

# **VACCINE ALLOCATION MODEL**

## **USER'S GUIDE**

**Version 2.1**

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**Institute for Systems Research**

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## **Introduction**

The Vaccine Allocation Model is intended to help public health officials determine how many persons in different target groups can receive treatment given a limited number of doses. This model was developed for vaccinations but can also be used for any other type of medication.

The Vaccine Allocation Model can be used either in the advance planning stages of a vaccination campaign or for support during a vaccination campaign. It is based on recommendations for use of vaccine against novel influenza A (H1N1). These recommendations were made by the Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices (ACIP) on July 29, 2009 (<http://www.cdc.gov/media/pressrel/2009/r090729b.htm>).

The Vaccine Allocation Model allows public health officials to enter information about the population in their jurisdiction and the number of doses of a vaccine (or other medication) that will be available in their jurisdiction. The model immediately determines how many persons in different target groups can receive treatment. A user can adjust the population of the target groups, add more target groups, modify the expected demand for each target group, and reprioritize target groups.

Because the Vaccine Allocation 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: "VAM 2.1.xls."

This user guide includes details on using the Vaccine Allocation Model. At each step, an example, with snapshots from the model, will be provided.

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 an Advanced Practice Center (APCs) for Public Health Preparedness funded by NACCHO through the CDC. This APC and the University of Maryland have been collaborating since 2004 on providing models to public health officials to improve decision-making and emergency preparedness planning.

## Important Terms

1. **Vaccination:** a single dose of a vaccine, a single shot. Also known as a “bolus.” In this version of the Vaccine Allocation Model, the default is that each person will receive two doses. The user can change this parameter on the Main page. Thus, the number of persons who can be treated is the number of available doses divided by this parameter.
2. **Population:** the total number of people in a target group in a jurisdiction. Not everyone in a population will necessarily want to receive treatment.
3. **Demand:** the percentage of persons in a target group who will want to receive treatment. This may depend upon the pandemic severity. This is also known as uptake.
4. **Severity:** the severity of a pandemic based on the proportion of individuals with pandemic illness who die (the “case fatality rate”). Pandemics are defined as “severe” (PSI categories 4 or 5), “moderate” (PSI category 3), and “less severe” (PSI categories 1 and 2).
5. **Target Group:** People targeted for treatment defined by a common occupation, type of service, age group, or risk level. A target group is a group of persons with the same occupation or age and health status. Every person in the United States is included in one or more target groups. Target groups are treated in tiers, with all groups in a tier treated simultaneously.
6. **Category:** Pandemic vaccination target groups are clustered into four broad categories (homeland and national security, health care and community support services, critical infrastructures, and the general population). These four categories together cover the entire population. (These were used in previous versions of the Vaccine Allocation Model.)
7. **Tier:** A set of target groups in different categories. Medication will be allocated and administered according to tiers where all groups designated for treatment within a tier have equal priority. Groups within tiers vary depending on pandemic severity.
8. **Severity:** the severity of a pandemic based on the proportion of individuals with pandemic illness who die (the “case fatality rate”). Pandemics are defined as “severe” (PSI categories 4 or 5), “moderate” (PSI category 3), and “less severe” (PSI categories 1 and 2).

## **Using the Vaccine Allocation Model**

### ***Orientation***

Open the “Vaccine Allocation Model.xls” workbook using Microsoft Excel.

The workbook consists of five worksheets:

- Main
- Target Groups
- Tiers
- Allocation
- Calculations

The workbook also contains one chart:

- Tier Allocation Chart

Go to a worksheet (or chart) by clicking on the tab with the corresponding name at the bottom of the worksheet.

The following pages describe each step of creating a Vaccine Allocation Model.

## Steps 1 & 2: Main

### Step 1

Go to the Main worksheet. Click on the box underneath the instructions “1. Select Pandemic Severity.” Then click on the small triangle just to the right of the box. A pull-down list will appear with the options “Severe,” “Moderate,” and “Less severe.” Click on one of these options.

