Countries in the WHO African Region have adopted and are working towards various goals including the eradication of polio, the elimination of measles, neonatal tetanus and epidemic meningitis, and the control of yellow fever. These initiatives rely on the provision of vaccination services in routine immunization, in supplementary immunization activities (SIAs) and outbreak response campaigns, as well as the conduct of intensive disease surveillance to monitor the progress and determine the impact of interventions.

Access to timely, high-quality information is essential for effective immunization. Critical information includes process indicators that allow programmes to monitor their performance and take corrective action, and outcome indicators that measure the impact of programmes.

Monitoring and use of data for action is one of the pillars of the Reaching Every District (RED) approach, which aims to increase district capacity building to address common obstacles to increasing immunization coverage, with a focus on planning and monitoring. The immunization and vaccine-preventable disease (VPD) control programmes in countries across the African Region have been utilizing a structured data management system for more than a decade now. This data management system was built with WHO support, in such a way as to create a standard and uniform system across the Region.

All the data generated from country level programme implementation is fully owned by the countries, and is primarily kept and utilized by the national programmes. However, the various datasets are shared with the WHO for purposes of monitoring the coverage and disease trends across the Region. WHO provides the necessary policy guidance and technical support to standardize the approaches, methodology and tools used for data management by the national programmes, and to ensure that these norms and standards are applied and maintained in the day-to-day handling of data.

This article gives a basic overview of the immunization monitoring and surveillance data management systems in place within the countries in the African Region, discusses the key challenges, and outlines the activities undertaken to improve data quality.

Data quality is defined as: timely and up-to-date, complete, representative, clean, accurate, consistent, and provides relevant information on the epidemiological situations and/or population immunity within a defined geographic unit, and a specific time period, responding to the programmatic needs and objectives of national immunization and vaccine-preventable disease control programmes.

**Methods**

The national immunization and disease control programmes generate various types of programme data on a day-to-day basis. The denominator data for the
various programmes are the population data within the different target age brackets. These population denominator data are often generated from projections based on latest census figures.

The administrative method of routine immunization coverage monitoring is in place in all countries. Data generated at the point of service delivery are captured using health facility registers and daily service tally sheets. These data are summarized monthly at health facility level and are shared with the district level, from where they are aggregated up to the national level on a monthly basis. The administrative immunization coverage monitoring data are corroborated by regular data quality validation exercises and periodic coverage surveys.2,3

Immunization monitoring data collected from the service delivery sites (during routine immunization services or during SIAs) are primarily used at district and national levels, to determine levels of population immunity, and identify geographic areas and populations with service gaps; to help design and implement appropriate strategies to reach unreached populations; to drive decisions in the immunization programme related to vaccine demand forecasts and to determine the allocation of resources.

During SIAs the number of people receiving interventions is monitored using tally sheets at the point of service delivery. These data are then summarized at the district level and aggregated up to the national level.4,5

The reporting of data on the epidemiological situation of the vaccine-preventable diseases is done from the peripheral health facilities (polio, measles, yellow fever, neonatal tetanus, meningitis) or from sentinel sites (diarrhoea with severe dehydration, paediatric bacterial meningitis), using paper forms which then are sent to the district and then to the national level, along with laboratory specimens as applicable. Immediate reporting of cases is done for the target diseases through the case-based surveillance system, while aggregate summary reporting (including zero reporting) is done on a weekly or monthly basis through the integrated disease surveillance aggregate reporting system. The case-based data are entered into a database at the national level using standard computerized data management tools.6

Data from the various case-based surveillance, laboratory and aggregate reporting systems are primarily used to identify and characterize the epidemiological situation within a geographic area and to monitor the impact of the immunization programme activities; to identify and characterize circulating strains of pathogens, and to monitor chains of transmission including importations across boundaries; to identify outbreaks timely enough to undertake response activities; to identify and characterize geographic areas and populations with immunity gaps, in order to prioritize for programme actions; to monitor the impact of vaccination activities and overall strategies for the control of VPDs; and to monitor progress towards disease control goals.7

Countries share their population data with WHO at the start of every calendar year. Administrative routine immunization coverage data are shared

