Unlocking the power of the tiered laboratory network through laboratory mapping
Mapping laboratory networks: Why?

- Where are the laboratories?
- What can they do?
- How much population is covered by the laboratory services?

Use the information to improve the functions of the laboratory network

Strengthen the capacity of the laboratory technical working group (TWG) to manage the laboratory network
Re-introducing national tiered laboratory networks

Communicable diseases

Non-communicable diseases

Quality

Integration

Efficiency

Decreasing specialization of lab cadres

Increasing test complexities

Routine

Emergencies

Limited Resources

Individual patient health

Public health

Global health

Communicable diseases

Non-communicable diseases

Routine

Emergencies

Limited Resources

Individual patient health

Public health

Global health
If the laboratory network was a computer...

Laboratory systems
*The hardware*

- Infrastructure & supplies
- Equipment
- Workforce
- Quality
- Data
- Etc.

Tiered Laboratory network
*The software*

- Mutualize resources
- Synergize functions
- Creates cost effectiveness
- Cover population need

Governance
*The administrator*

**TWG**
- MoH Laboratory directorate
- Administrative leadership
- Laws & regulation
- National Public Health Laboratory
- Technical arm

**Disease programmes**
**Private sector**

**Research, Academia**
**Partners**
The guiding principles of the network functions

- **Maputo declaration**: Integrated & quality laboratory services at all levels of health system/network
- **UHC**: access to health services for all, without causing financial hardship
- **IHR**: collective and coordinated prevention, detection and response to disease threat.
- **Freetown declaration**: clinical and surveillance functions conducted through a single integrated national network
- Others...

The laboratory mapping data can provide the evidence to shape the network according to these guiding principles.
Collect Laboratory Data

- Use pre-configured, customizable and reusable digital forms via Ona.io that allow to collect data offline

- Collect GPS coordinates and service data via onsite assessments

- Integration to a facility registry (database) for curation & use,

- The data collection tool covers test menu (including AMR), QMS, staffing, linkage to networks, infrastructure, etc…

Laboratory Staffing Information

- Category of laboratory staff

  - How many pathologists work in the lab?
  - How many microbiologists work in the lab?
  - How many lab technologists work in the lab?
  - How many lab scientists work in the lab?
  - How many lab technicians work in the lab?
  - How many lab assistants / microscopists work in the lab?
Maping laboratories in Burkina Faso: the process

- **Upload the data**
  - Tablets

- **Data cleaning**
  - ASLM IT

- **Analysis**
  - ASLM analyst
  - Country team

- **Visualizations**
  - Web

- **Triangulate layers of informations** *(Planwise)*
  - GIS data (location)
  - Population (coverage, demand)
  - Road network (access)
Preliminary analysis from Burkina Faso
Distribution of the 235 Laboratories that are mapped

Geographical distribution

Distribution by affiliation

<table>
<thead>
<tr>
<th>Level 1 (n=159)</th>
<th>Public</th>
<th>NGO_religious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>38%</td>
<td>26%</td>
</tr>
<tr>
<td>Private</td>
<td>36%</td>
<td>4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 2 (n=67)</th>
<th>Public</th>
<th>NGO_religious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>52%</td>
<td>0%</td>
</tr>
<tr>
<td>Private</td>
<td>43%</td>
<td>0%</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Level 3 (n=9)</th>
<th>Public</th>
<th>NGO_religious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>100%</td>
<td>0%</td>
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</tbody>
</table>
Case study 1:

Assessing the implementation of the tier-specific minimum testing package in Burkina Faso
National norm for medical laboratory testing in Burkina Faso guides the recommended minimum testing at each tier of the network (2009)

Population in Burkina Faso: 20,853,837 (WHO population database)

Coverage: access to care within a radius of maximum 2 hour travel (by car or on foot)
Using the labmap data to compare the norm and the practice

Exhaustive list aimed at capturing every possible diagnostics

Test menu (> 120 diagnostics)
- HIV diagnostics
- Hepatitis
- EHF
- Bacteriology
- Tuberculosis
- Parasitology
- Immuno-Hematology
- Blood banking
- Histology

Priorities of Burkina Faso MoH

Actual availability of tests at each tier
- Tier 1
- Tier 2
- Tier 3

Gaps between policy and practices
The case of HIV and tuberculosis diagnostic
What do national norms recommend in terms of HIV and tuberculosis testing?

