

Strengthening Vaccine Supply Chains: A systems approach using HERMES

(Highly Extensible Resource for Modeling Event-Driven Supply Chains)

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What is a system?



Transportation systems



Ecological systems



Manufacturing systems



Meteorological systems

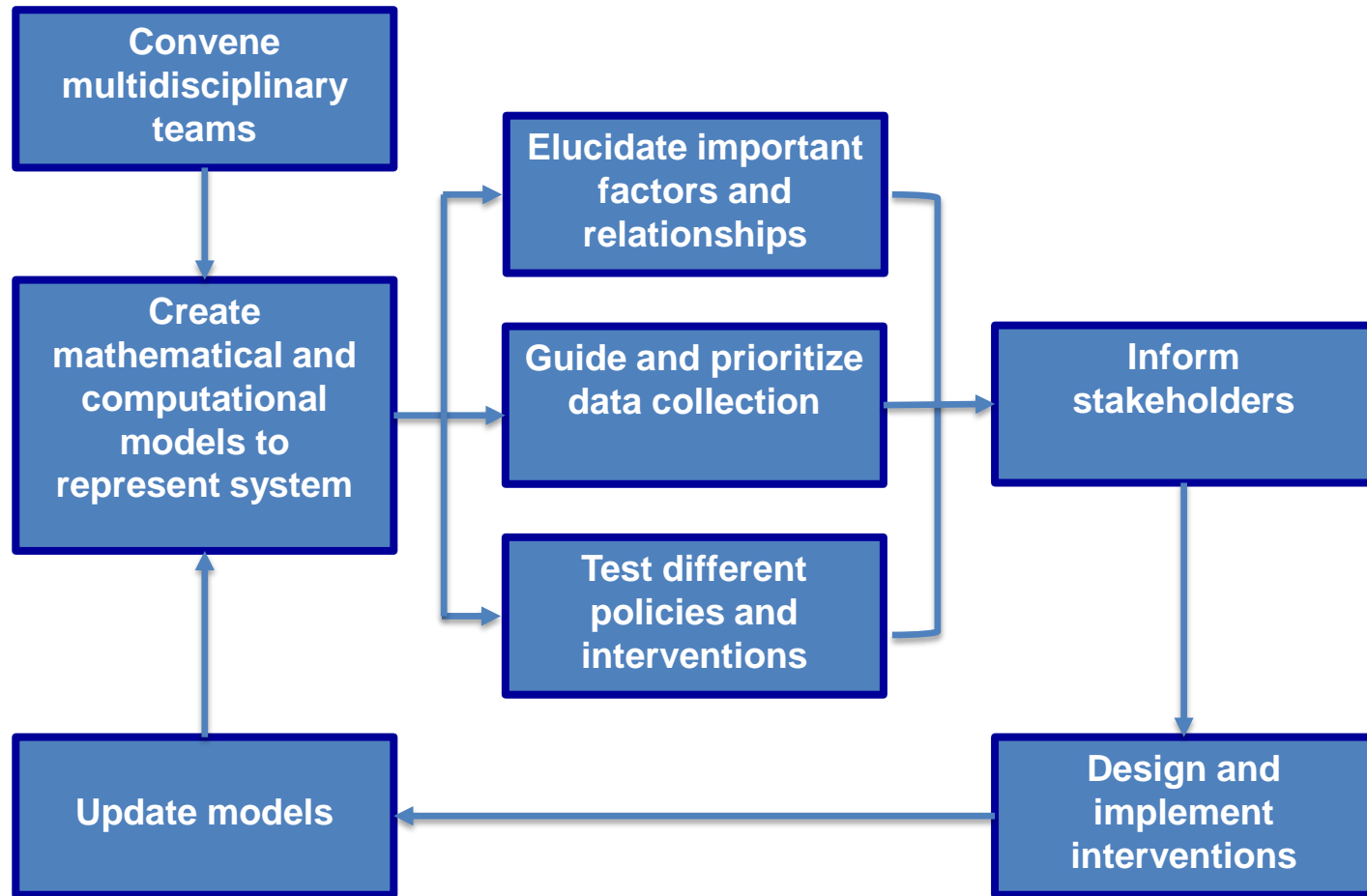


Financial systems

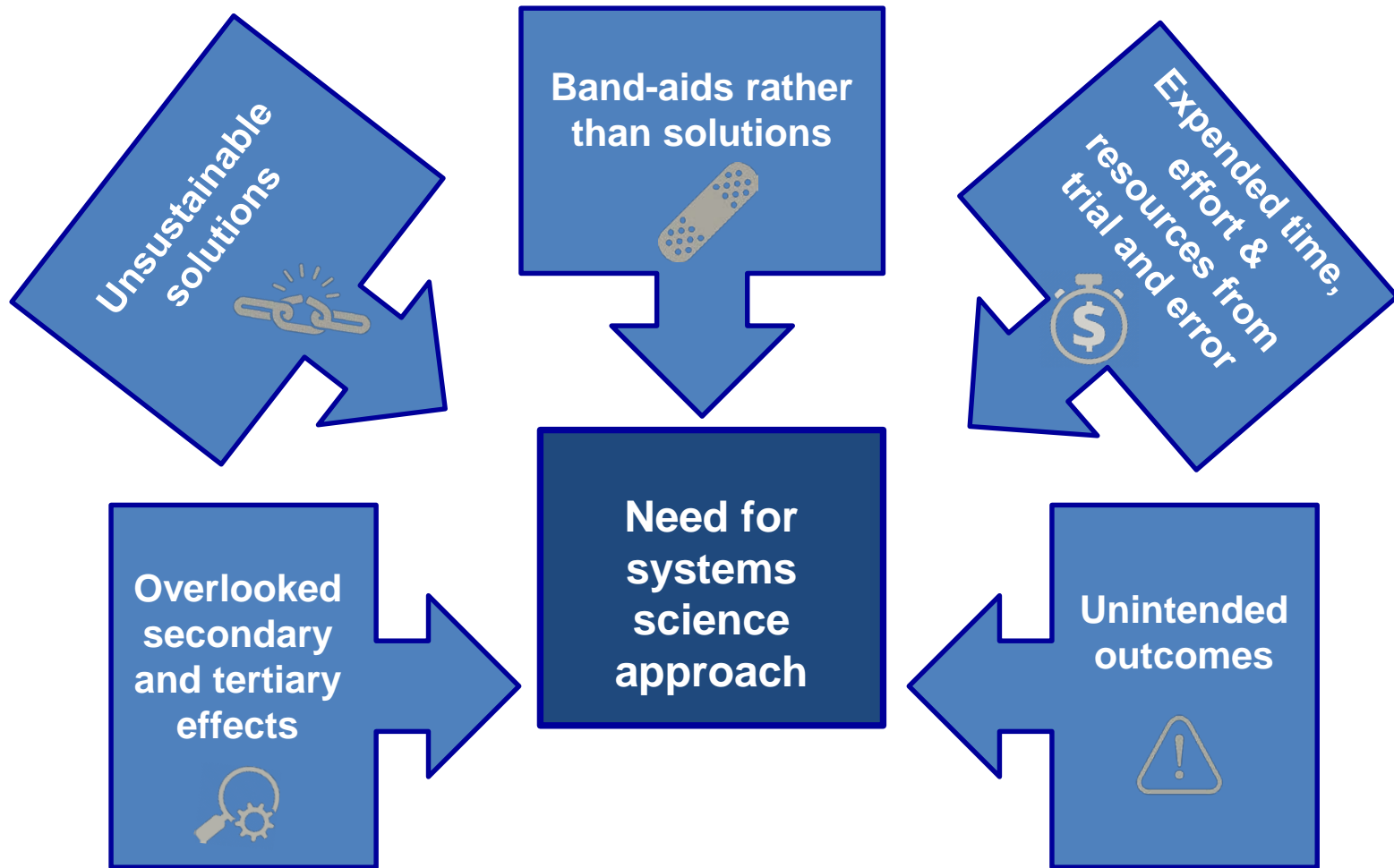


Aerospace systems

What is a systems approach?



