans for mass vaccination or dispensing sites (PODs), including estimates of patient waiting time and staff utilization.
- Clinic Surge Planning Model: for short-duration, high-volume clinics that have a surge of patients when the clinic opens.
- Maxi-Vac: calculates staffing requirements and allocates staff for large-scale smallpox vaccination clinics.
- RealOpt: includes simulation and optimization modules to determine staffing that optimizes performance in user-defined scenarios.
- RealOpt Regional: identifies the best locations for multiple PODs.
- Vaccine refrigeration planning model: determines the storage space needed to keep vaccine refrigerated.

# Other models

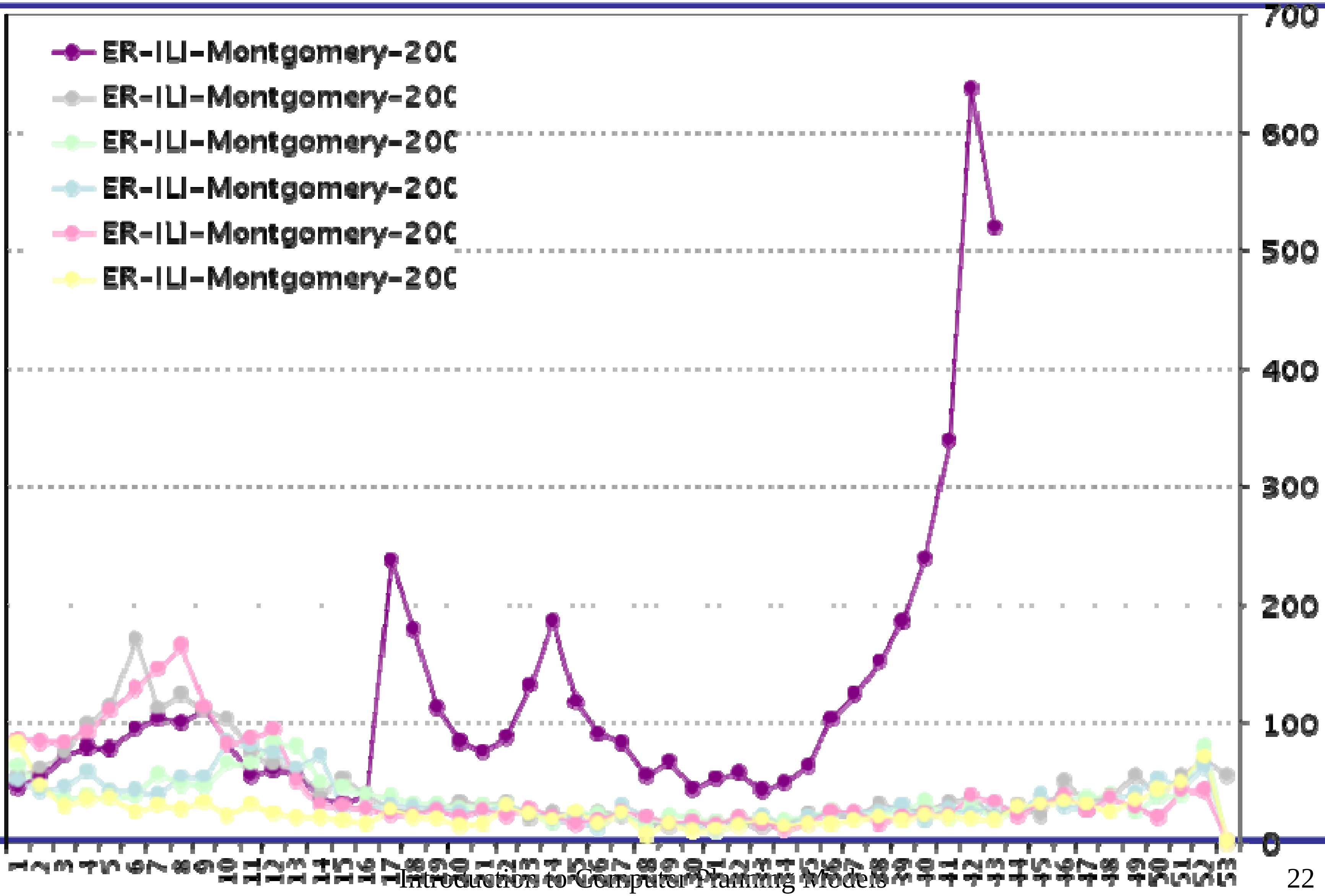
- Evacuation Planning
  - Urban to Rural Evacuation Tool: presents statistical data for counties surrounding large cities where evacuations may occur in case of a terrorist attack or other disaster.
- Casualty Assessment
  - EMCAPS: estimates casualties arising from biological (Anthrax, Plague, Food Contamination), chemical (blister, nerve and toxic agents) radiological (dirty bomb) or explosive (IED) attacks.
- Decontamination Operations
  - Mass Casualty Detailed Decontamination Model: calculates decontamination throughput and decontamination site staffing.
- RSS Operations
  - SNS TourSolver: web-based software for use by the Strategic National Stockpile for planning and managing distributions.
- Radiologic release
  - plume models
- Severe heat wave
  - National Weather Service Heat Index

