Analysis of health facility data: Guidance for managers and analysts

DRAFT of 17 September, 2015
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Introduction

**What is the purpose of this document?**

This publication presents guidelines for managers and analysts to review, analyze and present the findings from data that are routinely reported by health facilities\(^1\).

**What is meant by routine health facility data?**

Routine health facility data are collected at clinics, hospitals and other health service points (public; private; community-based) at the time that services are provided. These data are processed at the health facility and summary reports are then sent to the appropriate administrative authority. The system for collection, management and reporting on this routine data is sometimes referred to as the Health Management Information System (HMIS).

**Uses and virtues of routine health facility data**

Routine health facility data are widely used for national and sub-national health sector reviews and planning. The findings are frequently published in annual reports of health statistics and periodic analytical reviews. Individual health programs and district health teams also often feature analyses of health facility data in their annual reports. Through analysis of routine health facility data it is possible to obtain levels, trends and geographic differences in many health indicators. These include indicators related to the delivery of services, the coverage of interventions and the leading diagnoses among those attending health facilities. Standard indicators are listed at the outset of Module 1 and defined and discussed in Modules 2 to 4. From a collection of such indicators it is possible to construct summary indexes with which to compare overall health system performance over time or between regions or districts.

Health facility data are reported on a continuing basis and thus can present a timely picture of population health. Other data sources such as population-based surveys and health facility surveys also provide indispensable information about health status and the health system but they are often conducted infrequently and as such do not always reflect current health realities. Moreover, surveys provide information on limited samples that typically cannot provide precise estimates at fine sub-national levels (e.g. individual districts).

**Limitations of routine facility data**

Routine facility data have a number of limitations related to quality, particularly missing values, biases, misclassification and transcription errors. To analyze these data, managers and analysts must first address these limitations through review of data quality and methods such as field investigations and imputation (editing) of missing or clearly incorrect values. Module 1 of this document describes the process for review of data quality, provides examples of the data limitations and suggests some methods for addressing these limitations.

**Methods for analysis and presentation**

The core purpose of this document is to provide an overview of the most promising methods and tools that can be used to analyze facility data to assess and present levels, trends and differences in these core indicators. These methods are introduced in Module 1 and discussed for each of the standard indicators in Modules 2, 3 and 4.

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\(^1\) In addition to data that are routinely collected and reported, information is collected through occasional facility assessments and surveys. Together these data constitute a Health Facility Information System which is one component of a broader health information system (HIS). The HIS brings together data from multiple sources, including from health facilities, household surveys, censuses, civil registration systems, surveillance systems, and other administrative data sources. For further discussion see the WHO document Facility Information Systems Resource Kit. For elaboration on the components of an HIS see the HMN Framework (http://www.who.int/healthmetrics/documents/hmn_framework200803.pdf)
1 GENERAL PRINCIPLES FOR ANALYSIS OF FACILITY DATA

1.1 First principle: Focus on a limited set of standard indicators

A focus on a limited set of standard indicators helps reduce reporting requirements and facilitates efforts to assure high quality data and analysis. This document focuses on a subset of indicators derived from WHO’s Global Reference List of 100 Core Health Indicators. The indicators selected for analysis will vary from one country to another and vary by level of the health system. However, the indicators that are selected should meet the following basic criteria:

- Each indicator must be clearly defined: both the numerator and the denominator;
- The numerator for each indicator must be measurable with routine health facility data – either data that are reported each month/quarter or with related data systems such as those of sentinel sites, disease surveillance systems or annual inventories of health infrastructure and human resources.
- The indicators selected for national-level analysis should be specified in a monitoring and evaluation framework for the national health sector strategy;
- Collectively, the indicators should reliably and comprehensively assess the performance of the health system;

The model indicators which are the focus of this document are listed in Table 1 and defined and discussed in detail in Modules 2, 3 and 4.

Resources for selection of standard indicators

- Global Reference List of 100 Core Health Indicators. Final version. WHO. Geneva, 10 March 2015
<table>
<thead>
<tr>
<th>Domain</th>
<th>Group</th>
<th>Sub-group</th>
<th>Indicator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health status</td>
<td>Inpatient</td>
<td>Mortality</td>
<td>Incidence of inpatient death and case fatality rates for top causes Institutional deaths as a proportion of total estimated deaths Incidence of the top diagnoses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morbidity</td>
<td>Incidence of the top diagnoses</td>
</tr>
<tr>
<td></td>
<td>Outpatient</td>
<td>Morbidity</td>
<td>Malaria incidence Estimated TB incidence New cases of notifiable diseases</td>
</tr>
<tr>
<td></td>
<td>Surveillance</td>
<td>Priority diseases</td>
<td>Incidence of the top diagnoses</td>
</tr>
<tr>
<td>Health service</td>
<td>Reproductive</td>
<td>Antenatal care (ANC)</td>
<td>ANC 1 &amp; ANC 4 Mean ANC visits per client ANC1 in early pregnancy 2nd or 3rd dose of intermittent presumptive treatment for malaria during pregnancy (IPTp2 or IPTp3) 2nd dose of tetanus toxoid vaccine (TT2) Skilled birth attendance Institutional deliveries Caesarian section (CS) rate</td>
</tr>
<tr>
<td>coverage (Module 3)</td>
<td>maternal and</td>
<td>Delivery care</td>
<td></td>
</tr>
<tr>
<td></td>
<td>neonatal preventive</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>health services</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Delivery care</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neonatal care</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Family planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Child preventive</td>
<td>Immunization</td>
<td>DTP1 &amp; DTP3(^2); 1st dose of measles-containing vaccine (MCV1) DTP1 – DTP3 dropout rate</td>
</tr>
<tr>
<td>health services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Micro-nutrients</td>
<td></td>
<td>Vitamin A supplementation</td>
</tr>
<tr>
<td>Health system</td>
<td>HIV/AIDS</td>
<td></td>
<td>People living with HIV diagnosed HIV care coverage ART coverage ART retention HIV viral suppression TB notification rate TB treatment success Malaria diagnostic testing rate Cervical cancer screening Completeness &amp; timeliness of weekly surveillance reporting AFP rate Measles confirmation rate</td>
</tr>
<tr>
<td>inputs and outputs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Module 3)</td>
<td>Inputs</td>
<td>Health infrastructure</td>
<td>Health facilities per 10,000 population, by type of facility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human resources</td>
<td>Health professionals per 1,000 population, by type of worker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supplies</td>
<td>Stockouts of tracer drugs</td>
</tr>
<tr>
<td></td>
<td>Outputs</td>
<td>Outpatients</td>
<td>Outpatient department (OPD) visits per capita</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inpatients</td>
<td>Admissions per 100 population</td>
</tr>
</tbody>
</table>

\(^2\)Coverage with the pentavalent vaccine (diphtheria-tetanus-pertussis-hepatitis B – haemophilis influenza) is still often labeled “DTP coverage”
1.2 Second principle: Begin with a desk review of the completeness and quality of the data

All data have limitations that affect the reliability and interpretation of the data. The data routinely reported by health facilities are certainly no exception. The data cannot be interpreted without first knowing how complete they are and examining them for inconsistencies and errors. The data may need to be adjusted before they can be meaningfully analyzed. Findings from review of data quality and explanations of any adjustments to the data must be presented explicitly and transparently as part of presentation of the analytic findings.

During the initial stages, a “desk review” of data quality can proceed with the data immediately available to the analyst without field investigations. Although a desk review can be completed with the statistics aggregated to each individual district level, a more revealing review can be carried out if the fully disaggregated data (for all facilities and all months for the period of analysis) are available.

If time and resources permit, the desk review should be complemented by a survey of a sample of districts and health facilities to determine to what extent the reported data match with the source documents (i.e. facility registers and tally sheets) and to assess the data management system.

WHO has developed a toolkit to support both a desk review and field investigations of data quality. This toolkit includes an Excel-based DQR tool which, when populated with key data from health facilities and other sources, analyzes the completeness, internal consistency and external consistency of the data. Examples of some findings from use of this DQR tool are given in Annex 1, Annex 2 and Annex 3.

**Resources for review of data quality**

- Data Quality Review: A toolkit for facility data quality assessment. WHO. 2015

The remainder of this section discusses the minimal data quality assessments that should be conducted as part of any analysis of health facility data.

1.2.1 Assess reporting completeness

Completeness is the percentage of expected reports\(^3\) which have been submitted to a higher level. The analysts should assess both the completeness of facility reports (submitted to district level) and the completeness of district reports (aggregated data from multiple facilities which have been submitted to the national level).

**Example**

In Kenya the completeness of facility reporting and district reporting of outpatient morbidity were both consistently high (≥96%) from 2011 to 2014. This would permit meaningful analysis of, for example, trends in reporting of sexually transmitted infections.

**Figure 1: Completeness of monthly reporting on outpatient morbidity, Kenya, facilities reporting to districts and districts reporting to national level, 2011 (year 1) to 2014 (year 4). Data source: Kenya HMIS**

\(^3\)For example, 12 monthly reports are expected per facility per year.
**a) Assess completeness of reporting of each form and each key data element**

Different forms are often used to report different types of services. For example, outpatient morbidity is often reported separately from immunizations, antenatal care, etc... The number of facilities delivering each type of service and expected to report each form (which determines the denominator for calculating completeness) may vary from one service to another. The number of reports submitted (the numerator) may also vary by form.

Along with the findings from analysis of an indicator, also present findings on the completeness of reporting of the relevant form. Along with any analysis of the trend in an indicator, also present findings on the trend in completeness of reporting of the relevant form.

Each cell of a reporting form is called a data element. Some examples of data elements might be: the number of first visits for antenatal care visits by women < 16 weeks of gestation, the number of first antenatal care visits by women ≥ 16 weeks of gestation, etc... Reporting forms often include disaggregated (split up) data elements. For example, for each disease reported on an outpatient morbidity form there are usually multiple cells for recording separately the number of cases in each of multiple age groups. Or the number of first doses of measles vaccine may be split between two data elements – one to record the doses given to boys and a separate cell to record the number of doses given to girls.

The splitting of data elements multiples the number of data elements. This can considerably increase the burden of recording and reporting facility data. Faced with the burden of completing numerous cells, a substantial percentage of health workers may consistently leave certain cells blank, using only a sub-set of cells to report all the data⁴. For example, staff at some health facilities may report all doses of DTP3 as being given prior to 12 months of age even though some of these reported doses were given to older children. Hence the analysts need to examine the completeness of reporting for specific data elements. **Annex 4** provides an example of how assessment of the completeness of reporting on specific data elements can be essential for valid analysis of some indicators.

To limit the reporting burden and assure high quality data (especially data that reliably distinguish DPT3 from earlier doses of DTP and data that reliably distinguish 4th ANC visits from other ANC visits), those designing routine reporting forms should aim to limit the number of cells and rely upon findings from household surveys to more reliably answer many questions. For example, WHO recommends that health facility data on immunization not be disaggregated by gender. The analyst can help promote streamlining of reporting forms by identifying problems with the completeness and consistency of the separate data elements and bringing such findings to the attention of those managing the health facility reporting system.

**b) Assess completeness of reporting from hospitals and from private sector facilities**

Hospitals report the great majority of inpatient deaths and admissions and a significant percentage of outpatient services. Yet, in some health systems, the completeness of reporting is significantly lower from hospitals than from health centres and health posts.

While private, not-for-profit facilities may reliably report routine data, this is often not true of for-profit health facilities. Especially in cities, such for-profit facilities may account for a significant percentage of select services such as delivery care. Assessment of the completeness of reporting from such private facilities begins with a robust inventory of all facilities as part of efforts to prepare a Master Facility List for the country. WHO has developed guidance for developing and maintaining a Master Facility List⁵.

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⁴ In one country, data on administration of doses of DTP vaccine was split into 24 separate data elements to provide data disaggregated by dose sequence number, gender, <1 versus ≥1, and inside the catchment area versus outside the catchment area of the health facility. Review of the data for this country showed that, in the course of 2014, 59% of health facilities filled in only half or fewer of the vaccination cells each month and consistently left the others blank. For example, 37% of health facilities never reported giving DTP to a child who was 12 months or older. This has obvious implications for the validity of an analysis which depends upon these disaggregated data elements to estimate, for example, immunization coverage by 12 months of age.

c) Consider imputation of missing data

Incomplete reporting reduces the level of indicators. It introduces a bias. If completeness is roughly the same over time then the indicator can show the trends for those facilities that reported. If, however, there is significant variation over time in completeness, no real trend can be determined. For example, if the national completeness of facility reporting was 65% in 2011 then completeness rose to 85% in 2012, no trend should be presented unless “imputations” can be made.

Imputation involves making assumptions about missing or invalid data. Such assumptions should be based upon a good understanding, after conferring with local staff, of why the data is missing or invalid (Was staffing or supply interrupted? Were staff not yet oriented to a new reporting system?) and whether the affected facilities or affected months are similar to other facilities or other months for which valid data were reported. Annex 5 explains how values can be imputed based upon findings from such field investigations.

There are three possible explanations for missing reports:
No report was provided because no services were provided;
Services were provided, but not at the same level as during other reporting periods;
Services were provided as during other months, but no report was provided.

When the completeness of data is ignored and the analysis is made on all available data, this, effectively, assumes the first of these three explanations – no report was provided because no services were provided. It is important for the analyst to be aware of this assumption and to be aware that, without further investigation, there is a strong probability that the assumption is not justified. As just noted, such an assumption is especially problematic when the completeness varies over time and the analyst wants to examine trends in an indicator. When completeness drops below 75%, imputation based upon reported data is not a reliable way of estimating missing values. Also, when completeness varies by more than 15 percentage points, the trend should not be presented because imputation of missing data will not reliably correct for the missing data.

In some cases, missing data can be estimated from surveys. For example, data on deliveries at private for-profit facilities is often highly incomplete. Nationwide household surveys such as a DHS or MICs typically measure the percentage of women delivering in private health facilities, by region. These estimates can be added to estimates based upon data reported from government/NGO health facilities to estimate the total percentage of women delivering in health facilities. An example of this analytic method is presented as Annex 6.
Example 1: Imputing missing data on first antenatal visits

In one country, a new reporting and data management system was phased in starting in 2012. From the first 6 months of 2012, data on ANC1 visits are available from only about 25% of the health facilities reporting on ANC services. As shown in Figure 2, completeness rose sharply during the second half of 2012 and reached 80% by the end of that year. Completeness remained high and climbed somewhat during 2013 and 2014.

Figure 2: Completeness of monthly reporting on ANC visits and annualized ANC1 coverage, January 2012 to December 2014 Source: National HMIS

Suppose that we want to know whether coverage with first ANC visits increased during this period. Because the completeness was so low, coverage during 2012 cannot be assessed with this dataset. That leaves us with data from 2013 and 2014. We could simply compare the unadjusted coverage during the 2013 to the unadjusted coverage during 2014. When we do this we find that, as shown in Figure 3, the coverage appears to have risen from 75.5% to 80.5%. However, as shown in Figure 2, the completeness of reporting was, on average, somewhat lower during 2013 than 2014. Hence, to assess the trend we should adjust the data. To do this, we replace each missing datum with the average value for the same health facility during the same year. This imputation effectively assumes that explanation 3 above applies – during months with no report, services were provided as during other months during the same year. After making this adjustment we find that ANC1 coverage dropped from in 2013 to in 2014. Notice that no estimate is provided for the ANC1 coverage in 2012. This is because the reporting completeness was less than 75% in 2012.

Figure 3: ANC 1 coverage, 2013 and 2014, unadjusted data versus imputed data (see text) Source: National HMIS

*The annualized coverage for any given month is the coverage that would be achieved if services continued to be delivered at the same monthly rate for a full year. It is calculated by multiplying the monthly number of services times 12 and dividing by the usual target population to be reached during a full year.

1.2.2 Review the fully disaggregated data to identify AND CORRECT data entry errors

Data entry errors can occur either when a paper form is first completed or when the data is transcribed such as when it is entered into an electronic database. An example of a data entry error is shown in Figure 4.
Some data entry errors can be identified by screening for outliers – values that are more than two or three standard deviations from the mean. Fortunately, most outliers are so small that they contribute much less than 5% to the annual district total and an even lower percentage to the regional total. A spreadsheet can be used to rapidly identify the outliers that are large enough to have a major influence on the district value of the indicator. It is then practical to carefully investigate each large outlier to determine whether, as with the above example, there is strong evidence that the value is erroneous.

Example: A small number of extreme values can have a large effect on aggregate coverage.

A spreadsheet of the 2014 DTP3 data of all health facilities in a country was used to identify monthly values of greater than 500 (roughly 5% of the annual total from an average district) and isolate the data from 13 health facilities (see Table 3). For each of these health facilities the full set of immunization data were reviewed for the specific monthly report which contained the outlier. DTP3 values were compared to the DTP1, Polio1 and Polio 3 values reported by the health facility for the same month. Eleven of the thirteen facilities had DTP3 values more than 50% greater than DTP1 and Polio1 and Polio3 for the same facility and same month. These DTP3 values were judged to be erroneous and for the analysis these values were replaced by the 2014 average monthly DTP3 values for these same health facilities. In most cases these imputations had a significant effect on the aggregate regional and district total. As a result of the imputations, the total annual doses of DTP3 decreased by 5% or more in 4 of the 8 regions and 8 of the 10 districts involved. Four of the 11 health facilities reporting large, apparently erroneous values were located in the same region and three of these were located in the same district.