Why do we need to take a systems approach?



Why focus on the supply chain?

Forbes

Are Vaccines Getting To Where They Need To Go?

Bruce Y. Lee, CONTRIBUTOR
I cover the intersection of business, health and public health.
Opinions expressed by Forbes Contributors are their own.

By Judith R. Kaufmann, Roger Miller, and James Cheyne

ANALYSIS & COMMENTARY

Vaccine Supply Chains Need To Be Better Funded And Strengthened, Or Lives Will Be At Risk

DOI: 10.1377/hlthaff.2011.0368
HEALTH AFFAIRS 30,
NO. 6 (2011): 1113-1121
©2011 Project HOPE—
The People-to-People Health
Foundation, Inc.

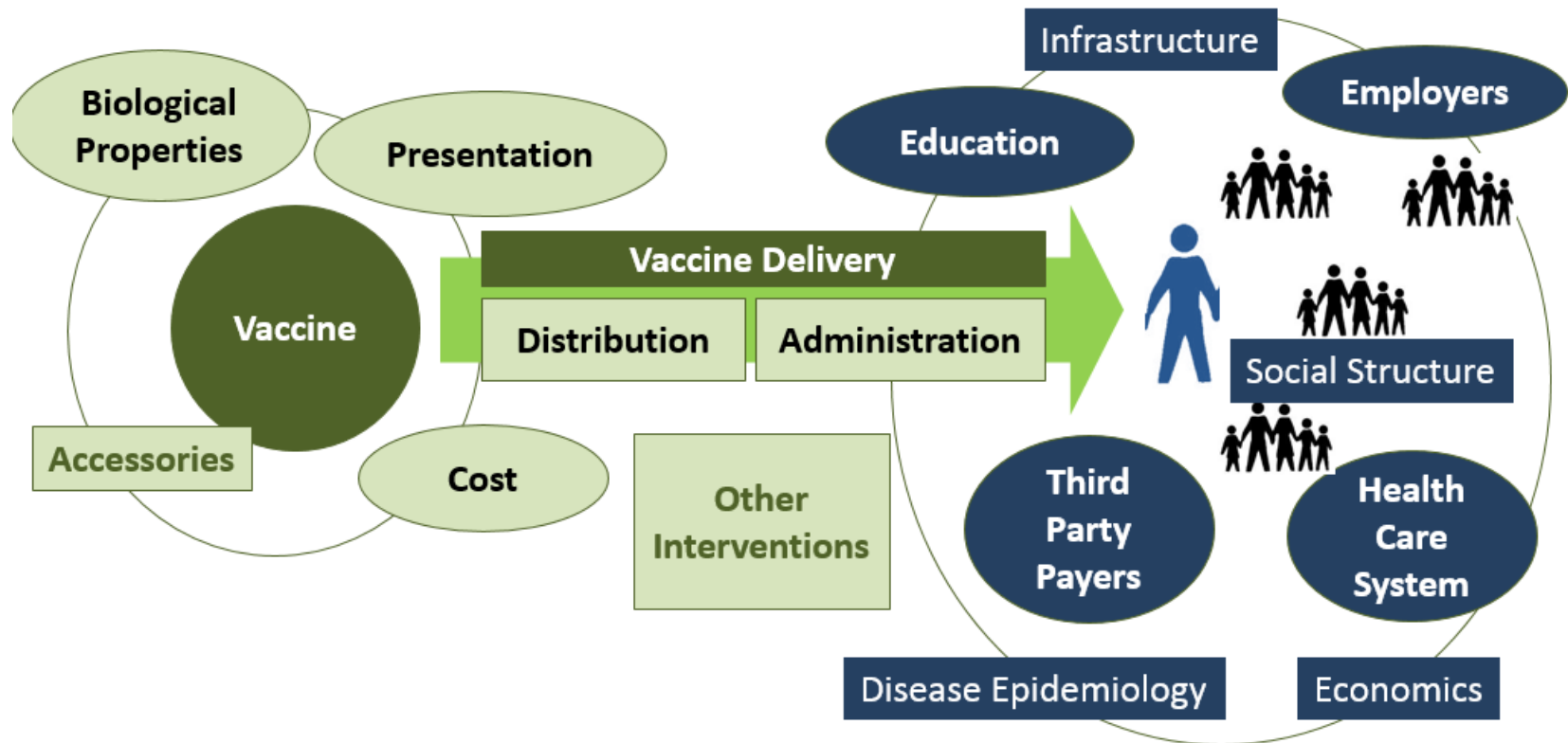
Contents | **Vaccine**

journal homepage: www.elsevier.com/locate/vaccine

Editorial

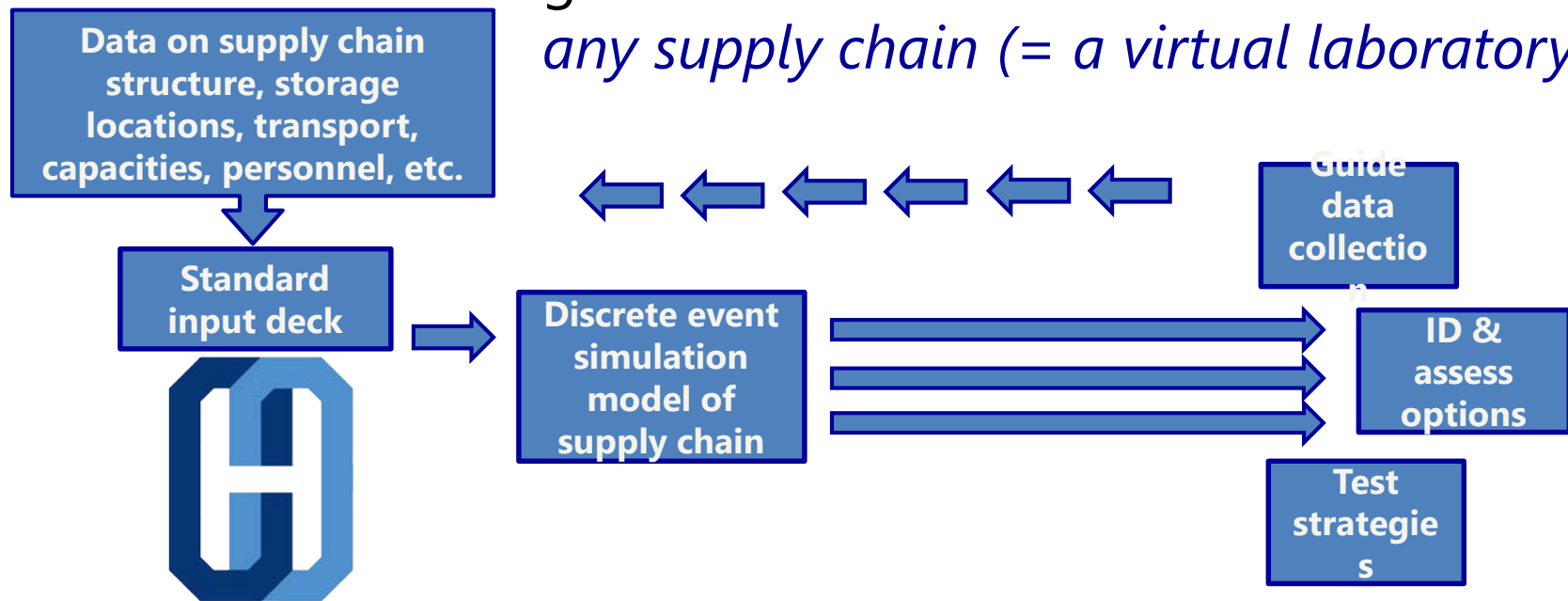
No product, no program: The critical role of supply chains in closing the immunization gap[☆]