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**Legend**

1. WHO CO data managers
   - 1 WHO CO data manager
   - 2 WHO CO data managers
   - 3 WHO CO data managers
2. IAT and Regional data managers
   - IAT data managers
   - Regional data managers
   - IAT CO Countries
   - IAT WA Countries
   - IAT E & SA Countries

**NOTE:** This map is illustrative and does not represent the actual geographic extent of the countries or regions.
with WHO on a monthly basis while official coverage information is reported annually to WHO-UNICEF through the Joint Reporting Form (JRF). In SIAs, administrative coverage data is shared with WHO within a few weeks of the end of the SIAs. Countries share their polio and measles surveillance and lab data weekly with WHO, and monthly for the other disease control databases.3,8

At the WHO regional and subregional level, the national programme data are merged, cleaned and analysed on a regular basis. Depending on the schedule of data flow for the specific type of data, WHO provides regular written feedback to the countries on data quality, programme performance indicators as well as epidemiological trends and patterns.

Annually, WHO and UNICEF generate national coverage estimates for each antigen based on the administrative coverage data received from countries, but also taking into consideration various other sources of data including coverage surveys.3

For this article reports were reviewed from data quality audit exercises done in six countries between 2012 and 2014, as well as immunization and surveillance programme reviews conducted across the Region between 2006–2014, and discussion papers and presentations made at WHO regional and subregional level were also consulted in order to identify the challenges with data quality in the Region.

Results

The various types of databases and the number of country datasets that the WHO Regional office handles on an annual basis are shown in Table 1.10

All 47 Member States in the African Region compile and report these databases regularly, with the exception of the following: yellow fever and measles case-based surveillance are established in only 23 and 44 countries respectively; rotavirus and paediatric bacterial meningitis sentinel surveillance sites are present in 32 countries; polio virological laboratories are present in 16 countries; measles-rubella national serological laboratories are present in 44 countries. There are three regional polio referral laboratories, three measles-rubella and one yellow fever regional referral laboratories in the Region.

The database structures contain provisions for minimizing data entry errors. WHO provides regular training for people involved in database and programme management to help improve the capacity at country level, and regularly monitors the quality of data and programme outputs.

Table 1. Type and format of immunization and surveillance databases handled at WHO African Region level

<table>
<thead>
<tr>
<th>Database</th>
<th>Frequency of data sharing with WHO</th>
<th>Format of database</th>
<th>Number of datasets expected per year at WHO-AFR level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population data</td>
<td>Annually</td>
<td>Excel spreadsheet</td>
<td>47</td>
</tr>
<tr>
<td>Routine immunization coverage</td>
<td>Monthly</td>
<td>MS-Access database</td>
<td>564</td>
</tr>
<tr>
<td>Stock management tool</td>
<td>Weekly</td>
<td>Excel spreadsheet</td>
<td>564</td>
</tr>
<tr>
<td>District vaccine data management tool</td>
<td>Weekly</td>
<td>Excel spreadsheet</td>
<td>564</td>
</tr>
<tr>
<td>WHO-UNICEF Joint Reporting Form: coverage and incidence data</td>
<td>Annual</td>
<td>Excel spreadsheet</td>
<td>47</td>
</tr>
<tr>
<td>SIA’s coverage data</td>
<td>Activity related</td>
<td>Excel spreadsheet</td>
<td>Ad hoc</td>
</tr>
<tr>
<td>SIA’s independent monitoring data</td>
<td>Activity related</td>
<td>Excel spreadsheet</td>
<td>Ad hoc</td>
</tr>
<tr>
<td>SIA’s lot quality assurance survey data</td>
<td>Activity related</td>
<td>Excel spreadsheet</td>
<td>Ad hoc</td>
</tr>
<tr>
<td>AFP/polio surveillance</td>
<td>Weekly</td>
<td>MS-Access database</td>
<td>Ad hoc</td>
</tr>
<tr>
<td>Measles surveillance</td>
<td>Weekly</td>
<td>MS-Access database</td>
<td>2 444</td>
</tr>
<tr>
<td>Yellow fever case-based surveillance</td>
<td>Monthly</td>
<td>MS-Access database</td>
<td>2 444</td>
</tr>
<tr>
<td>Neonatal tetanus surveillance</td>
<td>Monthly</td>
<td>MS-Access database</td>
<td>564</td>
</tr>
<tr>
<td>Paediatric bacterial meningitis surveillance</td>
<td>Monthly</td>
<td>MS-Access database</td>
<td>564</td>
</tr>
<tr>
<td>Rotavirus surveillance</td>
<td>Monthly</td>
<td>MS-Access database</td>
<td>324</td>
</tr>
<tr>
<td>Polio lab data</td>
<td>Weekly</td>
<td>MS-Access database</td>
<td>324</td>
</tr>
<tr>
<td>Measles rubella national lab data</td>
<td>Monthly</td>
<td>MS-Access database</td>
<td>832</td>
</tr>
<tr>
<td>Measles rubella regional referral lab data</td>
<td>Quarterly</td>
<td>MS-Access database</td>
<td>528</td>
</tr>
<tr>
<td>Yellow fever national lab data</td>
<td>Monthly</td>
<td>MS-Access database</td>
<td>36</td>
</tr>
<tr>
<td>Yellow fever regional reference lab data</td>
<td>Monthly</td>
<td>MS-Access database</td>
<td>12</td>
</tr>
<tr>
<td>Integrated disease surveillance data</td>
<td>Weekly/monthly</td>
<td>MS-Access database/ Excel spreadsheet</td>
<td>564</td>
</tr>
</tbody>
</table>