#### Instructions:

1. Select Pandemic Severity from drop-down list (click on box and then on triangle to get list):

|                                   |           |   |
|-----------------------------------|-----------|---|
| Severe<br>Moderate<br>Less severe | available |   |
| and number of doses per person:   |           | 2 |

### Step 2

In the box to the right of the instructions “2. Enter the total number of doses available,” enter the total number of doses available. This is the number of doses, not the number of persons.

Also, enter the number of doses per person in the box provided.

After a total number of doses available is entered, the total number of person who can be treated will appear to the right of the label “Total number of persons who can be treated:”

#### Vaccine Allocation Model - Version 2.1

This model can be used to estimate how many doses can be allocated to which tiers of target groups.

#### Instructions:

1. Select Pandemic Severity from drop-down list (click on box and then on triangle to get list):

|        |
|--------|
| Severe |
|--------|

2. Enter total number of doses available  
and number of doses per person:

|             |
|-------------|
| 300,000,000 |
| 2           |

Total number of persons who can be treated: 150,000,000

**Step 3: Target Groups**

Go to the Target Groups worksheet. Initially, this worksheet contains the list of target groups from the ACIP recommendations. Enter the total population for each target group in the corresponding box in Column D of this worksheet.

Any cells left blank will be treated as 0.

If desired, updated the demand percentages. (This is also known as uptake.) There is a different demand percentage for each pandemic severity. 100% means that everyone in this target group will want to be treated in that scenario. Any value between 0 and 100% can be entered.

The group names in Column C can be changed. To do so, just type over the current target group name.

Other groups can be added to this list. Enter the group name in Column C between Row 9 and Row 70. Enter the population in Column D and the demand percentages in Columns F, G, and H of the same row as the group name.

Changes to the list of target groups on this worksheet will appear on the Tiers and Allocation worksheets. *Note: do not change the lists on the Tiers and Allocation worksheets.*

**Target Groups worksheet**

Enter the total population for each target group. If desired, updated the demand percentages.

| Target Group   | Total population in target group | Demand for vaccination in each target group based on pandemic severity (percentage) |          |             |
|--|----------------------------------|---|----------|-------------|
|  |                                  | Severe  | Moderate | Less severe |
| Healthcare and emergency medical services (EMS) workers  | <input type="text"/>             | 100%  | 100%     | 100%        |
| Pregnant women   | <input type="text"/>             | 100%  | 100%     | 100%        |
| Household contacts of infants under 6 months old         | <input type="text"/>             | 100%  | 100%     | 100%        |
| Children and young people aged 6 months through 24 years | <input type="text"/>             | 100%  | 100%     | 100%        |
| People between 25 and 64 with chronic medical conditions | <input type="text"/>             | 100%  | 100%     | 100%        |
| Healthy adults, 25 – 64 years old                        | <input type="text"/>             | 100%  | 100%     | 100%        |
| People aged 65 and older                                 | <input type="text"/>             | 100%  | 100%     | 100%        |

**Step 4: Tiers**

Go to the Tiers worksheet. This worksheet contains the list of target groups and the assignment of each target group to a tier, based on pandemic severity.

The tier assignments can be modified. To do so, update the number in the corresponding cell.  
*Note: The tier assignment must be 1, 2, 3, 4, or 5.*

**Tiers worksheet**

If desired, updated the tier for each target group.

**Tier for each target group based on pandemic severity**

| Target Group   | Pandemic Severity |          |             |
|--|-------------------|----------|-------------|
|  | Severe            | Moderate | Less severe |
| Healthcare and emergency medical services (EMS) workers  | 1                 | 1        | 1           |
| Pregnant women   | 1                 | 1        | 1           |
| Household contacts of infants under 6 months old         | 1                 | 1        | 1           |
| Children and young people aged 6 months through 24 years | 1                 | 1        | 1           |
| People between 25 and 64 with chronic medical conditions | 1                 | 1        | 1           |
| Healthy adults, 25 – 64 years old                        | 2                 | 2        | 2           |
| People aged 65 and older                                 | 3                 | 3        | 3           |

**Step 5: Main**

Go to the Main worksheet. This worksheet now shows the allocation of doses to each tier. These numbers were calculated based on the inputs entered in Steps 1, 2, 3, and 4.

