

Introduction to Vaccine Supply Chains:

Using a Systems
Approach &
Systems Modeling

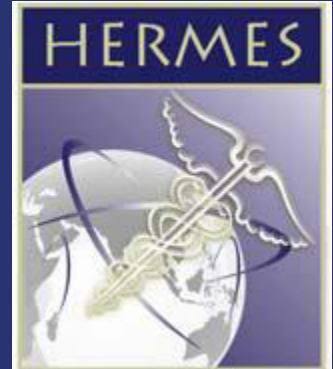
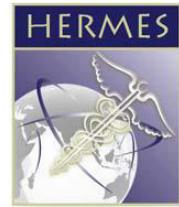


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Introduction to Vaccine Supply Chains: Using a Systems Approach & Systems Modeling

A course on vaccine supply chains, supply chain modeling and how to use HERMES (*A Highly Extensible Resource for Modeling Supply Chains*)

What is a supply chain?

A supply chain is the complex system of equipment, vehicles, personnel, policies and processes needed to deliver a product from its point of origin to the consumer or population.

Why are vaccine supply chains important?

As described in “**The importance of vaccine supply chains to everyone in the vaccine world**”,¹² even the most effective vaccine cannot have any impact on human health without a properly functioning supply chain. Understanding and addressing this system is critical to ensuring the full impact of vaccines. Everyone involved in vaccine decision-making plays a role in this system, from manufacturers who develop and package the vaccine to funders who finance the vaccines to policymakers and public health officials who help ensure a healthy population. For each of these groups, taking the supply chain into account can guide informed decisions about the design of vaccines and vaccine programs to better match the system.

Focusing extra attention on supply chains has led to advancements in other industries. Many companies in the food and retail industries employ or consult supply chain experts regularly to ensure that their supply chains run effectively and efficiently. Additionally, product design often occurs with supply chains in mind. The packaging, size, shape and composition of the product facilitates its storage and delivery. Examples include furniture stores developing pieces that can be shipped in component parts more readily and food manufacturers adding preservatives and developing dried and compact versions of food.

By contrast, evidence suggests that vaccine supply chains have not received the same degree of extra attention. Studies have shown that many vaccine supply chains around the world have substantial constraints and bottlenecks and are not delivering vaccines to many of the people who need them.³ Supply chain issues have hindered efforts to control, eliminate or eradicate diseases such as polio and measles.⁴ While supply chains in many low and middle income countries may have the most substantial problems, many vaccine supply chains in high income countries face challenges as well.



Why is computation simulation modeling needed to better understand vaccine supply chains?

Unaided by technology, humans can struggle to appreciate and understand complex systems.⁵ Modeling is essentially using mathematical equations or computational programs to represent the components, relationships and processes in a system. A computational model can then serve as a “virtual laboratory” to help better understand how a system operates and test the effects of different changes within the system. Using data and information on storage, transport, vaccines and personnel along with data on how these factors work together, a user can use our HERMES software to create a computational simulation model that represents all of the components and processes of the vaccine supply chain to help users view the system as a whole. Without this computational system, it is far more difficult to diagnose system vulnerabilities, coordinate operations, develop solutions and anticipate the impact of changes in the system or new technology. HERMES can project what may happen if things stay the same or circumstances change so that appropriate modifications can be made.

What is HERMES?

HERMES is a software program that allows users to generate a detailed computer simulation model of a supply chain. The model can serve as a “virtual laboratory” for users to evaluate a supply chain and test the effects of implementing different potential policies, interventions, practices and technology changes. The vaccine supply chain is one example of the various supply chains HERMES can be used for. HERMES for vaccine supply chains can help decision makers (e.g., policymakers, decision-makers and planners within health ministries, vaccine supply chain logisticians, vaccine manufacturers, and funders that deal with vaccine supply chains) answer a variety of questions such as:

- What will be the impact of introducing new technologies?
- What are the effects of altering the characteristics of health products?
- How does the configuration and the operations of the supply chain (e.g., storage devices, shipping frequency, personnel or ordering policy) affect performance and cost?
- What may be the effects of differing conditions and circumstances (e.g., power outages, delays, inclement weather, etc.)?
- How should one invest or allocate resources most effectively resources (e.g., adding refrigerators vs. increasing transport frequency)?
- How can product delivery be optimized?

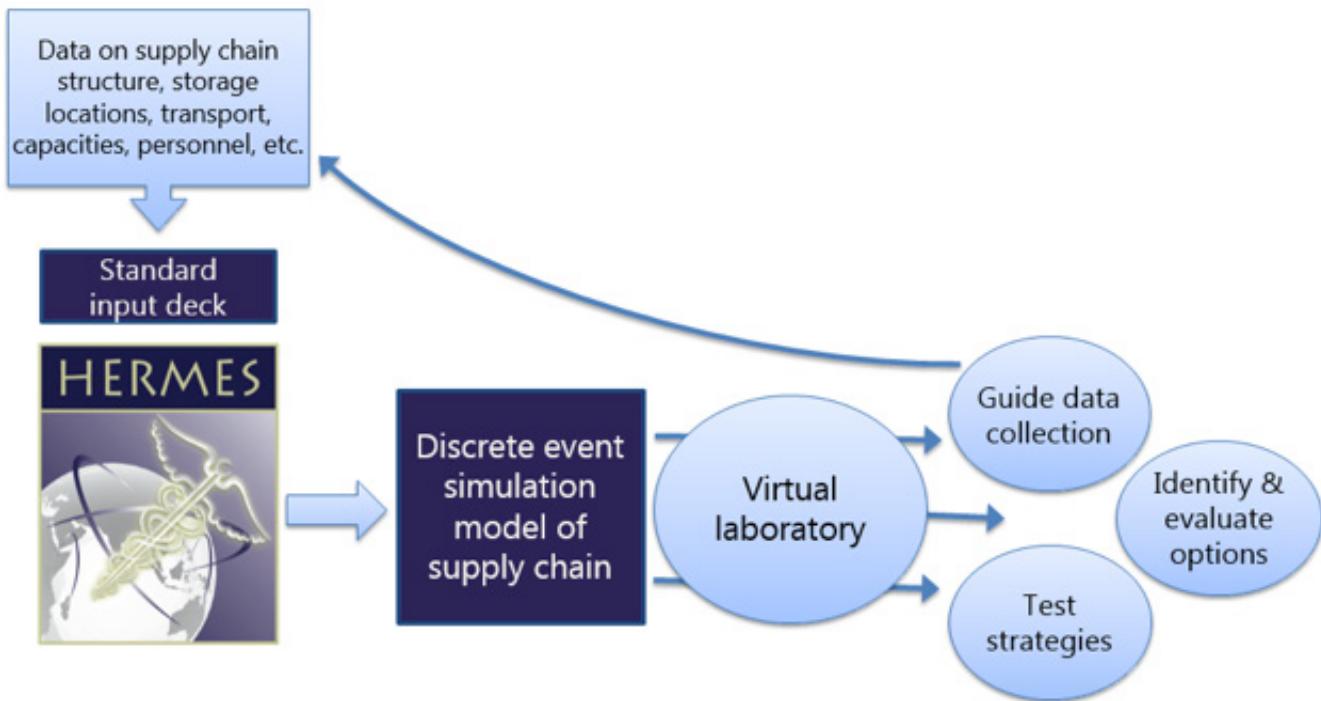
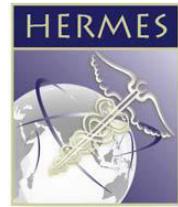


Figure 1 - HERMES Modeling Process & Outputs

What are the learning objectives of the tutorials?

1. Identify each of the components of the vaccine supply chain system
2. Understand the complexities of the supply chain and how each component interacts with each other
3. Describe common vaccine supply chain system issues
4. Identify and assess the critical measures of a vaccine supply chain's "health"
5. Understand the benefit of modeling in assessing the vaccine supply chain system, and testing changes to the system



How are the series of tutorials organized?

The 7 tutorials will walk you through the steps involved in building and using a HERMES model of a vaccine supply chain. This will help you understand the structure and operations of a vaccine supply chain and some key vaccine supply chain principles.

Tutorial 1: Creating a New Vaccine Supply Chain Model

This tutorial will take you through building a vaccine model in HERMES. Through this tutorial you will learn the different components of the vaccine supply chain and how they fit together.

Tutorial 2: Running Your New Model & Viewing Results

This tutorial will teach you how to run your vaccine supply chain model. Through this, you will learn different measures of supply chain performance and operations and how seemingly small changes in the system can lead to significant effects.

Tutorial 3: Introducing or Changing Vaccines

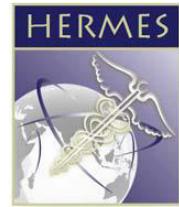
A common question is whether a supply chain can handle the introduction of a new vaccine and what the effects may be. For example, previous studies have shown the challenges countries may face if a new vaccine such as Rotavirus (RV) is introduced.⁶ In this tutorial, you will learn how to customize a new vaccine or change the characteristics of a current vaccine in the supply chain model and determine the potential obstacles and effects.

Tutorial 4: Adding, Removing, and Changing Storage Devices

Increasing storage capacity is a useful method for reducing bottlenecks in a supply chain, but achieving the desired outcome means knowing at which level to introduce these devices. In this tutorial, you will learn how to make changes to the available storage devices across a given supply chain level and determine the potential effects.

Tutorial 5: Removing A Level From The Supply Chain

Supply chain redesign, which includes restructuring the number of levels in a supply chain, may help improve efficiencies in vaccine delivery. In this tutorial, you will learn how to make changes to your model by removing a supply chain level and adjusting the policies that determine how vaccines are shipped.



Tutorial 6: Modifying Transport Characteristics by Level

The type of vehicle or mode of transport one uses, the policy that dictates ordering and moving a product and geographic characteristics can all have a significant impact on the performance and efficiency of a supply chain. This tutorial will walk you through making changes to transport routes in your model. The experiment will allow you to choose a collection of routes based on what supply chain level the routes originate at and which supply chain levels the routes run between. You can then specify operations to perform on the routes, such as increasing frequency of trips or changing the vehicle type.

Tutorial 7: Introduce Transport Loops

Transport loops can be more efficient and provide more reliable shipping of products than routes that only make one delivery at a time because they require maintaining a smaller fleet of vehicles that can potentially travel shorter distances and provide a more regular shipping pattern. However, transport loops may also require larger vehicles with additional storage volume which may be more costly to operate and maintain. This experiment will take you through a series of screens that will ask you between which supply chain levels you would like to create transport loops, the number of locations per transport loop and the vehicle that you would like to use for each loop.

INSTALLING HERMES SOFTWARE:

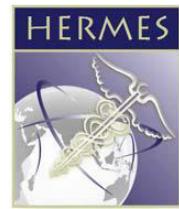
Step 1: If you haven't installed HERMES on your computer yet, please go to the HERMES Installation Instructions to find out how to do so. Once you have installed HERMES onto your computer you can proceed to step 2.

Step 2: Find the HERMES application icon on either the desktop or the START menu.

Step 3: Double click the HERMES application icon to launch HERMES.

Step 4: If a Registration Screen appears, please complete the information requested.

Step 5: You should then be taken to the Welcome Screen for HERMES.



¹ Lee BY, and Haidari LA. “The importance of vaccine supply chains to everyone in the vaccine world.” *Vaccine* (2017).

² Lee BY. “A New Hope: Vaccine Supply Chains Get More Attention.” *Forbes* (2017). <https://www.forbes.com/sites/brucelee/2017/05/01/a-new-hope-vaccine-supply-chains-get-more-attention>

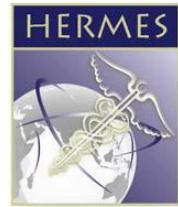
³ Lee BY, Connor DL, Wateska AR, Norman BA, Rajgopal J, Cakouros BE, Chen S-I, Claypool EG, Haidari LA, Karir V, Leonard J, Mueller LE, Paul P, Schmitz MM, Welling JS, Weng YT, Brown ST.

⁴ Landscaping the structures of GAVI country vaccine supply chains and testing the effects of radical redesign

⁵ World Health Organization. Immunization supply chain and logistics: a neglected but essential system for national immunization programmes; 2014. Available at: http://www.who.int/immunization/call-to-action_ipac-iscl.pdf.

⁶ Lee BY, Bartsch SM, Mui Y, Haidari LA, Spiker ML, Gittelsohn J. A systems approach to obesity. *Nutrition Reviews*, Volume 75, Issue suppl_1, 1 January 2017, Pages 94–106

⁷ Lee BY, Assi TM, Rajgopal J, Norman BA, Chen S-I, Brown ST, Slayton RB, Kone S, Kenea H, Welling JS. “Impact of introducing the pneumococcal and rotavirus vaccines into the routine immunization program in Niger.” *American journal of public health* 102.2 (2012): 269-276.



Tutorial 1

Creating a New Vaccine Supply Chain Model

This is the first tutorial for the **“Introduction to Vaccine Supply Chains: Using a Systems Approach & Systems Modeling”** tutorial series. This tutorial will provide an overview of the vaccine supply chain system and introduce you to simulation modeling as a tool to visualize, evaluate and experiment with vaccine supply chains.

Through our HERMES model, this module will walk you through the construction of a virtual supply chain. HERMES is based on real-world data from the expanded program on immunization (EPI) vaccine supply chain in Gaza Province, Mozambique. This tutorial explores each of the components of a vaccine supply chain through a hands-on approach. You will build a model of your own in order to conduct baseline and experimental simulation runs.

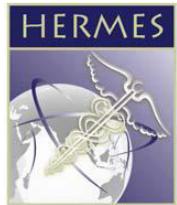
This example model will include the Gaza provincial vaccine store, two district stores in Cidade de Xai-Xai and Massinger, and 11 health centers in these districts. You will be able to build a model with detailed representations of the storage devices, personnel, vehicles and associated operating costs at each location, as well as the transport routes and shipping policies between locations, and the vaccine vials flowing through the supply chain. Additional tutorials alter this wexample model to produce and run experimental scenarios to assess the impact of changes such as introducing new vaccines, removing a supply chain level, adding storage capacity, modifying shipping policies and introducing shipping loops.

HERMES MODEL CREATION GUIDED WORKFLOW

Part 1: Getting Started

Note: You should already have HERMES downloaded and opened. Please see here if you still need to download and open prior to starting step #1.

1. On the Welcome Page, click **“Create or Upload a New Model”**
2. Click on **“Create a New Model”** in the dialogue box
3. Enter **“tutorial_newmodel”** when prompted for model name then click the **“Create”** button.

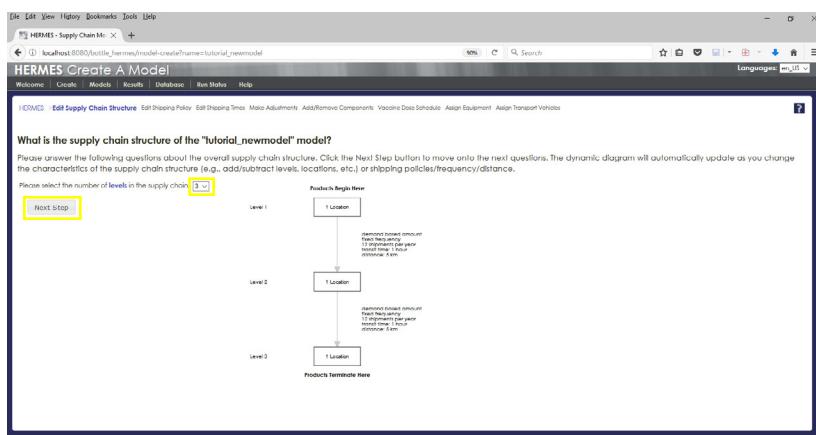


Part 2: Supply Chain Structure

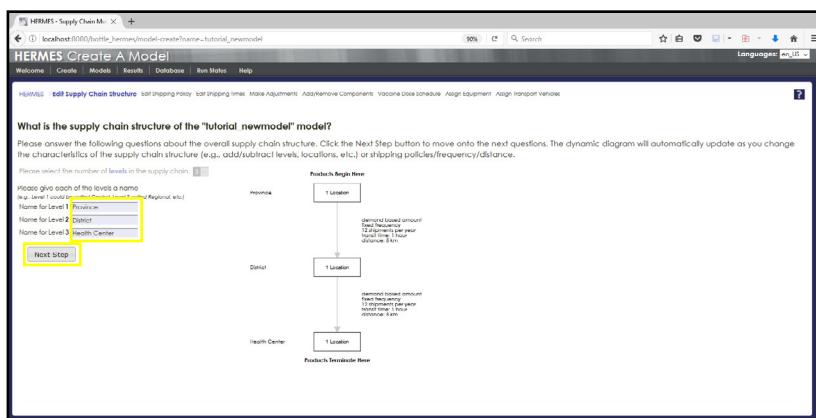
Note: Please zoom in to see screenshots. We recommend zooming in to at least 2000%.

The structure of a supply chain is the hierarchy of locations between which products travel to reach the population. The structure of a national vaccine supply chain often starts with a central store that receives vaccines from the manufacturer. Beyond the central store, a supply chain may contain regional or provincial hubs, state stores, district stores and local stores such as health posts to optimize outreach. The structure of a supply chain can have various effects on the function of the supply chain.

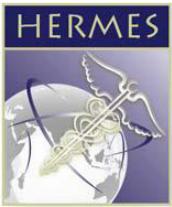
To begin:



1. Select **3** from the “Please select the number of **levels** in the supply chain” dropdown
2. Click the “**Next Step**” button



3. Rename:
 - Level 1** to “Province” – this is where vaccines will enter the model
 - Level 2** to “District” – this level both receives and distributes vaccines
 - Level 3** to “Health Center” – this is where vaccines will be administered
4. Click the “**Next Step**” button



What is the supply chain structure of the "tutorial newmodel" model?

Please answer the following questions about the overall supply chain structure. Click the Next Step button to move onto the next questions. The dynamic diagram will automatically update as you change the characteristics of the supply chain structure (e.g., add/subtract levels, locations, etc.) or shipping policies/frequency/distance.

Please select 1. The number of levels in the supply chain:

Province: 1 location
District: 2 locations
Health Center: 11 locations

Please enter the total number of locations (e.g., storage, immunization, and outreach) for each level:

Number of Locations in Province level: 1
Number of Locations in District level: 2
Number of Locations in Health Center level: 11

Next Screen

5. For the number of locations:

Set Province Level to **1**

Set District Level to **2**

Set Health Center Level to **11**

6. Click the “**Next Step**” button

Part 3: Shipping Details

The shipment policies between each level can differ based on transport availability and other factors. In our example, most or all locations at each level (Provincial, District and Health Center) receive the vaccines via delivery instead of traveling to a higher level to manually pick up the vaccines. The shipment sizes for each delivery is based on demand rather than a fixed quantity. These shipments are delivered at a fixed monthly interval, rather than allowing extra shipments as needed.

Each of these shipping details can be changed in the model with direct and indirect effects. The HERMES model allows the user to set the policy not just between each level, but between each store, based on available data or interest.

How are goods shipped?

Please answer this series of questions about the shipping policies between the levels of the network. The answer below will be used to create a new route between each of the locations at these levels.

For routes from the Province to District levels:

Products are delivered by the supplier
for an amount that is based on demand
on a schedule that is of a fixed interval
at a frequency of 12 times per year

For routes from the District to Health Center levels:

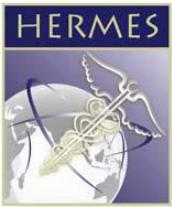
Products are delivered by the supplier
for an amount that is based on demand
on a schedule that is of a fixed interval
at a frequency of 12 times per year

Next Screen

7. The policies described above are preset for this example model.

Please select “**Next Screen**”

NOTE: In addition to shipping policies (direction, quantity, frequency), shipping time is an important consideration when considering the effectiveness of a supply chain. The time to ship between places can be effected by geographical distance as well as road and weather conditions. Simulation modeling via HERMES allows the user to set the time between each level and store based on available data or assumptions.



The screenshot shows the 'Edit Shipping Times' page. It displays three levels of hierarchy: Province, District, and Health Center. For each level, it specifies the average time taken and the average distance. The 'District' row is highlighted with a yellow box.

Level	Average Time	Average Distance
Province	1 hour	130 km
District	2 hours	30 km
Health Center		

8. What is entered in the “**Edit Shipping Times**” page will be modified later because shipping times and distances vary for individual routes, but for now input the following approximate averages for this model then click the “**Next Screen**” button.

Parameters	Province to District	District to Health Center
Average Time	2 hours	1 hour
Average Distance	130 km	30 km

Part 4: Location Names

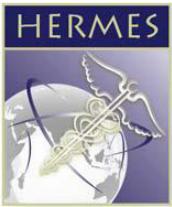
The screenshot shows the 'Make Adjustments' page. It lists location names at three levels: Province, District, and Health Center. The 'District' row is highlighted with a yellow box.

Level	Current Location Name	idcode #	Pick Up or Receive Shipments?	Scheduled or Demanded Schedule of Shipment	Amount of Shipment Held or Demand Based	Frequency of Shipments per
Province	District_1	1	receive	scheduled	variable	12 year
District	District_1_1	2	receive	scheduled	variable	12 year
Health Center	District_1_2	3	receive	scheduled	variable	12 year

9. The “**Make Adjustments**” page allows details to be entered for individual locations, including location names. Location names can also be entered and edited at any time using the Advanced Model Editor. Entering the names now will facilitate further location-specific data entry in future steps.

Change the Current Location Name for the Province Level to “**Gaza**.”

10. In the first column, titled “**Level**”, click the triangle next to Province (if you haven’t already) and then click the triangle next to District in the row with Current Location Name “**District_1**” to open all levels served by that district.



Screenshot of the HERMES 'Create A Model' interface showing the 'Make Adjustments' screen. The table displays a 'Model Transport Network' with columns: Level, Current Location Name, idcode, Pick Up or Receive Shipments?, Scheduled or Demand-Based Schedule of Shipments, Amount of Shipment Fixed or Demand Based, Frequency of Shipments, and per. Rows include District_1 (Gaza), District_1 (Marien Nguabi), District_1 (Patrice Lumumba), District_1 (Praia Xai-Xai), District_1 (Unidade 7), District_1 (Zulo), and District_2 (District_2). The 'District_1' row is highlighted with a yellow box.

11. Change “Current Location Names”:

District_1 to “Cidade de Xai-Xai”

Health Center_1 to “Marien Nguabi”

Health Center_2 to “Patrice Lumumba”

Health Center_3 to “Praia Xai-Xai”

Health Center_4 to “Unidade 7”

Health Center_5 to “Zulo”

NOTE: (Zulo actually belongs to the second district, but we will move it later using the Advanced Model Editor).

Screenshot of the HERMES 'Create A Model' interface showing the 'Make Adjustments' screen. The table displays a 'Model Transport Network' with columns: Level, Current Location Name, idcode, Pick Up or Receive Shipments?, Scheduled or Demand-Based Schedule of Shipments, Amount of Shipment Fixed or Demand Based, Frequency of Shipments, and per. Rows include Gaza, Cidade de Xai-Xai, Marien Nguabi, Patrice Lumumba, Praia Xai-Xai, Unidade 7, Zulo, and Massingir distrito. The 'Massingir distrito' row is highlighted with a yellow box.

12. Now click the triangle next to District in the row with Current Location Name “District_2” to open all levels served by that district.

13. Change “Current Location Names” then click the “Next Screen” button:

District_2 to “Massingir distrito”

Health Center_6 to “Cubo Massingir”

Health Center_7 to “Macaringue”

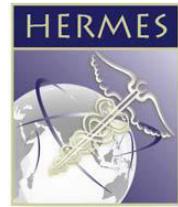
Health Center_8 to “Machamba”

Health Center_9 to “Chibotane”

Health Center_10 to “Mavodze”

Health Center_11 to “Mucatine”

NOTE: It is recommended that you continue to build your model without exiting the workflow. If you do exit the Model Creation workflow at this point (by exiting the program or clicking on a link to a different page), you will be able to access the new model from your available models table (which can be accessed by clicking “Models” in the main menu, located at the top left of every page).



Part 5: Adding Supply Chain Components

In this section, we will begin adding in each of the components that make up the system of a vaccine supply chain (e.g. vaccines, storage devices, vehicles, personnel and the population served). Each component is defined by a set of characteristics that effect the overall function of the supply chain. We will describe each of these characteristics as we incorporate each component into the model.

The “Edit Components” page allows you to add or create all components needed in your model, including: vaccines, storage devices, transport vehicles, target populations, supply chain personnel and per diem policies. These components will be assigned to locations and routes later in the Model Creation workflow. Clicking the “Info” button next to any component will display detailed information about its characteristics. Components can be copied from your other available models as well as the HERMES database, which includes examples from World Health Organization (WHO) prequalified catalogs.

Vaccines

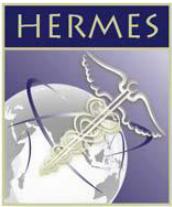
Vaccines are the basic element of the vaccine supply chain. Vaccines manufactured at one location need to be procured and delivered to a population at another location. When determining which vaccines to procure, decision-makers will consider the demand for the vaccine, the physical characteristics of a vaccine and the storage needs of a vaccine.

Vaccine demand:

The demand for vaccines can be influenced by which diseases pose the highest risk to a country, which diseases are common for routine vaccination and which diseases are prioritized by international and national organizations through vertical programs.

Physical characteristics of a vaccine and vaccine components:

The size, shape and packaging of a vaccine and its components can have unexpected effects on the supply chain function. Previous findings from simulation modeling of the Benin vaccine supply chain show that reducing the number of doses per vial (and subsequently increasing the number of vials flowing through the system) can lead to a decrease in overall vaccine availability and an increase in logistical costs per dose administered.¹ Another study looking at the vaccine vial presentation size (10-dose, 5-dose, 1-dose) found that decreasing the doses per container led to a decrease in overall vaccine availability, an increase in transport utilization and an increase in costs per immunized patient.²

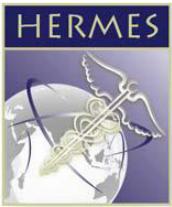


Storage needs of a vaccine and vaccine components:

Whether or not a vaccine needs to be kept in thermostable conditions can affect the function of the supply chain and the final costs of immunization. In many parts of the world, scarce cool and cold storage availability and frequent power outages can lead to bottlenecks, vaccine wastage and reduced vaccine availability. Modeling studies have shown that removing one or more vaccines from cold storage, even at increased price points, can save operational costs by reducing bottlenecks, as well as clinical costs by increasing vaccine availability.^{3,4}

14. The Vaccine category is initially selected (shown by the grayed-out Vaccine box). Choose “**MozGaza**” from the source dropdown menu to get the list of vaccines associated with the MozGaza model.

This is how your screen should look after selecting MozGaza from the dropdown menu.



15. All of the vaccines shown in the MozGaza model will be used in the new model you are creating.

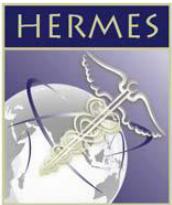
These represent the 2014 EPI vaccines in Mozambique, which include Bacille Calmette-Guérin (BCG), diphtheria-tetanus-pertussis-haemophilus influenza type B-hepatitis B (DTP-HepB-Hib), measles (M), oral polio (OPV), pneumococcal conjugate (PCV) and tetanus toxoid (TT) vaccines. Move the first vaccine from the MozGaza model to your new model:

a. Select a vaccine by clicking on its row (right table).

b. Click “**Add Component to Model**” button between the two tables to add the vaccine to the current model.

16. Continue to add the rest of the vaccines from the MozGaza model (right table) to the new model “**tutorial_newmodel**” (left table) by repeating step 15 for each row.

This is how your screen should appear after completion.

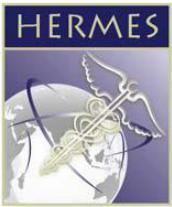


Storage

The types of storage in a vaccine supply chain are critical, given that most vaccines in the supply chain require cool or cold storage to remain effective. Storage containers can include freezers, refrigerators and transportable cold boxes. Within these categories, storage containers can be powered differently (via gas, electricity, solar or passively) and store different volumes. All of these components have an effect on the overall function and costs of the supply chain. The HERMES model allows the user to address questions around which types of storage are the best fit for a given location. Previous modeling work has looked at the role of passive cold storage devices⁵, using solar-powered refrigeration instead of electrical refrigeration^{6,7}, and the benefits and costs of adding stationary storage compared to transportable cold boxes⁸.

17. Click on the “**Storage**” button on the left hand side of the page (between “Vaccine” and “Transport”) to add the relevant refrigerators and freezers that will be used in your new model. These devices appear in the MozGaza model, so keep this model selected as the source in the dropdown box.

18. Adding the first storage device to the model:
- Scroll down to find “**TC 883**” in table on right
 - Click “**Add Component to Model**” button between the two tables to add the storage type to the current model



19. Repeat steps in 18 to add “**TCW 3000 AC**” and “**RCW 42 EK/CF**” to the storage options for your model.

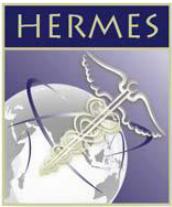
Transportation

Transportation plays an important role in vaccine supply chains. Transport vehicles can be over-utilized, have a scarcity of storage space or be without cold storage. The HERMES model allows the user to input the volume, cold storage amount and type of each vehicle from a large truck to public transportation. The model considers fuel, capital and depreciation costs for each vehicle.

20. Click on the “**Transport**” button on the left hand side of the screen to add modes of transportation used for vaccine distribution. MozGaza should remain as the source selected in the dropdown box.

21. Adding the first transport mode to the model:

- Public transport will be used for some routes in this model. Scroll down to find “**Bus**” in table on right and click on that row
- Click “**Add Component to Model**” button between the two tables to add the Bus transport type to the current model



HERMES Choose Types

Welcome | Create | Models | Results | Database | Run Status | Help

Edit Shipping Policy | Edit Shipping Times | Make Adjustments | Add/Remove Components | Vaccine Dose Schedule | Assign Equipment | Assign Transport Vehicles

Edit Components

Use the Source dropdown box to change what database or model to use to look for components. Select the component you wish to add to the tutorial_newmodel model, and click the arrow button located between the two tables to make it available to the model. To remove an existing component from the model, click the Del[ete] button in the component's row in the Used Types table on the left.

Used Types		Available Types	
Name	Info	Name	Info
bus	Edit Info Del	bus	Edit Info Del
motorbike	Edit Info Del	district truck	Edit Info Del
provincial Hilux	Edit Info Del	mobile brigade truck	Edit Info Del
		motorbike	Edit Info Del
		national cold truck	Edit Info Del
		provincial Hilux	Edit Info Del
		walk	Edit Info Del
		weekly CB pickup	Edit Info Del

+ Add Component To Model

Create a New Component

source: MazGaza

Previous Screen | Next Screen

22. Repeat step 21 to add “**provincial Hilux**” and “motorbike” to the transportation types for your model

HERMES Choose Types

Welcome | Create | Models | Results | Database | Run Status | Help

Edit Shipping Policy | Edit Shipping Times | Make Adjustments | Add/Remove Components | Vaccine Dose Schedule | Assign Equipment | Assign Transport Vehicles

Edit Components

Use the Source dropdown to select the source from which components can be selected. Select which component to add to the tutorial_newmodel model and click the arrow button to add it. To remove existing components, click delete.

Used Types		Available Types	
Name	Info	Name	Info
CB 20 CF	Edit Info Del	CB 1.7L	Edit Info Del
ICW 42 Br/CF	Edit Info Del	CB 2.0	Edit Info Del
TC 60	Edit Info Del	CB 2.5	Edit Info Del
TCW 3000 AC	Edit Info Del	CF 411 1M4/A	Edit Info Del
VC 1.7 CF	Edit Info Del	DMF 290	Edit Info Del

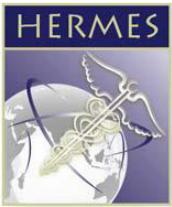
+ Add Component To Model

Create a New Component

source: MazGaza

Previous Screen | Next Screen

If you return to the Storage page after you have updated the transportation types, you will notice that two more storage types have been added to your used types: **CB 20 CF** and **VC 1.7 CF**. These were automatically added because this list includes not only stationary storage devices but also passively cooled devices for transport, such as cold boxes and vaccine carriers. These new devices represent the cold box and vaccine carrier types that carry vaccines in the transportation vehicles that were added to the model. The type and quantity of devices available in a vehicle can be modified using the “**Edit**” button next to any vehicle in the Transport page.



Population

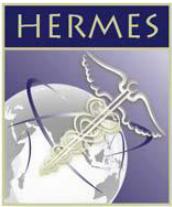
The screenshot shows the 'Edit Components' screen in the HERMES software. On the left, a sidebar lists components: Vaccine, Storage, Transport, Population (which is highlighted with a yellow box), Staff, and PerDiems. The main area has two tables. The 'Used Types' table contains 'Name? Inf' and 'Info'. The 'Available Types' table, with 'source: MozGaza', contains rows: '1.1months', '1Years', '12-24months', 'Newborn', and 'PW'. A yellow box highlights the 'PW' row.

23. Click on the “**Population**” button on the left hand side of the screen to add the population groups who will receive vaccines in the model. The vaccines you added to the model would be given to pregnant women (PW), newborns and infants under one year of age. In this example, you will also add children between 12 and 24 months, to facilitate future vaccine introduction experiments, such as what was described in the Vaccine Introductions tutorial. The population types in your new model are also found in the MozGaza model, which should remain as the source selected in the dropdown box.

The screenshot shows the same 'Edit Components' screen as the previous image, but now the 'Add - Component To Model' button between the 'Used Types' and 'Available Types' tables is highlighted with a yellow box.

24. Add the first population type to the new model:

- Find “**PW**” (pregnant women) in table on right and click on that row
- Click “**Add Component to Model**” button between the two tables to add that age range to the population types for the current model



HERMES Choose Types

Welcome Create Models Results Database Run Status Help Languages: en_US

Edit Shipping Policy Edit Shipping Times Make Adjustments Add/Remove Components Vaccine Dose Schedule Assign Equipment Assign Transport Vehicles

Edit Components

Use the Source dropdown box to change what database or model to use to look for components. Select the component you wish to add to the tutorial_newmodel model, and click the arrow button located between the two tables to make it available to the model. To remove an existing component from the model, click the Del(ete) button in the component's row in the Used Types table on the left.

Name	Info	Del
1-11months	[Edit] [Info]	[Del]
12-24months	[Edit] [Info]	[Del]
Newborn	[Edit] [Info]	[Del]
PW	[Edit] [Info]	[Del]

Available Types

Name	Info
1-11months	[Info]
10years	[Info]
12-24months	[Info]
Newborn	[Info]
PW	[Info]

Add Component To Model

source: MozGaza

Create a New Component Previous Screen Next Screen

25. Repeat step 24 to add “**Newborn**”, “**1-11months**” and “**12-24months**” to the population types for your model

Staff

The HERMES model considers the effect of personnel on the supply chain function and costs. Personnel include logisticians, drivers, medical officers, warehouse workers, etc. Each personnel has a certain wage and percentage of time dedicated to the supply chain tasks that factor into the overall cost of the model.

HERMES Choose Types

Welcome Create Models Results Database Run Status Help Languages: en_US

Edit Shipping Policy Edit Shipping Times Make Adjustments Add/Remove Components Vaccine Dose Schedule Assign Equipment Assign Transport Vehicles

Edit Components

Use the Source dropdown to select the source from which components can be selected. Select which component to add to the tutorial_newmodel model and click the arrow button to add it. To remove existing components, click delete.

Name	Info	Del
Driver	[Edit] [Info] [Del]	
Warehouse Worker	[Edit] [Info]	

Available Types

Name	Info
National Office-Training	[Info]
Planning M&S	[Info]
National D1 Vaccine, Supply & Quality Officer	[Info]
Driver with DLS	[Info]
Warehouse Worker with DLS	[Info]
United BH Manager no DLS	[Info]
United BH Manager with DLS	[Info]
Driver with DLS	[Info]
Direct Medical Officer with DLS	[Info]
Driver	[Info]
Health worker no DLS	[Info]
Health worker with DLS	[Info]
National BPI Administrative Officer	[Info]
National BPI Data Manager	[Info]

Add Component To Model

source: MozGaza

Create a New Component Previous Screen Next Screen

26. Click on the “**Staff**” button on the left hand side of the screen to add the types of personnel working in vaccine supply chain logistics in your new model. The six personnel types in your new model are also found in the MozGaza model, which should remain as the source selected in the dropdown box.

NOTE: You should notice that two example staff types are already listed in the Used Types table on the left. These will not be used in your new model, therefore they need to be removed. To delete the first default:

- Click on the “**Del**” button in the row labeled “**Driver**”

HERMES Tutorial: Creating a new model

Used Components

Use the source dropdown to select the source from which components can be selected. Select which component to add to the tutorial_newmodel model and click the arrow button to add it. To remove existing components, click delete.

Name	Info
Driver	Edit Info Del
Warehouse Worker	Edit Info Del

Available Types

source [MotC200]

Confirm Additional Removal?

Karma type: *shl_Driver*
Do you really wish to remove all instances of this type?

Add Remove Cancel

Components To Model

- National BPI Office-Training
- Planning_MSF
- Therapeutic Vaccine_Supply & Quality Offic
- District Driver no DLS
- District Manager no DLS
- District Medical Officer no DLS
- District Medical Officer with DLS
- Driver
- Health worker no DLS
- Health worker with DLS
- National BPI Executive Officer
- National BPI Data Manager

- b. Click the “**Remove**” button in the dialogue box that asks you to confirm additional removals

Used Components

Use the source dropdown to select the source from which components can be selected. Select which component to add to the tutorial_newmodel model and click the arrow button to add it. To remove existing components, click delete.

Name	Info
Warehouse Worker	Edit Info Del

Available Types

source [MotC200]

- National BPI Office-Training
- Planning_MSF
- Therapeutic Vaccine_Supply & Quality Offic
- District Driver no DLS
- District Manager no DLS
- District Medical Officer no DLS
- District Medical Officer with DLS
- Driver
- Health worker no DLS
- Health worker with DLS
- National BPI Executive Officer
- National BPI Data Manager

- c. Driver is no longer listed in table on right

Used Components

Use the source dropdown to select the source from which components can be selected. Select which component to add to the tutorial_newmodel model and click the arrow button to add it. To remove existing components, click delete.

Name	Info

Available Types

source [MotC200]

- National BPI Office-Training
- Planning_MSF
- Therapeutic Vaccine_Supply & Quality Offic
- District Driver no DLS
- District Manager no DLS
- District Medical Officer no DLS
- District Medical Officer with DLS
- Driver
- Health worker no DLS
- Health worker with DLS
- National BPI Executive Officer
- National BPI Data Manager

27. Repeat step 27 to remove **“Warehouse Worker”** from Used Types.



HERMES Choose Types

Use the Source dropdown to select the source from which components can be selected. Select which component to add to the tutorial_newmodel model and click the arrow button to add it. To remove existing components, click delete.

Used Types	Name	Info
Prov Field Coordinator	Edit Info Del	

Add Component To Model

source [MoC2020]

Available Types	Name	Info
Health worker with I&S	Edit	Info
National EPI Administrative Officer	Edit	Info
National EPI Driver	Edit	Info
National EPI Logistic Officer	Edit	Info
National EPI Manager	Edit	Info
National EPI Medical Delivery Officer	Edit	Info
National Secretary	Edit	Info
Prov Cold Chain Maintenance Tech	Edit	Info
Prov Driver	Edit	Info
Prov EPI Manager	Edit	Info
Prov Field Coordinator	Edit	Info
Prov Medical Officer	Edit	Info
Warehouse Worker	Edit	Info

Create a New Component

28. Add the first staff type to your new model:

- Scroll down to find **“Prov Field Coordinator”** in table on right and click on that row
- Click **“Add Component to Model”** button between the two tables to add the **“Prov Field Coordinator”** staff type to the current model

HERMES Choose Types

Use the Source dropdown box to change what database or model to use to look for components. Select the component you wish to add to the tutorial_newmodel model, and click the arrow button located between the two tables to make it available to the model. To remove an existing component from the model, click the Delete button in the component's row in the UsedTypes table on the left.

Used Types	Name	Info
District Driver no DLS	Edit Info Del	
District EPI Manager no DLS	Edit Info Del	
Health worker no DLS	Edit Info Del	
Prov Driver	Edit Info Del	
Prov EPI Manager	Edit Info Del	
Prov Field Coordinator	Edit Info Del	

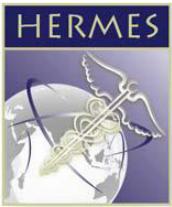
Add Component To Model

source [MoGaza]

Available Types	Name	Info
National EPI Officer-Training, Planning & Monitoring	Edit	Info
National EPI Vaccine, Supply & Quality Officer	Edit	Info
District Driver no DLS	Edit	Info
District EPI Manager no DLS	Edit	Info
District EPI Manager with DLS	Edit	Info
District Medical Officer no DLS	Edit	Info
District Medical Officer with DLS	Edit	Info
Driver	Edit	Info
Health worker no DLS	Edit	Info
Health worker with DLS	Edit	Info
National EPI Administrative Officer	Edit	Info
National EPI Data Manager	Edit	Info

Create a New Component

29. Repeat steps in 29 to add **“Prov EPI Manager,” “Prov Driver,” “District EPI Manager no DLS,” “District Driver no DLS”** and **“Health worker no DLS”** to the staff types for your model



Per diems

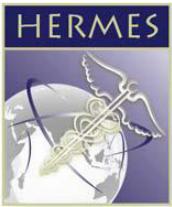
The screenshot shows the 'Edit Components' screen of the HERMES Choose types interface. On the left, a table titled 'Used Types' lists 'No PerDiem' and 'PerDiem'. On the right, a table titled 'Available Types' lists 'District', 'No PerDiem', 'Outreach', and 'Province'. A dropdown menu labeled 'source' is set to 'MozGaza'. A yellow box highlights the 'Add Component To Model' button at the bottom of the available types table.

30. “Per diems” are a daily allowance or payment given to an employee or worker for expenses occurred while traveling for work. Click on the **“PerDiems”** button on the left hand side of the screen to specify the policies that will govern when per diems are paid and how much in your model. You will notice that **“No Per Diem”** is included in the table on the left by default. This will be used for some routes in the model. Other per diem policies in your model vary by supply chain level and are found in the MozGaza model, which should remain as the source selected in the dropdown box.

The screenshot shows the 'Edit Components' screen of the HERMES Choose types interface. The 'Used Types' table now includes 'Province' in addition to 'No PerDiem' and 'PerDiem'. The 'Available Types' table remains the same as in the previous screenshot. The 'source' dropdown is still set to 'MozGaza'. A yellow box highlights the 'Add Component To Model' button at the bottom of the available types table.

31. Add a per diem type to the new model:

- Find **“Province”** in the table on right and click on that row. This represents the per diem policies for trips that originate at the provincial store, and will be assigned to deliveries from the provincial store to district stores in a future step.
- Click **“Add Component to Model”** button between the two tables to add the Province per diem type to the current model



32. Repeat step 32 to add “**District**” per diem to the per diem policies for your model. This represents the per diem policy used to pay drivers at the district level, who will deliver vaccines to health centers in this model.

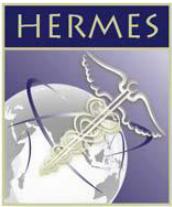
Check your work:

33. Click through the component category buttons on the left (Vaccine, Storage, Transport, etc.) to check that the “**Used Types**” table that contains the correct components for your model. When you are satisfied that you have the correct components, click the “**Next Screen**” button.

Part 6: Specify vaccine schedule

The Vaccine Dose Schedule page specifies the doses needed to fully immunize the target population.

34. If the Next Screen button does not take you there automatically, click on the “**Vaccine Dose Schedule**” at the top of the screen.



HERMES Specify Vaccine Dose Schedule

Edit Demand: Vaccine Dose Schedule

For "Include in the dose table", select the components (vaccines and population types) you'd like to include in the dose schedule. Or "How many doses of each vaccine?" enter the number of doses per population type for each vaccine.

Vaccines Population

Include in the dose table? How many doses of each vaccine per person per year?

Vaccine	Newborn	PW	1-11months
BCG Serum Institute of India 20 Dose [1.3 col/dose]	0	0	0
DTP-HepB-Hib Serum Institute of India 10 Dose [7.4 col/dose]	0	0	0
M Serum Institute of India 10 Dose [7.41 col/dose]	0	0	0
OPV WHO 10 Dose [2 col/dose]	0	0	0
PCV10 GSK 2 Dose [4.8 col/dose]	0	0	0
TT Serum Institute of India 10 Dose [2.61 col/dose]	0	0	0

Show Advanced Options Scale vaccines separately Proportion of population getting vaccinated: [] Projected vs actual: [] Implement calendar: []

Previous Screen Skip to Model Editor Next Screen

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35. Click on the “Population”

button that is above the tables to the left to display the populations you added to your model. Checking the box next to a population will add it to the table on the right ("How many doses of each vaccine per person per year?").

HERMES Specify Vaccine Dose Schedule

Edit Demand: Vaccine Dose Schedule

For "Include in the dose table", select the components (vaccines and population types) you'd like to include in the dose schedule. Or "How many doses of each vaccine?" enter the number of doses per population type for each vaccine.

Vaccines Population

Include in the dose table? How many doses of each vaccine per person per year?

Vaccine	Newborn	PW	1-11months
BCG Serum Institute of India 20 Dose [1.3 col/dose]	0	0	0
DTP-HepB-Hib Serum Institute of India 10 Dose [2.4 col/dose]	0	0	0
M Serum Institute of India 10 Dose [2.61 col/dose]	0	0	0
OPV WHO 10 Dose [2 col/dose]	0	0	0
PCV10 GSK 2 Dose [4.8 col/dose]	0	0	0
TT Serum Institute of India 10 Dose [2.61 col/dose]	0	0	0

Show Advanced Options Scale vaccines separately Proportion of population getting vaccinated: [] Projected vs actual: [] Implement calendar: []

Previous Screen Skip to Model Editor Next Screen

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36. By default, all populations are checked for inclusion in the table on the right. Click the box next to “12-24months” to uncheck that selection. The table on the right will update each time you check or uncheck a population type.