# *Using Computer Models to Plan H1N1 Vaccination Clinics*

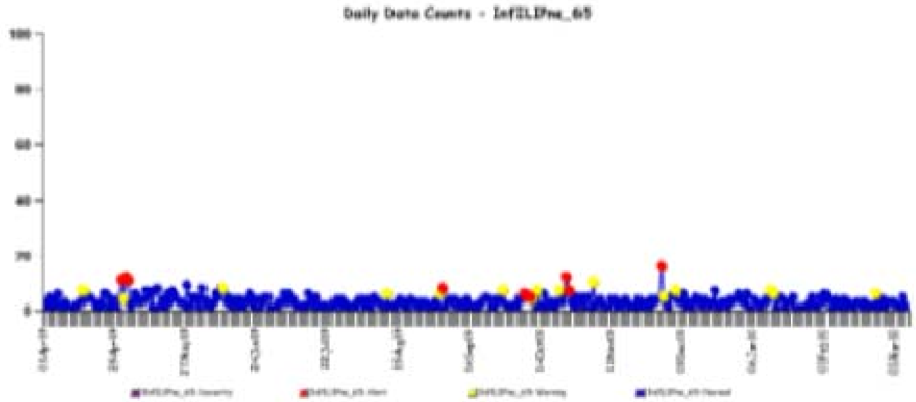
# H1N1 Background

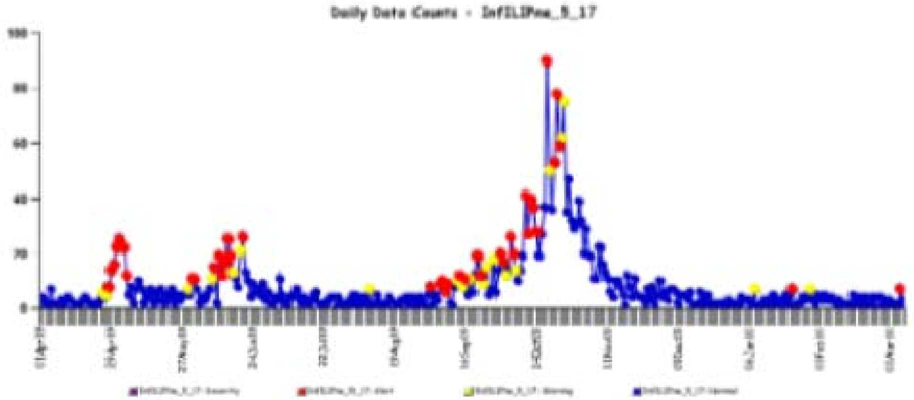
- Late March first discovery of H1N1 in Mexico
- WHO declared a flu pandemic in June 2009
- Development of vaccine July-September 2009
- Vaccine distribution began in early October 2009
- LHDs across the country began vaccination clinics to priority groups in October 2009