Common problems

Some commonly observed problems with the quality of immunization monitoring data include:

- Inaccurate population denominator data; reported coverage figures in excess of 100%;
- Problems of internal consistency of data from various sources;
- Data not shared timely;
- Missing data;
- Discrepancies in coverage data as they are shared from the operational level to the next higher administrative levels;
- Poor archiving of data;
- Gaps in the ownership and managerial oversight of data within national immunization programmes; and
- Poor use of available data at all levels.

The most frequently encountered issues with the quality of vaccine-preventable disease surveillance data are:

- Missing or erroneous entries at the point of capture of data;
- Problems of internal consistency of data from various sources;
- Data not shared timely;
- Missing data;
- Gaps in the ownership and managerial oversight of data within national disease control/surveillance programmes; and
- Inadequate use of data for decision-making.

Root causes

An informal review of reports from surveillance and immunization programme reviews conducted across the Region between 2006–2014, from data quality audit exercises done between 2012 and 2014, as well as observations and documentation at WHO-AFRO level related to data quality indicate a number of root causes for these gaps in data quality:

- Limited technical skills and programme experience of data entry clerks

Poor use of available data at all levels.
Currently, the immunization coverage data and surveillance data are used by national programmes and at regional and global levels for the programmatic monitoring of coverage and disease trends, as well as for epidemiological description. However, because of the gaps in data quality, the interpretation of these data is done cautiously with the added consideration of data from coverage surveys and disease modelling in some cases.

WHO support

The WHO Regional Office for Africa has been working systematically to support countries to improve the quality of immunization monitoring and surveillance data. The activities that have been, and are being implemented at country and other levels within the Region include:

- **Advocacy**: Promoting direct programmatic linkage between national immunization programmes and national statistic offices; encouraging national dialogue on the initiation of capturing vital events; promoting discussions on data quality within the task forces of the interagency coordination committees; encouraging national authorities to ensure that data management is supported by appropriate staff within the national immunization programmes; promoting the establishment of national task forces for the generation of national best coverage estimates for annual JRF reporting; using the WHO-UNICEF national coverage estimates in preference to the national reported coverage figures for programme planning.

- **Technical inputs into the data management system**: Standardizing the utility, database and shape files; standardizing the data management tools, and upgrading the data management software and tools; regularly cleaning the regional databases and providing feedback to national programmes and reporting laboratories.

- **Monitoring data quality**: Conducting regular data quality audit exercises; supporting countries to do data quality self-assessments; leading surveillance and immunization programme reviews in priority countries; supporting information management system assessment exercises.