HERMES Specify Vaccine Dose Schedule

Edit Demand: Vaccine Dose Schedule

For "Include in the dose table", select the components (vaccines and population types) you'd like to include in the dose schedule. Or "How many doses of each vaccine?" enter the number of doses per population type for each vaccine.

Vaccines Population

Include in the dose table? How many doses of each vaccine per person per year?

Vaccine	Newborn	PW	1-11months
BCG Serum Institute of India 20 Dose [1.3 col/dose]	0	0	0
DTP-HepB-Hib Serum Institute of India 10 Dose [2.4 col/dose]	0	0	0
M Serum Institute of India 10 Dose [2.61 col/dose]	0	0	0
OPV WHO 10 Dose [2 col/dose]	0	0	0
PCV10 GSK 2 Dose [4.8 col/dose]	0	0	0
TT Serum Institute of India 10 Dose [2.61 col/dose]	0	0	0

Show Advanced Options Scale vaccines separately Proportion of population getting vaccinated: [] Projected vs actual: [] Implement calendar: []

Previous Screen Skip to Model Editor Next Screen

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37. Update the table on the right by clicking in the appropriate cells and changing the numbers:

Pregnant women (PW) get **2** doses of **“TT Serum”**

Newborns get **1** dose of **“BCG”** and **1** of **“OPV”**

1-11 months get **3** doses of **“DTP-HepB-Hib”**, **3** of **“OPV”**, **3** of **“PCV”**, and **1** of **“M Serum”**

Screenshot of the "Edit Demand: Vaccine Dose Schedule" screen in the HERMES software. The interface shows a table of vaccine doses per person per year for various manufacturers and types. The "Population" tab is selected. A "Treatment Calendar" checkbox is checked.

Name	Vaccine	Newborn	PW	1-11months
BCG Serum Institute of India 20 Dose (1.0 cc/dose)	BCG Serum Institute of India 20 Dose (1.3 cc/dose)	1	0	0
DPT-Hep-B-Hib Serum Institute of India 10 Dose (2.0 cc/dose)	DPT-Hep-B-Hib Serum Institute of India 10 Dose (2.4 cc/dose)	0	0	3
M Serum Institute of India 10 Dose (2.0 cc/dose)	M Serum Institute of India 10 Dose (2.4 cc/dose)	0	0	1
OPV WHO 10 Dose (2 cc/dose)	OPV WHO 10 Dose (2 cc/dose)	1	0	3
PCV10 GS 2 Dose (4.8 cc/dose)	PCV10 GS 2 Dose (4.8 cc/dose)	0	0	3
TT Serum Institute of India 10 Dose (2.4 cc/dose)	TT Serum Institute of India 10 Dose (2.61 cc/dose)	0	2	0

Buttons at the bottom include "Skip to Model Editor", "Next Screen", and "Previous Screen".

When this is complete, click back on the “**Vaccines**” button shown to the left.

Screenshot of the "Edit Demand: Vaccine Dose Schedule" screen. The "Treatment Calendar" checkbox is highlighted with a yellow box. Other checkboxes like "Show Advanced Options" and "Scale vaccines separately" are also visible.

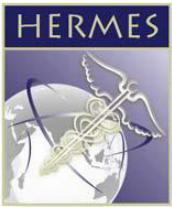
Name	Vaccine	Newborn	PW	1-11months
BCG Serum Institute of India 20 Dose (1.0 cc/dose)	BCG Serum Institute of India 20 Dose (1.3 cc/dose)	1	0	0
DPT-Hep-B-Hib Serum Institute of India 10 Dose (2.0 cc/dose)	DPT-Hep-B-Hib Serum Institute of India 10 Dose (2.4 cc/dose)	0	0	3
M Serum Institute of India 10 Dose (2.0 cc/dose)	M Serum Institute of India 10 Dose (2.4 cc/dose)	0	0	1
OPV WHO 10 Dose (2 cc/dose)	OPV WHO 10 Dose (2 cc/dose)	1	0	3
PCV10 GS 2 Dose (4.8 cc/dose)	PCV10 GS 2 Dose (4.8 cc/dose)	0	0	3
TT Serum Institute of India 10 Dose (2.4 cc/dose)	TT Serum Institute of India 10 Dose (2.61 cc/dose)	0	2	0

38. Click “**Treatment Calendar**” box in lower left corner to show options.

Screenshot of the "Edit Demand: Vaccine Dose Schedule" screen. The "Treatment Calendar" section is expanded, showing checkboxes for "days each week" (M, T, W, F) and "days each month" (W1, W2, W3, W4). The "Treatment calendar for simulations in which treatment does not occur every day, select the days per week, weeks per month, and months per year that treatment does occur" field is also visible.

Name	Vaccine	Newborn	PW	1-11months
BCG Serum Institute of India 20 Dose (1.0 cc/dose)	BCG Serum Institute of India 20 Dose (1.3 cc/dose)	1	0	0
DPT-Hep-B-Hib Serum Institute of India 10 Dose (2.0 cc/dose)	DPT-Hep-B-Hib Serum Institute of India 10 Dose (2.4 cc/dose)	0	0	3
M Serum Institute of India 10 Dose (2.0 cc/dose)	M Serum Institute of India 10 Dose (2.4 cc/dose)	0	0	1
OPV WHO 10 Dose (2 cc/dose)	OPV WHO 10 Dose (2 cc/dose)	1	0	3
PCV10 GS 2 Dose (4.8 cc/dose)	PCV10 GS 2 Dose (4.8 cc/dose)	0	0	3
TT Serum Institute of India 10 Dose (2.4 cc/dose)	TT Serum Institute of India 10 Dose (2.61 cc/dose)	0	2	0

39. Uncheck first and last “S” next to “**days each week**” then click “**Next Screen**” button.



Part 7: Assign storage devices and populations

What Equipment And Population Exist At Each Level?

Now, we need to allocate the equipment for storage and population that will be served for each location at each level. To add an item to all locations at a level, edit the cell to indicate the number to be added. You can modify individual locations by editing the modis.

NOTE: The count should be the number you would like at each location in the level (e.g. if you specify 100 Newborns at the Health Post level, each location at that level will be assigned 100 Newborns)

Home	Info	Province	District	Health Center
CR 20 CF	[Info]	0	0	0
HCW 42 EK/CF	[Info]	0	0	0
TC 883	[Info]	0	0	0
TCW 3000 AC	[Info]	0	0	0
VC 1 CF	[Info]	0	0	0

Population To Vaccinate at This Level	Info	Province	District	Health Center
1-11months	[Info]	0	0	0
12-24months	[Info]	0	0	0
Newborn	[Info]	0	0	0
PW	[Info]	0	0	0

[Previous Screen](#) [Next Screen](#)

What Equipment And Population Exist At Each Level?

Now, we need to allocate the equipment for storage and population that will be served for each location at each level. To add an item to all locations at a level, edit the cell to indicate the number to be added. You can modify individual locations by editing the modis.

NOTE: The count should be the number you would like at each location in the level (e.g. if you specify 100 Newborns at the Health Post level, each location at that level will be assigned 100 Newborns)

Home	Info	Province	District	Health Center
CR 20 CF	[Info]	0	0	0
HCW 42 EK/CF	[Info]	0	0	0
TC 883	[Info]	1	0	0
TCW 3000 AC	[Info]	0	0	0
VC 1 CF	[Info]	0	0	0

Population To Vaccinate at This Level	Info	Province	District	Health Center
1-11months	[Info]	0	0	0
12-24months	[Info]	0	0	0
Newborn	[Info]	0	0	0
PW	[Info]	0	0	0

[Previous Screen](#) [Next Screen](#)

*Devices may not be listed in same order as shown in image above

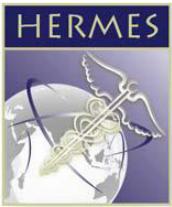
The Assign Equipment page allows you to specify the number of storage devices available and the size of the population served at each location, entered by supply chain level.

40. Click on the “**Assign Equipment**” tab at the top of the screen if not already there. Assign storage devices by clicking on the appropriate cells and entering the number available at a typical location in the selected level.

For “**Province**” enter **1 “TC 883”** and **1 “TCW 3000 AC”**

For “**District**” and “**Health Center**” enter **1 “RCW 42 EK/CF”**.

NOTE: Cold boxes and vaccine carriers should only be assigned here if they are used for stationary cold storage. The passively cooled devices in our example model are only used on vehicles, so the quantities on this page should remain zero.

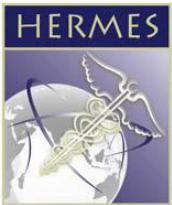


Screenshot of the HERMES software interface showing the 'Assign Equipment' screen for creating a new model. The window title is 'HERMES Create tutorial_newmodel'. The main content area displays a table titled 'What Equipment And Population Exist At Each Level?' with two sections: 'Equipment To Vaccinate At This Level' and 'Population To Vaccinate At This Level'. The table has columns for 'Info', 'Province', 'District', and 'Health Center'. The 'Info' column contains dropdown menus for selecting equipment like 'HCW 42 SP/PL' or 'HCW 42 SP/PL'. The 'District' and 'Health Center' columns show population counts for different age groups: 1-11months, 12-24months, Newborn, and PW.

	Info	Province	District	Health Center
All Districts To Where Vaccines of This Level				
HCW 42 SP/PL	Info	0	0	0
LC 1000 AC	Info	0	0	0
VC 12 OF	Info	1	0	0
LC 1000 AC	Info	1	0	0
VC 12 OF	Info	0	0	0
All Population To Vaccinate At This Level				
1-11months	Info	0	0	0
12-24months	Info	0	0	0
Newborn	Info	0	0	0
PW	Info	0	0	0

41. Similarly, populations entered here represent the number of people who would arrive for vaccinations at a typical location over a period of a year. Only enter population numbers for levels that administer vaccinations; the province level should have zero population here. Enter the average annual number of people in each target population group seeking vaccines at a district or health center location, as shown in the table below then click the “**Next Screen**” button:

Target Population	District	Health Center
1-11months	520	280
12-24months	500	270
Newborn	530	290
PW	660	360



Part 8: Assign transport vehicles

This step assigns transport vehicles to routes and locations by level, as well as per diem policies by level. Specifying the type of vehicle and per diem policy typically used between a pair of supply chain levels will assign that vehicle type and per diem policy to all routes between those levels. The number of vehicles specified will be added to each location at the appropriate supply chain level.

The screenshot shows the 'Assign Transport Vehicles' tab selected in the top navigation bar. Below it, there are two sections for defining routes between different levels:

- For Routes between the Province and the District levels:** Set to "motorbike" with 1 vehicle per location, and "No Per Diem" policy.
- For Routes Between the District and the Health Center levels:** Set to "motorbike" with 1 vehicle per location, and "No Per Diem" policy.

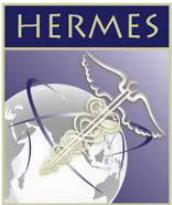
At the bottom right of the screen, there is a "Next Screen" button.

42. Click on the “**Assign Transport Vehicles**” tab at the top of the screen.

“For Routes between the **Province and District** levels”, select “**provincial Hilux**” of dropdown menu (this is the truck used at the province level to deliver to district locations), enter 1 (so the province store will have 1 truck in its inventory), and select the “**Province**” per diem policy.

“For Routes between the **District** and **Health Center** levels” select a “**motorbike**” and the “**District**” per diem policy (each district location should then be assigned 1 motorbike).

Then Click “**Next Screen**” button, which will return you to the home page.



Part 9: Enter data by location

Congratulations! You have finished the initial steps in creating a model! This model can be run, with the simplifying assumptions that each location at a level has the same characteristics, such as equipment inventory and population demand.

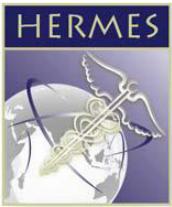
The screenshot shows the HERMES Model open page. On the left, there is a sidebar with various options like 'Welcome', 'Create', 'Models', 'Results', 'Database', 'Run status', and 'Help'. The main area has a title 'tutorial_newmodel Model' and a sub-section 'Please select what you would like to do with this model:'. It lists several actions, including 'Create Experiments Based on this Model', 'Edit model', 'Modify location with the Advanced Model Editor', 'Add or remove model components (e.g. vaccines, storage locations, and routes/locations/legends)', 'Tutorial interface for editing the model', 'Edit Storage Location Geographic Coordinates', 'Edit Storage Location Population Estimate', 'Edit Storage Location Device Inventory', 'Modify the Vaccine Date Schedule', 'Add and modify costs', 'Modify manufacturer', 'Transform the system with automatically created transport steps', 'Run a simulation experiment with this Model', 'View results from previously saved simulation Experiments', and 'Export Model as a HERMES ADP file'. Below this is a 'Supply Chain Network Diagram' section with a small network graph showing nodes for 'arvocate_1', 'District_1', and 'District_2' connected by edges. A note says: 'This diagram details the structure of this supply chain. Clicking on a location can expand or contract the routes and locations below the selected location. Right-clicking a location or route will bring up more detailed information.'

The following steps will allow you to fine tune your model, starting from the model open page shown here.

Geographic coordinates

The screenshot shows the 'Edit Model Geographic Coordinates' page. At the top, there is a header 'Edit the Geographic Coordinates for' and a note: 'Please enter in the geographic coordinates of individual locations in the table below. Your entries will be saved automatically as you add them.' Below this is a table with columns: 'Location Name', 'Supply Chain Level', 'Latitude', and 'Longitude'. The table contains data for various locations: Gaze, Gidole de Yon-Kia, Marlin Ngabzi, Pohme Lumumba, Poh Kuk-Ka, Wadde J, Nilo, Massingir District, Cubo Masangir, Macomque, Mucumbe, Chililene, Health Center 10, and Mucumbe. At the bottom of the table is a button 'Upload a Spreadsheet...' and a 'Done' button.

43. First select “**Edit Storage Location Geographic Coordinates**”



Screenshot of the HERMES software interface showing the "Edit Model Geographic Coordinates" screen. The table contains location names, supply chain levels, latitude, and longitude. The row for "Gaza" has its coordinates highlighted.

Location Name	Supply Chain Level	Latitude	Longitude
Gaza	Province	-25.0683	33.6583
Cidade de Xai-Xai	District		
Mareni ngubil	Health Center		
Patrica Lumumba	Health Center		
Pata Xai-Xai	Health Center		
Unidade /	Health Center		
Zulu	Health Center		
Massingir Githi	District		
Cubo Masanger	Health Center		
Macombera	Health Center		
Macombera	Health Center		
Chibilonze	Health Center		
Health Center, IU	Health Center		
Mucufwe	Health Center		

Note: The cells for Gaza's coordinates (-25.0683, 33.6583) are outlined in yellow, indicating they are selected for data entry.

44. Coordinates can be entered manually or by uploading a spreadsheet. To enter manually, click on the first row (Location Name “Gaza”) and enter a **latitude** of **-25.0683** and **longitude** of **33.6583**.

NOTE: the cells remained outlined for data entry. The changes are not recorded **until you press the Enter key** while in that row, at which point the cells return to a white background.

Screenshot of the HERMES software interface showing the "Edit Model Geographic Coordinates" screen. The table contains location names, supply chain levels, latitude, and longitude. The row for "Gaza" has its coordinates highlighted.

Location Name	Supply Chain Level	Latitude	Longitude
Gaza	Province	-25.0683	33.6583
Cidade de Xai-Xai	District		
Mareni ngubil	Health Center		
Patrica Lumumba	Health Center		
Pata Xai-Xai	Health Center		
Unidade /	Health Center		
Zulu	Health Center		
Massingir Githi	District		
Cubo Masanger	Health Center		
Macombera	Health Center		
Macombera	Health Center		
Chibilonze	Health Center		
Health Center, IU	Health Center		
Mucufwe	Health Center		

Note: The cells for Gaza's coordinates (-25.0683, 33.6583) are outlined in yellow, indicating they are selected for data entry.

45. You can also upload the coordinates from a spreadsheet. To do this, click the **“Upload a Spreadsheet”** button.

Screenshot of the HERMES software interface showing the "Edit Model Geographic Coordinates" screen. A modal dialog box is displayed, prompting the user to upload a completed spreadsheet. The "Upload a Completed Spreadsheet" button is highlighted with a yellow box.

You can upload an Excel file that contains the geographic coordinates of locations in your model.

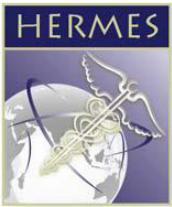
Would you like to

[Download a Preformatted Spreadsheet](#)

or

Upload a Completed Spreadsheet!

46. Then click **“Upload a Completed Spreadsheet”**



Edit the Geographic Coordinates for

Please enter in the geographic coordinates of individual locations in the table below. Your entries will be saved automatically as you add them.

Location Name	Supply Chain Level	Latitude	Longitude
Gaza	Province	-25.0683	33.6553
Cidade de Xai-Xai	District	-25.05226	33.64997
Marien Ngoubu	Health Center	-25.0149	33.6917
Pofadder	Health Center	-25.0144	33.6914
Pvua Xai-Xai	Health Center	-25.1156	33.7294
Unidade /	Health Center	-28.081	33.64181
Zulu	Health Center	-25.9186	33.1605
Mossoró Cinturão	District	-24.2314	32.4344
Galo-Masanga	Health Center	-20.9192	32.3030
Moseringue	Health Center	-24.123	32.5924
Macomia	Health Center	-20.5619	31.92
Chibarone	Health Center	-23.0564	33.2242
Health Center, IU	Health Center	-22.8122	32.0469
Mucoxene	Health Center	-24.1875	32.4761

Upload a Spreadsheet

Done

47. A completed spreadsheet is provided in the file **tutmodel_geocoord.xlsx**. Use the Browse button to select that file and then click on “**Upload XLS**”

Edit the Geographic Coordinates for

Please enter in the geographic coordinates of individual locations in the table below. Your entries will be saved automatically as you add them.

Location Name	Supply Chain Level	Latitude	Longitude
Gaza	Province	-25.0683	33.6553
Cidade de Xai-Xai	District	-25.05226	33.64997
Marien Ngoubu	Health Center	-25.0149	33.6917
Pofadder	Health Center	-25.0144	33.6914
Pvua Xai-Xai	Health Center	-25.1156	33.7294
Unidade /	Health Center	-28.081	33.64181
Zulu	Health Center	-25.9186	33.1605
Mossoró Cinturão	District	-24.2314	32.4344
Galo-Masanga	Health Center	-20.9192	32.3030
Moseringue	Health Center	-24.123	32.5924
Macomia	Health Center	-20.5619	31.92
Chibarone	Health Center	-23.0564	33.2242
Health Center, IU	Health Center	-22.8122	32.0469
Mucoxene	Health Center	-24.1875	32.4761

Upload a Spreadsheet

OK Done

48. Click “**OK**” in the Spreadsheet Update Successful dialog box and then click “**Done**” to return to the main model page.

Population Estimates

tutorial_newmodel Model

Please select what you would like to do with this model:

- Create Experiments Based on this Model
- Edit model:
 - Modify structure with the [Advanced Model Editor](#)
 - Add or remove model components (e.g. vaccines, storage devices, vehicles, and population categories)
 - Tabular interface for editing the model
 - [Edit Storage Location Geographic Coordinates](#)
 - Edit Storage Location Population Estimates** (highlighted with a yellow box)
 - [Edit Storage Location Device Inventories](#)
 - Modify the [Vaccine Date Schedule](#)
 - Add and modify [costs](#)
 - Transform the system with automatically created [transport loops](#)- Run a Simulation Experiment with this Model
- View Results from previously saved Simulation Experiments
- Export Model as a HERMES JZP File

Supply Chain Network Diagram

This diagram depicts the structure of this supply chain. Clicking on a location can expand or contract the routes and locations below the selected location. Right-clicking a location or route will bring up more detailed information.

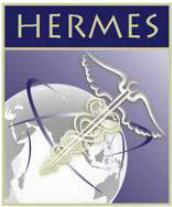
```

graph LR
    Gaza((Gaza)) --- r2((r2))
    r2 --- CidadeXaiXai((Cidade de Xai-Xai))
    r2 --- r3((r3))
    r3 --- MacomiaDistrito((Macomia distrito))
  
```

Model Network Model Notes

Done

49. Now select “**Edit Storage Location Population Estimates**” It shows the populations we assigned by level back in step 41



Screenshot of the HERMES software interface showing the 'Edit Model Population Demand Estimates' page. The page displays a table of population counts for various locations across different age groups (0-4, 5-11, 12-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80+). The table includes columns for Location Name, Supply Chain Level, Attached Demand ID, PW, 12-24months, 1-11months, and Newborn. A message at the top asks users to enter population estimates for each type of individual at each location. An 'Upload a Spreadsheet' button is present at the bottom left, and a 'Done' button is at the bottom right.

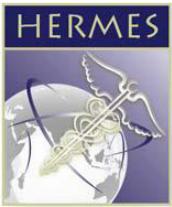
Screenshot of the HERMES software interface showing the 'Edit Model Population Demand Estimates' page after a spreadsheet update. A 'Spreadsheet Update Successful' dialog box is displayed, stating: 'The updating of the population estimates from the spreadsheet was successful'. The table of population counts remains the same as in the previous screenshot, showing data for Gato, Distrito de Xal-Xal, Marlen Ngobal, Palma Luminumba, and Unidade 7. The 'Done' button is visible at the bottom right.

Storage Devices

Screenshot of the HERMES software interface showing the 'Edit Model Population Demand Estimates' page. The page displays a table of storage device inventories for various locations. A message at the top asks users to enter the inventory of storage devices at each location. An 'Edit Storage Devices at each location for' button is present at the bottom left, and a 'Done' button is at the bottom right.

50. Similar to the Storage Location Geographical Coordinates, these numbers can be uploaded from a spreadsheet. The actual population totals for this model have been saved as **tutmodel_pop.xlsx**. Follow steps 45-47 to update the population totals.

51. The other tabular edit available from the main model page allows you to **Edit Storage Location Device Inventories** at individual locations. You can select this option to view the devices currently assigned at each location in the model. For this exercise, no changes to the device inventories are needed.



Advanced Editing

Some changes to add further detail and heterogeneity to the model can be most easily done using the Advanced Editor. The following steps demonstrate how to change the supplier of a location, enter shipping times and distances for each route, alter shipping policies and modes of transport for individual routes, add modes of transport to individual locations and assign building costs by level.

tutorial_newmodel Model

Please select what you would like to do with this model:

- Create Experiments Based on this Model
- Edit model:
 - Modify structure with the **Advanced Model Editor**
 - Add or remove model components (e.g. vaccines, storage devices, vehicles, and population categories)
 - Tabular interfaces for editing the model
 - Edit Storage Location Geographic Coordinates
 - Edit Storage Location Population Estimates
 - Edit Storage Location Service Inventories
 - Modify the Vaccine Dose Schedule
 - Add and modify costs
 - Transform the system with automatically created transport loops
- Run a Simulation Experiment with this Model
- View Results from previously saved Simulation Experiments
- Export Model as a HERMES JHP File

52. Choose “**Modify structure with Advanced Model Editor**” from the main model page to open the advanced interface.

HERMES Advanced Model Editor: tutorial_newmodel

Edit model

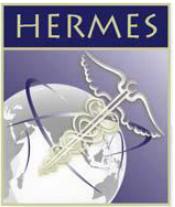
store viewing options route viewing options Model Validation

route to use as template for newly created routes: None

Gaza (1)

Unattached

53. Click the plus sign next to “**Gaza**” to expand the locations below

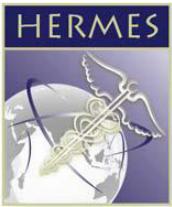


54. Then do the same next to the two district locations to open the health centers below them. All locations and routes in the model are now displayed.

Moving a Location

In this first example, we will move the location Zulo, currently located in the Cidade de Xai-Xai district, to the Massingir district where it is actually found.

55. Click on the label “**Zulo**” and start dragging it toward the Massingir Distrito label. You should notice it enlarge slightly as you move it.



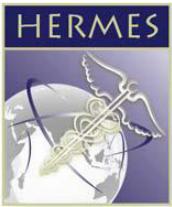
Screenshot of the HERMES Advanced Editor showing the supply chain structure. The tree view shows nodes under 'Gozo (1)' and 'Massingir Distrito (8)'. Under 'Massingir Distrito (8)', there are 14 route nodes labeled r1 through r14, and a single node 'Cubo Massingir (9)'. A tooltip 'Unattached' is visible near the right edge of the tree.

56. Drag it over the label
“Massingir Distrito” until it
enlarges then release.

Zulo is now part of the Massingir Distrito district. You will notice that the route name for Zulo has changed.

Screenshot of the HERMES Advanced Editor showing the supply chain structure after dragging. The tree view shows nodes under 'Gozo (1)' and 'Massingir Distrito (8)'. Under 'Massingir Distrito (8)', there are 14 route nodes labeled r1 through r14, and a single node 'Cubo Massingir (9)'. A tooltip 'Unattached' is visible near the right edge of the tree.

57. You can see these changes reflected in the supply chain network diagram if you exit the Advanced Editor by clicking on the model name breadcrumb at the top of the page, “**tutorial_newmodel**”, then clicking on the **Cidade de Xai-Xai** circle in the supply chain network diagram to see that there are now only 4 health center locations in this district.

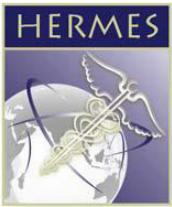


Viewing Information

Before we do any editing of locations or routes, we'll use the editor to view some of the information we're going to change.

58. From the middle dropdown box near the top of the page, click on “**route viewing options**”

Then click on “**route types**”



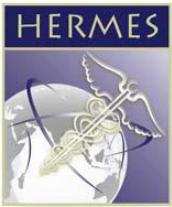
Then finally click on “**view route types.**” Notice that you can now see the type of each route in a colored box.

NOTE: You will be editing more than the route type in the next section, but you will see the type change reflected in the colored text boxes once the change is saved.

Editing specific routes

In this example, you will edit routes to 3 health centers (Marien Nguabi, Patrice Lumumba, and Unidade 7) that are very close to the Cidade de Xai-Xai district store and therefore can travel to pick up vaccines frequently via public transport, rather than receiving shipments from the provincial store.

59. Click on the “**edit**” button next to the route between Cidade de Xai-Xai and Marien Nguabi and then Click on “Edit Route”.



The screenshot shows the HERMES software interface with a tree view of locations and routes. A modal dialog box titled "Editing route r3 of model 3" is open, showing the configuration for route r3. The "Main" tab is selected, displaying the following settings:

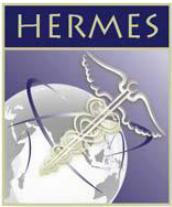
- Route type:** demandfetch
- Truck type:** bus
- Shipping interval:** 1
- On-demand order days:** 28.0
- Per diem rule:** STD_Per_Diem_None

60. Update:

a. Route type to “**demandfetch**”, which specifies that the receiving location (in our example, Marien Nguabi) travels to pick up vaccines from its supplier (Cidade de Xai-Xai) and allows extra trips as needed. An extra trip is needed when stock levels for any vaccine at the receiving location fall below the level of buffer stock prescribed by program policies (this model will use a policy of 25% buffer stock, as specified in a later step).

b. Change the truck type to “**bus**”, to indicate public transit is used. Enter **28** for on-demand order days, which specifies a policy of monthly trips, and enter **1** for shipping interval, which will allow extra trips as needed up to once per day.

c. Change the per diem rule to “**STD_Per_Diem_None**”, as health workers will not be paid per diems for traveling to pick up vaccines.

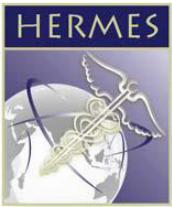


61. Then click “**Ok.**” Notice the change in type to demandfetch for the route supplying Marien Nguabi.

NOTE: Values for shipping latency in your model may differ from the screenshots in this tutorial but do not need to be changed. These are assigned automatically for model calibration purposes.

62. Repeat steps 59-61 for the routes serving Patrice Lumumba and Unidade 7 to have the same parameters as the route for Marien Nguabi.

63. From the “**route viewing options**” dropdown box choose “**route truck type**”, then “**view route truck type**”. You’ll notice that Prai Xai-Xai is the only location in the Cidade de Xai-Xai district with the original/default route parameters.



This screenshot shows the HERMES Model Editor interface. In the top left corner, there is a dropdown menu labeled "store viewing options". Below it, another dropdown menu is open, showing various route-related options like "route names", "route types", "route travel hours", "route distances", "route order amounts", and "route truck type". The "route truck type" option is highlighted with a yellow box.

64. To avoid clutter, click on “**route viewing options**,” “**route truck type**,” and “**hide route truck type**” to hide the information about truck types.

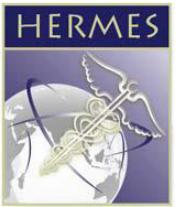
Editing specific routes

This screenshot shows the HERMES Model Editor with several route entries listed. Each entry includes the location name and a transport type listed next to it. For example, "Gaza (1) : edit" has "transport: provencial Heul." listed. Other entries include "Cidade de Xai-Xai (2) : edit" with "transport: motorcycle 1" and "Marien Nguabi (3) : edit" with "transport: varpush".

65. First, view the store transport types by clicking on the “**store viewing options**” dropdown box in the upper left corner, then “**store transport**”, then “**view store transport**.” Notice that you can stack the different types of views that you find useful.

This screenshot shows the HERMES Model Editor with a context menu open over the "Marien Nguabi (3) : edit" route entry. The menu includes options like "Uncheck Store", "Copy Store to Unattached", and "Delete Store".

66. You are only adding transport types to the locations whose route types were just changed. Because routes to the other health centers remain varpush, meaning these locations receive deliveries and do not need transport vehicles, the 3 health centers that pick up their vaccines will need a mode of transport in their inventories. Click the “**edit**” button next to Marien Nguabi, then click “**Edit Store**.”

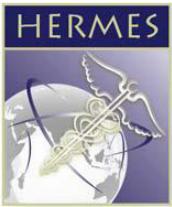


The screenshot shows the HERMES Advanced Model Editor interface. On the left, there is a tree view of locations and routes. In the center, a dialog box titled "Editing location 3 of model 3" is open, showing tabs for Main, Costs, Storage, Transport, Population, and Staff. The "Transport" tab is selected and highlighted with a yellow box. Below it is a table titled "Transport Vehicles" with columns: Type, Description, 2.8G Net Storage (L), Storage Devices, Count, and Details. A single row labeled "Totals" is present with a value of 0.00 in the storage column. At the bottom of the dialog are "Ok" and "Cancel" buttons.

67. Click on the “Transport” tab.

This screenshot is similar to the previous one, showing the HERMES Advanced Model Editor interface and the "Editing location 3 of model 3" dialog. The "Transport" tab is selected. In the "Transport Vehicles" table, the lower-left corner of the first data cell contains a yellow-bordered plus sign (+), indicating where to click to add a new row.

68. Click on the plus sign in the lower left corner of the table to add a new row.



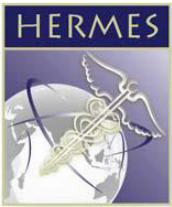
Screenshot of the HERMES Advanced Model Editor showing the 'Edit model' interface. A context menu is open over 'Route r2' (type: verpush) at location 2. The 'Editing location 3 of model 3' dialog is displayed, specifically the 'Transport' tab. In the 'Transport Vehicles' section, there is one entry for 'Max. preview 1' with a 'Type' of 'bus'. The 'Count' field is set to 1. The 'Ok' button is highlighted.

69. Change the type to “**bus**” and leave the count at 1. As shown in the storage devices column, a health worker can carry up to 2 vaccine carriers on each bus ride in this model then click “**Ok.**”

Screenshot of the HERMES Advanced Model Editor showing the 'Edit model' interface. The 'Editing location 3 of model 3' dialog is displayed, specifically the 'Transport' tab. In the 'Transport Vehicles' section, the 'Type' field has been changed to 'bus'. The 'Count' field is set to 1. The 'Ok' button is highlighted.

NOTE: Marien Nguabi now has a bus listed underneath it.

Screenshot of the HERMES Advanced Model Editor showing the 'Edit model' interface. The tree view shows 'Route r2' (type: verpush) at location 2 has been modified. The 'Route r2' node now includes a child node 'transport: bus 1'. The 'Ok' button is highlighted.

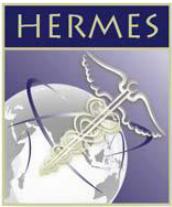


Screenshot of the HERMES software interface showing the 'Edit model' screen. The left sidebar lists locations: Gaza (1), Cidade de Xai-Xai (2), Marien Ngoubi (3), Police Lumumbwa (4), Praia Xai-Xai (5), Unidade 7 (6), and Route 18 (7). The right panel shows a tree structure of routes under each location, with route types like 'vorpush' and 'demandfetch'. A tooltip 'Unattached' is visible.

70. Repeat steps 66-69 to add a bus to the other 2 health centers in this district with “**demand-fetch**” route types.

Screenshot of the HERMES software interface showing the 'Edit model' screen. The left sidebar lists locations: Gaza (1), Cidade de Xai-Xai (2), Marien Ngoubi (3), Police Lumumbwa (4), Praia Xai-Xai (5), Unidade 7 (6), and Route 18 (7). The right panel shows a tree structure of routes under each location, with route types like 'vorpush' and 'demandfetch'. A tooltip 'Unattached' is visible. A context menu is open over the 'Route 18' node, with options: 'store viewing options', 'route viewing options', 'edit route types', 'view route types', and 'hide route types'.

71. Finally, **hide** the store transport view and the route type view (see step 64).



Editing details for all routes

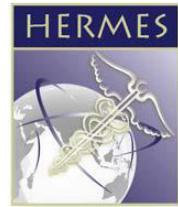
The Advanced Editor allows you to select specific parameters to view and edit for all locations or routes displayed that are displayed. You can stack combinations of view and edit boxes.

This screenshot shows the HERMES Advanced Editor interface. The main window displays several routes: Gaza (1), route r2, Cidade de Xai-Xai (2), Route n, Route m, Route o, Route p, Prai Xai-Xai (5), Route q, and Unattached. Each route entry contains fields for route names, route types, route transit hours, route order amounts, route truck type, route timings, route delivery policy, and route conditions. A yellow box highlights the "route viewing options" tab at the top left, and another yellow box highlights the "edit route transit hours" button within the route transit hours section of the route details.

72. Open “**route viewing options**,” click on “**route transit hours**” and then “**edit route transit hours**.”

This screenshot shows the HERMES Advanced Editor interface. The main window displays the same set of routes: Gaza (1), route r2, Cidade de Xai-Xai (2), Route n, Route m, Route o, Route p, Prai Xai-Xai (5), Route q, and Unattached. Each route entry contains fields for route names, route types, route transit hours, route order amounts, route truck type, route timings, route delivery policy, and route conditions. In addition to the route transit hours, this view includes distance fields: distance to Cidade de Xai-Xai(m) and distance to Prai Xai-Xai(m). A yellow box highlights the "route viewing options" tab at the top left, and another yellow box highlights the "edit route distances" button within the route distances section of the route details.

73. Also, open route viewing options, route distances, edit route distances.



74. The values shown reflect the average one-way distances and transit times you entered in step 8. You can optionally edit these for each individual route to add heterogeneity to the model, using the information in the table below:

Supplier Location	Recipient Location	Leg of trip	Transit time (hours)	Distance (km)
Gaza	Cidade de Xai-Xai	to Cidade de Xai-Xai	0.5	5.0
	<i>Return</i>	to Gaza	0.5	5.0
Cidade de Xai-Xai	Marien Nguabi	to Cidade de Xai-Xai	1.0	2.5
	<i>Return</i>	to marien Nguabi	1.0	2.5
Cidade de Xai-Xai	Patrice Lumumba	to Cidade de Xai-Xai	1.0	2.5
	<i>Return</i>	to Patrice Lumumba	1.0	2.5
Cidade de Xai-Xai	Prai Xai-Xai	to Prai Xai-Xai	1.0	10.0
	<i>Return</i>	to Cidade de Xai-Xai	1.0	10.0
Cidade de Xai-Xai	Unidade 7	to Cidade de Xai-Xai	1.0	2.5
	<i>Return</i>	to Unidade 7	1.0	2.5
Gaza	Massingir Distrito	to Massingir Distrito	3.0	248.0
	<i>Return</i>	to Gaza	3.0	248.0
Massingir Distrito	Macaringue	to Macaringue	1.0	70.0
	<i>Return</i>	to Massingir Distrito	1.0	70.0
Massingir Distrito	Machamba	to Machamba	1.0	67.0
	<i>Return</i>	to Massingir Distrito	1.0	67.0
Massingir Distrito	Chibotane	to Chibotane	1.0	18.0
	<i>Return</i>	to Massingir Distrito	1.0	18.0
Massingir Distrito	Zulo	to Zulo	1.0	45.0
	<i>Return</i>	to Massingir Distrito	1.0	45.0
Massingir Distrito	Mavodze	to Mavodze	1.0	22.0
	<i>Return</i>	to Massingir Distrito	1.0	22.0
Massingir Distrito	Mucatine	to Mucatine	1.0	65.0
	<i>Return</i>	to Massingir Distrito	1.0	65.0
Massingir Distrito	Cubo Massingir	to Cubo Massingir	1.0	17.0
	<i>Return</i>	to Massingir Distrito	1.0	17.0



HERMES Tutorial: Creating a new model

Screenshot of the HERMES web application showing the structure of a supply chain model. The model consists of several nodes and routes:

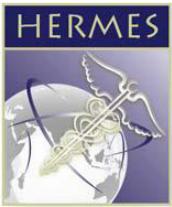
- Gaza (1)**: A node with two routes:
 - Route r2**: transit hours: time to Cidade de Xai-Xai(hours) [0.5], time to Oeate(hours) [0.5], distances: distance to Cidade de Xai-Xai(m) [3.0], distance to Guaxim [0.0]
 - Route r3**: transit hours: time to Cidade de Xai-Xai(hours) [1.0], time to Matien Ngubui(hours) [1.0], distances: distance to Cidade de Xai-Xai(m) [2.5], distance to Matien Ngubui(m) [2.5]
- Cidade de Xai-Xai (2)**: A node with three routes:
 - Route r4**: transit hours: time to Cidade de Xai-Xai(hours) [1.0], time to Matien Ngubui(hours) [1.0], distances: distance to Cidade de Xai-Xai(m) [2.5], distance to Matien Ngubui(m) [2.5]
 - Route r5**: transit hours: time to Cidade de Xai-Xai(hours) [1.0], time to Patice Lumumba(hours) [1.0], distances: distance to Cidade de Xai-Xai(m) [2.5], distance to Patice Lumumba(m) [2.5]
 - Route r6**: transit hours: time to Prop Xai-Xai(hours) [1.0], time to Cidade de Xai-Xai(hours) [1.0], distances: distance to Prop Xai-Xai(m) [2.0], distance to Cidade de Xai-Xai(m) [2.0]
- Matien Ngubui (3)**: A node with one route:
 - Route r7**: transit hours: time to Cidade de Xai-Xai(hours) [1.0], time to Matien Ngubui(hours) [1.0], distances: distance to Cidade de Xai-Xai(m) [2.5], distance to Matien Ngubui(m) [2.5]
- Patice Lumumba (4)**: A node with one route:
 - Route r8**: transit hours: time to Prop Xai-Xai(hours) [1.0], time to Patice Lumumba(hours) [1.0], distances: distance to Prop Xai-Xai(m) [2.0], distance to Patice Lumumba(m) [2.0]
- Prop Xai-Xai (5)**: A node with one route:
 - Route r9**: transit hours: time to Cidade de Xai-Xai(hours) [1.0]

Screenshot of the HERMES web application showing the structure of a supply chain model. The model consists of several nodes and routes:

- Route r1**: A route with two segments:
 - transit hours: time to Cidade de Xai-Xai(hours) [1.0], time to Unidade 7(hours) [1.0], distances: distance to Cidade de Xai-Xai(m) [2.5], distance to Unidade 7(m) [2.5]
 - transit hours: time to Massingir Distrito(hours) [3.0], time to Guaxim(hours) [3.0], distances: distance to Massingir Distrito(m) [248.0], distance to Guaxim(m) [248.0]
- Unidade 7 (6)**: A node with one route:
 - Route r10**: transit hours: time to Massingir Distrito(hours) [1.0], time to Massingir Distrito(hours) [1.0], distances: distance to Massingir Distrito(m) [70.0], distance to Massingir Distrito(m) [70.0]
- Massingir Distrito (8)**: A node with one route:
 - Route r11**: transit hours: time to Macarangue(hours) [1.0], time to Massingir Distrito(hours) [1.0], distances: distance to Macarangue(m) [67.0], distance to Massingir Distrito(m) [67.0]
- Macarangue (10)**: A node with one route:
 - Route r12**: transit hours: time to Machambala(hours) [1.0], time to Macarangue(hours) [1.0], distances: distance to Machambala(m) [67.0], distance to Macarangue(m) [67.0]
- Machambala (11)**: A node with one route:
 - Route r13**: transit hours: time to Chibotane(hours) [1.0], time to Machambala(hours) [1.0], distances: distance to Chibotane(m) [18.0], distance to Machambala(m) [18.0]
- Chibotane (12)**: A node with one route:
 - Route r14**: transit hours: time to Tule(hours) [1.0], time to Chibotane(hours) [1.0], distances: distance to Tule(m) [45.0], distance to Chibotane(m) [45.0]
- Tule (7)**: A node with one route:
 - Route r15**: transit hours: time to Massingir Distrito(hours) [1.0], time to Tule(hours) [1.0], distances: distance to Massingir Distrito(m) [45.0], distance to Tule(m) [45.0]
- Massingir Distrito (9)**: A node with one route:
 - Route r16**: transit hours: time to Zulu(hours) [1.0], time to Massingir Distrito(hours) [1.0], distances: distance to Zulu(m) [22.0], distance to Massingir Distrito(m) [22.0]
- Zulu (7)**: A node with one route:
 - Route r17**: transit hours: time to Morodave(hours) [1.0], time to Zulu(hours) [1.0], distances: distance to Morodave(m) [22.0], distance to Zulu(m) [22.0]
- Morodave (13)**: A node with one route:
 - Route r18**: transit hours: time to Mucatine(hours) [1.0], time to Morodave(hours) [1.0], distances: distance to Mucatine(m) [68.0], distance to Morodave(m) [68.0]
- Mucatine (14)**: A node with one route:
 - Route r19**: transit hours: time to Cubo Massingir(hours) [1.0], time to Mucatine(hours) [1.0], distances: distance to Cubo Massingir(m) [68.0], distance to Mucatine(m) [68.0]

Screenshot of the HERMES web application showing the structure of a supply chain model. The model consists of several nodes and routes:

- Route r2**: A route with three segments:
 - transit hours: time to Chibotane(hours) [1.0], time to Massingir Distrito(hours) [1.0], distances: distance to Chibotane(m) [18.0], distance to Massingir Distrito(m) [18.0]
 - transit hours: time to Tule(hours) [1.0], time to Chibotane(hours) [1.0], distances: distance to Tule(m) [45.0], distance to Chibotane(m) [45.0]
 - transit hours: time to Zulu(hours) [1.0], time to Tule(hours) [1.0], distances: distance to Zulu(m) [45.0], distance to Tule(m) [45.0]
- Chibotane (12)**: A node with one route:
 - Route r11**: transit hours: time to Tule(hours) [1.0], time to Chibotane(hours) [1.0], distances: distance to Tule(m) [45.0], distance to Chibotane(m) [45.0]
- Tule (7)**: A node with one route:
 - Route r12**: transit hours: time to Massingir Distrito(hours) [1.0], time to Tule(hours) [1.0], distances: distance to Massingir Distrito(m) [45.0], distance to Tule(m) [45.0]
- Massingir Distrito (9)**: A node with one route:
 - Route r13**: transit hours: time to Zulu(hours) [1.0], time to Massingir Distrito(hours) [1.0], distances: distance to Zulu(m) [22.0], distance to Massingir Distrito(m) [22.0]
- Zulu (7)**: A node with one route:
 - Route r14**: transit hours: time to Morodave(hours) [1.0], time to Zulu(hours) [1.0], distances: distance to Morodave(m) [22.0], distance to Zulu(m) [22.0]
- Morodave (13)**: A node with one route:
 - Route r15**: transit hours: time to Mucatine(hours) [1.0], time to Morodave(hours) [1.0], distances: distance to Mucatine(m) [68.0], distance to Morodave(m) [68.0]
- Mucatine (14)**: A node with one route:
 - Route r16**: transit hours: time to Cubo Massingir(hours) [1.0], time to Mucatine(hours) [1.0], distances: distance to Cubo Massingir(m) [68.0], distance to Mucatine(m) [68.0]
- Cubo Massingir (15)**: A node with one route:
 - Route r17**: transit hours: time to Massingir Distrito(hours) [1.0], time to Cubo Massingir(hours) [1.0], distances: distance to Massingir Distrito(m) [68.0], distance to Cubo Massingir(m) [68.0]



The screenshot shows a hierarchical supply chain structure. At the top level is 'Zulo (7)'. Below it are 'Route r1' (with 13 routes), 'Route r14' (with 1 route), 'Mavodze (13)', 'Route r10' (with 1 route), and 'Mucatine (14)'. Each location has a yellow box containing its transit hours and distances to other locations. For example, Zulo has 1 hour of transit time and 48 km distance to Mavodze.

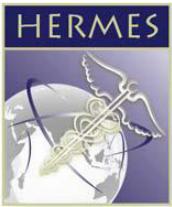
75. Finish by hiding (-) both types of route edit views, transit hours and distances.

Recursive editing

In the last advanced editing option for this tutorial, you will use recursive editing to make a similar change quickly on a large number of locations at a time. Locations are selected by hierarchy, so you can recursively edit the locations at any supply chain level located below a given location in the supply chain (e.g. selecting all health centers under Cidade de Xai-Xai). The cost for all annual building overhead will be changed in this section to reflect the electricity tariffs of **103 USD per year**.

The screenshot shows the 'Edit model' screen in the HERMES Advanced Model Editor. A context menu is open over the 'Gaza (1)' location. The 'Recursive Edit' option is highlighted in blue. Other options in the menu include 'Edit store', 'Delete Store', 'Copy Store to Unattached', 'Mail', and 'Choose a field'.