Table 3: DTP3 doses of health facilities reporting more than 500 doses of DTP3 in any one month, by month of 2014.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kawe Dispensary</td>
<td>52</td>
<td>42</td>
<td>78</td>
<td>110</td>
<td>38</td>
<td>409</td>
<td>54</td>
<td>12</td>
<td>33</td>
<td>40</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Kimara Dispensary</td>
<td>209</td>
<td>190</td>
<td>645</td>
<td>340</td>
<td>264</td>
<td>338</td>
<td>360</td>
<td>174</td>
<td>382</td>
<td>300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mbeki Dispensary</td>
<td>660</td>
<td>136</td>
<td>616</td>
<td>220</td>
<td>280</td>
<td>155</td>
<td>232</td>
<td>251</td>
<td>236</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tambuka Reli Disp.</td>
<td>196</td>
<td>164</td>
<td>184</td>
<td>300</td>
<td>438</td>
<td>308</td>
<td>374</td>
<td>582</td>
<td>132</td>
<td>106</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>Katozi HC</td>
<td>622</td>
<td>102</td>
<td>171</td>
<td>170</td>
<td>334</td>
<td>286</td>
<td>200</td>
<td>258</td>
<td>145</td>
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<tr>
<td>St Aloyce HC</td>
<td>51</td>
<td>37</td>
<td>45</td>
<td>61</td>
<td>59</td>
<td>55</td>
<td>54</td>
<td>50</td>
<td>3465</td>
<td>59</td>
<td>50</td>
<td>83</td>
</tr>
<tr>
<td>Kandashi Dispensary</td>
<td>36</td>
<td>21</td>
<td>45</td>
<td>39</td>
<td>30</td>
<td>36</td>
<td>30</td>
<td>1339</td>
<td>25</td>
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<td>41</td>
<td>29</td>
</tr>
<tr>
<td>Kateshi HC</td>
<td>69</td>
<td>437</td>
<td>103</td>
<td>104</td>
<td>118</td>
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<td>67</td>
<td>67</td>
<td>62</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Hydrom Luth. Hospital</td>
<td>507</td>
<td>161</td>
<td>126</td>
<td>144</td>
<td>161</td>
<td>114</td>
<td>365</td>
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<td>Ruanda HC</td>
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<td>311</td>
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<td>RCK/Ndege Dispensary</td>
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<tr>
<td>Mali HC</td>
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<td>23</td>
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<td>31</td>
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<td>26</td>
<td>16</td>
<td>1225</td>
<td>16</td>
<td>24</td>
<td>43</td>
</tr>
</tbody>
</table>

Example: As shown in Figure 4, Makonje HC III typically reports each month less than 100 cases of malaria per age/gender group. However, for February 2014, the health facility reported 9,258 cases among girls under five years of age compared to 97 cases among boys of this age group. This data error increased the total number of cases of malaria seen during the month in Mbale district by 75%.

Figure 4: Cases of infectious disease reported for February 2014 by Makonje HC III

1.3.2 Other Infectious/Communicable Diseases

Makonje HC III February 2014
Time permitting, the analysts could investigate a larger number of outliers. Investigations might involve communications with local staff at district and facility level or comparison, for specific health facilities, of records of doses administered with records of commodities supplied. This would be even more practical if investigations were conducted by district staff themselves as part of a monthly exercise.

Investigation of outliers is important for “cleaning” of the dataset prior to analysis. Such investigation is also important to identify regions, districts (see the above example) and health facilities with significant data problems.

1.2.3 Assess for the internal consistency of related indicators

Some services such as delivery of a third dose of DTP vaccine are preceded by another service such as delivery of the first dose of DTP vaccine. Some clients will receive the preceding dose (DTP1) but then fail to receive the third dose (DTP1) – the clients will “dropout”. Hence, DTP1 should be greater than DTP3. When DTP1 – DTP3 is negative this is called “negative dropout”. Negative dropout is a sign of poor data quality. Such findings should be discussed when presenting the results from analysis of the respective indicator.

**Example: Negative Pentavalent 1-3 dropout as a sign of poor data quality.**

On their webpage, HMIS Zanzibar posted Figure 5 which “… shows the drop-out-rate of the Pentavalent vaccine for three consecutive years by districts from 2011 to 2013. Pentavalent 1-3 dropout rates have become much more realistic in 2013, with 5 districts converting from negative to positive rates … A negative dropout rate indicates that there are MORE children getting the later vaccines than those getting the earlier vaccines, which shows data inconsistency and poor data quality, poor understanding and filling of forms by facility staff …”

**Figure 5: DTP1 to DTP3 dropout rate in the 10 districts of Zanzibar, 2011 to 2013. Source: HMIS Zanzibar**

Another pair of related indicators are first visits for ANC (ANC1) and first doses of DTP (DTP1). In many countries both ANC1 coverage and DTP1 coverage are estimated to be greater than 90% in almost all regions. When this is the case, then ANC1 should be only slightly greater than DTP1 (due to pregnancy loss and neonatal mortality occurring between the delivery of ANC1 and the delivery of DTP1). As shown in Figure 6, a scatterplot with one dot for each region or one dot for each district can be used to show whether ANC1 values are internally consistent with DTP1 values.
1.2.4 When analyzing trends, consider whether fluctuations reflect poor data quality

Data from multiple years not only permit assessment of trends but also assessment of the internal consistency of the data. Figure 7 shows fluctuations from one year to another in TB notifications reported by regions of Ghana. The figures jump up and down without a consistent pattern. When an indicator fluctuates by 10% or more from one year to another and/or when the trend is not consistent in one direction, analysts should consider the possibility that the changes observed reflect data quality problems rather than valid trends.

Example: Erratically fluctuating data probably reflect poor data quality.

Figure 7: TB Case (all forms) notifications: percentage change by year and by region, Ghana 2008 – 2012. Source: Ghana National TB Program as cited in Understanding and Using TB data
1.3 Third principle
Decide how to estimate denominators and describe this in the report

Denominators, estimates of the affected or target population, are required to derive rates (e.g. disease incidence per 1,000 population per year) and coverage (e.g. % of infants vaccinated) from the routine data reported by health facilities. Population estimates are typically based upon projections from the most recent national population census. The reliability of these projections declines as years pass since the last census. Due to internal migration (especially in rapidly developing countries or those affected by some crisis), estimations of the populations of administrative divisions (i.e. regions and districts) become especially unreliable with the passage of time.

Whichever denominators are used, the methods and assumptions for estimating should be presented along with the rest of the analysis. A table of estimates of the key denominators (total population, children less than 5, infants, pregnancies, surviving infants, etc...) by geographic region should be included in the full report of the analysis (as shown in the following example). The assumptions used to calculate the denominators should be explained. Where denominators are based upon projections of census figures, the annual growth rate should be stated explicitly.

---

### Example: Extract from a table of denominators used to calculate core indicators

#### Table 4: Sub-populations during 2012, by region of Tanzania. Based upon projections of the 2002 national census

Source: Mid-term Analytic Review of the Health Sector Strategic Plan III.

<table>
<thead>
<tr>
<th>Region</th>
<th>Annual growth rate</th>
<th>Total population</th>
<th>Pregnancies = Births</th>
<th>Births 0.95</th>
<th>Surviving infants = Birth * 0.95</th>
<th>Children &lt; 5 years</th>
<th>Women 15 - 49 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arusha</td>
<td>2.74%</td>
<td>1,694,310</td>
<td>71,161</td>
<td>71,161</td>
<td>67,603</td>
<td>254,147</td>
<td>406,634</td>
</tr>
<tr>
<td>Dar es Salaam</td>
<td>5.76%</td>
<td>4,364,541</td>
<td>130,936</td>
<td>130,936</td>
<td>124,389</td>
<td>654,681</td>
<td>1,047,490</td>
</tr>
<tr>
<td>Dodoma</td>
<td>2.12%</td>
<td>2,083,055</td>
<td>87,488</td>
<td>87,488</td>
<td>83,114</td>
<td>312,458</td>
<td>499,933</td>
</tr>
<tr>
<td>Iringa</td>
<td>1.11%</td>
<td>1,643,335</td>
<td>69,020</td>
<td>69,020</td>
<td>65,569</td>
<td>246,500</td>
<td>394,400</td>
</tr>
<tr>
<td>Kagera</td>
<td>3.25%</td>
<td>2,773,054</td>
<td>122,014</td>
<td>122,014</td>
<td>115,914</td>
<td>415,958</td>
<td>665,533</td>
</tr>
<tr>
<td>Kigoma</td>
<td>2.43%</td>
<td>2,127,930</td>
<td>89,373</td>
<td>89,373</td>
<td>84,904</td>
<td>319,190</td>
<td>510,703</td>
</tr>
<tr>
<td>Kilimanjaro</td>
<td>1.82%</td>
<td>1,640,087</td>
<td>49,203</td>
<td>49,203</td>
<td>46,742</td>
<td>246,013</td>
<td>393,621</td>
</tr>
<tr>
<td>Lindi</td>
<td>0.90%</td>
<td>864,652</td>
<td>31,127</td>
<td>31,127</td>
<td>29,571</td>
<td>129,698</td>
<td>207,516</td>
</tr>
</tbody>
</table>

Note that the assumption that the number of pregnancies = the number of births will cause the ANC coverage to be somewhat under-estimated.

---

A good way to estimate the number of births is to multiple the total population of an area times the best estimate of the Crude Birth Rate (CBR)\(^6\). Whichever method of estimation is used, the denominators used to calculate coverage with antenatal care, institutional delivery, post-natal care and childhood immunization must be mutually consistent:

- As the denominator for calculating coverage with first ANC visits prior to 16 weeks of gestation, use the number of early pregnancies = number births + total pregnancy loss. Total pregnancy loss may be roughly estimated as 10% of the number of births;
- As the denominator for calculating coverage with later ANC visits\(^7\), use the number of late pregnancies = number of births + number of still births. The number of stillbirths may be roughly estimated as 2% of the number of births;

---

\(^6\) Demographers estimate the Crude Birth Rate based upon specialized analysis and modeling of data derived from a national population census. An alternative way to estimated surviving infants and births (surviving infants + infants deaths) is to use a projection (based upon the annual population growth rate) of the number of infants counted during a national population census. This alternative approach can result in under-estimation of the number of surviving infants and births due to undercounting of infants during a national population census.

\(^7\) In countries where the majority of first ANC visits occur after 16 weeks of gestation it would be acceptable to use the number of late pregnancies as the denominator for calculating coverage with first ANC visits.
• As the denominator for calculating coverage with the institutional deliveries and coverage of mothers with post-natal care, use the number of deliveries = number of births – number of twins. The number of twins may be roughly estimated as 1% of the number of births;
• As the denominator for calculating coverage of children with post-natal care, use the number of births;
• As the denominator for calculating coverage with childhood immunization, use the number of surviving infants = number of births – number of infant deaths. The number of infant deaths may be estimated as the Infant Mortality Rate x total population / 1,000.

The inter-relation of these various denominators is illustrated in Figure 8 with an example from a district in Tanzania.

Some health programs may use their own estimations that differ from those of the National Bureau of Statistics. If this is the case and if program denominators are used for the analysis then the analytic report should include a table of these program denominators along with an explanation of the methods used to calculate them.

It is often difficult to use census projections to estimate appropriate denominators for individual districts and health facilities. This is because people often seek care from health facilities that are outside of their area. The result can be that some districts and some health facilities have coverage that is significantly greater than 100% while other districts and health facilities have very low coverage when census projections are used to estimate denominators. As an alternative to use of census data, when there is consistently very high coverage (> 95%) for a service such as ANC1 or DTP1 and when the data are felt to be of high quality then these data can be used to estimate the number of pregnancies or the number of surviving infants. For example, the ANC 4 coverage for a district can be calculated by dividing the number of fourth ANC (ANC4) visits in the district by the number of first ANC visits (ANC1) in the district. As another example, the DTP3 coverage for a health facility can be calculated by dividing the number of third doses of DTP (DTP3) administered by the health facility by the number of first DTP doses (DTP1) administered by the health facility. The analyst should be aware that such use of service data to estimate the size of the target population can modify conclusions reached about which districts are strong performers and which districts are weak performers. An example of this is presented as Annex 7.
1.4 Fourth principle
Reconcile the findings with estimates from other data sources

a) Compare estimates derived from routine health facility data with estimates from household surveys

When available, estimates from surveys such as a Demographic and Health Survey (DHS), a Multiple Indicator Cluster Survey (MICS) or immunization coverage survey should be included in graphs and tables to compare with the estimates derived from the routine data. Examples of this include Figure 19.

Estimates derived from household surveys are frequently cited as the “gold standard” measurements of coverage. Analysts should keep in mind, however, that these estimates are subject to both sampling error (i.e. for sub-national estimates the confidence intervals of estimates can be wide due to a small sample size) and non-sampling errors (for example, there can be a recall bias when vaccination cards are reviewed for less than half of children surveyed). For these reasons, reconciliation of facility data with survey data can sometimes be challenging. Examples of such reconciliation are given in Annex 8.

DHS reports and MICS reports include annexes estimating the confidence intervals for key indicators at national and regional levels. When available, these estimates of the confidence intervals should be displayed on graphs. An example is given in Figure 19.

Sometimes the most valid estimate may not be provided by a single data source but rather by “triangulation” of findings from multiple data sources, each of which provides a partially valid picture of levels and trends. For example, WHO’s estimates of trends in the incidence of malaria and tuberculosis are derived from such triangulation. This is discussed further in Module 2 and illustrated by a case study presented in Annex 11.

b) Compare the data from parallel systems that routinely report the same health events

Sometimes there are parallel systems that report on the same health events. For example, some countries have forms and data management systems for the Expanded Programme for Immunization (EPI) that collect data on immunizations on one form and also collect data on immunizations on a separate child health form. Such parallel reporting increases the reporting burden and can cause confusion when the data collected by the two systems do not agree. As another example of such parallel reporting, epidemic prone diseases may be reported on both a disease surveillance form and a monthly outpatient morbidity form. It is important to review and analyze the data from each of the parallel systems and present findings as part of the analysis. Possible reasons for any discrepancies should be discussed. With each related table or graph it is essential to specify which of the parallel systems was used for the analysis that is presented.

Data may also be available for sentinel sites such as hospitals and clinics that can assure higher quality diagnosis and reporting. Worthwhile data may also come from demographic surveillance sites (DSS) where regular tracking of household demographics and health status permits more reliable monitoring of the population and health events. The report of the analysis can compare findings from such sentinel sites and DSS’s to those derived from routine health data.

c) Compare the available data with the statistics that have been officially reported to WHO

Each year, immunization statistics from each country are officially reported to WHO and UNICEF on the Joint Reporting Form (JRF). Statistics on notified cases of tuberculosis, laboratory confirmed cases of malaria, admissions for malaria and inpatient deaths from malaria are also officially reported to WHO. These official statistics, which can be downloaded from WHO websites, do not represent a separate data source. Instead, these are official estimates which should be consistent with the data available to the analyst if they cover the same time period. Any discrepancy between these official statistics and the estimates made by the analyst should be investigated and explained. Module 3 provides an example of such a comparison.

---

8 Statistics from the Joint Reporting Form for each country, as well as the WHO-UNICEF Estimate of Immunization Coverage (WUENIC) can be downloaded from http://www.who.int/immunization/monitoring_surveillance/data/en/. TB notifications for each country and each year since 1980 can be downloaded from http://www.who.int/tb/country/data/download/en/. Trends in statistics on confirmed cases of malaria, admissions for malaria and inpatient deaths from malaria are presented in each year’s World Malaria Report: http://www.who.int/malaria/publications/world_malaria_report/en/
1.5 Fifth principle
Focus on effective presentation and communication of findings

a) Transformation of data into information, knowledge and decision making

At present, many health information systems are “data-rich” but “information-poor”. This is a consequence of the belief that data can be used directly for decision-making. Raw data alone are rarely useful. The point of a health information system is not just to generate high-quality data and hope that it will be used, but to convert it into credible and compelling evidence that informs local health system decision-making.

Only after data have been compiled, processed and analyzed do they produce information which can be integrated with other information and interpreted in terms of the issues confronting the health system. Information then becomes evidence that can be used by decision-makers.

Evidence must be effectively communicated to decision-makers in order to shape their understanding of health issues and needs. It must be properly formatted into reports and presentations with user friendly graphs, tables and maps. This is the process of transforming evidence into knowledge, and once applied can result in decisions which will directly impact upon health and health equity. The impact on health can then be monitored by the health information system by measuring changes in health indicators.

b) Key dimensions for analysis

To interpret the data, they can be analyzed and presented in various ways

- **Levels**: While absolute numbers can sometimes provide a useful sense of the volume of services (e.g. “7,623,415 rapid diagnostic tests for malaria were performed nationwide during 2012”) they usually cannot be easily interpreted and compared with the statistics from another geographic region or time. For this reason, health statistics are best presented as rates (e.g. “During 2011, the reported incidence of genital ulcer disease was 45 cases per thousand population in Ashanti Region compared to 37 per thousand in Upper East Region”) or
coverage ("35.6% of newborns were reported to have been visited by a health professional within 2 days of birth").

- **Proportional morbidity and mortality** -- One of the most meaningful ways to analyze disease-specific data on outpatient and inpatient morbidity and mortality is as a proportion of all diseases presenting at the health facility. For example, "Injuries accounted for 2.3% of all outpatient visits."

- **Age and sex differences**: For most diseases and most types of services there are important age differences, especially between children younger than 5 and older patients. For some diseases such as HIV/AIDS there may also be important differences between males and females. For other diseases and services, however, there may be no evidence from any source (including surveys and special studies) that there is any important difference between the sexes. In such cases, in the interest of focusing on more important findings, if the preliminary analysis reveals no notable difference by sex then disaggregation by sex should be omitted from tables and graphs.

- **Trends**: If comparable data (i.e. similar case definition, similar completeness) are available from multiple years, a multi-year trend is most enlightening. While some diseases (e.g. laboratory confirmed malaria) and services (e.g. total outpatient attendance) may show a seasonal trend, the data for most other diseases would not be expected to show a meaningful short-term trend. In such cases, disaggregation by month should be avoided in tables and graphs.

- **Geographic equity**: Routine facility data are an ideal source for assessment of disparities between geographic regions, districts and even individual health facilities.

- **Private sector**: While data from private sector facilities may sometimes be quite incomplete, the analysis should at least acknowledge this limitation. Any available data, such as those from confessional organizations or a small number of private for-profit facilities, should be separately analyzed to determine whether there are notable differences with data from government facilities.

c) Ways to present key findings

- **Tables**: Tables present precise numerical statistics in an orderly fashion. The interested reader can conduct some further analysis of these statistics if they so choose. However, it is often difficult for the reader to appreciate the most important conclusions to be derived from a large table of numbers.