<table>
<thead>
<tr>
<th>HIV Diagnostics captured in the labMap data collection tool (ONA)</th>
<th>In the norm Y/N?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genotypic ARV resistance testing</td>
<td></td>
</tr>
<tr>
<td>Viral load (HIV)</td>
<td>✓</td>
</tr>
<tr>
<td>Human Immunodeficiency Virus (HIV)</td>
<td>Polymerase chain reaction (PCR) for...</td>
</tr>
<tr>
<td>Early Infant diagnosis (EID); preparation of dried blood spot (DBS) for Early...</td>
<td></td>
</tr>
<tr>
<td>Line immunoassay (LIA) / western blot (WB)</td>
<td></td>
</tr>
<tr>
<td>HIV serology (enzyme-linked immunosorbent assay (ELISA) linked...</td>
<td></td>
</tr>
<tr>
<td>Rapid HIV antibody tests</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tuberculosis Diagnostics captured in the labMap data collection tool (ONA)</th>
<th>In the norm Y/N?</th>
</tr>
</thead>
<tbody>
<tr>
<td>DST second-line</td>
<td></td>
</tr>
<tr>
<td>DST first-line</td>
<td></td>
</tr>
<tr>
<td>MTBDR Plus Probe assay</td>
<td></td>
</tr>
<tr>
<td>GeneXpert MTB</td>
<td></td>
</tr>
<tr>
<td>Tuberculosis PCR</td>
<td></td>
</tr>
<tr>
<td>Culture liquid media MGIT</td>
<td></td>
</tr>
<tr>
<td>Culture solid media</td>
<td></td>
</tr>
<tr>
<td>Lateral flow urine assay (LAM)</td>
<td></td>
</tr>
<tr>
<td>TB LAMP</td>
<td></td>
</tr>
<tr>
<td>Light emitting Diode (LED) fluorescent microscopy</td>
<td></td>
</tr>
<tr>
<td>AFB smear Ziehl Neelsen</td>
<td>✓</td>
</tr>
</tbody>
</table>
Diagnostic test expected at each tier level according to the norms of BF

- **Tier 1**
  - Rapid antibody tests HIV
- **Tier 2**
  - Rapid antibody tests HIV
  - HIV Serology (ELISA)
  - Viral load
- **Tiers 3 et 4**
  - Rapid antibody tests HIV
  - HIV Serology (ELISA)
  - Viral load

Is the minimum testing package for HIV (the norm) implemented?

<table>
<thead>
<tr>
<th>Level 1 Labs</th>
<th>Level 2 Labs</th>
<th>Level 3 &amp; 4 Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid HIV antibody tests</td>
<td>HIV serology (enzyme-linked immunosorbent assay (ELISA) linked immunosorbent assay, ...)</td>
<td>Rapid HIV antibody tests</td>
</tr>
<tr>
<td><strong>99%</strong></td>
<td><strong>78%</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Viral load (HIV)</td>
<td>Rapid HIV antibody tests</td>
<td>HIV serology (enzyme-linked immunosorbent assay (ELISA) linked immunosorbent assay, ...)</td>
</tr>
<tr>
<td><strong>0%</strong></td>
<td><strong>44%</strong></td>
<td><strong>78%</strong></td>
</tr>
<tr>
<td>Viral load (HIV)</td>
<td>Rapid HIV antibody tests</td>
<td>HIV serology (enzyme-linked immunosorbent assay (ELISA) linked immunosorbent assay, ...)</td>
</tr>
<tr>
<td><strong>50%</strong></td>
<td><strong>97%</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Viral load (HIV)</td>
<td>Rapid HIV antibody tests</td>
<td>HIV serology (enzyme-linked immunosorbent assay (ELISA) linked immunosorbent assay, ...)</td>
</tr>
<tr>
<td><strong>100%</strong></td>
<td><strong>99%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**% of Lab Conducting the test** vs **Gap**
Is microscopy for AFB implemented at all level?

Diagnostic tests expected at each tier level according to the norms of BF

- **Level 1**
  - AFB

- **Level 2**
  - AFB

- **Level 3 and 4 labs**
  - AFB

<table>
<thead>
<tr>
<th></th>
<th>Level 1 Labs</th>
<th>Level 2 Labs</th>
<th>Level 3 &amp; 4 Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Labs conducting the test</td>
<td>36%</td>
<td>54%</td>
<td>78%</td>
</tr>
<tr>
<td>Gap</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
When practice is ahead of the norm

Tests not included in the norms, but which are implemented
— fluorescence microscopy LED
— Test TB Lamp
— Culture –solid medium
— Culture- liquid medium MIGT
— NAAT ( PCR) TB
— Test GeneXpert (MTB)
— LPA MTBDR Plus
— DST first-line
— DST second-line