76. Click on the “edit” button next to the top location, “Gaza”, and then “**Recursive Edit.**”



77. In this case, you will need to adjust the health center levels and the district levels. You can leave the level selector on Health Center “**Health Center (11)**” for now. Choose “**costs**” for field type from the dropdown menu.

78.

a. Enter 103.00 in “**set cost information**”

b. Choose year **2014**

c. Choose **USD** – United States Dollar (if not selected by default)

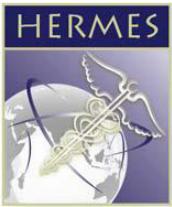
d. Then click “**Save Costs.**”

You may see a window pop up saying information is being saved, after which the dialog box will revert to the second picture in the previous step.

79. Click on Health Center to activate the dropdown box and select the District level “**District (2)**”.

80. Make the same cost changes to the district level as you did for the health center level (\$103, 2014, USD) then press “**Save Costs.**”

81. View the results by choosing “**store viewing options**,” “**store site costs**” and “**view store site costs**.” You can see that the costs have been changed at all the locations except the topmost level. You will be making that edit in a later section. Then, click “**hide store costs**” to remove the cost information from the screen.



Model validation

The Advanced Model Editor allows you to manually trigger a check of the validity of the model you have created to make sure you have included all necessary information. The validator will list all issues under the relevant locations and routes or in a scrollable window if supply chain network is not fully expanded. See **Section 6 in the User Guide** for more information on model validation.

The screenshot shows the HERMES Advanced Model Editor interface. In the top navigation bar, the 'Model Validation' button is highlighted with a yellow box. Below the navigation, there's a message: 'Route to use as template for newly created routes: None [Clear]'. The main area displays a tree view of locations and routes. Under 'Gaza (1)', there are several error messages: 'Has client stores or a vehicle but no staff', 'has a FUNCTION of Distribution, but no storage', 'has a FUNCTION of Distribution, but no 2-8°C storage', 'Has client stores or a vehicle but no staff', 'Has client stores or a vehicle but no staff', and 'Has client stores or a vehicle but no staff'. Other locations like 'Cidade de Xai-Xai (2)' and 'Palmeira Lumbumba (4)' also have similar error messages. A note at the bottom left says 'localhost:8080/bottle/hermes/model-edit-structureId=3#'.

82. Click on the “**Model Validation**” dropdown box near the top middle of the page box and choose “**Clear Messages**” to remove the messages from the screen, so you can begin to address these errors. In future use, it may be helpful to copy these errors to a separate document for reference.

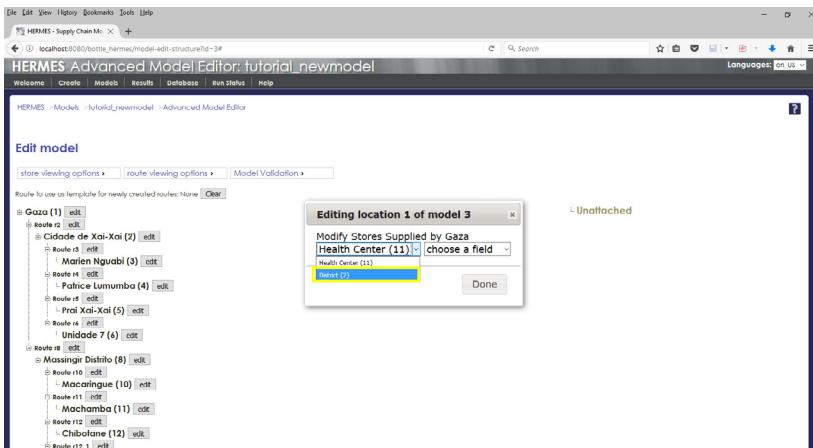
NOTE: Many of the locations have a complaint that they are missing staff.

Recursive and other editing, take 2

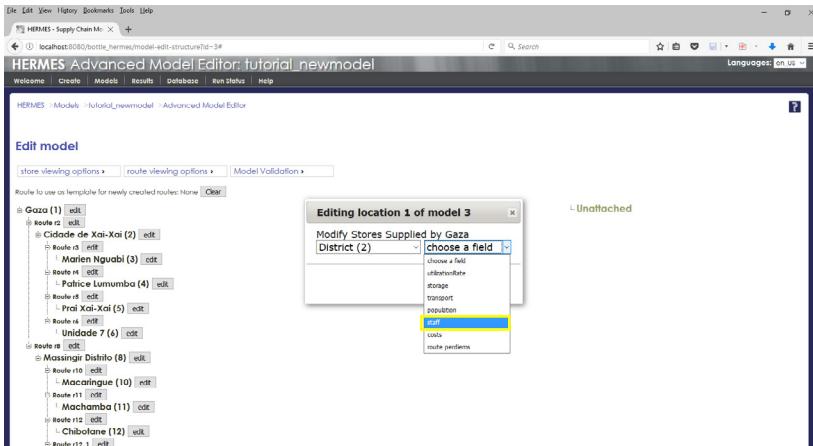
Since no staff has been added to the model, you will use a combination of recursive editing and specific store editing to update the staff at the different locations. In this model, we will assume that different locations at a given supply chain level have the same number and types of staff.

The screenshot shows the HERMES Advanced Model Editor with a modal dialog titled 'Editing location 1 of model 3'. The dialog contains the text 'Modify Stores Supplied by Gaza Health Center (11) [choose a field]'. Below this is a 'Done' button. The background shows the same tree structure of locations and routes as the previous screenshot, with the 'Edit Store' button highlighted in yellow next to the Gaza route node.

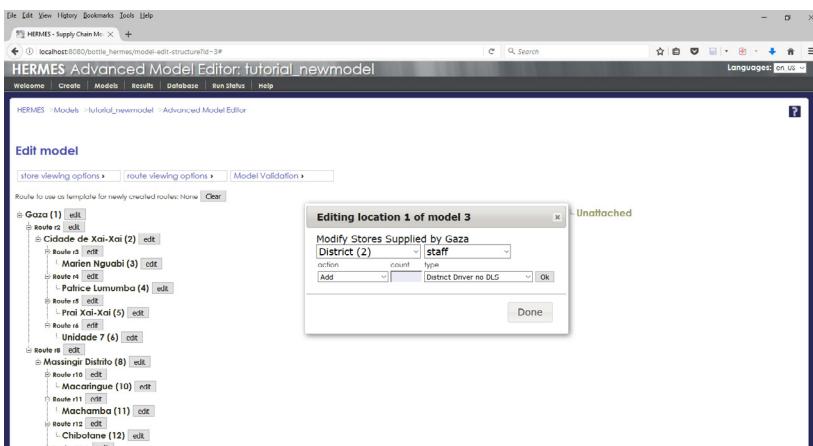
83. Click the “**edit**” button next to the Gaza store and then “**Recursive Edit**.”



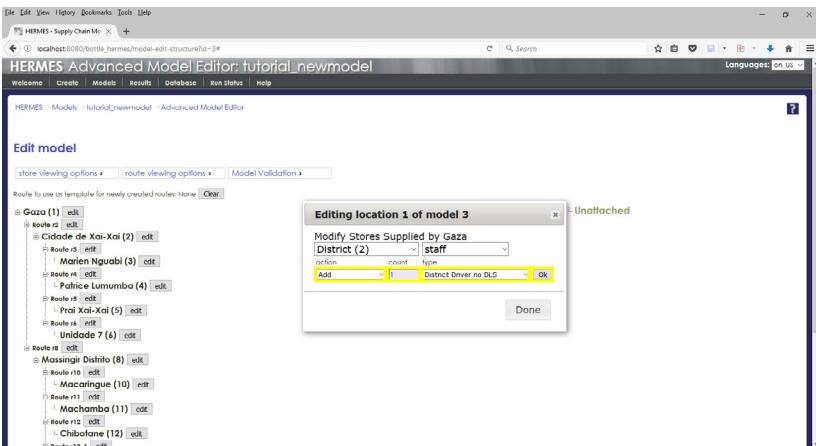
84. Then select “**District (2)**” from the dropdown menu.



85. Next, choose “**staff**” from the “**choose a field**” dropdown menu.

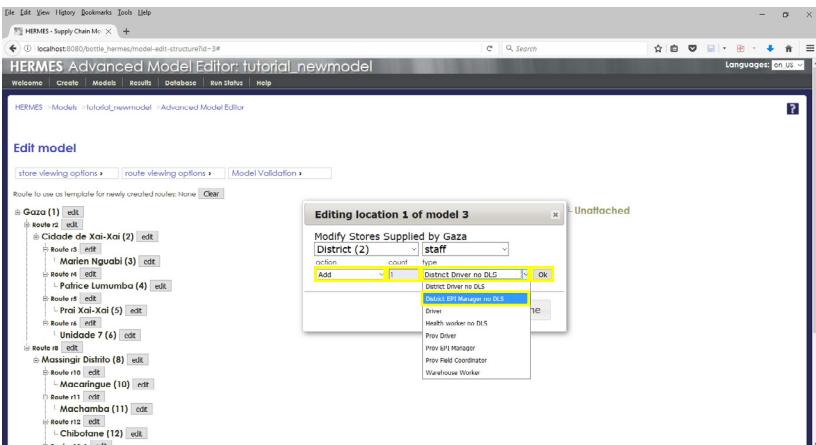


This dialogue box will then open.

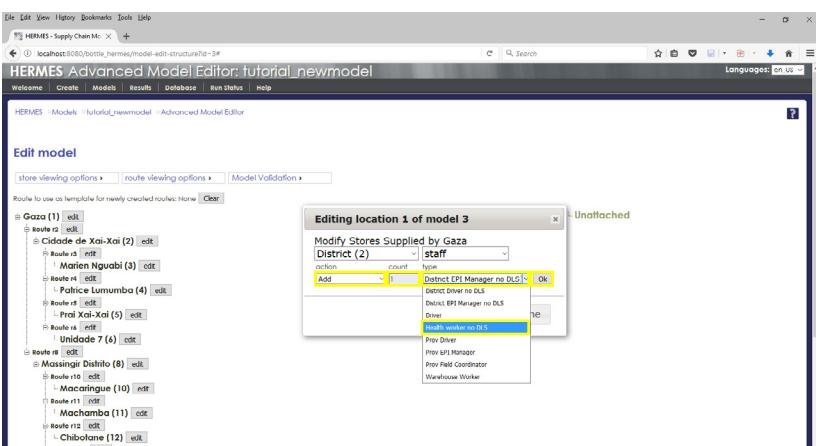


86. Leave the action as “**Add**” and type **1** into the count box and leave type as “**District Driver no DLS**” then click “**Ok.**” There might be a message box that flashes as the update is made and then the count box will be empty.

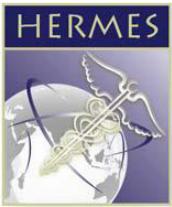
NOTE: Do not click on “**Done**” until step 90.



87. Leave “**Add**” for action, type **1** into count, change type to “**District_EPI_Manager_no_DLS**” from the dropdown menu and click “**Ok.**”



88. Similarly, leave “**Add**” for action, add **1** into count, change type to “**Health Worker no DLS**” from the dropdown menu and click “**Ok.**”



89. Change the level to “**Health Center**”, leave the field as “**staff**,” leave “**Add**” for action, add 1 to count, change type to “**Health worker no DLS**” from dropdown menu and press “**Ok.**”

90. Click the “**Done**” button to finish recursively editing.

91. Now click the “**edit**” button next to the Gaza location and choose “**Edit Store.**”

Type	Description	Count	Details
Totals		0	Info

92. Click the “**Staff**” tab and click the “**+**” symbol in the lower left of the table to add a row.

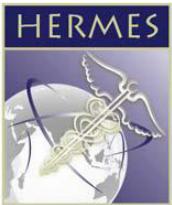
Type	Description	Count	Details
Prov_EPI_Manager		1	Info
Totals		0	Info

93. You need to add a “**Prov_EPI_Manager**” so leave the row as is and hit the “enter” or “return” on your keyboard.

Type	Description	Count	Details
Prov_EPI_Manager		1	Info
Prov_Field_Coordinator		1	Info
Totals		2	Info

94. Click the “**+**” symbol to add another row, change the Type to “**Prov_Field_Coordinator**” from the dropdown menu and hit enter.

95. Lastly, add a “**Prov Driver**”, then click “**Ok**” to close the edit dialog box.



Model validation, take 2

The Advanced Model Editor allows you to manually trigger a check of the validity of the model you have created to make sure you have included all necessary information. The validator will list all issues under the relevant locations and routes or in a scrollable window if supply chain network is not fully expanded. See **Section 6 in the User Guide** for more information on model validation.

96. Click on the “**Model Validation**” dropdown box near the top middle of the page.

NOTE: there are no more error messages about staff.

Part 10: Enter cost details

97. Choose “**Add and modify costs**” from the main model page.

Fuel and power

The screenshot shows the HERMES Costs interface with the 'Cost Components' section open. The 'Fuel and Power' component is highlighted with a yellow box. To its right, there is a 'Continue' button.

98. Most of the defaults on this page will be used in your new model. First change the “Base Year” dropdown to “**2014**” instead of 2011. Then, click the “**Continue**” button to the right of the “Fuel and Power” cost component on the left hand side.

The screenshot shows the HERMES Fuel Costs interface with a table titled "Showing fuel costs for tutorial_newmodel". The "Gasoline" row is highlighted with a yellow box.

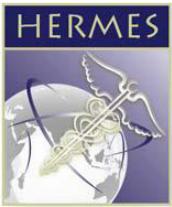
Commodity	Price	Per
LP gas		USD - Kg
Kerosene		USD - liter
Gasoline		USD - liter
Diesel		USD - liter
Electric Mains		Kilowatt Hour
Solar Power		USD - Installed Kilowatt
Ico	0.00	Herzo One Liter of Ico
Solar Panel Amortization	0	Years

This screen will then appear.

The screenshot shows the HERMES Fuel Costs interface with the same table as before. The "Gasoline" row now has a price of "1.17" and is highlighted with a yellow box. The "Done" button at the bottom right is also highlighted with a yellow box.

Commodity	Price	Per
LP gas		USD - Kg
Kerosene		USD - liter
Gasoline	1.17	USD - liter
Diesel		USD - liter
Electric Mains		Kilowatt Hour
Solar Power		USD - Installed Kilowatt
Ico	0.00	Herzo One Liter of Ico
Solar Panel Amortization	0	Years

99. Update the prices for “**Gasoline**” to “**1.17 USD per liter**” and “Electric Mains” “**0.10 per kWh**” then press “**Done**” to return to the main costing page.



Per diems

Showing Costs for **tutorial_newmodel**

Base Currency: **USD**

Base Year: **2014**

Inflation Rate: **5** Percent

Storage Maintenance: **5** Percent

Vehicle Maintenance: **10** Percent

unable to reconcile for this model

Cost Components

- Fuel and Power [Continue](#)
- Storage Equipment [Revisit](#)
- Vehicles [Revisit](#)
- Salaries [Revisit](#)
- Per Diem [REVISIT](#)**
- Buildings [Revisit](#)

Calculate vaccine costs! [Done](#)

Calculate vaccine costs! [Continue](#)

Showing per diem costs for **tutorial_newmodel**

Name	Base Amount	Currency	Base Amount Year	Must Be Overnight?	Count First Day?	Min Km Home	Details
District	36.29	USD	2014	false	true	0	Edit Info Del
Province	84.68	USD	2014	false	true	0	Edit Info Del
No Per Diem	0.00	USD	2012	false	false	0	Edit Info Del

Mark all unassigned routes as having no per diem? [Yes](#)

Route Per Diem Rules

Route Name*	Supplier	Per Diem Type	Details
District + 11 Item(s)			Edit Info Del
Province + 2 Item(s)			Edit Info Del

[View 1 - 12 of 12](#) [Done](#)

Showing per diem costs for **tutorial_newmodel**

Name	Base Amount	Currency	Base Amount Year	Must Be Overnight?	Count First Day?	Min Km Home	Details
District	36.29	USD	2014	false	true	0	Edit Info Del
Province	84.68	USD	2014	false	true	0	Edit Info Del
No Per Diem	0.00	USD	2012	false	false	0	Edit Info Del

Mark all unassigned routes as having no per diem? [Yes](#)

Route Per Diem Rules

Route Name*	Supplier	Per Diem Type	Details
District + 11 Item(s)	Mosinge Deltro		Edit Info Del
r1	Mosinge Deltro		Edit Info Del
r2	Mosinge Deltro		Edit Info Del
r3	Mosinge Deltro		Edit Info Del
r4	Mosinge Deltro		Edit Info Del
r5	Cidade de Xai-Xai		Edit Info Del
r6	Cidade de Xai-Xai		Edit Info Del
r7	Cidade de Xai-Xai		Edit Info Del
r8	Cidade de Xai-Xai		Edit Info Del
Province + 2 Item(s)	Gato		Edit Info Del

[View 1 - 12 of 12](#) [Done](#)

100. Click on the “**Revisit**” button next to the Per Diem cost component.

Screenshot of the HERMES Per Diem Rates interface showing the "Edit Per Diem Information for Route r10" dialog box. The dialog box has "Per Diem Type" set to "District". The main table shows routes r11 through r17 assigned to "Messenger Distrito".

Route	Route Name	Per Diem Type
r11	Messenger Distrito	District
r12	Messenger Distrito	District
r13	Messenger Distrito	District
r14	Messenger Distrito	District
r15	Ciudad de Xal-Xal	District
r16	Ciudad de Xal-Xal	District
r17	Ciudad de Xal-Xal	District
r18	Messenger Distrito	District

This dialogue box below will then appear.

Screenshot of the HERMES Per Diem Rates interface showing the "Edit Per Diem Information for Route r10" dialog box. The dialog box has "Per Diem Type" set to "District". The main table shows routes r11 through r17 assigned to "Messenger Distrito".

Route	Route Name	Per Diem Type
r11	Messenger Distrito	District
r12	Messenger Distrito	District
r13	Messenger Distrito	District
r14	Messenger Distrito	District
r15	Ciudad de Xal-Xal	District
r16	Ciudad de Xal-Xal	District
r17	Ciudad de Xal-Xal	District
r18	Messenger Distrito	District

102. Choose “**District**” from the “Per Diem Type” dropdown menu then click the “**Submit**” button.

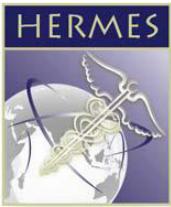
NOTE: the table has been updated appropriately.

Screenshot of the HERMES Per Diem Rates interface showing the "Edit Per Diem Information for Route r10" dialog box. The dialog box has "Per Diem Type" set to "District". The main table shows routes r11 through r17 assigned to "Messenger Distrito". The right arrow button in the dialog box is highlighted.

Route	Route Name	Per Diem Type
r11	Messenger Distrito	District
r12	Messenger Distrito	District
r13	Messenger Distrito	District
r14	Messenger Distrito	District
r15	Ciudad de Xal-Xal	District
r16	Ciudad de Xal-Xal	District
r17	Ciudad de Xal-Xal	District
r18	Messenger Distrito	District

103. Click the right arrow button in the Edit dialog box to advance to the next route.

NOTE: You’ll notice that “**r11**” is now highlighted in the table.



Screenshot of the HERMES software interface showing the "Per Diem Rates" screen. The "Route Per Diem Rules" table lists routes for District, Province, and no per diem categories. A modal window titled "Edit Per Diem Information for Route r10" is open, showing route details and a dropdown menu for "Per Diem Type". The dropdown menu is expanded, showing "District" and "Province" as options.

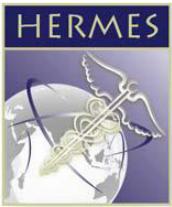
104. Repeat step 102 for the rest of the District routes.

Screenshot of the HERMES software interface showing the "Per Diem Rates" screen. The "Route Per Diem Rules" table lists routes for District, Province, and no per diem categories. A modal window titled "Edit Per Diem Information for Route r10" is open, showing route details and a dropdown menu for "Per Diem Type". The dropdown menu is expanded, showing "Province" as the selected option.

105. You can continue to use the right arrow button to edit the Province routes the same way that you did the District routes, just make sure to choose **"Province"** as the per diem type from the dropdown menu.

Screenshot of the HERMES software interface showing the "Per Diem Rates" screen. The "Route Per Diem Rules" table lists routes for District, Province, and no per diem categories. A modal window titled "Edit Per Diem Information for Route r10" is open, showing route details and a dropdown menu for "Per Diem Type". The dropdown menu is expanded, showing "Province" as the selected option.

106. Click **"Done"** when finished to return to the main costing page.



Buildings

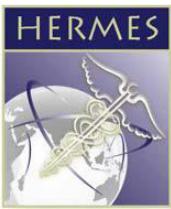
The screenshot shows the 'Cost Components' section of the HERMES Costs interface. It includes fields for Base Currency (USD), Base Year (2014), Inflation Rate (5%), Storage Maintenance (5%), and Vehicle Maintenance (10%). There is also a checkbox for 'unable to record' and a 'Check Completeness' button. The 'Building' component is highlighted with a yellow box.

107. Click on the “Revisit” button next to the Buildings cost component.

The screenshot shows the 'Building Costs' table in the HERMES Building Costs interface. The table has columns for ID, Store Name, Level, Cost Per Year, Cost Currency, Cost Base Year, and Details. The 'Health Center' location is expanded, showing 11 items under it, indicated by a yellow box around the '+' sign.

108. Click the “+” next to “Province,” “District” and “Health Center” to expand the locations.

The screenshot shows the 'Building Costs' table in the HERMES Building Costs interface. The table has columns for ID, Store Name, Level, Cost Per Year, Cost Currency, Cost Base Year, and Details. The 'Health Center' location is fully expanded, showing 11 individual health center entries, indicated by a yellow box around the '+' sign.



The screenshot shows the HERMES Building Costs interface. A modal dialog titled "Edit Site Cost Information for Store Gaza" is open. Inside the dialog, the "Cost Per Year" field contains "103.00", the "Cost Currency" dropdown is set to "USD", and the "Cost Base Year" dropdown is set to "2014". There are "Save" and "Done" buttons at the bottom right of the dialog.

109. This table should be filled out from the recursive editing exercise earlier. However, recursive editing can only change levels below the one which you select, and you did not update Gaza at that time. Click the “**Edit**” button in the first row (Province) to edit the information for the Gaza location.

The screenshot shows the same Building Costs page after the edit has been saved. The "Cost Per Year" field for the first row (Gaza) is highlighted in yellow, confirming the update was successful.

110. Update “Cost Per Year” to “**103.00**” and “Cost Currency” to “**USD**” with “**2014**” as the “Cost Base Year” then click “**Save**.”

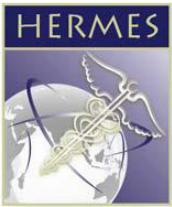
NOTE: You should see that the table has been updated with your input.

The screenshot shows the Building Costs page with the updated data. The "Done" button at the bottom right of the main page is highlighted in yellow, indicating the task is complete.

a. If you have other edits to make, you can click the right and left arrow buttons in the edit dialog box to move through the table and make adjustments.

b. For now, click “**Done**” in the edit dialog box.

c. Then click “**Done**” at the bottom corner of the page to return to the costing page.



Showing Costs for **tutorial_newmodel**

Base Currency: **USD**

Base Year: **2014**

Inflation Rate: **3** Percent

Storage Maintenance: **\$ 5** Percent

Vehicle Maintenance: **1%** Percent

enable microcosting for this model

Check Completeness

Cost Components

- Fuel and Power **Continue**
- Storage Equipment **Revisit**
- Vehicles **Revisit**
- Salaries **Revisit**
- Per Diem **REVISIT**
- Buildings **Revisit**
- Calculate vaccine costs!
- Vaccines **Continue**

Done

111. Finally, check the “**Enable microcosting for this model?**” box.

NOTE: Without checking this, no costing breakdowns will be performed when you go to run the model.

Showing Costs for **tutorial_newmodel**

Base Currency: **USD**

Base Year: **2014**

Inflation Rate: **3** Percent

Storage Maintenance: **\$ 5** Percent

Vehicle Maintenance: **1%** Percent

enable microcosting for this model

Check Completeness

Cost Components

- Fuel and Power **Continue**
- Storage Equipment **Revisit**
- Vehicles **Revisit**
- Salaries **Revisit**
- Per Diem **REVISIT**
- Buildings **Revisit**
- Calculate vaccine costs!
- Vaccines **Continue**

Done

112. The “**Check Completeness**” button performs validation of the costing parameters. Click on it to see what things might still need to be updated.

Showing Costs for **tutorial_newmodel**

Base Currency: **USD**

Base Year: **2014**

Inflation Rate: **3** Percent

Storage Maintenance: **\$ 5** Percent

Vehicle Maintenance: **1%** Percent

enable microcosting for this model

Check Completeness

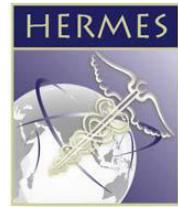
Cost Components

- Fuel and Power **Continue**
- Storage Equipment **Revisit**
- Vehicles **Revisit**
- Salaries **Revisit**
- Per Diem **REVISIT**
- Buildings **Revisit**
- Calculate vaccine costs!
- Vaccines **Continue**

Done

After clicking on the “**Check Completeness**” button, the below dialogue box should appear. Then click the “**Done**” button at the bottom of the page to return to the model open page.

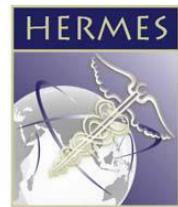
NOTE: The next tutorial on running a model and exploring results covers how to address these cost errors.



Next Steps

You have now completed the tutorial “Creating a New Vaccine Supply Chain Model”. Please proceed to the second tutorial “Running Your New Model & Viewing Results” to learn different measures of supply chain performance and operations and how seemingly small changes in the system can have significant effects.

1. Haidari LA, Wahl B, Brown ST, Privor-Dumm L, Wallman-Stokes C, Gorham K, Connor DL, Wateska A, Schreiber B, Dicko H. One size does not fit all: The impact of primary vaccine container size on vaccine distribution and delivery. *Vaccine*. 2015;33(28):3242-3247.
2. Assi T-M, Brown ST, Djibo A, Norman BA, Rajgopal J, Welling JS, Chen S-I, Bailey R, Kone S, Kenea H. Impact of changing the measles vaccine vial size on Niger's vaccine supply chain: a computational model. *BMC Public Health*. 2011;11(1):1.
3. Lee BY, Cakouros BE, Assi TM, Connor DL, Welling JS, Kone S, Djibo A, Wateska AR, Pierre L, Brown ST. The impact of making vaccines thermostable in Niger's vaccine supply chain. *Vaccine*. 2012;30(38):5637-5643.
4. Lee BY, Wedlock PT, Haidari LA, Elder K, Potet J, Manring R, Connor DL, Spiker ML, Bonner K, Rangarajan A, Hunyh D, Brown ST. Economic impact of thermostable vaccines. *Vaccine*. 2017;35(23):3135-3142.
5. Norman BA, Nourollahi S, Chen S-I, Brown ST, Claypool EG, Connor DL, Schmitz MM, Rajgopal J, Wateska AR, Lee BY. A passive cold storage device economic model to evaluate selected immunization location scenarios. *Vaccine*. 2013;31(45):5232-5238.
6. Haidari LA, Brown ST, Wedlock P, Connor DL, Spiker M, Lee BY. When are solar refrigerators less costly than on-grid refrigerators: A simulation modeling study. *Vaccine*. 2017;35(17):2224-2228.
7. McCarney S, Robertson J, Arnaud J, Lorenson K, Lloyd J. Using solar-powered refrigeration for vaccine storage where other sources of reliable electricity are inadequate or costly. *Vaccine*. 2013;31(51):6050-6057.
8. Haidari LA, Connor DL, Wateska AR, Brown ST, Mueller LE, Norman BA, Schmitz MM, Paul P, Rajgopal J, Welling JS. Only adding stationary storage to vaccine supply chains may create and worsen transport bottlenecks. *Journal of public health management and practice: JPHMP*. 2013;19(0 2):S65.



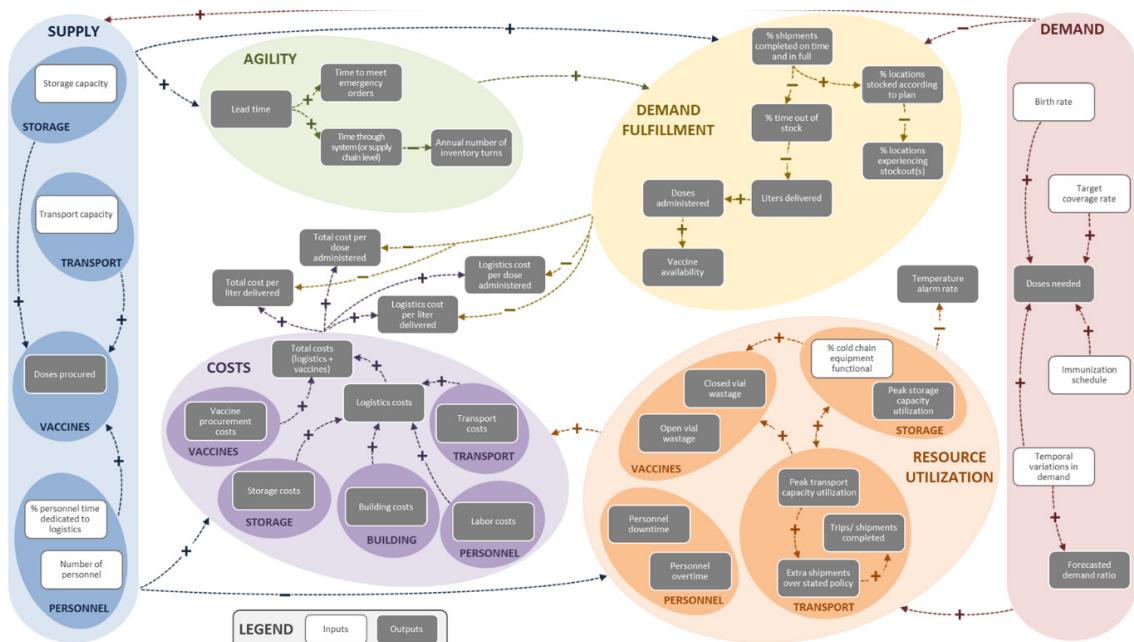
Tutorial 2

Running Your New Model And Viewing Results

Now that you have a model to run, this tutorial will walk you through the process of fixing any errors, running the model and analyzing the results.

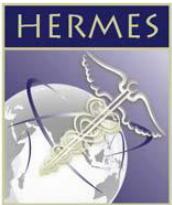
HERMES provides a comprehensive results page including a number of indicators that can help the user analyze the function and cost of a given supply chain. The graphic below illustrates these different measures within a few categories: supply, agility, costs, demand fulfillment, resource utilization and demand.

Map of Different Vaccine Supply Chain Efficiency Measures



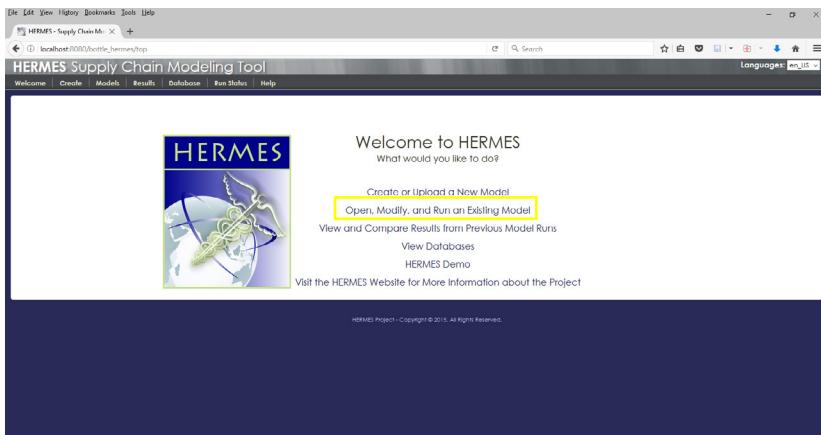
In this tutorial, you will validate, edit and run simulations of your vaccine supply chain model and explore the different types of results that are available in six different visualizations: tabular form, histograms, bar charts, tree maps, geographic conceptions and a downloadable Results Spreadsheet. These results will include outcomes for vaccine availability, doses procured and used, open vial wastage, storage conditions and costs (*including costs for each of storage, transport, personnel and vaccines*).

This tutorial utilizes the model you created in the “[Creating a new model](#)” tutorial (*Tutorial 1*). You can also find this model in the tutorial materials provided to you.

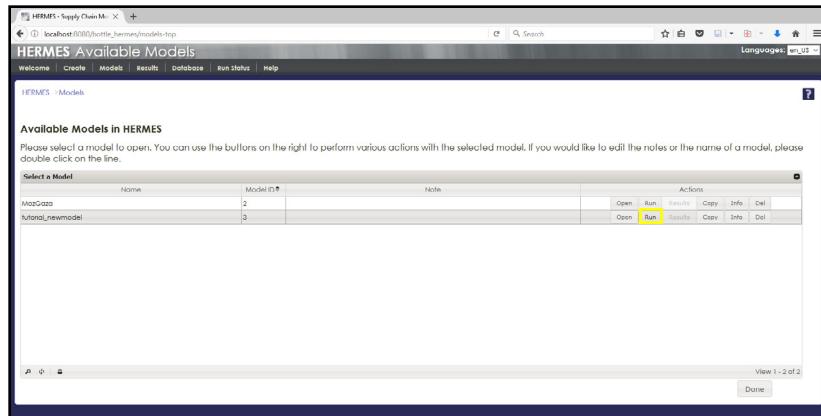


Part 1: Start run

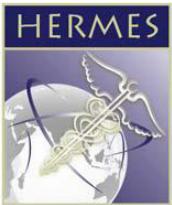
Note: Please zoom in to see screenshots. We recommend zooming in to at least 200%.



1. On the Welcome Page, click **“Open, Modify and Run and Existing Model”**.



2. Click on the **“Run”** button in the **“tutorial_newmodel”** row.



Screenshot of the HERMES 'Run A Model Simulation' page. The URL is localhost:8080/bottle/hermes/model-run?modelId=3. The page title is 'HERMES Run A Model Simulation'. It shows a form for running a model simulation with the following parameters:

What name should be given to this set of results?	<input type="text" value="run1"/>
How many stochastic (random) runs would you like to average the results over?	<input type="text" value="4"/>
Run Parameters for model tutorial_newmodel	
Number of Simulation Days	<input type="text" value="365"/>
Number of Shipments from the Manufacturer per Year	<input type="text" value="4"/>
Factor for Buffer Stock from the Manufacturer	<input type="text" value="1"/>
sets the default buffer stock for the whole model	<input type="text" value="0.25"/>

Buttons: Show Advanced Options, Submit, Cancel.

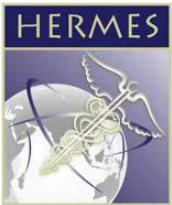
3. This opens the page for running a model simulation. Here you will enter a name for this set of results and specify the number of times you wish to run the model when generating these results. To better capture the day-to-day variation that occurs in the real world, HERMES models are theoretical (*unless otherwise specified in the parameters*). This means each run of the model will generate somewhat different results. For example, the daily demand at an immunizing location is not going to be the same every day-- some days will have more patients than others at any given location. Thus, HERMES generates a flux of daily demand.

Screenshot of the HERMES 'Run A Model Simulation' page. The URL is localhost:8080/bottle/hermes/model-run?modelId=3. The page title is 'HERMES Run A Model Simulation'. It shows a form for running a model simulation with the following parameters:

What name should be given to this set of results?	<input type="text" value="run1"/>
How many stochastic (random) runs would you like to average the results over?	<input type="text" value="4"/>
Run Parameters for model tutorial_newmodel	
Number of Simulation Days	<input type="text" value="365"/>
Number of Shipments from the Manufacturer per Year	<input type="text" value="4"/>
Factor for Buffer Stock from the Manufacturer	<input type="text" value="1"/>
sets the default buffer stock for the whole model	<input type="text" value="0.25"/>

Buttons: Show Advanced Options, **Submit**, Cancel.

4. In the text box, enter run1 for this set of results. Leave the rest of the parameters with their default settings. Then click the **“Submit”** button.



HERMES Run A Model Simulation

What name should be given to this set of results?

How many stochastic (random) runs would you like to average the results over?

Please wait while HERMES validates your model prior to running. This may take a few minutes so please be patient.

Run Parameters for model tutorial_newmodel

Number of Simulation Days:

Number of Shipments from the Manufacturer per Year:

Factor for Buffer Stock from the Manufacturer:

sets the default buffer stock for the whole model:

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5. HERMES will automatically validate your model before trying to run it.

HERMES Run A Model Simulation

What name should be given to this set of results?

How many stochastic (random) runs would you like to average the results over?

Run Parameters for model tutorial_newmodel

Number of Simulation Days:

Number of Shipments from the Manufacturer per Year:

Factor for Buffer Stock from the Manufacturer:

sets the default buffer stock for the whole model:

Validating Model

Test: Costing Errors

Message:

- pricezeroenper is not defined or is invalid
- pricelvlevper is not defined or is invalid
- pricopropnoprg is not defined or is invalid
- pricelorperv is not defined or is invalid

Major Costing Errors Exist

Your model has costing errors in it that could lead to erroneous results. You will not be able to run the simulation until this is corrected. You must correct these by editing the models costing page. Click the button at the bottom of the dialog labeled Go To Cost Model Editor to do this.

6. If there are errors, you will get one or more error messages (*for structure and cost errors*) as well as a dialog box listing the errors with buttons to take you to the location to fix them.



Part 2: Fix Errors

In this case, the model you created did not include costs for all the different types of fuel and power. You will correct these errors before coming back to try to run the simulation again.

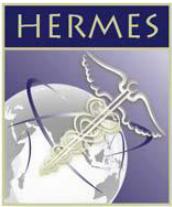
7. First click the “**Close**” button on the costing errors message.

8. You can now more clearly see the errors in the Validating Model dialog box. Click the “**Go To Cost Model Editor**” button.

NOTE: This will open the Costs page. On the costs page, click the “Continue” button next to “Fuel and Power”.

Commodity	Price	Per
LP gas	0.00	USD - KG
Kerosene	0.00	USD - liter
Gasoline	1.17	USD - liter
Diesel	0.00	USD - liter
Methyl Alcohol	0.10	USD - Kilowatt Hour
Solar Power	0.00	USD - Installed Kilowatt
Ice	0.00	USD - Freeze One Liter of Ice
Solar Panel Amortization	10	years

9. Enter 0 in the empty Price boxes, leaving “**Gasoline**” “**Electric Mains**” and “**Solar Panel Amortization**” the same. Then click the “**Done**” button.



The screenshot shows the HERMES Costs interface. At the top, it says "Showing Costs for tutorial_newmodel". Below that are fields for "Base Currency" (USD), "Base Year" (2014), "Inflation Rate" (2%), and "Storage Maintenance" (5%) and "Vehicle Maintenance" (15%) both set to "Percent". There is a checkbox "Enable microcosting for this model?" which is unchecked. A yellow box highlights the "Check Completeness" button. On the left, there's a sidebar titled "Cost Components" with options like Fuel and Power, Storage Equipment, Vehicles, Salaries, per Item, Buildings, Calculate vaccine costs!, and Vaccines. Each option has a "Revisit" or "Continue" button next to it.

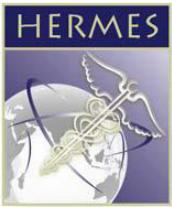
10. On the main cost page, click the **“Check Completeness”** button.

The screenshot shows the same HERMES Costs interface as above, but now with a modal dialog box in the center. The dialog box has a title "The Costing Component is Ready" and the message "This model is ready to run with microcosting.". A yellow box highlights the "Ok" button at the bottom right of the dialog. The background of the main window is dimmed.

11. **“The Costing Component is Ready”** dialogue box will appear. Click the **“Ok”** button. You should now be ready to run the model with microcosting.

The screenshot shows the same HERMES Costs interface. The "Run Simulation" breadcrumb in the top left corner is highlighted with a yellow box. The rest of the interface looks identical to the previous screenshots.

12. Click the **“Run Simulation”** breadcrumb in the top left corner to return to the Run page.



Part 3: Start Run (again)

File Edit View History Bookmarks Tools Help
HERMES - Supply Chain M... X
localhost:8080/tutorial/hermes/model-run?modelId=3
HERMES Run A Model Simulation
Welcome Create Models Results Database Run Status Help
Languages en_US
HERMES - Run - Run Simulation

Running a HERMES Model

What name should be given to this set of results? **joni**
How many stochastic (random) runs would you like to average the results over? **4**

Run Parameters for model tutorial_newmodel

Number of Simulation Days	334
Number of Shipments from the Manufacturer per Year	4
Factor for Buffer Stock from the Manufacturer	1
sets the default buffer stock for the whole model	0.25

Show Advanced Options **Submit**

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13. As above in step 4, enter a name into the text box and click the “**Submit**” button.

File Edit View History Bookmarks Tools Help
HERMES - Supply Chain M... X
localhost:8080/tutorial/hermes/model-run?modelId=3
HERMES Run A Model Simulation
Welcome Create Models Results Database Run Status Help
Languages en_US
HERMES - Run - Run Simulation

Running a HERMES Model

What name should be given to this set of results?
How many stochastic (random) runs would you like to average the results over?

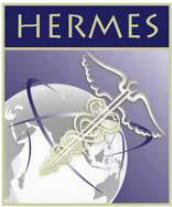
Validating Model

Test	Message
<input checked="" type="radio"/> success	
All	[There were no warnings or errors in the model, please proceed to press the Run Simulation button below]

Advanced Options **Run Simulation**

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14. Now that there are no errors, the Validating Model box will inform you of your success. Click the “**Run Simulation**” button to start the simulation.



Part 4: View Run Status

Clicking the Run Simulation button will bring you to the Run Status page. If you leave and want to view the status of your run, you can reach this page by clicking Run Status on the top menu bar.

The screenshot shows the HERMES Run Status interface. A modal dialog titled "Run Information: run1" is open over a table of available runs. The table has columns: Run Name, Model Name, Model ID, Submitted, Status, and Details. The first row, "run1", is selected. The "Details" column for "run1" contains three buttons: Info (highlighted in yellow), Cancel, and Clear. The "Info" button is currently active, displaying a summary of the run's details. The summary includes the run name, model name, start time, end time, duration, and current run status.

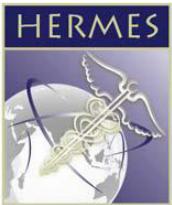
15. As you can see from the page below, the Run Status page offers you some basic information about the runs you have previously started, as well as buttons allowing you to get more detailed information (*Info*, *Logs*) or remove a run from the status table (*this does not delete the results*). Clicking the “**Info**” button for run1 displays a summary of the run details.

This screenshot shows the same Run Status interface as above, but the "Logs" button in the "Details" column for run1 is now highlighted in yellow. A modal dialog titled "logs" is open, displaying a large amount of log text. The log text is a JSON array of objects, each containing latency, name, clientID, and proc fields, along with a timestamp and buffer stock information.

16. Clicking the “**Logs**” button displays detailed logs for the run. The logs are a detailed description of model processes containing information that may be helpful when troubleshooting.

This screenshot shows the Run Status page again. The "Status" column for "run1" now shows "finished". The "Logs" button in the "Details" column for "run1" is now highlighted in yellow, indicating that the run has completed and its logs are available.

17. Once the run has finished, the status column will be updated accordingly.



Part 5: View results

Once your simulations have finished running, you can view and analyze the results through multiple interactive visualizations and charts, as well as detailed tables.

The screenshot shows the 'Status of Currently Running Simulations' section. It lists three runs:

Run Name	Model Name	Model ID	Submitted	Status	Details
run1	tutorial_newmodel	3	Tue Jul 11 14:04:58 2017	finished	Info Cancel Clear Log
MozGoo[1]	MozGoo[1]	4	Fri Jul 07 15:09:10 2017	finished	Info Cancel Clear Log
haha	MozGoo[2]	12	Fri Jul 07 14:30:48 2017	process stopped at running 99.29% (run 1)	Info Cancel Clear Log

18. Click on “**Results**” in the top menu bar to open the results page.

The screenshot shows the 'HERMES Simulation Results' page. On the left, there is a tree view of results:

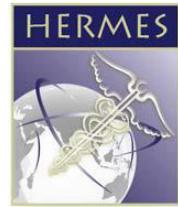
- tutorial_newmodel
 - Avg: [Done]
 - Average Result: [view](#)
 - Run:0: [Done]
 - Run:1: [Done]
 - Run:2: [Done]
 - Run:3: [Done]

Please select a result from the menu on the left to display.

19. The results are organized by model and the page opens with all results collapsed. Click the model name (*tutorial_newmodel*) or the small triangle to the left to show the simulations that have been run for this model.

The screenshot shows the same 'HERMES Simulation Results' page as above, but with the 'Average Result' link under 'tutorial_newmodel' highlighted in yellow.

20. Since we left the number of simulations at the default, 4, there are four separate runs (*labeled Run:0 to Run:3*), as well as the average result of all 4, available for you to review. For now, click on the “**Average Result**” link. Due to each model being hypothetical, your results will not match these exactly.



Tabular results

21. The Vaccine Results table lists statistics for each vaccine in the dose schedule, as well as overall statistics for all vaccines combined. These results include the following supply chain measures.

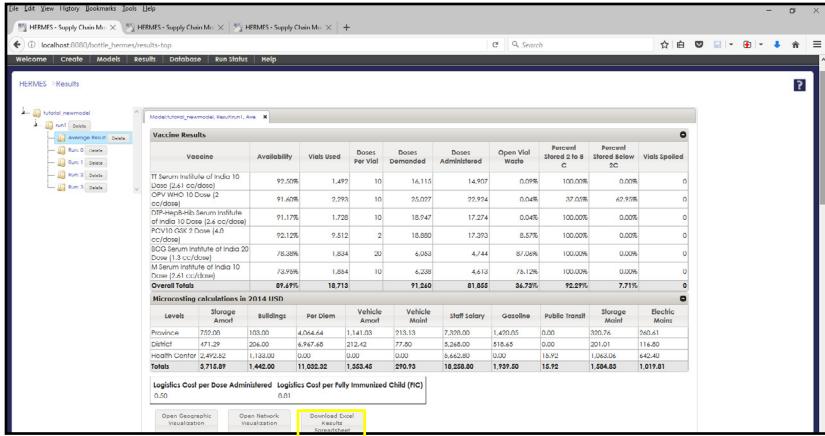
Availability expresses the Doses Administered as a percentage of the Doses Demanded. Doses Demanded indicates the number of doses of each vaccine that was needed at immunizing locations in order to administer the required vaccines to all people who arrived for vaccinations, while Doses Administered indicates the number of doses that were given to people arriving for vaccinations. This number may be lower than Doses Demanded if supply chain bottlenecks or ordering policies prevented the necessary vaccines from getting where they were needed, when they were needed.