---

**Example: Tabular presentation of coverage statistics**

Figure 10: Childhood vaccination coverage by region/district and by antigen, Burkina Faso, 2014: Source: an extract from the Annual Statistical Report of the Ministry of Health, May 2014

<table>
<thead>
<tr>
<th>Régions/districts</th>
<th>VP00</th>
<th>VP01</th>
<th>VP02</th>
<th>VP03</th>
<th>DTC+HepB-Hb1</th>
<th>DTC+HepB-Hb2</th>
<th>DTC+HepB-Hb3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boucle du Mouhoun</td>
<td>112,6</td>
<td>104,1</td>
<td>100,4</td>
<td>101,4</td>
<td>100,4</td>
<td>101,4</td>
<td></td>
</tr>
<tr>
<td>Boromo</td>
<td>114,6</td>
<td>100,8</td>
<td>97,7</td>
<td>98,1</td>
<td>100,9</td>
<td>97,7</td>
<td>99,1</td>
</tr>
<tr>
<td>Dedougou</td>
<td>108,9</td>
<td>104,5</td>
<td>98,6</td>
<td>102,4</td>
<td>104,5</td>
<td>99,8</td>
<td>102,4</td>
</tr>
<tr>
<td>Nouna</td>
<td>124,3</td>
<td>110,2</td>
<td>106,7</td>
<td>110,1</td>
<td>106,7</td>
<td>107,1</td>
<td></td>
</tr>
<tr>
<td>Solenzo</td>
<td>114,2</td>
<td>103,2</td>
<td>98,3</td>
<td>99,8</td>
<td>103,2</td>
<td>99,3</td>
<td>99,8</td>
</tr>
</tbody>
</table>

- **Graphs**: Bar charts, line charts and pie charts rapidly convey the relative size and trends in key values.
Maps: “Thematic maps” give a different color to each geographic region for quick appreciation of regional disparities in a key indicator. Alternatively, or in addition, the size or color of points placed on a map can represent the value of a key indicator. Maps can be created with sophisticated GIS software (ArcGIS or the free and open source QGIS). Some data management software such as DHIS has built in mapping capabilities. Alternatively, if each row of data in a spreadsheet includes the geo-coordinates (latitude and longitude), “fusion tables” can be used to map the data using the Google Maps website⁹.

Figure 11: Proportion of all institutional deaths among children under 5 (excluding neonates), Rwanda, 2012. Source: Rwanda Annual Health Statistics Bulletin for 2012

Example: Proportional mortality

Figure 12: Proportion of all outpatient visits attributed to malaria. Rwanda, 2012. Source: Rwanda Annual Health Statistics Bulletin for 2012

⁹ https://support.google.com/fusiontables/answer/2527132?hl=en
Websites and dashboards: Computer code can be written with computer or web-based data management systems to display multiple tables, graphs, and maps on the same page. The idea is that the “driver” can glance at these items to get a quick impression of performance with key indicators each time that they log onto the data management system.

Example: A DHIS2 dashboard for Sierra Leone

Figure 13: DHIS2 dashboard for Sierra Leone, accessed sometime in 2014

![DHIS2 dashboard for Sierra Leone](image)

Summary measures

A small set of standard indicators representing a range of health service functions can be selected to provide a comprehensive assessment of the overall performance of a national, regional or district health system. The scores from this fixed set of indicators can be combined mathematically (e.g. by averaging the coverage achieved with various health services) to calculate an index with which to judge trends from year to year or compare one district or regional to another. In this way, a “league table” can be generated.

Example: A league table comparing the performance of regions

Table 5: Ghana’s regional league table. Source: Holistic Assessment of the Health Sector Programme of Work 2012, MoH, June 2013

<table>
<thead>
<tr>
<th>Region</th>
<th>Score</th>
<th>Pent 3</th>
<th>ANC 4+</th>
<th>Skilled delivery</th>
<th>FP acceptors</th>
<th>OPD/capita</th>
<th>IMMR</th>
<th>TB treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Upper East</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Eastern</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Western</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Greater Accra</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Upper West</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Volta</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Ashgold</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Brong Ahove</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Northern</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
</tr>
</tbody>
</table>

Table 7: Holistic assessment of regional performance in 2012

“In the regional analysis of POW 2011, three regions came out with a score of zero or below. In the current review all regions have a positive score, which indicates a relative improvement over 2011 for these selected service delivery indicators.”

e) Ten rules for reports, tables, and figures

1. On the cover page of a report, always specify the month and year that the document was finalized.
2. Don’t forget to discuss the methods used for estimating denominators. Include in the report a table of key denominators.
3. In any report, and for each table or figure, always analyze data quality and present and discuss notable findings about date quality. Where relevant, discuss in particular the completeness of hospital data, the completeness of
private sector data and striking inconsistencies over time. Tables and graphs of data from multiple years not only permit assessment of trends but also consistency. When an indicator fluctuates by 10% or more from year to year the text should acknowledge the possibility that the change reflects a data quality problem.

4. If a table extends over more than one page of a report, always print the headers at the top of each column on each page of the report.

5. With graphs presenting estimates of immunization, ANC or delivery coverage also show recent survey estimates of the same indicator and, where possible, show the confidence interval for the survey estimate.

6. Every table and every figure needs a caption.

7. Specify the period and the geographic area for which the statistics apply.

8. Specify the data source – not just the publication or the organization that provided the data but the data source itself.

9. For each table, graph or map, include narrative in the report that interprets the most important findings and discusses how indicators are defined and any special limitations.

10. If findings are to be projected on a screen (e.g. with a powerpoint presentation) do not include any text or number with a font size smaller than 16.

f) Analysis of data must be linked to review processes: program reviews, national/district annual reviews and reviews of national health sector strategic plans

Analysis should be more than an academic exercise. While it is helpful for the analytic process to maintain some degree of independence, the analytic process should be officially recognized. The findings should be presented to, discussed by and acknowledged by key officials and stakeholders of the health system. To facilitate such a linkage, the timeline for conducting the analysis should be linked to the timeline for key review meetings.
2.1 Inpatient admissions and deaths

Specific indicators

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator(s)</th>
<th>Definition</th>
</tr>
</thead>
</table>
| Mortality           | Core           | Cause-specific institutional mortality:  
a) Incidence (deaths per 100,000 person-years);  
b) Proportional mortality (% of total mortality attributed to each of the top 10 to 20 causes) | The list of causes should include, at a minimum, pneumonia, diarrhea, malaria malnutrition, (malaria), AIDS, TB, leading chronic diseases (cardiovascular, cancer, diabetes, chronic respiratory disease), vaccine preventable diseases (measles, diphtheria, tetanus), injuries (road traffic, violence, suicide), epidemic-prone diseases of international public health importance (atypical influenza, cholera, meningitis, viral hemorrhagic fevers), maternal deaths and neonatal deaths |
| Inpatient morbidity | Core           | Cause-specific admissions:  
a) Admissions per 1,000 population;  
b) Proportional morbidity (% of total admissions attributed to each of the top 10 to 20 causes) | The minimum list of causes should include those listed above |

INSTITUTIONAL MORTALITY
Analysis of data on reported deaths should begin by estimating the percentage of all deaths nationwide (based upon UN estimates of the crude death rate\(^\text{10}\)) that are reported by health facilities. Where only a small minority of deaths are reported, institutional mortality rates (i.e. number of deaths reported by health facilities per 100,000 population per year) are difficult to interpret meaningfully. Institutional proportional mortality (% of all institutional deaths attributable to each of the top 10 to 15 causes) provides an indication of the relative importance of different causes of death.

Core analyses

1. **Institutional mortality:** Analyze the top ten to fifteen causes of death by mortality rate and proportional mortality. Dimensions: Trends over recent years. Disaggregations: Present findings for each age group (<5 versus ≥ 5, at a minimum) and each gender. Methodological issues/Interpretation: If institutional deaths that have been attributed to one cause (e.g. malaria) decline significantly over several years while institutional deaths from other causes are generally stable this is evidence of a decline in overall mortality from that cause.\(^{11}\)

2. **Institutional maternal mortality rate and the institutional neonatal mortality rate:** Analyze the number of deaths per 100,000 live births in a health facility. Dimensions: Trends over recent years. Disaggregations: by first administrative division (e.g. region / province / state). Methodological Issues/Interpretation: These are institutional case fatality rates which assess not only health status but quality of care.

\(^\text{10}\) UN estimates of the crude death rate and the total population of each country can be found at [http://unstats.un.org/unsd/mbs/app/DataSearchTable.aspx](http://unstats.un.org/unsd/mbs/app/DataSearchTable.aspx)

\(^{11}\) For malaria, such a pattern may be most evident from analysis of data on institutional mortality among children less than 5 years of age. The country profiles in WHO’s annual World Malaria Report include, for each country, a graph showing trends in institutional malaria mortality and inpatient admission as reported to WHO since 2000. An example is shown in Annex 11.
Additional analyses

3. **Institutional case fatality rates**: Analyze the deaths per person hospitalized for select other health conditions (e.g. malaria, cardiovascular disease, cancers) Dimensions: Trends over recent years. Disaggregations: by age groups and by first administrative divisions.

4. **All cause institutional mortality among adults 15 to 49**: Analyze the number of deaths from all causes per 100,000 persons 15 to 49 years of age. Methodological issues/Interpretation: If HIV prevalence is greater than 2%, a significant decline over several years in all-cause institutional mortality for adults 15 to 49 may complement evidence from other analyses and other data sources of a decline in total mortality from AIDS. Disaggregations: by sex.

Data quality issues and limitations

1. A large percentage of deaths may never be observed or reported by health workers\(^\text{12}\). Such reporting is influenced by care seeking practices which may vary considerably by age, disease, geographic region and in some cases by gender. The problem may be compounded by variations between health facilities, between geographic regions and between health conditions in the expertise, laboratory and equipment required to reliably diagnose diseases. If most deaths are not reported by health facilities and if the completeness of such reporting varies significantly over time and between geographic regions then those reporting on analyses of trends and inter-regional comparisons must acknowledge these considerable limitations.

2. Routine reporting from hospitals is sometimes markedly incomplete. Hence, reporting completeness must be assessed and presented. Proportional mortality is less sensitive to incompleteness of reporting but may still be affected by changes in the types of hospitals reporting (e.g. whether or not the referral hospitals are included).

3. The report should explicitly indicate where data come only from a selected group of sentinel hospitals.

4. The completeness (or lack) of reporting from private facilities should be noted.

---

**Example: Proportional institutional mortality**

**Figure 14**: Proportions of deaths in hospitals of children less than 5 years of age due to various leading causes, Tanzania, 2009 to 2012. Source: Tanzania HMIS as presented in the Tanzania Mid-term Analytic Review

<table>
<thead>
<tr>
<th>Year</th>
<th>Ill-defined causes</th>
<th>HIV/AIDS</th>
<th>Protein-energy malnutrition</th>
<th>Diarrhoeal diseases</th>
<th>Perinatal causes</th>
<th>Anemia</th>
<th>ARI/pneumonia</th>
<th>Malaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>10%</td>
<td>5%</td>
<td>15%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>2010</td>
<td>9%</td>
<td>19%</td>
<td>28%</td>
<td>12%</td>
<td>4%</td>
<td>14%</td>
<td>14%</td>
<td>10%</td>
</tr>
<tr>
<td>2011</td>
<td>8%</td>
<td>18%</td>
<td>26%</td>
<td>11%</td>
<td>3%</td>
<td>13%</td>
<td>13%</td>
<td>9%</td>
</tr>
<tr>
<td>2012</td>
<td>7%</td>
<td>17%</td>
<td>24%</td>
<td>10%</td>
<td>2%</td>
<td>12%</td>
<td>12%</td>
<td>8%</td>
</tr>
</tbody>
</table>

"Overall, 15% of the estimated total of 120,000 child deaths in mainland Tanzania took place in health facilities in 2011–12... Malaria declined but was still the lead cause of death among children in hospitals (30%), followed by pneumonia (19%) and anemia (11%). [Otherwise]... the time trend is difficult to ascertain as there are likely to be differences in coding practices over time, as well as reporting errors."

- Best practices: Presentation of proportional mortality; presentation of trends; disaggregation by age; acknowledgement that apparent trends may be due to inconsistencies in classification of the cause of death and data quality problems; acknowledgement of the percentage of total deaths which are reported by institutions

---

\(^\text{12}\)For many low income countries, less than 20% of childhood deaths and less than 10% of deaths among older age groups are reported by health facilities.
INPATIENT MORBIDITY

Core analyses:

- **Inpatient morbidity:** Analyze, for each of the top ten causes of admission, the incidence (number of cases per 1,000 population per year) and proportional morbidity (% of all admissions attributable to each cause).

  Dimensions: trends over recent years. Disaggregations: age groups (<5 versus ≥5, at a minimum), sex, region.

Data quality issues and limitations

1. Data on inpatient morbidity have the same limitations as data on institutional mortality: depending upon care seeking practices and diagnostic capacity only a small percentage of severe illness may result in hospitalization and this percentage varies by disease.

2. If completeness of hospital reporting varies significantly over time and between geographic regions then those reporting on analyses of trends and inter-regional comparisons must acknowledge these limitations.

3. Inpatient diagnosis (for more severe forms of illness; with diagnosis supported by more extensive evidence) is likely to be more reliable than outpatient diagnosis.

Example: Institutional maternal mortality

**Figure 15: from the Tanzania Mid-Term Analytic Review, September 2013**

Regional institutional maternal mortality ratios vary from about 100 in Dar es Salaam, Arusha and Kilimanjaro to over 250 in Tabora and Mtwara. Maternal mortality ratio trends are fairly consistent and plausible in most regions although underreporting of maternal deaths and/or deliveries is likely in several regions. Kagera region also has low maternal mortality but there is evidence of underreporting of deaths in 2012, as the number of deaths reported in 2012 is much lower than in previous years.

- **Best practices:** Presentation of institutional maternal mortality; regional disaggregation; discussion of trends in institutional maternal mortality and trends in completeness
Annex 9 provides another example of best practice from Rwanda.

2.2 Outpatient morbidity and routine surveillance of priority diseases

**Specific indicators**

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator(s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morbidity</td>
<td>Core</td>
<td>Cause-specific outpatient morbidity:</td>
<td>The list of causes should include, at a minimum, severe childhood illnesses (severe pneumonia, severe dehydration, severe anaemia, severe malnutrition, severe malaria), malaria (confirmed versus presumed), AIDS, TB, leading chronic diseases (cardiovascular, cancer, diabetes, chronic respiratory disease), vaccine preventable diseases (measles, diphtheria, tetanus, AFP, yellow fever), STIs (with genital discharge, with genital ulcers, PID), injuries (road traffic, violence, suicide), and epidemic-prone diseases of international public health importance (atypical influenza, cholera, meningitis, viral hemorrhagic fevers).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a) incidence (cases per 1,000 person-years);</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Proportional morbidity (% of total outpatient morbidity attributed to</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>each of the top 10 to 20 causes)</td>
<td></td>
</tr>
<tr>
<td>Routine surveillance of priority</td>
<td>Core</td>
<td>Malaria incidence</td>
<td>Laboratory confirmed cases of malaria per 1,000 population</td>
</tr>
<tr>
<td>diseases</td>
<td></td>
<td>TBincidence</td>
<td>Estimated number of new or relapse tuberculosis (TB) cases per year per 100,000 population</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>New cases of IHR and other notifiable diseases</td>
<td>IHR notifiable diseases: wild type poliovirus, human influenza caused by a new subtype, severe acute respiratory syndrome (SARS). Other notifiable diseases: cholera, pneumoniae plagues, yellow fever, viral hemorrhagic fevers, West Nile fever and other diseases of special regional concern.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional</td>
<td>Cancer incidence rate</td>
<td>New cases (by type of cancer) per 100,000 population</td>
</tr>
</tbody>
</table>

**OUTPATIENT MORBIDITY**

Core analyses

- **Outpatient morbidity:** Analyze, for each of the top ten outpatient diagnoses, the incidence (number of cases per 1,000 population per year) and proportional morbidity (% of all outpatient cases attributable to each cause).
Dimensions: trends over recent years. Disaggregations: age groups (<5 versus ≥ 5, at a minimum), sex, first level administrative division, type of facility (i.e. primary clinic versus referral facility – with more advanced diagnostic capacity).

Additional analyses

- **Incidence of severe childhood illness**: For each of the leading causes of childhood mortality (e.g. pneumonia, diarrhea, malnutrition, malaria, etc...) it is worthwhile collecting and analyzing data specifically on the number of severe cases. Such analysis can identify the life threatening illnesses presenting at each level of the health system and help with planning and evaluation of case management training, supervision and drug supply.\textsuperscript{13} Dimension: Trend over several years. Disaggregation: type of facility, first administrative division.

Data quality issues and limitations

1. Data on outpatient morbidity have the same types of limitations as data on inpatient morbidity and mortality: depending upon care seeking practices and diagnostic capacity only a small percentage of illnesses may be reported and this percentage varies by disease. Outpatient diagnoses are likely to be even less reliable than inpatient diagnoses. With the shift towards laboratory confirmation of malaria, health workers in many malaria endemic countries will want to increase their diagnoses of other febrile illnesses. However, accurate diagnosis of these other causes of fever will require additional laboratory investments.

2. Trends in the reporting of morbidity are influenced by changes in the completeness of reporting and changes in care seeking practices (e.g. as a result of drug stockouts). It is essential to assess and present findings on the completeness of reporting, including from hospitals and private facilities. Annex 10 provides an example of how the reported number of outpatient consultations can fluctuate substantially from year to year leading to an appearance that underlying disease incidence has changed.

Annex 10 provides an example of analysis and presentation of proportional outpatient morbidity. Notice that the reported cases of malaria (the top diagnosis, accounting for 36% of all outpatients) need to be disaggregated into confirmed malaria and presumed malaria. If this had been done then the proportion of outpatient morbidity attributable to malaria would be considerably less.

**MALARIA INCIDENCE**

In some malaria endemic countries it is not uncommon for one third or more of all outpatients to be diagnosed as having malaria. This largely reflects the fact that many cases of malaria are still diagnosed presumptively (i.e. without laboratory confirmation). Data on presumed cases of malaria cannot be meaningfully interpreted. Analysis should be limited to laboratory confirmed (either by blood smear or by rapid diagnostic test – RDT) cases.

**Core analysis**

- **Malaria incidence rate**: Analyze the incidence (number of laboratory confirmed cases per 1,000 population per year). Dimensions: trends over recent years. Disaggregations: age groups (<5 versus ≥ 5, at a minimum), first level administrative division. Methodological Issues/Interpretation: If testing practices (as assessed by the Malaria Diagnostic Testing Rate or Annual Blood Examination Rate - MDTR and ABER -- see Module 3) are stable, the completeness of reporting is stable and care seeking practices are stable, then trends in the number of confirmed cases of malaria may reflect true trends in malaria incidence. An example is given as Figure 15 below. However, if testing practices are not stable, then the trend in confirmed cases may be misleading.\textsuperscript{14}

\textsuperscript{13} The integrated management of childhood illness (IMCI) approach establishes clear case definitions for the severe forms of childhood illness. If a health facility or group of health facilities reports very few cases severe childhood illnesses this may reflect a need to reinforce case management practices. If a significant proportion of front-line health facilities report a particular childhood illness, this would suggest that referral drugs should be supplied to front-line health facilities (e.g. it may be important to supply artemisinin suppositories to front-line health facilities and train staff there to use them if a significant number of cases of severe malaria are reported by these facilities).