The norms need an update!!
Implication of test implementation in terms of population coverage

Exhaustive list

**Test menu (> 120 diagnostics)**

- HIV diagnostics
- Hepatitis
- EHF
- Bacteriology
- Tuberculosis
- Parasitology
- Immuno-Hematology
- Blood banking
- Histology

**Priorities of Burkina Faso MoH**

**Actual availability of tests at each tier**

- Tier 1
- Tier 2
- Tier 3

Gaps between policy and practices

Population not covered

Population covered

Implication for UHC Prioritizing improvements
INCREASE IN TESTS COVERAGE
16,204,581 (77.69%)
to a total of 16,204,802 (77.69%)

TOTAL TESTS UNDER GEOGRAPHIC COVERAGE
17,695,153

EFFORT REQUIRED
29

device to serve 79,344 tests

+ Laboratoire CHUR/Ouahigouya
Increased capacity on 1,186,509 test device to serve 1,080,382 tests

+ Laboratoire du Centre Hospitalier Universitaire Souro Sanou (CHUSS)
Increased capacity on 2,324,959 test device to serve 2,324,960 tests
Distribution et population coverage of HIV viral load

- 7 of 9 laboratories at tiers 3 & 4 provide HIV Viral load services.
- **59.3% of the population is covered** (within a radius of 2 hours travel)
Distribution et population coverage of microscopy for AFB

100 Laboratories conduct microscopy for the identification of AFB
- 57 at tier 1
- 36 at tier 2
- 7 at tiers 3 & 4

Good population coverage (almost 100%), but microscopy is not the most reliable technique.
‘What if?’ scenarios

**Case study:** increase the population coverage of HIV Viral load

1. Bring non-conform laboratories to the norms
2. Integrate VL testing to existing GeneXpert sites
3. Place new VL capacity
Improve the population coverage by increasing compliance to the norm.

Bring tiers 3 & 4 laboratories to the norm.

Centre de recherche en Santé Nouna: ‘What if?’ 61.25%

CHUN de Bogogo: ‘What if?’ 61.32%

Population coverage theoretically increases from 59.3% to 61.25% to 61.32%
Improve the population coverage by decentralizing VL testing toward geneXpert sites

4 / 8 GeneXpert sites are located in regions not covered by any HIV viral load laboratories.

IF VL is decentralized in those 4 sites

Population coverage increase from 62.32% to 67.95%
Where to place new capacity to increase the coverage up to 80%?

Identify the sites with most of the unsatisfied demand. i.e the sites not providing the services and located in an area of high population density.
Key considerations to place new Viral Load testing capacity

Key Considerations

1. The sites of Sahel, Centre-Nord and Est are the one with most unsatisfied demand for VL.

2. When the Laboratoire du Centre Medical Urbain de Dori in Sahel is activated, the population coverage increases from 67.95 to 71.39%.

3. When the Laboratoire du Centre Medical du secteur 1 au Centre-Nord is activated, the population coverage increases from 71.99 to 72.84% with a spillover to the East.
2nd iteration towards 80% population coverage

The new analysis show that the number of population not covered decreases per site.

The simulation is then repeated with the next critical sites.
The choice of bringing laboratories to the norms, placing new capacity, integrate VL on geneXpert available within the TB programme depends on the priorities of the Government.
Perspectives for Burkina Faso

- Consolidate the LabMap portal of Burkina Faso (at the MoH)
- Train the Burkina Faso data team to use the data and run their own scenarios for:
  - Developing, adjusting and optimizing the performance and capacity of the tiered laboratory network
  - Quickly identify the sites that can be activated during outbreak response, and for a maximum of population coverage
  - Monitor the implementation of the recommended minimum testing packages
  - Guide the mutualizing of resources in general and test integration in particular
  - Improve existing sample transport system

Scenarios can inform national plans and/or funding requests
Perspectives of the LabMap program

- Gabon
- Chad
- Congo
- Sao Tomé
- CAR
- Malawi
- Zambia
- Zimbabwe

Data collection with contribution from partners and funders
- IDDS
- GHSA
- Fondation Mérieux
- GHSS
- IRESSEF

Possibility to synergize with OptiDx from FIND

Niger integrated their data with DHIS-2
Perspectives of the LabMap program

• Ensure that all countries that completed the collections are trained and fully independent (Guinea, Mali, Burkina)

• Finalize data collection in countries already started and enroll new countries through the Africa CDC RISLNET

• Link the data update to the national system for laboratory registration and licensing

• Facilitate collaboration with partners also working on GIS-based laboratory improvement
Acknowledgements

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  - Samba Diallo
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