Maxi-Vac 2.0[*]

Version 1.0, July 2002

Version 2.0, October 2021

Software and manual to help state and local-level public health officials plan for setting up smallpox vaccination clinics.

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[*] Maxi-Vac 2.0 is an updated version of Maxi-Vac 1.0. The update focuses on presenting Maxi-Vac in a spreadsheet-based format. The Maxi-Vac 1.0 was produced in a Visual Basic format which may present software compatibility issues. The data underlying the calculations and results presented in Maxi-Vac 2.0 remain unchanged (see: Washington ML, Mason J, and Meltzer MI (2005). Maxi-Vac: A tool to assist in planning mass smallpox vaccination clinics. Journal of Public Health Management and Practice, 11(6):542-9.)

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Additional Reference for Maxi-Vac:

Washington ML, Mason J, and Meltzer MI (2005). Maxi-Vac: A tool to assist in planning mass smallpox vaccination clinics. Journal of Public Health Management and Practice, 11(6):542-9. See paper [here](#).

Meltzer MI, Mason J, Washington ML, Freyre R, 2002. Maxi-Vac 1.0: A manual to aid state and local-level public health officials plan, prepare and practice for large-scale smallpox vaccination (Beta test version). Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. See manual [here](#).

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See manual here.

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Washington ML, Mason J, and Meltzer MI (2005). Maxi-Vac: A tool to assist in planning mass smallpox vaccination clinics. Journal of Public Health Management and Practice, 11(6):542-9. See paper here.

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Introduction

The World Health Organization formally declared the eradication of smallpox on May 8, 1980. Following this major public health accomplishment, smallpox vaccinations were ceased throughout the world. As a result of the cessation of vaccination, millions of Americans and people around the world have no immunity to the smallpox virus. Although the last recorded natural case of smallpox occurred in 1977, the intentional release of the smallpox virus has emerged as a potentially devastating bioterrorism threat. Given the vulnerability of the world population to smallpox, such an attack could have devastating consequences.

To help states and local communities prepare to respond to a smallpox attack should one occur, the Centers for Disease Control and Prevention of the U.S. Department of Health and Human Services has released generic guidelines on how to set-up a smallpox vaccination clinic (see www.cdc.gov/agent/smallpox/response-plan/index.asp to view the plan). However, individual states and communities have differing numbers of qualified personnel that would be available in such an event.

Overview of Maxi-Vac

Maxi-Vac helps a public health official answer the following question: "How can I allocate the limited number of personnel available so that the maximum number of people are vaccinated in a 24 hour period?"

Maxi-Vac was developed by first building a computer model using both Arena® simulation software (version 5.0, Rockwell Software, Inc. Sewickley, PA) and an add-on optimization program (OptQuest®, version 5.0, OptTek Systems, Inc., Boulder, CO). The objective of the mathematical model was to allocate personnel such that a maximum number of people could be vaccinated in a clinic during a 24 hour-period. Built into the model was the stipulation that the average time spent in the clinic by the patients was less than or equal to 90 minutes. The data generated by each run of the model is stored in Maxi-Vac's database. Based on your inputs (e.g., the number of personnel available for each shift in a clinic), the appropriate set of data is accessed in the database and displayed in the "Results" section of Maxi-Vac. Technical details on the underlying assumptions used in Maxi-Vac are provided in the Appendix of this manual and at the end of the spreadsheet tool.

Description of the Simulation Model

A smallpox vaccination clinic consists of a number of "stations," or activities, that a patient may "visit." The actual number of stations that a given patient "visits" will depend upon that patient's personal circumstance (e.g., history of a possible pre-existing medical condition indicating that they should not be vaccinated unless exposed to somebody who was infectious) and the actual requirements for giving smallpox vaccinations. Clinic personnel must of course, staff each station. The stations, or activities are:

