

ADAPTABLE CLINIC PLANNING MODELS

USER'S GUIDE

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Institute for Systems Research

University of Maryland

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Introduction

The Adaptable Clinic Planning Model (ACPM) is intended to grant public health officials the ability to quickly create an accurate model that will provide immediate assistance with planning for a treatment campaign. The model can be used either in the advance planning stages of a campaign or for support during an active effort. In general this model is designed to assist in planning a clinic with improved efficiency and performance while enlightening the planners on what to expect in the event of an outbreak.

This adaptable model allows clinic planners to enter known population information and set time constraints specific to their application. Immediate results show suggested staff levels and detailed clinic information regarding waiting times, queue lengths, and cycle time. Adjustments can easily be made to staffing levels and other inputs until the user is satisfied with the efficiency of the clinic. The versatility of this model allows the user to accept default values if little information is known about their clinic, or input more detailed information such as routing probabilities and process times. Since the model operates entirely in the Microsoft Excel environment, some familiarity with this package is helpful. In order to run the model, only ONE file is needed: “ACPM-beta1.2.xls”

This user guide includes details on using the file to create and modify a clinic planning model. At each step, examples will be given pertaining to a small, fairly simple clinic planning model; the Excel file for this model, “Sample ACPM.xls,” is included in the installation package.

In 2004, Public Health Services of the Montgomery County, Maryland Department of Health and Human Services became one of the first eleven public health agencies in the nation to be recognized as Public Health Ready by the National Association of County and City Health Officials (NACCHO) and the Centers for Disease Control and Prevention (CDC) of the U.S. Department of Health and Human Services. The county is home to one of eight Advanced Practice Centers (APCs) for Public Health Preparedness funded by NACCHO through the CDC.

Important Terms

1. Cycle Time – the average time that a patient spends at a station. It includes queue time and process time. The total cycle time is the total time a patient is expected to be in the clinic.
2. Interarrival Time – the average time between patients arriving. In the case of bus interarrival time, this is the average time between two buses arriving with patients.
3. Process Time (Service Time, t_o) – the average time that a staff member is in contact with a patient at a station.
4. Queue Length – the average number of patients waiting in line at a station.
5. Queue Time (Wait Time) – the average time that a patient waits in line at a station.
6. Routing Probability – the probability that a patient at one station will visit that station when they leave. Example: If five percent of patients who leave Reception go to Sick Bay, and the remaining ninety-five percent go to Education then the routing probability from Reception to Sick Bay equals 0.05, and the routing probability from Reception to Education is 0.95.
7. Utilization – the fraction of available station capacity being used.
8. Variance (σ_o) – the variance of the processing time at a station.
9. Work in Process (WIP) – the average number of people at a station. This includes patients waiting and patients being serviced.

Clinic Setup

Step 1: Open the *ACPM-bet1.2a.xls* file (If a Security Warning appears, select 'Enable macros'; they are required for this software to function correctly). The splash page (right) will appear. Enter your name and a name for the model. (Note that this is not the file name.) Click on the yellow "Table of Contents" box. The Table of Contents tab will appear.

The splash page features a light blue background. At the top, a white box contains the title "Adaptable Clinic Planning Model". Below this is a yellow button labeled "Table of Contents". Underneath are two input fields: "Analyst Name:" and "Model Name:". At the bottom, there is a copyright notice: "© Copyright 2007 University of Maryland and Montgomery County APC. All rights reserved." and a paragraph of text: "This publication was supported by Cooperative Agreement Number U59CCU902718 from the CDC to NACCHO. Its contents are solely the responsibility of the University of Maryland and the Advanced Practice Center for Public Health Emergency Preparedness and Response of Montgomery County, Maryland, and do not necessarily represent the official views of CDC or NACCHO."

From the Table of Contents tab (right), click on the blue "Model Parameters" box. The Model Parameters tab will appear.

The Table of Contents page has a yellow background and is titled "Adaptable Clinic Planning Model" and "Contents". It includes an introductory paragraph: "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." Below this are seven buttons with descriptions: "1. Model Parameter" (blue) for adjusting internal settings; "2. Staffing" (orange) for support staff counts; "3. Routing Table" (green) for editing patient flow patterns; "4. Quick Overview" (yellow) for entering population and vaccination details; "5. Report" (pink) for detailed clinic performance output; "Author Credits" (blue); and "Startup Screen" (light blue).