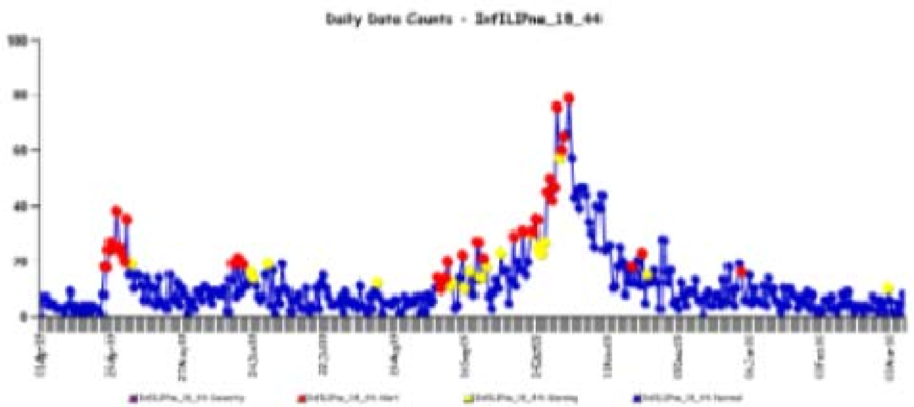
# Number of ER Encounters



# ILI Age Comparison



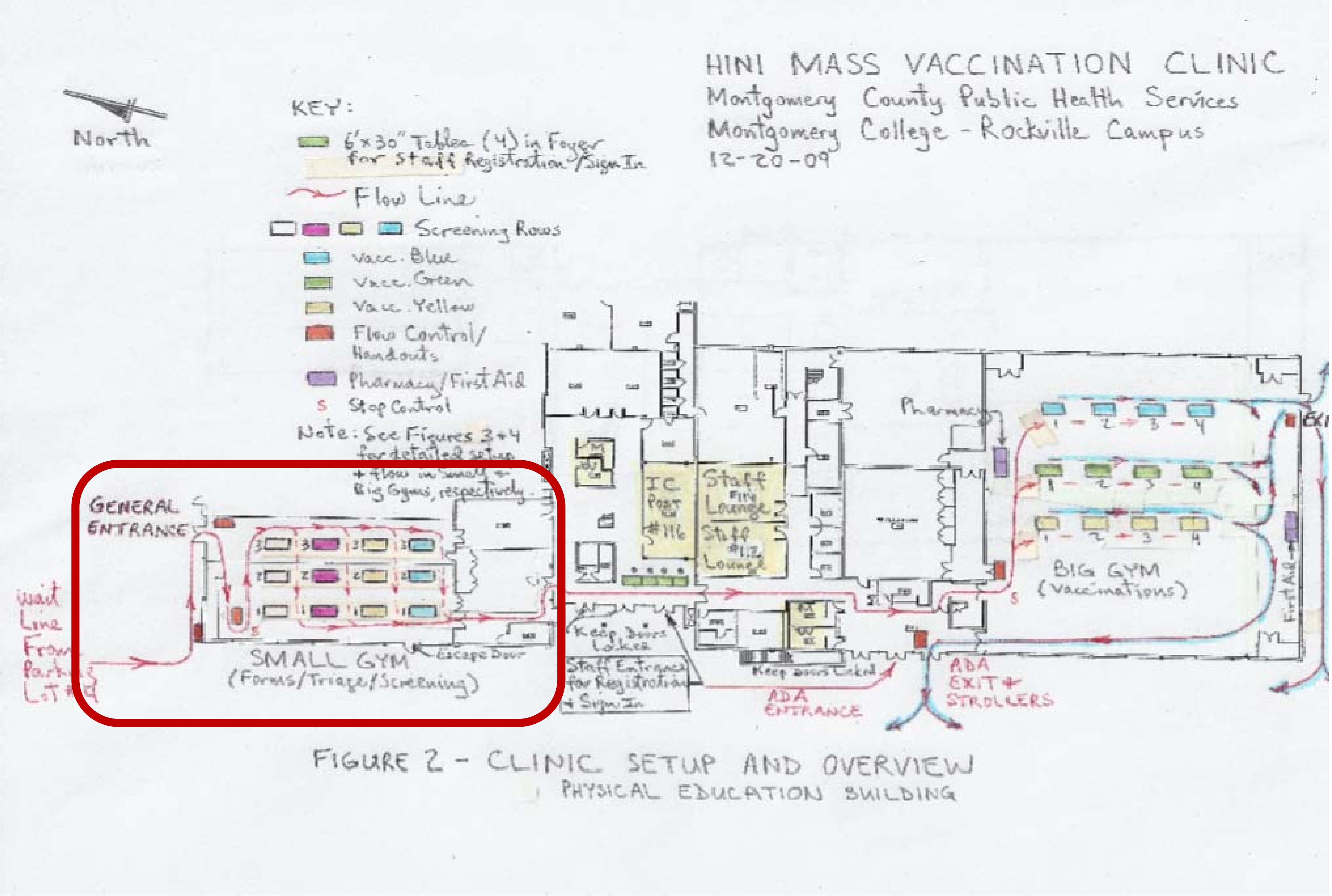




# H1N1 Scenario

- Montgomery County MD was charged with planning a mass vaccination clinic for 5,000 people in November 2009.
  - A four hour limit was imposed (not including setup and demobilization)
  - Located on a Sunday at a local community college
  - Open to all-priority groups