**Achievements**

Since 2007, when WHO-AFRO started to document and provide systematic and regular feedback on timeliness of data sharing as well as on the data entry errors and missing entries within the submitted databases, there have been significant improvements in various quality aspects of the data, with improved timeliness and completeness of data sharing, reductions in the internal inconsistency within databases, and a significant reduction in the proportion of datasets with missing variables, erroneous entries, etc.

**Discussion**

Strategic objective 4 of the Global Vaccine Action Plan 2011–2020 clearly identifies high quality data as a pillar of strong immunization systems. In addition, the Regional Strategic Plan for Immunization 2014–2020 indicates that focusing on strengthening the quality of data and their use will be one of the key approaches to attaining universal immunization coverage within the WHO African Region.

Countries in the African Region are generating large volumes of immunization and disease control programme data within a context of limited skilled manpower, and increasing expectations in terms of the data quality. There are various mechanisms in place to standardize and assure the quality of programme data, and WHO continues to provide the critical technical assistance to countries towards this end. However, as a result of weaknesses in the health systems, recurrent data quality gaps are documented. In addition to the programmatic documentation at country level and with the partner agencies, various published papers have referred to the discrepancy between officially reported coverage as compared with household surveys.

Most of the challenges with data quality can be handled through continuous training, supervision and adherence to data management protocols. WHO provides ongoing capacity building efforts through the provision of technical guidelines and tools, advocacy and training, as well as on-site support for data management. However, the major area of intervention in terms of improving data quality has to be upstream, through regular on-the-job training of health workers and immunization service delivery staff to improve the recording and data handling practices at the point of initial data capture.

Over the past few years, WHO and the CDC have helped to update the front-end analysis features of most of the existing computerized databases in use at country level, with a view to improve the cleaning and analysis of data. However, considering the continued occurrence of data entry errors, there is room for further updates in the check codes and data cleaning features to enable accurate and complete capture of information once it gets to the national level.

**Recommendations**

Many national immunization and surveillance programmes do not have capable professional persons handling...
their data. Moreover, most programme managers and epidemiologists do not engage adequately in the monitoring of data quality. Some possible approaches to consider in addressing this problem could involve:

- Increasing the profile of data managers within the structure of the national immunization and disease control surveillance programmes;
- Ensuring that national programme managers take full responsibility for the quality of data as a critical part of their terms of reference;
- Strengthening the terms of reference of national immunization technical advisory groups (NITAGs) to include data quality reviews;
- Developing mechanisms and tools for regular district-level data quality review to be integrated with daily monitoring activities;
- Developing relevant and sensitive indicators to monitor the intrinsic quality of the data, and to measure the impact of the measures implemented to improve data quality;
- Developing better metrics to measure the consistency between data sources and among datasets at different administrative/operational levels;
- Systematically utilizing a set of core indicators for monitoring data quality, as included in the regional guide for implementing the RDE approach; and
- Reviewing, systematically, the findings from data quality audit and data quality self-assessment exercises, and taking opportunities for similar programme reviews to document and address gaps in the quality of data.

Conclusions

The quality of programme data is one of the pivotal elements in immunization and disease control programmes. WHO-AFRO continues to provide technical support to Member States to standardize data management and address problems with the quality of immunization monitoring and surveillance data. Some of the key challenges with assuring high quality data result from the lack of skilled manpower and from the gaps in the managerial oversight of the data coming out of the national immunization and disease control programmes. Supportive supervision of field activities and sensitization of surveillance officers and immunization staff to improve on recording practices as well as training of data managers, and updating of the data management software, will need to continue in order to build capacity within countries.

In addition, more systematic implementation of data quality audit and self-assessment exercises, as well as critical analysis of the results from these exercises, will be important to address country specific issues with the verifiability of coverage data. The incorporation of data validation methods needs to be considered in the monitoring of coverage and surveillance activities at district level so as to be able to minimize the bias created by inaccuracies in denominators, and errors or gaps in data capture.

However, without due attention to the policy and managerial aspects of data quality within the national programmes, it will be impossible to address the challenge more effectively.

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References

5. WHO. Measles SIAs Planning & Implementation Field Guide. Regional Office for Africa 2010.