- **Triage:** Before patients enter the clinic, they go through a triage point where they are triaged by a medical provider for illness and/or to determine whether they have been in contact with confirmed cases of smallpox. This checkpoint is to screen out those individuals that may be ill or who may be contacts from the rest of the individuals at the clinic so as not to expose the clinic population. Examples of persons who will not be treated in the clinic after being triaged are those that are ill and therefore require treatment at another site, and those that are identified as contacts.
- **Orientation**: Individuals will view a video that contain a variety of information, such as care of the vaccination site, possible side-effects, when and how to seek treatment for such side effects, and (where necessary) the essential elements of informed consent as promulgated in 21 CFR 50.25.
- **Medical Forms**: All individuals (contacts and mainstream) will receive an information packet that will include medical screening and consent forms (where necessary) to be filled out for each family member.
- **Referral**: The completed medical screening forms mentioned above will be reviewed by non-medical personnel to see if the patients have self-reported any history of a possible pre-existing medical condition indicating that they should not be vaccinated unless exposed to somebody who was infectious (contraindications). Patients with potential contraindications will then proceed to the medical screening area; all others go directly to the vaccination area.
- **Medical Screening:** Patients who self-reported contraindicating conditions on their screening forms will receive screening and information from a medical professional. If the person conducting the screening is uncertain, or the patient wishes more information, that patient will be referred for additional screening to a qualified physician.
- **Physician Evaluation:** Patients with self-reported contraindicating conditions receive a more detailed screening if deemed necessary by the medical screener.
- **Vaccination/Witness:** Patients receive their smallpox vaccinations from an approved medical provider. A second medical provider acts as witness. To limit fatigue, the medical providers can, during the course of their shift, switch occupations.
- **Exit Review**: This is the final station in the clinic. Patients can have any remaining questions answered, and the personnel staffing this station can ensure that each patient exits with their information sheets and instructions.

Modification from Maxi-Vac Alternative: You have to have all the stations.

Data sources

Much of the data required to run this model are not readily available. Your health department will need to research to find data such as the number of health care providers, number of support staff, etc. Where appropriate, we have included a list of suggested data sources that may help you in this process.

Modeling philosophy: Sensitivity analyses and overall objectives

Much of the input data required for the model is unknown. The values used in the model are therefore mostly based on expert opinion. Even those data may not be reliable predictors of the process times and staff that will be required to engage in large-scale mass smallpox vaccinations. Therefore, we encourage you to be realistic when interpreting the results obtained from this software.

Given this uncertainty, we also encourage you to run the model several times. Once you have become adept at using the software, you may wish to consider a plan wherein you systematically alter the values of input variables. You may alter one variable at a time (univariate sensitivity analysis), or alter the values of two or more variables simultaneously (multivariate sensitivity analysis). Different results due to using different values for the various input variables will help you obtain a sense of the relative importance of each staff type in determining the number of people that can be treated in a 24-hour period. We have included in the results the impact of adding or removing one of each type of staff, which again, will give you a sense of the relative importance of increasing or decreasing staff at a specific station.

Additional Reference

Washington ML, Mason J, and Meltzer MI (2005). Maxi-Vac: A tool to assist in planning mass smallpox vaccination clinics. Journal of Public Health Management and Practice, 11(6):542-9. See paper here.

Disclaimer

Please keep in mind that this is a **test** version of the software and a **draft** version of the manual. The numbers generated through use of the software should not be considered predictions of what will definitely occur whilst running a mass immunization clinic. Rather, they are estimates of what could happen. The findings and conclusions of this manual and software are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Help and feedback

For help using Maxi-Vac and/or interpreting the results, please e-mail your questions to Dr. Martin Meltzer at qzm4@cdc.gov. Please note that we are not commercial developers of software, and we ask for your patience if it takes us some time to reply to your requests.

We also would appreciate any comments and suggestions as to how we could improve the software. For example, we would be interested in receiving suggestions for additional input/ output screens. What other data regarding impact would you like to see included in the software?

Differences between Maxi-Vac and Maxi-Vac Alternative

Although we list all the differences in this section, we also listed these differences in sections where they occur.

Table 1. Differences in user input

	Maxi-Vac	Maxi-Vac Alternative
Personnel	Physician (1, 3, **5, and 9**) Nurses (15, 30, and **45**) Other staff (5, 10, and **15**)	Physician (1 and 3) Nurses (**5,** 15, and 30) Other staff (5 and 10)
Activities	Orientation room size (30 or **75 seats**) You have to **operate all stations**	Orientation room size fixed at 30 seats You can decide **not to have** orientation You can decide **not to have** a witness
% of Families	% families sent to medical screeners **fixed at 10%**	% families sent to medical screeners **20% and 40%**

Table 2. Differences in Results Tabs

	Maxi-Vac	Maxi-Vac Alternative
Removing One Staff	Where you see 0, either no person from that category of personnel was assigned to that station, thus a person could not be removed, or no change in people being vaccinated occurred when one person was removed. Where you see "na," a person could not be removed from that station.	Where you see NA, either no person from that category of personnel was assigned to that station, thus a person could not be removed. Where you see "na", a person could not be removed from that station.
Plus One Staff	Where you see 0, either no person from that category of personnel was assigned to that station, thus a person could not be added or no change in people being vaccinated occurred when one person was added.	Where you see "na", no person from that category of personnel was assigned to that station, thus a person could not be added.

