



# Computing and Global Health

## Lecture 5

### Logistics

Winter 2015

Richard Anderson

# Today's topics

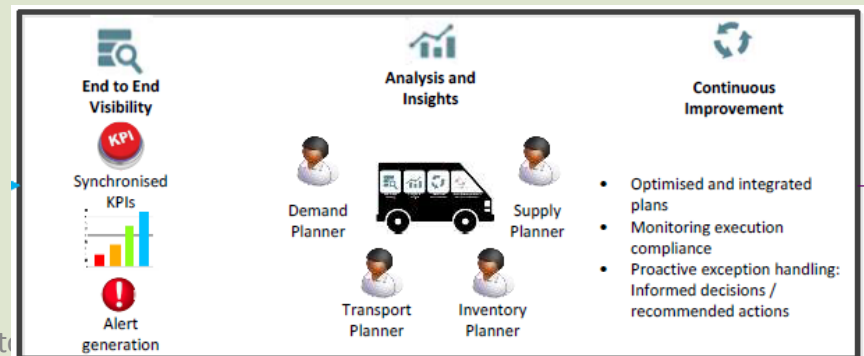
- Ron Pankiewicz, Village Reach
- GAVI Supply Chain Strategy
- Logistics requirements
- Logistics processes
  - Forecasting
  - Delivery
  - Ensuring product quality



# Readings and Assignments

- Logistimo
- SMS For Life (to assigned)
- Assignment 5: Design a data collection system for a Visibility & Analytics Network
- Assignment 6: Develop a syntax for an SMS reporting system

| Date         | Topic                 |
|--------------|-----------------------|
| Jan 7, 2015  | Overview              |
| Jan 14, 2015 | Surveillance          |
| Jan 21, 2015 | Tracking              |
| Jan 28, 2015 | Medical records       |
| Feb 4, 2015  | Logistics             |
| Feb 11, 2015 | Patient support       |
| Feb 18, 2015 | Treatment support     |
| Feb 25, 2015 | Health worker support |
| Mar 4, 2015  | Behavior change       |
| Mar 11, 2015 | Finance               |



# GAVI Supply Chain Slides

## Gavi, the Vaccine Alliance Immunisation supply chain strategy

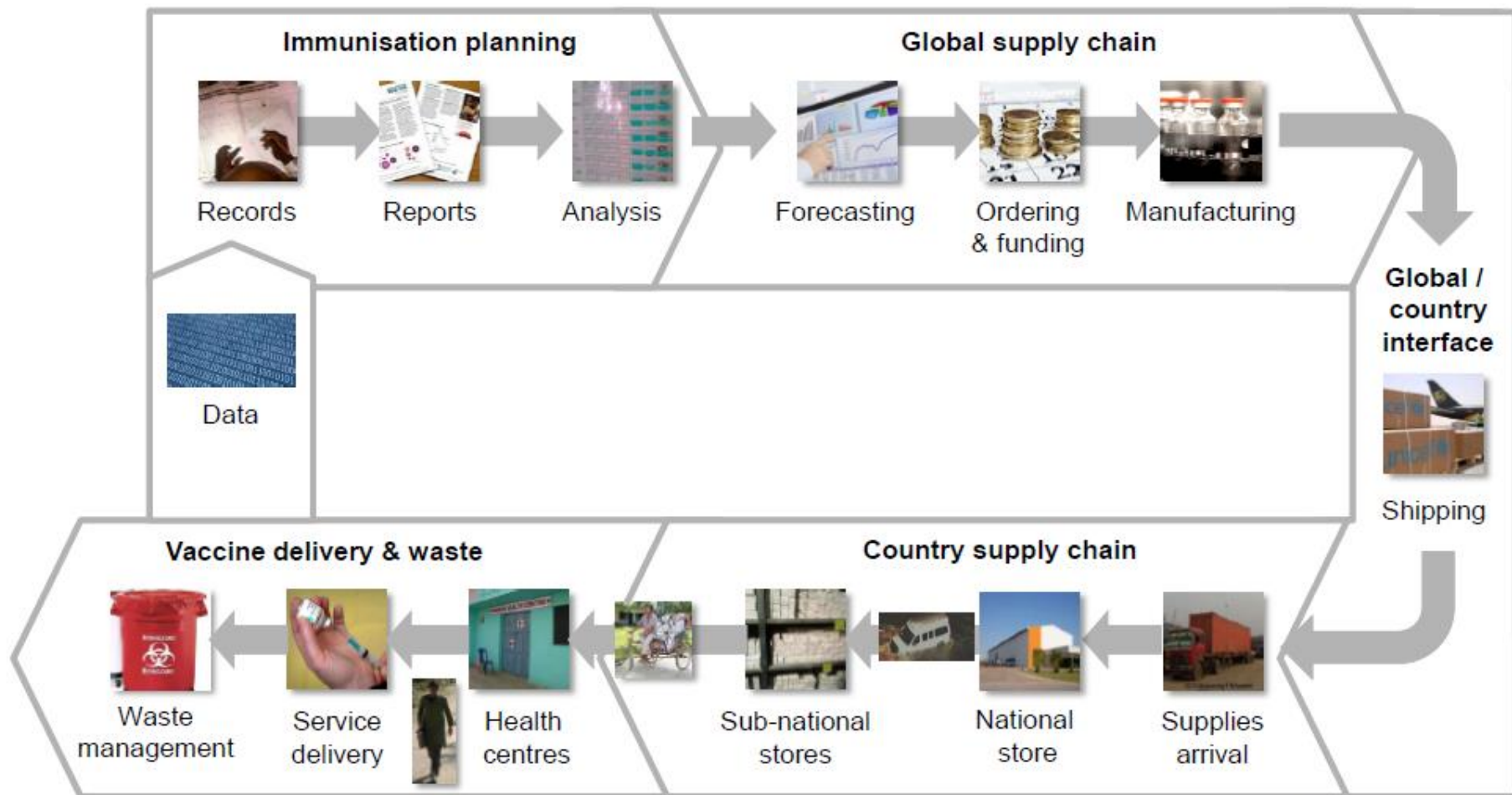
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Daniel Thornton  
30 October 2014, Copenhagen



[www.gavi.org](http://www.gavi.org)

