The Medical Commodities Supply Chain – a high level Overview

Pharmaceuticals Factory / Warehouse

Central Warehouse

Regional Hospital

Community Clinic

Health Post
A basic “R&R” or Requisition form

**REPORT FOR ESSENTIAL MEDICINES AND MEDICAL SUPPLIES**

<table>
<thead>
<tr>
<th>Drug Product</th>
<th>Unit</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylsalicylic Acid, tablet 300mg</td>
<td>1000 tabs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acyclovir, tablet 400mg</td>
<td>100 tabs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adrenaline Acid Tartrate, Injection, 1mg/ml</td>
<td>1ml ampoule</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Amantadine hydrochloride, tablet 25mg</td>
<td>1000 tabs</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin (Trimhydrate), Dry powder for suspension 125mg/5ml</td>
<td>200ml bottle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin (Trimhydrate) Capsule 250mg</td>
<td>1000 caps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amphotericin B, PWD for injection, 50mg</td>
<td>Vial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artesunate/Lumefantrine, tablet 120/20mg</td>
<td>6 tabs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artesunate/Lumefantrine, tablet 120/20mg</td>
<td>12 tabs</td>
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</tr>
<tr>
<td>Artesunate/Lumefantrine, tablet 120/20mg</td>
<td>24 tabs</td>
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<td></td>
</tr>
</tbody>
</table>

**Explanation for Losses/Adjustments:**

**Discrepancies or Remarks:**
A more detailed “R&R” or Requisition form

Dispensary or Health Center Report & Request for Anti-Retroviral Medicines and Related Medical Supplies and Equipment

Facility Code: __________  Facility Name: ___________________________ Type (GOV/NGO/FBO/OTHER): __________

Name of Council / Region: __________  Date Submitted: __________

Reporting Period:  Beginning Month: _________  Ending Month: _________  Year: _________

<table>
<thead>
<tr>
<th>MSD Code</th>
<th>Supply Item</th>
<th>Unit of Issue</th>
<th>Opening Balance (A)</th>
<th>Received This Period (B)</th>
<th>Lost Adjusted (C)</th>
<th>Closing Balance (D)</th>
<th>Estimated Consumed [(A-B)-C-D] (E)</th>
<th>Quantity Needed [(E+2)-(G)] (F)</th>
<th>Quantity Requested (G)</th>
<th>Price (H)</th>
<th>Cost (G x H) (I)</th>
<th>Approved Quantity (J)</th>
<th>Approved Cost (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001006c</td>
<td>Artemether/Lumefantrine Tab 20/120mg (Yellow-1x60)</td>
<td>Disp/300</td>
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<tr>
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<td>Artemether/Lumefantrine Tab 20/120mg (Blue-2x6)</td>
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<td>0</td>
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<tr>
<td>1001100e</td>
<td>Acetylsalicylic Acid (Aspirin) Tabs 300mg</td>
<td>1000Tc</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1001100d</td>
<td>Albuterol Tabs 200mg</td>
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<td>Aminophylline Tabs 100mg</td>
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<td>Chlorpheniramine Tabs 4mg</td>
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<td>Chlorpromazine Tabs 100mg</td>
<td>500Tc</td>
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<td>Co-Triamoxazole Tabs 400mg/80mg</td>
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<td>9000</td>
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<td>1001103c</td>
<td>Diclofenac tabs 50mg</td>
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<td>Doxycycline Caps 100mg</td>
<td>1000Tc</td>
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<td>13000</td>
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<td>Emetine Tabs 50mg</td>
<td>1000Tc</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>5000</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
A Closer Look at the Supply Chain

Programs
Funding Agencies
Procurement Agencies
Top-level Warehousing
Possible Intermediate Levels of Warehousing
Service Delivery Points
A Closer Look at the Supply Chain

= scope of typical ERP / Warehouse Management System

= scope of OpenLMIS
An LMIS needs to be configurable...
Programs can be customized to match your health care services

• Essential Medicines
• Infectious Diseases

• Essential Medicines
• Malaria
• TB
• ART

• Essential Medicines
• Malaria
• TB
• ART – Adult
• ART – Pediatric
• PMTCT – Community
• EPI
Variations in Distribution of Supplies

Stocking Depots at multiple levels, optional Level Skipping, etc – customizable by Program

- Essential Meds
- ART
- Reproductive Health
- Vaccines

Levels:
- Procurement
- National Level
- Regional Level
- District Level
- Service Delivery Level
- CHWs
“Pull” or Requisition Process

Approve → Ship → Deliver → Request → Deliver

“Push” or Allocation Process

Collect Data → Determine Quantity → Deliver Stock → Collect Data

Customizable by Program
Multiple Operating Schedules
Customizable by Program

Monthly Replenishment Cycles During the Year

Quarterly Replenishment Cycles During the Year

Interleaved Quarterly Replenishment Cycles During the Year

Replenishment Periods of Uneven Duration
Simple or Detailed Data Collection
Customizable by Program