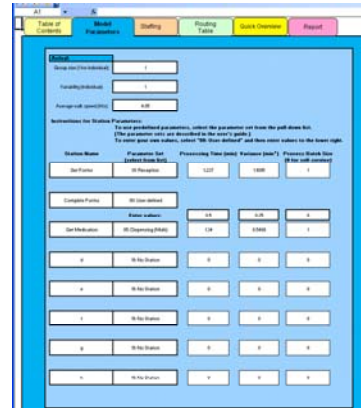
Step 2: On the Model Parameters tab, select the stations required for your clinic. For each station, select the corresponding parameter set from the pull-down list for the “Parameter Set” field. The complete list of processing time values is given in this user’s guide. When you select a parameter set, the corresponding processing time, variance, and process batch size will appear in the fields on the right-hand side. If you choose the “00: User-defined” parameter set, then enter the processing time, variance, and process batch size for that station. Enter a “0” process batch size for a self-service station.

You can use the same parameter set more than once. For instance, if you have two separate paths for patients, both of which include a registration or dispensing station.

If the clinic has less than eight (8) stations, the last, unused stations should have the “19: No Station” parameter set.

You may enter a descriptive name for each station.

Proceed to the Staffing tab by clicking on the orange “Staffing” box at the top of the page. The Staffing tab will appear.



for, this value will turn red to indicate an error.

Also on the Routing tab is the distance table. Enter the distance (in feet) from each station to any station where patients will go after leaving that station. It is not necessary to specify distances between stations if no patients travel between those stations.

In this example, there are distances between the first two stations and between the last two stations. There are also distances from Complete forms to the Exit and from Get medication to the Exit.

From Get Forms	From Complete Forms	From Get Medication	From d	From e	From f	From g	From h	
20.00								To Complete Forms
0.00	50.00							To Get Medication
0.00	0.00	0.00						To d
0.00	0.00	0.00	0.00					To e
0.00	0.00	0.00	0.00	0.00				To f
0.00	0.00	0.00	0.00	0.00	0.00			To g
0.00	0.00	0.00	0.00	0.00	0.00	0.00		To h
0.00	20.00	35.00	0.00	0.00	0.00	0.00	0.00	To Exit

Click on the “Quick Overview” box at the top of the page. The Quick Overview tab will appear.

- Step 6: On the Quick Overview tab, enter the following information in the upper-left hand box:
- Size of population to be treated
 - Time allotted for treatment (days)
 - Daily hours of operation
 - Number of clinic sites

Then, enter the number of operations staff per shift at each station. The number must be greater than or equal to the “Minimum staff per shift” number that is shown. Self-service stations do not require any staff.

If you haven’t already done so, saved your work.

Default Station Types

The adaptable clinic planning model contains a list of commonly used clinic stations. Each is associated with a processing time mean and variance, which will be added to the clinic model automatically. These times will not describe every possible clinic with perfect accuracy; they depend heavily on various factors, such as the familiarity clinic workers have with their jobs, the length of forms which must be filled by patients, and the type of medication being dispensed or vaccination being applied. The pre-defined parameters for each process can be modified if data is available describing the specific type of operation in question; otherwise, the default values will serve as guidelines.

The table below lists the included stations and the processes they are intended to model. Many of the stations listed have overlapping functions, appropriate for various types of clinic; only the ones appropriate for modeling your particular clinic should be used.

Parameter Set (Processing time mean, variance, process batch size)	Description
<i>Arrival Stations</i>	
01: Reception (1.237, 1.1095, 1)	Patients arrive at this station with a set of forms filled out at a Pre-POD; their answers are checked and then they are sent to the appropriate subsequent station.
02: Registration (1.154, 0.5329, 1)	Patients receive forms and instructions on filling them out.
03: Triage (Greeting) (0.259, 0.0741, 1)	Patients are greeted as they arrive at the clinic; those identified as needing special care (special needs populations), contact with an infectious agent, or showing symptoms of an illness are diverted to the appropriate stations.
04: Triage (Nurses) (1.752, 1.6104, 1)	Patients flagged as showing potential symptoms are examined and either return to the main patient path or receive appropriate treatment.
<i>Main Flow Stations</i>	
05: Dispensing (Multi) (1.34, 0.5408, 1)	This station has several medications available, and usually follows consultation for patients who cannot take the standard medication.
06: Dispensing (Single) (1.051, 0.3283, 1)	This station dispenses the same medication to every patient.
07: Education (Classroom) (24, 4, 30)	Patients are shown an educational video for purposes of informed consent; this station includes an added parameter defining the number of seats in each classroom.
08: Education (Individual)	Patients who have questions can be directed to this station to receive further information.