In this particular simulation (*Model:tutorial_newmodel, Result:run1, Ave*) Availability ranges from 74% to 93% across different vaccines, with an overall average of 90%. This indicates that an average of 10% of the Doses Demanded resulted in missed opportunities, where people were turned away because the necessary vaccines were not in stock at the time.

Open Vial Waste is the percentage of all doses in vials that were opened and not used. Doses must be discarded from opened vials depending on the type of vaccine (*lyophilized or liquid, for example*) and the immunization program policies (*some programs mandate discarding all opened vials at the end of every session, while others may allow some types of opened vials to be used in future sessions*). In this model, three vaccines (*TT, OPV and DTP-HepB-Hib*) could be used for up to a month after opening, which resulted in little to no open vial wastage for these vaccines. In contrast, open vials of PCV, BCG and M vaccines would be discarded at the end of each vaccination session, leading to higher open vial wastage. PCV experienced lower wastage (*at 9%*) than the BCG and M (*>75% wastage for each*) due to each PCV vial containing only 2 doses (*as compared to 20 doses per vial for BCG and 10 for M*).

The Microcosting Calculations table (“*Microcosting calculations in 2014 USD*” below) provides supply chain costs by supply chain level and for the overall system, divided into categories such as storage amortization, storage maintenance, staff salary, buildings and gasoline costs.

An additional table (“*Logistics Cost per Dose Administered*” and “*Logistics Cost per Fully Immunized Child (FIC)*” below) divides the total logistics costs for the simulation by the number of doses administered as well as by the number of fully immunized children (FIC). In this set of results, the logistics cost per dose administered was \$0.50 and the logistics cost per FIC was



The screenshot shows the HERMES software interface with the 'Results' tab active. A modal window titled 'Model_ttnewmodel_results.xls' displays 'Vaccine Results'. Below the table, there's a section for 'Microcosting calculations in 2014 US' with a table showing costs per dose administered. At the bottom of the modal, there are three buttons: 'Open Geographical Visualisation', 'Open Network Visualisation', and 'Download Excel Results Spreadsheet' (which is highlighted with a yellow box).

Vaccine	Availability	Viels Used	Doses Per Viel	Doses Demanded	Doses Administered	Open Vial Waste	Percent Stored at 8 °C	Percent Stored Below 2°C	Viels spoiled
TT Serum Institute of India 10 Dose (2.41 cc/dose)	97.05%	1,497	10	14,115	14,907	0.09%	100.00%	0.00%	0
OPV Wk 10 Dose (2 cc/dose)	91.40%	2,295	10	25,077	22,974	0.04%	37.00%	60.95%	0
DPT-Hep-B-Dt Serum Institute of India 10 Dose (0.9 cc/dose)	91.17%	1,728	10	18,947	17,274	0.04%	100.00%	0.00%	0
PCV10 GSK 2 Dose (4.8 cc/dose)	92.12%	9,812	2	18,880	17,372	0.57%	100.00%	0.00%	0
ICU Serum Institute of India 20 Dose (1.3 cc/dose)	78.26%	1,864	20	4,038	4,144	0.76%	100.00%	0.00%	0
ICU Serum Institute of India 10 Dose (2.1 cc/dose)	73.99%	1,884	10	6,038	4,612	7.12%	100.00%	0.00%	0
Overall Totals:	87.49%	18,713		91,210	81,855	36.70%	92.29%	7.71%	

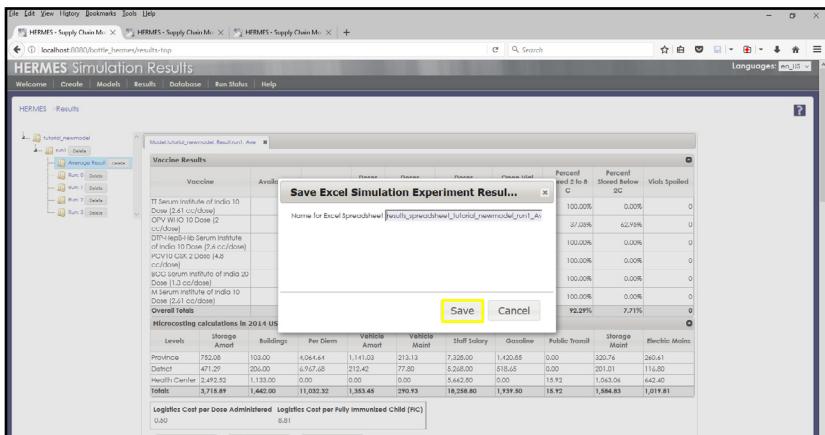
Microcosting calculations in 2014 US

Levels	Storage Amort	Buildings	Per Diem	Vehicle Amort	Vehicle Maint	Staff Salary	Gassoline	Public Transl	Storage Maint	Electric Maint
Province	752.00	103.00	4,064.44	1,141.03	213.13	7,328.00	1,420.65	0.00	320.74	260.41
District	471.29	204.00	6,974.48	212.42	77.80	5,268.00	518.45	0.00	201.01	116.80
Health Center	2,492.82	1,133.00	0.00	0.00	0.00	5,642.80	0.00	15.92	1,063.04	642.40
Totals	3,718.89	1,440.00	11,032.92	1,383.45	299.93	18,258.80	1,937.80	15.92	1,784.83	1,019.81

Logistics Cost per Dose Administered Logistics Cost per Fully Immunized Child (Pic) 0.50 0.81

22. Click on the “Download Excel Results Spreadsheet” button below the tables to acquire a spreadsheet of more detailed results, which includes supply chain metrics not only for the overall system and by supply chain level, but also for each individual location and route.

NOTE: The spreadsheet contains several sheets of information about the model. The first page is an overall model summary, followed by a level-wise device inventory, store locations with cost breakdowns, route information with cost breakdowns and listings of storage devices, vehicles and vaccines.



The screenshot shows the HERMES software interface with the 'Results' tab active. A modal window titled 'Save Excel Simulation Experiment Result...' is open. It contains a table of results and two buttons: 'Save' (highlighted with a yellow box) and 'Cancel'.

Vaccine	Availabilty	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Viels Spoiled
TT Serum Institute of India 10 Dose (2.41 cc/dose)	100.00%	0.00%	0						
OPV Wk 10 Dose (2 cc/dose)	97.05%	0.00%	0						
DPT-Hep-B-Dt Serum Institute of India 10 Dose (0.9 cc/dose)	91.40%	0.00%	0						
PCV10 GSK 2 Dose (4.8 cc/dose)	91.17%	0.00%	0						
ICU Serum Institute of India 20 Dose (1.3 cc/dose)	100.00%	0.00%	0						
ICU Serum Institute of India 10 Dose (2.1 cc/dose)	100.00%	0.00%	0						
Overall Totals:	92.29%	7.71%	0						

Microcosting calculations in 2014 US

Levels	Storage Amort	Buildings	Per Diem	Vehicle Amort	Vehicle Maint	Staff Salary	Gassoline	Public Transl	Storage Maint	Electric Maint
Province	752.00	103.00	4,064.44	1,141.03	213.13	7,328.00	1,420.65	0.00	320.74	260.41
District	471.29	204.00	6,974.48	212.42	77.80	5,268.00	518.45	0.00	201.01	116.80
Health Center	2,492.82	1,133.00	0.00	0.00	0.00	5,642.80	0.00	15.92	1,063.04	642.40
Totals	3,718.89	1,440.00	11,032.92	1,383.45	299.93	18,258.80	1,937.80	15.92	1,784.83	1,019.81

Logistics Cost per Dose Administered Logistics Cost per Fully Immunized Child (Pic) 0.50 0.81

23. Click the “Save” button.

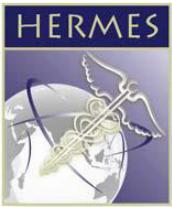


HERMES Tutorial: Running and results

The screenshot shows the HERMES software interface with a 'Vaccine Results' window open. The window displays a table of vaccine availability and usage across various facilities. A download dialog box is overlaid on the screen, asking the user what they want to do with the file 'results_spreadsheet_tutorial_remodel.xls'. Options include 'Open with Microsoft Excel (default)', 'Save File', and 'Do this automatically for files like this from now on.' Below the dialog, there is a table titled 'Miscellaneous calculations in 2014 US\$' showing storage, building, vehicle, staff, and fuel costs.

Level	Storage Amort	Buildings Amort	Per Dose Amort	Vehicle Main	Vehicle Maintenance	Staff Salary	Fuel	Public Transport	Storage Main	Electric Mains
Province	752.00	133.00	4,044.44	1,141.03	213.13	7,286.00	1,420.65	0.00	320.74	260.61
District	0.00	204.00	4,970.68	212.42	77.80	5,826.00	518.45	0.00	207.10	116.50
Health Center	2,412.52	113.00	0.00	0.00	0.00	5,443.00	0.00	15.92	1,043.06	40.40
Total	3,715.89	1,462.00	11,032.32	1,355.45	290.93	18,288.00	1,937.80	15.92	1,584.83	1,019.81

24. Use the download dialog box to either open or save a copy.

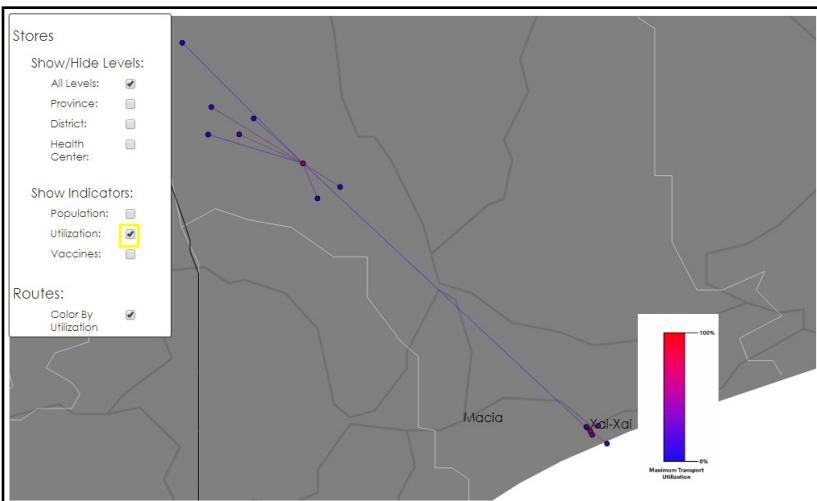


Visualizations

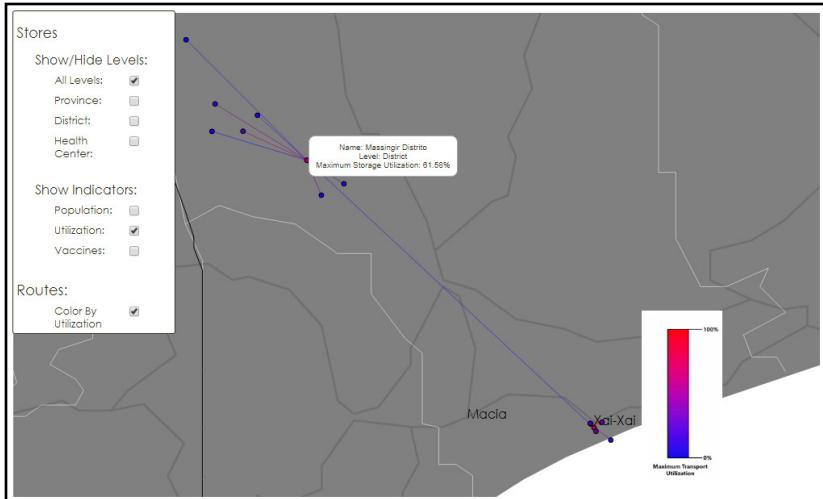
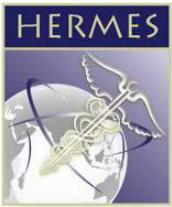
There are two types of visualizations accessible via buttons below the main tables—“**Open Geographic Visualization**” and “**Open Network Visualization**”.

Vaccine	Availability	Vials Used	Doses Per Vial	Doses Demanded	Doses Administered	Open Vial Waste	Percent Shipped to & C	Percent Shipped Below & C	Vials Spoiled
TT Serum Institute of India 10 Dose (2.41 cc/dose)	97.50%	1,497	10	14,115	14,917	0.09%	100.00%	0.00%	0
OPV WHO 10 Dose (2 cc/dose)	91.40%	2,295	10	25,077	22,934	0.04%	37.00%	63.90%	0
NIP-Hepatitis Serum Institute of India 10 Dose (2.4 cc/dose)	91.17%	1,726	10	18,947	17,274	0.04%	100.00%	0.00%	0
PCV10 WHO 10 Dose (4.0 cc/dose)	92.12%	9,512	2	18,880	17,373	0.57%	100.00%	0.00%	0
DSO Serum Institute of India 20 Dose (1.0 cc/dose)	78.38%	1,844	20	6,088	4,744	87.06%	100.00%	0.00%	0
M Serum Institute of India 10 Dose (1.0 cc/dose)	78.90%	1,684	10	6,208	4,612	78.10%	100.00%	0.00%	0
Overall Total:	89.47%	18,713		91,340	81,855	34.70%	92.29%	7.71%	

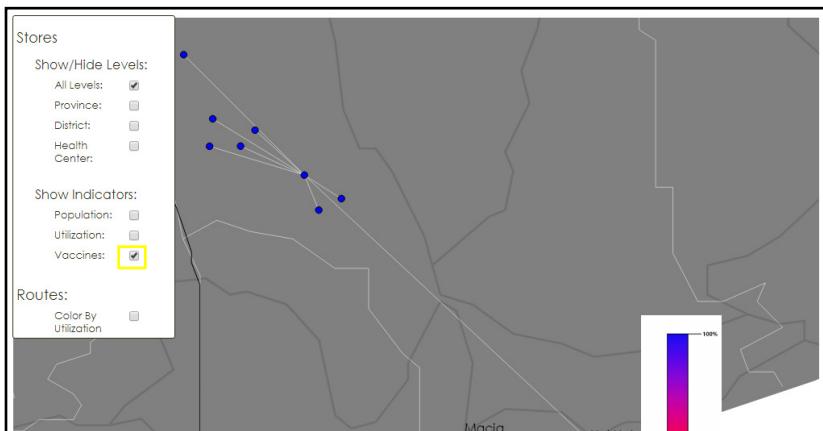
25. Click the “**Open Geographic Visualization**” button to view the supply chain locations and results on a map. This page will open in a new window and can take some time to load.



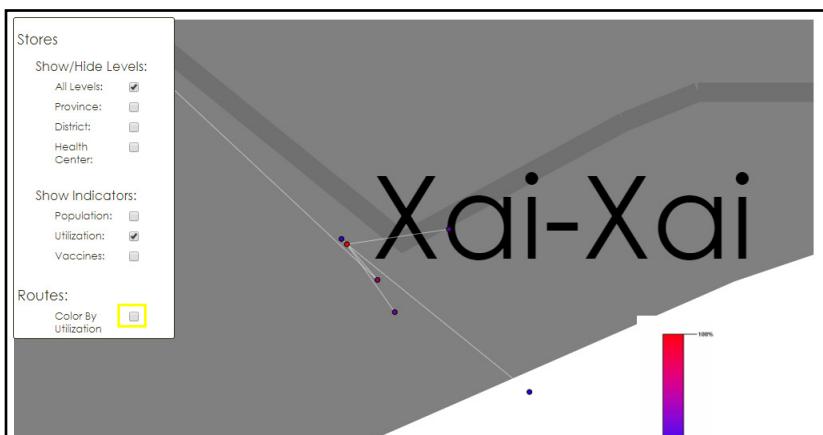
26. By default, locations are represented by circles that are sized and color coded by supply chain level. Lines between locations represent the routes connecting the province, health center and district stores to the locations they supply. You can choose other information to display from the box on the left to reveal potential supply chain bottlenecks. Check the “**Utilization**” box under “**Show Indicators**” to color locations by maximum storage utilization (*the peak percentage of available storage capacity utilized at a location at any time during the simulation*). Also select “**Color By Utilization**” under “**Routes**” to color each route by its maximum transport utilization (*the peak percentage of available vehicle capacity used at any point*).



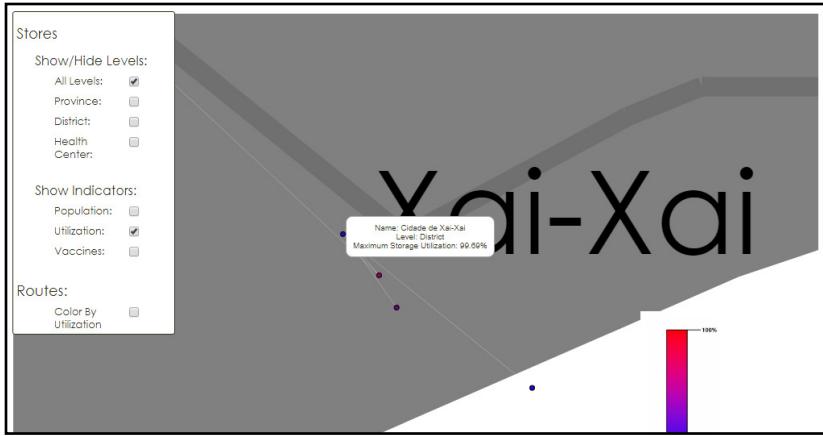
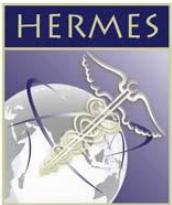
27. Hovering your cursor over a location identifies the location and supply chain level and quantifies its maximum storage utilization. For example, Massingir Distrito used approximately 62% of its storage capacity at peak utilization in this baseline scenario. This is higher than many other locations but does not indicate a current supply chain bottleneck as utilization did not reach near 100%.



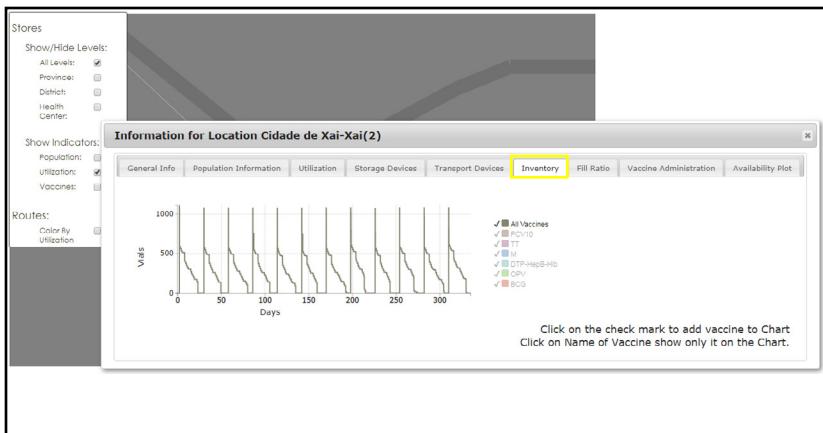
28. You can instead choose to view locations by their population size or vaccine availability results using the box on the left. Click on the “**Vaccines:**” under “**Show Indicators**” to see the vaccine availability results.



29. Zoom in and out using the scrollwheel or the buttons in the control box. Zoom in where the southernmost locations in the model are found and click on the “**color by utilization**” button.

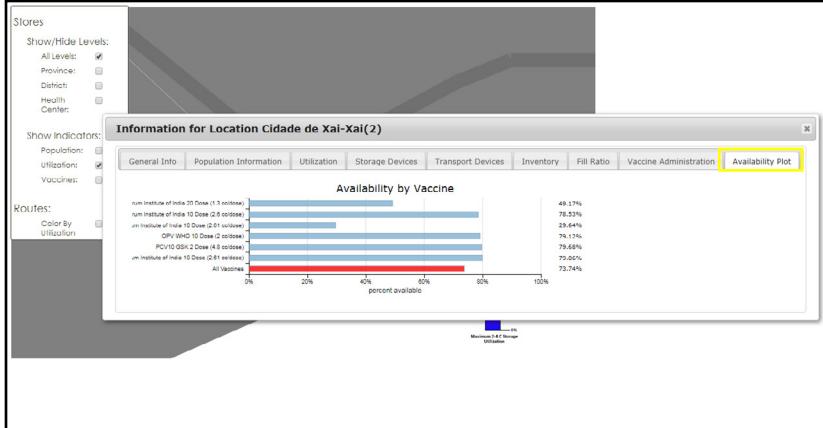
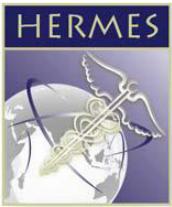


30. Hovering your cursor over the location that is most red in color (*red indicates the greatest maximum storage utilization*) reveals the “**Cidade de Xai-Xai**” district store with the highest peak utilization of greater than 99%. This indicates a storage bottleneck, as the storage device at this district store was filled to capacity before it could store all of the vaccines it needed for at least part of the simulation.

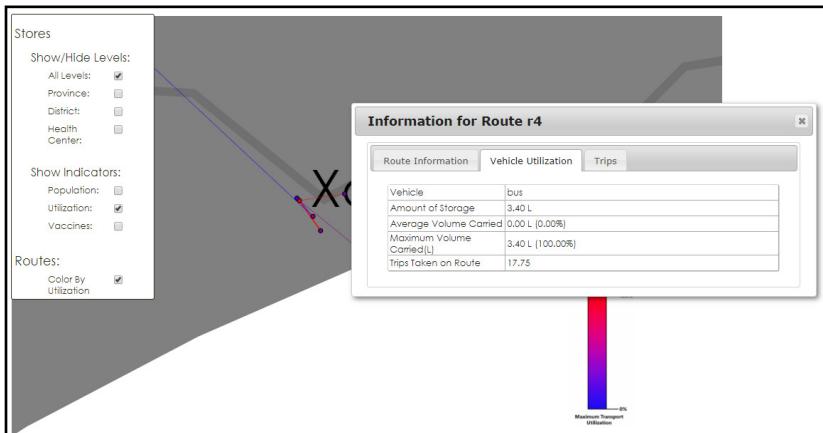


31. Clicking on a location or route provides specific, detailed information and results for your selection. Click on the “**Cidade de Xai-Xai**” district store and select the “**Inventory**” tab to display an interactive plot of the daily stock inventory at this location throughout the simulation.

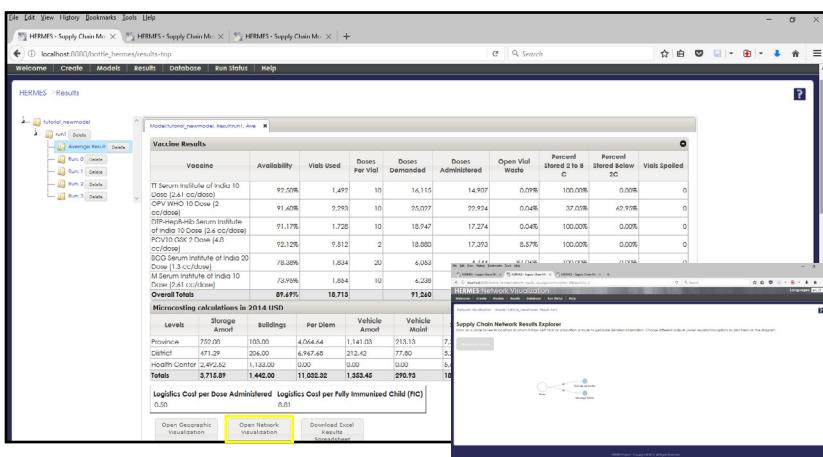
NOTE: Clicking on the name of any vaccine in the legend to the right will display only that vaccine and clicking the checkmark next to any vaccine will add that vaccine to the chart. This chart shows monthly stockouts at the Cidade de Xai-Xai district store.



32. Click the “**Availability Plot**” tab to show vaccine availability for each vaccine at this location. This chart reveals vaccine availability to be 74% among people arriving at the Cidade de Xai-Xai district store for vaccinations, indicating 26% of missed opportunities due to the stockouts here.



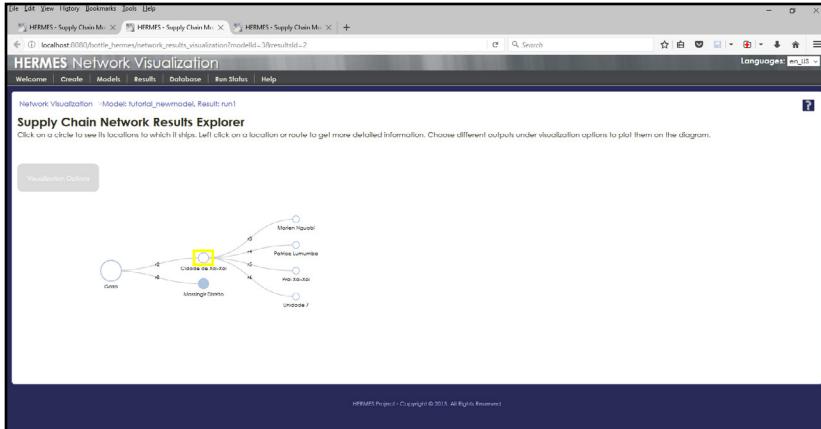
33. Explore the map using the various display options to identify transport bottlenecks. These can be found in routes using buses to pick up vaccines from the Cidade de Xai-Xai district store. These show 100% maximum transport utilization (*or volume carried*) and more than 12 trips in a one-year simulation, indicating extra instances of picking up vaccines beyond the monthly trips attempted.



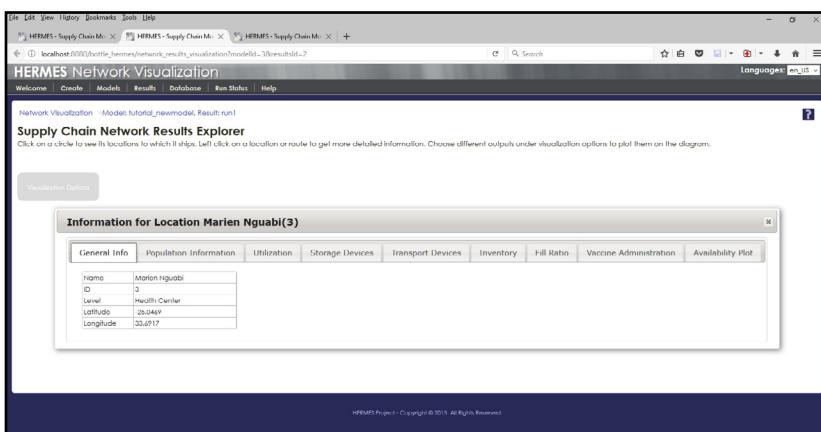
34. While the geographic visualization is only available for locations with geographic coordinate data, similar types of results can be displayed for any model in a network visualization. Click the “**Open Network Visualization**” button from the results page.

NOTE: This will open in a new window.

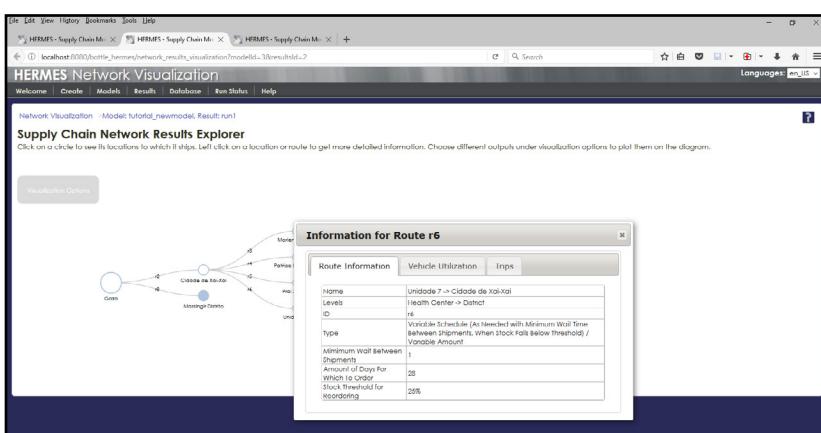
HERMES Tutorial: Running and results



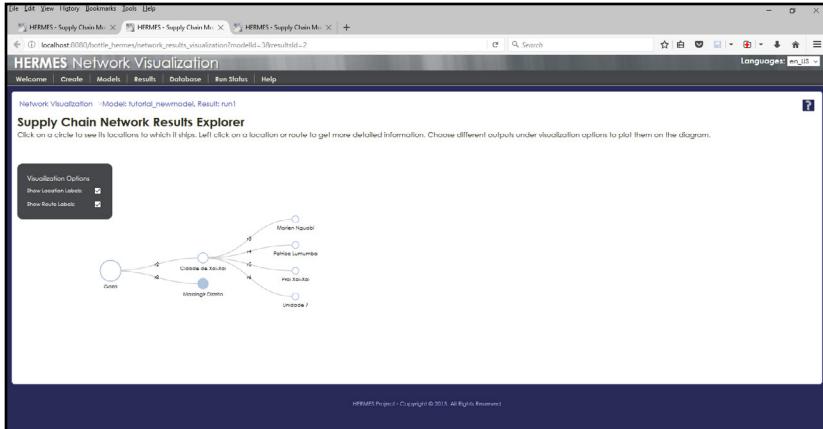
35. A filled in blue circle means there are locations below that one. Left click on the Cidade de Xai-Xai circle to expand the locations below.



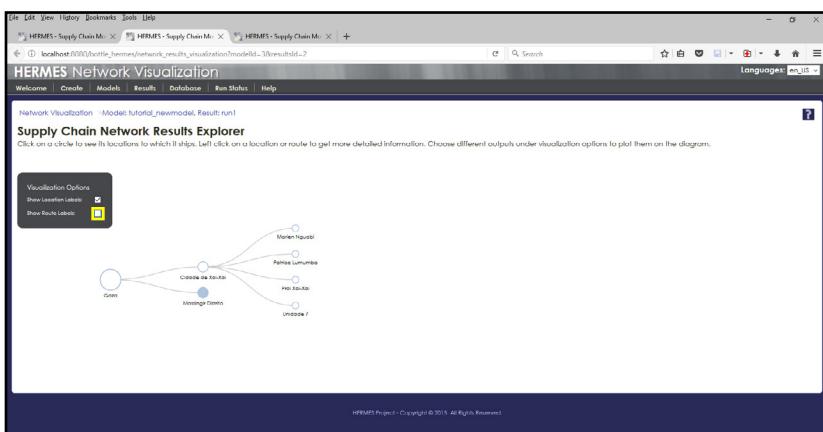
36. Right click on Marien Nguabi to display information about that location then close the window.



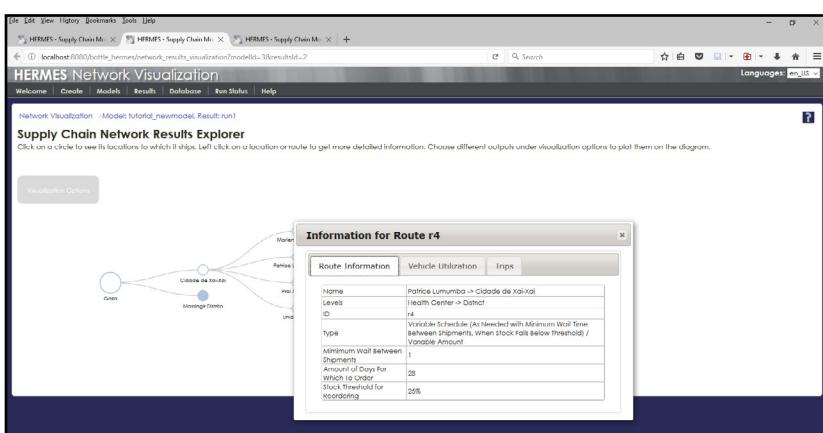
37. Right click on “r6” to get information about that route then close the window.



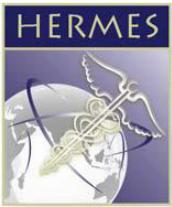
38. You can adjust what labels are shown on the diagram using the **“Visualization Options”** box on the top left. When you place your cursor over each button, it expands to show the available options.



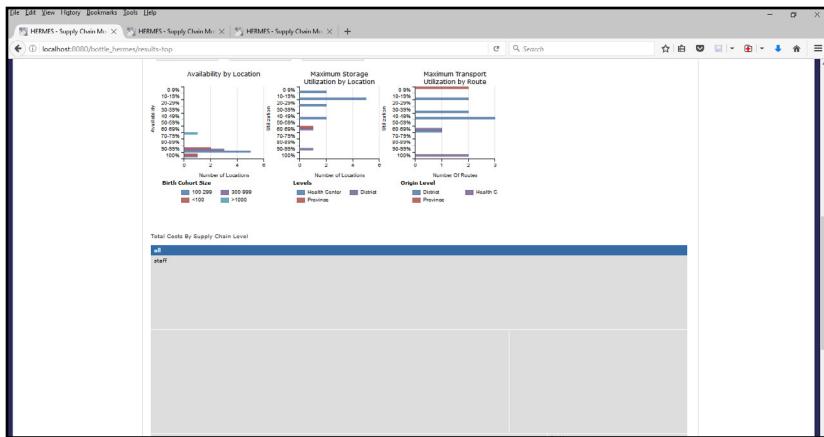
39. Uncheck **“Show Route Labels”** to remove them from the visualization.



40. Even though the routes are not labeled, you can still show their information by right clicking on the line.



Histograms

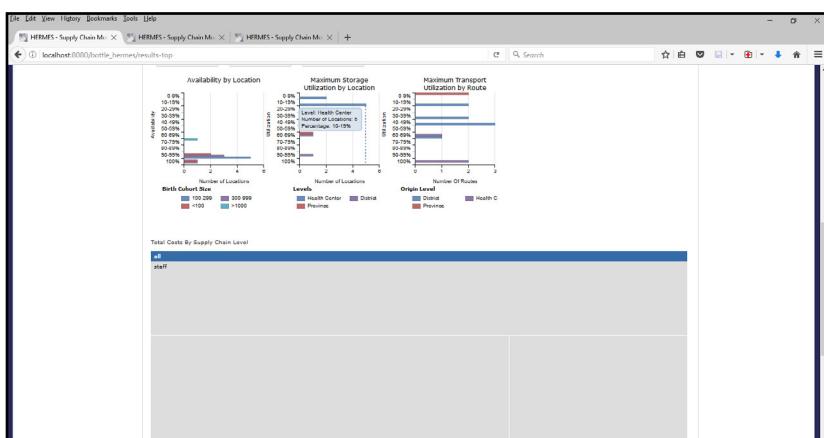


41. There are three histograms positioned below the visualization buttons. These histograms display the distribution of overall vaccine availability, maximum storage utilization and maximum transport utilization across locations.

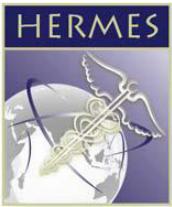
In our model, these show that availability was greater than 90% at the majority of the health centers, but the one with the largest population (*which we now know to be the Cidade de Xai-Xai district location*) experienced lower availability in the range of 70-79%.

The maximum storage utilization by location histogram shows one district (*Cidade de Xai-Xai*) potentially facing storage capacity constraints (*with peak utilization in the range of 90-99%*) while all other locations in the supply chain appeared to have sufficient capacity.

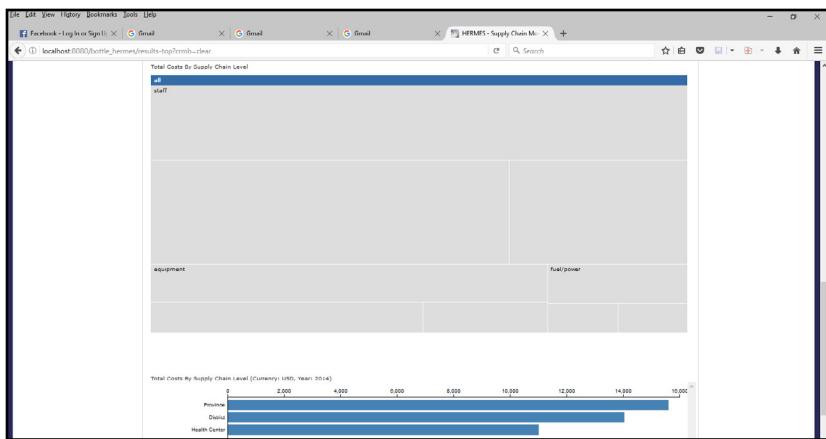
The maximum transport utilization also indicates a lack of bottlenecks in most routes, with two health centers utilizing their full transport capacity (*and potentially taking extra trips if allowed*).



42. Each of these will show further information if you hover your cursor over one of the lines in the bar graph.



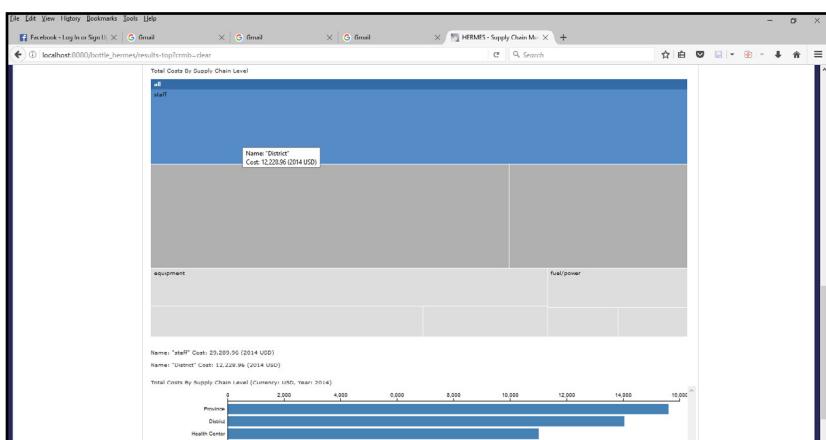
Interactive cost diagrams



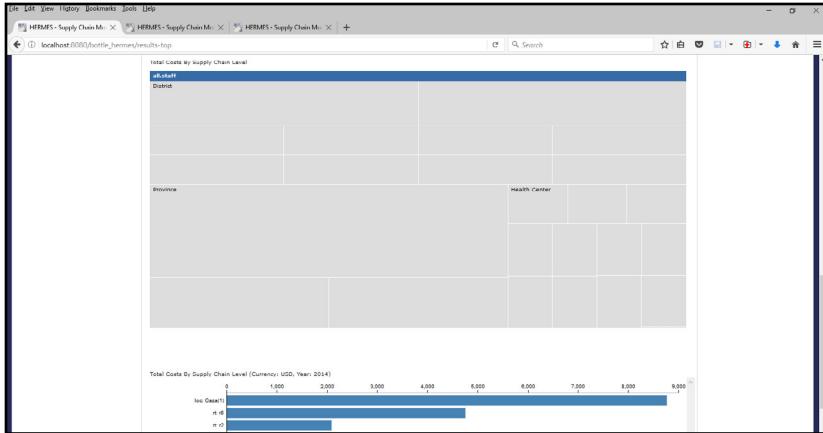
43. Total costs by supply chain level are represented by a treemap and bar chart, both of which are interactive.

The zoomable treemap allows for a quick visualization of the major cost driving categories and the relative cost of each level, location and route. The treemap displays boxes labeled with categories of costs, with the relative size of each box representing the relative share of costs attributed to that category. In this model, the costs of staff salaries comprised the greatest share of costs, followed by equipment costs and fuel/power costs.

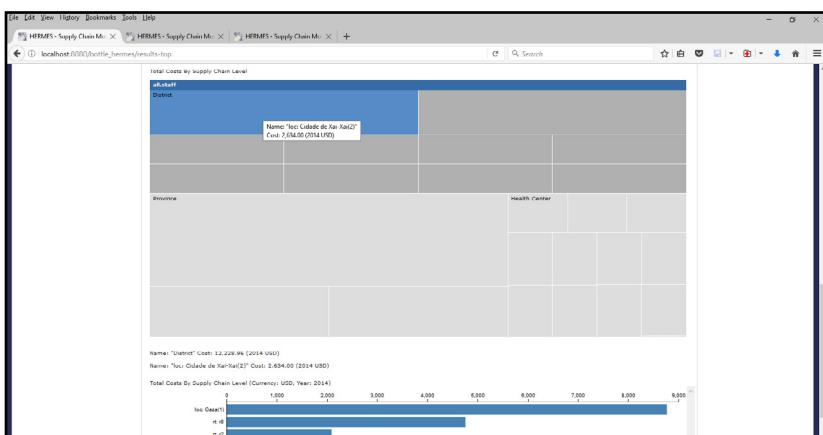
Clicking any box will “**zoom in**” the treemap to the selected category, now further broken down into subcategories. To zoom out to the previous level of costs, click on the blue bar at the top of the treemap, which displays a label of the current category.



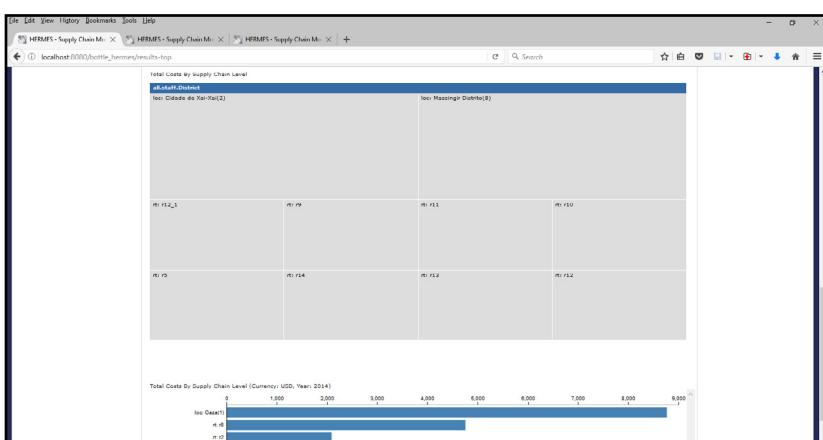
44. If you hover over a block of the treemap, information about that field and level will appear both in a pop up box and below the grid. The total for that field will also be shown below the grid.



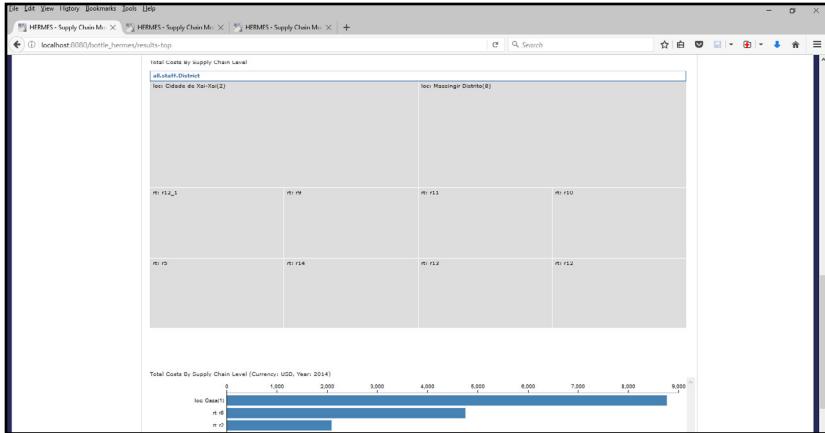
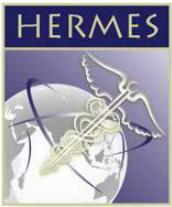
45. Click on the top staff box. The treemap will zoom in to show the staff broken out by locations. The blue bar at the top changes to reflect that you are looking at “**all.staff**”



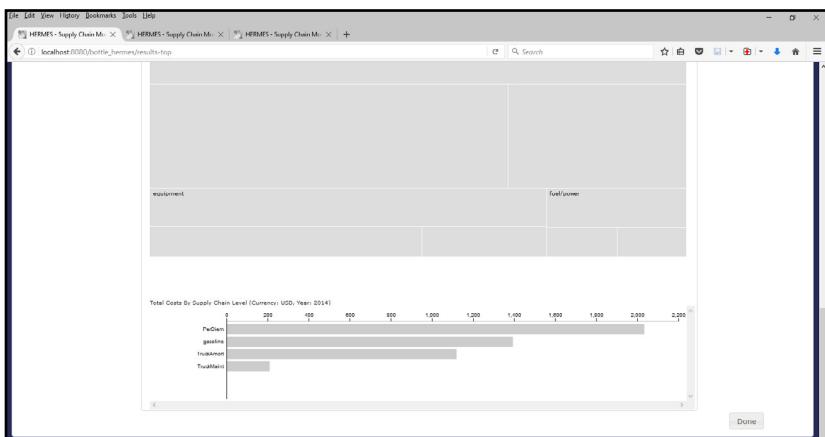
46. Similar to in the above level, you can hover over another box to get information.



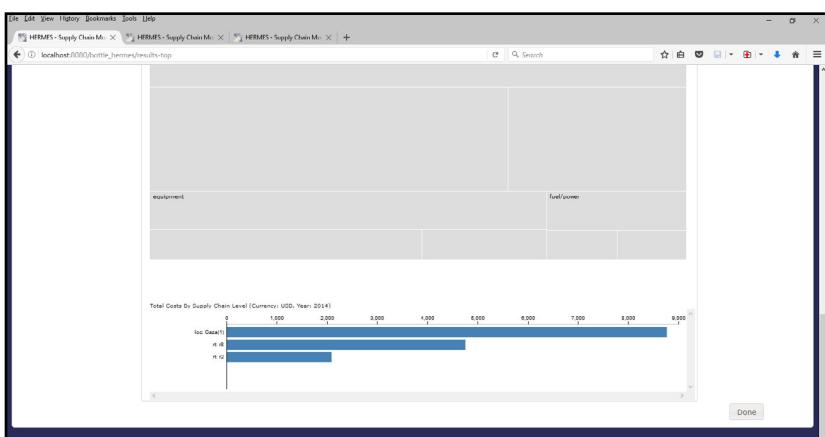
47. Click in the top left box to drill down into all staff at the district level (reflected in blue bar at top now saying “**all.staff.District**”)



48. If you hover over the blue bar at the top, it will turn white. Click on it to go back up a level.



49. An interactive Costs Bar Chart initially displays total costs by level. Clicking any level will regenerate the bar graph to show the costs accrued at each location and route at the selected level. Clicking any location or route will display the costs by category at that location or route. Return to the previous view by clicking in any empty white space in the chart. Click on the middle bar to show the breakdown of the costs for route r8.