### Logistics Management Information Systems

#### Home Requisitions Orders Reports Distributions

**Facility:** F902A - St. Boniface Hospital  
**Region:** Eastman  
**Operated by:** Province of Manitoba  
**Maximum Stock Level:** 3  
**Emergency Order Point:** 1  
**Reporting Period:** 01/05/2014 - 31/05/2014

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Product Description</th>
<th>Total Quantity Dispensed</th>
<th>Stock on Hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA1093</td>
<td>Doxycycline tablet 100 mg</td>
<td>272</td>
<td>186</td>
</tr>
<tr>
<td>10335-2</td>
<td>Malaria Rapid Diagnostic Test card 1 each</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>B060833</td>
<td>Quinine Sulfate capsule 300 mg</td>
<td>5</td>
<td>100</td>
</tr>
</tbody>
</table>

**Total R&R Cost:** $0.00

---

**Malaria & Malaria-Related**

- **Beginning Balance**
  - Doxycycline tablet 100 mg: 272
  - Malaria Rapid Diagnostic Test card 1 each: 176
  - Quinine Sulfate capsule 300 mg: 15

- **Total Received Quantity**
  - Doxycycline tablet 100 mg: 272
  - Malaria Rapid Diagnostic Test card 1 each: 50
  - Quinine Sulfate capsule 300 mg: 5

- **Total Consumed Quantity**
  - Doxycycline tablet 100 mg: 100
  - Malaria Rapid Diagnostic Test card 1 each: 100
  - Quinine Sulfate capsule 300 mg: 5

- **Stock on Hand**
  - Doxycycline tablet 100 mg: 186
  - Malaria Rapid Diagnostic Test card 1 each: 100
  - Quinine Sulfate capsule 300 mg: 100

- **Total Stockout Days**
  - Doxycycline tablet 100 mg: 0
  - Malaria Rapid Diagnostic Test card 1 each: 0
  - Quinine Sulfate capsule 300 mg: 0

- **Calculated Order Quantity**
  - Doxycycline tablet 100 mg: 257
  - Malaria Rapid Diagnostic Test card 1 each: 800
  - Quinine Sulfate capsule 300 mg: 100

- **Requested Quantity**
  - Doxycycline tablet 100 mg: 257
  - Malaria Rapid Diagnostic Test card 1 each: 800
  - Quinine Sulfate capsule 300 mg: 100

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**Comments**
Custom Approval Hierarchies and Routing to Warehouses
Customizable by Program and by Region

Single-step Approval Process

Multi-step Approval Process
OpenLMIS: Adaptable & Highly Configurable
OpenLMIS System Architecture
**System Architecture Design Considerations**

- **Open source technology.** OpenLMIS is built entirely with open source technology, using open source tools, and designed to run on open source platforms.

- **Hosting platform neutral.** The system is designed to be deployable on physical server(s) or virtual server(s), whether on-premise or cloud-based instances of standard Linux configurations.

- **Stateless processing.** Core services are accessed via REST style interface.

- **Bandwidth efficient.** Modules and applications (web-forms and clients) can be deployed on PC’s and mobile devices (phones, tablets, etc.), while user-interface screens make limited use of large graphical elements.

- **Minimum browser requirements.** OpenLMIS is designed to be compatible with Firefox, v25.01 or newer, Chrome, v23 or newer, and IE10 or newer. Since browser-based applications for mobile devices will be specific to a device.

- **Reporting.** The default reporting engine, Jasper, is an open-source solution, and can be configured to use the production data base, or a separate reporting database with near real-time replication.

- **Connection agnostic.** The architecture is compatible with private and public networks that support connectivity between end-user devices and the respective system gateways.
System Architecture Design Considerations, cont’d

• **Online and offline capability.** End-user devices with appropriate data and form caching capabilities allow intermittent connections between browsers and the system for collecting data related to the informed-push replenishment process.

• **Scalability.** Depending upon the number of supported users and the transaction volume, the system can be deployed on a single server, or distributed across a cluster of servers. OpenLMIS has been tested to support 5,000+ concurrent users, with a simulated mix of user activities (creating requisitions, reviewing and approving requisitions, etc). Details of the scalability tests are available at [openlmis.hingx.org](http://openlmis.hingx.org)

• **Data hygiene at point of entry.** Modules incorporate data validation at point of entry – including when in offline mode – and again at the point of data submission.

• **Security by roles.** Access to system functionality is assignable per user, based on roles. Roles encompass the right to take one or more actions, e.g. create a requisition, or approve a requisition). Users are granted role(s) for a specific scope, e.g. review requisitions from their base facility or from all the facilities they supervise, and specifically for the TB program or the Malaria program, etc.