# Clinic Layout/Site Selection



# Clinic Layout/Site Selection

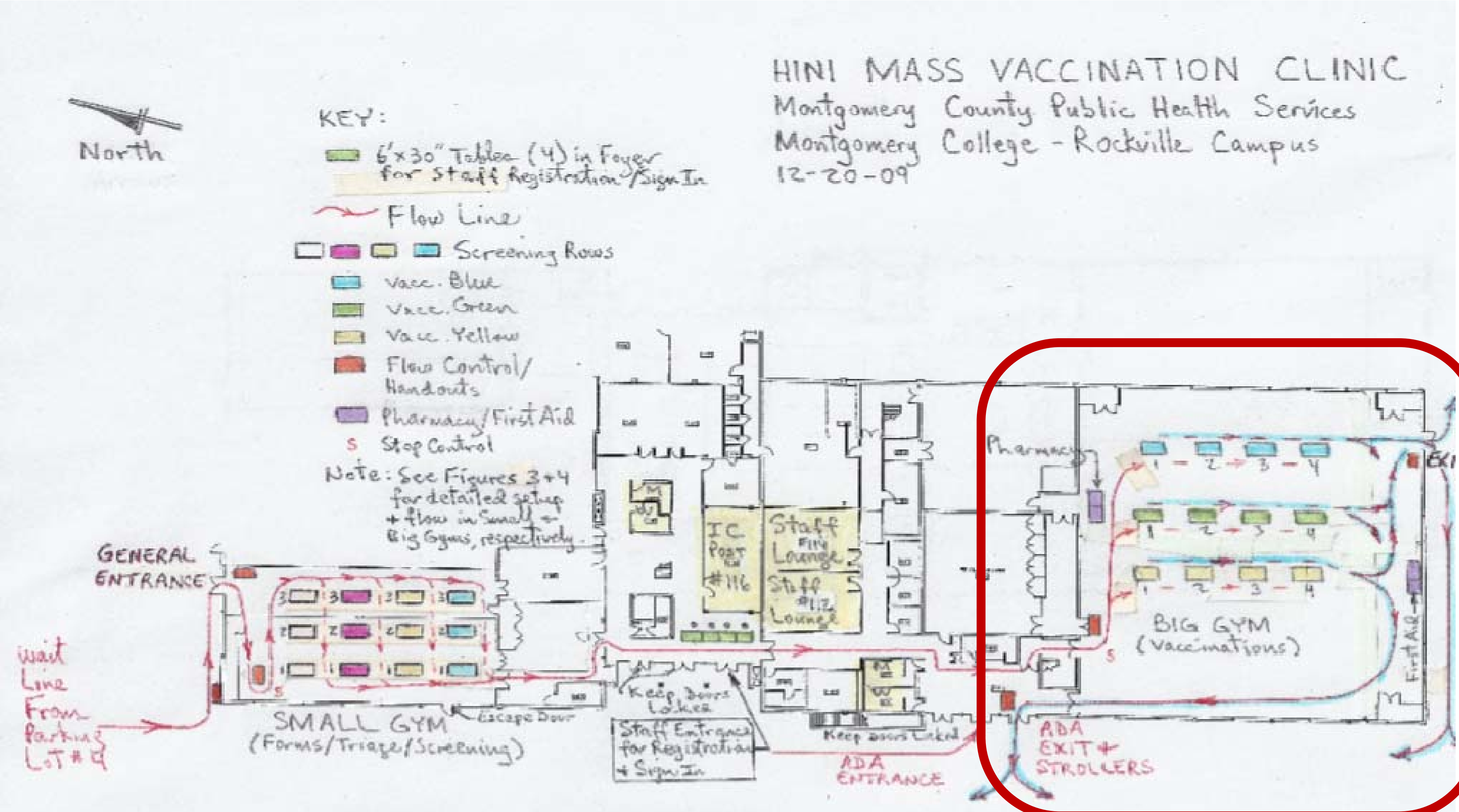
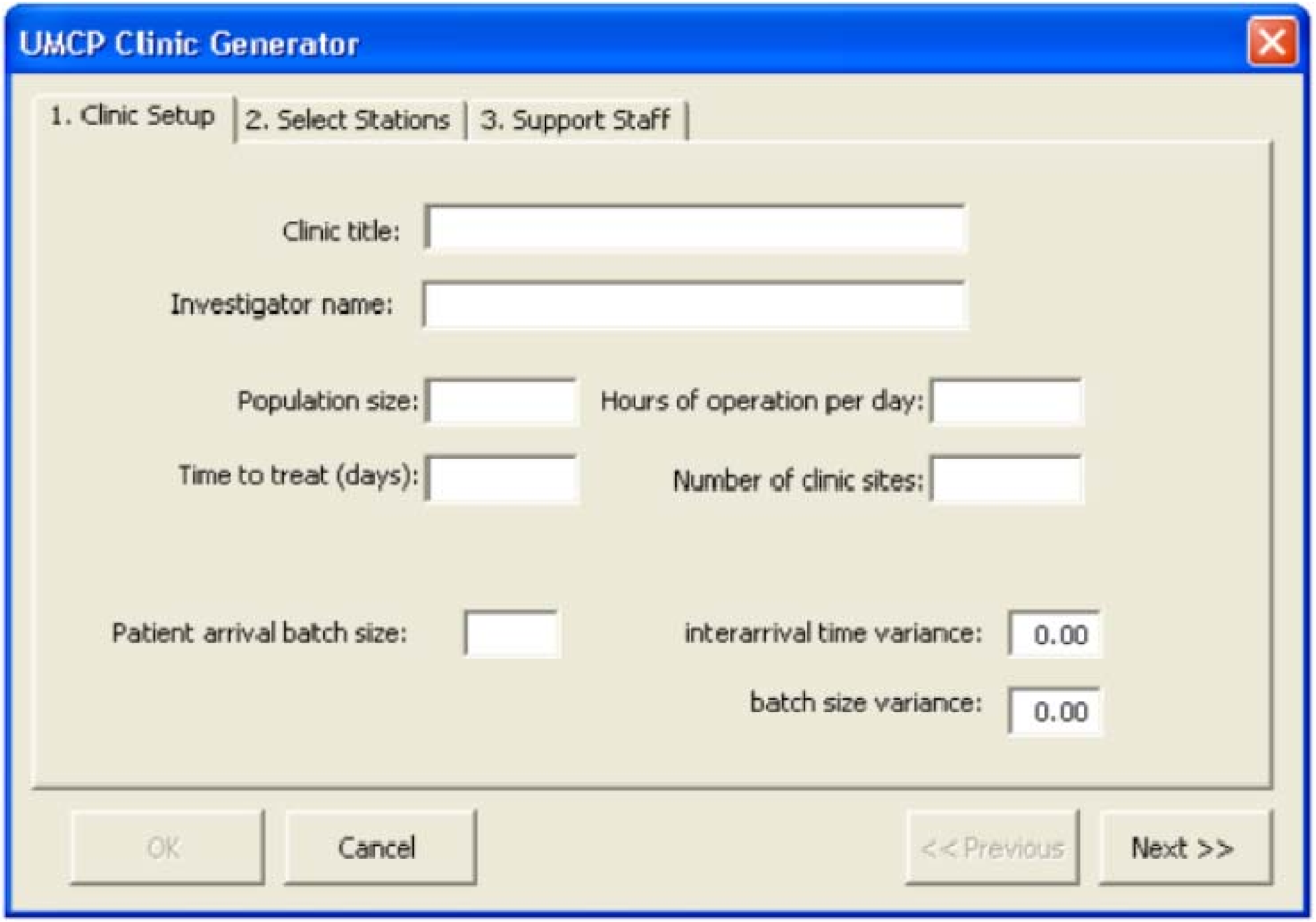
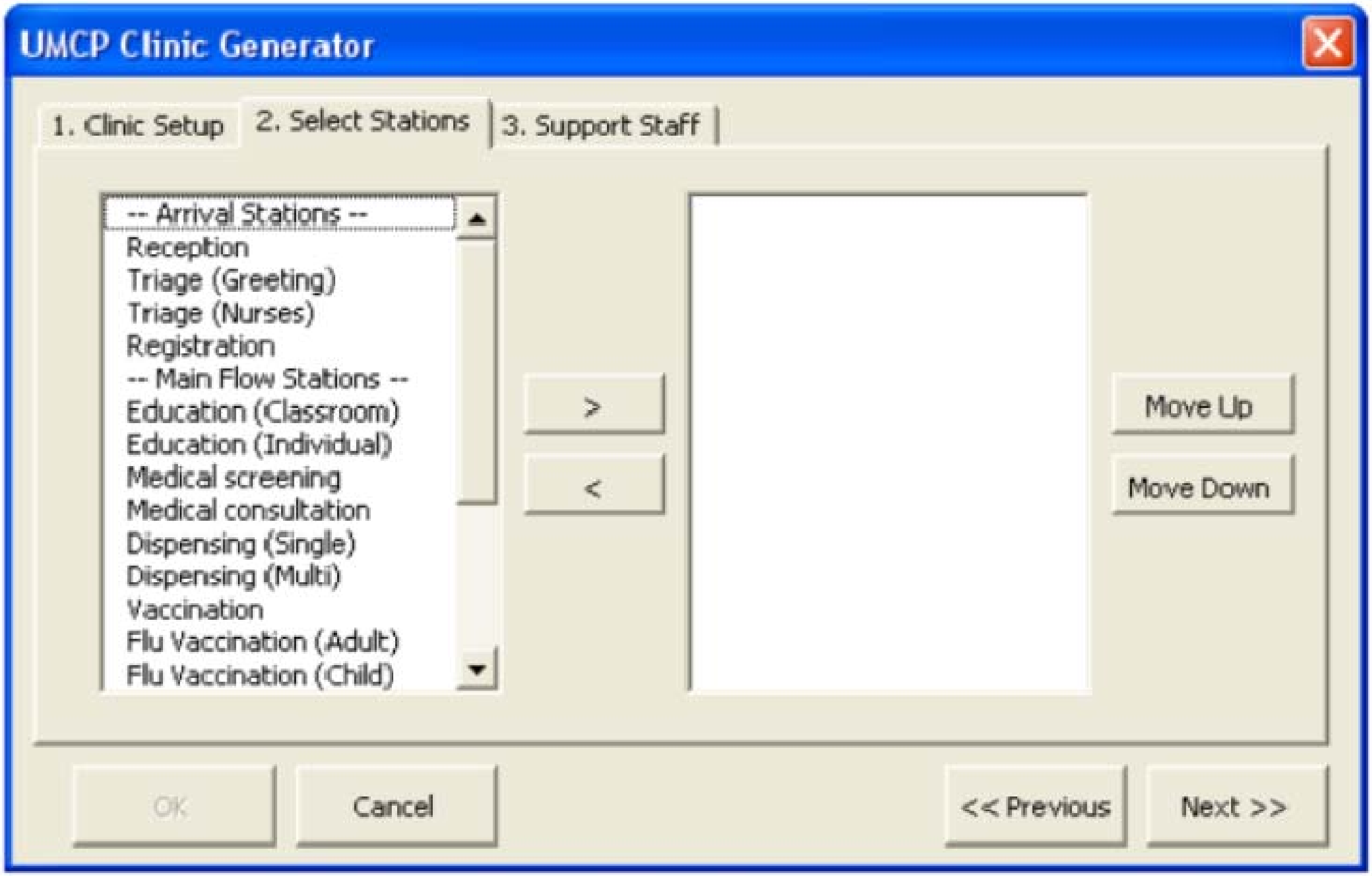