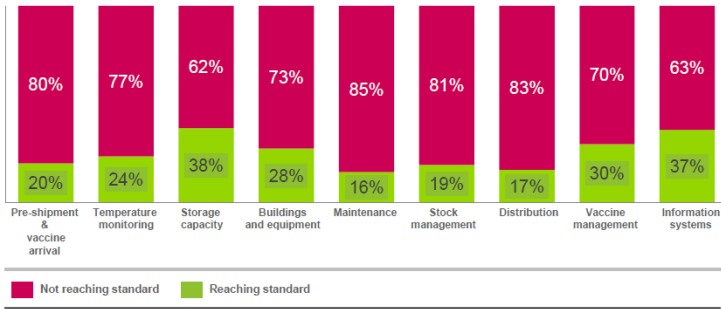
# Immunisation supply chain: an interconnected system involving flows of goods, funds and data



## Immunisation supply chain challenge

Most Gavi-eligible countries do not meet standards for most dimensions, and no country meets all standards

Percentage of GAVI-eligible countries currently meeting WHO standards for Effective Vaccine Management (EVM)<sup>1</sup>



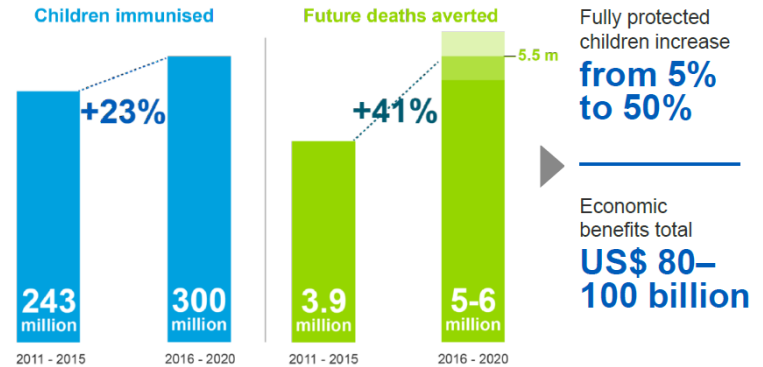
<sup>1</sup> EVM (Effective Vaccine Management) Assessments – Average score of Principal, Sub-National, Local District and Service Point Level. Source: EVM assessment for 57 GAVI countries, WHO

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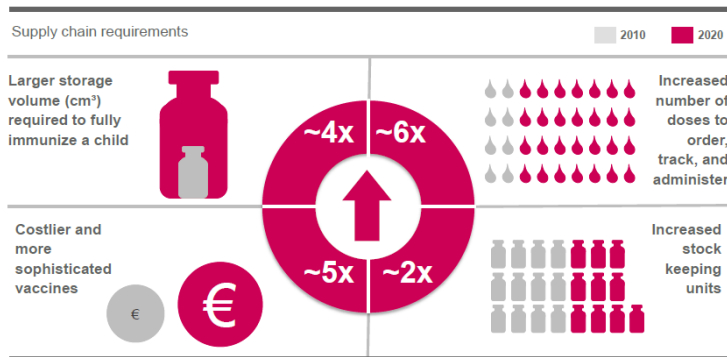


## ACCELERATING IMPACT 2016–2020

With US\$ 7.5 billion over 5 years:



## The challenge will get greater: higher volumes, doses and vaccine cost



Note: All figures relate to GAVI-funded vaccines  
 1. UNICEF Supply 2012 Financial report, WHO data for Pneumo and Rota vaccines, and HPV (only for girls);  
 2. 2010: GAVI Shipment Data; 2020: GAVI SDF Forecast; including volume for GAVI future graduated countries;  
 3. Comparison based on 2013 Price: 2020 Vaccines include: Rota, Pneumo, HPV; 2010 Vaccines include: YF, Measles, DPT, OPV (UNICEF SD); 4. GAVI Background SDF Information; 2010\* - estimates based on 2009 data; 2020\* - estimates based on 2013 forecast

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## Gavi Alliance partners jointly developed a strategy, approved by Gavi Board in June



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# The immunisation supply chain house

Save children's lives and protect people's health by increasing access to immunisation in poor countries

Vision 2020

Immunisation supply chains provide potent vaccines efficiently to all

Objectives

- 1
- Maintain vaccine potency
  - Ensure availability of right vaccines and supplies

- 2
- Use resources efficiently

Change



Alliance-wide theory of change

Priorities and Initiatives



System Design & Optimisation



People & Practices



Cold Chain Equipment



Data for Management



Distribution & Transport

Implementation mechanisms

Policy changes and guidance

In-country change process

Roles & responsibilities

Funding mechanisms

Technical assistance

Implementation roadmap

Budget

## Putting fundamentals in place



MANAGERS

### Supply chain managers

Ensure supply chain managers are in place with right capabilities, authority and accountability in every country



PLANS

### Supply chain management and improvement plans

Support development and implementation of comprehensive supply chain management plans



DASHBOARDS

### Supply chain dashboards

Track and use supply chain performance metrics to make strategic and operational decisions



SYSTEM REDESIGN

**System design (select countries only)**  
Support countries to improve system design.

## Supply chain managers

Supply chain managers are in place in all countries to manage the growth and change of the immunisation supply chain.



MANAGERS

Help countries establish or reinforce the post of immunisation supply chain manager and ensure that he or she has the appropriate level of expertise, authority, and resources to oversee the supply chain within a strengthened overall management system.

GAVI Alliance partners will support countries to hire and strengthen supply chain managers by providing focused technical assistance, tools, access to training, and other resources.

### Examples of support from People and Practice working group

- Access to professional training for supply chain managers
- Job descriptions and guidance for hiring supply chain managers
- Best practices for managerial processes and decision-making
- Technical assistance to develop managerial capacity
- Ongoing professional development opportunities – improved supply of high quality training

## Strategy encourages countries to consider supply chain convergence and partnership with private sector

### Supply chain convergence

Opportunities for economies of scale, streamlining and clarification of roles and responsibilities

Build on existing projects e.g. Project Optimize, Deliver. Countries already integrating supply chains e.g. Senegal, Ethiopia, Nicaragua



### Private sector and social enterprises

Opportunities in parts of supply chain to leverage expertise and services

Case studies show private sector can play effective role in managing or supporting parts of supply chains

Gains possible – requires strong change management and technical assistance. Decision by countries based on local circumstances and needs.