For each tier, the worksheet shows the number of doses needed (based on the corresponding target groups and the demand in each target group) and the number of doses allocated to that tier. The worksheet shows number of persons in that tier who want to be treated (based on the corresponding target groups and the demand in each target group) and the number of persons who can be treated. The worksheet shows the percentage of demand that can be satisfied.

Finally, the worksheet shows totals across all of the tiers.

**Vaccine Allocation Model - Version 2.1**

This model can be used to estimate how many doses can be allocated to which tiers of target groups.

**Instructions:**

1. Select Pandemic Severity from drop-down list (click on box and then on triangle to get list):

2. Enter total number of doses available and number of doses per person:

\_\_\_\_\_ Total number of persons who can be treated: 150,000,000

3. Enter population for each target group on the **Target Groups** worksheet. If desired, change expected demand based on pandemic severity.

4. If desired, update tier assignments on **Tiers** worksheet.

5. View allocation by tier below:

|   | Tier        |             |            |   |   | Total       |
|---|-------------|-------------|------------|---|---|-------------|
|   | 1           | 2           | 3          | 4 | 5 |             |
| Doses needed for tier:                                | 253,800,000 | 246,700,000 | 76,000,000 | 0 | 0 | 576,500,000 |
| Doses allocated:                                      | 253,800,000 | 46,200,000  | 0          | 0 | 0 | 300,000,000 |
| Number of persons in tier:                            | 126,900,000 | 123,350,000 | 38,000,000 | 0 | 0 | 288,250,000 |
| Number who can be treated:                            | 126,900,000 | 23,100,000  | 0          | 0 | 0 | 150,000,000 |
| Percentage of persons in tier who will get treatment: | 100%        | 19%         | 0%         |   |   | 52%         |

6. View allocation of treatments to tiers on **Tier Allocation Chart**.

7. View allocation of treatments to target groups on **Allocation** worksheet.

**Step 6: Tier Allocation Chart**

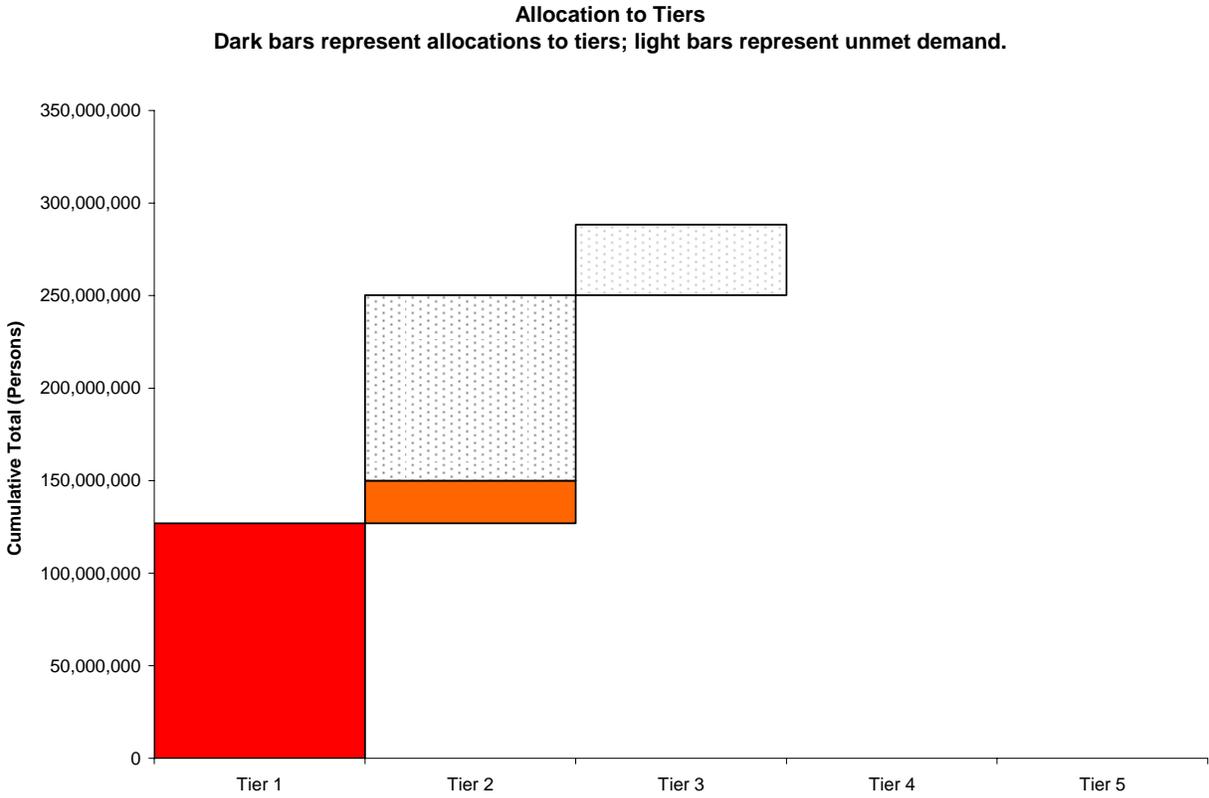
Go to the Tier Allocation Chart. This chart now shows the allocation of doses to each tier (like the table on the Main worksheet). These numbers were calculated based on the inputs entered in Steps 1, 2, 3, and 4.