\textsuperscript{14} As illustrated by the case discussed in Annex 11, data on inpatient admissions and deaths may provide the best evidence of trends in disease incidence when the data on confirmed outpatient cases are confounded by trends in confirmatory testing. However, for a large percentage of countries with the highest burden of malaria, even when all routine data are viewed together, they do not yet permit robust conclusions to be reached about a trend in the incidence of malaria and the impact of malaria control activities. The country profiles included in WHO’s annual World Malaria Report include an assessment, for each endemic country, of whether the data since 2000 on testing, confirmed cases, admissions and deaths from malaria have been sufficiently consistent to conclude whether or not the incidence of malaria has increased or decreased during this period. The 2014 World Malaria Report (summarized in Annex 12) concludes that, as of 2013, the proportion of countries with routine data that is consistent enough to reach such conclusions varies by WHO region: only 13 of 31 (42%)
Data quality issues and limitations

1. As testing practices improve (as measured by the “Malaria diagnostic testing rate” or the “Annual Blood Examination Rate” -- indicators discussed with Module 3), even though the true incidence of malaria is stable or declining the number of confirmed malaria cases reported may increase. An example of this is included as Annex 11.

2. Some malaria endemic countries have only recently expanded their capacity for laboratory confirmation of malaria and only recently introduced new reporting forms to distinguish confirmed from presumptive malaria. In such instances, several years may be needed before high quality reporting on confirmed malaria can be assured. The quality and consistency of malaria-specific data elements (including data elements for reporting testing) is best explored by examining the fully disaggregated data (i.e. from each facility and each month). An example of such analysis is given as Annex 4.

Example: Trend in malaria incidence

Figure 17: Confirmed malaria cases per 1000 and ABER, Afghanistan, 2000 - 2013. Source: officially reported health facility data presented in the World Malaria Report, 2014

ESTIMATED TB INCIDENCE

Estimates of TB incidence are produced through a consultative and analytic process led by WHO. Estimates for each country and for multiple years are available online (http://www.who.int/tb/country/data/download/en/). While these estimates are, in part, based on annual case notifications, the case notification data frequently must be adjusted based upon an assessment of the quality and coverage of TB case detection efforts. Such adjustments rely upon alternative methods for estimation of TB incidence using national surveys of the prevalence of TB disease as well as information from death (vital) registration systems. TB incidence rates are published annually by WHO for the national level. These include estimates of the incidence of TB cases per 100,000 population and estimates of the incidence of TB cases which are HIV positive per 100,000. Point estimates are provided along with estimates of an upper limit and estimates of a lower limit. Sub-national data on case notifications are not reported to WHO and WHO does not publish sub-national estimates of TB incidence.

Core analysis

- Estimated TB incidence rate: Review and comment upon the estimated number of TB cases per 100,000 population per year. Dimensions: trends over recent years. Disaggregations: HIV status.
  
  Methodological Issues/Interpretation -- Interpretation of routine case notification data is discussed further in Module 3.

NEW CASES OF IHR AND OTHER NOTIFIABLE DISEASES

Some diseases are notifiable under the International Health Regulations (IHR). Cases of IHR and other notifiable diseases must be reported immediately. Hence, weekly reporting systems are often established that function in parallel with monthly reporting of health facility data.

endemic countries in African region, 7 of 12 countries (58%) of endemic countries in the Eastern Mediterranean and at least 80% of the endemic countries in the other regions of the world.

15 http://www.who.int/ihr/en/
Core analyses

- **New cases of IHR and other notifiable diseases**: Analyze laboratory confirmed cases by date (the “epidemic curve”), location, age, sex and outcome (recovery versus death)\(^\text{16}\).

Data quality issues and limitations

- **The completeness/timeliness of weekly reporting** are indicators that are discussed in Module 3. Timely laboratory confirmation of reported cases is a major challenge. Even when weekly reporting by health facilities is timely and complete, facility-based surveillance is often not sufficiently sensitive to assure early warning of disease outbreaks.

**INCIDENCE OF THE MOST COMMON TYPES OF CANCER:**

Cancer registries compile data from sentinel sites which are specially equipped and trained to collect and report on the incidence of the most common cancers. Even if population coverage is low, data from a few sentinel hospitals can be used to determine the most common types of cancer and, for the population living within the catchment areas of the sentinel sites, estimate incidence.

Core analysis

- **Incidence of the most common cancers**: Analyze the incidence of cases per 100,000 persons in the catchment area and proportional cancer morbidity (% of all new cancer cases due to each of the top 5 types of cancer) and mortality (% of all cancer deaths due to the top 5 types of cancer). Disaggregations: age groups, sex.

Data quality issues and limitations

- **Low population coverage of existing cancer registries**: A review article on cancer registries in sub-Saharan Africa found that “Population coverage of the cancer registries ranged from 2.3% of the population in Kenya to 100% in The Gambia, with a heavy urban bias in all countries. However, 20 countries (300 million people) had no cancer registration systems\(^\text{17}\).”

\(^{16}\) Technical guidelines for integrated disease surveillance and response in the African Region. WHO/AFRO and CDC. 2010
Example: Age-specific incidence of leading cancers

Figure 18: Age specific incidence rates for the four most common cancers of women, Kampala cancer registry, 2007 – 2009 Source: Kampala Cancer Registry Report for the period 2007 – 2009. August, 2012

"Cancer of the oesophagus shows a steadily increasing incidence by age, while the incidence rates of cancers of the cervix and breast tend to be more or less constant after age 50."

The Kampala Cancer Registry collects data on cancer occurrence in the population of Kyadondo County, in which the capital city of Kampala is situated. Tumour registrars are employed to search for cancer cases treated in any of the four main hospitals in Kampala (and, in recent years, the Uganda Hospice) and, for individuals resident in Kyadondo County, to extract somewhat more extensive information onto special notification forms.
3.1 Coverage with reproductive, maternal and neonatal preventive health services

Specific indicators

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator(s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenatal care (ANC) Core</td>
<td>ANC 1 &amp; ANC 4</td>
<td>% of pregnant women who have made ≥ 1 ANC visit; % who have made ≥ 4 ANC visits</td>
<td></td>
</tr>
<tr>
<td>Additional</td>
<td>Mean ANC visits per client</td>
<td>(first ANC visits + all ANC re-visits) / (first ANC visits)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ANC1 in early pregnancy</td>
<td>% of pregnant women with a first ANC visit before 16 weeks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IPT2 or IPT 3</td>
<td>% of pregnant women receiving 2 or 3 doses of SP^2 for presumptive treatment of malaria</td>
<td></td>
</tr>
<tr>
<td>Delivery care Core</td>
<td>Skilled birth attendance</td>
<td>% of expected deliveries which are attended by a skilled health worker</td>
<td></td>
</tr>
<tr>
<td>Additional</td>
<td>Institutional deliveries</td>
<td>% of expected deliveries which take place in a health facility</td>
<td></td>
</tr>
<tr>
<td>Neonatal care Core</td>
<td>Caesarian section (CS) rate</td>
<td>% of expected deliveries for which CS is reported</td>
<td></td>
</tr>
<tr>
<td>Family planning Additional</td>
<td>Post-natal care within 2 days</td>
<td>% of expected newborns visited by a health worker within 48 hours of birth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Family planning coverage</td>
<td>Number of new contraceptive acceptors as a percentage of women 15 – 49 years of age</td>
<td></td>
</tr>
</tbody>
</table>


Additional analyses:

2. **Coverage with ANC1 by 16^18 weeks of gestation**
3. **IPT3 as a percentages of ANCA**: When IPT3 coverage is below ANC4^19 coverage it suggests that health workers are missing opportunities to administer IPT.
4. **Caesarian section rate**: When the caesarian section rate is below 5%, an increase in caesarian sections is associated with decreased maternal and neonatal mortality. However, caesarean section rates higher than 10% are not associated with reductions in maternal and newborn mortality rates.
5. **Family planning coverage**: The numerator for this indicator is the cumulative number of distinct family planning clients registered in a year. The denominator is the number of women 15 to 49 years of age. Data should be disaggregated by contraceptive method. An alternative indicator routinely measured in some countries is Couple Years of Protection (CYP) which attempts to aggregate the impact on fertility of multiple forms of contraception^20.

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^18 Alternative cut offs are sometimes used: ≤ 12 weeks or ≤20 weeks  
^19 Allowance must be made for the fact that IPT is contraindicated during the first 12 weeks of pregnancy and some percentage of women make their first ANC visit during that time. For this reason, a gap between IPT3 and ANC4 provides evidence that health workers are missing opportunities for this intervention.  
^20 Unlike Family Planning Coverage, CYP quantifies the duration of contraception provided for. CYPs are calculated by multiplying the number of units provided times a conversion factor (e.g. 1/12 CYP per cycle of oral contraceptives). Total CYP’s = sum of CYPs for each
Reconciliation with survey estimates

- Coverage estimates based upon routine health facility data should be reconciled with coverage estimates from large nationwide household surveys.

Methodological issues/interpretation:

- What denominator to use for calculation of coverage?

  a. For ANC, IPT and TT2 coverage, the ideal denominator is the number of expected pregnancies. Yet, the estimated number of deliveries is often used. The effect is to exclude pregnancy loss from the denominator, underestimate the denominator and thus over-estimate the ANC coverage in comparison to survey estimates. For purposes of judging trends or comparing one region to another, however, this should not be a problem. One published analysis suggested that a good estimate of the number of expected pregnancies is the number of expected birth x 1.2[^21].

  b. For skilled birth attendance, institutional deliveries and post-natal care coverage, the correct denominator to use is the expected number of deliveries which is often estimated by multiplying an estimate of the crude birth rate (which may be uncertain) times the estimated population.

  c. Denominators based upon census projections may not be reliable for calculation of district coverage and especially for the coverage achieved by individual facilities. As an alternative, if ANC 1 coverage is consistently very high and the data is felt to be of high quality, then the number of ANC 1 clients can be used as the denominator for calculating coverage with ANC 4, IPT 1 & 2, TT 2, skilled birth attendance, institutional deliveries and post-natal care. As discussed in Annex 7, such use of service statistics as a denominator alters the relative ranking of districts and health facilities.

Data quality issues and limitations

1. **Misclassification:** To estimate the percentage of pregnant women who make a sufficient number of return visits it is essential for facility staff to accurately record the sequence number of each visit. If return visits are mistakenly classified as first visits then ANC1 will be over-estimated. If targets are set for ANC4 then health workers may have an incentive to misclassify – for example, reporting a second, third or fifth visit as a fourth visit. There is also a risk of misclassifying IPT1 as IPT2 or IPT3.

2. **Difficulties counting ANC1 < 16 weeks.** To accurately count the number of early ANC visits, the health worker must accurately assess how advanced the pregnancy is at the time of the first visit. Adding this data element to the monthly reporting form doubles the space and time required to report first ANC visits. The more detail that facility staff are asked to report on, the greater the chance that either the detail will be omitted (e.g. the cell for ANC1 < 16 weeks may be left blank) or an error will be made in record keeping and data transcription[^22].

3. **TT2 under-estimates tetanus protection.** A woman who receives five doses of tetanus toxoid during her life is considered to be fully immunized and is protected against tetanus throughout her childbearing years. Hence, ANC TT2 data under-estimate the percentage of pregnant women protected because they do not take in account doses of vaccine administered during a previous pregnancy or during childhood. Nonetheless, ANC TT2 coverage can provide a useful minimum estimate of protection of the mother and her newborn.

4. **How to interpret institutional delivery coverage.** Giving birth in a health facility does not assure high-quality care. Especially at smaller health facilities, deliveries may be attended by inadequately trained staff or the facility may lack the equipment required to manage obstetrical emergencies.

5. **Difficulties measuring skilled birth attendance.** To measure skilled birth coverage using routine facility data, it is first necessary to define which cadres are adequately skilled – consensus on this has proven challenging in some countries. Next, facility-based deliveries which are attended by these select cadres must be distinguished from facility-based deliveries which were not attended by these cadres (for example, a delivery that was attended by a nurse’s aide when no midwife was present). If the reporting system does not adequately make such a distinction then the data that are reported will measure institutional delivery coverage rather than skilled birth attendance.

[^22]: For this reason, reporting about the content of ANC care (e.g. whether iron pills were administered) is often less reliable than reporting about the number of ANC visits. Bias is another factor reducing the reliability of data reported on the content of care as it is the health worker who must report on whether he or she provided high quality care.
6. **Difficulties counting deliveries in private health facilities.** A major challenge is to determine the percentage of deliveries that occur in (non-reporting but often qualified) private facilities. This percentage can be derived from a recent nationwide household survey and added to the percentage delivering in public facilities (as estimated from the routine facility data).

7. **Reconciliation with estimates from household surveys.** Given that women are asked about pregnancies as long ago as 5 years before the survey, recall is an issue with survey estimates. A woman’s recall of antenatal care and place of delivery are likely to be relatively accurate. However, they may find it difficult to accurately recall the timing of the first visit, the number of ANC visits, the qualifications of the health worker who attended their delivery and whether any contact with a health worker after delivery constitutes a post-natal visit. Apart from the problem of recall bias, surveys may also miss early pregnancies. Such biases or the biases in the facility data may be responsible for some of any discrepancy found between facility-based and survey-derived estimates of coverage with maternal/neonatal health services.

8. **Difficulties counting family planning clients.** Care must be taken to count each family planning client only once each year. Analysts should call attention to the fact that Ministry of Health family planning statistics typically do not reflect the sometimes large volume of donor-subsidized “social marketing” of condoms and oral contraceptives.

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**Example 1: Skilled birth attendance (“Supervised deliveries”)**

**Figure 19:** Coverage in Ghana with supervised deliveries, by region and nationwide, 2007 to 2012. Source: *Holistic Assessment of the Health Sector Programme of Work 2012, Ministry of Health, June 2013*

“Over the past 3 years, supervised delivery coverage has increased by 28.2%, and over the past 5 years by 66.5%. Coverage of supervised deliveries in 2012 was 58.5%, based on the estimated expected delivery of 4% of the population and 77.9% based on 3% estimate. The 58.5% represents a relative increase of 6.7% over 2011. The [2011] MICS gave the country a skilled attendant at delivery coverage of 68.4%. … The good performance may be attributed to … improvement in the data collection.”
Example 1: Skilled birth attendance (continued)

Table 6: Highest and lowest regional coverages with supervised deliveries and the ratio of these two coverages, 2007 to 2012. Source: Holistic Assessment of the Health Sector Programme of Work 2012, Ministry of Health, June 2013

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>74.0%</td>
<td>-</td>
<td>56.3%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>UER</td>
<td>-</td>
<td>43.5%</td>
<td>-</td>
<td>58.8%</td>
<td>66.3%</td>
<td>68.6%</td>
<td></td>
</tr>
<tr>
<td>BAR</td>
<td>-</td>
<td>-</td>
<td>53.7%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>WR</td>
<td>-</td>
<td>17.6%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NR</td>
<td>25.1%</td>
<td>-</td>
<td>26.0%</td>
<td>36.1%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>VR</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>31.1%</td>
<td>39.9%</td>
<td>45.0%</td>
</tr>
<tr>
<td>Ratio</td>
<td>1:2.55</td>
<td>1:2.47</td>
<td>1:2.17</td>
<td>1:1.49</td>
<td>1:1.89</td>
<td>1:1.66</td>
<td>1:1.53</td>
</tr>
</tbody>
</table>

“The equity index for supervised deliveries by region is improving and reached the target of being below 1:1.7”

Note:
- Best practices: discussion of how the denominator was calculated (and acknowledgement of uncertainties), presentation of trends, regional comparisons for assessing geographic equity, comparison with survey estimates, acknowledgement that reporting practices have likely contributed to some of the apparent improvement in the indicator.
- Ways to improve the presentation: The report should a) present trends in completeness of the data and consider adjusting the data for variation in completeness; b) acknowledge that deliveries taking place in private health facilities are not included in the analysis.

Example 2: IPT2 as a percentage of ANC1


<table>
<thead>
<tr>
<th>Regions/Districts</th>
<th>CPN1</th>
<th>TP2</th>
<th>Proportion des femmes ayant bénéficié d'un TP2 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boucle du Mouhoun</td>
<td>78 850</td>
<td>48 432</td>
<td>61,4</td>
</tr>
<tr>
<td>Boromo</td>
<td>11 905</td>
<td>7 504</td>
<td>63,0</td>
</tr>
<tr>
<td>Dédougou</td>
<td>12 665</td>
<td>7 290</td>
<td>57,9</td>
</tr>
<tr>
<td>Nouna</td>
<td>17 741</td>
<td>12 561</td>
<td>76,8</td>
</tr>
<tr>
<td>Solyzo</td>
<td>15 345</td>
<td>7 614</td>
<td>45,6</td>
</tr>
<tr>
<td>Toma</td>
<td>8 376</td>
<td>3 523</td>
<td>42,1</td>
</tr>
<tr>
<td>Tougarg</td>
<td>12 069</td>
<td>9 540</td>
<td>77,1</td>
</tr>
<tr>
<td>Cascades</td>
<td>31 304</td>
<td>21 487</td>
<td>57,6</td>
</tr>
<tr>
<td>Bandioug</td>
<td>16 304</td>
<td>10 142</td>
<td>61,9</td>
</tr>
<tr>
<td>Manguigara</td>
<td>12 746</td>
<td>7 274</td>
<td>57,1</td>
</tr>
<tr>
<td>Sibou</td>
<td>6 174</td>
<td>4 071</td>
<td>49,8</td>
</tr>
</tbody>
</table>

Note:
- This is an example of use of service data (ANC1 visits) as a denominator to calculate coverage.
- Nationwide, ANC1 coverage was 83.6%. Hence, IPT2/ANC1 (= 54.8% nationwide) over-estimates IPT2 coverage.
- As a percentage of all expected pregnancies, IPT2 coverage was 45.8% nationwide.