## Implementation

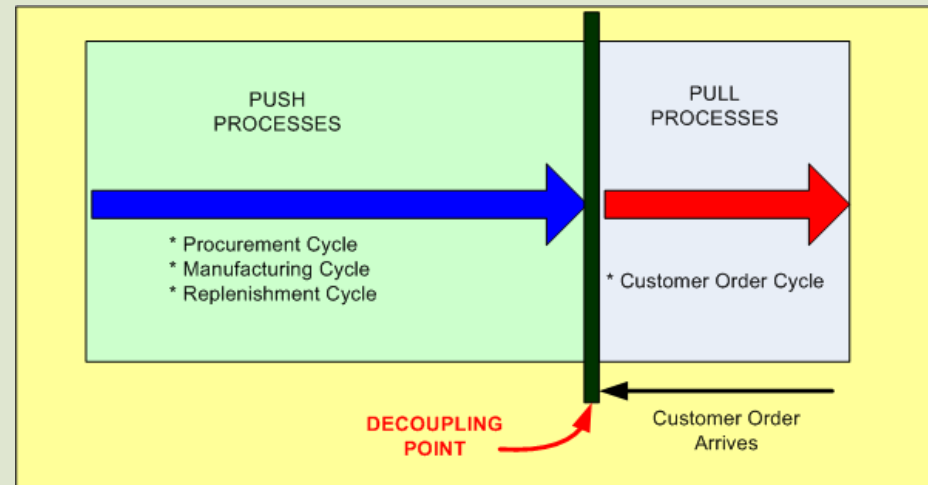
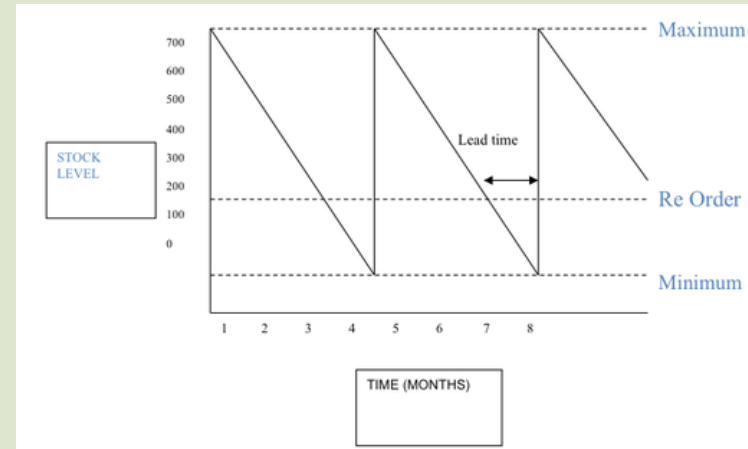
### What to expect in 2014 and beyond.

|                        | 2014  | 2015 | 2016 – 2020   |
|------------------------|---|------|---|
| Three fundamentals     | 1: Supply chain managers                                      |      | Countries adopt systems for continuous improvement of supply chain performance                              |
|                        | 2: Comprehensive supply chain plans linked to multiyear plans |      |   |
|                        | 3: Dashboards to monitor performance                          |      |   |
| + System design        | +1: (selected countries only) Redesigned supply chain systems |      | Systems become more efficient (in more countries)   |
| Supporting Environment | Assess and monitor (EVM ++ and daily monitoring)              |      | Supportive environment helps countries adopt systems for continuous improvement of supply chain performance |
|                        | Plan (EVM linked to cMYP, advocacy platforms)                 |      |   |
|                        | Fund (HSS, bilateral, government, donor)                      |      |   |
|                        | Implement (new equipment, training, information systems etc.) |      |   |
|                        | Support (TA, tools, guidance, policies)                       |      |   |



# Supply Chain and Logistics

- Supply chain 101
  - Push process
  - Pull process



# Global health logistics

- Large scale public sector
  - National scale distribution
  - Usually externally sourced products
  - Commercial or non-commercial goods
  - Multiple financing models
- Local logistics
  - Regional or NGO distribution of goods

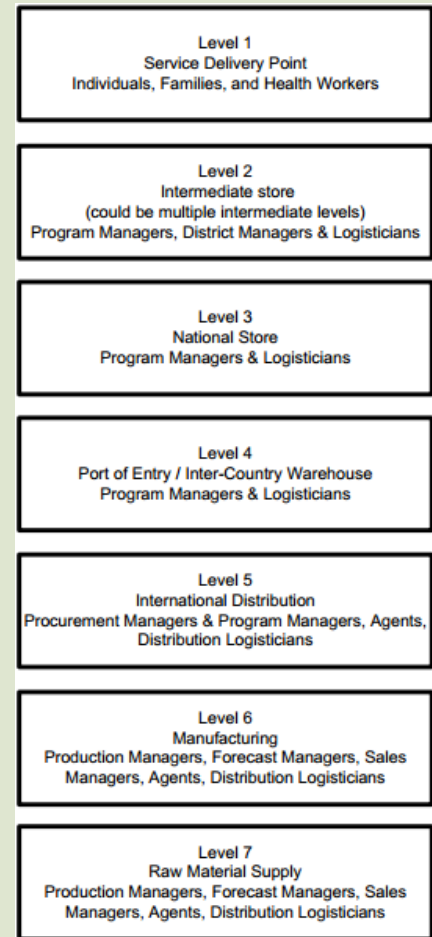
# Private sector

- We will ignore the private sector, but . . .
- Some LMIC engage private sector in logistics
- Some goods are available both in public system and in the markets
  - Parallel public and private networks



# Basic logistics models

- Multiple levels
  - National
  - Regional
  - Facility



# Logistics Requirements

- Requirement derived from country workshops and visits
- Country independent requirements
  - What is common across countries



## Common Requirements for Logistics Management Information Systems

Produced with the Collaborative  
Requirements Development  
Methodology (CRDM)

September 30, 2010

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PO Box 900922  
Seattle, WA 98109 USA

**STREET**  
2201 Westlake Avenue, Suite 200  
Seattle, WA 98121 USA

Tel: 206.285.3500  
Fax: 206.285.6619  
[www.path.org](http://www.path.org)