Vaccine delivery is a complex system



HERMES is a systems modeling tool for decision support

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 has addressed

- **Introducing new vaccines and technology**
e.g. vaccines, storage, vehicles
- **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 resources**
e.g. adding refrigerators vs. increasing transport frequency
- **Optimizing vaccine delivery**
e.g. minimize cost, cost per outcome, maximize immunizations

Making vaccines thermostable



Contents lists available at SciVerse ScienceDirect

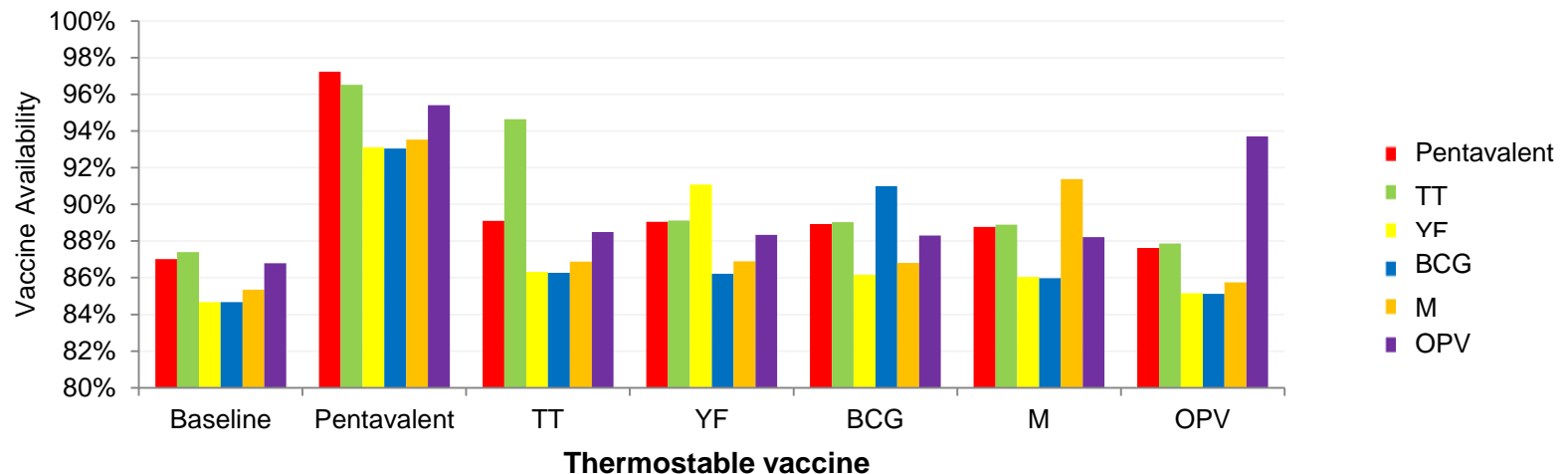
Vaccine

journal homepage: www.elsevier.com/locate/vaccine



The impact of making vaccines thermostable in Niger's vaccine supply chain

Bruce Y. Lee^{a,*}, Brigid E. Cakouros^a, Tina-Marie Assi^a, Diana L. Connor^a, Joel Welling^b, Souleymane Kone^c, Ali Djibo^d, Angela R. Wateska^a, Lionel Pierre^e, Shawn T. Brown^{b,f}



Evaluating solar refrigerators



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Vaccine

journal homepage: www.elsevier.com/locate/vaccine



When are solar refrigerators less costly than on-grid refrigerators: A simulation modeling study [☆]



