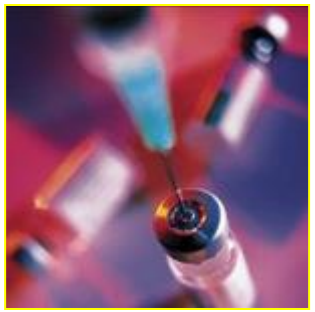
Vaccine Supply Chain Modeling: The HERMES Project

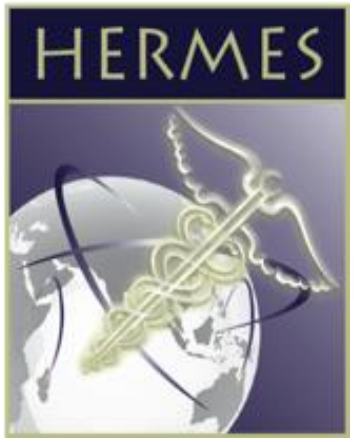




HERMES vision

Data on Supply Chain Structure, Storage Locations, Transport, Capacities, Personnel, etc.

Standard input deck



Discrete event simulation model of supply chain

Supply chain performance metrics

Economic Metrics

- Total Costs
- Unit Costs
- Cost Drivers

Create a *freely available* and *user-friendly software tool* for decision makers to generate an *interactive simulation model of any supply chain (= a virtual laboratory)*.

Example topics HERMES can address

- **Introducing new vaccines and technology**
  e.g., vaccines, storage
- **Monitoring the health and status of the supply chain**
  e.g. augment imperfect surveillance of the immunization program
- **Altering characteristics of vaccines and other technologies**
  e.g., vaccine vial size, vaccine thermostability, cold device capacity
- **Changing configuration and operations of the supply chain**
  e.g., storage, shipping frequency, personnel, ordering policy
- **Differing conditions/circumstances**
  e.g., power outages, delays, inclement weather, limited access
- **Investing or allocating of resources**
  e.g., adding refrigerators vs. increasing transport frequency
- **Optimizing vaccine delivery**
  e.g., minimize cost, cost per outcome, maximize immunizations

HERMES global work

2009

Formation of HERMES Logistics Team

2010

Thailand

- *Partners:* Prince of Songkla University and MOH
- *Evaluated*:
  - Impact of changing vaccine presentations
  - Impact of PCV and RV introductions
  - Impact of vendor-managed inventory system

2011

Senegal

- *Partners*: Senegal EPI Team and Project Optimize
- *Evaluated*:
  - Impact of changing vaccine presentations
  - Impact of PCV and RV introductions
  - Impact of Mobile Warehouse
- In-country hands-on workshop

Passive Vaccine Storage Devices (PVSDs)

- *Partners*: Global Good
- *Evaluated*:
  - Potential designs and impact of PVSDs

2012

India (Bihar, Kerala, & Gujarat)

- *Partners*: INCLEN, ITSU, PHFI
- *Evaluated*:
  - Current UIP status
  - Impact of isolated and combined introduction Rotavac, IPV, PCV, and Pentavalent vaccines
  - Simple, Complex and Radical improvements

2013

Decade of Vaccines Economics (DOVE) Collaboration

- *Partners:* BMGF, GAVI, WHO, UNICEF
- *Evaluated*:
  - Vaccine delivery costs in all GAVI-eligible countries

2014

Niger

- *Partners*: Niger Ministry of Health (MOH) and WHO
- *Evaluated*:
  - Impact of changing vaccine presentations
  - Impact of PCV and RV introductions
  - Impact of system redesign
  - Impact of thermostable vaccines
  - Impact of information system

Vietnam

- *Partners*: Vietnam MOH and EPI Team and Project Optimize
- *Evaluated*:
  - Impact of changing vaccine presentations
  - Impact of PCV and RV introductions
  - Impact of system redesign
- In-country hands-on workshop

Vaccine Supply Chain Re-Design

- *Partners:* Bill and Melinda Gates Foundation (BMGF) Co-Chair Meetings
- *Evaluated:*
  - Segmentation analysis of all GAVI eligible country supply chains
  - Potential supply chain redesign (simplification) in three sample countries

