A Community Vaccination and Mass Dispensing Model (CVMDM) for Public Health Officials

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Summary

Argonne National Laboratory, in partnership with the Illinois Department of Public Health and the Chicago, DuPage County, and Will County Departments of Public Health, is developing a model of the vaccine and anti-viral dispensing process that can be used to help local public health agencies develop, review, and test their mass vaccination and prophylaxis dispensing plans. Presenters will share lessons learned while highlighting key model components including:

- Delivery of SNS supplies from Federal to State and from State to local jurisdictions and hospitals,
- Priority dispensing or vaccination of first responders, center personnel and health care personnel,
- Victim and process flows at vaccination/dispensing centers,
- Center performance metrics based on personnel availability and allocations,
- Incorporation of a six-cohort, five-stage disease progression model to derive morbidity and mortality metrics.

The presentation will include local and state case studies that demonstrate how the model can be used to evaluate a jurisdiction's level of preparedness and response. If compatible with the technical session format, an interactive session will give participants an opportunity to interact with the model to explore the attainability of a specified prophylaxis deadline, the number of vaccination or dispensing centers needed, and the personnel and logistical resources required.

Suggested Category

- Emergency Healthcare Delivery, or
- Community Mitigation Measures

Learning Objectives

Following this session attendees will understand how modeling can aid public health preparedness planning and policy development for a pandemic event or other public health threat. The session's learning objectives are as follows:

- Demonstrate how the model can be used to help public health officials develop, review and test their mass vaccination and mass dispensing plans,

- Learn how the model can be used to predict the potential impact of a mass vaccination/mass dispensing campaign upon an entire jurisdiction's population,
- Understand how the model can help public health officials explore the attainability of a specified prophylaxis deadline, determine the number of vaccination or dispensing centers needed and personnel and logistical resources required,
- Explore with public health officials how the model can be used to simulate differences in prophylaxis effectiveness by disease stage, timing and quantity of prophylaxis deliveries, staffing profiles, and other logistical factors,
- Explore how the model can also help to improve public health and health care integration by enabling public health and hospitals to model surge capacity issues requirements in their community.

Narrative

Please see accompanying description of the Community Vaccination and Mass Dispensing Model.

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Community Vaccination and Mass Dispensing Model

Summary –

Argonne's Community Vaccination and Mass Dispensing Model will simulate the distribution and dispensing of vaccination injections or oral antibiotic/antiviral drugs at local mass prophylaxis centers. Given an arrival time of the initial stockpile, estimated re-supply times, population size and age distribution, physical size of the region covered, and prophylaxis center personnel resources, the model calculates the estimated start time of public vaccinations, prophylaxis center throughput, and operation closure. Linked with a disease progression sub-model, the Community Vaccination and Mass Dispensing Model tracks and reports the number of infections and fatalities based on prophylaxis supply and personnel resource assumptions.

The Community Vaccination and Mass Dispensing Model is consistent with the National Incident Management System and Incident Command System (NIMS/ICS) standards. The model provides timely information to the Planning Section and Incident Commander during a public health emergency.

In its current formulation the Community Vaccination and Mass Dispensing Model is intended for, but not limited to, use in planning for response to a potential pandemic influenza outbreak. Because the disease characteristics of a pandemic influenza are still unknown, the user can select from several alternative disease characterizations that are based on historical pandemic influenzas. The user can also change the disease parameters to customize the model for other infectious diseases.

Selected Inputs –

- Total population
- Stockpile quantity
- Regional square mileage
- Personnel resources
- Number of prophylaxis centers

Selected Outputs –

- Start time for public vaccinations or oral dispensing
- Hours until closure of current prophylaxis process
- Estimated queuing at prophylaxis centers
- Estimated infections by hour
- Estimated fatalities by hour

Scope –

All of the 50 states and many of localities have established plans for dealing with a pandemic influenza. Many of these plans set targets for mass prophylaxis that need to be further tested based on the logistical and personnel resources available to local and state authorities. While an effective vaccine may not be available during the first wave of a pandemic influenza, vaccines may be an important life-saving option in later phases of the disease progression. When a vaccine is available, there will be many challenges to achieving a sufficiently high throughput of vaccinations to slow or stop the spread of the disease.