Annex 14 provides an example of analysis of CYP data.
3.2 Coverage with preventive health services for children

Specific indicators

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator (s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunization</td>
<td>Core</td>
<td>DTP1 &amp; DTP3; MCV1</td>
<td>% of surviving children immunized with the 1st &amp; 3rd doses of DTP vaccine and 1st dose of measles-containing vaccine</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>DTP1 – DTP3 dropout rate</td>
<td>(DTP1 – DTP3) / DTP1</td>
</tr>
<tr>
<td>Micro-nutrient supplementation</td>
<td>Core</td>
<td>Vitamin A supplementation</td>
<td>% of children 6 – 59 months receiving a vitamin A supplement in a 6 month period</td>
</tr>
</tbody>
</table>

1 Or Pentax now that the pentavalent vaccine has almost universally replaced DTP vaccine.

Core analyses

1. **DTP3 coverage and MCV1 coverage** – Analyze the national level and trends over recent years. Disaggregations: sub-national levels (for assessment of geo-graphic equity).

Additional analyses:

2. **DTP 1 to DTP3 dropout rate** is frequently calculated to assess problems with access or limited demand for immunization services\(^2\). As discussed below, this is also an indicator of data quality.

3. **DTP3 coverage before 12 months of age**.

4. **Vitamin A supplementation**.

Reconciliation with other data sources:

5. **Reconciliation with survey estimates**: DHS and MICS surveys provide a valuable source of estimates at national and first administrative level of immunization coverage and vitamin A supplementation. Survey estimates of coverage among children 12 – 23 months of age largely reflect immunizations delivered the year before the survey (e.g. estimates from a 2014 DHS should be compared to estimates based on facility data from 2013). Note that the detailed tables appearing in these reports of coverage by region, by wealth quintile, etc... refer to immunizations given at any time before the survey including immunizations given after 12 months of age. On the other hand, these reports do provide a single national estimate of immunization coverage by 12 months of age.

6. **Reconciliation with statistics submitted to WHO and UNICEF**: Estimates of immunization coverage should be compared with the statistics submitted each year to WHO and UNICEF on the Joint Reporting Form (JRF). JRF statistics do not represent a separate data source. Instead, they are official statistics derived from the same routine facility data used by the analyst. These statistics can be downloaded from a WHO website\(^24\) including, for each vaccine (and distinguishing DTP 1 from DTP 3), the number of doses administered (at any age), the number of children in the target population (i.e. the denominator), the official country estimate of coverage\(^25\), findings from household surveys and the WHO-UNICEF Estimate of National Immunization Coverage (WUENIC). A WUENIC summary for each country can also be downloaded\(^26\) with a graph for each vaccine showing the trends in administrative, official and WUENIC estimates over the last 10 years. These graphs are good examples of reconciliation of facility data with survey findings. **Annex B** provides two examples: one for which reconciliation was straight-forward and one for which various estimates were quite discrepant and difficult to reconcile. At the conclusion of each country profile, information is provided on each recent coverage surveys including their sample sizes and the percentage of children for which cards were observed.

Methodological issues:

- **What denominator to use for calculation of coverage?**

---

\(^2\) DTP1 – DTP3 dropout rates of greater than 10% at national level are considered to indicate poor access to immunization services.


\(^25\) Countries that are aware of issues with the numerator or the denominator sometimes choose to report an “official estimate” that is higher or lower than the “administrative estimate” (i.e. doses administered divided by children in the target population).

\(^26\) Report for each country for the most recent completed year can be downloaded from [http://apps.who.int/immunization_monitoring/globalsummary/wuccountrylist.html](http://apps.who.int/immunization_monitoring/globalsummary/wuccountrylist.html)
a. The denominator for estimation of immunization coverage is the number of “surviving infants”: children less than 12 months of age. This statistic can either be based upon a projection from the most recent census (i.e. children 0 years of age) or it can be estimated by subtracting the estimated number of infant deaths from the estimated number of births. 27

b. Denominators based upon census projections may not be reliable for calculation of district coverage and especially for the coverage achieved by individual facilities. As an alternative, if DTP 1 or ANC1 coverage are consistently very high and the data are felt to be of high quality, then the number of DTP1 doses or ANC 1 clients can be used as the denominator for calculating immunization coverage. 28 As noted in the discussion of general principles, such an approach can modify conclusions reached about which districts are strong performers and which districts are weak performers.

c. For coverage with vitamin A supplementation, the denominator is the number of children 6 to 59 months of age which can be estimated from projections of census data. Routine reporting on vitamin A administration usually does not distinguish whether the child received a previous dose in the last 6 months. Six-monthly coverage can be calculated by dividing the annual number of doses by 2. This over-estimates coverage in the last 6 months to the extent that the numerator includes some children who have been dosed more frequently than once each 6 months.

Data quality issues and limitations

1. Misclassification: Children given their first or second doses of DTP vaccine can be misclassified as receiving their third dose of DTP. If this happens frequently enough, the health facility can report DTP3 greater than DTP1 (i.e. a “negative dropout rate”), sometimes for an entire year overall. In the worst case, an entire district or even an entire region can report that DPT3 exceeded DPT1 for an entire year. A negative dropout rate for a full year is an indication of poor data quality and warrants investigation of whether there may be incentives for misclassification in order to boost DTP3 coverage.

2. Misclassification: Immunizations given before 12 months of age. To determine whether children are protected as early as possible, immunization data are sometimes disaggregated by age – doses administered before 12 months of age are recorded in one cell of the form and doses administered at 12 months or greater are recorded in a separate cell. When this is done, the time required to report vaccine doses is doubled and the chances increase that the data will be reported inaccurately -- some of those completing the form may report all doses as being administered before 12 months (leaving blank the cell for doses administered at 12 months or greater). For this reason, before analyzing immunization coverage by age, it is important to assess the reliability of the age-specific data. 29

3. Sampling and non-sampling errors of survey estimates. The reliability of survey estimates of immunization coverage depends upon the quality of the survey (sample size, supervision of survey teams) and the percentage of sampled children for which immunization cards are reviewed.

27 For each geographic area, live births can be estimated by multiplying total population by the crude birth rate. Infant deaths can be estimated by multiplying total population by the infant mortality rate.
28 Use of the number of ANC1 clients will over-estimate the number of surviving infants (due to infant mortality and pregnancy loss following the first ANC visit) and thus under-estimate immunization coverage. Assuming that such mortality is roughly constant, however, coverage estimates calculated in this manner can be compared between districts, between health facilities or between years.
29 For example, review of the age-specific immunization data for one country showed that, during 2014, 37% of the health facilities reporting immunizations never reported giving DTP to a child who was 12 months or older.
Example: DTP3 vaccination coverage


“The HMIS and EPI program have different reporting systems ... the EPI data led to slightly higher coverage estimates ... [and] had higher consistency and were used for the analysis.”

“About two-thirds of the information [collected during the surveys] was copied from the child health card, the rest was recalled by the mother. Sample sizes for regions, however, are small, causing large sampling errors in regional estimates of immunization coverage.”

“Both the facility reports and the two surveys in 2010 and 2012 ... suggest that DTP3 coverage among children under 1 year is continuing to increase gradually.... The true rate may be a little lower because of over-reporting of vaccinations during infancy or underestimation of eligible children (based on the 2012 census)...”

Note:

- **Best practices:**
  - presentation of the 4 year trend;
  - comparison with survey estimates and presentation of confidence intervals for the survey estimates (the “I” at the top of each of the bars for survey estimates);
  - discussion about the reliability of the survey estimates (percentage of children with a child health card);
  - acknowledgement that there are two parallel systems for routine reporting with discrepancies between them.

- **Ways to improve the presentation:**
  - specify how the denominator was estimated (surviving infants versus newborns) and reasons for suspecting “underestimation of eligible children (based on the 2012 census)”;
  - reconcile the statistics presented with those officially reported to WHO and UNICEF on the Joint Reporting Form (2012 DTP3 coverage = 92%).
### 3.3 Coverage with services for control of priority health problems

#### Specific indicators

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator(s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>Core</td>
<td>People living with HIV diagnosed (HTS.1)*</td>
<td>% of people living with HIV who have been tested HIV-positive</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>HIV care coverage (LINK.2)*</td>
<td>% of people living with HIV who received HIV care in the last 12 months (receipt of at least one of the following: clinical assessment/WHO staging OR CD4 count OR viral load or currently receiving ART)</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>ART coverage (ART.3)*</td>
<td>% of people living with HIV who are currently receiving antiretroviral therapy</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>ART retention rate (ART.5)*</td>
<td>% of people living with HIV and on ART who are retained on ART 12 months after initiation; also recommended at 24, 36, 48, 60 months etc.</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>Viral suppression (VLS.3)*</td>
<td>% of people living with HIV and on ART who are virologically suppressed (&lt;1,000 copies/mL)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>Core</td>
<td>TB– notification rate</td>
<td>Number of TB cases (new and relapse) detected and notified to WHO in a given year per 100,000 population.</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>TB treatment success</td>
<td>% of TB cases successfully treated (cured or treatment completed at 12 months) among all new TB cases notified during a specified period</td>
</tr>
<tr>
<td>Malaria</td>
<td>Core</td>
<td>Malaria diagnostic testing rate</td>
<td>% of suspected malaria cases that had a diagnostic test = 100 x number of malaria tests performed (positive or negative) divided by number of malaria cases suspected. The number of malaria cases suspected can be estimated from the number of malaria cases reported (confirmed + presumed) plus the number of negative malaria tests</td>
</tr>
<tr>
<td>Chronic diseases</td>
<td>Core</td>
<td>Cervical cancer screening</td>
<td>% of women 30 to 49 years who were screened in the last 5 years using a reliable method.</td>
</tr>
<tr>
<td>Disease surveillance</td>
<td>Additional</td>
<td>Completeness / timeliness of weekly reporting</td>
<td>100 x number of weekly reports submitted within the required deadline divided by the number of weekly reports expected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AFP rate</td>
<td>Number of non-polio cases of acute flaccid paralysis per 100,000 children &lt; 15 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measles confirmation rate</td>
<td>% of reported measles cases for which a positive lab test was obtained</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-measles febrile rash rate</td>
<td>Number of non-measles cases of acute febrile rash per 100,000 population</td>
</tr>
</tbody>
</table>

* The codes associated with the HIV/AIDS indicators are those assigned by the Consolidated Strategic Information Guidelines for HIV in the Health Sector.

### HIV/AIDS

The overall HIV response has reached millions of people with HIV services. However, there are specific sub-populations that still have high unmet needs. Monitoring coverage by age and sex and other characteristics will assist with targeting services to the populations who need them.

With electronic medical records it should be possible to disaggregate indicator values by numerous age groups (<1, 1-9, 10-14, 15-19, 20-24, 25-49, 50+) and key populations (men who have sex with men; people who inject drugs; people in prisons and other closed settings; sex workers; transgender people). When routine data are collected and reported with a paper-based system, however, such disaggregation of routine data will typically not be practical and surveys will be required to measure indicators for specific key populations.

#### Core analyses

1. **People living with HIV diagnosed**—Analyze national and sub-national levels with trends over recent years. Disaggregations: sex, age (<1, 1-9, 10-14, 15-19, 20-24, 25-49, 50+), pregnancy status, key populations. The numerator is the cumulative number of reported new HIV diagnoses minus deaths. Estimation of HIV deaths often requires modeling. The denominator is estimated based on an internationally consistent modelling method (e.g. SPECTRUM)
2. HIV care coverage -- Analyze national and sub-national levels with trends over recent years. Disaggregations: sex, age (<5, 5-14, 15+), pre-ART/ART, received care for the first time in the reporting year, pregnancy status.

3. ART coverage -- Analyze national and sub-national levels with trends over recent years. Disaggregations: regimen (first-line vs second line, etc...), sex, age (<15, 15+ at a minimum with paper-based systems), provider type (public/private), TB status, pregnancy, key populations. With ART coverage it is important to disaggregate the statistics by age and sex because both the prevalence of HIV and care seeking practices can vary markedly by age and sex. HIV greatly increases the risk of active TB. Denominator: use HIV estimation models such as Spectrum or survey estimates. Countries have varying criteria for eligibility for ART and hence may choose to use as a denominator a subset of those HIV+. For purposes of international comparison, however, total HIV+ population is the recommended denominator.

4. ART retention rate -- Analyze national and sub-national levels with trends over recent years. Disaggregations: Sex, age (<15, 15+ at a minimum with paper-based systems), pregnancy at initiation, breastfeeding at initiation, TB status. The retention rate is used to describe the follow-up experience of a cohort of HIV+ patients who start ART at a specific time (e.g. the first quarter of 2014). The number of people retained, after 12 months (or other specified time interval), is those who started ART minus deaths, minus loss to follow-up and minus discontinuation of treatment. Countries that cannot currently report retention at all sites can, in the interim, obtain nationally representative estimates of retention by sampling a subset of sentinel clinics. Monitoring loss to follow-up may require special studies to investigate and estimate how many patients were truly lost to follow-up and how many transferred to a different site or died. If this indicator is assessed for only a sub-set of facilities, the data source should be described and the representativeness of these sites should be discussed. The use of all persons living with HIV as the denominator does not endorse the concept that all people living with HIV should receive ART; instead this is a simpler measure that will not change over time and will result in coverage values that are consistent when compared globally and when calculated for national purpose.

5. Viral suppression -- Analyze national and sub-national level with trends over recent years. Disaggregations: Sex, age (<15, 15+ at a minimum). Can also be assessed by time since initiation of ART, as a cohort. This indicator assesses to what degree ART programs are improving the clinical outcomes of patients in care. This indicator corresponds to the third “90” of the “90-90-90” target (90% of those on ART have suppressed viral loads). Unsuppressed viral load will also lead to the development of drug resistance.

Data quality issues and limitations

- People living with HIV diagnosed -- When counting the cumulative number of people testing positive, it is difficult to avoid double counting. To use routine data to estimate the number of living persons who have tested positive it is necessary to estimate (usually using a modeling method) the number of persons who died after they tested positive.

- ART coverage -- To report on the number of people currently on ART, it is necessary to exclude patients lost to follow-up (LFU), those who have stopped treatment and deaths from the total of those who ever started ART. WHO recommends that a patient is classified as LFU if there was no contact for 90 days after the last missed appointment for ARV refill. Patients seeking care at another health facility may be misclassified as LFU. Patients given multiple months of ARVs at one visit may also fail to visit during a reporting period and thus be misclassified as LFU. Reporting on patients receiving antiretroviral therapy in the private sector may be especially incomplete.

- ART retention rate -- When ART retention is aggregated at the facility level, retention is often under-estimated because patients may be followed up at another health facility. Gaps in data can be reduced if there is a nationwide system of unique patient identifiers. Electronic data systems greatly facilitate cohort analysis by making it easier to track patients from one contact with the health care system to the next. At the same time, however, as ART services are decentralized to primary care facilities, data systems must suit limited local resources and staff capacity. For some health systems, ART retention rate can only be analyzed with data from select sentinel sites complemented with special studies to identify patients still receiving ART at other sites.

Reference documents


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30 Statistics should be disaggregated to a larger set of age groupings (<1, 1-9, 10-14, 15-19, 20-24, 25-49, 50+) in settings where more detailed information is feasible to collect (e.g. with electronic record systems at the point of care)

31 If routine data can only be disaggregated to a minimal number of age groupings (<5, 5 – 9, 10 – 14, 15 – 19, 20 – 24, 25 – 49, 50+) should, at least once each year, be extracted from a sample of facilities.
Example 1: ART coverage by region

Using the 2012 population census data and the HIV prevalence surveys in 2007–08 and 2011–12 to estimate numbers of people living with HIV the ART coverage rate can be estimated. In 2009 and in 2011, an estimated 1.37 million people were living with HIV infection. National ART coverage increased considerably: from 51% to 65% among persons 15 years and older, and from 23% to 48% among children in 2009 and 2011 respectively. This uses a CD4 cell count below 200 to determine the need for treatment. If the more recent cut off of 350 cells per mm3 is used then the coverage drops to 40% of adults and 26% of children (assuming that 30% of all people living with HIV corresponds with a CD4 <350).”

“ART coverage ranges from 40% to over 80% in regions. Almost all regions however had large increases in coverage since 2009…. In three … regions coverage was lower in 2011 than in 2009.”

Note:
- Best practices: Disaggregation by region; presentation of a trend
- Ways to improve: The lack of consistency in the ranking of regions between the two periods may suggest inconsistencies in completeness or data quality. Any apparent trend for an individual region should be interpreted with caution.

Example 2: Trend in coverage of pregnant women with HIV counselling and testing

“Coverage of HIV testing & counselling among pregnant women increased from 43% to 62% according to the surveys. The health facility data (hMIS) also show an increase from 44% to 77%.”

Note:
- Best practices: Presentation of trends; comparison with survey estimates
- Ways to improve: The major increase in the HMIS estimate of coverage between 2009 and 2010 was not confirmed by the most recent survey and deserves to be discussed.
1. **TB notification rate** – The TB notification rate is, in principle, an indicator for assessing the incidence of TB. Hence, it is a *health status indicator*. Once a TB surveillance system achieves a certain standard, the case notification rate will approximate TB incidence⁴². In countries where surveillance systems are still weak there may be a significant amount of underreporting. For some countries where an inventory study has been carried out the case notification rate can be adjusted for under-reporting. If, however, under-reporting cannot be quantified, the case notification rate will not directly measure the TB incidence. For this reason, it is important to review the estimated TB incidence (as discussed in the section devoted to this indicator in Module 2).

Where active case finding is still not adequate but either improving or deteriorating, a trend in the TB notification rate may reflect a trend in the quality and coverage of the TB surveillance systems as much as it reflects a change in the true incidence of TB. Used in this way, the TB notification rate becomes a *health service coverage* indicator.⁴³ An example of this is given in Annex 13.

Annual values since 1990 for the TB notification rate, WHO’s estimate of CDR and WHO’s estimate of TB incidence can be downloaded from the WHO Global TB Database (http://www.who.int/tb/country/data/download/en/).

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⁴² The STOP TB policy paper on TB Impact Measurement (http://apps.who.int/iris/bitstream/10665/44231/1/9789241598828_eng.pdf?ua=1) concluded that there were, as of 2008, only 20 out of 212 countries in the world for which TB notification data could be used directly to estimate the incidence or the trends in incidence of TB.