Benin

- *Partners*: Benin MOH, LOGIVAC Project (AMP and WHO), UNICEF, and PATH
- *Evaluated*:
  - Impact of system redesign
- In-country workshops

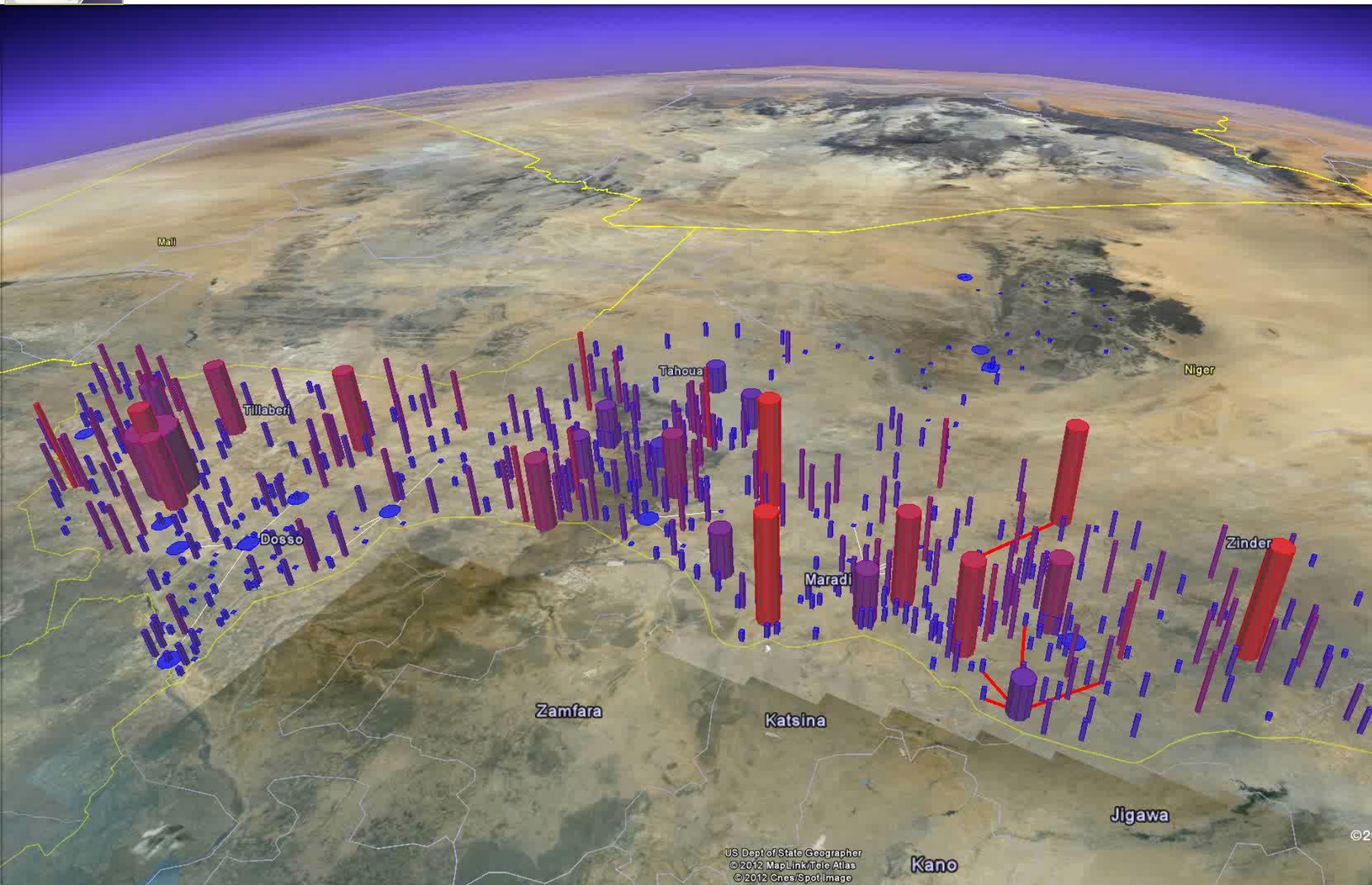
Kenya

- *Partners:* Kenya MOH and UNICEF
- *Assisted with*:
  - Development of GAVI HSS Proposal

Mozambique (Gaza & Cabo Delgado)

- *Partners*: UNICEF and Village Reach
- *Evaluated*:
  - Current supply chain performance
  - Impact of system redesign

Modeling Vaccine Supply Chains



Mozambique Workshop on Modeling and HERMES

The workshop provided the first step in capacity building and creating a local team of experts on the concept of modeling and the HERMES tool.