FIGURE 2 - CLINIC SETUP AND OVERVIEW
PHYSICAL EDUCATION BUILDING

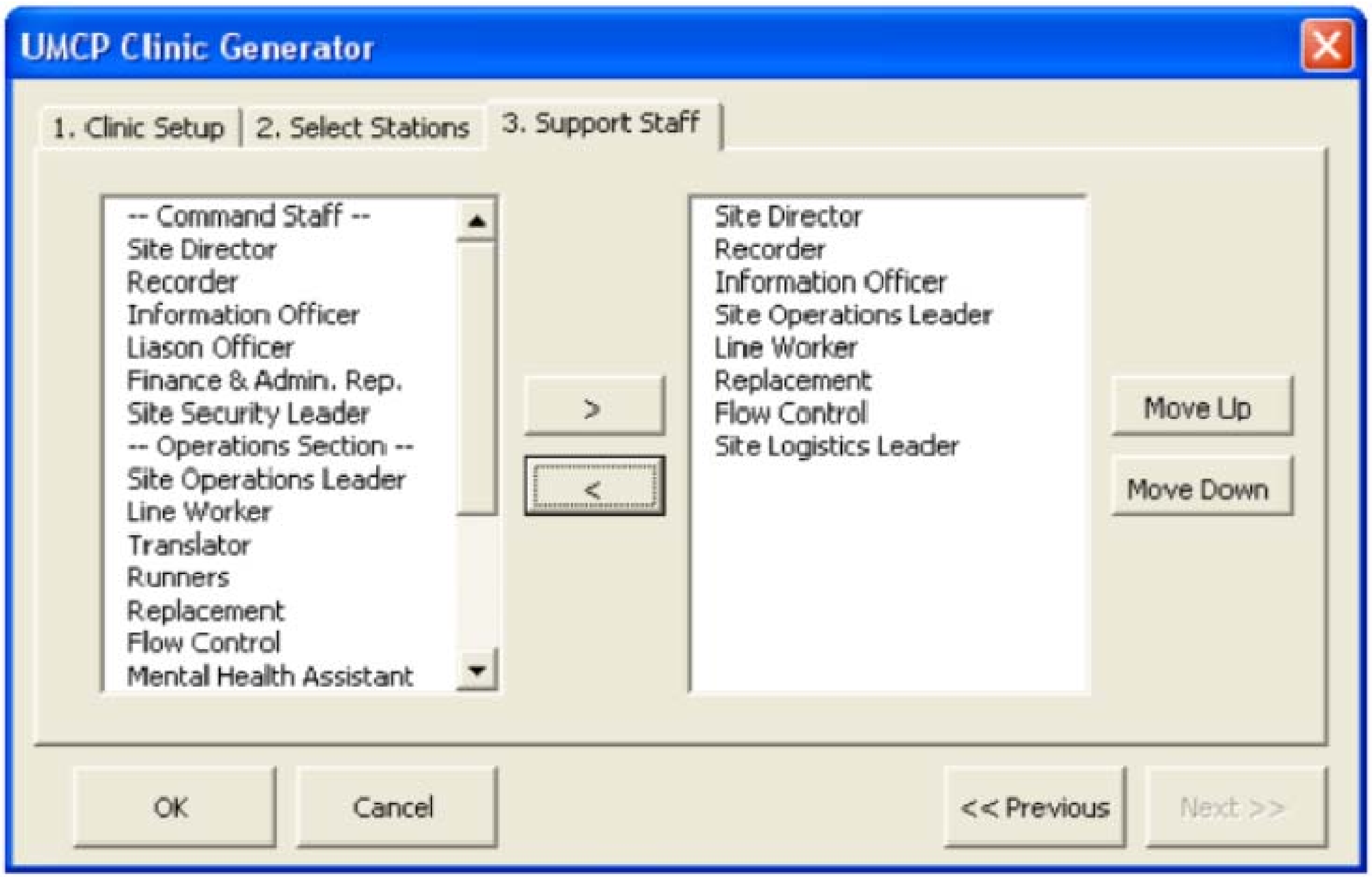
# CPMG Development-Screen One



# CPMG Development-Stations



# CPMG Development-Support Staff



# CPMG Development-Routing

**Routing Probabilities**

| From Triage/Pre-Screening | From Medical screening | From Flu Vaccination (All ages) | |
|---|---|---|---|
| 98.0% | | | To Medical screening |
| 0.0% | 99.0% | | To Flu Vaccination (All ages) |
| 2.0% | 1.0% | 100.0% | To Exit |
| | | | |
| *100.0%* | *100.0%* | *100.0%* | *Sum* |