50. Click in the white area below the lowest bar to reset the chart so you can choose another location or route.

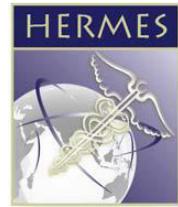


Part 6: Next steps

You have now completed the HERMES tutorial on running your new model and exploring results. See other tutorials for experiments you can perform with your model, such as introducing new vaccines, adding storage devices and removing a supply chain level.

REFERENCE:

1. Haidari LA, Brown ST, Wedlock P, Lee BY. Map of different vaccine supply chain efficiency measures. *Vaccine*. 2017;35(1):199-200.



Tutorial 3

Introducing a New Vaccine

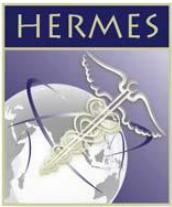
Now that you created a model and ran simulations to produce some results, the next three tutorials allow you to experiment with different scenarios. The first scenario is the introduction of a new vaccine.

With new disease threats and outbreaks occurring all over the world, policymakers, governments and Ministries of Health need to consider the development and introduction of new vaccines. In this tutorial, we will take a look at the operational and economic effects of introducing two vaccines – the rotavirus vaccine and injectable polio vaccine – into the model (NOTE: these two vaccines were selected because they're commonly used in this region.)

It's important to keep in mind that while the introduction of a new vaccine into a supply chain can be beneficial, it can also have a number of unintended consequences. For example, bottlenecks may occur in cold-storage and transport due to an increased number of doses flowing through the system that may lead to reduced vaccine availability for the consumer. Previous modeling work using HERMES has helped show how adding one or more vaccines into a supply chain can lead to bottlenecks in storage and transport and how varying different factors (such as shipping frequency, storage space and population demand) can alter this effect.^{1,2}

These instructions will guide you through introducing two new vaccines as well as an additional dose of another vaccine, to create an experimental scenario based on an existing model. The following steps will add the rotavirus and injectable poliovirus vaccines to the model and allow you to specify the dose schedule for these new vaccines. You will also add an additional dose of the measles vaccine to the vaccine schedule in your model for experimental purposes.

This tutorial utilizes the model you created in the “Creating a new model” tutorial (Tutorial 1). You can also find this model in the tutorial materials provided to you.



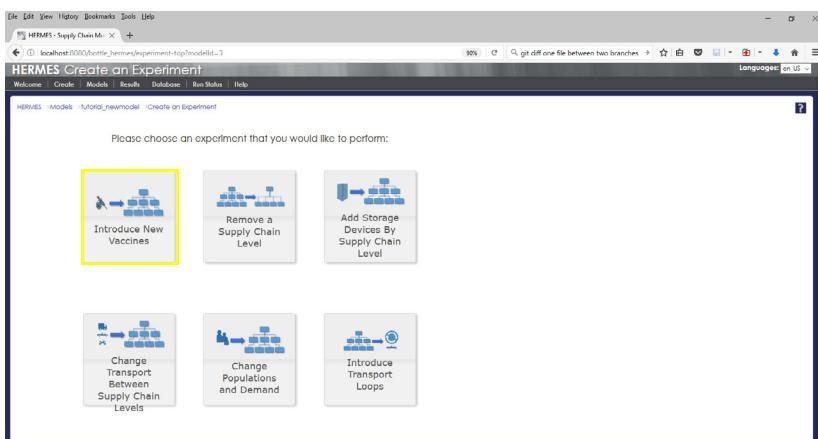
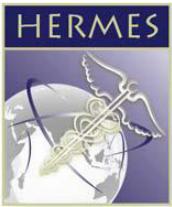
Begin vaccine introduction experiment workflow

Note: Please zoom in to see screenshots. We recommend zooming in to at least 2000%.

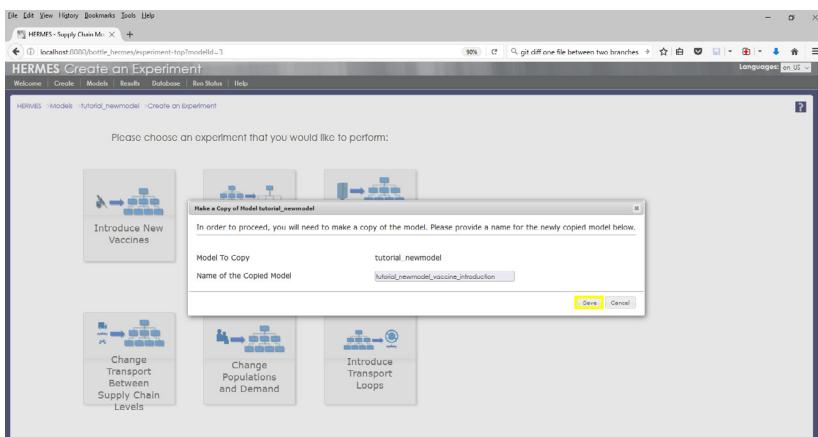
1. On the Welcome Page, click “**Open, Modify, and Run an Existing Model**”

2. Click the “**Open**” button in the tutorial_newmodel row under “**Actions**”.

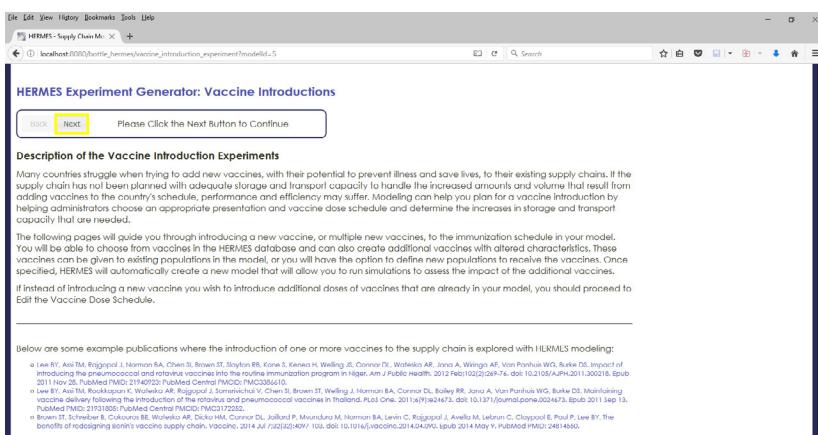
3. This opens the main model page. Click on “**Create Experiments Based on this Model**”.



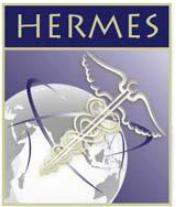
4. Click on the “**Introduce New Vaccines**” box.



5. You will be prompted to create a copy of the model to run. Making a copy allows you to keep the original model as a baseline comparator to the experimental model you are creating. Enter a new name for the model copy (or use the one automatically filled in) and click the “**Save**” button.



6. This page offers additional information on the vaccine introduction scenarios you can include using this experiment generator. Click the “**Next**” button when you are done reading and ready to move to the next page.



Add new vaccines

The screenshot shows the 'Vaccine Introductions' section of the HERMES Experiment Generator. On the left, a table lists various vaccine types and their details. On the right, a table shows 'Vaccines Currently in the Model' with columns for Name, Info, and Delete. A search bar at the bottom is used to find specific vaccines.

	Name	Info
▪ 10-valent Pneumococcal vaccine (PCV10) - 3 types[3]	PCV10 GSK 1 Dose (11.5 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (10 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (8 cc/dose)	[Info] [Delete]
▪ 10-valent Pneumococcal vaccine (PCV10) - 2 types[2]	PCV10 GSK 1 Dose (11.5 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (10 cc/dose)	[Info] [Delete]
▪ 7-valent Pneumococcal vaccine (PCV7) - 1 Type[1]	PCV7 GSK 1 Dose (21 cc/dose)	[Info] [Delete]
▪ BCG Vaccine-Glutelin (BCG) vaccine - 5 Types[5]	BCG WHO Shipping Guidelines 20 Dose (1.2 cc/dose)	[Info] [Delete]

	Name	Info
BSC Serum Institute of India 10 Dose (1.3 cc/dose)	[Info] [Delete]	
OPV Measles (1 dose (1 cc/dose))	[Info] [Delete]	
DTP-hepat-Hib serum institute of india 10 Dose (2.4 cc/dose)	[Info] [Delete]	
M Serum Institute of India 10 Dose (2.41 cc/dose)	[Info] [Delete]	
II Serum Institute of India 10 Dose (2.41 cc/dose)	[Info] [Delete]	
PCV10 GSK 2 Dose (4.8 cc/dose)	[Info] [Delete]	

7. From this page, you will be adding two new vaccines. You can see the vaccines that are already present in the model in the table on the right. The table on the left shows vaccines that exist in the database that can easily be added to your model by following the steps listed below.

NOTE: The “**Next**” button will remain greyed out until you add at least one new vaccine to your model.

The screenshot shows the 'Vaccine Introductions' section with a search dialog open. The search bar contains 'RV GSK'. The results table on the right shows vaccines matching this search term.

	Name	Info
▪ 10-valent Pneumococcal vaccine (PCV10) - 3 types[3]	PCV10 GSK 1 Dose (11.5 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (10 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (8 cc/dose)	[Info] [Delete]
▪ 10-valent Pneumococcal vaccine (PCV10) - 2 types[2]	PCV10 GSK 1 Dose (11.5 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (10 cc/dose)	[Info] [Delete]
▪ 7-valent Pneumococcal vaccine (PCV7) - 1 Type[1]	PCV7 GSK 1 Dose (21 cc/dose)	[Info] [Delete]
▪ BCG Vaccine-Glutelin (BCG) vaccine - 5 Types[5]	BCG WHO Shipping Guidelines 20 Dose (1.2 cc/dose)	[Info] [Delete]

8. The first vaccine we need to add is rotavirus: “**RV GSK 1 Dose (17.1 cc/dose)**”. The easiest way to locate a vaccine in the table on the left is to press the “**Search**” button that is below that table. Then, the dialogue box below will appear.

The screenshot shows the 'Vaccine Introductions' section with the search bar containing 'RV GSK'. The results table on the right shows vaccines matching this search term.

	Name	Info
▪ 10-valent Pneumococcal vaccine (PCV10) - 3 types[3]	PCV10 GSK 1 Dose (11.5 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (10 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (8 cc/dose)	[Info] [Delete]
▪ 10-valent Pneumococcal vaccine (PCV10) - 2 types[2]	PCV10 GSK 1 Dose (11.5 cc/dose)	[Info] [Delete]
	PCV10 GSK 1 Dose (10 cc/dose)	[Info] [Delete]
▪ 7-valent Pneumococcal vaccine (PCV7) - 1 Type[1]	PCV7 GSK 1 Dose (21 cc/dose)	[Info] [Delete]
▪ BCG Vaccine-Glutelin (BCG) vaccine - 5 Types[5]	BCG WHO Shipping Guidelines 20 Dose (1.2 cc/dose)	[Info] [Delete]

9. Type “**RV GSK**” into the search box to display only rotavirus vaccines manufactured by GSK.

HERMES Tutorial: Introducing vaccines

Screenshot of the HERMES Experiment Generator: Vaccine Introductions interface. On the left, a list of 'Choose vaccines that you would like to add to the model.' shows various Rotavirus (RV) vaccine types. On the right, a table titled 'Vaccines Currently in the Model' lists existing vaccines from GSK, including different brands and doses. A search bar at the bottom indicates results for 'RV GSK'.

10. Then press the **Search** button. HERMES will update the table to only show vaccines matching your search criteria. Several presentations of rotavirus vaccine from the manufacturer GSK are shown, which differ on characteristics such as the number of doses per primary container and the cold chain volume required per dose in secondary packaging. Clicking the **“Info”** button next to any vaccine will display detailed information about its characteristics.

Screenshot of the HERMES Experiment Generator: Vaccine Introductions interface. The 'Choose vaccines that you would like to add to the model.' list now includes 'RV GSK 1 Dose (17.1 cc/dose)' with a checked checkbox. The 'Vaccines Currently in the Model' table remains the same as in the previous screenshot.

11. Pick the **“RV GSK 1 Dose (17.1 cc/dose)”** by clicking the check box next to it in the table on the left.

Screenshot of the HERMES Experiment Generator: Vaccine Introductions interface. The 'Add Vaccine →' button between the two tables is highlighted with a yellow box. The 'Vaccines Currently in the Model' table now includes 'RV GSK 1 Dose (17.1 cc/dose)' with a checked checkbox.

12. Press the **“Add Vaccine”** button located between the two tables. You will see the vaccine appear in the table on the right.

HERMES Tutorial: Introducing vaccines

Screenshot of the HERMES Experiment Generator: Vaccine Introductions interface. A search dialog box titled "Search for Vaccines" is open, showing results for "IPV Statens". The main table lists various vaccines, including IPV Statens Serum Institute 1 Dose (12.9 cc/dose).

Name	Info
IPV Statens [IPV vaccine 3 types]	[Info] [Delete]
IPV GSK 1 Dose (7.5 cc/dose)	[Info] [Delete]
IPV GSK 1 Dose (10.5 cc/dose)	[Info] [Delete]
IPV GSK 1 Dose (115.5 cc/dose)	[Info] [Delete]
IPV GSK 1 Dose (156 cc/dose)	[Info] [Delete]
IPV GSK 1 Dose (16.6 cc/dose)	[Info] [Delete]
IPV GSK 1 Dose (164 cc/dose)	[Info] [Delete]
IPV GSK 1 Dose (174 cc/dose)	[Info] [Delete]
IPV GSK 1 Dose (43.3 cc/dose)	[Info] [Delete]

13. Press the “**Search**” button again to look for the second vaccine, injectable poliovirus, and enter “**IPV Statens**” in the search box.

Screenshot of the HERMES Experiment Generator: Vaccine Introductions interface. The search dialog box now shows results for "IPV Statens". The main table lists various vaccines, including IPV Statens Serum Institute 1 Dose (12.9 cc/dose).

Name	Info
IPV Statens [injectable polio vaccine (IPV) 3 types]	[Info] [Delete]
IPV Statens Serum Institute 1 Dose (26.8 cc/dose)	[Info] [Delete]
IPV Statens Serum Institute 1 Dose (12.9 cc/dose)	[Info] [Delete]
IPV Statens Serum Institute 1 Dose (101.4 cc/dose)	[Info] [Delete]

14. Then press the “**Search**” button in the dialogue box to filter out all vaccines except IPV manufactured by Statens Serum Institut.

Screenshot of the HERMES Experiment Generator: Vaccine Introductions interface. The search dialog box shows results for "IPV Statens". The main table lists various vaccines, including IPV Statens Serum Institute 1 Dose (12.9 cc/dose), which is highlighted with a yellow box.

Name	Info
IPV Statens [IPV vaccine 3 types]	[Info] [Delete]
IPV Statens Serum Institute 1 Dose (26.8 cc/dose)	[Info] [Delete]
IPV Statens Serum Institute 1 Dose (12.9 cc/dose)	[Info] [Delete]
IPV Statens Serum Institute 1 Dose (101.4 cc/dose)	[Info] [Delete]

15. Choose “**IPV Statens Serum Institute 1 dose (12.9 cc/dose)**”



HERMES Tutorial: Introducing vaccines

Screenshot of the HERMES Experiment Generator: Vaccine Introductions interface.

The left panel shows a list of vaccines to choose from, with checkboxes next to their names. The right panel shows a list of vaccines currently in the model, each with an "Info" and "Delete" button.

Left Panel (Choose vaccines that you would like to add to the model):

Name	Info
<input checked="" type="checkbox"/> Injectable Polio vaccine (IPV) 2 types[...]	[Info]
<input type="checkbox"/> IPV Statens Serum Institute 1 Dose (2a-8 doses)	[Info]
<input type="checkbox"/> IPV Statens Serum Institute 1 Dose (101-4 doses)	[Info]

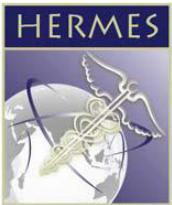
Right Panel (Vaccines Currently in the Model):

Name	Info
IPV Statens Serum Institute 1 Dose (19.9 cc/dose)	[Info] [Delete]
IPV 1 Dose (17.1 cc/dose)	[Info] [Delete]
Statens Serum Institute of India 20 Dose (1-a cc/dose)	[Info] [Delete]
OPV WHO 10 Dose (2 cc/dose)	[Info] [Delete]
DTP-HepB-Hib Serum Institute of India 10 Dose (2.4 cc/dose)	[Info] [Delete]
M serum institute of India 10 Dose (2.61 cc/dose)	[Info] [Delete]
TT Serum Institute of India 10 Dose (2.61 cc/dose)	[Info] [Delete]
PCV10 dose 2 Dose (4.6 cc/dose)	[Info] [Delete]

Buttons:

- Back, Next, Please Click the Next Button to Continue
- Add Vaccine → (highlighted with a yellow box)
- Search, Show All, Show All Items
- Showing Results for term: 'IPV Statens'

16. Cont. - Add it to your model by pressing the “**Add Vaccine**” button.

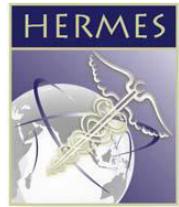


Specify dose schedule for new vaccines

17. Click the “**Next**” button to access the page where you can update the vaccine dose schedule for the two vaccines you just added, which will be administered to infants under one year of age in the model.

Vaccine	Newborn	12 months	18 months	11 months
IPV (Stolens Serum Institute 1 Dose (26.8 cc/dose))	0	0	0	0
IPV (Dek 1 Dose (17.1 cc/dose))	0	0	0	0

NOTE: This how your screen should now appear

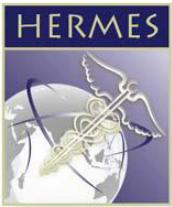


Screenshot of the HERMES Experiment Generator: Vaccine Introductions interface. The page title is "HERMES Experiment Generator: Vaccine Introductions". Below it, a note says: "Now, for the new vaccines, please specify the dose schedule that you would like to have for each new vaccine that you are introducing. You will need to specify in the table below at least one dose be administered to one population for each new vaccine." A table is shown with columns: Vaccine, Age Group, Newborn, 12-24months, PW, and 1-11months. The table contains the following data:

Vaccine	Newborn	12-24months	PW	1-11months
IPV Statens Serum Institute 1 Dose (12.9 cc/dose)	0	0	0	0
RV GSK 1 Dose (17.1 cc/dose)	0	0	0	0

18. You'll need to now update the table by clicking on the appropriate row and entering the number in the population column you want to update. For this model, you will want to **add 1 dose of “IPV Statens Serum Institute 1 Dose (12.9 cc/dose)”** for **“1-11 months”** and 2 doses of **“RV GSK 1 Dose (17.1 cc/dose)”** for **“1-11 months”**. Changes are saved when you press the Enter key on your keyboard while in the row you are changing.

NOTE: The “Next” button will remain greyed out until you update the table. All vaccines need to have at least one dose given to one population or an error box will pop up and you will be prevented from proceeding.



Alter dose schedule for other vaccines

HERMES Experiment Generator: Vaccine Introductions

Next Please Click the Next Button to Continue

Now, for the new vaccines, please specify the dose schedule that you would like to have for each new vaccine that you are introducing. You will need to specify in the table below at least one dose be administered to one population for each new vaccine.

Vaccine	Newborn	12-24months	PW	1-11months
IPV Strains Serum Institute 1 Dose (17.9 cc/dose)	0	0	0	1
RV GSK 1 Dose (17.1 cc/dose)	0	0	0	2

19. Press the “**Next**” button.

NOTE: This new page offers you a variety of options to continue interacting with the experiment as well as a link to run the simulation.

HERMES Experiment Generator: Vaccine Introductions

Done Please Click the Done Button to Finish

Vaccine Introduction Experiment Summary

The vaccine introduction experiment that you have specified includes adding these vaccines:

- IPV Strains Serum Institute 1 Dose (17.9 cc/dose)
With a Dose Schedule of:
1 Dose to 1-11months
- RV GSK 1 Dose (17.1 cc/dose)
With a Dose Schedule of:
2 Doses to 1-11months

If you would like to continue to edit the experiment, here are a few options:

- Add New Types of Vaccines to the Model
- Add New Types of People to the Model
- Update the Number of People Served by Each Supply Chain Location
- Edit the Vaccine Dose Schedule**

Or if you are finished creating this experiment

- Run Simulations of this Model

20. Before you run the simulation, click on “**Edit the Vaccine Dose Schedule**”

HERMES Specify Vaccine Dose Schedule

Edit Demand: Vaccine Dose Schedule

For “Include in the dose table?”, select the components (vaccines and population types) you’d like to include in the dose schedule. For “How many doses of each vaccine?” enter the number of doses per population type for each vaccine.

Vaccine	Population	How many doses of each vaccine per person per year?
IPV Serum Institute of India 20 Dose (1.3 cc/dose)	Newborn	0
IPV Serum Institute of India 10 Dose (2.4 cc/dose)	PW	0
IPV Serum Institute 1 Dose (17.9 cc/dose)	1-11months	0
M Serum Institute of India 10 Dose (2.61 cc/dose)	Newborn	0
M Serum Institute of India 10 Dose (2.61 cc/dose)	PW	0
M Serum Institute of India 10 Dose (2.61 cc/dose)	1-11months	1
OPV WHO 10 Dose (2 cc/dose)	Newborn	0
OPV WHO 10 Dose (2 cc/dose)	PW	0
OPV WHO 10 Dose (2 cc/dose)	1-11months	2

Show Advanced Options?
 Scale vaccines separately?
 Proportion of population getting vaccinated:
 Projected vs. actual: 1
 Treatment Calendar
 Schedule population types separately?
 Which days should clinics be open?
 days each week: M T W F S
 weeks each month: W1 W2 W3 W4

21. You will be updating the schedule to **add 1 dose** of the Measles (M) vaccine to the **“12-24months”** population. First click the “**Population**” radio button near the top left of the page (next to Vaccines which is selected by default).

HERMES Tutorial: Introducing vaccines

Screenshot of the HERMES software interface showing the "Edit Demand: Vaccine Dose Schedule" screen. The table displays vaccination requirements for different age groups (Newborn, 1-11 months, PW) across various vaccine types. The "1-11 months" row for "M Serum Institute of India 10 Dose (2.61 cc/dose)" is selected.

Vaccine	Newborn	PW	1-11 months
BCG Serum Institute of India 2Dose (1.2 cc/dose)	1	0	0
DPT-HepB-Hib Serum Institute of India 10 Dose (2.6 cc/dose)	0	0	0
IPV Stolzen Serum Institute 1 Dose (12.9 cc/dose)	0	0	0
M Serum Institute of India 10 Dose (2.61 cc/dose)	0	0	1
OPV WHO 1 Dose (4.8 cc/dose)	1	0	0
PCV10 GS 1 Dose (4.8 cc/dose)	0	0	0
RV CSF 1 Dose (17.1 cc/dose)	0	0	0
TIT Serum Institute of India 10 Dose (2.61 cc/dose)	0	2	0

22. Click the box next to “**12-24months**” (in between 1-11 months and Newborn) to include that population in the scheduling table to the right.

Screenshot of the HERMES software interface showing the "Edit Demand: Vaccine Dose Schedule" screen. The "12-24months" row for "M Serum Institute of India 10 Dose (2.61 cc/dose)" is now selected.

Vaccine	Newborn	10-11months	PW	1-11months
BCG Serum Institute of India 2Dose (1.3 cc/dose)	1	0	0	0
DPT-HepB-Hib Serum Institute of India 10 Dose (2.6 cc/dose)	0	0	0	3
IPV Stolzen Serum Institute 1 Dose (12.9 cc/dose)	0	0	0	1
M Serum Institute of India 10 Dose (2.61 cc/dose)	0	1	0	1
OPV WHO 1 Dose (4.8 cc/dose)	1	0	0	0
PCV10 GS 1 Dose (4.8 cc/dose)	0	0	0	0
RV CSF 1 Dose (17.1 cc/dose)	0	0	0	0
TIT Serum Institute of India 10 Dose (2.61 cc/dose)	0	0	2	0

23. Update the table to add **1 dose of “M Serum Institute of India 10 Dose (2.61 cc/dose)”** to the “**12-24months**” population by clicking on the row with M, updating the “**12-24months**” column and then pressing the “**Enter**” key. Then press “**Done**”.

Screenshot of the HERMES software interface showing the "HERMES Experiment Generator: Vaccine Introductions" screen. A message at the top says "Please Click the Next Button to Continue". Below it is a section titled "Description of the Vaccine Introduction Experiments".

Description of the Vaccine Introduction Experiments

Many countries struggle when trying to add new vaccines, with their potential to prevent illness and save lives, to their existing supply chains. If the supply chain is not planned with adequate storage and transport capacity to handle the increased amounts of volume that result from adding vaccines to the country's schedule, performance and efficiency may suffer. Modeling can help you plan for a vaccine introduction by helping administrators choose an appropriate presentation and vaccine dose schedule and determine the increases in storage and transport capacity that are needed.

The following pages will guide you through introducing a new vaccine, or multiple new vaccines, to the immunization schedule in your model. You will be able to choose from vaccines in the HERMES database and can also create additional vaccines with altered characteristics. These vaccines can be given to existing populations in the model, or you will have the option to define new populations to receive the vaccines. Once specified, HERMES will automatically create a new model that will allow you to run simulations to assess the impact of the additional vaccines.

If instead of introducing a new vaccine you wish to introduce additional doses of vaccines that are already in your model, you should proceed to Edit the Vaccine Dose Schedule.

Below are some example publications where the introduction of one or more vaccines to the supply chain is explored with HERMES modeling:

e Lee ST, Asz TM, Rappaport J, Norman SA, Chen SI, Brown ST, Daylon TD, Kone S, Teresi H, Welling JL, Connor DL, Waterfall AE, Jones A, Wirsiga AC, Van Peltius WG, Burke DS. Impact of introducing the pneumococcal and rotavirus vaccines into the routine immunization program in Niger. Am J Public Health. 2012 Feb;102(2):268-74. doi: 10.2105/AJPH.2011.300518. Epub

You have now introduced rotavirus and injectable poliovirus vaccines, as well as an additional dose of measles vaccine, to the model.

View changes to model

24. Before running the simulation, take a look at the changes in the model. To do this, open the model “**tutorial_newmodel_vaccine_introduction**” (or whatever you named it in step 5) by going to the **Models page** and clicking “**Open**” in the “**tutorial_newmodel_vaccine_introduction**” row.

25. Click on “**Add or remove model components**” which is the second sub-bullet underneath “Edit model:”

26. In the source dropdown box above the right hand table, choose “**tutorial_newmodel**”



HERMES Tutorial: Introducing vaccines

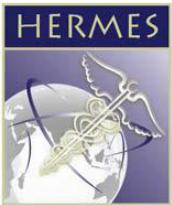
Used types

Use the Source dropdown box to change what database or model to use to look for components. Select the component you wish to add to the tutorial_newmodel.vaccine_Introduction(1) model, and click the arrow button located between the two tables to make it available to the model. To remove an existing component from the model, click the Del(ete) button in the component's row in the Used types table on the left.

Name	info
ICOC Serum Institute of India 20 Dose (1.3 cc/dose)	[Edit] [Info] [Del]
DPT-lepro-1b Serum Institute of India 10 Dose (2.41 cc/dose)	[Edit] [Info] [Del]
IPV 5-drops Serum Institute 1 Dose (1.27 cc/dose)	[Edit] [Info] [Del]
M Serum Institute of India 10 Dose (7.41 cc/dose)	[Edit] [Info] [Del]
OPV Who 10 Dose (2 cc/dose)	[Edit] [Info] [Del]
PCV10 GSX 2 Dose (4.8 cc/dose)	[Edit] [Info] [Del]

Name	info
ICOC Serum Institute of India 20 Dose (1.3 cc/dose)	[Info]
DPT-lepro-1b Serum Institute of India 10 Dose (2.41 cc/dose)	[Info]
M Serum Institute of India 10 Dose (2.41 cc/dose)	[Info]
OPV Who 10 Dose (2 cc/dose)	[Info]
PCV10 GSX 2 Dose (4.8 cc/dose)	[Info]
TT Serum Institute of India 10 Dose (2.41 cc/dose)	[Info]

27. This will load the vaccines available in the original model in the right hand table. Notice that the table on the left now includes the viruses you added in the experiment (for used types in the current model).



Run simulation

Available Models in HERMES

Please select a model to open. You can use the buttons on the right to perform various actions with the selected model. If you would like to edit the notes or the name of a model, please double click on this line.

Select a Model	Name	Model ID	Note	Actions
MonData	?			Open Run Results Copy Info Del
tutorial_newmodel	3			Open Run Results Copy Info Del
tutorial_newmodel_level_removal	4			Open Run Results Copy Info Del
tutorial_newmodel_vaccine_introduction	5			Open Run Results Copy Info Del

Running a HERMES Model

What name should be given to this set of results?

How many stochastic (random) runs would you like to average the results over?

Run Parameters for model tutorial_newmodel_level_removal

Number of Simulation Days: 336
Number of Shipments from the Manufacturer per Year: 4
Factor for Buffer Stock from the Manufacturer: 1
sets the default buffer stock for the whole model: 0.25

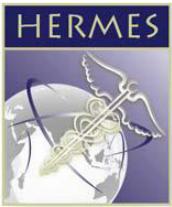
Show Advanced Options

28. Click on “**Models**” in the top menu bar to get to the models page. Then click the “**Run**” button in the row with your vaccine introduction model, which is “**tutorial_newmodel_vaccine_introduction**” in this tutorial.

NOTE: Step 28 will open the “**Run Simulation**” page.

29. Type a name for your model and click the “**Submit**” button. There should be no warnings or errors in the model.

NOTE: if there are warnings or errors, please see the Troubleshooting section for further instructions.



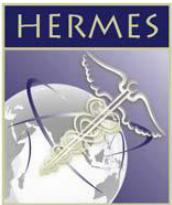
The screenshot shows the HERMES Run A Model Simulation interface. A modal window titled "Validating Model" is open, displaying a success message: "There were no warnings or errors in the model, please proceed to press the Run Simulation button below." Below the message are "Advanced Options" and "Submit" buttons. A yellow box highlights the "Run Simulation" button.

30. Click “Run Simulation”.

NOTE: The run status page will open and you can watch the progress of your run.

The screenshot shows the HERMES Run Status interface. It displays a table of currently running simulations:

Status of Currently Running Simulations						
Available Runs		Model Name	Model ID	Submitted	Status	Details
run1	tutorial_newmodel	3	Tue Jul 11 14:04:58 2017	finished	[Info] [Cancel] [Clear Log]	
MoGozo[1]		4	Fri Jul 07 18:09:10 2017	finished	[Info] [Cancel] [Clear Log]	
run_3	tutorial_newmodel_level_removal	4	Wed Jul 12 01:24:33 2017	finished	[Info] [Cancel] [Clear Log]	
run_4	tutorial_newmodel_vaccine_introduction	5	Wed Jul 12 09:59:21 2017	running 25.20% (run 1)	[Info] [Cancel] [Clear Log]	
haha	MoGozo[2]	12	Fri Jul 07 14:30:48 2017	process stopped at running 99.29% (run 1)	[Info] [Cancel] [Clear Log]	



View results

Once your simulations have finished running, you can view and analyze the results through multiple interactive visualizations and charts, as well as detailed tables, and compare them to your original or baseline model.

The screenshot shows the HERMES Model interface. On the left, a sidebar lists actions: 'Create Experiments Based on this Model', 'Edit model', 'Modify structure with the Advanced Model Editor', 'Add or remove model components (e.g. vaccines, storage devices, vehicles, and population categories)', 'Tables for editing the model', 'Edit Storage Location Geographic Coordinates', 'Edit Storage Location Population Estimates', 'Edit Storage Location Device Inventories', 'Modify the Vaccine Dose Schedule', 'Add and modify costs', 'Transform the system with automatically created transport loops', 'Run a Simulation Experiment with this Model', 'View Results' (highlighted in yellow), and 'Export Model as a HERMES JSON File'. The main area displays a 'Supply Chain Network Diagram' with nodes: 'Gaza', 'R2', 'Ciudad de Yar-Kal', and 'Measles Distrito', connected by arrows.

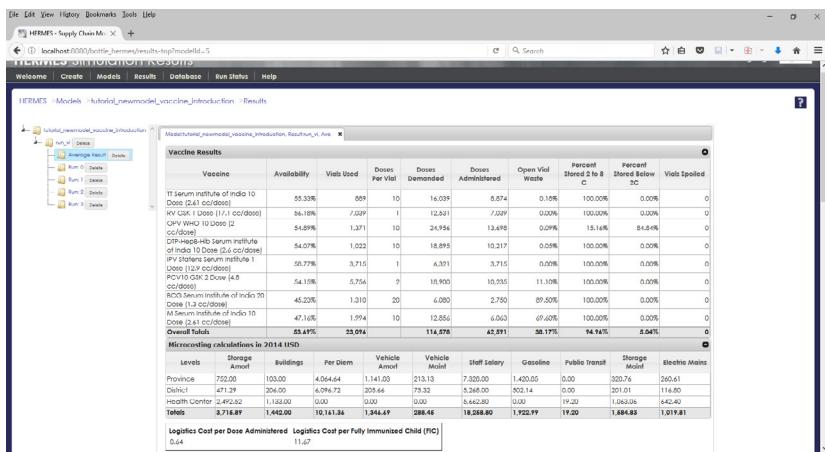
31. On the main model page, click on “**View Results**” (near the bottom of the page) to open the results page.

The screenshot shows the HERMES Simulation Results interface. On the left, a tree view under 'tutorial_newmodel_vaccine_introduction' shows 'Run 1', 'Run 2', 'Run 3', and 'Run 4'. A message at the top says 'Please select a result from the menu on the left to display.' A 'Done' button is at the bottom right.

32. Expand the “**tutorial_newmodel_vaccine_introduction**” tree and select the Average Results

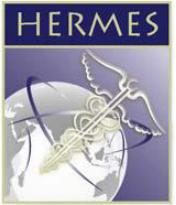


Tabular results



33. As you can see on the screenshot, introducing RV, IPV and a second dose of M vaccine caused overall vaccine availability to drop from 90% to 54%. The new vaccine introductions caused fewer doses to be administered (62,591) than at baseline (81,855) due to their larger cold chain volume per dose, as compared to most vaccines in the schedule at baseline.

Logistics costs rose to \$0.64 per dose administered (from \$0.50 before the introductions) and \$11.67 per fully immunized child (from \$8.81).



Screenshot of the HERMES software interface showing the "Vaccine Results" section. A modal dialog box titled "Save Excel Simulation Experiment Result..." is open, prompting the user to choose a file name for the spreadsheet. The dialog includes "Save" and "Cancel" buttons.

Vaccine	Availability	Visits used	Doses Per Visit	Doses Demanded	Doses Administered	Open Vial Waste	Percent Shoved to & C	Percent Shoved to & DC	Visits Spoiled
II Serum Institute of India 10 Dose (1 cc/dose)	55.32%	889	10	14,039	8,874	0.18%	100.00%	0.00%	0
RV GSK 1 Dose (17.1 cc/dose)	56.10%	7,037	1	12,531	7,037	0.00%	100.00%	0.00%	0
OPV WHO 10 Dose (2 cc/dose)									
DTP-Hib Serum Institute of India 10 Dose (1 cc/dose)									
PCV WHO 2 Dose (4.8 cc/dose)									
BCG Serum Institute of India 20 Dose (1.0 cc/dose)									
M Serum Institute of India 10 Dose (2.4 cc/dose)									
Overall Total:									

Microdosing calculations in 201

Levels	Storage Amort
Province	752.05
District	471.29
Health Center	2,492.52
Total:	3,715.89

Logistics Cost per Dose Administered Logistics Cost per Fully Immunized Child (FIC) 0.44

11.47

Open Dashboard Visualization Open Network Visualization Download Excel File Spreadsheet

34. Click on the “Download Excel Results Spreadsheet” button below the tables to acquire a spreadsheet of more detailed results, where you can compare supply chain metrics not only for the overall system and by supply chain level, but also for each individual location and route.

Screenshot of the HERMES software interface showing the "Vaccine Results" section. A modal dialog box titled "Save Excel Simulation Experiment Result..." is open, prompting the user to choose a file name for the spreadsheet. The dialog includes "Save" and "Cancel" buttons.

Vaccine	Availability	Visits used	Doses Per Visit	Doses Demanded	Doses Administered	Open Vial Waste	Percent Shoved to & C	Percent Shoved to & DC	Visits Spoiled
II Serum Institute of India 10 Dose (1 cc/dose)	55.32%	889	10	14,039	8,874	0.18%	100.00%	0.00%	0
RV GSK 1 Dose (17.1 cc/dose)	56.10%	7,037	1	12,531	7,037	0.00%	100.00%	0.00%	0
OPV WHO 10 Dose (2 cc/dose)									
DTP-Hib Serum Institute of India 10 Dose (1 cc/dose)									
PCV WHO 2 Dose (4.8 cc/dose)									
BCG Serum Institute of India 20 Dose (1.0 cc/dose)									
M Serum Institute of India 10 Dose (2.4 cc/dose)									
Overall Total:									

Microdosing calculations in 201

Levels	Storage Amort
Province	752.05
District	471.29
Health Center	2,492.52
Total:	3,715.89

Logistics Cost per Dose Administered Logistics Cost per Fully Immunized Child (FIC) 0.44

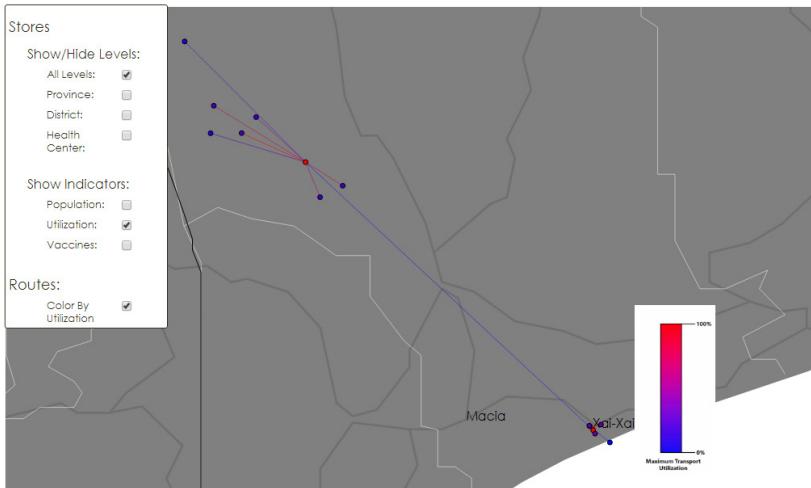
11.47

Open Dashboard Visualization Open Network Visualization Download Excel File Spreadsheet

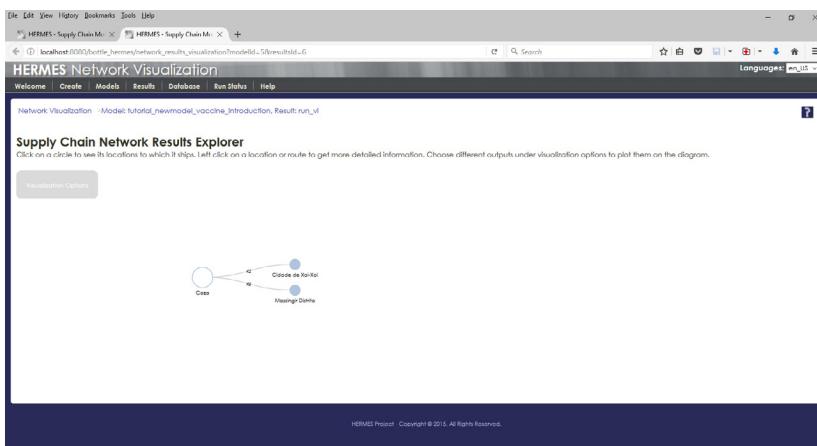
35. Click the “Save” button and then use the download dialog box to either open or save a copy.



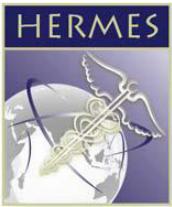
Visualizations



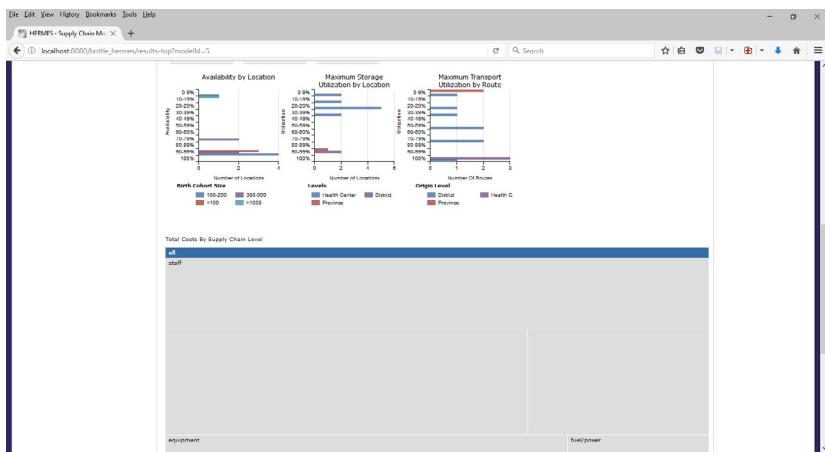
36. Click the “**Open Geographic Visualization**” button to view the supply chain locations and results on a map. This page will open in a new window and can take some time to load. Click the “color by utilization” button and explore the map to identify which locations and routes experience bottlenecks after the vaccine introductions.



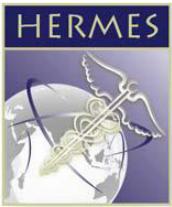
37. Go back to the “**Results**” page and click the “**Open Network Visualization**” button. This page will also open in a new window. This diagram is the same as that on the main model page, but there is more room here to maneuver with it. You should notice that the structure has not changed from the original model.



Histograms

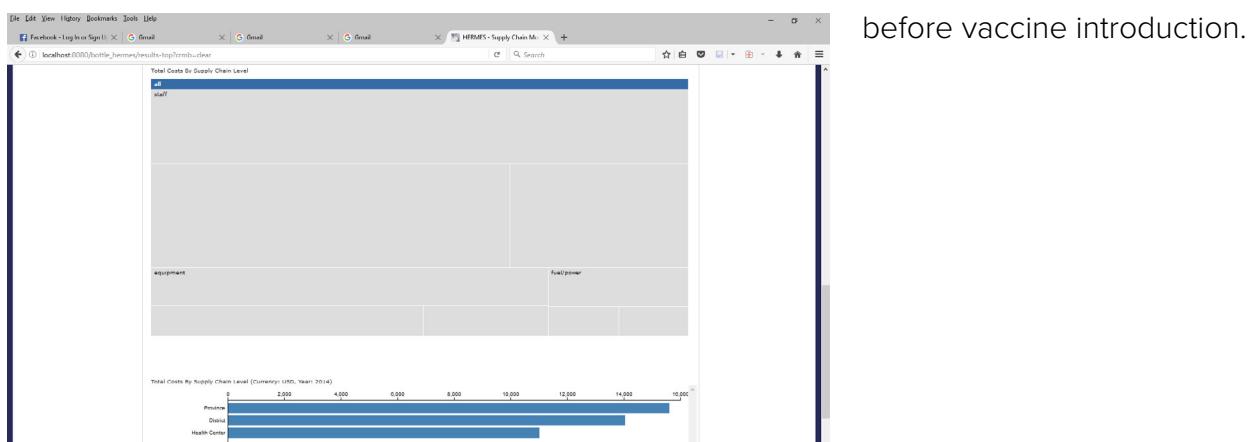
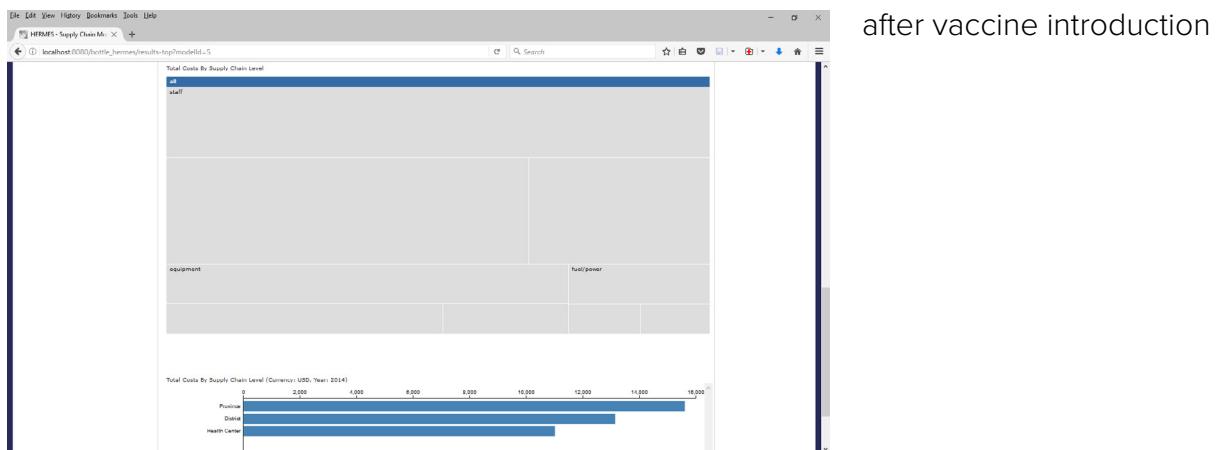


38. Go back to the Results page and scroll to the colored histograms. The vaccine availability histogram now shows two locations with availability below 20%, and two in the range of 70-79%. The storage utilization histogram shows storage constraints at both district stores and the province level store (whereas previously only one district store faced a storage constraint). The transport utilization histogram shows that all three routes originating from health centers (to pick up vaccines via public transit) face bottlenecks after vaccine introductions, as does a newly constrained route originating from the district level.