• **Transaction models.** Transaction models supported include: form-based data entry/editing, real-time transaction processing of data submitted by external systems (e.g., mobile apps), and ftp-mediated data exchanges with external systems.
Online and offline capability. End-user devices with appropriate data and form caching capabilities allow intermittent connections between browsers and the system for collecting data related to the informed-push replenishment process.

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OpenLMIS Demo...
Recent Supply-Chain Innovations
Passive Vaccine Storage Device (PSVD), developed by Global Good
Thank you
extra slides...
OpenLMIS Feature List

Basic Capabilities and Configurability

• One or more customizable programs (e.g. ART, PMTCT, EPI, Malaria, Primary Care, RMNCH etc.)

• Hierarchy of geographic zones can be defined with arbitrary depth

• Facilities (with 30 facility-specific attributes), plus programs supported by each facility

• Products (with 45 product-specific attributes), grouped by customizable product categories

• Products can be segmented by program, and assigned to one or more programs

• Products can be further segmented by facility type, and assigned to one or more facility types
OpenLMIS Feature List - continued

Basic Capabilities and Configurability

• Multiple customizable operating schedules (e.g., monthly, quarterly, interleaved quarters, schedules with non-uniform periods, etc.)

• Facilities can be grouped per common programs, schedules, approval hierarchies, supplying depots, and delivery points, to simplify managing approvals and order fulfillment

• Multi-tier or nested requisition/order/fulfillment loops, including mixed requisition- and allocation-based replenishment process

• Level skipping for distribution of commodities, for both requisition and allocation replenishment processes

• All user interfaces can be customized to support one or more languages, simultaneously
OpenLMIS Feature List - continued

Requisition-Based Replenishment (“Pull” process)

• Customizable requisition form for each program
• Products organized by category (anesthetics, antibiotics, etc) – assignable and sortable per Program
• Shipment/receivals data from previous cycle is automatically populated on new Requisition
• Arithmetic validation of user-entered data
• Replenishment amounts are automatically calculated, based on historical consumption
• Optional automatic calculation of “dependent values” (e.g., remaining stock on hand)
• Configurable work flow for review and approval of Requisitions, with one or more review steps
• Automatic notifications of pending work sent to users involved in the review-approval workflow
• Emergency requisitioning, with optional customized format
• Optimized to minimize bandwidth - only changed data is submitted back to the server
• HMIS data collection tool (configurable forms to collect summary patient data, e.g. for ART regimens)
OpenLMIS Feature List - continued

Informed-Allocation Replenishment ("Push" process)

• Facilities grouped into delivery zones, independent of geographic location
• Manage product distributions per delivery zone and program
• Define ideal stock amounts per WHO formulas, with optional enhancements, plus exceptions for individual facilities
• Calculate quantities to take on delivery run
• Forms to capture field observations, inventory data, usage data, cold chain status, plus coverage data for immunization program
• Data collection forms are compatible with browsers on both computers and tablets
• Status indicators highlight fields and forms where mandatory data is missing
• Data can be entered while online or offline
• Data entered while offline can be uploaded whenever users reconnects on the internet
Order Process
• Fully approved requisitions are released as orders, ready to be filled
• Orders can be exported to a warehouse ERP system
• Format of order export files is customizable
• Orders and associated export files can be manually reviewed

Shipment Process
• Import shipment files from warehouse ERP system, confirming order was filled
• Generate and print the packing list / "Proof of Delivery" document (POD)

Receiving Process
• Update delivery records after POD is completed including substituted products, mis-delivered products, and returned products
• Review updated PODs returned from the field
OpenLMIS Feature List - continued

**Reporting**
- Integrated with Jasper Reporting Server (available free open source)
- Reports can be in HTML, PDF and Excel formats
- System can be configured to report from the production database, or from a dedicated clone reporting database server, with automatic real-time data propagation

**System Deployment and Administration**
- Role-based security for all operational responsibilities, assignable by task, by program, by facility
- Role-based security for all administrative responsibilities, assignable by task
- Graphic user interfaces (GUIs) to manage:
  - users, and their roles and rights
  - geographic zones and facilities
  - programs and products
  - schedules, workflow and order fulfillment
OpenLMIS Feature List - continued

**Interoperability**
- Application interfaces to operate with CommTrack
- Application interfaces currently in development to export data to DHIS2
- Application interfaces currently in development to operate with ColdTrace remote temperature monitoring equipment

**Facility Budgets**
- Budget allocations can optionally be assigned by facility, by program, by period
- Budget allocations are received from a ministry finance or accounting system, (based on customizable CSV file format)
- System records spending by program and period when budgeting applies, and flags any overspending

**Forecasting**
- Forecasting can be done through data extracts for “Quantimed” and “Pipeline” software