Processing times

The main difference between the two versions is the time to complete a task. Times that are different in Maxi-Vac Alternative came from a report by Brian G. McCue and Monica J. Giovachino titled "A field test of the CDC smallpox vaccination clinic model" completed in April 2003. The bold font numbers are what come from the data analyses. The other numbers are from expert opinions. More detailed information about the times can be found in the manual.

Table 3. Average processing times in each station (in mins)

Station	Maxi-Vac	Maxi-Vac Alternative
Triage	1	1
Orientation	25	14
Fill-out forms w/o help	1	2.53
Fill-out forms w/ help	1	2.53
Referral	0.5	0.5
Medical screening	10	0.86
Physician evaluation	10	0.5
Vaccination	1	1.6
Exit review	3	0.3

System Requirements

This software (Maxi-Vac 2.0) requires a spreadsheet program; Maxi-Vac 2.0 was set-up using Microsoft Excel, but it can run with other software too. Note that the user may experience difficulties with adds-on and buttons if using another software than Microsoft Excel.

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Using Maxi-Vac and Maxi-Vac Alternative

The Maxi-Vac spreadsheet may be downloaded from the internet.

To download from the internet:

Use your internet browser to go to the Maxi-Vac website. The following download options will be presented:

- Maxi-Vac spreadsheet; this is the first version of the spreadsheet tool.
- Maxi-Vac Alternative spreadsheet; this is the alternative version of the spreadsheet.

The following tabs are available on every page of the spreadsheet:

| 1. Personnel | 2. Activities | 3. % of Families | 4. Scenario Summary |

1. Personnel   This tab takes you to the sheet where you select the number of staff in each category: physicians, nurses, and support staff.

2. Activities   This tab takes you to the sheet where you select the size of the orientation room.

3. % of Families   This tab takes you to the sheet where, in Maxi-Vac Alternative, you can select the proportion of families are sent to medical screeners.

4. Scenario Summary This tab offers you a visual of display of all the inputs you selected for your review.

| 5. Results – Vaccinated & Staff | 6. Results – Time & Auxiliary | 7. Results – Adding & Removing |

5. Results –
Vaccinated & Staff   This tab takes you to "Results – Vaccinated and Staff" sheet where you find the results associated with: "People Treated," "Optimal Staff Placement," and "Staff Utilization." For detailed descriptions on the screens associated with each of these tabs, please refer to the appropriate section in this manual.

6. Results –
Time & Auxiliary   This tab takes you to "Results – Time & Auxiliary" sheet where you find the results associated with the "Average Time Spent at Each Station" and "Auxiliary Staff." For detailed descriptions on the screens associated with each of these tabs, please refer to the appropriate section in this manual.

7. Results –
Adding & Removing   This tab takes you to "Results – Adding & Removing" sheet where you find the results associated with: "Impact/Minus One" and "Impact/Plus One." For detailed descriptions on the screens associated with each of these tabs, please refer to the appropriate section in this manual.

1. Personnel

Select the total number of physicians, other medical staff, and non-medical support staff estimated to be available to work each shift at the vaccination center from the pull-down menu under each category.

Number of shifts per 24-hour period (cannot be changed):	2
Select number of physicians per shift from pulldown menu:	1
Select number of nurses per shift from pulldown menu:	15
Select number of other staff per shift from pulldown menu:	5

Help on how to determine available staff

Nurses

Other Staff

Total Staff	
Total number of physicians in a 24-hour period:	2
Total number of nurses in a 24-hour period:	30
Total number of other staff in a 24-hour period:	10
Total staff in a 24-hour period:	42

This page allows you to enter input values for the number of each staff type.

- **Number of each type of staff available to work on each shift:** Select the total number of physicians, nurses, and other, non-medical, support staff estimated to be available to work each shift at the vaccination center from the pull-down menu under each category.
- **Number of shifts in a 24-hour period:** The only (default) value is 2 shifts per 24-hour period. The assumption can be made that each shift will only run for 8 hours (i.e., clinic will be open 16 hours per 24 hour period); the number of people treated per 24-hour window will then only be two-thirds of the amount indicated in the spreadsheet. The clinic director may need to adjust the length of each shift to allow for changes in patient arrivals and the actual amount of time in the clinic taken by a "typical" patient.

Help on how to determine available staff: You may want to obtain composite estimates of the number of personnel available to work at the clinics from appropriate sources such as local/regional health departments, state licensing organizations, hospitals, professional societies, support organizations (e.g. Red Cross), etc. Reasonable estimates of the number of staff at any particular locations will be constrained by the number of staff available and the physical space in which the clinic will be setup.