⁴³ The indicator conventionally used to assess the TB surveillance system has been the Case Detection Rate (CDR). CDR is equal to the number of notified cases in a year divided by WHO’s estimate of the number of incident cases in the same year, expressed as a percentage. CDR was an MDG indicator. However, CDR is now felt to be an outdated indicator. The number of incident TB cases (the denominator for calculating the CDR) is uncertain and not measured but estimated. Therefore, the case detection rate is uncertain. WHO’s estimates of the incidence of tuberculosis typically have wide confidence intervals. Estimates of TB incidence are also subject to major revisions as new findings from surveys and other sources become available. Another problem with the CDR is that it can usually only be assessed at national level because the true number of incident cases can only be estimated at national level.
2. **TB treatment success** – This is the proportion of notified cases who have a successful treatment outcome (i.e. cured or completed) at 12 months. National and sub-national levels with trends. Disaggregations: by age, sex, bacteriological confirmation status, previous treatment history, HIV-status, drug resistance status.

**Data quality issues and limitations**

1. **TB notification rate** - The WHO handbook “Understanding and Using TB data” cautions that “Changes in the way TB is recorded and reported often have profound effects on the volume and quality of data that are notified. This can complicate the interpretation of ecological analyses. Therefore it is always worthwhile to look closely to ensure that re-classification, transitions from paper to electronic systems and other reforms in record keeping do not obscure understanding of the underlying TB epidemic.”

2. **TB treatment success** – Assessment of TB treatment success, like assessment of the ART retention rate, requires a system for longitudinal tracking of a cohort of patients who begin treatment at one time (e.g. the first quarter of 2014). Analysts should keep in mind that a variable percentage of persons diagnosed with TB are lost to follow-up before they begin TB treatment. WHO guidelines specify that persons lost to follow-up before treatment must be included when reporting TB notifications. Unless such persons are included among the TB notifications then the TB notification rate will be understated and the success of treatment efforts will be overstated. As with for ART, longitudinal tracking of TB treatment is complicated by patients who seek care at more than one health facility (especially a facility in a district not monitored by the district tuberculosis officer). It is important for TB programmes to track the proportion lost to follow-up and those who have died. To improve on treatment outcomes, the reasons why individuals are not completing treatment must be determined.

**Reference documents**


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34 For MDR the outcomes should be reported at 24 months. For those still on treatment at 24 months or XDR these outcomes should be reported at 36 months.


36 Most TB programmes are able to keep track of such transferred patients whose outcome is then assessed from records of the second clinic. If this system is not functioning well, however, then there will be an increase in the proportion of cases without an evaluated outcome.
MALARIA

Core analysis

- **Malaria diagnostic testing rate** – National and sub-national levels with trends. Disaggregated by type of test (blood smear versus RDT). This is a key indicator to assess progress with an objective that is relatively new for many countries with the highest burden of malaria -- laboratory testing of all suspected malaria (see Figure 20). Understanding and acceptance of this indicator is gradually improving. While most malaria endemic countries now ask health facilities to report on the numerator (total malaria tests -- both blood smears and RDTs; both positive results and negative results) few health systems collect data on the denominator (number of suspected cases of malaria). For most countries, the number of suspected cases of malaria needs to be calculated as the sum of all reported cases (both confirmed cases and presumed cases) plus negative malaria tests.

For other indicators that are sometimes used to track testing practice either there is no clear target (for example total tests divided by total reported cases – see Annex 15) or the indicator does not increase in a simple linear fashion as testing practice improves (for example positive tests divided by total reported cases).37

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37 The country profiles that appear in WHO’s annual World Malaria Report (examples are shown in Figure 15 of Module 2 and Figure 37 of Annex 11) present the trend in another indicator of testing practice: the Annual Blood Examination Rate (ABER. This is the annual total...
Data quality issues and limitations

- **Malaria diagnostic testing rate** – The health worker who performs and reports on a laboratory test is typically different from the health worker who performs and reports on diagnoses. Reporting is often done on separate forms. This separation of duties can lead to inconsistencies in the reported data. Now that heavy emphasis is being placed on laboratory confirmation of malaria, malaria control programs are confronting this challenge. At present, however, inconsistencies may remain. For this reason, as illustrated by the examples discussed in Annex 4 and Annex 15, it is important for the analyst to review the quality and the consistency of the malaria testing data. For example, the fully disaggregated data set may include a number of monthly reports for which the number of confirmed cases of malaria differs markedly from the number of positive malaria tests. If necessary, clearly inconsistent data may need to be omitted or imputed.

Reference documents

CHRONIC DISEASES

Core analyses

- **Cervical cancer screening** – Analyze at national level with trend. Denominator: Projection of census estimate of women 30 to 49 years of age divided by 5 (since screening should be done at least once each 5 years). Survey estimates may be available for purposes of comparison. Cervical cancer is the second most common cancer in women living in less developed regions. Each year approximately 270 000 women worldwide die from the disease. As countries begin to introduce vaccination against the causative agent, human papilloma virus (HPV), they should recognize that screening for abnormal cervical cells and pre-cancerous cervical lesions, starting at age 30, is essential for combating the disease.

Reference documents

DISEASE SURVEILLANCE

Core Analyses

- **Completeness / timeliness of weekly reporting** – National and sub-national levels and trends
- **AFP surveillance**: National and sub-national levels and trends. For detection of polio virus, the target is for at least 80% of cases of acute flaccid paralysis (AFP) under 15 years of age to be investigated within 48 hours, and two stool specimens to be collected 24-48 hours apart and within 14 days of the onset of paralysis. If more than one case of non-polio AFP (for which polio has been ruled out by adequate lab testing) are documented per year per 100 000 children under 15 years of age then polio surveillance is considered to be adequate.
- **Measles confirmation rate**: National level and sub-national levels and trends. For detection of measles virus, the target is for at least 80% of clinical cases to be investigated with a lab specimen within 28 days of the onset of the rash.

Data quality issues and limitations

- **Completeness/timeliness of weekly reports** – Passive surveillance (weekly reports from health facilities) is likely to detect only a fraction of cases. Those cases presenting at a health facility are often misdiagnosed. Hence, additional assessments are required to monitor and evaluate the adequacy of surveillance for notifiable and other diseases.

Reference documents
- Technical Guidelines for Integrated Disease Surveillance and Response in the African Region. WHO/AFRO, Brazzaville, October 2010
Health facility surveys and special studies are frequently the main sources of data on general health service inputs (funds, staffing, drugs, equipment, buildings etc...).

However, some information about inputs such as the incidence of stock outs can be reliably reported each month without unduly burdening facility staff.

A reliable inventory of the health facilities themselves (“the master facility list” – public and private) is a pre-requisite for development of the database of health facility data and for assessing the completeness of such data.

Data on staffing of health facilities need not be collected each month along with other routine health facility data. A separate database such as a Human Resource Information System (HRIS) is needed to maintain a reliable inventory of staff that is updated and validated at least once each year.

### 4.1 Health infrastructure

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator(s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Core</td>
<td>Health facility density</td>
<td>Number of health facilities per 10,000 population</td>
</tr>
<tr>
<td></td>
<td>Additional</td>
<td>Geographic access</td>
<td>% of population within 5 km of a health facility</td>
</tr>
</tbody>
</table>

**Core analyses**

1. **Infrastructure density** – National and sub-national levels and trends. **Disaggregations**: by type of facility (general hospital, health center, health post) and managing authority (public versus private). The preferred indicator measures facilities per population (for which more is better) rather than population per facility (for which less is better – see example in Annex 16).

**Additional analyses**

2. **% of population within 5 km of a health facility** – National and sub-national levels with disaggregation by type of health facility. This indicator is especially important for assessing the access of vast, sparsely populated sub-national regions. Estimation of this indicator can often be done with assistance from the national statistics office which is likely to have the population database, software and expertise required for geospatial analysis. At a minimum, when compiling the master facility list, the geo-coordinates of each facility should be recorded and the health facilities placed on a map.

**Data quality issues and limitations**

1. The master facility list (MFL) needs to be updated at least annually\(^ {38}\) and the findings used to update the structure of the database of routine health facility data.

2. Listing of non-reporting private sector facilities is a special challenge

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**Example 1: Health facility density by region**

*Figure 26:* from Midterm Analytical Review of Performance of the Health Sector Strategic Plan III. 2009 – 2015. Ministry of Health and Social Welfare, United Republic of Tanzania, June 2013

The increase in the number of health facilities is just keeping up with population growth. The proportion of health facilities that are private did not increase: 15% in 2009, and 14% in 2012. Also the proportion of facilities owned by faith-based organizations went down from 14% in 2009 to 12% in 2012.

**Note:**
- Best practice: Presentation of health facility density, disaggregated by sub-national region and managing authority (public versus faith-based versus private), discussion of trends (not shown in the graph)

**Example 2: National map of referral facilities**

*Figure 27:* Map showing districts, referral facilities and population density. Source: webpage of the Ministry of Health of Burkina Faso. (http://www.sante.gov.bf/files/Carte%20sanitaire/sante_bf/carte6.htm)
### 4.2 Human resources

#### Specific indicator

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator (s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human resources</td>
<td>Core</td>
<td>Health worker density</td>
<td>Health professionals per 1,000 population, by type of health professional</td>
</tr>
</tbody>
</table>

#### Core analyses

3. **Health worker density:** National and sub-national levels. Disaggregations: by type of core health professional (physician, midwife, nurse), specialist health staff (surgeons, anesthetists, dentists, etc...) and managing authority (public versus private). Comparisons with estimates from other data sources: Administrative counts should be periodically reconciled with findings from health facility surveys (e.g. a Service Availability or Readiness Assessment -- SARA\(^{39}\)) or censuses.

The preferred indicator measures health workers per population (for which more is better) rather than population per health worker (for which less is better).

When assessing geographic equity and comparing health worker density of different sub-national regions, the best practice is to exclude from the analysis health professionals engaged in administrative tasks rather than provision of clinical services. Some analyses also exclude staff of tertiary referral hospitals. Without such exclusions the analysis will exaggerate the access to health services of the national capital and other largest cities.

Another HR indicator that is sometimes reported on is the percentage of approved posts that are filled. This indicator is not recommended because the denominator (approved posts) may fluctuate over time and between geographic areas and is typically not based upon any clear and consistent criteria that reflect the need for health workers.

#### Data quality issues and limitations

1. While data on staffing is sometimes collected from each facility each month it is difficult to assure that such routine data is complete and of high quality. This is noted in the example presented in Annex 17.

2. In too many countries the health workforce is only tracked through simple spreadsheets housed in different, unlinked departments and agencies: the HR department of the MoH, the payroll department of the MoH or Civil Service, decentralized managers, licensing agencies, professional associations, .... Duplications, gaps, out of date information and inconsistencies are hard to identify and correct. The national database of the human resources department of the Ministry of Health may not specify the current location of employment or even reflect retirements and deaths. As a result, this national HR database may need to be periodically verified with a special census of health staff or health facility survey.\(^{40}\)

3. Tracking of private sector health professionals (private-for-profit in particular) is a major challenge.

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\(^{39}\) See [http://www.who.int/healthinfo/systems/sara_introduction/en/](http://www.who.int/healthinfo/systems/sara_introduction/en/)

\(^{40}\) A few countries have implemented more reliable and efficient human resource information systems (HRIS) which track the health workforce by continually gathering and updating human resource data at each stage of the career of a health professional: pre-service training, licensing, recruitment, posting, promotion, transfer, migration, transition to another employer, retirement or death. Such a system requires collaboration between the Ministry of Health, the licensing agency, professional associations and training institutions. An example of an HRIS is described in Annex 17.
**Example 1: Health worker density**