Participants included Ministry of Health national and provincial level, UNICEF, WHO, University of Eduardo Mondlane, VillageReach, and the HERMES Logistics team

Sample HERMES publications

- **Introducing new vaccines and technology**
  - Lee BY, Assi T, Rajgopal J, Norman BA, Chen S, Brown ST, Bailey RR, Kone S, Kenea H, Welling J, Connor DL, Wateska AR, Jana A, Wiringa AE, Van Panhuis WG, Burke DS. (2012) Impact of introducing the pneumococcal and rotavirus vaccines into the routine immunization program in Niger. Am J Public Health, 102(2):269-76.
  - Norman BA, Nourollahi S, Chen S, Brown ST, Claypool EG, Connor DL, Schmitz MM, Rajgopal J, Wateska AR, Lee BY. (2013) A passive cold storage device economic model to evaluate selected immunization location scenarios. Vaccine, 31(45):5232-8.
  - \+ 3 more
- **Altering characteristics of vaccines and other technologies**
  - Lee BY, Cakouros BE, Assi TM, Connor DL, Welling J, Kone S, Djibo A, Wateska AR, Pierre L, Brown ST. (2012) The impact of making vaccines thermostable in Niger's vaccine supply chain. Vaccine, 30(38):5637-43.
  - Lee BY, Assi T, Rookkapan K, Connor DL, Rajgopal J, Sornsrivichai V, Brown ST, Welling J, Norman BA, Chen S, Bailey RR, Wiringa AE, Wateska AR, Jana A, Van Panhuis WG, Burke DS. (2011) Replacing the measles ten-dose vaccine presentation with the single-dose presentation in Thailand. Vaccine, 29(21):3811-7.
  - \+ 2 more
- **Changing configuration and operations of the supply chain**
  - Assi TM, Brown, ST, Kone S, Norman BA, Djibo A, Connor DL, Wateska AR, Rajgopal J, Slayton RB, Lee BY. (2013) Removing the regional level from the Niger vaccine supply chain. Vaccine, 31(26):2828-34.
  - \+ 2 more
- **Investing or allocating resources**
  - Haidari LA, Connor DL, Wateska AR, Brown ST, Mueller LE, Norman BA, Schmitz MM, Paul P, Rajgopal J, Welling JS, Leonard J, Chen S, Lee BY. (2013) Augmenting transport versus increasing cold storage to improve vaccine supply chains. Plos One, 8(5):e64303.
  - \+ 1 more
- **Optimizing vaccine delivery**
  - Brown ST, Schreiber B, Cakouros BE, Wateska AR, Dicko HM, Connor DL, Jaillard P, Mvundura M, Norman BA, Levin C, Rajgopal J, Avella M, Lebrun C, Claypool E, Paul P, Lee, BY. (2014) The benefits of redesigning Benin's vaccine supply chain. Vaccine, 32(32):4097-103.

HERMES graphical user interface (GUI)

HERMES Simulation Results

Welcome | Models | People | Vaccines | ColdStorage | Transport | Demand | Costs | Run Hermes | Results | Developer | Help

