A Systems Approach: New Methods and Technologies to Predict and Manage Food Supply Threats

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Content

• GOPC overview
  • Food supplies are complex systems
  • Systems approaches are needed to manage and protect food supplies
  • An example of systems modeling of food supplies
  • Summary and discussion
The GOPC is a university-wide Center

The Center includes experts across Johns Hopkins University
Organization of the GOPC

GLOBAL OBESITY PREVENTION CENTER (GOPC) AT JOHNS HOPKINS

- Administrative Core
- Systems Science Core
- Education & Training Program
- Domestic & International Efforts
Content

- GOPC overview
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What is a system?

Individuals do not exist in isolation; they are all part of many different systems, such as social, political, environment, and economic systems.
Examples of complex systems

- Transportation systems
- Ecological systems
- Manufacturing systems
- Meteorological systems
- Financial systems
- Aerospace systems
Dangers of not using a systems approach

- Band-aids rather than solutions
- Unsustainable solutions
- Missing secondary and tertiary effects
- Unintended consequences
- Expended time, effort, and resources from trial and error

Need for systems science approach
Content

• GOPC overview
• Food supplies are complex systems
• **Systems approaches are needed to manage and protect food supplies**
• An example of systems modeling of food supplies
  • VPOP Laboratories
  • HERMES Agri-food
• Summary and discussion
In a complex system, where to intervene?

Agricultural production
Grow, harvest, store

Supply chains
Store, transport, process, package

Retail environments
Stock, display, advertise, sell

Consumer behavior
Purchase, cook, consume, absorb

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Computational modeling can help understand and address complex systems

**Not** this type of modeling...

**This type of modeling...**

Laptop
Computer
Modeling is the bridge to translation

Modeling can and does occur at different time points along the research path from idea inception to policy implementation

**Modeling Considerations for study designs:**
- Data availability
- Generalizability
- Granularity

**Retrospective studies:**
- Generalizability
- Study population
- Expense
- Ethical and legal issues

**Prospective studies:**
- Generalizability
- Study population
- Expense
- Ethical and legal issues

**Policy and practice**
A systems approach iteratively brings together various disciplines, stakeholders, and methods.
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Food Supplies Have Similarities To Other Supply Systems
What is HERMES?

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 products and technology
  e.g. food and beverages, storage, vehicles

Monitoring the health and status of the supply chain
  e.g. augment imperfect surveillance

Altering characteristics of products and other technologies
  e.g. product size and vulnerability/stability

Changing configuration and operations of the supply chain
  e.g. storage, shipping frequency, personnel, ordering policy

Differing conditions/circumstances
  e.g. infectious disease outbreaks, contamination, delays, and inclement weather

Investing or allocating resources
  e.g. adding refrigerators vs. increasing transport frequency

Optimizing product delivery and safety
  e.g. minimize negative health outcomes and cost
Examples of HERMES collaborations

Niger
World Health Organization

Thailand

Senegal
PATH
MINISTÈRE DE LA SANTÉ ET DE L’ACTION SOCIALE

Vietnam
PATH

Passive Vaccine Storage Devices

Vaccine Supply Chain Redesign

Benin
globalgood

India

Kenya
unicef
Republic of Kenya

Decade of Vaccines

Mozambique

Unmanned Aerial Vehicles

SPACES Consortium


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Visualization of Supply Chain
Introducing new vaccines in a country
Implementing a system to forecast demand for vaccines

The impact of implementing a demand forecasting system into a low-income country’s supply chain


Fig. 2. Vaccinations administered with demand forecasting (DF) system.
Utilizing drones for vaccine transport
Making vaccines thermostable

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

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Baseline Pentavalent TT YF BCG M OPV

Vaccine Availability

Thermostable vaccine

- Pentavalent
- TT
- YF
- BCG
- M
- OPV
Investing resources to improve supply chain performance
Changing vaccine primary container sizes

One size does not fit all: The impact of primary vaccine container size on vaccine distribution and delivery


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Re-designing a country supply chain

The benefits of redesigning Benin’s vaccine supply chain

HERMES for Food Supply Chains

Location attributes:
- GIS coordinates
- Operating schedule
- Capital costs
- Operating costs

Previous location

Route attributes:
- Mode of transport
- Distance
- Travel time
- Order of stops
- Ordering policies

Storage attributes:
- Storage: ambient
- Storage: cool / shade
- Storage: refrigeration

example: wholesale market

Storage equipment attributes:
- Capacity
- Temperature
- Energy use
- Maintenance cost
- P (failure)

Personnel attributes:
- Wages
- % time

Vehicle attributes:
- Capacity
- Speed
- Fuel efficiency
- Driver wages
- P (delay)

Demand attributes:
- Type of people
- Demand per person
- People per location

next location
Example of HERMES Modeling: State of Odisha, India

[Diagram illustrating the supply chain from farms to consumers, with intermediaries such as warehouse or bulk cold storage, pre-wholesale intermediary, and pre-retail intermediary.]
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Questions and Discussion

Thank you!

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