(1.304, 0.5024, 1)	
09: Flu Vaccination (Adult) (1.525, 0.1154, 1)	The times for this station are based on observations of a nurse vaccinating only individual, healthy adults (rather than children or family groups).
10: Flu Vaccination (All ages) (2.2306, 0.8554, 1)	The times for this station are based on the combined observations of the two previous groups and can be used for stations where families with children are not treated separately.
11: Flu Vaccination (Child) (3.1944, 0.5082, 1)	The times for this station are based on observations of a nurse vaccinating only children and their parents.
12: Medical consultation (3.765, 4.3732, 1)	Patients with possible complications have an interview with an expert to determine whether they should be treated, and how.
13: Medical screening (1.752, 1.6104, 1)	Patients' forms are examined to make sure they can safely receive the treatment in question; those with potential complications are referred to an expert for a consultation.
14: Vaccination (3.26, 1.3131, 1)	The times for this station are based on a vaccine that requires three separate injections.
<i>Patient Care Stations</i>	
15: Contact (3.8, 14.44, 1)	Patients who know they have been in contact with the agent being treated for are held for medical examination, after which they are allowed to re-enter the main clinic flow, or sent to a primary care facility.
16: Mental Health (10, 0, 1)	Patients who become overly anxious or disruptive can be brought here to receive care from mental health professionals or crisis counselors.
17: Sick Bay (12.698, 75.3647, 1)	Patients who develop symptoms after passing the initial triage area are sent here for medical examination, after which they are allowed to re-enter the main clinic flow, or sent to a primary care facility.
18: Symptoms (1.213, 0.3881, 1)	Patients showing symptoms consistent with the disease being treated are brought to a holding room for medical examination, after which they are allowed to re-enter the main clinic flow, or sent to a primary care facility.

Working with a Clinic Planning Model

Clinic Planning Model Pages: Startup Screen

When the clinic planning model is created or opened, the startup screen appears. You may enter your name and a descriptive name of your model (note that this is not the file name). This will appear on the report page. To continue, click on the link to the table of contents.

Clinic Planning Model Pages: Table of Contents

The table of contents contains links to different pages in the model.

Below is a list of the entries in the table of contents; more detailed explanations of each page follow. The same navigation buttons are used throughout the model.

Model Parameters	The Model Parameters page contains values that govern station operations, including arrival type and average process time and variance.
Staffing	The Quick Overview portion of the model allows you to dynamically configure the service staff at each station, but many other personnel are required for the operation of a clinic. The Staffing page tallies the support staff to provide an accurate estimate of total clinic staff. Security personnel are not included in the staffing estimate.
Routing Table	The routing table on this page is used to set the percentage of people who visit each station. A distance table is also included, which is used to calculate the time patients spend walking from one station to another.
Quick Overview	This page is the most important part of the interface, where demand and staffing values are set, and where the resulting clinic statistics can be seen.
Report	This page gives a simple, printable summary of the clinic's performance, including graphs comparing the performance of individual stations.
Author Credits	The Author Credits simply names the main authors of the Clinic Model Generator program, along with several significant contributors
Startup Screen	The Startup Screen button returns the user to the initial screen of the model, which gives the clinic's name and creator.

Clinic Model Pages: Model Parameters

The Model Parameters page contains data describing patient arrivals to the clinic and operations at each station.