Nurses: Note that the term "Nurses" refers to any medically-trained staff (other than physicians) who are qualified to work in the clinic—EMTs, for example.

> **Other Staff:** Note that the term "Other Staff" refers to any non-medical staff who can help with different stations (e.g., orientation).

Differences between Maxi-Vac and Maxi-Vac Alternative
1. Maxi-Vac
   a. Physician (1, 3, 5, and 9)
   b. Nurses (15, 30, and 45)
   c. Other staff (5, 10, and 15)
2. Maxi-Vac Alternative
   a. Physician (1 and 3)
   b. Nurses (5, 15, and 30)
   c. Other staff (5 and 10)

2. Size of Orientation Room

Enter the activities that will be included in your clinic on this screen. In Maxi-Vac (2.0), all activities must be included; "Yes" is shown for all activities on the right-hand side of the image. In this sheet, you must select the number of people that each orientation session can hold (i.e. 30 or 75 people). Please see the Appendix for additional technical details.

Differences between Maxi-Vac and Maxi-Vac Alternative
1. Maxi-Vac
   a. You can select the size of the orientation room (30 or 75 seats)
   b. You have to operate all stations
2. Maxi-Vac Alternative
   a. You cannot select the size of the orientation room. The only size is 30 seats.
   b. You can decide not to have orientation.
   c. You can decide not to have a witness.

3. Percentages of Families

> **NOTE:** The following percentages are fixed and cannot be changed in this version (Maxi-Vac 2.0) of the program. See Maxi-Vac Alternative (2.0) to change the percentage of families sent to medical screeners.

Percentage of families turned away at triage:	2.00%	**More Information**
Percentage of families that need to be treated elsewhere:	2.00%	**More Information**
Percentage of families sent to medical screeners:	10.00%	**More Information**
Percentage of families to see physician evaluator:	10.00%	**More Information**

Select the percentage of families falling in the following categories:

- **Percentage of families turned away at triage:** This is the percent of the total population where at least one family member is either sufficiently ill or shows symptoms of smallpox and therefore requires treatment at another site. If a family member does show possible symptoms of smallpox (or, perhaps, self-identifies as having been in close contact with a known smallpox victim) then it is quite likely that the entire family will be moved to another site for a medical exam, vaccination and perhaps quarantine (as appropriate).
- **Percentage of families that need to be treated elsewhere:** This is the percent of the total population where the physician evaluator determines that at least one family member requires treatment at another site.
- **Percentage of families to see a medical screener:** This is the percent of the total population where at least one family member has a condition noted on the screening form that should be reviewed by a medical professional such as a nurse or EMT.
- **Percentage of families to see a physician evaluator:** This is the percent of the total population where at least one family member has a potentially serious contraindication that can best be determined by a physician.

Differences between Maxi-Vac and Maxi-Vac Alternative
1. Maxi-Vac
    a. You cannot modify anything on this page.
2. Maxi-Vac Alternative
    a. You can only change "Percentage of families sent to medical screeners (20% and 40%)

4. Scenario Summary

This screen displays your selections for the setup of the smallpox vaccination for your review. You may make changes to your inputs by clicking on the appropriate sheet, e.g. "1. Personnel". If there are no changes to be made, proceed to the next screen by clicking on the "Next" button or the "5. Results – Vaccinated & Staff" sheet.

Differences between Maxi-Vac and Maxi-Vac Alternative (None)

5. Results – Number of People Vaccinated, Optimal Staff Allocation and Utilization

Total number of staff available per shift:	21
Actual number of staff used per shift:	21
Maximum number of people that can be treated in a 24-hour period:	3310

RECOMMENDATION: To see how adding or removing one staff member can greatly affect the results, change the values in "1. Personnel" and switch back to this sheet.

Optimal Staff Placement by Station per Shift

Station Description	Physicians	Nurses	Other Staff
Triage personnel	0	3	0
Orientation personnel	0	0	2
Medical form helper	0	0	1
Referral personnel	0	0	2
Medical screener	0	2	0
Physician evaluator	1	0	0
Vaccinator	0	4	0
Witness	0	4	0
Exit review Personnel	0	2	0
Total	1	15	5

NOTE: Totals in red (if any) indicate at least one staff member from that category is not being utilized.