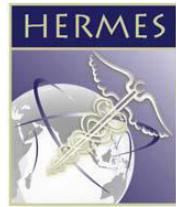


Total costs by supply chain level

39. Comparing the new treemap & barchart to the old can be an easy way to notice some differences. In this case the changes are not very dramatic.



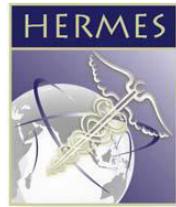
40. Take some time to interact with the results.



Next steps

You have now completed the HERMES tutorial on introducing vaccines to a model. See other tutorials for additional experiments you can perform with your model, such as modifying supply chain capacity by level.

1. Lee BY, Assi T-M, Rajgopal J, et al. Impact of introducing the pneumococcal and rotavirus vaccines into the routine immunization program in Niger. *American journal of public health*. 2012;102(2):269-276.
2. Lee BY, Assi T-M, Rookkapan K, et al. Maintaining Vaccine Delivery Following the Introduction of the Rotavirus and Pneumococcal Vaccines in Thailand. *PLoS ONE*. 2011;6(9):e24673.



Tutorial 4

Adding storage devices by supply chain level

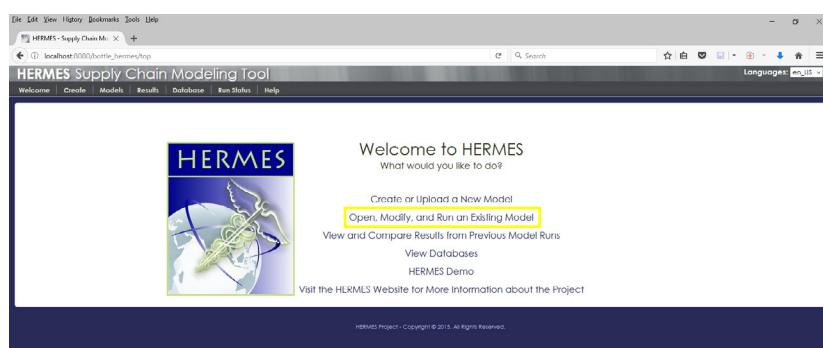
This tutorial will allow you to experiment with adding storage devices by level (Province, District and Health Center) into the supply chain. This experiment shows the effect of a new storage device on overall vaccine availability. For example, adding storage devices could allow X more doses of vaccines to flow through the system, resulting in a Y% increase in vaccine availability. Examples of secondary and tertiary effects include the effects on transport utilization (does transport capacity need to increase as well?) and logistics costs (increased capital, electricity, and personnel costs). Previous modeling work has highlighted these effects.

These instructions will guide you through adding cold storage devices to all locations in a supply chain level to create an experimental scenario based on an existing model. The following steps will add a refrigerator to each district level location in your model, which was previously shown to face storage capacity constraints at a district store.

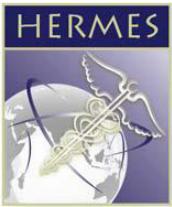
This tutorial utilizes the model you created in the “Creating a new model” tutorial. You can also find this model in the tutorial materials provided to you.

Begin add storage devices by level workflow

Note: Please zoom in to see screenshots. We recommend zooming in to at least 2000%.



1. On the Welcome Page, click “**Open, Modify and Run an Existing Model**”



Screenshot 1: Available Models

The screenshot shows the HERMES interface for selecting a model. A table lists two models: 'MonVacc' (Model ID 2) and 'tutorial_newmodel' (Model ID 3). The 'Actions' column for 'tutorial_newmodel' contains buttons for Open, Run, Remove, Copy, Info, and Del. The 'Open' button is highlighted with a yellow box.

Select a Model	Name	Model ID	Note	Actions
MonVacc		2		Open Run Remove Copy Info Del
tutorial_newmodel		3		Open Run Remove Copy Info Del

2. Click on the “**Open**” button in the “**tutorial_newmodel**” row.

Screenshot 2: Supply Chain Network Diagram

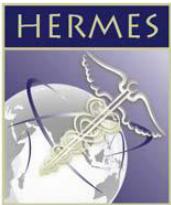
This screenshot shows the main model page for 'tutorial_newmodel'. On the left, a sidebar lists options like 'Create Experiments Based on this Model', 'Edit model...', and 'Run a Simulation experiment with this Model'. The central area displays a 'Supply Chain Network Diagram' with nodes: 'Gaza', 'Cidade de Xai Xai', and 'Massinair District'. A tooltip for the diagram states: 'This diagram depicts the structure of this supply chain. Clicking on a location can expand or contract the routes and locations below the selected location. Right-clicking a location or route will bring up more detailed information.'

3. **NOTE:** This opens the main model page. Click on “**Create Experiments Based on this Model**” (top bullet) to open the Create an Experiment page.

Screenshot 3: Create an Experiment

The screenshot shows the 'Create an Experiment' page. It asks 'Please choose an experiment that you would like to perform:'. Five options are listed: 'Introduce New Vaccines', 'Remove a Supply Chain Level', 'Add Storage Devices By Supply Chain Level' (this option is highlighted with a yellow box), 'Modify Transport Routes Between Supply Chain', and 'Introduce Transport Loops'.

4. Click on the “**Add Storage Devces by Supply Chain Level**” box.



Please choose an experiment that you would like to perform:

Make a Copy of Model tutorial_newmodel

In order to proceed, you will need to make a copy of the model. Please provide a name for the newly copied model below.

Model To Copy: tutorial_newmodel

Name of the Copied Model: tutorial_newmodel_add_storage

Save Cancel

Introduce Vaccines

Modify Transport Routes Between

Introduce Transport Loops

5. You will be prompted to create a copy of the model to run. Making a copy allows you to keep the original model as a baseline comparator to the experimental model you are creating. Enter a new name for the model copy (or use the one automatically filled in) and click the “**Save**” button.

HERMES Add / Modify Storage Devices at a Supply Chain Level

HERMES Experiment Generator: Add/Modify Storage by Level

Bar Next! Please Click The Next! Button To Continue

Description of Add/Modify Storage by Level Experiments

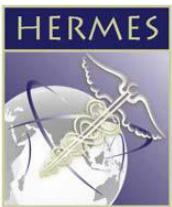
One of the central components of any supply chain is storage. The characteristics of storage devices such as net storage capacity, temperature of storage, and costs may have a significant impact on the performance and efficiency of the supply chain. Modeling can help you decide what storage devices are appropriate for your supply chain at which supply chain level.

This experiment will take you through a series of screens that will allow you to augment or swap out the storage devices for an entire supply chain level. You will be asked which supply chain level you would like to edit, whether you would like to add devices or completely replace devices, or replace a certain device at that level. Then you will be able to specify what complement of storage devices you would like to use and then HERMES will automatically create a new model based on your input.

Below are some example publications where modify or adding storage to a supply chain is explored with HHMMS modeling:

- a Hoddinott A, Cornejo O, Winkler AP, Rennet ST, Mueller F, Hermon RA, Schmid MA, Pfeiffer P, Riegerer J, Weigel S, Lee BY. Augmenting transport versus increasing cold storage to improve vaccine supply chains. *PLoS One*. 2013 May;22(8):e204430. doi:10.1371/journal.pone.0044303. Print 2013. PMID: 23717970; PubMed Central PMCID: PMC367440.
- a Hoddinott A, Cornejo O, Winkler AP, Rennet ST, Mueller F, Hermon RA, Schmid MA, Pfeiffer P, Riegerer J, Weigel S, Lee BY. Only adding stationary storage to vaccine supply chains may create and worsen transport bottlenecks. *J Public Health Manag Pract*. 2013 Sep-Oct;19 Suppl 2:S48-7. doi:10.1097/phm.0b013e3182932f. PubMed Central PMCID: PMC4540566.
- a Rennet ST, Lee BY. Unintended consequences made in the name of efficiency: how cold-chain energy prevent vaccines from reaching the population. *Vaccine*. 2014 May;32(21):2818-9. doi:10.1016/j.vaccine.2014.02.040. Epub 2014 Feb 26. PubMed PMID: 24552433.

6. This page offers additional information on the modified storage capacity scenarios you can model using this experiment generator. Click the “**Next**” button when you are ready to move to the next page.



Specify level and type of modification

The screenshot shows the HERMES Experiment Generator interface. The title bar reads "HERMES Add / Modify Storage Devices at a Supply Chain Level". The main content area has a heading "HERMES Experiment Generator: Add/Modify Storage by Level" and a sub-instruction "Please select from below the supply chain level of which you would like to modify the storage." Below this are three radio buttons: "Province", "District", and "Health Center". The "Province" button is selected.

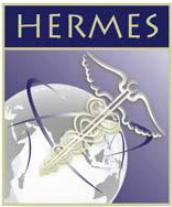
7. Click “**Next**” to initiate your choices for adding or modifying storage at a specific level.

This screenshot shows the same interface as the previous one, but the "District" radio button is now selected, indicated by a yellow box around it. The other two options, "Province" and "Health Center", are unselected.

8. Select “**District**” as the level whose storage you would like to modify. This will open another selection below.

This screenshot shows the interface after selecting "District". It displays a new set of options under the heading "Now you must select from the options below to decide how to apply new storage devices to the level. Would you like to...". Three radio buttons are shown: "Completely replace the existing storage at each location in the supply chain level with a new complement of storage devices.", "Add to the current complement of storage devices at each location in the supply chain level.", and "Replace a specific storage device with one or more other storage devices in a supply chain level.". The first option is selected and highlighted with a yellow box.

9. Select “**Completely replace the existing storage at each location...**” as the type of action you want to perform.



Select storage devices

Choose storage devices that you would like to add to the complement of devices:

Name	Model	Energy type	Info
Apex CR 111	ACR 4441	ice	info
Cold Room 30L	CR 30L	ice	info
Cold Room 100L	CR 100L	ice	info
CR RCW 20	RCW20	ice	info
CR RCW12	RCW12	ice	info

Storage Devices Currently in the Model

Name	Count	Info
No records to view		

10. Click “**Next**”. You are now on the screen that allows you to choose the new device(s) to be added at the level selected.

Choose storage devices that you would like to add to the complement of devices:

Name	Model	Energy type	Info
BFRV55	BFRV55	Solar Power	info

Storage Devices Currently in the Model

Name	Count	Info
No records to view		

11. In the table on the left, choose “**BFRV55**”, which is the only item under “**Refrigerator – Solar Direct Drive**”. You can locate it either by scrolling through the table or using the Search button below the table. Once you’ve found it, click the check box next to it.

Choose storage devices that you would like to add to the complement of devices:

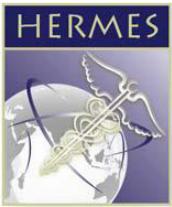
Name	Model	Energy type	Info
CR RCW 55	RCW55	ice	info
CR RCW12	RCW12	ice	info

Storage Devices Currently in the Model

Name	Count	Info
BFRV55	1	info

12. Now click on the “**Add Device**” button in the middle of the page to update the “**Storage Devices Currently in Model**” table.

NOTE: If you wanted to add more than one to each location at the level, you could change the count in the table on the right by clicking on the row. Or if you added the wrong type, you could delete it and then add the correct type.



Add / Modify Storage By Supply Chain Level Experiment Summary
You have chosen to replace all of the storage in the District supply chain level with:
The following modifications are being made:
1 BVRV55
Please click the Next button above to complete the experiment.

13. Once you are satisfied with the complement of storage devices you are adding to your selected level, click the “**Next**” button to get a summary page.

NOTE: If something looks wrong, you can always use the “**Back**” button to fix it before changing the model.

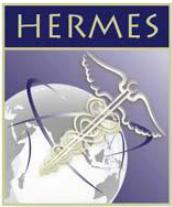
HERMES is implementing your experiment.

14. Click the “**Next**” button to have HERMES adjust the model by updating the storage at each location at the District level to have one BVRV55 solar refrigerator and nothing else. This might take a few seconds or a few minutes depending on how large your model is (It shouldn't take more than 10 secs for this model.)

Below are some additional actions that you may want to perform on your newly modified model:

- o Update the Number of People Served by Each Supply Chain Location
- o Further Modify the Storage Device Inventory of Each Supply Chain Location
- o Open the New Model in the HERMES Advanced Editor to Make Further Changes
- o Or if you are finished creating this experiment: Run Simulations of This Model

15. When the model has been adjusted, the page will be updated with some further possible actions.



View changes in model

Supply Chain Network Diagram

This diagram details the structure of this supply chain. Clicking on a location can expand or contract the routes and locations below the selected location. Right-clicking a location or route will bring up more detailed information.

```

graph LR
    Gaza((Gaza)) --- RX[Route X]
    RX --- XaiXai((Cidade de Xai-Xai))
    RX --- Masingir((Masingir Distrito))
    style Gaza fill:#fff,stroke:#000
    style XaiXai fill:#fff,stroke:#000
    style Masingir fill:#fff,stroke:#000
    style RX fill:#fff,stroke:#000
  
```

Edit model

Route viewing options > route viewing options > Model Validation >

Routes to use as template for newly created routes: None

Gaza (1) Unattached

Edit model

Route viewing options > route viewing options > Model Validation >

Routes to use as template for newly created routes: None

Gaza (1)

- Route P Attached
- Route R Attached

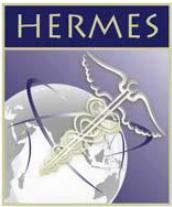
Cidade de Xai-Xai (2)
Route R
Masingir Distrito (3)

Unattached

16. Take a look at the changes in the model. Open the model “**tutorial_newmodel_add_storage**” (or whatever you named it in step 5) by going to the “**Models**” page and clicking “**Open**” in its row. Click on “**Modify Structure with Advanced Model Editor**” underneath “**Edit model:**”

17. This will lead you to the model editing page shown to the left.

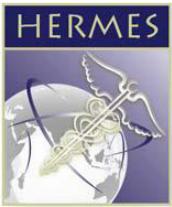
18. Click on the plus sign next to “**Gaza (1)**” so you can see the District levels.



19. From the store viewing options dropdown box in the top left, select “**store storage**” and “**view store storage**”.

20. You should see that the districts **Cidade de Xai-Xai** and **Massingir Distrito** each contain **1 BFRV55**, as you would expect.

21. If you perform steps 16-20 but open the original **tutorial_newmodel** instead, you should see that the two districts each have **1 RCW 42 EK/CF**, not the **BFRV55** you just substituted. If you have previously run results on your original model, you will first need to make a copy before opening the Advanced Model Editor.



Run the simulation

The screenshot shows the 'Available Models in HERMES' section. A table lists models with columns for Name, Model ID, Note, and Actions. Model 7, 'tutorial_newmodel_add_storage', is selected, and its 'Run' button is highlighted.

Select a Model	Name	Model ID	Note	Actions
MoreData	?			Open Run Results Copy Info Del
tutorial_newmodel	3			Open Run Results Copy Info Del
tutorial_newmodel_level_removal	4			Open Run Results Copy Info Del
tutorial_newmodel_vaccine_introduction	5			Open Run Results Copy Info Del
tutorial_newmodel_with_loops	6			Open Run Results Copy Info Del
tutorial_newmodel_add_storage	7			Open Run Results Copy Info Del

22. Click on “**Models**” in the top menu bar to get to the models page. Then click the “**Run**” button in the row with your vaccine introduction model, here **tutorial_newmodel_add_storage** to open the “**Run Simulation**” page.

The screenshot shows the 'Running a HERMES Model' section. It asks for a name for the results and specifies 4 stochastic runs. Below, it shows run parameters for 'tutorial_newmodel_add_storage' with fields for simulation days, shipments per year, buffer factor, and total buffer stock. The 'Submit' button is highlighted.

What name should be given to this set of results?

How many stochastic (random) runs would you like to average the results over?

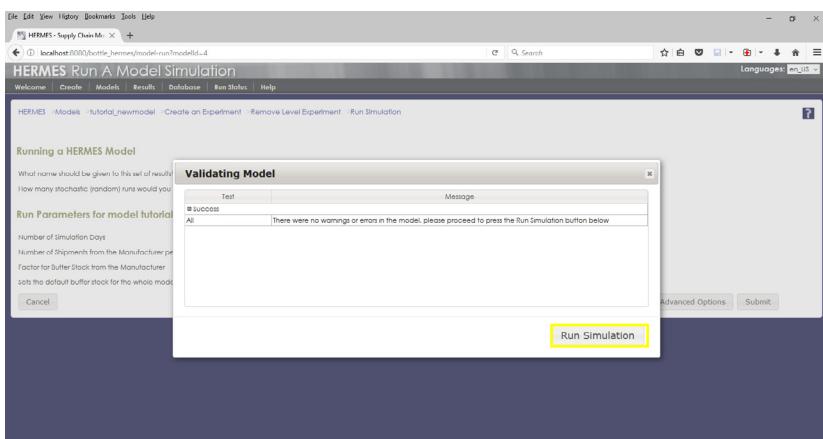
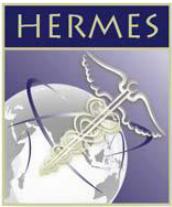
Run Parameters for model tutorial_newmodel_add_storage

Number of Simulation Days	334
Number of Shipments from the Manufacturer per Year	4
Factor for Buffer Stock from the Manufacturer	1
Sets the default buffer stock for the whole model	0.25

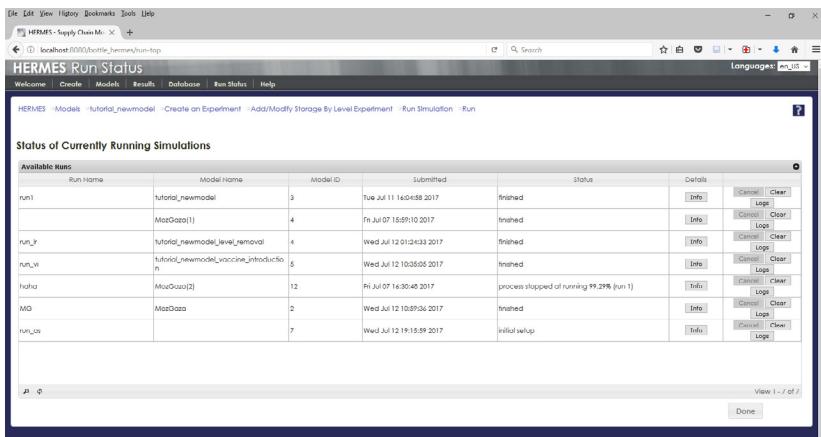
Show Advanced Options

23. Type a name for your model in the box next to “**What name should be given to this set of results?**” and click the “**Submit**” button.

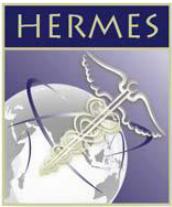
NOTE: There should be no errors in the model.



24. Click the “**Run Simulation**” button.



NOTE: The run status page will open and you can watch the progress of your run.



View results

Once your simulations have finished running, you can view and analyze the results through multiple interactive visualizations and charts, as well as detailed tables, and compare them to your original or baseline model.

Please select what you would like to do with this model:

- Create Experiments Based on This Model
- Edit model:
 - Modify structure with the Advanced Model Editor
 - Add or remove model components (e.g. vaccines, storage devices, vehicles, and population categories)
 - Tabular Interfaces for editing the model:
 - Set Storage Location Geographic Coordinates
 - Set Storage Location Population Estimates
 - Set Storage Location Device Inventories
 - Modify the Vaccine Dose Schedule
 - Add and modify doses
 - Transform the system with automatically created transport loops
- Run a Simulation Experiment with This Model
- View Results** (on previously saved Simulation Experiments)
- Export Model as a HERMES HDP File

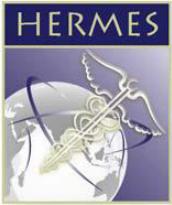
Please select a result from the menu on the left to display.

Results

- tutorial_newmodel_add_storage
- Run 1 (Done)
 - Average Result (Done) **Selected**
 - Run 1 (Done)
 - Run 2 (Done)
 - Run 3 (Done)

25. On the main model page, click on “**View Results**” (near the bottom of the page) to open the results page.

26. Expand the “**tutorial_newmodel_add_storage**” tree and select the “**Average Results**”



Tabular results

27. Adding a refrigerator to the district level stores increased vaccine availability to greater than 99% (from 90% at baseline, or before adding storage). The increased number of doses caused the logistics cost per dose administered to drop to \$0.45 (from \$0.50 before adding the refrigerators) and the logistics cost per fully immunized child to fall to \$6.93 (from \$8.81).

Vaccine	Availability	Vials Used	Doses Per Vial	Doses Demanded	Doses Administered	Open Vial Waste	Percent Stored 2 to 8 C	Percent Stored Below 2C	Vials Spoiled
T2 Serum Institute of India 10 Dose (2.41 cc/dose)	99.00%	1,000	10	16,076	16,011	0.0%	100.00%	0.00%	0
OPV WHO 10 Dose (2 cc/dose)	99.00%	2,475	10	24,967	24,744	0.0%	100.00%	49.14%	0
DTP-hepat B Serum Institute of India 10 Dose (2.4 cc/dose)	99.99%	1,875	10	18,556	18,778	0.0%	100.00%	0.00%	0
PCV 10 CSK 2 Dose (4.8 cc/dose)	99.75%	10,182	2	18,784	18,738	7.9%	100.00%	0.00%	0
BCG Serum Institute of India 20 Dose (1.3 cc/dose)	97.30%	1,873	20	6,040	5,077	84.3%	100.00%	0.00%	0
M Serum Institute of India 10 Dose (1.0 cc/dose)	99.46%	2,106	10	6,370	6,337	70.4%	100.00%	0.00%	0
Overall totals:	99.44%	20,111		90,873	90,385	34.72%	92.95%	4.05%	0

Microcosting calculations in 2014 USD

Levels	Storage Amount	Buildings	Per Diem	Vehicle Amount	Vehicle Model	Per diem Salary	Gasoiline	Public Transport	Storage Mains	Electric Mains
Province	753.00	103.00	4,094.44	1,141.03	213.13	7,328.00	11,420.85	0.00	320.74	260.41
District	414.94	204.00	4,967.68	212.42	77.80	8,260.00	918.48	0.00	262.28	0.00
Health Center	2,495.52	1,133.00	0.00	0.00	5,642.00	0.00	14.00	1,064.06	442.40	
Totals	3,897.56	1,442.00	11,092.32	1,383.48	270.73	18,258.00	1,937.80	14.00	1,646.10	103.01

Logistics Cost per Dose Administered: 0.45 Logistics Cost per Fully Immunized Child (HIC): 6.93

Open Geographical Visualization Open Network Visualization Download Results Spreadsheet

28. Click on the “Download Excel Results Spreadsheet” button below the tables to acquire a spreadsheet of more detailed results, where you can compare supply chain metrics not only for the overall system and by supply chain level, but also for each individual location and route.

Name for Excel Spreadsheet: *Result_Spreadsheet_tutorial_newmodel_Undr_3.xls*

Save

Cancel

Vaccine	Availability	Vials Used	Doses	Doses	Doses	Open Vial Waste	Percent Stored 2 to 8 C	Percent Stored Below 2C	Vials spoiled
T2 Serum Institute of India 10 Dose (2.41 cc/dose)	99.00%	1,000	10	16,076	16,011	0.0%	100.00%	0.00%	0
OPV WHO 10 Dose (2 cc/dose)	99.00%	2,475	10	24,967	24,744	0.0%	100.00%	49.14%	0
DTP-hepat B Serum Institute of India 10 Dose (2.4 cc/dose)	99.99%	1,875	10	18,556	18,778	0.0%	100.00%	0.00%	0
PCV 10 CSK 2 Dose (4.8 cc/dose)	99.75%	10,182	2	18,784	18,738	7.9%	100.00%	0.00%	0
BCG Serum Institute of India 20 Dose (1.3 cc/dose)	97.30%	1,873	20	6,040	5,077	84.3%	100.00%	0.00%	0
M Serum Institute of India 10 Dose (1.0 cc/dose)	99.46%	2,106	10	6,370	6,337	70.4%	100.00%	0.00%	0
Overall totals:	99.44%	20,111		90,873	90,385	34.72%	92.95%	4.05%	0

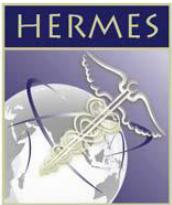
Microcosting calculations in 2014 USD

Levels	Storage Amount	Buildings	Per Diem	Vehicle Amount	Vehicle Model	Per diem Salary	Gasoiline	Public Transport	Storage Mains	Electric Mains
Province	753.00	103.00	4,094.44	1,141.03	213.13	7,328.00	11,420.85	0.00	320.74	260.41
District	414.94	204.00	4,967.68	212.42	77.80	8,260.00	918.48	0.00	262.28	0.00
Health Center	2,495.52	1,133.00	0.00	0.00	5,642.00	0.00	14.00	1,064.06	442.40	
Totals	3,897.56	1,442.00	11,092.32	1,383.48	270.73	18,258.00	1,937.80	14.00	1,646.10	103.01

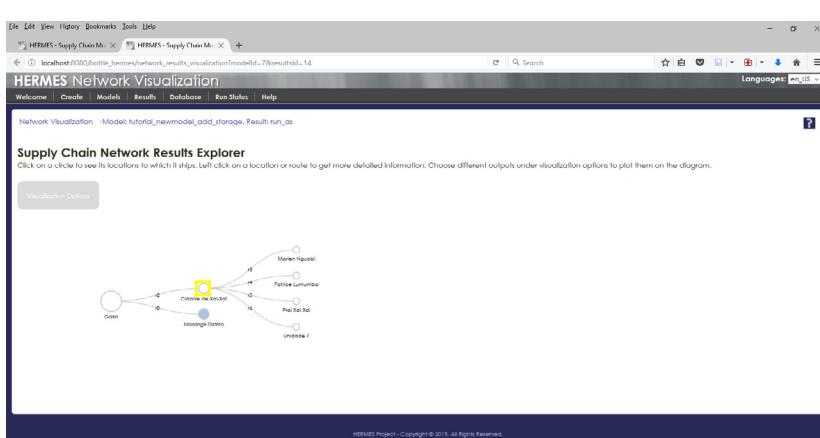
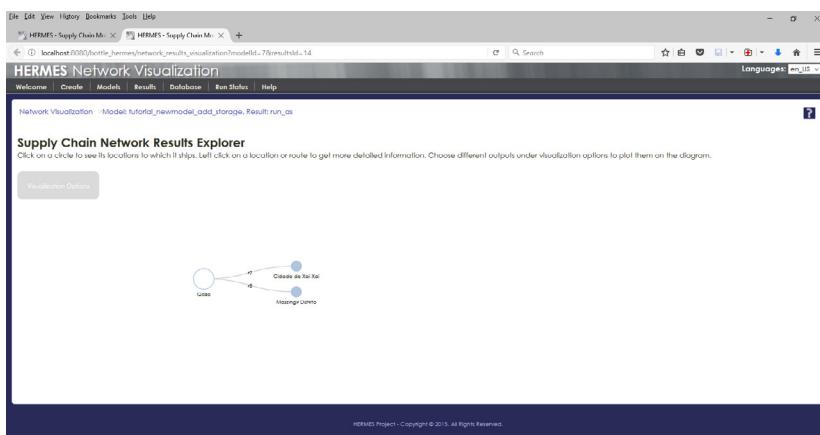
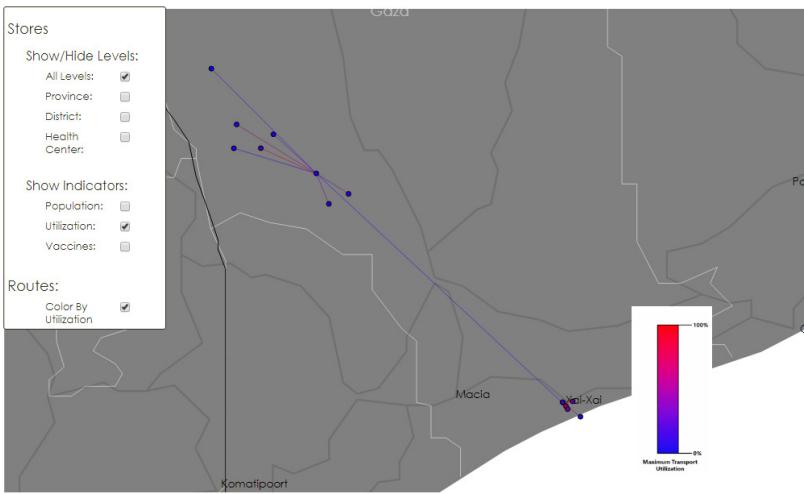
Logistics Cost per Dose Administered: 0.45 Logistics Cost per Fully Immunized Child (HIC): 6.93

Open Geographical Visualization Open Network Visualization Download Excel

29. Click the “Save” button and then use the download dialog box to either open or save a copy.



Visualizations



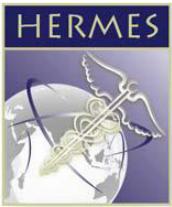
30. On the “**Results**” page, click the “**Open Geographic Visualization**” button to view the supply chain locations and results on a map.

NOTE: This page will open in a new window and can take some time to load. Click on “Color by Utilization” and explore the map to identify whether any locations or routes experience bottlenecks after the addition of refrigerators at the district stores.

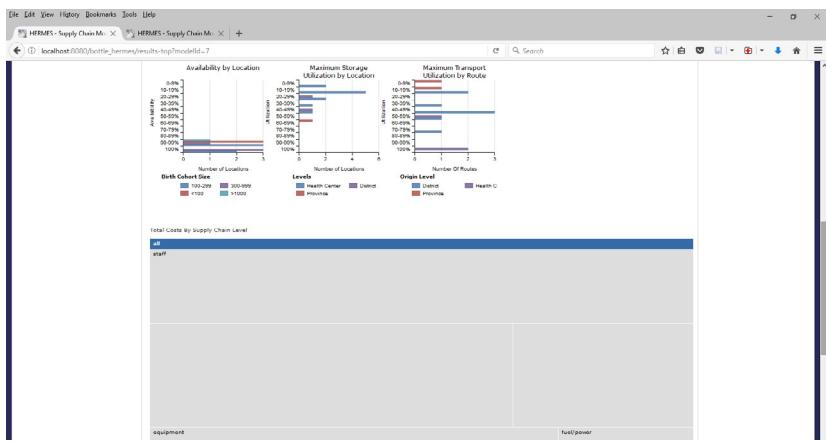
31. On the “**Results**” page, click the “**Open Network Visualization**” button.

NOTE: This page will also open in a new window. This diagram is the same as that on the main model page, but there is more room here to maneuver with it. Take some time to explore the structure and notice that it is still the same as the original model.

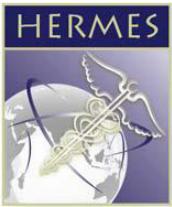
32. A filled in circle means there are locations below that one, which you can see if you left click on the circle. Left click on the “**Cidade de Xai-Xai**” circle to expand the locations below.



Histograms

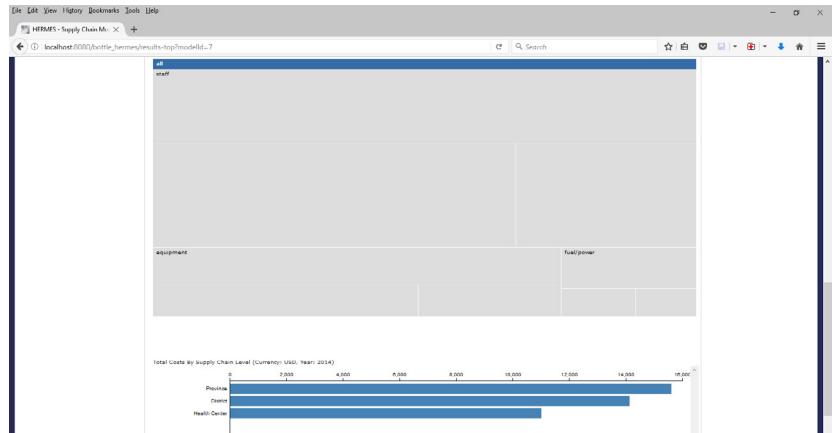


33. The vaccine availability histogram now shows all vaccinating locations achieving greater than 90% availability. The maximum storage utilization histogram also indicates that the storage bottleneck at the Cidade de Xai-Xai district store has been resolved, as all locations peak at under 70% storage utilization. The two bus routes to the district store remain constrained, however.

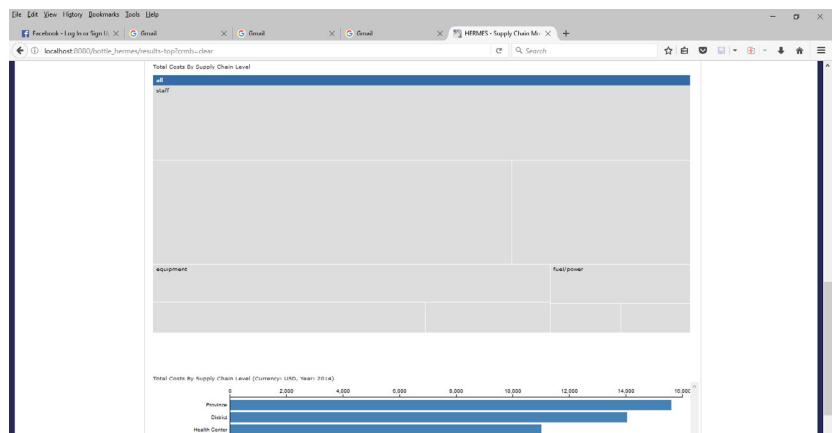


Total costs by supply chain level

34. Total costs by supply chain level are represented by a treemap and bar chart, both of which are interactive. Comparing the new ones to the old model can be an easy way to notice some differences. In this case, the changes are not very dramatic.

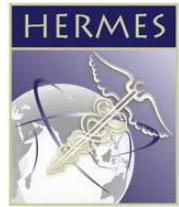


with BRFV55



with RCW

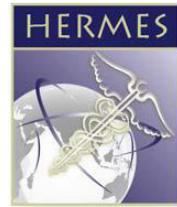
35. Take some time to interact with the results.



Next Steps

You have now completed the HERMES tutorial on adding storage devices by supply chain level to a model. See other tutorials for additional experiments you can perform with your model, such as removing a supply chain level.

1. Haidari LA, Connor DL, Wateska AR, et al. Augmenting transport versus increasing cold storage to improve vaccine supply chains. PloS one. 2013;8(5):e64303.



Tutorial 5

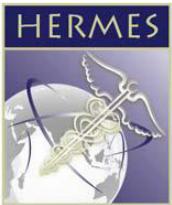
Removing A Level From The Supply Chain

This tutorial will allow you to experiment with removing a supply chain level from the vaccine supply chain. Removing a level (regional, district, health center, etc.) from the supply chain can cut out storage costs, but can simultaneously increase transport frequency, utilization and costs. Given the substantial alterations to a supply chain that this would likely have, the HERMES model allows the user to simulate this scenario and compare the direct and indirect effects on the supply chain indicators to results in previous tutorials. For example, the removal of a supply chain necessitates a new policy for shipping to be set. In previous work, the HERMES model showed the effects of supply chain removal on the Niger vaccine supply chain under multiple shipping policies.

In this tutorial, you will re-design the supply chain to produce a two-level system, in which the provincial store delivers vaccines directly to the vaccinating locations by truck once per month, rather than distributing vaccines through the two district level stores.

You will re-design the supply chain to transport the vaccines directly from the provincial hub (where the vaccine is introduced into the system) to the vaccinating locations by a truck once per month rather than distributing vaccines through the district level stores.

This tutorial utilizes the model you created in the “Creating a new model” tutorial. You can also find this model in the tutorial materials provided to you.



Begin supply chain level removal experiment workflow

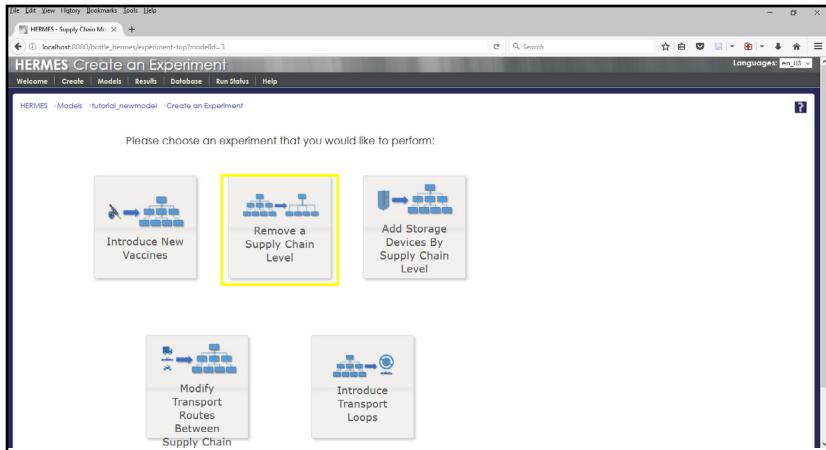
Note: Please zoom in to see screenshots. We recommend zooming in to at least 2000%.

1. On the Welcome Page, click “Open, Modify and Run an Existing Model”

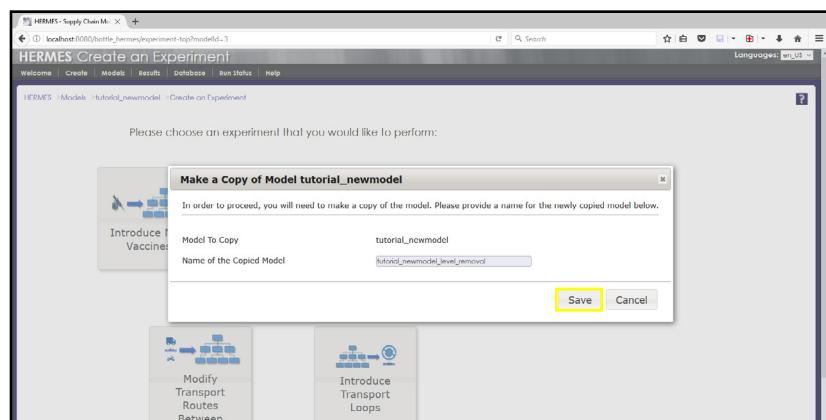
2. Click the “Open” button in the “tutorial_newmodel” row.

3. This opens the main model page. Click on “Create Experiments Based on this Model”.

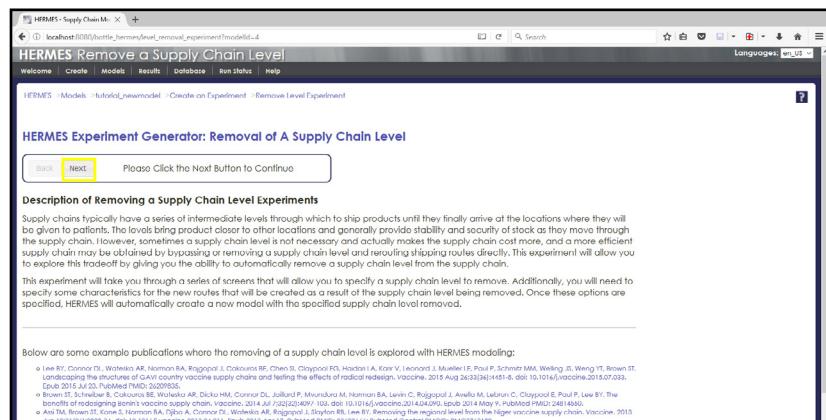
HERMES Tutorial: Removing a level



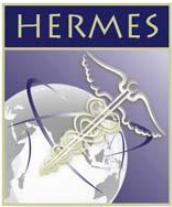
4. Click on the “**Remove a Supply Chain Level**” box.



5. You will be prompted to create a copy of the model to run. Making a copy allows you to keep the original model as a baseline comparator to the experimental model you are creating. Enter a new name for the model copy (or use the one automatically filled in) and click the “**Save**” button.



6. This page offers additional information on the different supply chain level removal scenarios you can model using this experiment generator. Click the “**Next**” button when you are ready to move to the next page.



Specify New Structure and Route Characteristics

The screenshot shows the 'HERMES Experiment Generator: Removal of A Supply Chain Level' interface. A yellow box highlights the radio button for 'District' under the heading 'Please select from below the supply chain level that you would like to remove from the system.'

7. Select the “**District**” level for removal (*your only option in this scenario*).

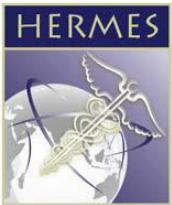
NOTE: This will reveal another set of options below.

The screenshot shows the same interface after selecting 'District'. A yellow box highlights the radio button for 'use the characteristics of routes from the supply chain level above the level to be removed' under the heading 'Now you must select how the new routes between locations of the supply chain levels will be defined. Please select one of the following options'.

8. Select “**Use the characteristics of routes from the supply chain level above the level to be removed**.” This means the provincial store will now deliver vaccines to health centers using a truck.

The screenshot shows the 'Remove a Supply Chain Level Experiment Summary' page. A yellow box highlights the 'Next' button at the top left. The text on the page states: 'You have chosen to create a new system with the District supply chain level removed and replace the existing routes with routes that currently originate at the supplier.' Below this, it says 'Please click the Next button above to complete the experiment.'

9. Click “**Next**” to get a summary page.



HERMES Experiment Generator: Removal of A Supply Chain Level

HERMES is implementing your experiment.

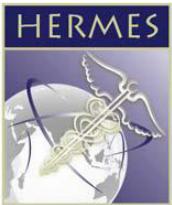
10. Click “**Next**” again to have HERMES remove the district stores and create new routes between the remaining levels. This may take a few seconds depending on how large the model is.

Please Click the Done Button to Finish

Below are some additional actions that you may want to perform on your newly modified model:

- o Update the Number of People Served by Each Supply Chain Location
- o Further Modify the Storage Device Inventory of Each Supply Chain Location
- o Open the Now Model In the HERMES Advanced Editor to Make Further Changes
- o Or If you are finished creating this experiment: Run Simulations of this Model

11. When the model has been adjusted, the page will update with some further options. You have now removed the district stores from the supply chain model and created routes for the province level to directly supply the vaccines to the health centers.



View Changes to Model

Please select what you would like to do with this model:

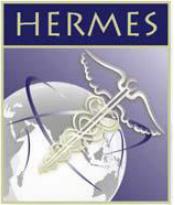
- Create Experiments Based on this Model
- Edit model
- Modify structure with the Advanced Model Editor
- Add or remove model components (e.g. vaccines, storage devices, vehicles, and population categories)
- Tabular Interfaces for editing the model
 - Edit Storage Location Geographic Coordinates
 - Edit Storage Location Population Estimates
 - Edit Storage Location Device Inventories
- Modify the Vaccine Dose Schedule
- Add and modify costs
- Transform the system with automatically created transport loops
- Run a Simulation Experiment with this Model
- View Results from previously saved Simulation Experiments
- Export Model as a HERMES XDP file

Please select what you would like to do with this model:

- Create Experiments Based on this Model
- Edit model
- Modify structure with the Advanced Model Editor
- Add or remove model components (e.g. vaccines, storage devices, vehicles, and population categories)
- Tabular Interfaces for editing the model
 - Edit Storage Location Geographic Coordinates
 - Edit Storage Location Population Estimates
 - Edit Storage Location Device Inventories
- Modify the Vaccine Dose Schedule
- Add and modify costs
- Transform the system with automatically created transport loops
- Run a Simulation Experiment with this Model
- View Results from previously saved Simulation Experiments
- Export Model as a HERMES XDP file

12. To view the changes in the model, open the model “**tutorial_newmodel_level_removal**” (or whatever you named it in step 5) by going to the Models page and clicking “**Open**” in the “tutorial_newmodel_level_removal” row. This will lead you to the page shown here.

13. Notice that the routes have new names (*level_remove_X_X*) and that the structure of the supply chain network diagram looks much different than it did before. The two district level locations (*Cidade de Xai-Xai* and *Massingir Distrito*) still appear in the network but only as vaccinating locations rather than as distribution centers. These locations will continue to receive vaccines in order to vaccinate the populations they directly serve. Spend a few minutes exploring the new structure and right clicking on the routes to see their descriptions.



Run Simulation

The screenshot shows the HERMES Model interface with the title "tutorial_newmodel_level_removal Model". A dialog box titled "Information for Route level_remove_1_13" is open, displaying route details: Name (Cabo -> Morroda), Levels (Province -> Health Center), ID (level_remove_1_13), Type (fixed schedule / variable Amount based on Frequency), and Frequency (fixed). Below the dialog, a network diagram shows nodes like level_remove_1_14, level_remove_1_13, level_remove_1_12, and level_remove_1_11.

14. Click “Run a Simulation Experiment with this Model”

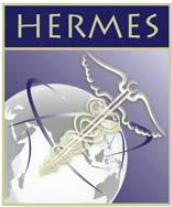
The screenshot shows the HERMES Run A Model Simulation interface. A dialog box titled "Run Parameters for model tutorial_newmodel_level_removal" is open, containing fields for Number of Simulation Days (336), Number of Shipments from the Manufacturer per Year (4), Factor for Buffer Stock from the Manufacturer (1), and Sets the default buffer stock for the whole model (0.25). A yellow box highlights the "Submit" button.

15. Type a name for your model and click the “Submit” button.

NOTE: There should be no errors in the model.

The screenshot shows the HERMES Run A Model Simulation interface. A dialog box titled "Validating Model" is open, showing a success message: "There were no warnings or errors in the model, please proceed to press the Run Simulation button below." A yellow box highlights the "Run Simulation" button.

16. Click the “Run Simulation” button. The run status page will open and you can watch the progress of your run.

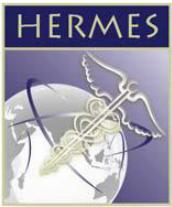


View Results

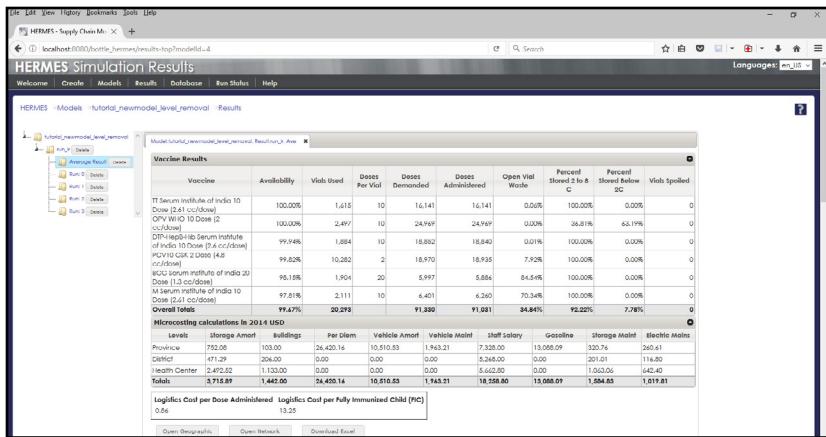
Once your simulations have finished running, you can view and analyze the results through multiple interactive visualizations and charts, as well as detailed tables, and compare them to your original or baseline model.