For each tier, the chart shows the number of persons who can be treated as a dark (or solid) bar and the unmet demand (in persons) as a light (dotted) bar. The bars are offset vertically to indicate the total number of persons who can be treated.

The tiers are color-coded:

- Tier 1: red
- Tier 2: orange
- Tier 3: yellow
- Tier 4: green
- Tier 5: blue

Typically, the high-priority tiers will be completely solid because their allocations are enough to meet their demand. Then there will be a tier in which some of the demand is met and some is unmet. The remaining low-priority tiers receive no allocation, so all of their demand is unmet.



**Step 7: Allocation**

Go to the Allocation worksheet. This worksheet now shows the allocation of doses to each target group. These numbers were calculated based on the inputs entered in Steps 1, 2, 3, and 4.

For each target group, the worksheet shows the number of doses needed in that target group (based on the population and the demand) and the number of doses allocated to that target group. The worksheet shows number of persons in that target group who want to be treated (based on the population and the demand) and the number of persons who can be treated. The worksheet shows the percentage of demand that can be satisfied.

**Allocation worksheet**

| <b>Target Group</b>                                      | <b>Expected number of persons who will need treatment in target group</b> | <b>Number of persons who can be treated in target group</b> | <b>Number of doses needed for target group</b> | <b>Number of doses allocated to target group</b> | <b>Percentage</b> |
|--|---|---|--|--|-------------------|
| Healthcare and emergency medical services (EMS) workers  | 8,200,000   | 8,200,000   | 16,400,000                                     | 16,400,000                                       | 100%              |
| Pregnant women   | 3,100,000   | 3,100,000   | 6,200,000                                      | 6,200,000  | 100%              |
| Household contacts of infants under 6 months old         | 4,300,000   | 4,300,000   | 8,600,000                                      | 8,600,000  | 100%              |
| Children and young people aged 6 months through 24 years | 75,300,000  | 75,300,000  | 150,600,000                                    | 150,600,000                                      | 100%              |
| People between 25 and 64 with chronic medical conditions | 36,000,000  | 36,000,000  | 72,000,000                                     | 72,000,000                                       | 100%              |
| Healthy adults, 25 – 64 years old                        | 123,350,000   | 23,100,000  | 246,700,000                                    | 46,200,000                                       | 19%               |
| People aged 65 and older                                 | 38,000,000  | 0   | 76,000,000                                     | 0  | 0%                |

## Changing a Model

At any point, one can go back to the Main worksheet, Target Groups worksheet, or Tiers worksheet to modify the inputs already entered. The results in the Main worksheet and the Allocation worksheet will change immediately as well.

To change or add target groups, go to the Target Groups worksheet. The group names in Column C can be changed. To do so, just type over the current target group name. To add a target group, enter the group name in Column C between Row 9 and Row 70. Enter the population in Column D and the demand percentages in Columns F, G, and H of the same row as the group name. Changes to the list of target groups on this worksheet will appear on the Tiers and Allocation worksheets. *Note: do not change the lists on the Tiers and Allocation worksheets.*

## Dose Allocation Rules

This section describes the algorithm used to allocate doses to target groups.