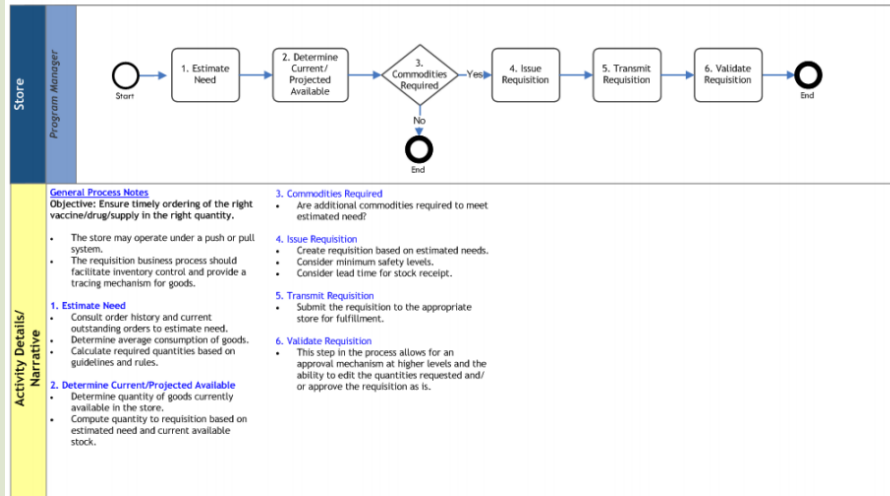


# Business processes

## No. 1 Requisition Business Process

Logistics Management Information System (LMIS)

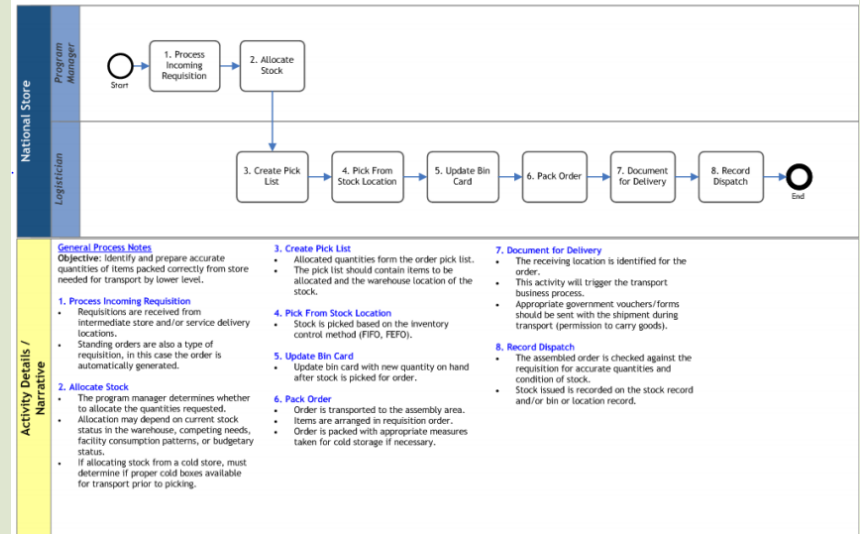
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## No. 4 Dispatch Business Process

Logistics Management Information System (LMIS)

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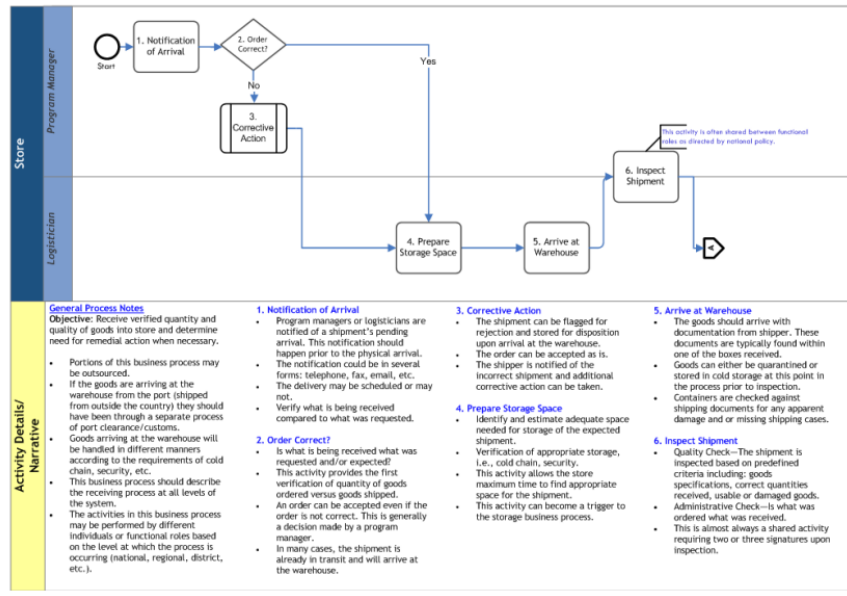


# Business Processes

## No. 2 Receiving Business Process

Logistics Management Information System (LMIS)

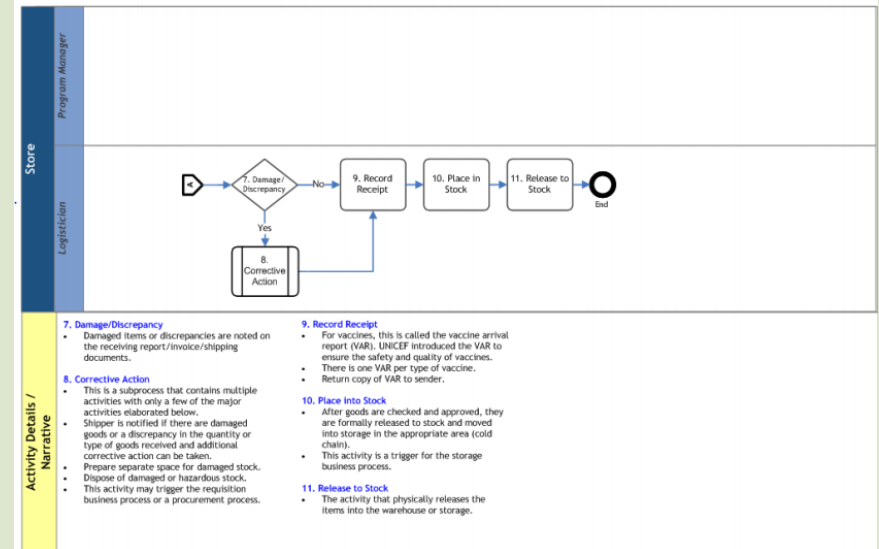
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## No. 2 Receiving Business Process