*Figure 28: Health workers per 10,000 population, by region, 2012. Source: HRIS database as presented in Midterm Analytical Review of Performance of the Health Sector Strategic Plan III. 2009 – 2015. Ministry of Health and Social Welfare, United Republic of Tanzania, June 2013*

```
<table>
<thead>
<tr>
<th>Region</th>
<th>Doctors</th>
<th>AMO</th>
<th>Clin Off</th>
<th>NMW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kilimanjaro</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dar es Salaam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iringa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lindi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mtwara</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morogoro</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruvuma</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tabora</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

“Health worker density varies from below 4 per 10,000 in Rukwa, Kigoma, Shinyanga and Tabora regions to more than 10 in Kilimanjaro, Dar es Salaam and Iringa regions.... The HRIS data show the substantial differences in health worker density between regions. Kilimanjaro and Dar es Salaam region already have higher workforce density [even] without the major referral hospital data.”

“Completeness of the register is difficult to estimate in the absence of a census of health workers. Incomplete reporting is likely to be higher for the eight national referral hospitals, especially Muhimbili Medical Centre, KCMC and Buganda.... In addition, data from the private sector are less complete than those from the public sector.”

“In 2012, the classification of nurses and midwives differed from previous years, making it hard to assess the trend.”

- **Best practices:** Presentation of health worker density disaggregated by core cadres; analysis with and without the major referral hospitals; discussion of completeness; discussion of changes in classification and how this affects trend analysis; specification of the data source
- **Ways to improve:** The label for the graph should indicate whether or not data from the major referral centers have been excluded.
Example 2: Population per health worker

Table 9: Figure 25: Ratio of population per health worker, Rwanda, 2011 and 2012. Source: Database of the HR Department of the MoH as presented in the Rwanda Annual Health Statistics Bulletin of 2012.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctors</td>
<td>625</td>
<td>683</td>
<td>99%</td>
<td>15,428</td>
</tr>
<tr>
<td>Nurses</td>
<td>8,275</td>
<td>8,779</td>
<td>6%</td>
<td>1,200</td>
</tr>
<tr>
<td>Midwives</td>
<td>240</td>
<td>451</td>
<td>88%</td>
<td>23,364</td>
</tr>
<tr>
<td>Mental Health</td>
<td>140</td>
<td>N/A</td>
<td>N/A</td>
<td>75,266</td>
</tr>
<tr>
<td>Paramedical</td>
<td>656</td>
<td>1,334</td>
<td>103%</td>
<td>7,899</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>83</td>
<td>99</td>
<td>19%</td>
<td>106,437</td>
</tr>
<tr>
<td>Laboratory Technician</td>
<td>1,187</td>
<td>1,164</td>
<td>-2%</td>
<td>9,053</td>
</tr>
<tr>
<td>Administrative and Support Staff</td>
<td>2,156</td>
<td>2,471</td>
<td>15%</td>
<td>4,264</td>
</tr>
<tr>
<td>Social Workers</td>
<td>1,192</td>
<td>988</td>
<td>-17%</td>
<td>10,665</td>
</tr>
<tr>
<td>Environmental Officers</td>
<td>230</td>
<td>254</td>
<td>10%</td>
<td>41,485</td>
</tr>
<tr>
<td>Educators</td>
<td>142</td>
<td>142</td>
<td>0%</td>
<td>74,206</td>
</tr>
</tbody>
</table>

“The number of health care staff increased most significantly among paramedics, pharmacists, and midwives.”

- Best practices: Presentation of trends; disaggregation by core health cadres; specification of the data source
- Ways to improve: The table presents population per health worker rather than the preferred health worker per population.
4.3 Drugs and supplies

Specific indicators

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator(s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drugs and supplies</td>
<td>Core</td>
<td>Stockouts</td>
<td>% of health facilities with no stockouts of tracer drugs and supplies in the last month</td>
</tr>
</tbody>
</table>

Core analyses:

1. **Percentage of health facilities with no stockout during the year:** National and sub-national levels with trends. Dissaggregations: by individual tracer drug or program (e.g. for malaria care at primary care facilities: first line ACT for children, artemisinin suppositories); by type of facility (different sets of tracers drugs should be defined for each type of health facility). Comparison with other data sources: HMIS findings on stockouts should be compared with findings from health facility surveys (e.g. SARA) and from analysis of LMIS data.

Additional analyses:

2. **Percentage of health facilities with no stockout during a month:** Month-by-month trends may be informative in instances where there were large scale (e.g. entire region or entire country), short-term stockouts.

3. **Association between stockouts and service delivery:** Indicators of coverage and general service outputs (e.g. OPD per capita) can be compared between facilities/geographic regions which experienced stockouts and those that did not experience stockouts.

Data quality issues and limitations

1. “Logistics management information systems” (LMIS) designed expressly for logistics management can provide detailed data on the distribution and inventories of drugs, vaccines and other commodities. However, the LMIS may not have yet been implemented at all health facilities or the LMIS data may be not be available to the analyst. In some cases the LMIS will track only a subset of health commodities or only those financed by particular partners. Where this is the case, those designing the HMIS should add a small number of items to a monthly report submitted by every health facility to indicate whether or not there was a stockout during the month of each of a set of tracer drugs.

2. Some HMIS forms ask for more detailed information including days of stockout or quantities of commodities received/distributed/in stock. Requests for such detailed information (which may also be reported on LMIS forms or program specific forms) increases the reporting burden and can easily discourage facility staff from reporting even minimal information on stock outs.

3. Those completing monthly reports can easily get into the habit of skipping the cells for reporting stockouts. They should be instructed that they must check the box for “no stockout” (or the box for “never supplied”) if they do not check the box for “stockout”. The analyst should exclude from the analysis any monthly reports for which neither “no stockout” nor “stockout” was reported.
Example 1: Stock outs of tracer drugs

Figure 29: from Uganda’s Annual Health Sector Performance Report of 2011/2012. Ministry of Health of Uganda

Table 13: % of Health Facilities with “No Stockout” for the 6 Tracer Medicines 2012/13 FY

<table>
<thead>
<tr>
<th>Tracer Medicines</th>
<th>No Stockout 2012/13</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
</tr>
<tr>
<td>1. ACT</td>
<td>85.8%</td>
</tr>
<tr>
<td>2. Measles vaccine</td>
<td>91.7%</td>
</tr>
<tr>
<td>3. ORS Sachets</td>
<td>86.0%</td>
</tr>
<tr>
<td>4. Cotrimoxazole</td>
<td>90.7%</td>
</tr>
<tr>
<td>5. Deco-Provera</td>
<td>88.9%</td>
</tr>
<tr>
<td>6. Sulphadoxine/ Pyrimethamine (Fansidar)</td>
<td>93.9%</td>
</tr>
</tbody>
</table>

Prep. No Stock-out in any of the Six Tracer medicines | 61.7% | 68.6% | 65.4% | 65.3%

Source: MoH HIMS

“Table 13 shows the proportion of health facilities with no stock out for the 6 tracer medicines by quarter during 2012/13. ... of the 3,873 health units (public and private) reporting in the last six months of FY 2012/13, 2,036 (53%) reported “no stockout” in any of the tracer medicines during that period.”

Example 2: Monthly reporting on stockouts


“The new DHIS has selected 10 tracer items to track the availability of medicines and commodities. The system has been implemented in six regions and shows that stock outs in the reporting month of at least one of the ten medicines were common. Overall, 19% had all items available during March 2013. The availability was much better in the reporting facilities in Dar es Salaam, Dodoma and Pwani than in Shinyanga.”
4.4 General service delivery

Specific indicators

<table>
<thead>
<tr>
<th>Indicator sub-group</th>
<th>Priority level</th>
<th>Indicator(s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>General service outputs</td>
<td>Core</td>
<td>Outpatient visits per capita</td>
<td>Number of outpatient visits per person in the population</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Admissions</td>
<td>Inpatient admissions per 100 population</td>
</tr>
</tbody>
</table>

Core analyses:

1. **Outpatient department (OPD) visits per capita**: National and sub-national levels and trends. Disaggregations: age, sex and type of facility. This indicator reflects demand for and access to health services.

2. **Admissions per 100 population**: National and sub-national levels and trends. Disaggregations: age, sex and type of facility

Additional analyses

3. **Absolute number of OPD visits**: National and sub-national levels and trends Disaggregations: age, sex and type of facility. A graph of absolute numbers of OPD visits provides a profile of the age and sex distribution of clients seen at outpatient departments.

Data quality issues and limitations

1. It is difficult to get consistent, reliable reporting that distinguishes initial visits from follow-up visits so most systems combine data on both types of visits. Many systems exclude immunizations.

2. The principle issue with data quality is the completeness of monthly reporting, especially by hospitals. Annex 10 provides an example of how the reported number of total OPD visits can be highly erratic. Data on visits to private-for-profit providers are seldom available.

**Example 1: Trends in outpatient visits by region**

**Figure 31**: OPD visits per capita by region, Ghana, 2006 – 2012  
Source: HMIS data presented in *Holistic Assessment of the Health Sector Programme of Work 2012, Ministry of Health, June 2013*

“The National Health Insurance since its introduction has led to increase in utilization of OPD services across all the regions. The number of outpatients per capita... more than doubling 2006 figure. Ashanti region like all the regions showed an increase in OPD attendance till 2012 when it experienced a drop in OPD per capita. It was the year that the capitation was piloted in the region. Northern Region’s low OPD per capita rate might be a reflection of poor geographical access in the Region.”

- Best practices: Presentation of trends and sub-national estimates; good explanation of trends
Example 2: Absolute number of outpatient visits

Figure 32: Outpatient visits by age and sex. Ghana. 2012. Source: Holistic Assessment of the Health Sector Programme of Work 2012, Ministry of Health, June 2013

“61.4% of those attending outpatient were females. For the males children 1-4 years were seen more at the OPD than any age group.”
Annexes

Annex 1: Use of the DQR tool to assess the percentage of outliers

Table 10 shows output from the Data Quality Review (DQR) tool summarizing the number of outliers (district monthly values more than 3 standard deviations from the district mean) among DTP3 data reported during 2014 by Kenya districts. It was generated automatically by the DQR tool after entering each district’s monthly values into the spreadsheet. Garissa and Markwet districts each had one monthly value which was more than 3 standard deviations above the mean of monthly values for 2014. Of the 960 expected monthly values (80 districts x 12 months), 0.2% were greater than 3 standard deviations. Of the 163 districts, two (2.5%) reported at least one monthly value greater than 3 standard deviations above the district monthly mean.

Table 10: Extreme outliers (> 3SD from the district monthly mean for 2014) among Kenyan district monthly data reported in 2014, various indicators, Source: [to be provided by David Boone]

<table>
<thead>
<tr>
<th>Program Area and Indicator</th>
<th>National score</th>
<th>Districts with at least one extreme outlier relative to the district monthly mean for 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal_Health - ANC 1st Visit</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>Immunization - 3rd dose DPT-containing vaccine</td>
<td>0.2%</td>
<td>2 2.5% Garissa, Marakwet</td>
</tr>
<tr>
<td>HIV/AIDS - Number of HIV+ persons currently on ART</td>
<td>0.2%</td>
<td>2 2.5% Garissa, Bungoma</td>
</tr>
<tr>
<td>TB - Number of Notified TB cases (all forms of TB)</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>Malaria - Number of confirmed malaria cases reported</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>General_Service_Statistics - OPD Total Visits</td>
<td>0.4%</td>
<td>4 5.0% Moyale, Keiyo, Bomet, Trans Mara</td>
</tr>
<tr>
<td>Total (all indicators combined)</td>
<td>0.1%</td>
<td>-</td>
</tr>
</tbody>
</table>
Annex 2: Use of the DQR tool to assess the relationship between related indicators.

A drop in reported numbers should logically occur between ANC1 & ANC4; ANC1 & IPT1 or IPT2; ANC1 & DPT1; TB cases notified & persons successfully treated for TB; total OPD patients seen & patients treated for malaria. Data on each of these pairs of indicators might be analyzed for negative dropout suggesting poor data quality. Alternatively, the data can be graphed in a scatter plot with values of the first data element (e.g. IPT1) on the horizontal access and values of the second data element (ANC1) on the vertical access. As the two data elements are inter-related, the points should appear almost in a straight line as shown in Figure 33 with 2014 data from Kenya. In this graph, the bold line represents the national totals while the dashed lines represent the national totals +/- 10%. The graph shows that the annual totals for each district are closely aligned with the national totals. An even better graph for illustrating data quality issues would have one point for each month of district reporting or even one point for each month of facility reporting. Such graphs would likely have a number of points more than 10% different from the line representing the national totals.

Figure 33: Plot for each Kenyan district of the 2014 annual IPT 1st doses (z-axis) versus 2014 annual ANC 1st visits. Source: [to be specified]
Annex 3: Use of the DQR tool to assess consistency over time –

The consistency of data over time can be assessed by comparing, for each district, values for the current year with mean values from up to 3 preceding years. For indicators with expected growth over time, the current year value can be compared to what is expected from previous years.

Figure 34 provides an example of how the DQR tool assesses consistency over time. Each point represents, for a single district, the annual total for the current year versus the average annual total. The bold line represents equivalence (good consistency) between the current year value and the mean value from previous years. The dashed lines indicate values for the current year which differ by 33% from the mean value for the preceding years. There are 9 districts with current year values that are significantly higher than those reported during previous years. There are 22 districts with current year values that are significantly less than those reported during previous years.

Such an assessment should be conducted for a tracer set of key data elements such as antenatal care, immunizations, ART and the tuberculosis notifications.

Figure 34: Persons on ART, 2014 versus annual average 2011 to 2013, by district of Kenya. Source: Kenya HMIS

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41 Or the expected value based on the trend from previous years.
Annex 4: Assessing completeness of reporting on specific data elements

In 2011 the Ghana Health Service introduced a new form to report data on laboratory tests for malaria. Data from this new form as well as data from the monthly morbidity form (which reports on the number of malaria cases) are submitted by facilities each month to the district where they are entered into a DHIS2 database. Of the 2,975 facilities which reported malaria cases at least once during 2012, data on malaria cases were reported on 87% of the expected monthly reports. However, only 1,810 facilities (61%) ever reported data on the number of malaria tests during 2012 and the overall completeness of reporting on the number of malaria tests was only 26%. During 2012, health facilities reported a total of 7,968,449 malaria cases, 2,173,219 malaria tests, 805,010 positive tests and 1,368,209 negative tests. As discussed in Module 3, the malaria Diagnostic Testing Rate measures progress towards the objective of laboratory testing of all suspected malaria cases. The number of suspected malaria cases can be estimated by adding the number of negative malaria tests (blood smears or rapid diagnostic tests) to the total number of malaria cases reported (confirmed plus presumed). Using the raw data, for 2012 the crude malaria Diagnostic Testing Rate was thus only \( \frac{100 \times 2,173,219 \text{ total malaria tests}}{7,968,449 \text{ total malaria cases} + 1,368,209 \text{ negative malaria tests}} \) = 23%. However, if the data are limited to facility-months (reports for specific facilities for specific months) for which malaria test data were reported, the adjusted malaria Diagnostic Testing Rate for 2012 was \( \frac{100 \times 2,173,219 \text{ malaria tests}}{2,903,236 \text{ malaria cases reported for facility-months for which malaria tests were also reported} + 1,368,209 \text{ negative malaria tests}} \) = 51%. As of 2012, Ghana appears to have made more progress with confirmation of malaria diagnosis than with reporting on this practice. This type of adjustment of the data is only possible with a fully disaggregated data set that includes data for each individual health facility and each month (e.g. DHIS2 data).
Annex 5: Imputation based upon findings from field investigations

The preferred action for correcting for missing reports is to follow up with the responsible authorities and obtain the missing reports. However, if this is not possible, efforts should be made to find out real activity levels at service delivery sites with missing information. Based upon this information, adjustments can be made.

The formula used for making adjustments is:  \( e' = e + e(1/(d)-1)*k \)

where  \( e' = \text{imputed service outputs} \);
\( e = \text{reported service outputs} \);
\( d = \text{reporting completeness} \);
\( k = \text{adjustment factor} \)

If there is evidence that no events occurred or services were provided, the suggested adjustment factor is  \( k=0 \)

If there is evidence that the lack of reporting is an indication of less service provision, an assumption is made that service outputs/events occurred at only half of the value in the reporting facilities, the suggested adjustment factor is  \( k=0.5 \).

If there is no evidence of reduced activity - the missing facilities provide services at the same rate as those who reported, then the adjustment factor is  \( k=1 \).

Special attention needs to be given to the reporting rate of large facilities, especially hospitals. Such facilities generally provide services to large populations and therefore greatly influence provincial and national totals. In addition, hospitals often have poor reporting rates or are part of a separate reporting system.
Annex 6: Imputing deliveries at non-reporting private facilities

Ghana’s Holistic Assessment of the Health Sector Programme of Work 2012 presents findings on the percentage of births attended by a trained health worker. These findings are presented and discussed further in Module 3 (see Figure 18 and the accompanying Table 6). The analysis is based upon data from health facilities reporting to the Ghana Health Service (GHS). Hence, data are missing from private health facilities that do not report to the GHS. The 2011 MICS survey found that, nationwide, 10.6% of deliveries during the 5 years preceding the survey took place at private health facilities. This statistic varied substantially from 20.0% of deliveries in the Greater Accra Region (GAR) to 1.0% of deliveries in the Northern Region. For a comprehensive assessment of the percentage of deliveries attended by a trained worker, we need to make three assumptions: 1) none of the deliveries taking place at a private facility were reported to the GHS; 2) all deliveries at private facilities are attended by a trained health worker; and 3) use of private facilities for delivery has not changed since the period covered by the 2011 MICS (2007 – 2011). The MICS estimate of the percentage of deliveries at private facilities (10.6% nationwide) can then be added to each year’s estimate of the percentage of deliveries attended by a trained health worker at a facility reporting to the GHS (e.g. 58.5% in 2012) to arrive at an estimate of the total percentage of deliveries attended with a trained health worker (e.g. 69.1% in 2012). Similar adjustments can be made to the regional statistics. Without such an adjustment, in 2012 only 57.2% (i.e. below the national average) of deliveries in GAR appear to have taken place with a trained health worker. With the adjustment, in 2012 GAR ranked at the top of all regions with 77.2% of deliveries attended by a trained health worker.

42 This assumption warrants further investigation. Unfortunately, DHS and MICS surveys do not distinguish between deliveries at private, not-for-profit (e.g. confessional) health facilities which frequently report health data to the Ministry of Health and deliveries at private for-profit facilities which frequently do not report.
Annex 7: Use of service statistics as denominators

To calculate coverage, the size of the target population (i.e. the denominator) must be estimated. Population census projections are the preferred source. However, for small areas (for districts and certainly for individual health facilities) it can be difficult to reliably estimate the denominator. This is to some extent due to uncertainty about the size of the population (especially when a reliable census has not been recently completed or where internal migration has been high). However, the principal challenge to reliable estimation of the size of the “catchment population” is that people frequently seek care outside of defined administrative boundaries. This is shown by 2014 immunization data from Tanzania’s HMIS. Figure 35 shows districts ranked according to their coverage with DPT3. DPT3 coverage is estimated using 3 different methods and for each method the districts are ranked separately on the horizontal axis from lowest to highest. Rankings for the conventional method of calculation, using census projections for each district to estimate the number of surviving infants, are shown by the light green line. For 52 (31%) of the 162 districts the DPT3 coverage by census was greater than 100%. Those designing the HMIS for Tanzania have attempted to address this anomaly by asking those delivering vaccinations to distinguish immunizations delivered to children living within a defined catchment area from children living outside of the catchment population. The result, using census projections for each district as denominators but including in the numerator only immunizations reported to have been given to children living within the catchment population, are shown by the red line. With this method, a somewhat smaller but still significant percentage of districts (18%) are found to have had coverage greater than 100%.