Leila A. Haidari ^{a,b}, Shawn T. Brown ^{a,b}, Patrick Wedlock ^{a,c}, Diana L. Connor ^{a,c}, Marie Spiker ^{a,c}, Bruce Y. Lee ^{a,c,*}

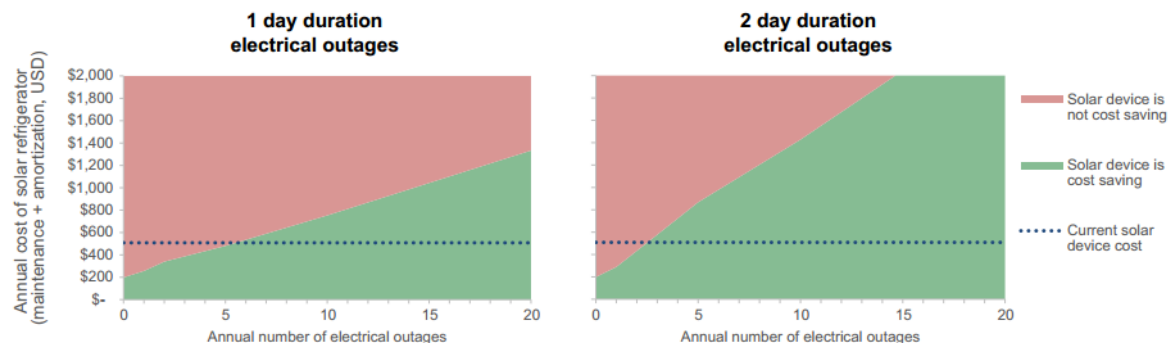


Fig. 2. Conditions under which solar powered refrigerators can provide savings over electric refrigerators at health facilities. The maximum annual cost for each solar device (including amortization and maintenance) that can provide savings over electric mains-powered refrigerators in total cost per dose administered at the health facility level is shown when electrical outages of varying frequency and duration occur at all health facilities. Results assume the electric refrigerator holdover time exceeds the duration of the outage.