Hint

Staff Utilization (Percentage of Time Busy) per Shift

Station Description	Physicians	Nurses	Other Staff
Triage personnel	0	99.6	0
Orientation personnel	0	0	95
Medical form helper	0	0	4.7
Referral personnel	0	0	65
Medical screener	0	93	0
Physician evaluator	20.6	0	0
Vaccinator	0	67.2	0
Witness	0	67.2	0
Exit review Personnel	0	51.9	0

NOTE: Values in red indicate a high staff utilization (80% or above). The staff in these positions will be working almost non-stop and will require frequent breaks.

Hint

This screen displays the results from the simulation and optimization runs based on the inputs you chose. The top two boxes show the number of total staff available and total staff used. The third box presents the maximum number of people that can be vaccinated at the clinic using the staff as shown in the left table, based on the model assumptions. (The model assumptions are presented in the technical appendix of this manual and at the end of the spreadsheet). You should be aware that the results might be significantly different for another set of model assumptions.

The left table displays the number of specific types of personnel needed at each station. When a particular staff type is not used at a station, "0" is shown in the table. *If the total number of people that can be treated is too low, you may be able to increase patient flow by adding additional staff.* Reviewing the "Impact" results (i.e., the "7. Results – Adding & Removing" sheet) will provide some insights into the potential benefit of adding or removing 1 staff person at specific stations.

HINT: The placement of specific staff types at each station is based on recommendations made by medical professionals familiar with mass vaccination procedures. You should determine whether there are any difference between the suggested type of personnel at each station and those called for in your community's smallpox response plan.

Differences between Maxi-Vac and Maxi-Vac Alternative (None)

The right table displays the percent of time each type of personnel is busy seeing a patient during his or her shift. When a particular staff type is not used at a station, "0" is displayed in the table. In general, you want the system to be "balanced" so that the majority of staff is kept sufficiently busy, but are not working at a pace that cannot be sustained throughout their shift. Keep in mind that the tool (Maxi-Vac 2.0) does not consider staff breaks of any type. To account for breaks, additional staff will be required to relieve workers. Also note that staff utilizations may be low at stations where only a percentage of people are seen (e.g., physician evaluation) if the percentage of people requiring service at that station is low enough. However, low utilizations may be indications of having more staff than are needed at the affected stations. Also note that low utilizations do not necessarily correspond to short patient wait times.

> **HINT:** Utilization is the amount of time that an individual spends actively working. For example, a utilization of 100% corresponds to a person who works non-stop (no breaks of any kind) for the entire shift. You might consider having additional personnel to provide relief for staff who are busy more than 80% of the time, and/or having these staff work fewer hours.

Differences between Maxi-Vac and Maxi-Vac Alternative (None)

6. Results – Average Time Spent at Each Station and Auxiliary Staff

Average Time Families Spent at Each Station (in Minutes)	
Station Description	**Average time (in minutes)**
Triage	4.293
Orientation	34.277
Medical froms help	3.829
Referral	3.891
Medical screening	166.348
Physician evaluation	41.781
Vaccination	4.661
Witness	4.661
Review/Exit	3.824

Hint

Auxiliary Staff	
Station Description	**Number per shift**
Form distribution	9
Vaccine preparation	2
Medical records data	10
Clinic manager	2
Supply manager	2
Clinic QA reviewer	4
Security	20
Traffic flow	2
Translator	1 (per major language)
Float staff	3
Contact evaluation	4
EMT	1
IT support	1
Total	**61**

NOTE: Auxiliary staff are not included in the model. The purpose of this table is to help the user plan for auxiliary staffing needs.

Hint

The table on the left shows the average amount of time patients spend at each station. In general, longer times indicate either a process that requires a significant amount of time (e.g. orientation) or a bottleneck in the system. Whereas orientations represent an unavoidable bottleneck (because they do not start until there are enough people waiting inside the orientation room – an input value), bottlenecks at other stations may result because of the time it takes for the service to be administered and/or the sheer volume of people that must be seen at a specific station (e.g. triage, clerk). The size of these bottlenecks will greatly depend on the number of personnel available to work at the affected station(s).

Often there are tradeoffs to be made when there is a limited number of each staff available to work in the clinic. For example, medical professionals (other than physicians) staff 5 of the 9 stations in this model: triage, medical screening, vaccination/witness and exit review. In order to move the maximum number of people through the clinic, it is important to allocate a sufficient number of medical staff to work at these stations since all patients that come to the clinic must go through these stations. Consequently, the number of staff allocated to these stations must be "balanced" to allow for patients to move through the clinic at the maximum rate possible given the input constraints (see the technical appendix for a list of constraints used).

> **HINT:** Average times shown on this screen includes processing time at the station plus the time spent waiting in the queue for service. Times spent in the clinic do not include any waiting time experienced before entering the clinic or station-to-station transit time.