- **Group size:** if value is greater than 1, this is the average size of the groups arriving at the clinic. For example, if patients are being transported by bus, it may equal the average number of patients per bus. Setting the value to 1 indicates that patients will arrive individually.
- **Variability:** for individual arrivals, this determines the regularity of the arrival process. A variability of 1 indicates moderately variable arrivals; values close to 0 mean that patients arrive like clockwork, while values greater than 1 suggest that patients arrive in very irregular spurts.
- **Average walk speed:** this walking speed is used to calculate the time patients spend walking from one station to the next. The default value is based on previous studies of pedestrian behavior.
- **Station processing time:** this is the average time required to complete a station process. Default values come from data recorded at mass vaccination and dispensing exercises.
- **Station variance:** the variance in a station's processing times.
- **Process batch size:** the number of patients who go through the process together. For example, an education station that uses classroom may have 30 patients

Station Name	Parameter Set (select from list)	Processing Time (min)	Variance (min ²)	Process Batch Size (0 for self-service)
Get Forms	01: Reception	1.237	1.1095	1
Complete Forms	00: User-defined	Enter values:		
		0.5	0.25	0
Get Medication	05: Dispensing (Multi)	1.34	0.5408	1
d	19: No Station	0	0	0
e	19: No Station	0	0	0
f	19: No Station	0	0	0
g	19: No Station	0	0	0
h	19: No Station	0	0	0

going through the process at the same time. A process batch size of 0 indicates a self-service station.

Clinic Model Pages: Staffing

	Staff
Site Director	1
Logistics Chief	1
Logistics Assistants	3
Operations Chief	1
Line Directors	2
Reception Supervisor	1
Dispensing Supervisor	1
	0
	0
	0
	0
	0
	0
	0
	0
Total	<input type="text" value="10"/>

This page allows the model to estimate the various support staff required to run a clinic. The titles and numbers for each support position, highlighted with green borders, can be adjusted by the user, but service staff at each station can only be changed on the Quick Overview page. The total of the staff specified here is the number seen at the bottom of the Quick Overview page and used to calculate staffing across all clinics. The staffs listed here do not affect clinic capacity or queuing.

Clinic Model Pages: Routing Table

The Routing Table is used to describe the paths that patients will take through the clinic. For example, in a disease outbreak situation, some small percentage of patients will be identified as symptomatic, and routed away from the main clinic path. The default routing specified at model creation is linear; all patients move through every station in the clinic in order. This should be modified by the user if the patient paths are less straightforward. The cells in the upper right corner of the table are shaded grey because the model does not allow patients to move backwards through the clinic.

Note: if the number of stations in the model makes it difficult to see everything at once, you can zoom out to view more of the table. Alternatively, you can select the first of the 'To' stations on the right and click on 'Window – Split'. This will allow you to scroll the main part of the table while the top and right labels remain visible.

Routing Probabilities							
From Greeters	From Triage (Nurses)	From Registration	From Medical screening	From Medical consultation	From Dispensing (Multi)	From Sick Bay	
10.0%							To Triage (Nurses)
90.0%	50.0%						To Registration
0.0%	0.0%	100.0%					To Medical screening
0.0%	0.0%	0.0%	10.0%				To Medical consultation
0.0%	0.0%	0.0%	90.0%	50.0%			To Dispensing (Multi)
0.0%	50.0%	0.0%	0.0%	0.0%	0.0%		To Sick Bay
0.0%	0.0%	0.0%	0.0%	50.0%	100.0%	100.0%	To Exit
100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	Sum
Sum should be 100%							

The table lists departure stations across the top, and arrival stations down the right side. The cells denote the percentage of patients departing from a station that will arrive at another station; a probability of 0% indicates that patients cannot make that particular trip. For instance, using the values shown above, upon leaving the Greeter station, 10% of patients will be sent to Triage (Nurses), while the rest will proceed to Registration.

Note that the sums in the bottom row are all 100%. If the patients departing from a station aren't all accounted for, this value will turn red to indicate an error.