Logistics Management Information System (LMIS)

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# Computing and logistics

- Tracking
- Visibility of Inventory
- Management of Transactions
- Warehouse management
- Forecasting
- Alerts
- Supply chain optimization





# Global health logistics vs. corporate

## Procter and Gamble

- Daily deliveries
- Centralized control
- Thousands of products
- End to end visibility



## Tanzania EPI

- Quarterly or monthly deliveries
- Decentralized system
- Small number of products
- Single level visibility



# Logistics challenges

- Service delivery – stocks not available
- Other issues
  - Overstock
  - Delivery timing
  - Lost stock and spoilage
  - Transportation costs



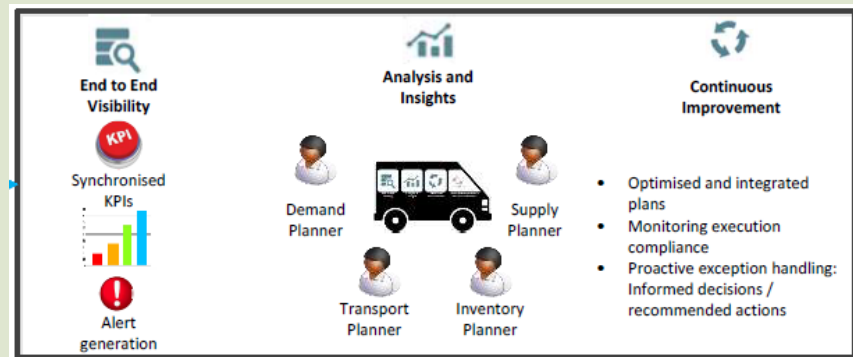
# Causes of stock outs

- Insufficient overall supply
- Misallocation
- Lack of funds
- Lack of transport
- Demand variation
- Delay in transport
- Improper ordering
- Spoilage
- Leakage



# Visibility and analysis

- Goals
- Components
  - Planning
  - Delivery
  - Quality of product
  - Quality of supply chain



# Planning

- How do you know how much stuff to order



# EPI Forecasting

Vaccine demand =

$\text{Doses} * \text{Population} * \text{Coverage} * \text{Supply Period} / (52 * (1 - \text{Wastage}))$

Min Stock =

$\text{Doses} * \text{Population} * \text{Coverage} * \text{Reserve Period} / (52 * (1 - \text{Wastage}))$

Max Stock = Vaccine demand + Min Stock



# Delivery

- Receive order
- Approve order
- Arrange transport
- Pack order
- Send shipment
- Receive shipment
- Verify / record shipment
- Unpack shipment
- Store shipment



# DVDMT Reporting

DVD-MT ZANZIBAR ROUTINE DATA 2009\_COMPLETE.xls [Protected View]

| STATUS OF VACCINATION SUPPLIES DISTRIBUTED PER MONTH |                   |                           |        |        |        |        |        |        |        |      |
|--|-------------------|---------------------------|--------|--------|--------|--------|--------|--------|--------|------|
| Districts  | Surviving infants | Quantity issued per month |        |        |        |        |        |        |        |      |
|  |                   | BCG                       |        |        |        |        |        |        |        |      |
|  |                   | Jan-09                    | Feb-09 | Mar-09 | Apr-09 | May-09 | Jun-09 | Jul-09 | Aug-09 | Sep- |
| <b>Unguja Provinces</b>                              |                   |                           |        |        |        |        |        |        |        |      |
| CENTRAL  | 184               | -                         | -      | -      | -      | -      | -      | -      | -      | -    |
| NORTH 'A'  | 369               | -                         | -      | -      | -      | -      | -      | -      | -      | -    |
| NORTH 'B'  | 218               | -                         | -      | -      | -      | -      | -      | -      | -      | -    |
| SOUTH  | 89                | -                         | -      | -      | -      | -      | -      | -      | -      | -    |
| URBAN  | 609               | 20                        | 1,510  | -      | -      | -      | -      | -      | -      | -    |
| WEST   | 631               | 550                       | 740    | -      | -      | -      | -      | -      | -      | -    |
| <b>Pemba Provinces</b>                               |                   |                           |        |        |        |        |        |        |        |      |
| CHAKE CHAKE  | 467               | -                         | -      | -      | -      | -      | -      | -      | -      | -    |
| MICHEWENI  | 483               | -                         | -      | -      | -      | -      | -      | -      | -      | -    |
| MKOANI   | 504               | -                         | -      | -      | -      | -      | -      | -      | -      | -    |
| WETE   | 492               | -                         | -      | -      | -      | -      | -      | -      | -      | -    |
|  |                   | 570                       | 2,250  | -      | -      | -      | -      | -      | -      | -    |

Prog\_data vaccinations logistics Compl\_Prompt Qty\_issued VVM Expired indicators REC

DVD-MT ZANZIBAR ROUTINE DATA 2009\_COMPLETE.xls [Protected View]