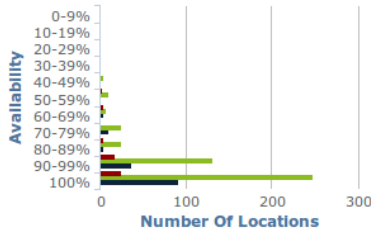
Welcome

Vaccine Results

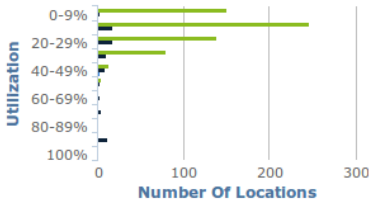
Vaccine	Availability	Vials Used	Doses Per Vial	Doses Requested	Doses Administered	Open Vial Waste	Percent Stored 2 to 8 C	Percent Store Below 2C	Vials Spoiled
Measles Vaccine Generic 10 Dose	85.37%	51,646	10	322,743	275,512	46.65%	100.00%	0.00%	0
DTP HepB Hib Generic 2 Dose	94.79%	519,861	2	1,067,900	1,012,235	2.64%	100.00%	0.00%	0
Tetanus Toxoid Generic 10 Dose	95.50%	60,332	10	631,420	603,028	0.05%	100.00%	0.00%	0
Prevenar PCV13 1 Dose	94.86%	969,903	1	1,022,473	969,903	0.00%	100.00%	0.00%	1
BCG Generic	89.69%	32,032	20	362,254	324,908	49.28%	100.00%	0.00%	0
OPV Generic 20 Dose	95.42%	67,968	20	1,424,008	1,358,855	0.04%	16.35%	83.65%	0
Yellow Fever Generic 10	85.36%	51,704	10	322,741	275,479	46.72%	100.00%	0.00%	0

Show Google Earth Viz

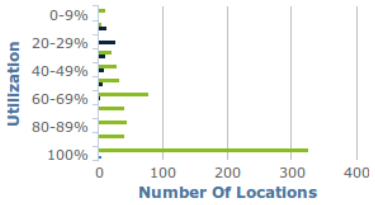
Availability by Location



Maximum Storage Utilization by Location



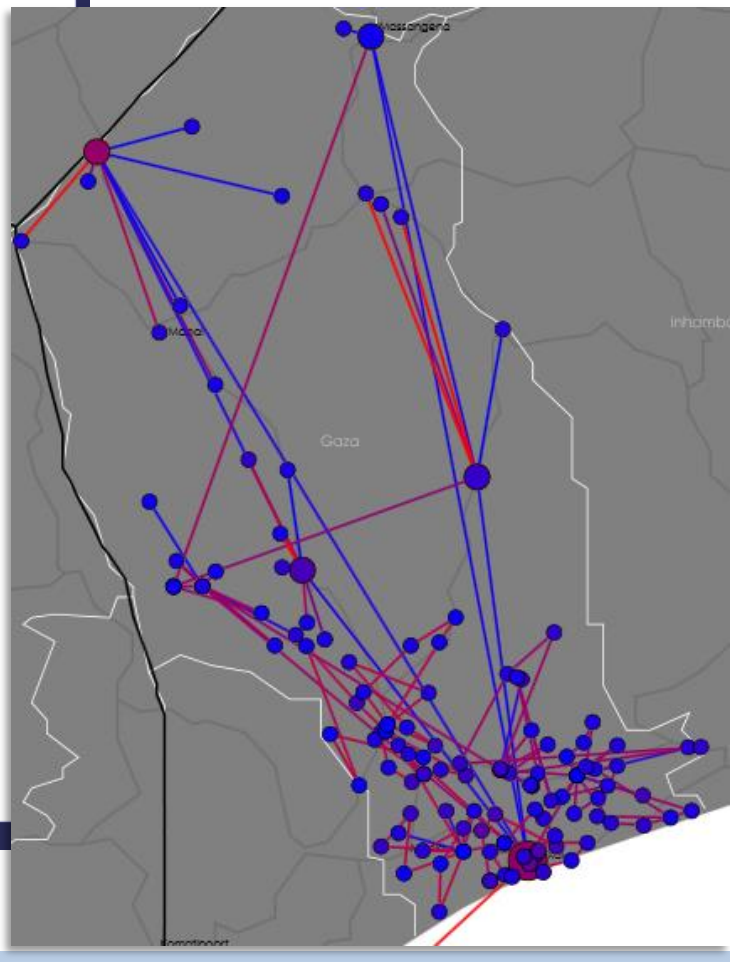
Maximum Transport Utilization by Route



Birth Cohort Size
<100 100-299 300-999 >1000

Levels
Department Commune HealthPost Central

Origin Level
Department Commune HealthPost Central



PITTSBURGH SUPERCOMPUTING CENTER

JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

IVAC Evidence ➤ Policy ➤ Access

For more information, please visit: hermes.psc.edu

HERMES logistics team

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