Differences between Maxi-Vac and Maxi-Vac Alternative (None)

The table on the right shows estimates of the number of various types of clinic support staff. These are the suggested values given in the CDC Smallpox Response Plans and Guidelines (Version 3.0), Annex 3. Please be aware that the numbers of staff and the activities included in this table have not been optimized.

> **HINT:** This table contains suggested numbers of various types of personnel based on approximately 5000 people being treated as contained in the CDC Smallpox Response and Guidance Plan (Version 3.0), Annex 3. To our knowledge, no actual data exists to corroborate these suggested values – the values are based on expert opinion. As such, clinic planners may wish to increase (or decrease) the numbers of "Auxiliary Clinic Personnel" as they deem needed. appropriate.

Differences between Maxi-Vac and Maxi-Vac Alternative (None)

7. Results – Impact of Removing and Adding One Person at Each Station

Impact on the Number of People Treated by Removing One Staff per Station per Shift			
Station Description	Physicians	Nurses	Other Staff
Triage	0	-1059	0
Orientation	0	0	-1555
Medical froms help	0	0	na
Referral	0	0	-804
Medical screening	0	-131	0
Physician evaluation	na	0	0
Vaccination	0	-16	0
Witness	0	-16	0
Review/Exit	0	-142	0

NOTE: Values in red (if any) indicate a significant reduction in the number of people vaccinated when one staff is removed from that particular station. See "Hint: Interpretation" for more information.

| Hint: Interpretation | | Hint: Size of Variations |

| Hint: Not Applicable (NA) |

Impact on the Number of People Treated by Adding One Staff per Station per Shift			
Station Description	Physicians	Nurses	Other Staff
Triage	0	124	0
Orientation	0	0	1
Medical froms help	0	0	-2
Referral	0	0	1
Medical screening	0	47	0
Physician evaluation	-4	0	0
Vaccination	0	1	0
Witness	0	1	0
Review/Exit	0	-13	0

NOTE: Values in green (if any) indicate a significant increase in the number of people vaccinated when one staff is added to that particular station. See "Hint: Interpretation" for more information.

| Hint: Interpretation | | Hint: Size of Variations |

The left table on this sheet displays the impact of removing one person at each station where the optimum allocation of staff is greater than 1. For stations where the optimal allocation is 1, "na" is shown in the table to indicate that it was inappropriate to reduce the number of staff at these stations. The values shown in the table are the differences between the maximum number of people that can be vaccinated if the clinic is fully staffed based on results for your specific inputs and the number that can be treated if the optimal number of staff at that specific station is decreased by one. Small changes in the number of people treated, say differences of around 10% or less, are not of interest here. What is of interest is when a reduction in the number of staff at a station by 1 results in a substantial decrease in the number of people that can be vaccinated in 24 hours. The size of the decrease (or increase) is related to the relative importance of having sufficient personnel at a particular station. In general, it is important to have a sufficient number of staff for those stations through which the majority of people must pass (e.g. triage, orientation, etc). When a particular staff type is not used at a station, "0" is displayed in the table.

HINT (Interpretation): The table on the right displays the impact of adding an additional person at each station. For example, adding one nurse to the triage station increases the number of people vaccinated by 1059 in a 24-hour period. The values shown in the table are the differences between the number that can be treated if the optimal number of staff at that specific station is increased by one and the number of people that can be vaccinated if the clinic is fully staffed based on results for your specific inputs. The size of the increase (or decrease) is an indication of the relative benefit (or cost) of adding an additional person at a particular station.

HINT (Size of Variations): Given your specific input choices, increases (or decreases) below 331 in the number of people vaccinated (i.e., 10% of the total number of people vaccinated in a 24-hour period) when one staff member is added at a particular station are not significant.

HINT (Not Applicable): For stations where the optimal allocation is one, "na" is shown in the table to indicate that it was not possible to reduce the number of staff at these stations (because they are necessary stations). At stations where a staff type is not assigned, "0" is shown in the table to indicate that it was inappropriate to reduce the number of staff at these stations (because no one was assigned to them).

Differences between Maxi-Vac and Maxi-Vac Alternative
1. Maxi-Vac
   a. Where you see 0, either no person from that category of personnel was assigned to that station, thus a person could not be removed, or no change in people being vaccinated occurred when one person was removed. Where you see "na," a person could not be removed from that station.
2. Maxi-Vac Alternative
   a. Where you see NA, either no person from that category of personnel was assigned to that station, thus a person could not be removed. Where you see "na", a person could not be removed from that station.