| MONTHLY VACCINATION DATA IN FIXED STRATEGY |                     |                                |               |                 |       |       |       |       |       |       |       |       |       |                  |         |
|--|---------------------|--------------------------------|---------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------------------|---------|
| Districts                                  | Month of the Report | Timeliness of monthly reportin | No. of sessis | TT vaccinations |       |       |       |       |       |       |       |       |       | BCG vaccinations |         |
|  |                     |                                |               | TT              |       |       |       |       |       |       |       |       |       | BCG              |         |
|  |                     |                                |               | TT-1f           | TT-1f | TT-2f | TT-2f | TT-3f | TT-3f | TT-4f | TT-4f | TT-5f | TT-5f | BCG<1ye          | BCG>1ye |
| NORTH 'A'                                  | Jan-09              | T                              | 45            | 44              | 30    | 22    | 14    | 209   | -     |       |       |       |       |                  |         |
| NORTH 'B'                                  | Jan-09              | L                              | 39            | 28              | 18    | 10    | 6     | 139   | -     |       |       |       |       |                  |         |
| SOUTH                                      | Jan-09              | T                              | 8             | 13              | 6     | 5     | 7     | 102   | -     |       |       |       |       |                  |         |
| URBAN                                      | Jan-09              | T                              | 450           | 411             | 145   | 109   | 45    | 1,198 | -     |       |       |       |       |                  |         |
| WEST                                       | Jan-09              | T                              | 205           | 166             | 78    | 52    | 35    | 577   | 2     |       |       |       |       |                  |         |
| CHAKE CHAKE                                | Jan-09              | T                              | 126           | 94              | 70    | 64    | 68    | 450   | 1     |       |       |       |       |                  |         |
| MICHEWENI                                  | Jan-09              | L                              | 120           | 72              | 61    | 58    | 63    | 382   | -     |       |       |       |       |                  |         |
| MKOANI                                     | Jan-09              | T                              | 49            | 55              | 44    | 40    | 35    | 331   | -     |       |       |       |       |                  |         |
| WETE                                       | Jan-09              | L                              | 85            | 91              | 79    | 53    | 57    | 437   | 7     |       |       |       |       |                  |         |
| CENTRAL                                    | Feb-09              | T                              | 69            | 44              | 29    | 17    | 11    | 173   | -     |       |       |       |       |                  |         |
| NORTH 'A'                                  | Feb-09              | L                              | 73            | 51              | 35    | 37    | 23    | 248   | -     |       |       |       |       |                  |         |
| NORTH 'B'                                  | Feb-09              | T                              | 46            | 48              | 10    | 11    | 11    | 151   | -     |       |       |       |       |                  |         |
| SOUTH                                      | Feb-09              | L                              | 14            | 13              | 7     | 9     | 11    | 76    | -     |       |       |       |       |                  |         |
| URBAN                                      | Feb-09              | L                              | 477           | 469             | 227   | 102   | 62    | 1,243 | 2     |       |       |       |       |                  |         |
| WEST                                       | Feb-09              | L                              | 225           | 156             | 85    | 69    | 61    | 721   | 1     |       |       |       |       |                  |         |
| CHAKE CHAKE                                | Feb-09              | L                              | 111           | 72              | 58    | 40    | 36    | 473   | -     |       |       |       |       |                  |         |
| MICHEWENI                                  | Feb-09              | L                              | 86            | 66              | 56    | 44    | 57    | 299   | -     |       |       |       |       |                  |         |
| MKOANI                                     | Feb-09              | L                              | 47            | 65              | 49    | 36    | 39    | 268   | -     |       |       |       |       |                  |         |
| WETE                                       | Feb-09              | T                              | 95            | 109             | 98    | 77    | 65    | 597   | -     |       |       |       |       |                  |         |
| CENTRAL                                    | Mar-09              | T                              | 80            | 68              | 31    | 23    | 12    | 191   | 1     |       |       |       |       |                  |         |
| NORTH 'A'                                  | Mar-09              | L                              | 53            | 72              | 37    | 34    | 27    | 258   | -     |       |       |       |       |                  |         |
| NORTH 'B'                                  | Mar-09              | L                              | 48            | 71              | 21    | 15    | 11    | 194   | -     |       |       |       |       |                  |         |
| SOUTH                                      | Mar-09              | L                              | 11            | 17              | 6     | 3     | 12    | 70    | -     |       |       |       |       |                  |         |

Prog\_data vaccinations logistics Compl\_Prompt Qty\_issued VVM Expired indicators RED CAT Classe Vaccin



# Bar coding



**FIGURE 2**

Composition of a vaccine barcode, Murcia region, Spain

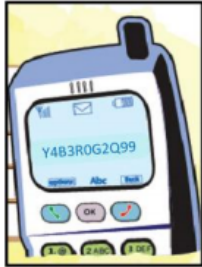


# Stock data reporting

- Regular reports of stock levels to SMS sent to a server
- SMS for Life
  - Reporting project supported by Novartis
  - Weekly reports of supplies of Malaria medication
  - Pilot studies show significant drop in stock outs
  - Scales quickly (reach 5000 health facilities 7 months)
  - Reported costs: “operational cost of less than 80 USD per health facility”