Sum should be 100%

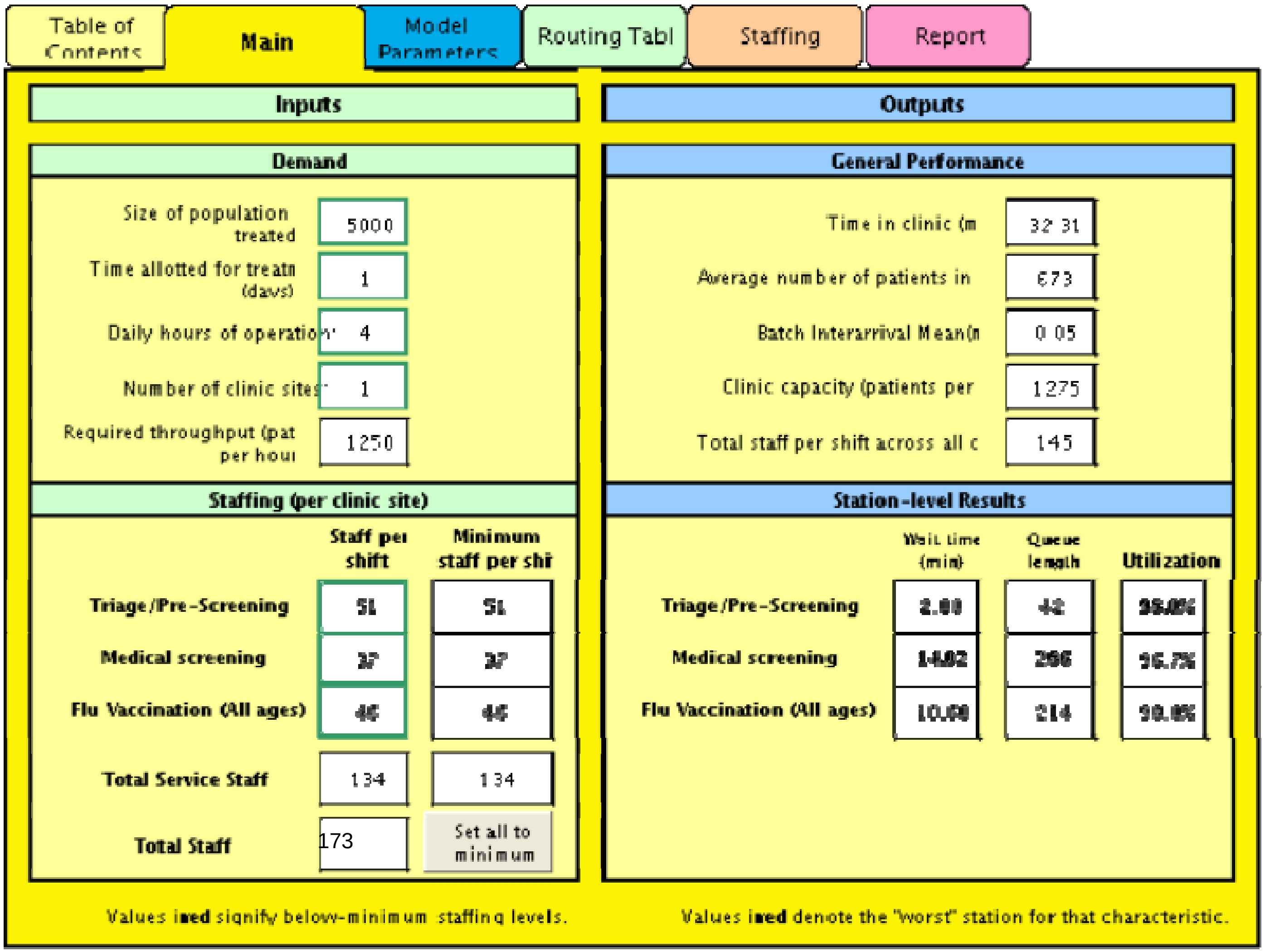
# CPMG Development-Model Parameters

**Arrival:**

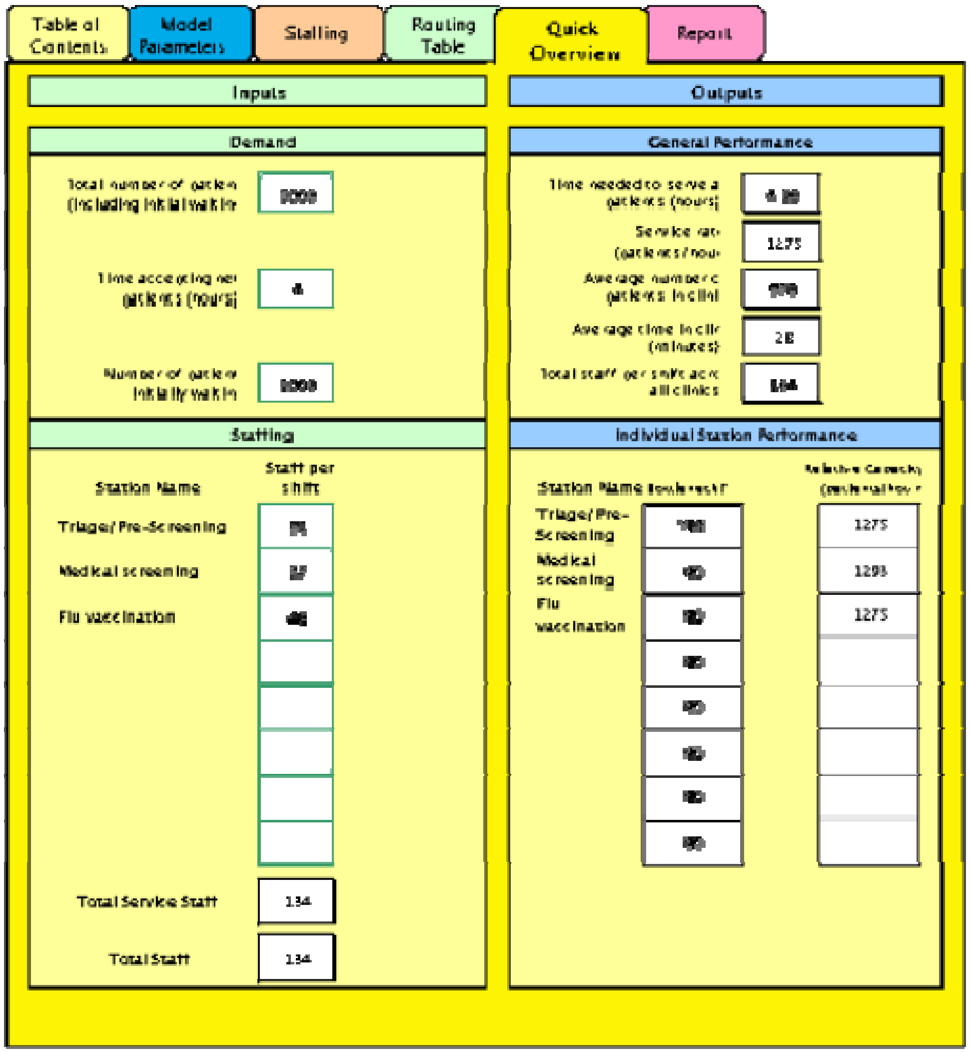
| | | | |
|---|---|---|---|
| Arrival batch size | 1 | Arrival batch size variance | 0 |
| Interarrival time SCV | 1 | | |
| Average walk speed (ft/s) | 4.05 | | |

| Station | Processing Time (min) | Variance (min²) | Batch Size | Self service |
|---|---|---|---|---|
| Triage/Pre-Screening | 2.4 | 0.0741 | 1 | FALSE |
| Medical screening | 1.752 | 1.6104 | 1 | FALSE |
| Flu Vaccination (All ages) | 2.2306 | 0.8554 | 1 | FALSE |

# Staff Planning



# Surge Planning



# Actual Event

Table of Contents | **Main** | Model Parameters | Routing Table | Staffing | Report

## Inputs

### Demand

| | |
|---|---|
| Size of population to be treated | 3947 |