Distance Table (in ft)							
From Greeters	From Triage (Nurses)	From Registration	From Medical screening	From Medical consultation	From Dispensing (Multi)	From Sick Bay	
0.00							To Triage (Nurses)
0.00	0.00						To Registration
0.00	0.00	0.00					To Medical screening
0.00	0.00	0.00	0.00				To Medical consultation
0.00	0.00	0.00	0.00	0.00			To Dispensing (Multi)
0.00	0.00	0.00	0.00	0.00	0.00		To Sick Bay
0.00	0.00	0.00	0.00	0.00	0.00	0.00	To Exit

The Distance Table on the same page works similarly. Here, the distance from each station to the next is specified, in order to incorporate walking times into the model. By default, all distances are zero, so that walking time is ignored. When assigning distances, it is only necessary to fill in values for possible combinations. For instance, in the previous example, no patients go from registration to the exit, so there is no need to assign a distance to this route.

Clinic Model Pages: Quick Overview

The Quick Overview page of the clinic planning model contains a lot of information, so let's go through each part of it in detail.

Upper Left Corner: Input Demand

After you create a model with the generator program, the numbers you input for the population demands and clinic operations will appear here. To investigate alternative scenarios, such as the effect of changing the number of clinic hours or length of a treatment campaign, change the values in the green-edged boxes.

The model calculates the *required throughput*, which is the number of patients that must be processed by the clinic every hour in order to treat the given population in the allotted time.

Note: The model assumes that the population will be equally distributed among the chosen number of clinic sites. If this is not appropriate for your region, each clinic should be evaluated individually, with the appropriate population size and with a single clinic site.

Table of Contents	Model Parameters	Staffing	Routing Table
Inputs			
Demand			
Size of population to be treated:	<input type="text" value="1000"/>		
Time allotted for treatment (days):	<input type="text" value="1"/>		
Daily hours of operation:	<input type="text" value="8"/>		
Number of clinic sites:	<input type="text" value="1"/>		
Required throughput (patients per hour):	<input type="text" value="125"/>		

Lower Left Corner: Input Staffing

Based on the patient flow requirements and the performance of the stations you selected in the model creation dialog, a minimum staffing level for each station has been determined. This value is shown in the right-hand column of black-edged boxes. To the left is the staffing level that will actually be used. This is initially zero for each station. You can set all of the stations to the minimum value by clicking on the button labeled "Set all to minimum."

Note that self-service stations require no staff, since the patients perform the process by themselves. (Helpers or supervisors should be entered in the Staffing tab.)

It is often useful to add more staff to a station that is not performing as well as it might. As in the input demand area, green-edged boxes indicate a user-input value. If the user-selected value for a station is below the minimum value, it will be highlighted in red. This must be corrected in order

Staffing (per clinic site)		
Station Name	Staff per shift	Minimum staff per shift
Get Forms	<input type="text" value="3"/>	<input type="text" value="3"/>
Complete Forms	<input type="text" value="0"/>	<input type="text" value="0"/>
Get Medication	<input type="text" value="3"/>	<input type="text" value="3"/>
d	<input type="text" value="0"/>	<input type="text" value="0"/>
e	<input type="text" value="0"/>	<input type="text" value="0"/>
f	<input type="text" value="0"/>	<input type="text" value="0"/>
g	<input type="text" value="0"/>	<input type="text" value="0"/>
h	<input type="text" value="0"/>	<input type="text" value="0"/>
Total Service Staff	<input type="text" value="6"/>	<input type="text" value="6"/>
Total Staff	<input type="text" value="16"/>	<input type="button" value="Set all to minimum"/>

Values in red signify below-minimum staffing levels.

for the model to function correctly; while below-minimum values are selected, outputs will give errors or negative values.

Station service staff are totaled below each column; below that, the total staff, including team leaders and administrators (see Staffing page), is given.

Upper Right Corner: General Performance

This area gives overall performance measures for the clinic; all of these values are calculated dynamically, and will update automatically when you change any input value.

- Time in clinic: the total time that, on average, each patient will spend in the clinic, including wait time, treatment time, and walking time.
- Average number of patients in clinic: the total number of patients in queue and being serviced at all stations.
- Clinic capacity: the number of patients the slowest station in the clinic (known as the bottleneck station) is capable of processing per hour. This should be larger than the required throughput in the input demands section.
- Clinic utilization: the ratio of required throughput (based on the population) to clinic capacity.
- Total staff per shift across all clinics: This total number of staff includes support and service staff for each clinic in the model, but does not take into account incident command staff.