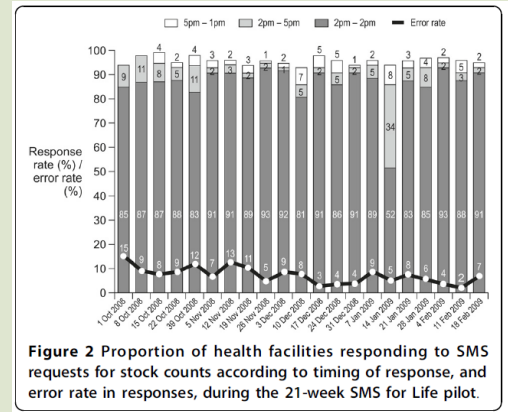
# SMS for Life

**Figure 1: SMS stock levels and interpretation**

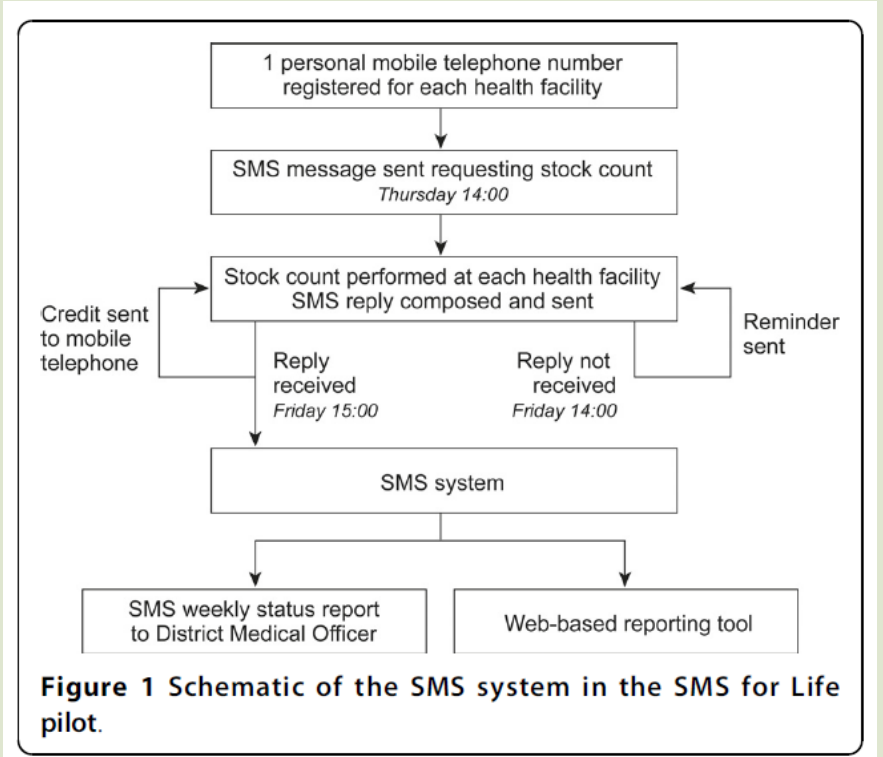


- Y4: Coartem Yellow, for babies 5–15 kg: 4 boxes
- B3: Coartem Blue, for children 15–25 kg: 3 boxes
- R2: Coartem Red, for children 25–35 kg: 0 boxes
- G1: Coartem Green, for children above 35 kg and adults: 2 boxes
- Q99: Quinine injectables: 99

The mobile phone credit was an incentive to motivate health workers to send the message on time and also to recognize the additional tasks they had to perform for the pilot above their normal workload.



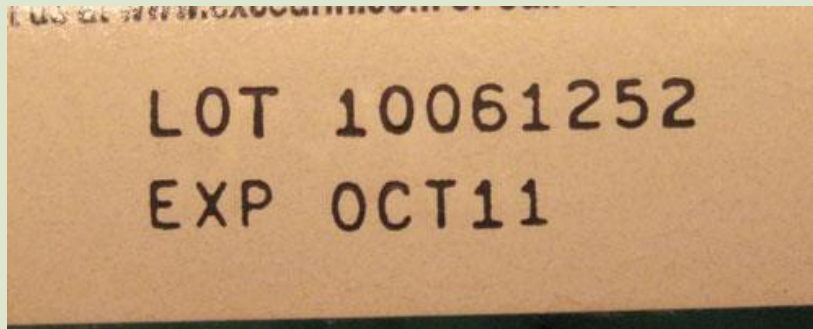
**Figure 2** Proportion of health facilities responding to SMS requests for stock counts according to timing of response, and error rate in responses, during the 21-week SMS for Life pilot.



**Figure 1** Schematic of the SMS system in the SMS for Life pilot.

# Product quality

- Product spoilage
- Product expiration



# Supply chain quality

- How good is the supply chain infrastructure



# Cold chain equipment inventory

## 1. Health facility data



Photo: Heng Chivoan

## 2. Refrigerators, freezers, cold room, cold box data



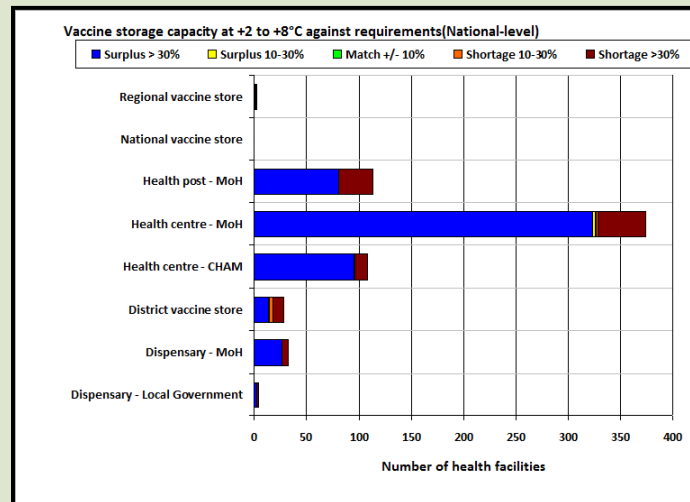
## 3. Vaccine and equipment reference data

# Cold chain capacity analysis

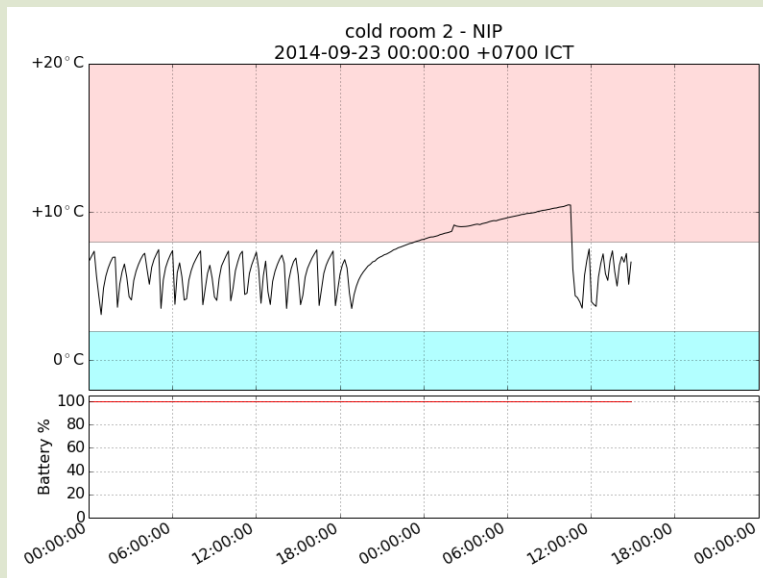
- Maximum volume of storage necessary to store all vaccines
  - VFIC: Volume per fully immunized child
  - $POP * VFIC / \text{Supply Interval}$