The right table on this sheet displays the impact of adding an additional person at each station. The values shown in the table are the differences between the number that can be treated if the optimal number of staff at that specific station is increased by one and the number of people that can be vaccinated if the clinic is fully staffed based on results for your specific inputs. The size of the increase (or decrease) is an indication of the relative benefit (or cost) of adding an additional person at a particular station. In general, there will be little benefit in adding additional staff at any one station because the allocation of staff has already been optimized. When a particular type of staff is not used at a station, "0" is displayed in the table.

Due to the time associated with running each combination of inputs long enough to obtain the "true" optimal allocation of resources given the constraints inputted, it may be possible that there are other arrangements that might result in more people vaccinated than is shown on "People Treated" tab of the Results file. You might be tempted to use the Impact Results to find a "better" arrangement. For example, if the combined results of adding and removing staff suggests that moving one or more persons from one position (say medical screening) to another position for which she/he is qualified to work (say triage), it might be possible to treat more people. However, such an arrangement might not satisfy one or more of the constraints (e.g. patient time in the clinic ≤ 90 minutes; see "Model Assumptions" in the Technical Appendix), therefore caution must be used in attempting to combine the impact of adding and removing staff. This is especially true in the example used in the manual.

Differences between Maxi-Vac and Maxi-Vac Alternative

1. Maxi-Vac
   a. Where you see 0, either no person from that category of personnel was assigned to that station, thus a person could not be added or no change in people being vaccinated occurred when one person was added.
2. Maxi-Vac Alternative
   a. Where you see "na", no person from that category of personnel was assigned to that station, thus a person could not be added.

Technical Appendix

Model Assumptions

The following assumptions were used to develop the current version of the simulation model:

1. Each scenario is run for a period covering 24 hours.
2. One average, patients spend no more than 90 minutes in the clinic **(constraint)**.
3. An unlimited number of people are outside of the dispensing center waiting for treatment at all times – a worst-case scenario.
4. All family members move together through the dispensing center.
5. All family members have the same level of potential exposure.
6. Sufficient resources are available to keep each station fully staffed and functioning at 100% efficiency during the 24 hours.
7. A linear relationship exists between mean provider service time and the number of people in a family.
8. A maximum of 5 orientation rooms will be set up at each vaccination clinic **(constraint).**
9. Patient transit times between stations are not included in the model.

Schemata of Model Vaccination Clinic*
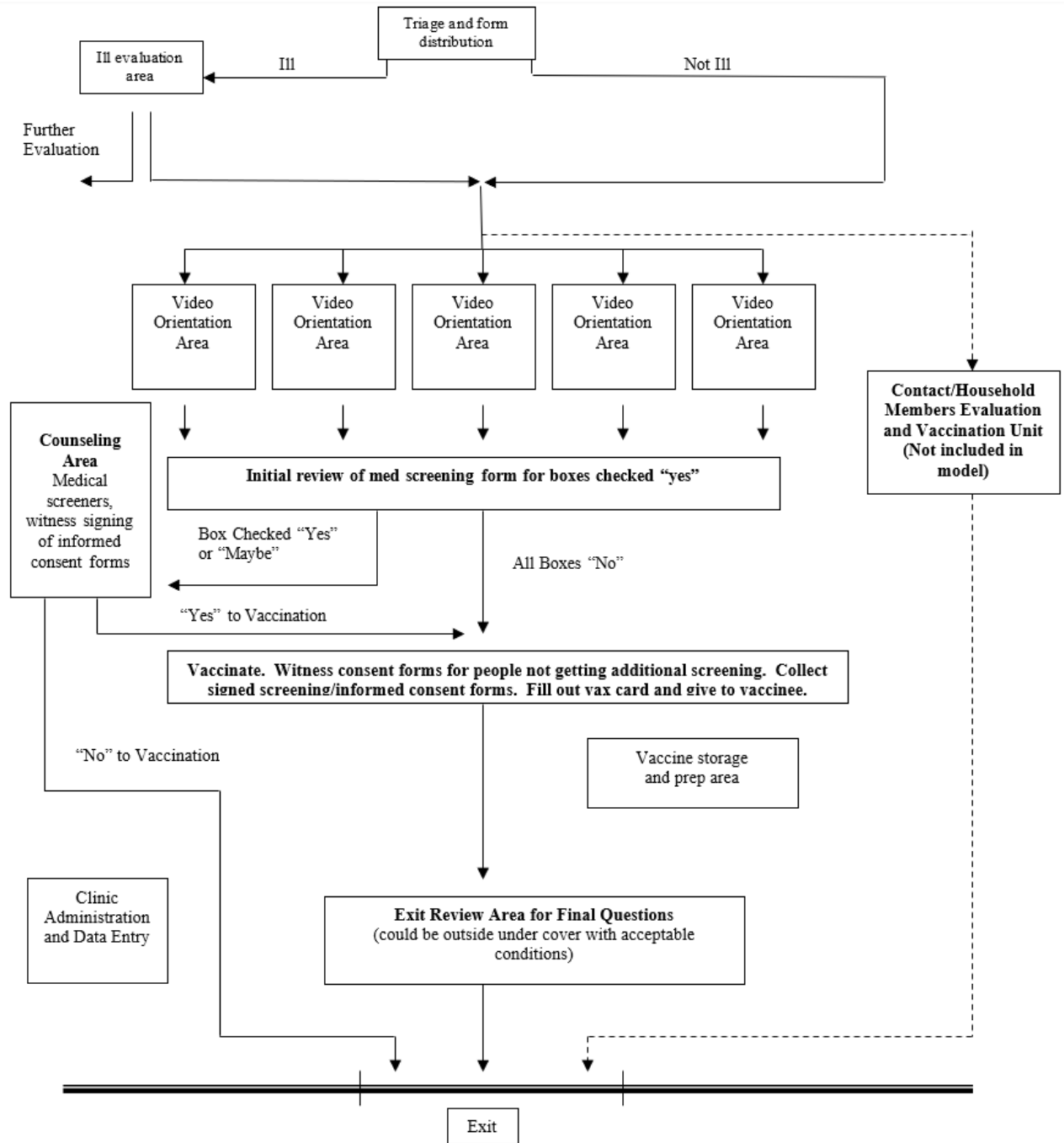
*Note – This figure has been slightly modified from Figure 1 presented in the CDC Smallpox Response Plan and Guidelines (Version 3.0), Annex 3.