| Time allotted for treatment (days) | 1 |
| Daily hours of operation | 4 |
| Number of clinic sites | 1 |
| Required throughput (patients per hour) | 987 |

### Staffing (per clinic site)

| | Staff per shift | Minimum staff per shift |
|---|---|---|
| **Triage/Pre-Screening** | 30 | 25 |
| **Medical screening** | 33 | 41 |
| **Flu Vaccination (All ages)** | 81 | 36 |
| **Total Service Staff** | 144 | 102 |
| **Total Staff** | 183 | Set all to minimum |

Values in red signify below-minimum staffing levels.

## Outputs

### General Performance

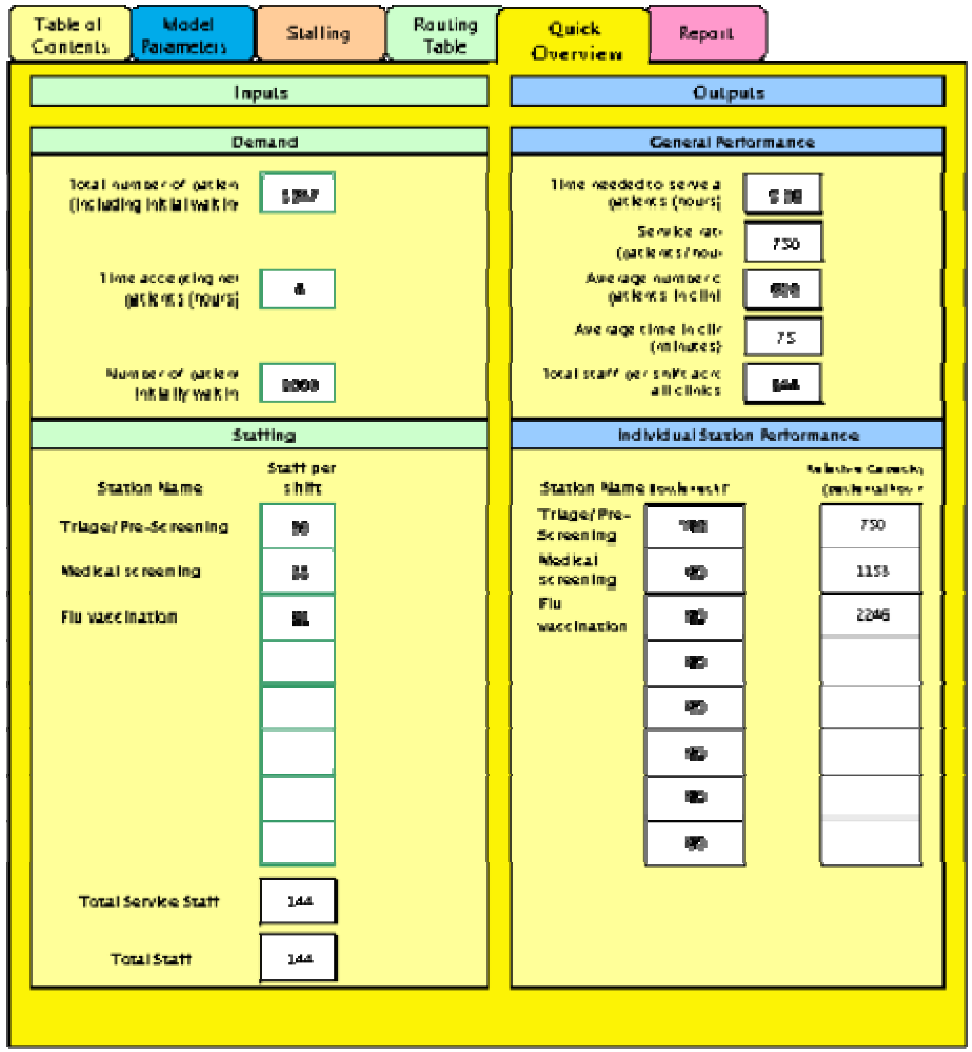
| | |
|---|---|
| Time in clinic (min) | 5.16 |
| Average number of patients in clinic | 85 |
| Batch Interarrival Mean (min) | 0.06 |
| Clinic capacity (patients per hour) | 808 |
| Total staff per shift across all clinics | 155 |