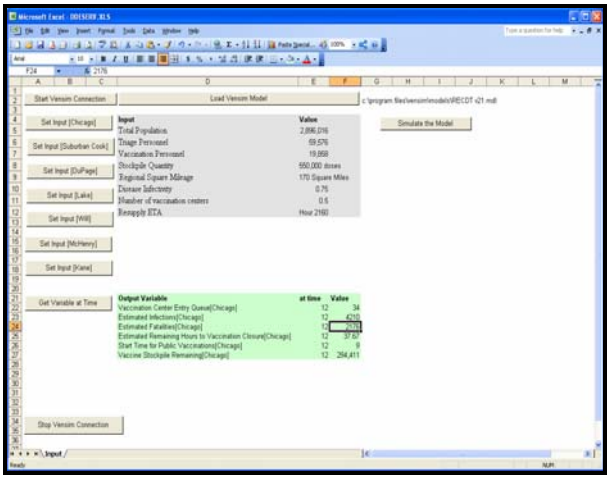

Figure 1. Input/Output Screen Uses a Familiar Microsoft Excel Workbook

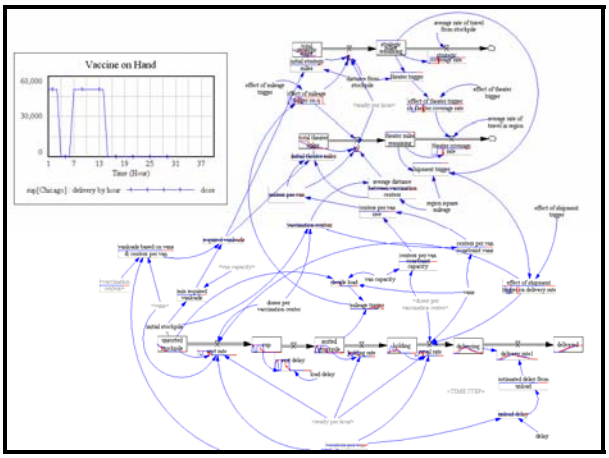

Figure 2. Underlying System Dynamics Model of Vaccine Logistics

Some important challenges may include:

- *Delays in vaccine stockpile delivery to local prophylaxis centers*. Timely delivery of adequate stockpile resources is critical to reducing illnesses and fatalities. Ensuring efficient and timely delivery and planning for contingencies that can delay delivery should be a key goal for local and State health authorities.
- *Adequate availability of qualified and trained personnel*. The primary constraint on the number of prophylaxis centers called for in state and local plans, will likely be the total number of qualified and trained workers who can meet state mandated minimum standard of care statues and who will be available to staff the centers. Understanding the impact of reduced (or supplemental) staff resources is critical to responsible public planning.
- *Equitable policies to deal with limited resources*. The Community Vaccination and Mass Dispensing Model can help explore the effectiveness of alternative policy options, such as prioritization schemes and allocation strategies for limited resources, to minimize illness and fatality rates.

These and many other issues can be easily addressed with the Argonne Community Vaccination and Mass Dispensing Model simulation model. The model is specifically designed to help local public health agencies develop, review, and test their mass vaccination and prophylaxis dispensing plans. For example, the model can be used to help officials determine the attainability of a specified vaccination campaign deadline, the number of vaccination or dispensing centers needed, and the personnel and logistical resources required.

The model can also help to improve public health and health care integration. Specifically, public health and hospitals can use the model to address surge capacity issues in their community.

Intended Audience –

The Community Vaccination and Mass Dispensing Model is designed with a convenient and easy to use interface shown in Figure 1. It is intended for key decision makers within the NIMS Incident Command System, particularly the Incident Commander, the Planning Section Chief, and others supporting that section. The model is also useful to public health and emergency management officials during both the incident management preparedness and response phases.

Primarily, the model will be used to enhance preparedness and resource management planning but it will also have a command and management function that can support emergency management decision-making. For example, during a public health emergency, the model's outputs can be used by the Planning Section to shape and forecast future logistical and operational objectives for the Incident Commander.

If the model output revealed that five vaccinations centers were easily meeting their vaccination operational period objectives but three others within the same geographic area were experiencing overcrowding and delays, then with the assistance of the model, the Incident Commander could act to shift resources to those overcrowded sites.

The bottom line objective is cities and or counties achieving their vaccination/ prophylaxis deadlines because the right resource allocation decisions were made during each IAP operational period.

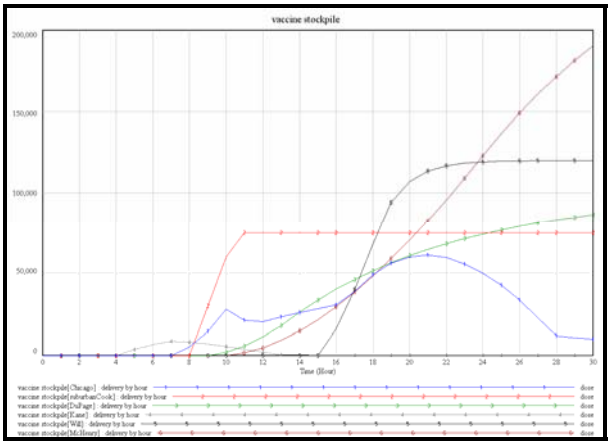

Figure 3. Example scenario where Chicago collar counties have vaccine stockpiles but Chicago (blue) struggles with inadequate supplies

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