17. On the main model page, click on **“View Results from previously saved Simulation Experiments”** (near the bottom of the page) to open the results page.

18. Expand the **“tutorial_newmodel_level_removal”** tree and select the **“Average Results”**



Tabular Results



19. Removing the district level raised vaccine availability to greater than 99% (from 90% at baseline, or before removing the district stores from the supply chain.)

NOTE: There are no transport related costs at the district level, which now only receives vaccines to vaccinate populations that are in demand. However, transport costs increased overall as the provincial store used a more costly mode of transport to deliver to health centers (*a 4x4 truck*) than that previously used by the district stores (*motorbikes*). So despite the increased number of doses administered, the increased transport costs caused the logistics cost per dose administered to increase to \$0.86 (from \$0.50 before adding the refrigerators) and the logistics cost per fully immunized child rose to \$13.25 (from \$8.81).

Screenshot of the HERMES Simulation Results interface showing the "Vaccine Results" table. The table details vaccine availability, usage, doses demanded, administered, and waste across various locations. A yellow box highlights the "Download Excel Results Spreadsheet" button at the bottom right of the table.

Vaccine	Availability	Visits Used	Doses Per Visit	Doses Demanded	Doses Administered	Open Vial Waste	Percent Shoved 2 to 8 C	Percent Stored Below 2C	Visits Spoiled
TT Serum Institute of India 10 Dose (2.1 cc/dose)	100.00%	1,615	10	16,141	16,141	0.0%	100.00%	0.00%	0
OPV WHO 10 Dose (2 cc/dose)	100.00%	2,497	10	24,967	24,967	0.0%	34.81%	63.19%	0
DTP-AcIP-Hib Serum Institute of India 10 Dose (2.6 cc/dose)	99.94%	1,004	10	18,052	18,040	0.1%	100.00%	0.00%	0
PCV-IGE 2 Dose (4.8 cc/dose)	99.07%	10,263	2	18,970	18,935	7.9%	100.00%	0.00%	0
BCG Serum Institute of India 20 Dose (0.1 cc/dose)	99.15%	1,904	20	5,997	5,994	0.4%	100.00%	0.00%	0
M Serum Institute of India 10 Dose (2.1 cc/dose)	97.81%	2,111	10	6,401	6,210	70.3%	100.00%	0.00%	0
Overall totals	99.47%	20,219		91,330	91,081	54.64%	92.22%	7.78%	0

Microcosting calculations in 2014 USD

Levels	Storage Amort	Buildings	Per Person	Vehicle Amort	Vehicle Maint	Staff Salary	Overtime	Storage Maint	Electric Mains
Province	752.08	103.00	26,420.16	10,510.83	1,963.21	7,328.00	13,088.09	320.76	260.41
District	471.29	266.00	0.00	0.00	0.00	5,746.00	0.00	201.01	116.80
Health Center	2,492.52	1,133.00	0.00	0.00	0.00	5,642.80	0.00	1,063.06	642.40
Totals	5,715.89	1,442.00	26,420.14	10,510.83	1,963.21	18,558.80	13,088.07	1,584.83	1,019.81

Logistics Cost per Dose Administered Logistics Cost per Fully Immunized Child (FIC) 0.06

Open Geographic Visualization Open Network Visualization Download Excel Results Spreadsheet

20. Click on the “**Download Excel Results Spreadsheet**” button below the tables to acquire a spreadsheet of more detailed results, where you can compare supply chain metrics not only for the overall system and by supply chain level, but also for each individual location and route.

Screenshot of the HERMES Simulation Results interface showing the "Save Excel Simulation Experiment Result..." dialog box. The dialog box prompts for a file name and includes "Save" and "Cancel" buttons. A yellow box highlights the "Save" button.

Save Excel Simulation Experiment Result...

Name for Excel Spreadsheet: results_spreadsheet_tutorial_remodel_level_0.xls

Save Cancel

21. Click the “**Save**” button and then use the download dialog box to either open or save a copy.

Visualizations

Vaccine Results

Vaccine	Availability	Visits Used	Doses Per Visit	Doses Demanded	Doses Administered	Open Vial Waste	Percent Shoved 2 to 8 C	Percent Stored Below 2C	Visits Spoiled
T Dexam (dexamethasone 10 Dose (1 ATU/dose))	100.00%	1,615	10	16,141	16,141	0.00%	100.00%	0.00%	0
OPV WHO 10 Doses (2 doses)	100.00%	2,497	10	24,967	24,967	0.00%	34.81%	63.19%	0
ZPP-AI-HB Serum Institute of India 10 Dose (2.6 cc/dose)	99.94%	1,004	10	18,032	18,040	0.01%	100.00%	0.00%	0
OPV WHO 2 Dose (4.8 cc/dose)	99.07%	10,263	2	18,970	18,935	7.9%	100.00%	0.00%	0
BIG Serum Institute of India 20 Doses (1.0 cc/dose)	95.15%	1,904	20	5,997	5,994	0.4%	100.00%	0.00%	0
M Serum Institute of India 10 Dose (2.41 cc/dose)	97.81%	2,111	10	6,401	6,210	70.3%	100.00%	0.00%	0
Overall	99.47%	20,213		\$1,330	\$1,081	34.84%	92.22%	7.78%	0

Microplanning calculations in 2014 USD

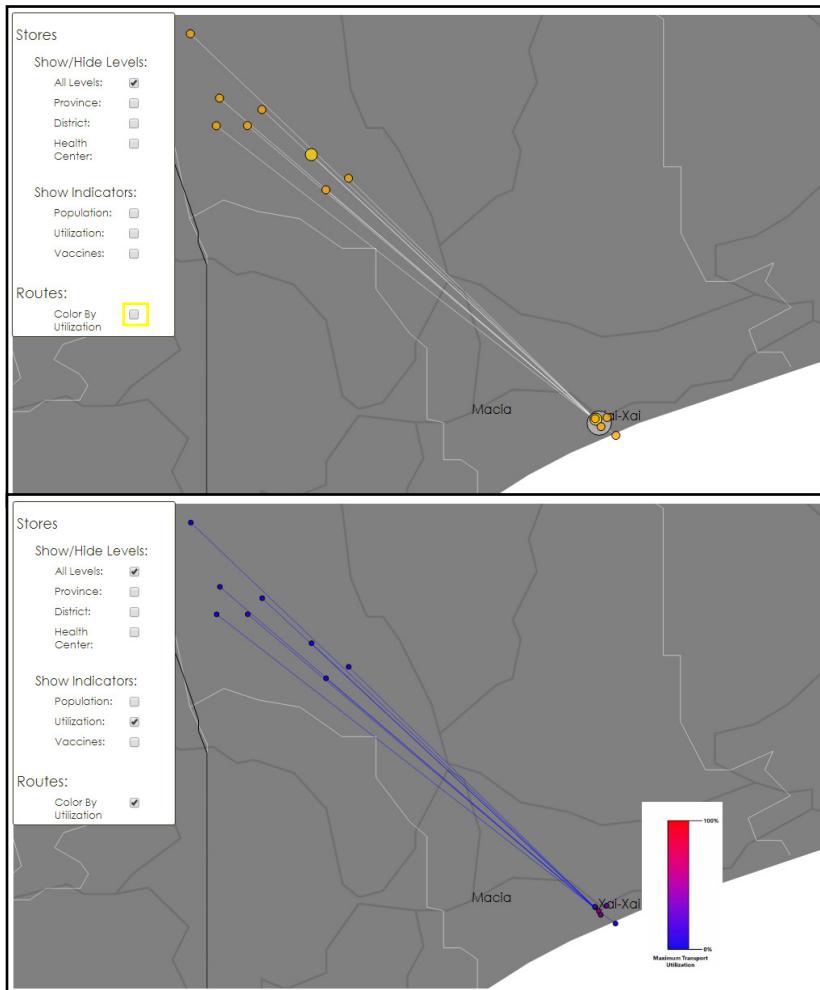
Levels	Storage Amort	Buildings	Per Diem	Vehicle Amort	Vehicle Maint	Staff Salary	Glossine	Storage Maint	Electric Mains
Province	752.08	103.00	26,400.16	10,510.83	1,763.21	7,028.00	13,088.07	320.76	250.41
District	471.29	256.00	0.00	0.00	0.00	5,748.00	0.00	201.01	116.80
Health Center	2,492.52	1,133.00	0.00	0.00	0.00	5,642.80	0.00	1,063.06	643.40
Total	\$7,715.89	1,442.00	26,400.16	10,510.83	1,743.21	18,358.80	13,088.07	1,564.83	1,019.81

Logistics Cost per Dose Administered: 0.06
Logistics Cost per Fully Immunized Child (FIC): 0.06

Open Geographic Visualization **Open Network Visualization** **Download Excel Spreadsheet**

22. Click the “**Open Geographic Visualization**” button to view the supply chain locations and results on a map. This page will open in a new window and can take some time to load.

NOTE: The new supply chain structure depicted by the routes connecting the province store directly to the health centers.



23. Click on the “**Color By Utilization**” button and explore the map to identify whether any locations or routes experience bottlenecks after the removal of the district stores from the supply chain.

Vaccine	Availability	Vials Used	Doses Per Vial	Doses Demanded	Doses Administered	Open Vial Waste	Percent Shoved to & C	Percent Shoved Below 2C	Vials Spoiled
Td vaccine ineffective India 10 Dose 0.1 ml (0.3 ml)	100.00%	1,616	10	16,141	16,141	0.00%	100.00%	0.00%	0
OPV WHO 10 Dose (2 cc/dose)	100.00%	2,497	10	24,967	24,967	0.00%	24.81%	63.19%	0
MMR vaccine India Institute of India 10 Dose (2 cc/dose)	99.94%	1,264	10	18,882	18,840	0.31%	100.00%	0.00%	0
Polio vaccine India 2009 (4 cc/dose)	99.02%	10,282	2	18,970	18,935	7.95%	100.00%	0.00%	0
ICU serum ineffective India 20 Dose (2.1 ml each dose)	98.15%	1,904	20	5,997	5,884	64.54%	100.00%	0.00%	0
M serum ineffective India 10 Dose (2.1 ml each dose)	97.81%	2,111	10	6,401	6,240	70.34%	100.00%	0.00%	0
Overall	99.47%	20,279		91,330	91,001	34.84%	95.22%	7.78%	0

Microneeting calculations in 2014 USD

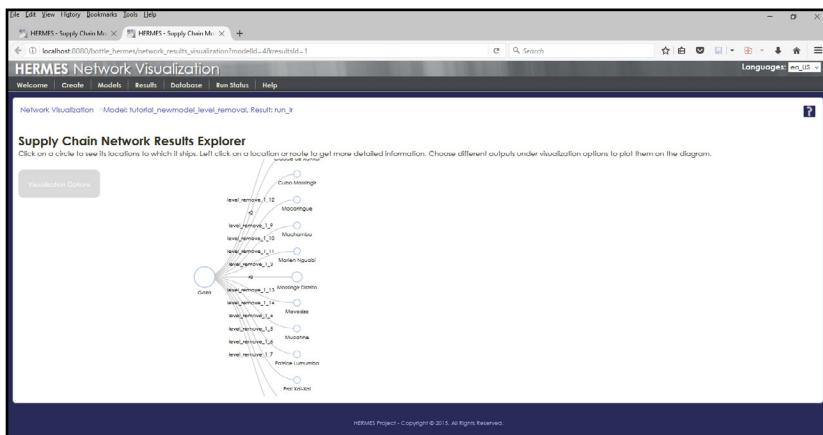
Levels	Storage Amort	Buildings	Per Diem	Vehicle Amort	Vehicle Maint	Staff Salary	Gasoline	Storage Maint	Electric Mains
Province	752.08	103.00	26,420.16	10,510.33	1,943.21	7,328.00	13,008.09	320.76	260.41
District	471.29	206.00	0.00	0.00	0.00	5,246.00	0.00	201.01	116.80
Health Center	2,472.02	1,133.00	0.00	0.00	0.00	5,662.00	0.00	1,003.06	642.40
Total	3,715.69	1,442.00	24,450.14	10,510.63	1,943.21	18,258.80	15,008.09	1,354.83	1,019.81

Logistics Cost per Dose Administered Logistics Cost for fully Immunized Child (PIC)
 0.6¢ 0.6¢

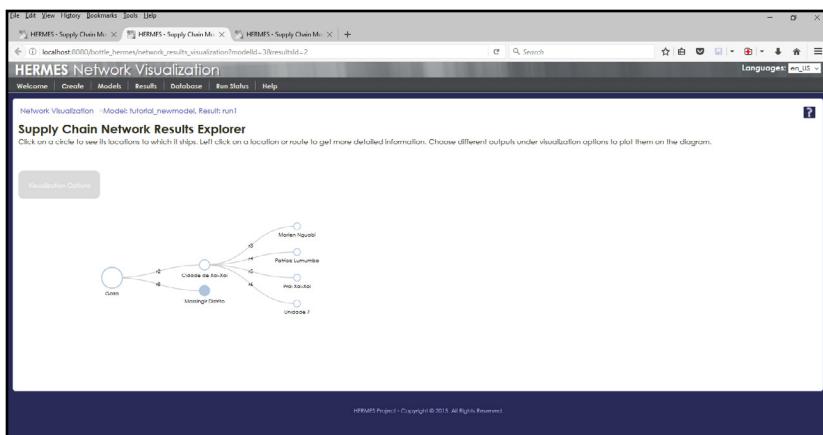
[Open Details](#) [Open Network](#) [Download Excel](#)

24. Click the “Open Network Visualization” button.

NOTE: This page will also open in a new window. This diagram is the same as that on the main model page, but there is more room here to maneuver with it.



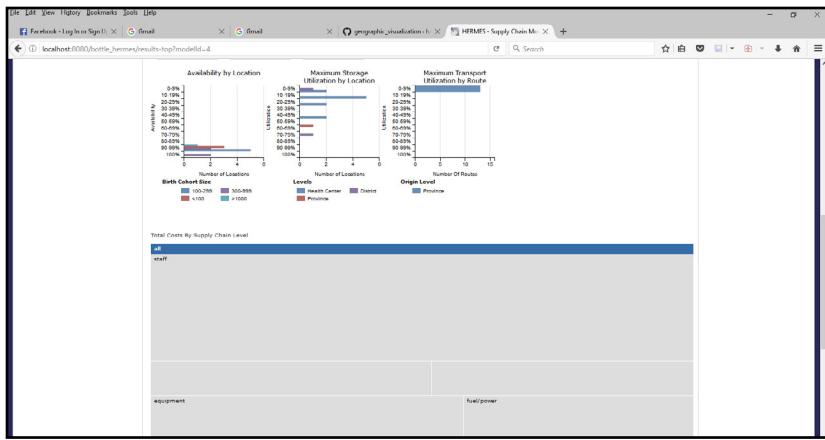
25. Compare the structure here from your new model, with the District level removed, to the original one below. Notice that everything now emanates from the Province and ends at either a District or Health Center, where before, the Districts were intermediaries.



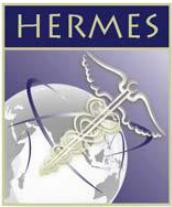
Structure before level removal

(The solid circle for Massingir Distrito means the locations below are unexpanded)

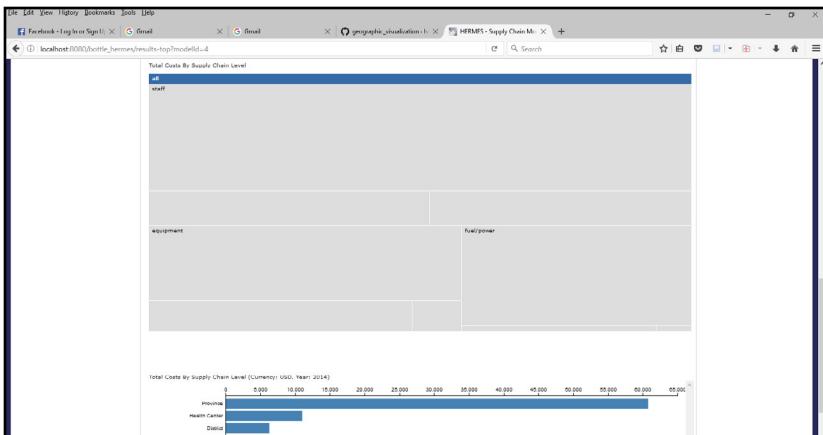
Histograms



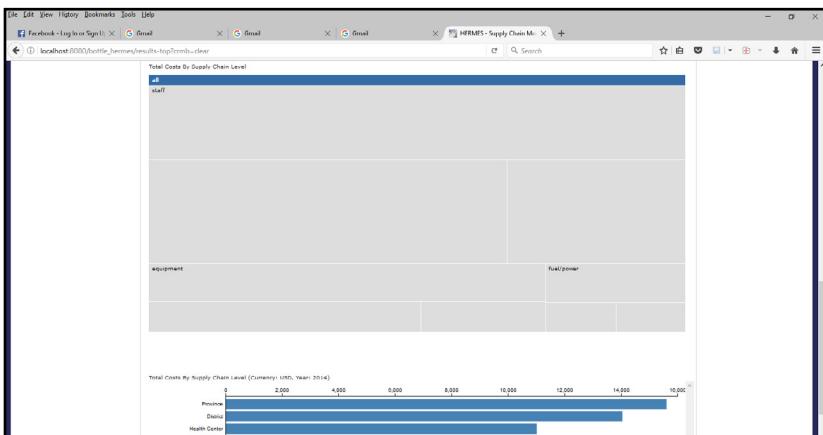
26. The vaccine availability histogram now shows all vaccinating locations achieving greater than 90% availability. The maximum storage utilization histogram also indicates no storage bottleneck after the removal of the Cidade de Xai-Xai district store, with all locations peaking at under 80% storage utilization. Furthermore, the new supply chain structure not only has no transport bottlenecks but in fact has very low transport utilization. This suggests that the vehicle used by the province store to deliver vaccines may be underutilized for this purpose (*and costly, as shown in the tabular results*).



Total Costs by Supply Chain Level



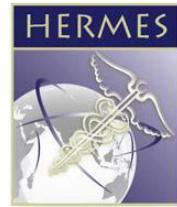
After level removal



Before level removal

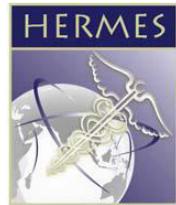
27. Explore the new cost implications of the province level routes to the health centers. Comparing the new treemap & barchart to the old is an easy way to notice some differences.

28. Take some time to interact with the results.



Next Steps

You have now completed the HERMES tutorial on removing a supply chain level from a model. See other tutorials for additional experiments you can perform with your model, such as introducing new vaccines.



Tutorial 6

Modify Transport Routes

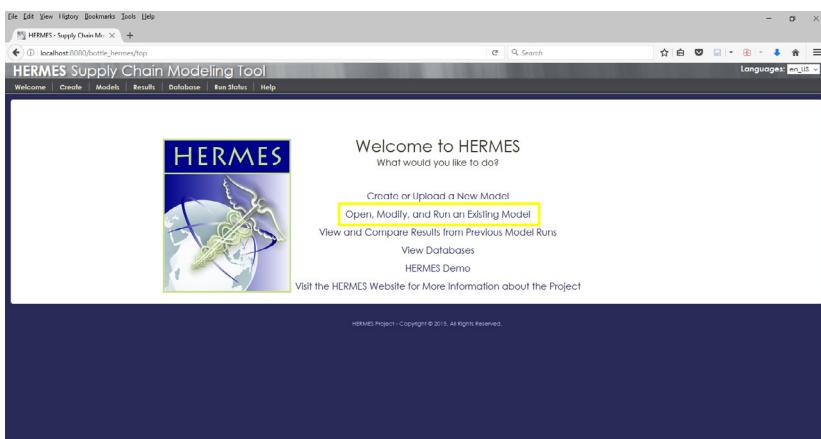
In this tutorial, you will alter the tutorial_newmodel you previously created by modifying the transport equipment available to all locations at a specific level.

The type of vehicle or mode of transport one uses, the policy that dictates ordering and moving a product and geographic characteristics can all have a significant impact on the performance and efficiency of the supply chain. Modeling can help understand and quantify this impact.

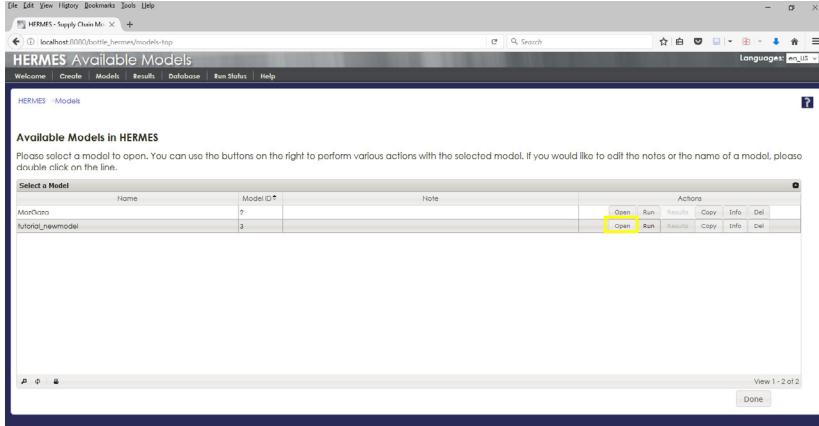
This tutorial will walk you through making changes to transport routes in your model. The experiments will allow you to choose a collection of routes based on what supply chain level the routes originate at and which supply chain levels the routes run between. You can then specify operations to perform on the routes, such as increasing frequency of trips or changing the mode of transport. Based on the changes you make to your model, HERMES will create a new model that alters all of the selected routes.

Open Model

Note: Please zoom in to see screenshots. We recommend zooming in to at least 2000%.



1. On the Welcome Page, click “**Open, Modify and Run an Existing Model.**”

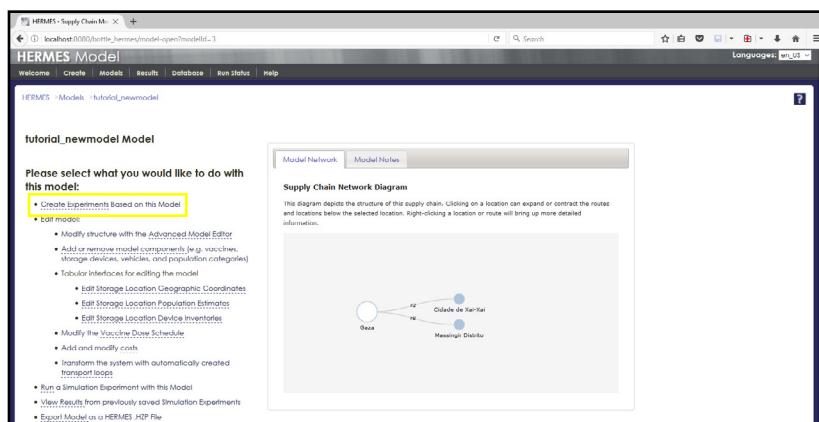


Available Models in HERMES

Please select a model to open. You can use the buttons on the right to perform various actions with the selected model. If you would like to edit the notes or the name of a model, please double click on the line.

Select a Model	Name	Model ID	Note	Actions
ModelData	2			Open Run Results Copy Info Del
tutorial_newmodel	3			open run results copy info del

2. Click on the Open button in the tutorial_newmodel row.



tutorial_newmodel Model

Please select what you would like to do with this model:

- Create Experiments Based on this Model **(highlighted)**
- Edit model
- Modify structure with the Advanced Model Editor
- Add or remove model components (e.g. vaccines, storage devices, vehicles, and population categories)
- Tableau Interfaces for editing the model
 - Edit Storage Location Geographic Coordinates
 - Edit Storage Location Population Estimates
 - Edit Storage Location Device Inventories
- Modify the Vaccine Dose Schedule
- Add or remove delivery costs
- Randomize the system with automatically created transport loops
- Run a Simulation Experiment with this Model
- View Results from previously saved Simulation Experiments
- Export Model as a HERMES XDF File

Supply Chain Network Diagram

This diagram depicts the structure of this supply chain. Clicking on a location can expand or contract the routes and locations below the selected location. Right-clicking a location or route will bring up more detailed information.

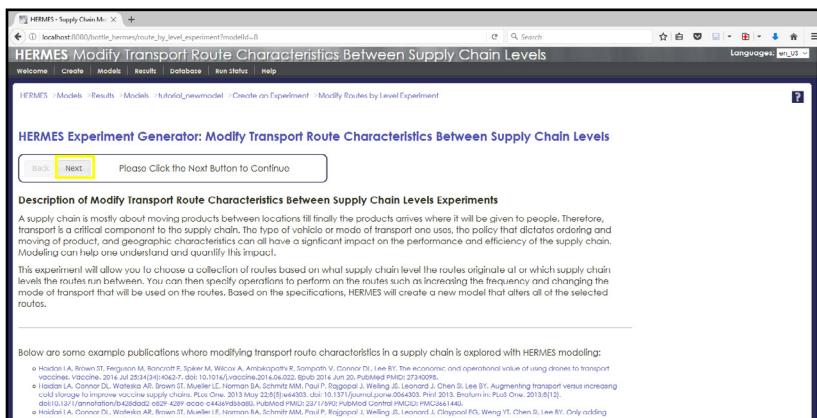
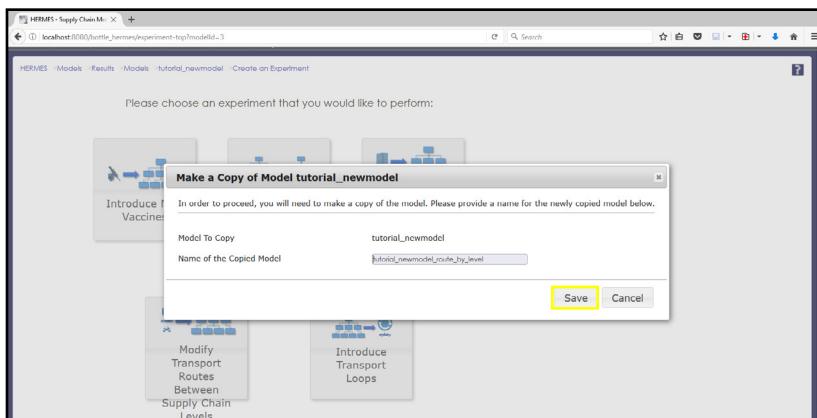
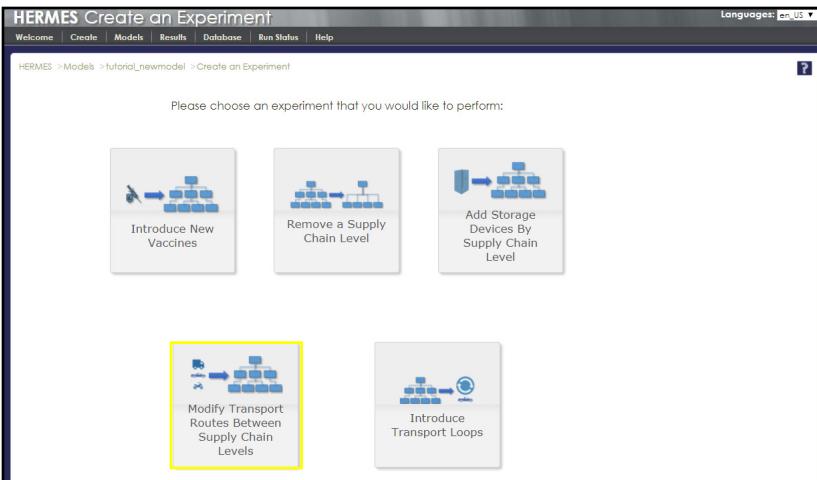
```

graph LR
    Osaka -- rx --> Oaxaca
    Oaxaca -- rx --> Ciudad de Xalapa
    Ciudad de Xalapa -- rx --> Monterrey
    Monterrey -- rx --> Distrito
    
```

3. This opens the main model page.

4. Click on “Create Experiments Based on this Model”.

Start Experiment



5. Click on “**Modify Transport Routes Between Supply Chain Levels**” box. You will be prompted to create a copy of the model to run.

6. Click “**Save**” unless you want to change the name of the copied model first. The next page has some text describing this type of experiment.

7. Click “**Next.**” This is the beginning of your choices for modifying transport route characteristics between supply chain levels.

Would you like to select supply chain levels by:

Specifying the supply chain level where routes originate

Specifying between which two supply chain levels the routes travel

8. Select the first option, “**Specifying the supply chain level where routes originate**”

Would you like to select supply chain levels by:

Specifying the supply chain level where routes originate

Specifying between which two supply chain levels the routes travel

Please select below originating supply chain level for which you would like to modify the routes.

Province

District

Health Center

9. Now select “**Province**” as the level whose routes you would like to modify.

Would you like to select supply chain levels by:

Specifying the supply chain level where routes originate

Specifying between which two supply chain levels the routes travel

Please select below originating supply chain level for which you would like to modify the routes.

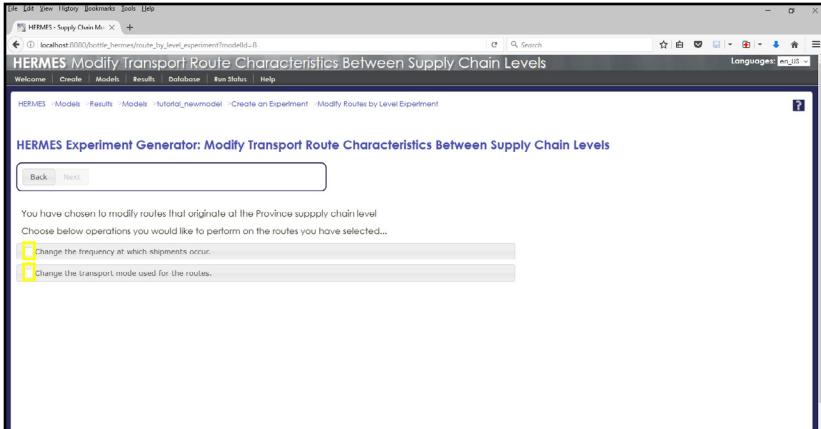
Province

District

Health Center

Please Click the Next Button to Continue

10. Click “**Next**” to add some more parameters.

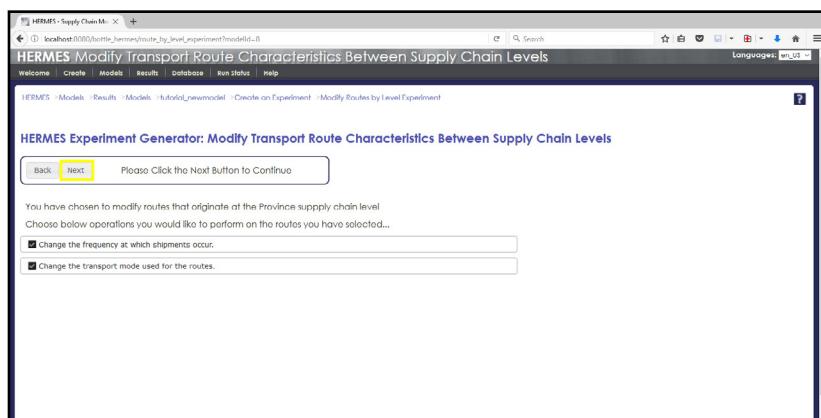


You have chosen to modify routes that originate at the Province supply chain level. Choose below operations you would like to perform on the routes you have selected...

Change the frequency at which shipments occur.

Change the transport mode used for the routes.

11. You will be changing both the frequency and the mode of transport for routes originating from the Province level. Select both options on the page.



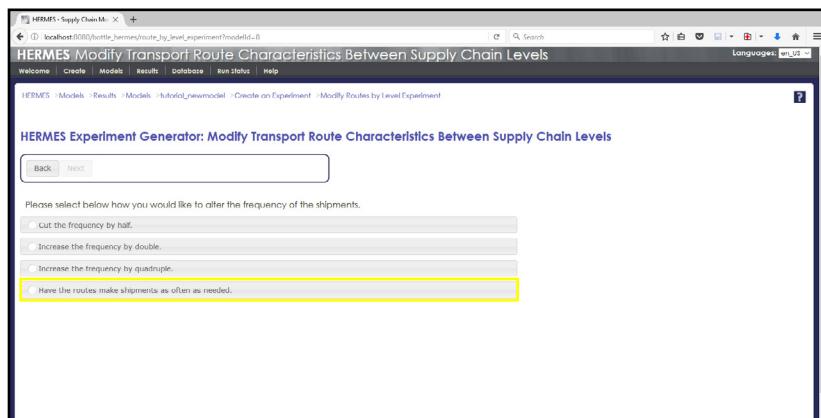
Please Click the Next Button to Continue

You have chosen to modify routes that originate at the Province supply chain level. Choose below operations you would like to perform on the routes you have selected...

Change the frequency at which shipments occur.

Change the transport mode used for the routes.

12. Click “**Next**” to bring up options for altering the frequency.



Please select below how you would like to alter the frequency of the shipments.

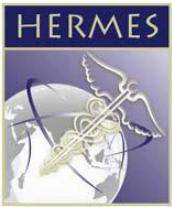
Cut the frequency by half.

Increase the frequency by double.

Increase the frequency by quadruple.

Have the routes make shipments as often as needed.

13. Select the last option, “**Have the routes make shipments as often as needed.**”



Please select below how you would like to alter the frequency of the shipments.

- Cut the frequency by half.
- Increase the frequency by double.
- Increase the frequency by quadruple.
- Have the routes make shipments as often as needed.

14. Click “**Next**” to bring up options for altering the mode. The table lists all available modes of transport already loaded into the model.

Name	Info
provincialibus	Info
motorcycle	Info
bus	Info

15. Below the table you have the option of creating a new type of transport, which is what you will be doing next. Click the “**Create a New Type button.**”

Create a New Mode of Transport for the Modified Routes

Name: Double cab Truck 4 large CB

Capital Cost: 50,000.00 in 2010 USD

Vehicle Lifetime: 300,000 KM

Fuel Type: Petrol

Fuel Consumption Rate: 5.0km/liter

16. Fill in the following information:

Name:

Double cab Truck 4 large CB

Capital Cost:

50,000.00 in 2010 USD

Vehicle Lifetime:

300,000 KM

Fuel Type:

Petrol

Fuel Consumption Rate:

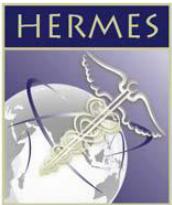
5.0km/liter

Screenshot of the HERMES software interface showing the "Create a New Mode of Transport for the Modified Routes" dialog box. The dialog contains fields for Name (Double cab truck 4x8), Capital Cost (50000), Lifetime of Vehicle (KM) (300000), Fuel Type (Petrol), Fuel Consumption Rate (5.0 km/liter), and Net Storage of 24C (Outside of Storage Devices). The "Storage on Vehicle" table shows a single row for "Total" with values 0.00, 0.00, 0.00, and Count 0. A yellow box highlights the "Add new row" button. The Notes section is empty.

For storage on the vehicle you will need to add 4 cold boxes. To do this, click the “+” in the lower left corner of the storage table.

Screenshot of the HERMES software interface showing the "Create a New Mode of Transport for the Modified Routes" dialog box after adding a new row. The "Storage on Vehicle" table now has two rows: one for "Total" and one for "Std_KLW48x8P_XS_cham". The "Std_KLW48x8P_XS_cham" row has values 0.00, 18.20, 0.00, and Count 1. A yellow box highlights the "Count" field in this row. The Notes section contains the text "Std_KLW48x8P_XS_cham" and "Std VC_8K1/JCF", followed by "TGV9000_E".

17. In the new row that's added, select “**CB_20CF**” from the type dropdown box. Change the count in that row to 4.



Remove a Supply Chain Level Experiment Summary

You have chosen to modify all of the shipping routes originating at the Province supply chain level.

The modifications to be made are:

- Increasing the frequency of shipping to occur as often as needed to satisfy demand.
- Changing the transport mode to Double cab truck 4CB.

Please click the Next button above to complete the experiment.

18. Click “**Save**”. The truck you just created is now available in the table. Make sure that it is selected by clicking on it.

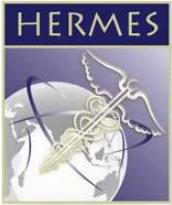
HERMES is implementing your experiment.

19. Click “**Next**” to get a summary page. If one of your parameters looks wrong, you can always use the Back button to fix it before changing the model.

Below are some additional actions that you may want to perform on your newly modified model:

- o Update the Number of People Served by Each Supply Chain Location
- o Further Modify the Storage Device Inventory of Each Supply Chain Location
- o Open the New Model in the ILKMLS Advanced Editor to Make Further Changes
- o Or if you are finished creating this experiment: Run Simulations of this Model

21. When the model has been adjusted, the page will update with further options.



Run Simulation

Below are some additional actions that you may want to perform on your newly modified model:

- o Update the Number of People Served by Each Supply Chain Location
- o Further Modify the Storage Device Inventory of Each Supply Chain Location
- o Open the New Model in the HERMES Advanced Editor to Make Further Changes
- o Or if you are finished creating this experiment: Run Simulations of the Model

22. Click “**Run Simulations of this Model**” in the last line of text.

Running a HERMES Model

What name should be given to this set of results?

How many stochastic random runs would you like to run?

Run Parameters for model tut...

Number of Simulation Days
Number of Shipments from the Manufacturer
Factor for Buffer Stock from the Manufacturer
Sets the default buffer stock for the whole system

Validating Model

Test Message

Success All There were no warnings or errors in the model, please proceed to press the Run Simulation button below.

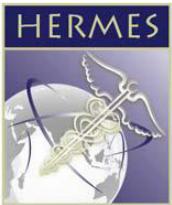
Advanced Options Submit

Run Simulation

23. Type a name for your run and click “**Submit**”. There should be no errors in the model. (*Note: If there are errors, please see the Troubleshooting section to fix*).

Status of Currently Running Simulations						
Available Runs	Run Name	Model Name	Model ID	Submitted	Status	Details
	run_rbl		8	Wed Nov 29 15:39:24 2017	Initial setup	Info Cancel Clear Logs

24. Click “**Run Simulation**”. The run status page will open and you can watch the progress of your run.



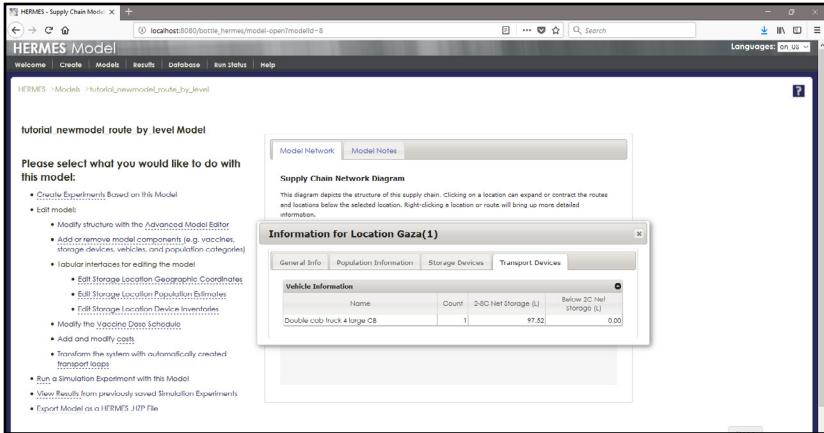
View Changes in the Model

While waiting for the simulation to finish running, take a look at the changes in the model.

26. Open the model tutorial_newmodel_route_by_level (or whatever you named it in step 5) by going to the models page and clicking “Open” in the row of that name.

27. The structure of this model hasn't changed, but the frequency and transport used for the routes from Gaza to its districts have. If you right click on either the r2 or r8 lines, you will see that the Type has changed from “Fixed Schedule / Variable Amount Based on Frequency” to “Variable Schedule (As Needed When Stock Falls Below Threshold) / Variable Amount”

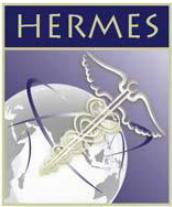
28. To see the change in transport type, first right click on Gaza to show its location information.



The screenshot shows the HERMES software interface. On the left, there's a sidebar with various options like 'Create Experiments Based on this Model', 'Edit model', and 'Run a simulation Experiment with this Model'. The main area has tabs for 'Model Network' and 'Model Notes'. Below these is a 'Supply Chain Network Diagram' which is currently empty. A modal window titled 'Information for Location Gaza(1)' is open, showing three tabs: 'General Info', 'Population Information', and 'Transport Devices'. The 'Transport Devices' tab is selected, displaying a table with one row:

Name	Count	2SC Net Storage (L)	Below 2C Net Storage (L)
Double cab truck 4 large CB	1	97.52	0.00

29. Then click on the “**Transport Devices**” tab. This will now show the infomation for the double cab truck 4 large CB that was added to replace the provincial Hilux which was originally there.



View Results

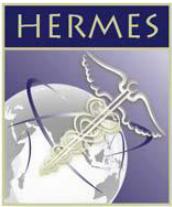
Once your run has finished you will want to look at the results and compare them to your original run.

A screenshot of a web browser window titled "HERMES - Supply Chain Model". The address bar shows "localhost:8080/bottle_hermes/results-top?cmfb-clear". The top menu bar includes "Welcome", "Create", "Models", "Results" (which is highlighted in yellow), "Database", "Run Status", and "Help". A language selection "Languages: en_US" is also present. The main content area displays a message: "Please select a result from the menu on the left to display." On the left, there is a tree view with several items under "tutorial_newmodel_route_by_level": "tutorial_newmodel_route_by_level", "tutorial_newmodel_vaccine_introduction", "tutorial_newmodel_vaccine_introduction", "tutorial_newmodel_vaccine_introduction", "tutorial_newmodel_vaccine_introduction", and "tutorial_newmodel_vaccine_introduction". A "Done" button is located in the bottom right corner of the content area.

30. Click on the “Results” on the top menu bar to open the Results page.

A screenshot of the same web browser window as the previous image. The "Results" menu item is still highlighted. The tree view on the left now shows the expanded "tutorial_newmodel_route_by_level" node, which contains a "Run 0" node. Under "Run 0", there are four "Route" nodes labeled "Run 0 1", "Run 0 2", "Run 0 3", and "Run 0 4". The "Run 0 1" node is highlighted in yellow. A "Done" button is located in the bottom right corner.

31. Expand the tutorial_newmodel_route_by_level tree and select the “Average



Spreadsheet Costing Results

The screenshot shows the HERMES interface with the following details:

- Vaccine Results:**

Vaccine	Availability	Vials Used	Doses Per Vial	Doses Demanded	Doses Administered	Open Vial Waste	Percent Shoved 2 to 8 °C	Percent Shoved Below -2°C	Vials Spilled
II Serum Institute of India 10 Dose (2.11 cc/dose)	99.50%	1,410	10	14,185	14,140	0.07%	100.00%	0.00%	0
GPI/Hopk/Hip Serum Institute of India 10 Dose (2.4 cc/dose)	99.70%	2,481	10	24,840	24,800	0.06%	92.12%	47.88%	0
PCV10 GM 2 Dose (2.11 cc/dose)	99.70%	1,874	10	18,747	18,747	0.04%	100.00%	0.00%	0
RCS Serum Institute of India 10 Dose (2.11 cc/dose)	99.80%	12,174	2	18,407	18,407	0.08%	100.00%	0.00%	0
BCU Serum Institute of India 20 Dose (2.11 cc/dose)	91.50%	1,919	20	6,022	5,532	85.59%	100.00%	0.00%	0
M Serum Institute of India 10 Dose (2.11 cc/dose)	97.40%	2,079	10	6,278	6,118	70.84%	100.00%	0.00%	0
Overall Total:	99.13%	20,160		90,673	90,082	35.40%	94.11%	5.89%	0
- Microcosting calculations in 2014 USD:**

Levels	Storage Amount	Buildings	Per Item	Vehicle Amount	Vehicle Miles	Staff Salary	Overtime	Public Transport	Storage Miles	Flexible Miles
Province	402.70	100.00	6,701.42	1,060.31	300.03	7,220.00	2,000.23	0.00	257.05	205.61
District	471.29	206.00	4,547.48	312.42	77.00	5,760.00	518.65	0.00	201.01	114.00
Health Center	2,492.52	1,138.00	0.00	0.00	0.00	5,642.80	0.00	15.44	1,063.08	642.40
Total:	3,564.51	1,449.00	13,869.10	1,818.73	377.83	18,258.80	9,518.88	15.44	1,591.19	1,019.81

32. Spreadsheet costing results

The screenshot shows the HERMES interface with the following details:

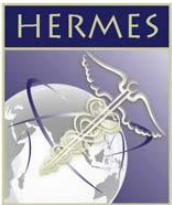
- Vaccine Results:**

Vaccine	Availability	Vials Used	Doses	Doses	Open Vial	Percent Shoved 9 to 8 °C	Percent Shoved Below -2°C	Vials Spilled
II Serum Institute 10 Dose (2.11 cc/dose)	100.00%	0.00	0.00	0.00	0.00	0.00%	0.00%	0
GPI WHO 10 Dose (2.11 cc/dose)	92.12%	0.00	0.00	0.00	0.00	47.88%	0.00%	0
PCV10 GM 2 Dose (2.11 cc/dose)	100.00%	0.00	0.00	0.00	0.00	0.00%	0.00%	0
RCS Serum Institute 10 Dose (2.11 cc/dose)	100.00%	0.00	0.00	0.00	0.00	0.00%	0.00%	0
M Serum Institute 10 Dose (2.11 cc/dose)	100.00%	0.00	0.00	0.00	0.00	0.00%	0.00%	0
Overall Total:	94.11%	0.00	0.00	0.00	0.00	5.89%	0.00%	0
- Microcosting:**

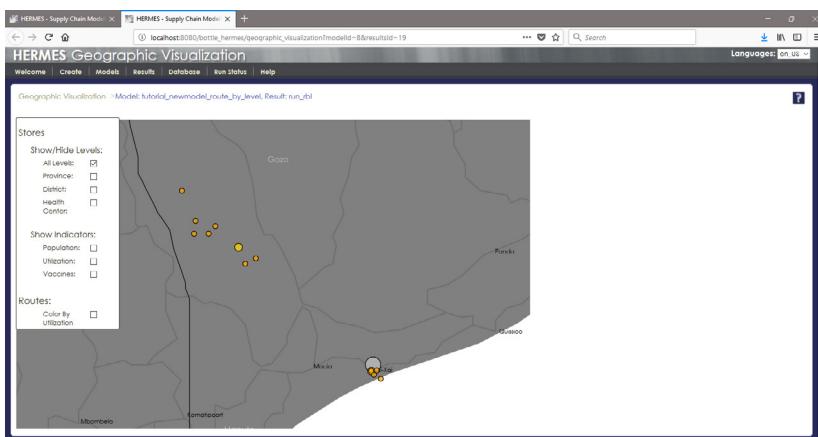
Levels	Storage Amount	Buildings	Per Item	Vehicle Amount	Vehicle Miles	Staff Salary	Overtime	Public Transport	Storage Miles	Flexible Miles
Province	40	100	6,701.42	1,060.31	300.03	7,220.00	2,000.23	0.00	257.05	205.61
District	47	206	4,547.48	312.42	77.00	5,760.00	518.65	0.00	201.01	114.00
Health Center	2,492.52	1,138.00	0.00	0.00	0.00	5,642.80	0.00	15.44	1,063.08	642.40
Total:	3,564.51	1,449.00	13,869.10	1,818.73	377.83	18,258.80	9,518.88	15.44	1,591.19	1,019.81
- Buttons at the bottom:**
 - Save
 - Cancel
 - Open Geographic Visualization
 - Open Network Visualization
 - Download Excel Results...