The screenshot shows a software interface with a yellow background. At the top, there are two buttons: 'Quick Overview' and 'Report'. Below these buttons is a blue header bar labeled 'Outputs'. Underneath that is another blue header bar labeled 'General Performance'. The main area contains five rows of performance metrics, each with a label and a numerical value in a white box:

General Performance	
Time in clinic (min):	7.16
Average number of patients in clinic:	15
Clinic capacity (patients per hour):	141
Clinic utilization:	88.4%
Total staff per shift across all clinics:	16

Lower Right Corner: Station-level Results

This part of the page gives more detailed information about individual stations, including averages for wait time, length of queue (the number of people waiting at a station), and utilization (the proportion of the time that servers are not idle).

For each of these three columns, the station with the highest value will be highlighted in red. This is intended to call attention to the station *most likely* to need improvement; however, no matter how efficient the clinic is, there will *always* be stations with the longest wait time, longest queue, and highest utilization.

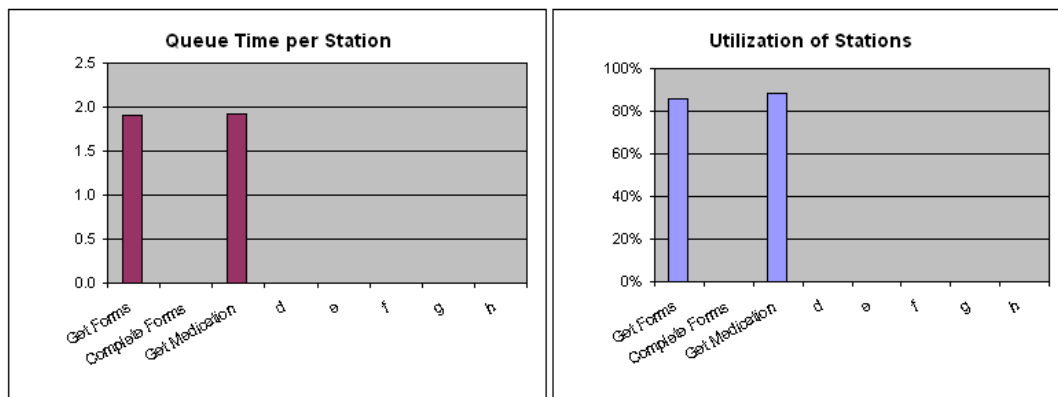
Station-level Results			
	Wait time (min)	Queue length	Utilization
Get Forms	1.91	4	85.9%
Complete Forms	0.00	0	0.0%
Get Medication	1.92	4	88.4%
d	0.00	0	0.0%
e	0.00	0	0.0%
f	0.00	0	0.0%
g	0.00	0	0.0%
h	0.00	0	0.0%

Clinic Model Pages: Report

A printable summary of the clinic can be found on the Report page. It lists the clinic demand information, along with the overall clinic performance data and a breakdown of each station. Additional station details are included in this table, such as the physical queuing space required and station cycle time. Two bar charts are also provided; these allow easy comparison of station queue time and utilization.

Table of Contents	Model Parameters	Staffing	Routing Table	Quick Overview	Report
Analyst Name: 0					2/12/2007
Model Name: 0					
Size of population to be treated:	1000			Time in clinic (min):	7.16
Time allotted for treatment (days):	1			Average number of patients in clinic:	14.92
Daily hours of operation:	8			Clinic capacity (patients per hour):	141.40
Number of clinic sites:	1			Clinic utilization:	88.4%
Required throughput (patients per hour):	125			Total staff per shift across all clinics:	16

Station	Staff	Utilization	Process Time (min)	Wait Time (min)	Cycle Time (min)	Queue Length	Suggested Queue Space (ft)	WIP
Get Forms	3	86%	1.24	1.91	3.23	4	24	7
Complete	0	0%	0.50	0.00	0.70	0	0	1
Get Medic	3	88%	1.34	1.92	3.40	4	23	7
d	0	0%	0.00	0.00	0.00	0	0	0
e	0	0%	0.00	0.00	0.00	0	0	0
f	0	0%	0.00	0.00	0.00	0	0	0
g	0	0%	0.00	0.00	0.00	0	0	0
h	0	0%	0.00	0.00	0.00	0	0	0
Total	6							



Additional Information

For information about how the model calculates its results, see the report “Technical Description: Mass Vaccination Clinic Spreadsheet Model,” by Mark Treadwell and Jeffrey Herrmann.