### Station-level Results

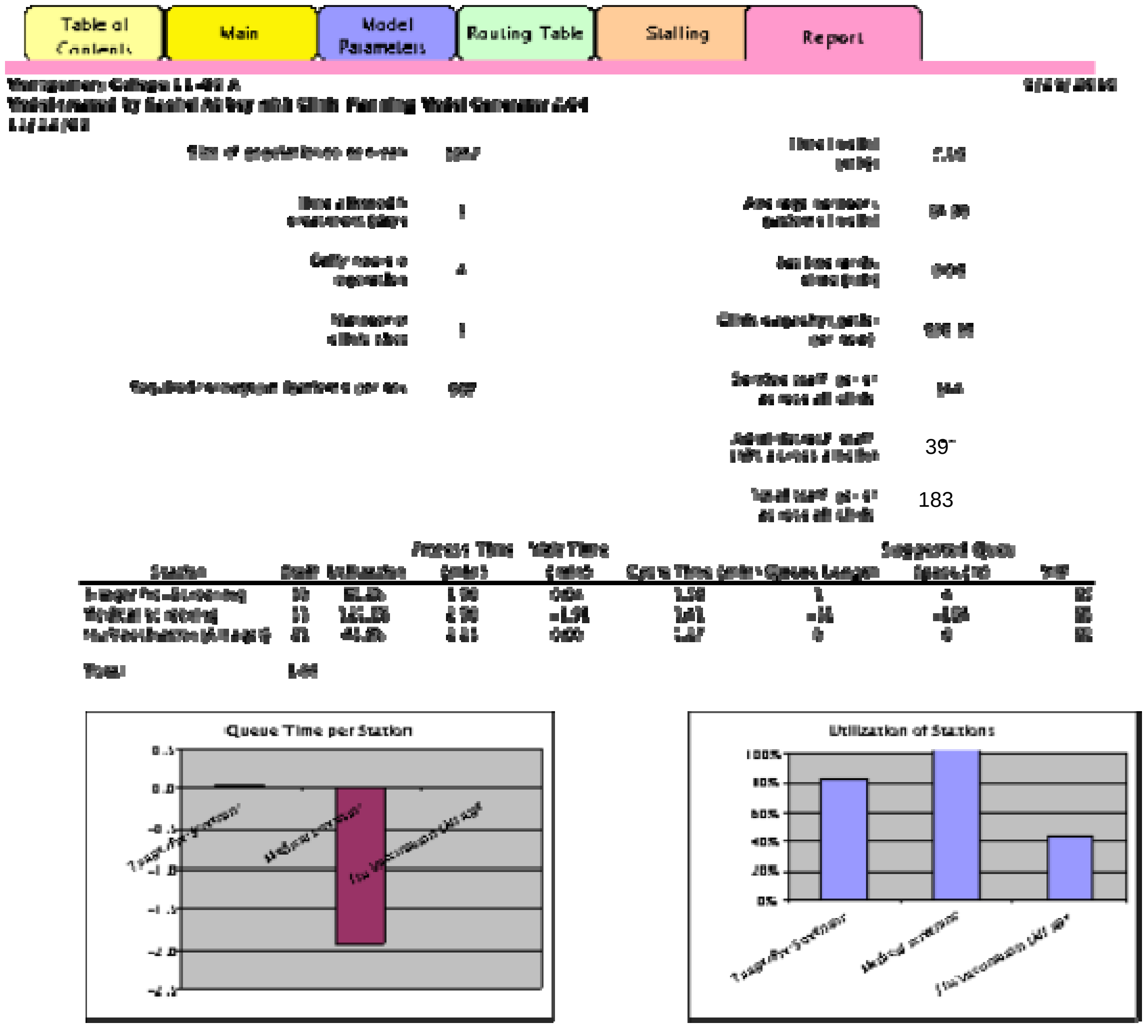
| | Wait time (min) | Queue length | Utilization |
|---|---|---|---|
| **Triage/Pre-Screening** | 0.04 | 1 | 62.2% |
| **Medical screening** | -1.91 | -31 | 122.1% |
| **Flu Vaccination (All ages)** | 0.00 | 0 | 43.3% |

Values in red denote the "worst" station for that characteristic.

# Actual Event



# Actual Event End Report



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# Using Computer Models

- This module covered three key topics:
  - What are computer planning models?
  - Types of computer planning models
  - Computer planning models during H1N1
- Future modules on this topic:
  - Using POD planning models
  - Medication distribution models
  - Visual modeling and end-user models

# For more information

- Online community:
  - phpmodels.ning.com
- Public Health Preparedness Modeling Blog:
  - http://blog.umd.edu/phpm
- Project web site:
  - http://www.isr.umd.edu/Labs/CIM/projects/clinic/
- APC web site:
  - http://www.montgomerycountymd.gov/apc