| Benin's Expanded Program on Immunization (EPI) Vaccines.                                      |                      |                  |                |   |                                |                              |
|---|----------------------|------------------|----------------|---|--------------------------------|------------------------------|
| Current EPI vaccines  | Presentation         | Doses per person | Doses per vial | Vaccine packed volume per dose (cm <sup>3</sup> ) | Diluent packed volume per dose | Storage location             |
| Bacille calmette-guérin tuberculosis vaccine (BCG)  | Lyophilized          | 1                | 20             | 1.2   | 0.7 cm <sup>3</sup>            | Refrigerator (2-8°C)         |
| Diphtheria-tetanus-pertussis-haemophilus influenzae type B-hepatitis B vaccine (DTP-HepB-Hib) | Liquid + lyophilized | 3                | 1              | 11.0  | n/a                            | Refrigerator (2-8°C)         |
| Measles vaccine (M)   | Lyophilized          | 1                | 10             | 3.5   | 4.0 cm <sup>3</sup>            | Refrigerator (2-8°C)         |
| Oral polio vaccine (OPV)  | Liquid               | 4                | 20             | 1.0   | n/a                            | Preferably freezer (-15-0°C) |
| Pneumococcal conjugate vaccine (PCV13)  | Liquid               | 3                | 1              | 12.0  | n/a                            | Refrigerator (2-8°C)         |
| Yellow fever vaccine (YF)   | Lyophilized          | 1                | 10             | 2.5   | 3.0 cm <sup>3</sup>            | Refrigerator (2-8°C)         |
| Tetanus toxoid vaccine (TT)   | Liquid               | 2                | 10             | 3.0   | n/a                            | Refrigerator (2-8°C)         |
| Introduction Rotavirus vaccine (Rota)   | Liquid               | 2                | 1              | 17.1  | n/a                            | Refrigerator (2-8°C)         |



# Temperature monitoring





# Supply chain optimization

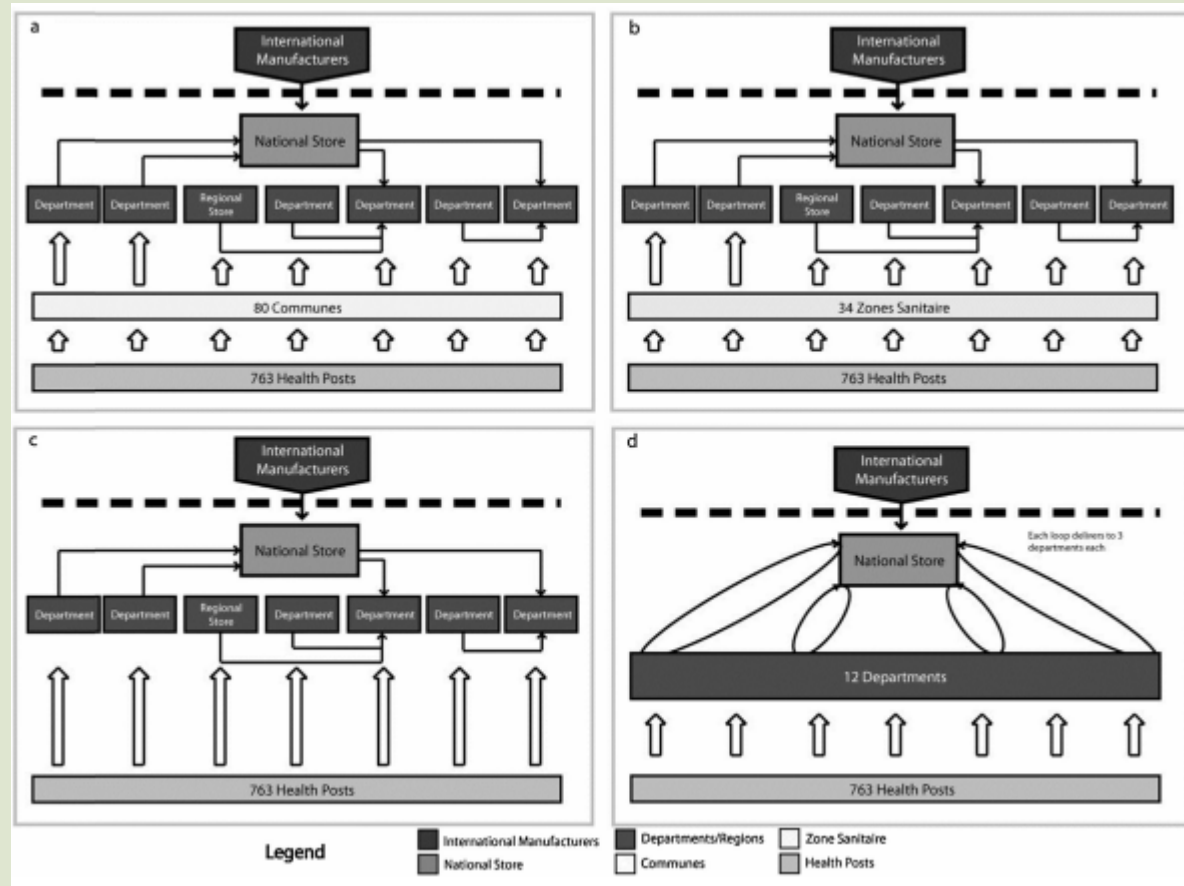
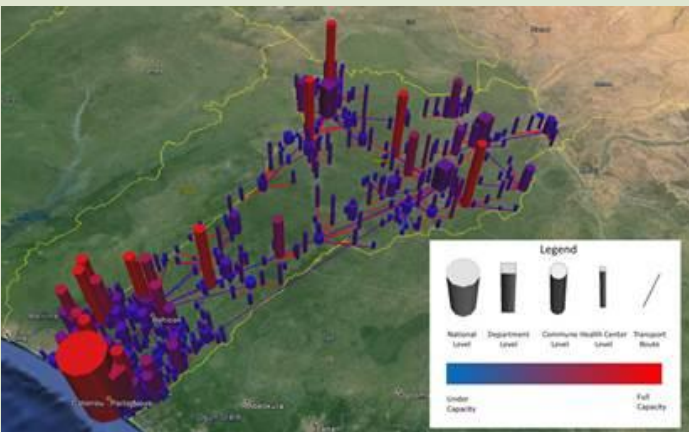


# US Vaccine Supply Chain

- 1994: 64 distribution networks, 430 depots
- 2008: single distribution network, 4 depots

|                    | 1994  | 2008  |
|--------------------|---|---|
| Public-sector cost | US\$200 million   | US\$3 billion   |
| Number of vaccines | 6   | 12  |
| Funds allocation   | 64 lines of credit and multiple fund allocations each year                              | One centralized account   |
| Distribution       | 64 independent distribution systems operating their own storage depots (430 nationwide) | One company distributes vaccines with a few depots and guarantees performance |
| Delivery           | Up to 4 weeks   | 3 to 8 days   |

# Supply chain modeling



# Next week

- Patient Support