Input Probabilities*

Percent of families in which all have previously been vaccinated*	2
Percent symptomatic/contact (exit clinic); these families exit the clinic after being triaged	1
Percent identified as not treatable at the clinic site; these families exit the clinic after being triaged	2
Percent of people who need help with filling out their medical/consent forms	2
Percent with complicating health factors; these families require additional medical screening beyond that given at the referral station	10
Percent with complicating health factors that are identified by the medical screener and who are not treatable on site; these families will exit the clinic after seeing a medical screener and will exit the clinic before receiving a vaccination	10
Percent with complicating health factors that are identified by the physician evaluator and who are not treatable on site; these families will exit the clinic after seeing the physician evaluator and will exit the clinic before receiving a vaccination	5

Note: These are assumed values only. The current version of the model assumes that even if a single member of a family meets a given criteria (e.g., at triage sent to another site for treatment), then the entire family will accompany that one person.

*Previously vaccinated during current vaccination campaign, such as at another clinic. The term "previously vaccinated" does not include those vaccinated, say, 30 years ago.

Input Distributions*

	Maxi-Vac	Maxi-Vac Alternative
Process	**Triangular Distribution (Minimum, Most Likely, Maximum)** (minutes)	**Unless specified below, the distribution is triangular**
Triage (per family member)	(0.5, 1.0, 2)	(0.5, 1.0, 2)
Orientation	(20, 25,30)	(13, 14,15)
Fill-out forms w/o help (per family member)	(0.5, 1.0, 1.5)	**33 * BETA(0.518, 6.25)**
Fill-out forms w/ help (per family member)	(0.3, 1.0, 1.5)	**33 * BETA(0.518, 6.25)**
Referral (per family member)	(0.4, 0.5,0.75)	(0.4, 0.5,0.75)
Medical screening (per family member)	(5, 10, 15)	**-0.001 + LOGN(0.859, 0.508)**
Physician evaluation	(5, 10, 15)	**(0.1,0.5,0.75)**
Exit review (per family member)	(2, 3, 5)	**ERLA(0.0599, 5)**
Vaccination (per family member)	(0.5, 1, 1.5)	**1+ ERLA(0.3,2)**

Note: The values in this table may differ from those given in the CDC Smallpox Response Plans and Guidelines (Version 3.0), Annex 3. These values may change in later versions if and when additional new data become available.

Times that are different in Maxi-Vac Alternative came from a report by Brian G. McCue and Monica J. Giovachino titled "A field test of the CDC smallpox vaccination clinic model" completed in April 2003.

BETA means beta distribution.

LOGN means lognormal distribution

ERLA means Erlang distribution