1. Total number of persons who can be treated = the total number of doses available divided by 2.
2. According to the pandemic severity, each target group's demand equals the target group's total population times the target group's demand percentage.
3. According to the pandemic severity, each target group is assigned to a tier.
4. Each tier's demand equals the sum of the demand of the target groups in that tier.
5. The Tier 1 allocation = the minimum of the Tier 1 demand and the total number of persons who can be treated. The Tier 1 remainder = the total number of persons who can be treated - the Tier 1 allocation.
6. The Tier 2 allocation = the minimum of the Tier 2 demand and the Tier 1 remainder. The Tier 2 remainder = the Tier 1 remainder - the Tier 2 allocation.
7. The Tier 3 allocation = the minimum of the Tier 3 demand and the Tier 2 remainder. The Tier 3 remainder = the Tier 2 remainder - the Tier 3 allocation.
8. The Tier 4 allocation = the minimum of the Tier 4 demand and the Tier 3 remainder. The Tier 4 remainder = the Tier 3 remainder - the Tier 4 allocation.
9. The Tier 5 allocation = the minimum of the Tier 5 demand and the Tier 4 remainder. The Tier 5 remainder = the Tier 4 remainder - the Tier 5 allocation.
10. Each tier's allocation percentage = that tier's allocation / that tier's demand.
11. The allocation to each target group = that target group's demand times the allocation percentage for the tier to which the target group is assigned. Note that this is number of person who can be treated.
12. The number of doses allocated to each tier and target group = 2 times the allocation to each tier and target group.

## Example

This example is extremely simplified to illustrate the calculations. It does not represent a realistic scenario. The values are classified as INPUT (those supplied by the user) or CALCULATED (those determined by the Vaccine Allocation Model).

INPUT: The total number of doses available = 140,000.

CALCULATED: Total number of persons who can be treated =  $140,000 / 2 = 70,000$ .

There are six target groups. Two target groups (A & B) are assigned to Tier 1. Two target groups (C & D) are assigned to Tier 2. Two target groups (E & F) are assigned to Tier 3.

INPUT: The total population for the six target groups:

A: 10,000

B: 20,000

C: 50,000

D: 60,000

E: 100,000

F: 200,000

INPUT: The demand percentages (based on the pandemic severity) for the six target groups:

A: 100%

B: 75%

C: 100%

D: 67%

E: 100%

F: 50%

CALCULATED: The demand for the six target groups:

A:  $100\%(10,000) = 10,000$

B:  $75\%(20,000) = 15,000$

C:  $100\%(50,000) = 50,000$

D:  $67\%(60,000) = 40,000$

E:  $100\%(100,000) = 100,000$

F:  $50\%(200,000) = 100,000$

CALCULATED: The demand for the tiers:

Tier 1: 25,000

Tier 2: 90,000

Tier 3: 200,000

CALCULATED: The allocation to the tiers:

Tier 1: 25,000 (with a remainder of  $70,000 - 25,000 = 45,000$ )

Tier 2: 45,000 (with no remainder)

Tier 3: 0

CALCULATED: Each tier's allocation percentage:

Tier 1:  $25,000 / 25,000 = 100\%$

Tier 2:  $45,000 / 90,000 = 50\%$

Tier 3:  $0 / 200,000 = 0\%$

CALCULATED: Each target group's allocation (number of persons who can be treated):

A:  $100\%(10,000) = 10,000$

B:  $100\%(15,000) = 15,000$

C:  $50\%(50,000) = 25,000$

D:  $50\%(40,000) = 20,000$

E:  $0\%(100,000) = 0$

F:  $0\%(100,000) = 0$

CALCULATED: Each target group's allocation (number of doses):

A:  $2 \times 10,000 = 20,000$

B:  $2 \times 15,000 = 30,000$

C:  $2 \times 25,000 = 50,000$

D:  $2 \times 20,000 = 40,000$

E:  $2 \times 0 = 0$

F:  $2 \times 0 = 0$

### **Additional Information**

See the project web site at <http://www.isr.umd.edu/Labs/CIM/projects/clinic/>

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

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