Redesigning the system



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

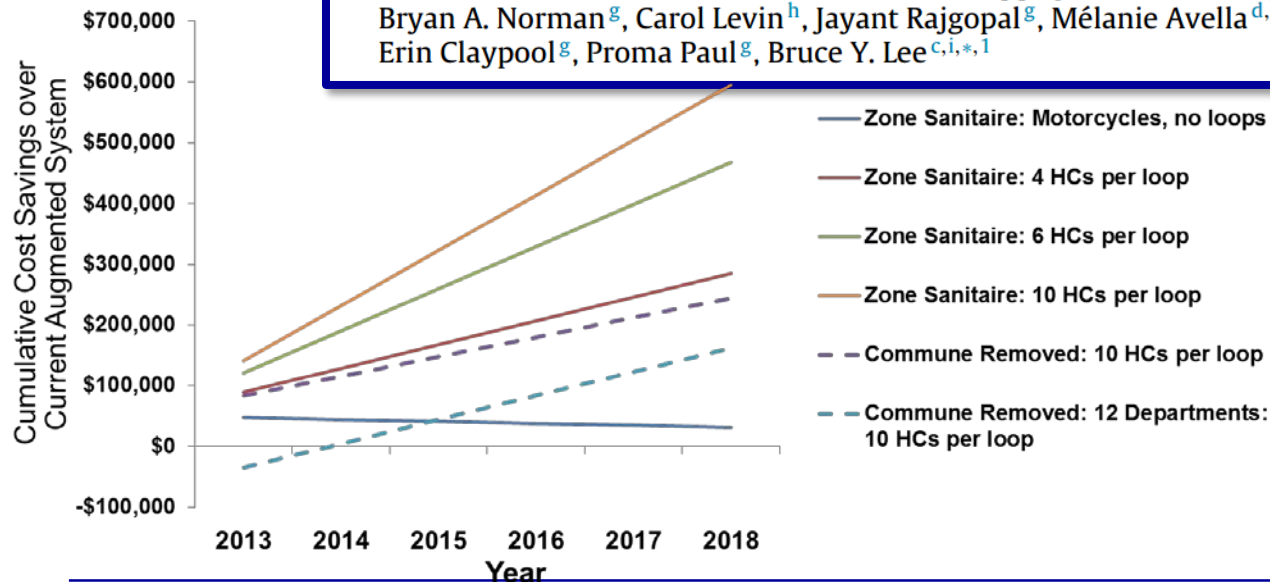
Vaccine

journal homepage: www.elsevier.com/locate/vaccine



The benefits of redesigning Benin's vaccine supply chain

Shawn T. Brown^a, Benjamin Schreiber^b, Brigid E. Cakouros^{c,1}, Angela R. Wateska^{c,1}, Hamadou M. Dicko^{d,e}, Diana L. Connor^{c,1}, Philippe Jaillard^{d,e}, Mercy Mvundura^f, Bryan A. Norman^g, Carol Levin^h, Jayant Rajgopal^g, Mélanie Avella^{d,e}, Caroline Lebrun^{d,e}, Erin Claypool^g, Proma Paul^g, Bruce Y. Lee^{c,i,*,1}



Assessing alternative transport

The Next New Frontier For Drones: Saving Lives

Bruce Y. Lee, CONTRIBUTOR
I cover the intersection of business, health and
Opinions expressed by Forbes Contributors are their own.






Contents lists available at ScienceDirect

Vaccine

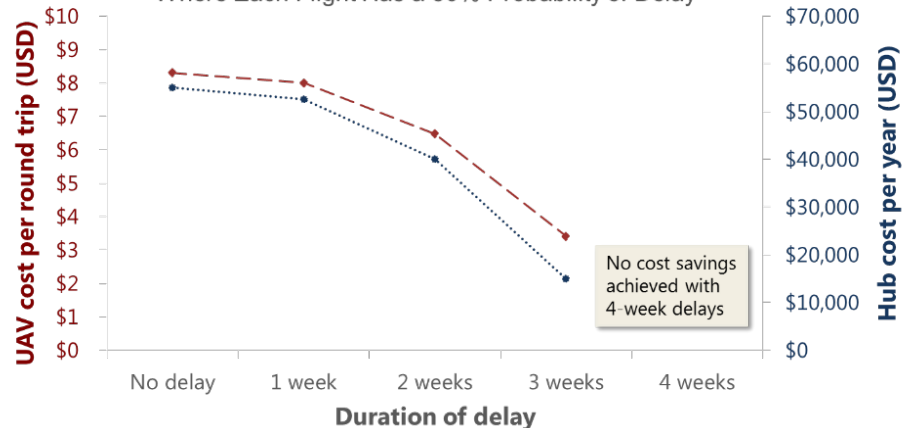
journal homepage: www.elsevier.com/locate/vaccine

The economic and operational value of using drones to transport vaccines

Leila A. Haidari^{a,b}, Shawn T. Brown^{a,b}, Marie Ferguson^{c,d}, Emily Bancroft^e, Marie Spiker^{c,d}, Allen Wilcox^e, Ramya Ambikapathi^{c,d}, Vidya Sampath^e, Diana L. Connor^{a,d}, Bruce Y. Lee^{a,c,d,*}

Maximum UAV and Hub Costs* to Produce Cost Savings Over TMLTS (EPI with Rota, IPV, MSD, and HPV Introductions), Where Each Flight Has a 50% Probability of Delay



HERMES 1.0 now available @ hermes.psc.edu

Johns Hopkins Bloomberg School of Public Health
Global Health **NOW**

GHN EXCLUSIVE | VACCINES

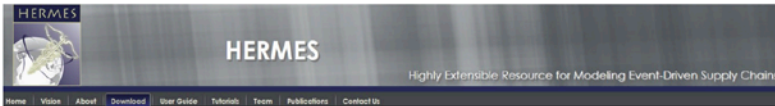
The Journey Matters: Why Vaccine Supply Chains Deserve Much More Attention