If you have questions or suggestions, please contact Jeffrey Herrmann at the following address:

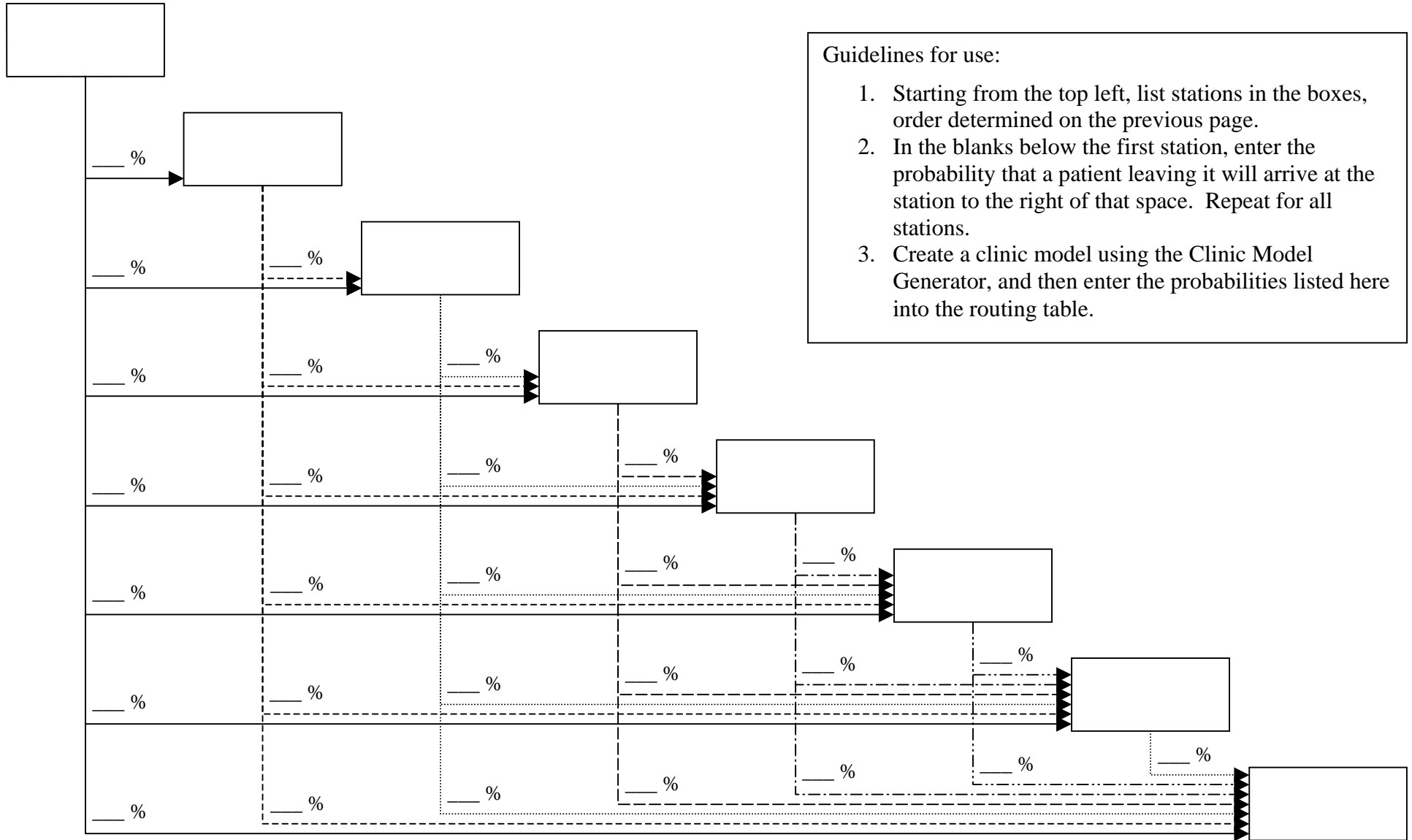
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Appendix A:
Clinic Planning Worksheets

Clinic Routing Worksheet



Clinic Routing Worksheet