33. Click on the “**Download Excel Results**” Spreadsheet button below the tables to acquire a spreadsheet of results.

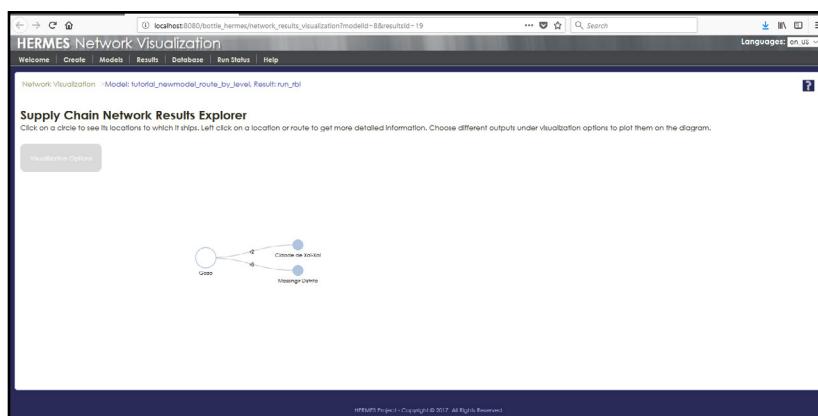
34. Click the “**Save**” button and then use the download dialog box to either open or save a copy.



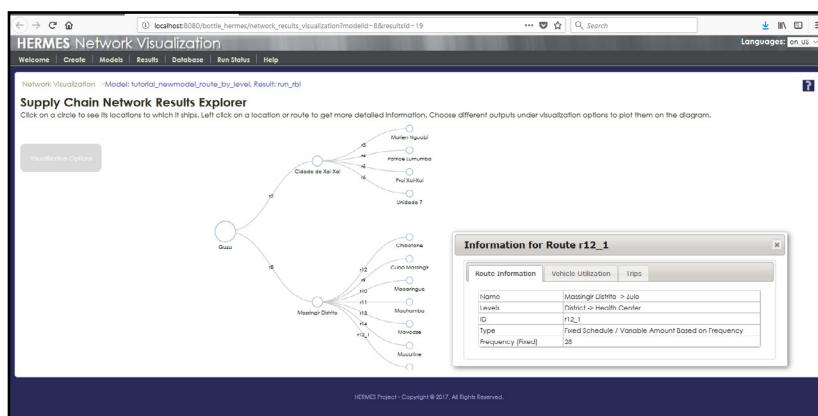
Visualization Buttons



35. Click the “**Open Geographic Visualization**” button. This page will open in a new window and can take some time to load.



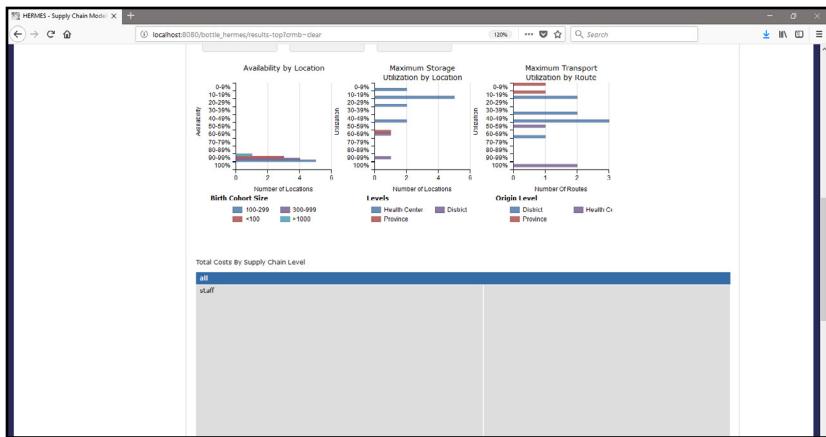
36. Back on the results window, click the “**Open Network Visualization**” button. This page will also open in a new window. A filled-in circle means there are locations below that one. This is the same diagram as you looked at from the model page.



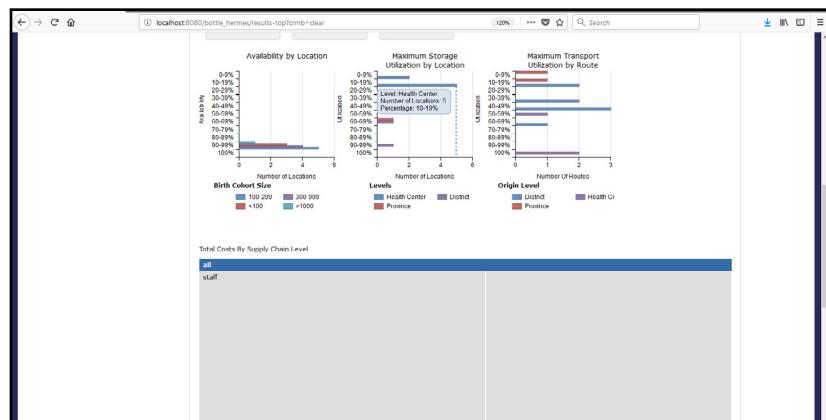
37. You can navigate this the same way you did on the models page; left click a circle to expand or contract locations; right click a circle or route to get information on that location or route.



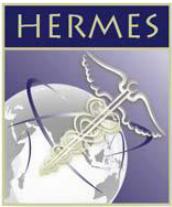
Histograms



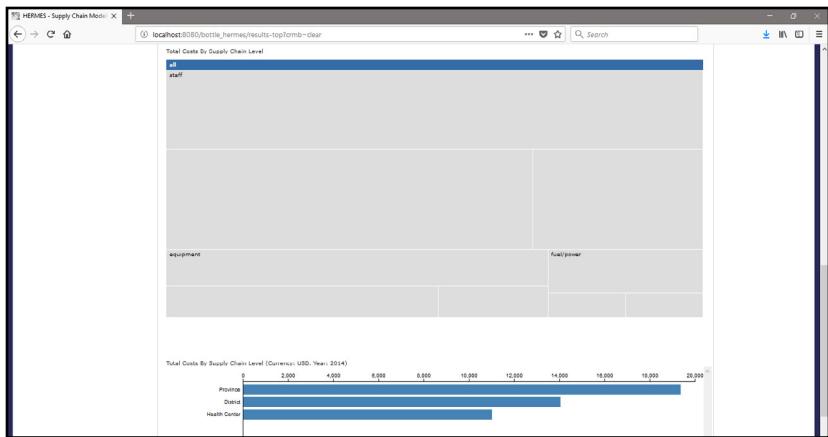
38. Look at the histograms.



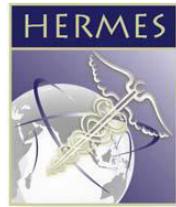
39. Hovering your mouse over a bar will pop up more information about the bar (see *middle chart*).



Total Costs by Supply Chain Level



40. Total costs by supply chain level are represented by a treemap and bar chart, both of which are interactive.



Tutorial 7

Introduce Transport Loops

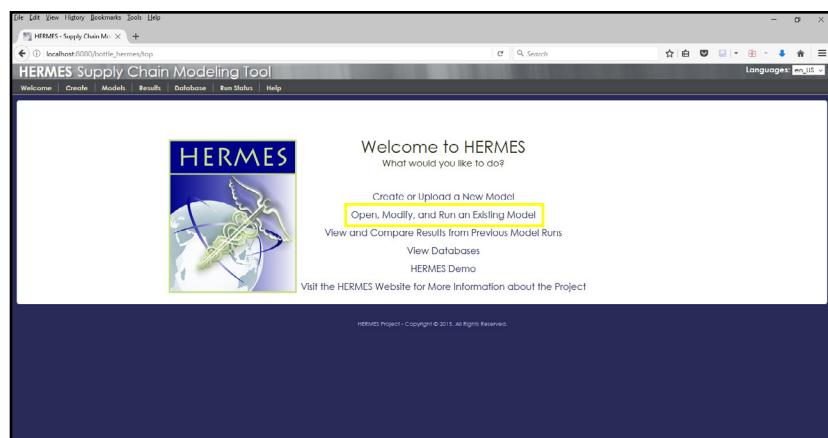
In this tutorial, you will alter the tutorial_newmodel you previously created by introducing transport loops.

Many supply chains utilize transport routes that start at one location and visit multiple locations before returning to their origin. This type of shipping route is known as a “loop”. Loops can be more efficient and provide more reliable shipping of products than delivering to locations one at a time because they require maintaining a smaller fleet of vehicles that can potentially travel shorter distances and provide a more regular shipping pattern. However, transport loops may also require larger vehicles with additional storage space which may be more costly to operate and maintain and may incur per diem costs as the routes become quite long. Modeling can help a user understand these tradeoffs and where and when transport loops may make sense for your supply chain.

This experiment will take you through a series of screens that will ask you between which supply chain levels you would like to create transport loops, the number of locations per transport loop and the vehicle that you would like to use for each loop. After you insert your parameters, HERMES will automatically create transport loops for the model based on shortest distance.

Open Model

Note: Please zoom in to see screenshots. We recommend zooming in to at least 2000%.



1. On the Welcome Page, click **“Open, Modify and Run an Existing Model.”**

Available Models in HERMES

Please select a model to open. You can use the buttons on the right to perform various actions with the selected model. If you would like to edit the notes or the name of a model, please double click on the line.

Select a Model	Name	Model ID	Note	Actions
ModelData	1			Open Run Results Copy Info Del
tutorial_newmodel	2			open Run Results Copy Info Del

2. Click on the “**Open**” button in the tutorial_newmodel row.

tutorial_newmodel Model

Please select what you would like to do with this model:

- Create Experiments Based on This Model**
- Modify structure with the Advanced Model Editor
- Add or remove model components (e.g. vaccines, storage devices, vehicles, and population categories)
- Tabular Interfaces for editing the model
 - Edit Storage Location Geographic Coordinates
 - Edit Storage Location Population Estimates
 - Edit Storage Location Device Inventories
- Modify the Vaccine Dose Schedule
- Add or remove delivery costs
- Randomize the system with automatically created transport loops
- Run a Simulation Experiment with this Model
- View Results from previously saved Simulation Experiments
- Export Model as a HERMES XML File

Supply Chain Network Diagram

This diagram depicts the structure of this supply chain. Clicking on a location can expand or contract the routes and locations below the selected location. Right-clicking a location or route will bring up more detailed information.

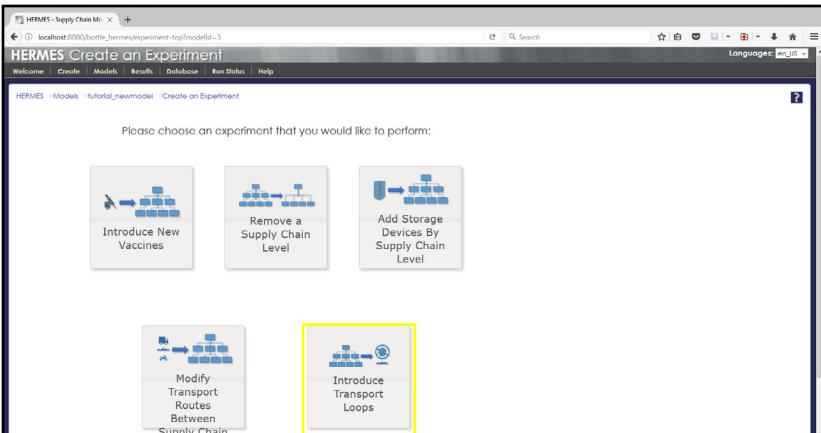
```

graph LR
    G[Giza] -- rx --> O[Ondale de Xer-Xai]
    O -- rx --> M[Mezengiz Dikulu]
    
```

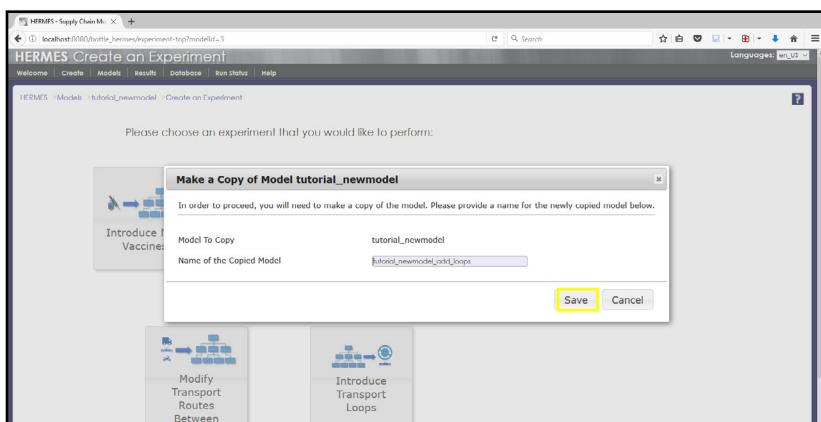
3. This opens the main model page.

4. Click on “**Create Experiments Based on this Model**”.

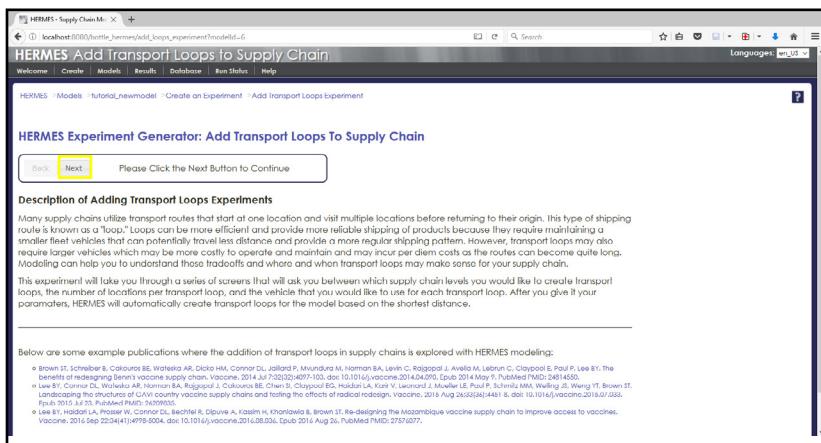
Start Experiment



5. Click on the “**Introduce Transport Loops**” box. You will be prompted to create a copy of the model to run.



6. Click “**Save**”, unless you want to change the name of the copied model first. The next page has some text describing this type of experiment.



7. Click “**Next**”. This is the beginning of your choices for adding a transport loop.

HERMES - Supply Chain M... X

localhost:8080/tutelle_hermes/add_loops_experiment?modelId=6

HERMES Add Transport Loops To Supply Chain

Welcome | Create | Models | Results | Database | Run Status | Help

Language: en_US

HERMES - Models - tutorial_newmodel - Create an Experiment - Add Transport Loops Experiment

HERMES Experiment Generator: Add Transport Loops To Supply Chain

Back Next Please Click the Next Button to Continue

Please select below the level you would like to start the transport loops.

Province District

8. Select “**District**” as the level at which to start the loops. This will open another selection below.

HERMES - Supply Chain M... X

localhost:8080/tutelle_hermes/add_loops_experiment?modelId=6

HERMES Add Transport Loops To Supply Chain

Welcome | Create | Models | Results | Database | Run Status | Help

Language: en_US

HERMES - Models - tutorial_newmodel - Create an Experiment - Add Transport Loops Experiment

HERMES Experiment Generator: Add Transport Loops To Supply Chain

Back Next Please Click the Next Button to Continue

Please select below the level at which you would like to start the transport loops.

Province District

Please select below the level(s) to include in the transport loops.

Health Center All Locations Below

9. Now select “**Health Center**” as the level the loops will distribute to.

HERMES - Supply Chain M... X

localhost:8080/tutelle_hermes/add_loops_experiment?modelId=6

HERMES Add Transport Loops To Supply Chain

Welcome | Create | Models | Results | Database | Run Status | Help

Language: en_US

HERMES - Models - tutorial_newmodel - Create an Experiment - Add Transport Loops Experiment

HERMES Experiment Generator: Add Transport Loops To Supply Chain

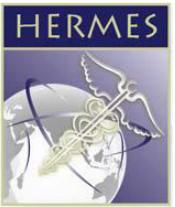
Back Next Please Click the Next Button to Continue

Please select below the level at which you would like to start the transport loops.

Province District

Please select below the level(s) to include in the transport loops.

Health Center All Locations Below



HERMES Tutorial: Introducing transport loops

Screenshot of the HERMES Experiment Generator: Add Transport Loops To Supply Chain interface. The page shows fields for specifying transport loop parameters: "Maximum Number of Locations Per Transport Loop" set to 6, and "Transport Component to be Used for Loops" set to "provincial Hilux". A yellow box highlights the "Next" button.

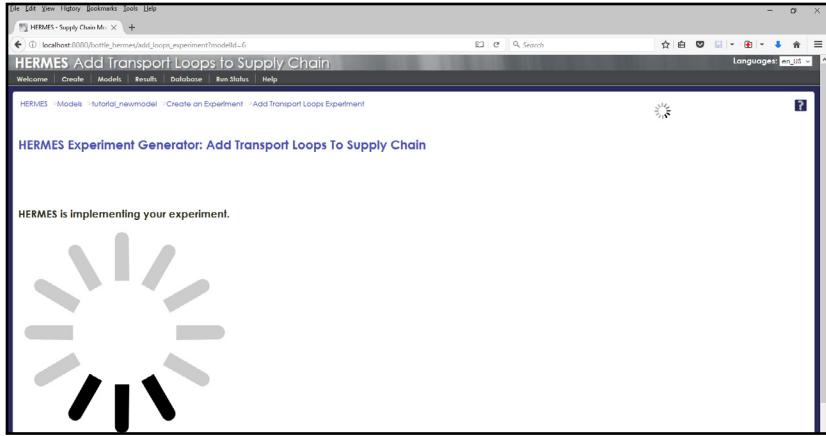
10. Click “**Next**” to add in some more parameters.

Screenshot of the same interface after changing the maximum number of locations per transport loop to 7. The "Maximum Number of Locations Per Transport Loop" field is highlighted with a yellow box, showing the value 7. The transport component remains set to "provincial Hilux".

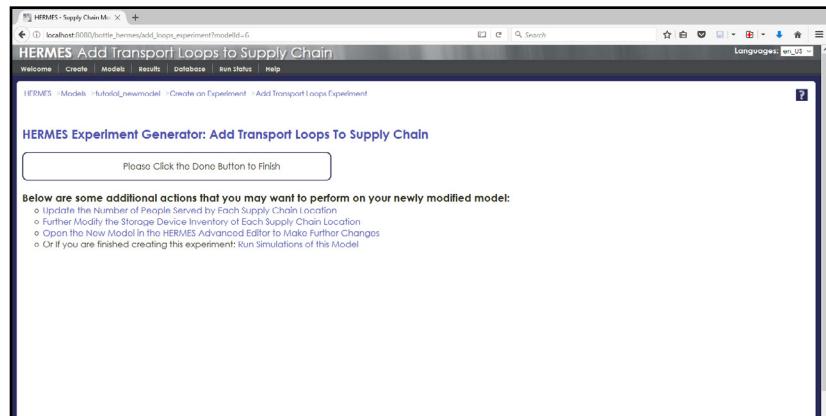
11. Change the Maximum Number of Locations Per Transport Loop to 7. Make sure the Transport Component is the provincial Hilux.

Screenshot of the interface showing the "Add Transport Loops Experiment Summary" page. It displays the summary of the chosen options: "The number of locations per transport loop is: 6" and "With the mode of transport: provincial Hilux".

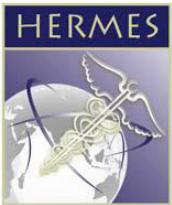
12. Click “**Next**” to get a summary page. If one of your parameters looks wrong, you can always use the Back button to fix it before changing the model.



13. Click “**Next**” to have HERMES adjust the model by creating transport loops. This might take a few seconds or a few minutes depending on how large your model is. (*It shouldn’t take more than 30 secs for this model.*)



14. When the model has been adjusted, the page will update with some further options.



Run Simulation

Please Click the Done Button to Finish

Below are some additional actions that you may want to perform on your newly modified model:

- o Update the Number of People Served by Each Supply Chain Location
- o Further Modify the Strategic Device Inventory of Each Supply Chain Location
- o Open the New Model in the HERMES Advanced Editor to Make Further Changes
- o Or if you are finished creating this experiment **Run Simulations of this Model**

15. Click “**Run Simulations of this Model**” (in the last line of text)

Running a HERMES Model

What name should be given to this set of results
How many stochastic (random) runs would you like to run?

Run Parameters for model tutorial

Number of Simulation Days
Number of Shipments from the Manufacturer per Day
Factor for buffer stock from the Manufacturer
Sets the default buffer stock for the whole model

Validating Model

Test	Message
All	There were no warnings or errors in the model; please proceed to press the Run Simulation button below.

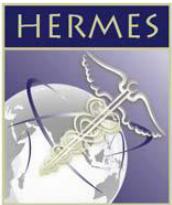
Run Simulation

16. Type a name for your run and click the “**Submit**” button. There should be no errors in the model.

Status of Currently Running Simulations

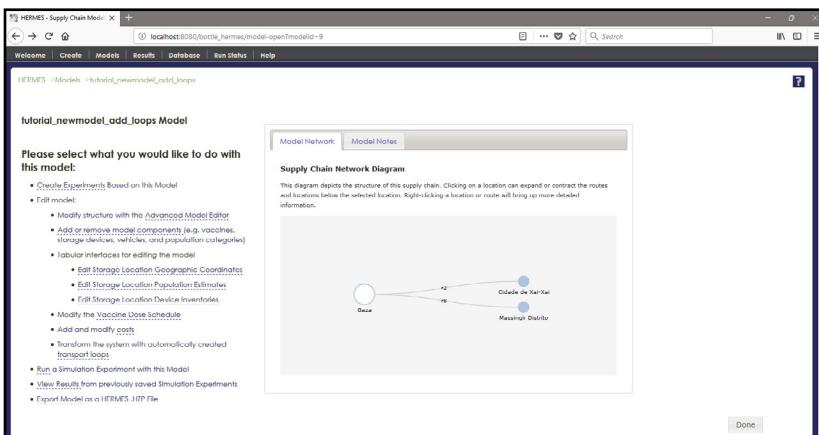
Available Runs	Run Name	Model Name	Model ID	Submitted	Status	Details
	run_ibl	tutorial_newmodel.route_by_level	8	Wed Nov 29 15:59:24 2017	finished	Info Logs
	run_olt	tutorial_newmodel.add_loops	9	Wed Nov 29 16:06:23 2017	running 11.11% (run 1)	Info Logs

17. Click “**Run Simulation**”. The run status page will open and you can watch the progress of your run.

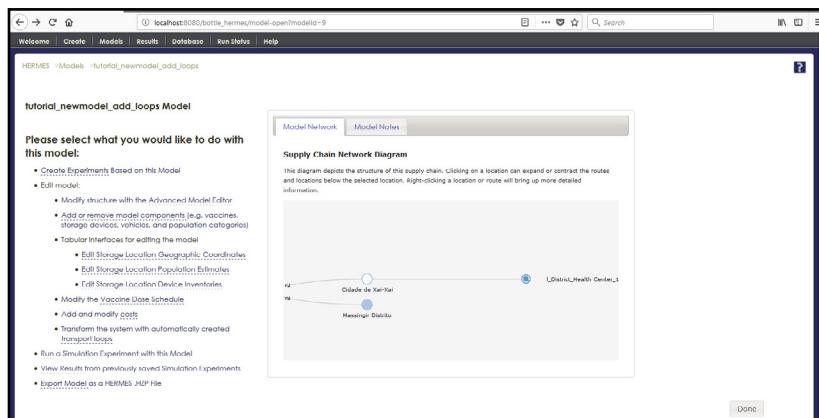


View Changes in Model

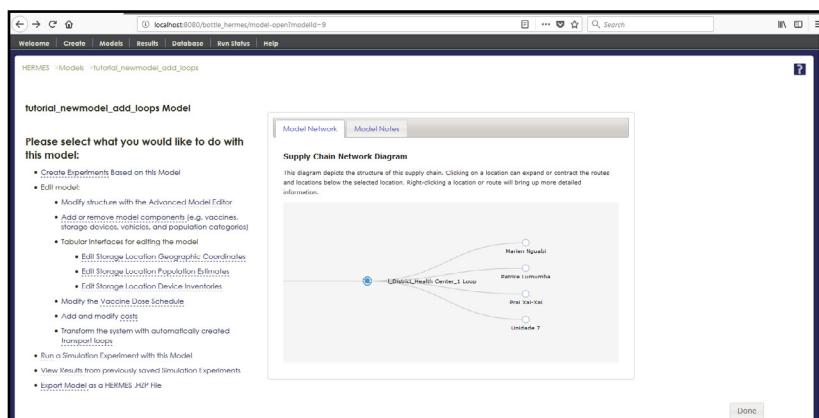
While waiting for the simulation to finish running, take a look at the changes in the model.



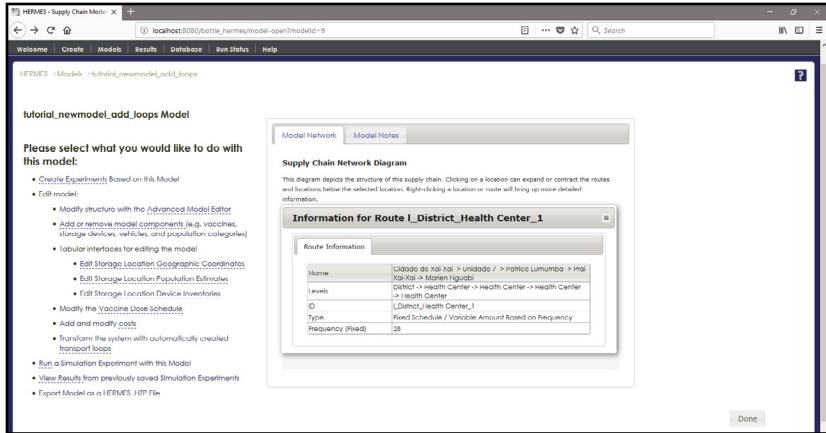
18. Open the model tutorial_newmodel_add_loops (or whatever you named it in step XX) by going to the Models page and clicking “Open” in the row of that name.



19. At the top level, this may look the same as the original tutorial_newmodel diagram. Click on “**Cidade de Xai-Xai**”. The blue circle with arrows indicate a loop has been formed and labeled as a loop.



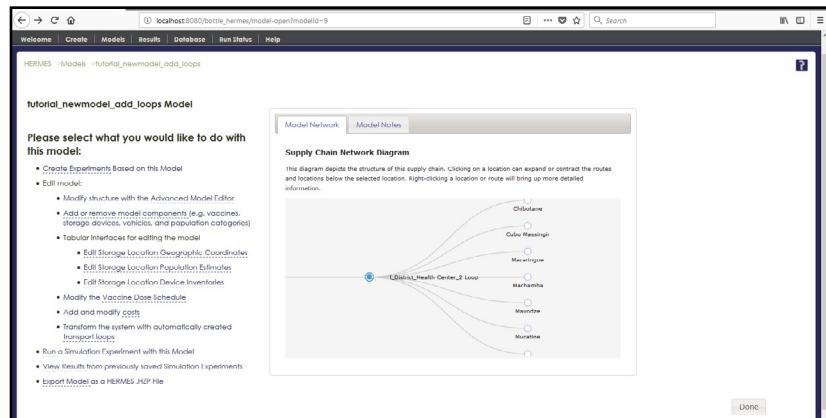
20. Click on the blue circle with arrows. This shows you the locations included in the loop.



Information for Route 1_District_Health Center_1

Name:	Coppo do Xa Ici > Mwendo / > Ntocco Lumumba > Irai
Levels:	Xa Ici > Mwendo (uganda)
ID:	District > Health Center > Health Center > Health Center
Type:	Loop
Frequency (fixed):	28

21. Although the locations are portrayed as separate routes listed in alphabetical order, right clicking on any of the lines emanating from the blue circle with arrows will give the same information about the looped route, including the looping order.



22. Similarly, clicking on “Massingir Distrito” and then the blue dot with arrows will show the loop that was created for that district.

23. Spend a few minutes exploring the new structure and right clicking on the routes to see their descriptions.



View Results

Once your run has finished you will want to look at the results and compare them to your original run.

This screenshot shows the HERMES Simulation Results interface. The top navigation bar includes 'Welcome', 'Create', 'Models', 'Results' (which is highlighted with a yellow box), 'Database', 'Run Status', and 'Help'. Below the navigation bar, there is a message: 'Please select a result from the menu on the left to display.' On the left side, there is a tree view of simulation results. The tree starts with 'tutorial_newmodel_level_loops' and branches into several sub-folders: 'Model', 'Run 1', 'Run 2', and 'Run 3'. Each of these sub-folders contains a 'Results' folder. At the bottom right of the interface, there is a 'Done' button.

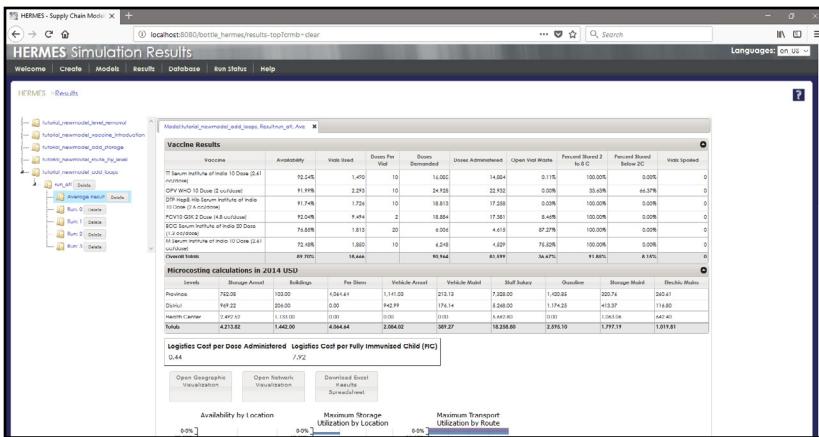
24. Click on “**Results**” on the top menu bar to open the Results page.

This screenshot shows the same HERMES Simulation Results interface as the previous one, but with more detail. The 'Results' menu option is still highlighted with a yellow box. The tree view on the left now shows the full path: 'tutorial_newmodel_level_loops' > 'Run 1' > 'Results'. The 'Results' folder under 'Run 1' is also highlighted with a yellow box. The rest of the interface remains the same, with the message 'Please select a result from the menu on the left to display.' and the 'Done' button at the bottom right.

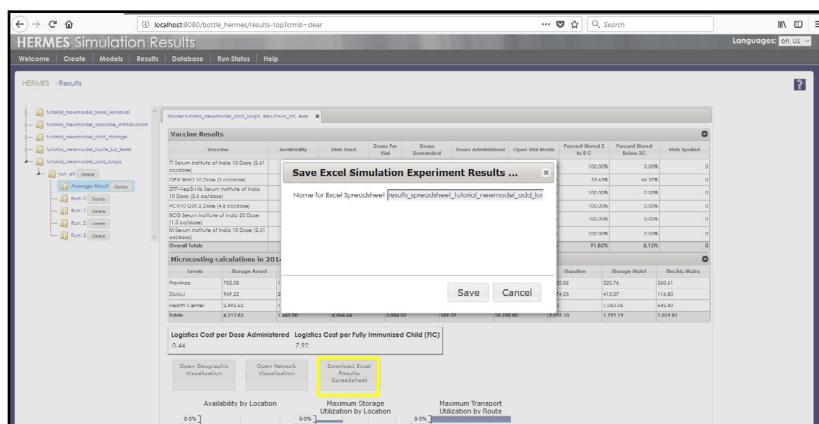
25. Expand the `tutorial_newmodel_level_loops` tree and select the “**Average Results**”.



Spreadsheet Costing Results

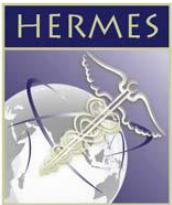


26. Spreadsheet costing results

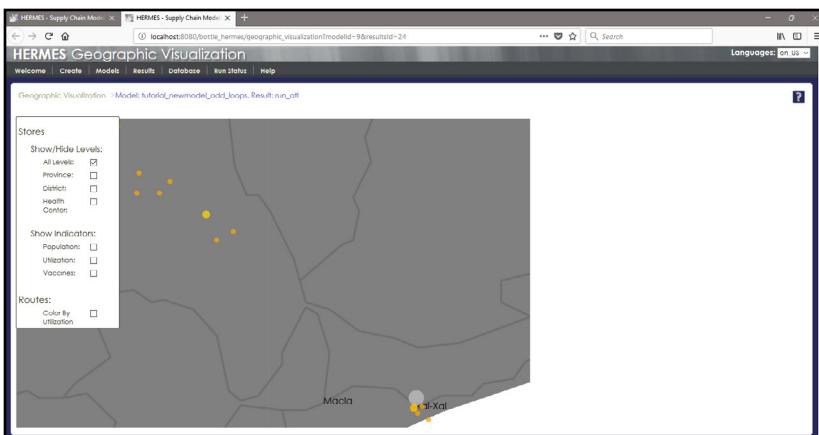


27. Click on the “Download Excel Results Spreadsheet” button below the tables to acquire a spreadsheet of the results.

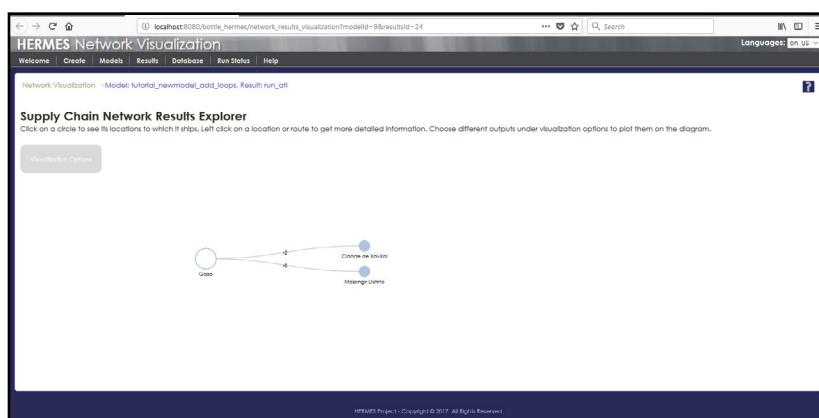
28. Click the “Save” button and then use the download dialog box to either open or save a copy.



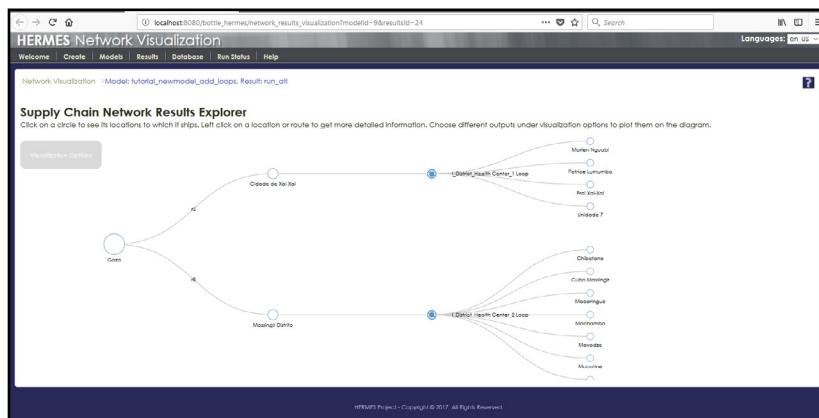
Visualization Buttons



29. Click the “**Open Geographic Visualization**” button. This page will open in a new window and can take some time to load.



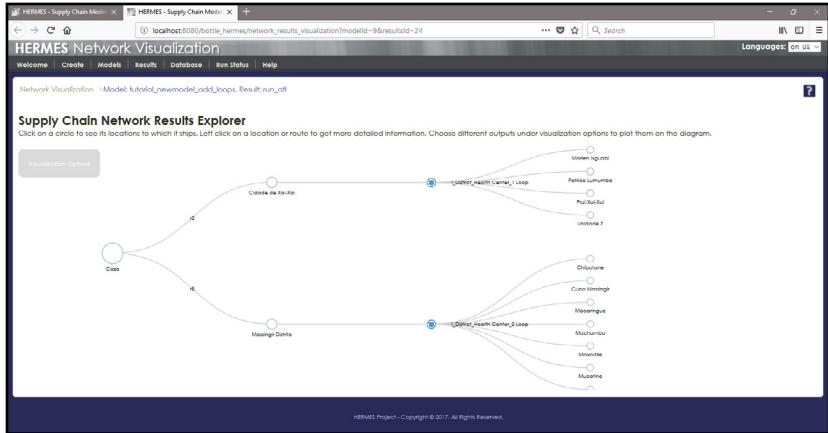
30. Click the “**Open Network Visualization**” button. This page will also open in a new window. A filled in circle means there are locations below that one. This is the same diagram as you looked at from the model page.



31. Left click on the “**Cidade de Xai-Xai**” circle to expand the locations below.



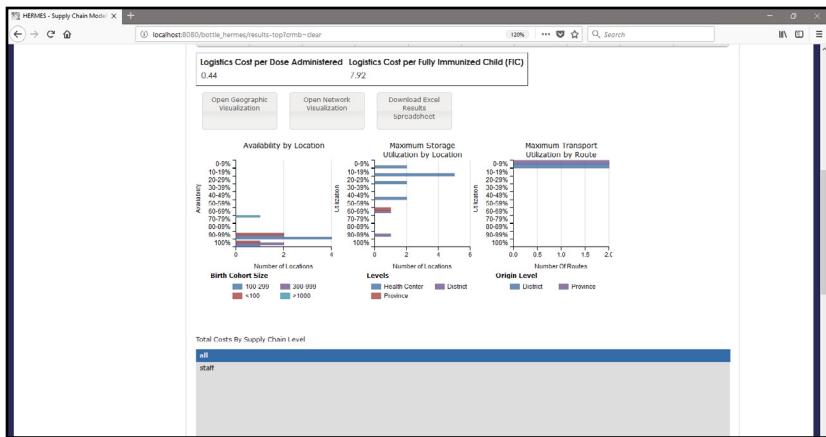
HERMES Tutorial: Introducing transport loops



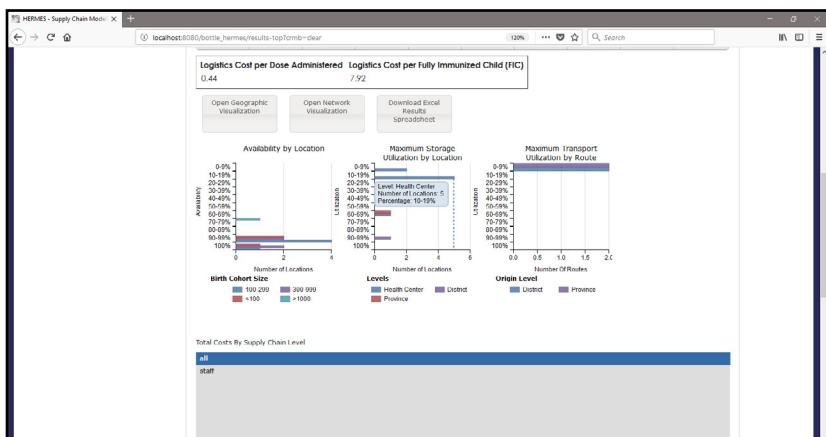
32. The diagram here shows the structure with all locations displayed (*any filled in circles were clicked*).



Histograms



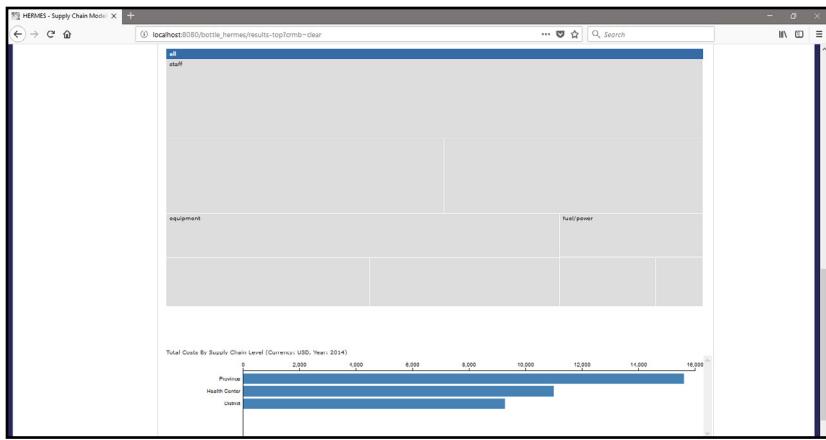
34. Look at the histograms.



35. Hovering your mouse over a bar will pop up more information about that bar (see *middle chart*).



Total Costs by Supply Chain Level



36. Total costs by supply chain level are represented by a treemap and bar chart, both of which are interactive.

Glossary

Supply Chain Basics

Supply Chain

The term for a system of processes through which product is moved from a manufacturer to the user.

Push

Alternately called an *allocation system*. In this type of system, the person who issues the supplies (e.g. the higher level) calculates the quantities sent through to the next level. Quantities can either be fixed in size or variable with regards to the demand (referred to in HERMES as "varpush").

Pull

Alternately called a *requisition system*. In this type of system, the location which receives the supplies (at the lower level) calculates the quantities that are required at their level. Quantities are usually variable, as these systems request whatever stock is needed.

Cold Chain

The supply chain when it utilizes cold devices, such as refrigerators, freezers, and vaccine carriers, as well as cold vehicles (e.g. cold trucks). Important in the vaccine supply chain because vaccine efficacy is maintained *only* when vaccines are kept in the cold chain.

Leaf Nodes

Alternatively called *service delivery points* or *SDPs*. According to the [USAID Logistics Handbook](#), it is defined as "any facility where users receive supplies related to health services". These locations are usually hospitals and health centers, but may also include mobile units, community-based distributors, laboratories, and health posts.

Supply Chain Levels

The administrative depots where products are usually kept and vaccine is transferred to and from. Common levels include the *National* or *Central* store, *Regional* or *Provincial* stores, *District* or *State* stores, and the service delivery points (i.e. *health centers*).

Point-to-Point Shipments

A type of shipping route in which a vehicle delivers or picks up just enough vaccine for one location.

Transport Loop

A type of shipping route in which a vehicle travels to multiple destinations before returning to its point of origin.

Vaccine Supply Chain Terminology

EPI

Expanded Program on Immunization. A program started by the World Health Organization in 1974, with the goal of making vaccines for childhood diseases available to children throughout the world.

this is the program that dictates the specific vaccines, ages and doses per child for each specific country.

NVI

New Vaccine Introduction. The catch-all term for the introduction of new vaccines into the standard EPI regimen.

qstockout

The term for when a location runs out of a particular product's stock. Can either be a partial stockout (a stockout for a particular product) or a full stockout (when the location has run out of all of a products' stock).

Supply Ratio (Vaccine Availability)

Defined as the number of treated individuals divided by the total number of individuals who are available to vaccinate. Analogous to prevalence, which is a measure in public health. When applied specifically to vaccines, it can be denoted as vaccine availability.

Open Vial Waste

Occurs when vials are opened but not all the doses are completely consumed before the vaccine vial expires. This process has been detailed by a previously published VMI file and the WHO's Multidose Vial Policy.

Baseline Scenario

The supply chain as it currently stands, with no population, storage, transportation or policy modifications.

4x4 Truck

Refers in this case to a pick-up truck,*not* an all-terrain vehicle (ATV). The space available for vaccines varies based on the specifications for the country-specific truck, as well as if it is a single-cab or a double-cab truck.

Vaccine Carrier

A type of cold box carried to the leaf nodes of a supply chain, often by motorcycle or public transport.

Probability Distributions

Stochastic Model

Alternately called a probabilistic model. The outputs of the model will vary slightly each time, as the model is based on the selection of a random number.

Stochasticity

Refers to a process which uses a random variable and/or uses a random sampling procedure which, over time and many trials, can approximate a certain outcome (opposed to a *deterministic* process, which parameterizes a variable into a discrete unit, which is subsequently used to create a certain outcome).

Poisson Distribution

The distribution from which the number of patients arriving at a clinic per vaccination session, and any other process involving a random number selection, is based. It is a discrete statistical distribution which expresses the probability of a given number of events occurring in a fixed interval of time and/or space if these events occur with a known average rate and independently of the time since the last event. It is usually based on the *Poisson law of small numbers*. This distribution is characterized by the parameters: mean = λ and standard deviation = $\sqrt{\lambda}$.