Global Immunization News (GIN)

April 2018

Next generation vaccine supply chain software available
User-friendly supply chain software can help guide decision makers through a hands-on approach
Sarah Rebert, Johns Hopkins Bloomberg School of Public Health



Vaccine supply chains are complex systems of storage locations, equipment, vehicles and personnel that get vaccines from the Central Store in a country to the population. Designing, planning, managing and fixing such complex systems has

HPC WIRE

HERMES Public Health Modeling Software Released for Public Use
April 23, 2018

Since 1987 - Covering the Fastest Computers in the World and the People Who Run Them

April 23, 2018 — Public health experts at the **Global Obesity Prevention Center (GOPC)** at Johns Hopkins U

International Vaccine Access Center at JHSPH @IVAcHerts - Apr 25
~3 million people die every year due to vaccine-preventable diseases.
#Vaccines are not getting to where they need to go. To address @GlobalObesity & @hpc_wire are releasing their HERMES software to improve vaccine delivery TODAY #immunizationWeek bit.ly/2HpaZDM



HERMES Create A Model

Welcome Create Models Results Database Run Status Help

HERMES Edit Supply Chain Structure Edit Shipping Policy Edit Shipping Times Make Adjustments Add/Remove Components Vaccine Dose Schedule

What is the supply chain structure of the "Country" 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 the number of levels in the supply chain:

Please give each of the levels a name (e.g., level 1 could be called Central, level 2 could be Regional, etc.)

Name for Level 1: Central 1 Location

Name for Level 2: Region 18 Locations

Name for Level 3: Health Post 135 Locations

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

Number of Locations in Central level:

Number of Locations in Region level:

Number of Locations in Health Post level:

Products Begin Here

1 Location → 18 Locations → 135 Locations

demand based amount fixed frequency 12 shipments per year travel time: 1 hour distance: 5 km

HERMES Simulation Results

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

Welcome

Vaccine	Availability	Vials Used	Doses Per Vial	Doses Requested	Doses Administered	Open Vial Waste	Percent Stored to 2 C	Percent Store Below 2C	Vials Spoiled
Measles Vaccine Generic 10 Dose	85.37%	51,646	10	322,743	275,512	46.65%	1	1	1
DTP HepB Hib Generic 2 Dose	94.79%	519,861	2	1,067,900	1,012,235	2.64%	1	1	1
Tetanus Toxoid Generic 10 Dose	95.50%	60,332	10	631,420	603,028	0.05%	1	1	1
Prevenar PCV13 1 Dose	94.86%	969,903	1	1,022,473	969,903	0.00%	1	1	1
BCG Generic	89.69%	32,032	20	362,254	324,908	49.28%	1	1	1
OPV Generic 20 Dose	95.42%	67,968	20	1,424,008	1,358,855	0.04%	1	1	1
Yellow Fever Generic 10	85.36%	51,704	10	322,743	275,470	46.75%	1	1	1

Show Google Earth Viz

Availability by Location: Bar chart showing availability percentages across different numbers of locations.

Maximum Storage Utilization by Location: Bar chart showing utilization percentages across different numbers of locations.

Birth Cohort Size: Legend for Birth Cohort Size: < 100, 100-299, 300-999, > 1000.

Levels: Legend for Levels: Department, HealthPost, Commune, Central.

Systems Science Core Team



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The background features a dark blue gradient with several light blue, semi-transparent graphic elements. At the top left, there is a stylized open book. Below it, a globe is partially visible on the left side. A series of vertical bars of varying heights and widths are arranged in a row, resembling a bar chart or a stylized architectural element. The text "Thank you" is centered in the middle of the page in a white, sans-serif font.

Thank you