Recent household surveys have found that Tanzania’s nationwide DPT1 coverage is 99%. Under these circumstances the number of children receiving DPT1 becomes a reasonable estimate of the true catchment population for childhood immunization services. DPT3 coverage can thus be calculated as DPT3/DPT1. The results are shown by the blue line. For 4 districts (2.5%; shown by the dashed blue line) during 2014 the reported number of doses of DPT3 exceeded the number of doses of DPT1 and thus the coverage calculated by this method was greater than 100%.

For both of the lines in Figure 36 districts are ranked according to their DTP3 coverage as calculated conventionally. In this way, the graph illustrates the effect on estimated coverage of using DTP1 as a denominator. For many of the districts that ranked low based upon the conventional estimate of DTP3 (i.e. those on the left of the graph), use of DTP1 as a denominator improves their estimated coverage. In fact, when DPT1 is used as the denominator, the DTP3 coverage for some of these apparently low performing districts is above the nationwide average (shown by the horizontal orange line). In contrast, for many of the districts that ranked high based on the conventional estimate of DTP3, use of DPT1 as a denominator reduces their estimated coverage. For some of the districts ranked highly based upon conventional DTP3 coverage, the coverage greater than 100% might reflect their popularity as service providers – their ability to attract clients from outside of their catchment area. Hence, use of DPT1 (or any other measure of the volume of services delivered) to estimate the target population arguably penalizes districts that attract clients from outside their boundaries (perhaps for reasons such as road access that have nothing to do with the quality of services) and rewards the districts where the population seeks care elsewhere. Nonetheless, when reliable population data are lacking (especially for individual health facilities or when census data old or suspect) data on services for which coverage is consistently very high can provide for more accurate denominators.

Figure 35: 2014 DTP3 coverage of Tanzania’s 163 districts calculated by 3 different methods described in the text; districts ranked separately for each method; Tanzania DHIS2 data
Figure 36: 2014 DTP3 coverage as estimated by 2 different methods; districts ranked by DTP3 coverage as conventionally calculated; Tanzania DHIS2 data
Annex 8: WUENIC – Examples of reconciliation with survey estimates

Each July WHO and UNICEF review the routine immunization data reported for the previous year by each country (reported on the Joint Reporting Form) and compare it with the findings from the most recent, high quality immunization coverage survey(s). Based upon such reconciliation of the data over multiple years they produce graphs such as those shown in Figures 37 (for Tanzania) and Figure 38 (for Ethiopia). These graphs summarize the opinions of the WHO and UNICEF experts on recent trends in coverage.

In the case of Tanzania, findings from a survey in 2011 (the vertical red line furthest to the right) and a DHS in 2010 (the middle of the vertical red lines) were both highly consistent with the reasonably stable coverage estimates based upon routine data (“administrative estimates; the red asterisks) of coverage with DPT3. For both surveys immunization records were observed for a high percentage of the children (> 75%). In this instance, WHO and UNICEF experts based their own summary of immunization trends (the blue line) entirely upon the estimates derived from routine data.

Figure 37: 2014 WUENIC summary for Tanzania
The circumstances have been quite different for Ethiopia. Administrative coverage estimates (the red asterisks) have varied considerably from findings of most coverage surveys. The surveys, while sometimes conducted in consecutive years, yielded markedly different estimates. The percentage of children for whom cards were observed (between 29% and 60%) was not reassuring.

Figure 38: 2014 WUENIC summary for Ethiopia

In conclusion, findings from population-based surveys can be used to validate estimates based upon routine data. However, survey findings are not available for most years and some surveys may themselves be affected by data quality issues, especially when a high percentage of data are based upon recall rather than written documentation.
Annex 9: Best practice in presentation of institutional mortality statistics

Institutional mortality in Rwanda

Table 11: Top ten causes of deaths in district hospitals and health centers, 2012. Rwanda Annual Health Statistics Bulletin for 2012

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cause of death</th>
<th>Total</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neonatal illness</td>
<td>2,722</td>
<td>33%</td>
</tr>
<tr>
<td>2</td>
<td>Pneumonopathies</td>
<td>650</td>
<td>8%</td>
</tr>
<tr>
<td>3</td>
<td>Cardio-vascular disease</td>
<td>698</td>
<td>7.4%</td>
</tr>
<tr>
<td>4</td>
<td>Malaria</td>
<td>693</td>
<td>7.4%</td>
</tr>
<tr>
<td>5</td>
<td>Obstetrical problems</td>
<td>595</td>
<td>7.3%</td>
</tr>
<tr>
<td>6</td>
<td>Physical Trauma and Fractures</td>
<td>550</td>
<td>6.7%</td>
</tr>
<tr>
<td>7</td>
<td>HIV/AIDS opportunistic Infections</td>
<td>432</td>
<td>5.3%</td>
</tr>
<tr>
<td>8</td>
<td>Diarrhea</td>
<td>335</td>
<td>4%</td>
</tr>
<tr>
<td>9</td>
<td>Cancer</td>
<td>321</td>
<td>3.9%</td>
</tr>
<tr>
<td>10</td>
<td>ARI</td>
<td>283</td>
<td>3.4%</td>
</tr>
<tr>
<td></td>
<td>All other reported deaths</td>
<td>1032</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>Grand Total</td>
<td>8143</td>
<td></td>
</tr>
</tbody>
</table>

Source: Rwanda HMIS, 2012

“In this report, data on mortality concern exclusively information collected from health facilities through HMIS. Deaths that happened in the community are reported only in the MCH section (maternal deaths), because they are notified by CHWs in their monthly reports and available in Community health database (SISCom).... by far the major leading cause of mortality for all ages in health centers, district and provincial hospitals in 2012 was neonatal illness with 22% of all the reported deaths.... Although referral hospital staff have been trained to report using the RHMIS, deaths from referral hospitals were not reported according to diseases in 2012. This is a major gap that should be resolved next year as referral hospitals receive most of cases with complications and are expected to record higher death rates than district hospitals and health centers.”

Note:
• The report acknowledges that community deaths are not included. It also acknowledges the “major gap” that reports were not received from referral hospitals. Ideally the report would compare the total reported deaths in health facilities (10,237 including those in referral hospitals) to UN estimates of the total annual deaths in Rwanda (crude death rate x population = 7/1000 x 11,776,522 = 82,436/year) to calculate that only about 12.5% of all deaths are reported by district hospitals and health centres²
• The above table groups together deaths among all age groups. It would be better to present deaths among children separate from deaths among those 5 years and older.
Annex 10: Major changes in total in OPD attendance

Table 12: from the Uganda Annual Performance Review for 2012/2013

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>2009/09</th>
<th>2010/11</th>
<th>2012/13</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Malaria</td>
<td>117,448</td>
<td>14,166,098</td>
<td>38.3</td>
</tr>
<tr>
<td></td>
<td>12,614,609</td>
<td>36.0</td>
<td>13,263,020</td>
</tr>
<tr>
<td></td>
<td>15,997,210</td>
<td>36.8%</td>
<td></td>
</tr>
<tr>
<td>No Pneumonia - Cough or Cold</td>
<td>5,794,516</td>
<td>18.0</td>
<td>4,851,602</td>
</tr>
<tr>
<td></td>
<td>6,712,597</td>
<td>15.0</td>
<td>8,855,616</td>
</tr>
<tr>
<td></td>
<td>12,650,161</td>
<td>29.1%</td>
<td></td>
</tr>
<tr>
<td>Intestinal Worms</td>
<td>1,767,586</td>
<td>6.0</td>
<td>1,666,559</td>
</tr>
<tr>
<td></td>
<td>1,826,240</td>
<td>5.0</td>
<td>2,018,551</td>
</tr>
<tr>
<td></td>
<td>2,403,712</td>
<td>5.5%</td>
<td></td>
</tr>
<tr>
<td>Skin Diseases</td>
<td>1,177,313</td>
<td>4.0</td>
<td>1,101,113</td>
</tr>
<tr>
<td></td>
<td>1,118,821</td>
<td>3.0</td>
<td>1,112,903</td>
</tr>
<tr>
<td></td>
<td>1,408,967</td>
<td>3.4%</td>
<td></td>
</tr>
<tr>
<td>Acute Diarrhoea</td>
<td>955,145</td>
<td>3.0</td>
<td>1,031,914</td>
</tr>
<tr>
<td></td>
<td>1,029,615</td>
<td>3.0</td>
<td>1,191,137</td>
</tr>
<tr>
<td></td>
<td>1,357,965</td>
<td>3.1%</td>
<td></td>
</tr>
<tr>
<td>Eye Conditions</td>
<td>749,997</td>
<td>2.0</td>
<td>751,508</td>
</tr>
<tr>
<td></td>
<td>935,445</td>
<td>3.0</td>
<td>907,194</td>
</tr>
<tr>
<td></td>
<td>1,136,641</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>Urinary Tract Infections</td>
<td>646,326</td>
<td>2.0</td>
<td>1,297,733</td>
</tr>
<tr>
<td></td>
<td>747,354</td>
<td>2.0</td>
<td>867,769</td>
</tr>
<tr>
<td></td>
<td>1,125,153</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>867,917</td>
<td>3.0</td>
<td>912,283</td>
</tr>
<tr>
<td></td>
<td>819,180</td>
<td>2.0</td>
<td>941,816</td>
</tr>
<tr>
<td></td>
<td>1,046,440</td>
<td>2.4%</td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal Obstructive (Non Infective)</td>
<td>726,862</td>
<td>2.0</td>
<td>811,144</td>
</tr>
<tr>
<td></td>
<td>825,338</td>
<td>2.0</td>
<td>730,903</td>
</tr>
<tr>
<td></td>
<td>1,157,245</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>Ear, Nose and Throat (ENT) Conditions</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>747,949</td>
<td>1.7%</td>
<td></td>
</tr>
<tr>
<td>Injuries/Tragedy due to other causes</td>
<td>627,412</td>
<td>2.0</td>
<td>641,967</td>
</tr>
<tr>
<td></td>
<td>657,542</td>
<td>2.0</td>
<td>642,409</td>
</tr>
<tr>
<td></td>
<td>723,416</td>
<td>1.7%</td>
<td></td>
</tr>
<tr>
<td>All Others</td>
<td>6,830,214</td>
<td>2.0</td>
<td>1,373,847</td>
</tr>
<tr>
<td></td>
<td>7,967,354</td>
<td>2.2</td>
<td>5,994,951</td>
</tr>
<tr>
<td></td>
<td>4,770,596</td>
<td>11.0%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31,861,966</td>
<td>100.0</td>
<td>36,828,890</td>
</tr>
<tr>
<td></td>
<td>34,853,145</td>
<td>100.0</td>
<td>36,807,794</td>
</tr>
<tr>
<td></td>
<td>43,415,169</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Source: MoH HMS

"... there was a significant increase in the number of malaria cases from 13,263,620 in 2011/2012 to 15,997,210 in 2012/2013."

Note:
- The reported number of outpatient consultations rose by 20% between 2011/2012 and 2012/2013.
- It is a best practice to present data from a series of years. To assess for trends in the data, however, it is essential to first assess for trends in the completeness of the data and consider whether large fluctuations from year to year may reflect data quality issues. The up and down fluctuation in reported malaria cases suggests that completeness/data quality may have been as important as any real disease trend in determining the number of cases reported in 2012/2013. Notice that the proportion of morbidity attributed to malaria does not change significantly over the 4 years whereas the proportion attributed to cough or cold rose from 18% to 29%.
- The report does not distinguish presumed malaria from confirmed malaria. If this had been done, malaria would likely have accounted for a significantly lower percentage of outpatient morbidity.
Annex 11: Triangulation of data sources to assess trends in disease incidence

The country profile for Rwanda in the 2014 World Malaria Report includes the following two graphs. Figure 39 presents the trend, between 2000 and 2013, in confirmed cases of malaria reported per 1000 population per year. Shown on the same graph is the trend in the Annual Blood Examination Rate (ABER - the number of lab tests performed to confirm malaria per 100 population per year). Notice how confirmed cases reported has risen and fallen in parallel with the ABER.

Figure 39: Confirmed cases of malaria reported /1000 population and ABER , Rwanda, 2000 to 2013. Source: 2014 World Malaria Report.

Rwanda’s 2014 country profile also includes Figure 40 which presents trends in the incidence of hospital admissions and inpatient deaths due to malaria per 100,000. Both admissions and deaths from malaria have declined markedly since 2006. Based upon the trends in admissions and deaths, the World Malaria Report found that there is sufficient evidence to conclude that the true incidence of malaria in Rwanda has declined by more than 75% since 2000 even though confirmed cases reported has risen markedly over the last 2 years. The conclusion that there has been a marked reduction in malaria incidence is supported by survey findings that the prevalence of parasitemia among children 6 to 59 months fell from 2.6% in 2007-2008 to 1.4% in 2010. This example illustrates the value of triangulation of findings from multiple data sources.

Figure 40: Trends in hospital admissions and inpatient deaths from malaria per 100,000, Rwanda, 200 to 2013. Source: . Source: 2014 World Malaria Report.

Source: Table R.1 from the World Malaria Report, 2014

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>Algeria, Botswana, Cabo Verde, Eritrea, Namibia, Rwanda, Sao Tome and Principe, South Africa, Swaziland</td>
<td>Ethiopia, Zambia, Zimbabwe</td>
<td>Madagascar</td>
<td>Angola, Benin, Burkina Faso, Burundi, Cameroon, CAR, Chad, Comoros, Congo, Congo DRC, Cote d’Ivoire, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea</td>
<td>Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mauritania, Mayotte (Fr.), Mozambique, Niger, Nigeria, Senegal, Sierra Leone, Togo, Uganda, Tanzania</td>
</tr>
<tr>
<td>Region of the Americas</td>
<td>Argentina, Belize, Bolivia, Brazil, Columbia, Costa Rica, Ecuador, El Salvador</td>
<td>Fr. Guiana, Guatemala, Honduras, Mexico, Nicaragua, Paraguay, Peru, Suriname</td>
<td>Dominican Republic, Panama</td>
<td>Guyana, Venezuela, Haiti</td>
<td></td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>Afghanistan, Iran, Iraq, Morocco</td>
<td>Oman, Saudi Arabia, Syria</td>
<td></td>
<td></td>
<td>Djibouti, Pakistan, Somalia, Sudan, Yemen</td>
</tr>
<tr>
<td>European</td>
<td>Armenia, Azerbaijan, Georgia, Kyrgyzstan</td>
<td>Tajikistan, Turkey, Turkmenistan, Uzbekistan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South-East Asian</td>
<td>Bangladesh, Bhutan, Korea, DPRK</td>
<td>Nepal, Sri Lanka, Timor-Leste</td>
<td>India, Thailand</td>
<td></td>
<td>Indonesia, Myanmar</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>Cambodia, China, Laos, Malaysia, PNG</td>
<td>Philippines, Rep. Korea, Solomon Is., Vanuatu, Viet Nam</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Annex 13: The TB notification rate as a reflection of the quality and coverage of TB surveillance

Beginning in 2000, the National Tuberculosis Program of Bangladesh took steps to improve TB case-finding and support private sector health care providers with TB treatment and reporting. The estimated Case Detection Rate (the light green line) increased from 31% to 53%. The total notifications of TB cases per 100,000 population in Bangladesh (the blue line) increased significantly from 2004 to 2013. However, the estimated incidence of TB (the horizontal red line), as assessed through a consultative and analytic process led by WHO, remained unchanged throughout this period. Hence, for Bangladesh during this period, the TB notification rate appears to have reflected the quality and coverage of TB surveillance more than it reflected changes in TB incidence.

Figure 41: TB notification rate, case detection rate and incidence, Bangladesh, 2004 - 2013. Source: Statistics downloaded from the Global TB database
Annex 14: Couple Years of Protection (contraception)

Ghana’s Holistic Assessment of the Health Sector Programme of Work 2012, compares CYP statistics with findings from recent household surveys: “The contraceptive prevalence rate has markedly increased since 2008 [from 13.3% to 23.4%]. The positive trend observed in the survey, is supported by routine information, which shows a significant increase in short-term CYP and minimal increase in long-term CYP... [see Table 13]"

Table 13: Couple years of protection, by region or Ghana, 2010 to 2012. Source: Holistic Assessment of the Health Sector Programme of Work 2012, Ministry of Health, June 2013

<table>
<thead>
<tr>
<th>Year</th>
<th>AR</th>
<th>WR</th>
<th>NR</th>
<th>BAR</th>
<th>CR</th>
<th>VR</th>
<th>UFR</th>
<th>UWR</th>
<th>ER</th>
<th>GAR</th>
<th>Ghana</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>181,281</td>
<td>78,345</td>
<td>29,135</td>
<td>58,837</td>
<td>56,880</td>
<td>47,027</td>
<td>19,831</td>
<td>25,163</td>
<td>80,879</td>
<td>54,662</td>
<td>632,960</td>
</tr>
<tr>
<td>2011</td>
<td>94,796</td>
<td>47,268</td>
<td>74,625</td>
<td>121,181</td>
<td>96,635</td>
<td>51,093</td>
<td>26,048</td>
<td>19,833</td>
<td>104,586</td>
<td>30,867</td>
<td>688,512</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,922,289</td>
</tr>
</tbody>
</table>

“Analysis by GHS shows that an increasing proportion of family planning clients are accessing the services from the private sector including pharmacy shops, since this is more convenient for the clients. This leads to incompleteness of the data collected by GHS.”

“... the calculation and understanding of CYP at the service delivery and data collection points also need to be investigated.”

Note:
- The report offers no explanation of the massive increase in CYP in 2012 and no explanation as to why there is no regional breakdown of CYP for 2012.
- The report notes the need to improve understanding of CYP and methods to calculate it.
- The report notes that GHS data under-estimate contraceptive prevalence because they omit data from sales of contraceptives by private providers.
Annex 15: Problems reporting and analyzing malaria testing data

Table 14: from the Annual Statistical Report for 2013 of the Ministry of Health of Burkina Faso, May 2014.

<table>
<thead>
<tr>
<th>Structures</th>
<th>Total des cas de paludisme</th>
<th>Gouttes épaisse(s) Réalisées</th>
<th>Gouttes épaisse(s) Positives</th>
<th>TDR Réalisées</th>
<th>TDR Positives</th>
<th>Taux de confirmation</th>
<th>Taux de positivité</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boucle du Mouhou</td>
<td>593 335</td>
<td>13 157</td>
<td>6 073</td>
<td>325 021</td>
<td>296 730</td>
<td>67,0</td>
<td>119,1</td>
</tr>
<tr>
<td>CHR Dédougou</td>
<td>3 931</td>
<td>6 031</td>
<td>2 646</td>
<td>0</td>
<td>0</td>
<td>153,4</td>
<td>43,9</td>
</tr>
<tr>
<td>Bocomo</td>
<td>89 318</td>
<td>1 149</td>
<td>792</td>
<td>43 720</td>
<td>161 050</td>
<td>50,2</td>
<td>360,7</td>
</tr>
<tr>
<td>Dédougou</td>
<td>96 803</td>
<td>904</td>
<td>322</td>
<td>32 611</td>
<td>27 541</td>
<td>38,7</td>
<td>82,9</td>
</tr>
<tr>
<td>Nouna</td>
<td>88 169</td>
<td>949</td>
<td>553</td>
<td>47 925</td>
<td>38 024</td>
<td>56,4</td>
<td>80,0</td>
</tr>
<tr>
<td>Solenko</td>
<td>117 710</td>
<td>2 222</td>
<td>1 416</td>
<td>61 449</td>
<td>54 360</td>
<td>54,1</td>
<td>67,6</td>
</tr>
<tr>
<td>Toma</td>
<td>67 024</td>
<td>0</td>
<td>57 290</td>
<td>50 831</td>
<td>85,5</td>
<td>98,7</td>
<td>98,7</td>
</tr>
<tr>
<td>Tougan</td>
<td>140 380</td>
<td>1 822</td>
<td>344</td>
<td>82 025</td>
<td>64 424</td>
<td>59,7</td>
<td>77,2</td>
</tr>
<tr>
<td>Cascades</td>
<td>314 052</td>
<td>11 709</td>
<td>4 263</td>
<td>248 260</td>
<td>197 074</td>
<td>82,8</td>
<td>77,4</td>
</tr>
<tr>
<td>CHR Bantora</td>
<td>5 985</td>
<td>9 009</td>
<td>3 060</td>
<td>0</td>
<td>0</td>
<td>150,0</td>
<td>34,0</td>
</tr>
</tbody>
</table>

Note:
1. The regional hospital in Dédougou ("CHR Dédougou") reported more positive “TDR” (RDT) tests than RDT tests “réalisées” (performed). This is clearly impossible and reflects problems with reporting of malaria testing data.
2. The next to last column, labeled “Taux de confirmation” (malaria confirmation rate) is calculated by summing the number of “TDR’s” (RDTs) performed and the number of “Gouttes épaisse(s)” (thick blood smears) performed and dividing the result by the total number of cases of malaria that were reported. Such an indicator has no target as shown by the finding for “CHR Dédougou” where the number of tests was 50% greater than the reported number of cases of malaria (confirmed + presumed). The preferred indicator, the malaria diagnostic testing rate, divides total tests by the sum of total cases plus negative tests. For CHR Dédougou the malaria diagnostic testing rate for 2013 was 91.7% -- a quite high rate.
### Annex 16: Population per facility rather than facility per population

#### Table 15: Population per health center (CSPS), by region / district, Burkina Faso, 2013, extract from the Annual Statistical Report for 2013 of the Ministry of Health of Burkina Faso, May 2014.

<table>
<thead>
<tr>
<th>Régions / districts</th>
<th>Population en 2013</th>
<th>CSPS*</th>
<th>Ratio habitant/CSPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boucle du Mouhoun</td>
<td>1 723 830</td>
<td>208</td>
<td>8 288</td>
</tr>
<tr>
<td>Borome</td>
<td>257 486</td>
<td>33</td>
<td>7 603</td>
</tr>
<tr>
<td>Dedougou</td>
<td>358 239</td>
<td>37</td>
<td>9 682</td>
</tr>
<tr>
<td>Nouna</td>
<td>331 020</td>
<td>42</td>
<td>7 881</td>
</tr>
<tr>
<td>Solonzo</td>
<td>323 502</td>
<td>33</td>
<td>9 806</td>
</tr>
<tr>
<td>Torra</td>
<td>193 773</td>
<td>27</td>
<td>7 177</td>
</tr>
<tr>
<td>Tougan</td>
<td>259 710</td>
<td>36</td>
<td>7 214</td>
</tr>
<tr>
<td>Cascades</td>
<td>607 170</td>
<td>81</td>
<td>8 484</td>
</tr>
<tr>
<td>Banfora</td>
<td>537 242</td>
<td>38</td>
<td>8 675</td>
</tr>
</tbody>
</table>

**Note:** With population per health facility, less is better
Annex 17: Data sources for tracking human resources

The report of Tanzania’s Mid-Term Analytic Review provides the following overview of the data available on human resources for health:

- **Health facilities reports**: HMIS data includes staffing by cadre for the facilities, which are aggregated at the districts.

- **Human resources for health information system (HRHIS)**: maintained by the HRH unit in the Ministry of Health and Social Welfare. The HRHIS is separate from the payroll and includes the whole health workforce. It has improved in 2012 following the development of an individual level registry of health workers. It also includes the *Training institution information system (TIIS)* which has comprehensive data on all training institutions.

- **Quality**: the comparison of the two sources and the same source over time shows many inconsistencies in reporting completeness and quality. The HRHIS data base is more comprehensive and will be used but it is difficult to compare with previous years, as the system is improving every year. The reporting by national referral institutions is still incomplete. Also reporting by private institutions is considerably poorer than for public institutions.

- **Completeness** of the register is difficult to estimate in the absence of a census of health workers. Incomplete reporting is likely to be higher for the eight national referral hospitals, especially Muhimbili Medical Centre, KCMC and Buganda...

In addition, data from the private sector are less complete than those from the public sector.