Topic 4 in Debate on Vaccine Supply Chain Futures

Introducing data-driven, remote oversight

Vaccine supply chains in most countries have maintained manual records of vaccine stocks and storage temperatures but these data are seldom accurate and cannot be meaningfully interpreted or acted upon by health staff. No performance indicators have been established for the supply chain so the quality of the system can only be assessed by periodic evaluation. Evaluations, such as EVM, apply only to an instant of time and only at the sample facilities that are visited.

Two lessons seem to partly explain the relatively poor standards of the vaccine supply chain until recently. First, the motivation to collect data is limited by the many calls on staff time, risk of criticism, small rewards perceived and only a frail link to supervision. Second, data is more readily used at the location that it is generated (e.g. temperatures monitored at health facilities) than data taken to higher levels of the system for aggregation and analysis. Incomplete reports and inaccurate aggregation and analysis have resulted in low confidence to support decisions by supervisors.

Transition to remote monitoring of temperatures and performance

The answer to the above challenges is not to intensify evaluation activities that should be used as a periodic external check on performance at a large scale. The answer is to establish and maintain accurate continuous monitoring. Monitoring the temperature of vaccine during storage and transport is fundamental to maintain the standard of vaccine handling required to ensure protection. Temperature deviations also trigger maintenance services effectively when they are recorded, transmitted and reported automatically. The current expansion in the use of GPRS and SMS cell-telephone transmission of data facilitates remote alarms and automatic analysis of data for supervisors. This significantly affects the ability to monitor and manage at higher levels of the system while remaining synchronized with changing rates at field level.

Table 1 lists activities that use centralized data and that are currently being evaluated or await evaluation.

Table 1: Monitoring parameters for the vaccine supply chain

Parameter	*Data collection*	*Purpose*
Storage/transport temperatures	• 30DTR – RTM* by refrigerator and by refrigerated vehicle	➔ Alarms (local/remote), Monthly reports by area for oversight
Refrigerator Maintenance	• Speed of response to equipment failures, • % of failures related to power cuts • % of failures corrected without visit from technician • Repair interventions coded and reported by phone	➔ Speed of response (oversight) ➔ Performance record by model for procurement ➔ Assessment of reliability by model and history of failures ➔ spares consumption to inform planners
Vaccine stock control and consumption monitoring	• Storekeeper, all stores • Vaccine consumption: no. Of vials opened for use x doses/vial = doses consumed	➔ Track stocks, distribution oversight and forecast requirements based on consumption
Immunization doses administered by vaccine and by type of service delivery (fixed/outreach etc.)	• Paper/electronic records kept by session and summarized weekly/monthly by vaccine and delivery mode	➔ Monthly tracking vaccine utilization rate and consumption rate based on doses administered v. consumed

NOTE * DTR-30/60-day Temperature recorder RTM / Remote temperature monitoring

Smartphones, bar/matrix code readers and automatic temperature recording devices are increasingly being used to collect data and send it to a central Ministry of Health server that runs a standard data management system (e.g. HMIS2.0). While connectivity is still variable, all applications sharing data and in communication with the central server should be designed to operate autonomously during power cuts and automatically synchronize when connectivity permits.

Dis-aggregation of performance and cost of outreach operations

Many countries still report the combined immunizations at fixed sites together with immunization outreach even though daily records may be separately recorded. Common practice separates special immunization activities from routine recording and reporting. Costing immunization also combines data from outreach with fixed facilities. So supply chain costs cannot be assigned to different types of immunization operations relative to numbers of doses administered.

Data that is being collected by remote monitoring devices within new LMIS need to include breakdowns of vaccine consumption and immunizations for each type of activity. As variations in the cost per series for each target is closely related to the logistic, transport and personnel investments made in different population densities and communications infrastructure, closer control of health facility outreach budgets will be possible.

Potential to use data at both national and international levels

Performance data collected by remote monitoring devices not only support better management in country but also strengthens international stakeholders who are engaged in country support. For example, continuous temperature monitoring data analyzed by model of refrigerator will help equipment manufacturers to correct persistent and complex design problems. These data will also inform the deliberations of WHO/PQS in decisions to modify equipment or develop new equipment as needed for the vaccine supply chain.

In country, transmitting temperature and alarms to a central server for analysis will also provide a channel for other LMIS data. The timeliness of the equipment maintenance process will be automatically trapped, distinguishing between failures that can be corrected by the local health staff or storekeepers and those that require more costly visits by repair technicians. These visits and repair interventions will be reported by technicians using a phone-application linked to central databases, providing coded information on failure modes, spares consumption and repair activities.

Aggregation of these 'job-card-equivalent' reports by analysis of specific models at national scale will guide assessment of long-term performance to guide procurement towards the most reliable choices. Dis-aggregated data at local or area levels will reveal the efficiency of maintenance services and point supervision to the most needy destinations.

> **Discussion Point 7: Have wider the benefits of Remote Temperature Monitoring (RTM) been assessed to include refrigerator field performance, maintenance benchmarks and other SC performance indices – as well as oversight of vaccine handling standards**

Performance indeces

Generic indeces of performance and efficiency are needed to follow the evolution of the supply chain and the performance of cooling equipment at international and national levels. Specific indicators tailored to each countries management needs will also need to be developed at country level. An example of the types of indicators under consideration is as follows:

- **Temperature maintenance**: Each temperature reading can be assigned to a data range within which the reading falls. By taking percentages of the chosen time interval, the values can be seen as positive indicators of vaccine temperature management, regardless of the status of power supplies.
- **Managing intermittent power**: By filtering the readings that are associated with power outages, it is possible to distinguish failures and alarms that are not associated with power outages. If many or most failures are associated with power, the solution may be different than when power is continuous. Ice-lined and cold-buffer type refrigerators should reduce power associated failures.
- **Monitoring deviations below alarm thresholds**: Alarms indicate failures but both hot and cold alarms have a time delay associated with the alarm threshold. Calculating the temperature exposures mean/max/min during each 'lead-time' before an alarm sounds will detect extreme sub-alarm temperatures that have not lasted long enough to trigger the alarm.

- **Indicating efficient use of repair services:** All failures trigger an investigation by health staff responsible for vaccine handling first. Then, if no solution can be found, the staff phone a technician for advice – over the phone. If no solution can still not be found then a technician visit will be made. The percent failures that do not require a technician visit indicate efficient, lower cost corrective action instead of transportation and time costs of a visiting technician.
- **The performance of repair services** is also assessed by the delays between the start of an alarm and the visit made to repair the refrigerator. If the delay is longer than the limit chosen by managers in a country, more detailed steps may be insterted to detect the source of the delays.