Designing Optimal Integrated Sample Referral Systems in Kenya

Jeremiah Ogoro

Laboratory network optimization to improve service delivery for TB. 31th October,
The 50th Union World Conference on Lung Health, Hyderabad, India
Improving TB sample referral is an NSP priority

Significant scale up of GeneXpert testing and sample referral is needed to meet NSP targets

TARGET:
80% counties have an established TB sample referral system that covers
75% of level 2 to level 6 health facilities (by 2023)

1st PRIORITY
CLOSE THE DIAGNOSTIC GAP

Meet people who are seeking care anywhere in the health system with quality TB, leprosy and lung health services
Kenya: Designing demand-driven sample referral systems

CURRENT
- Incomplete data on sample referral flows
- Health facilities often refer to multiple testing sites
- Most referrals within county boundaries although not always to the closest site
- Very long transport legs in the northern (hard-to-reach) counties

OPTIMISED SAMPLE REFERRAL LINKAGES
- Model-recommended allocation of health facilities to testing sites based on weighted demand/distance to improve efficiency and increase access
- Improved utilization of existing device capacity

TRANSPORTATION ROUTE DESIGN & OPERATIONAL PLANNING
- Detailed SRS route plans, costs and transport modes (motorbike, public transport etc.)
- Integrated system designed for transport of TB, HIV and other samples
- Country operational plans developed to implement recommended network designs

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Total Health Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>▲</td>
<td>Test Facility</td>
</tr>
<tr>
<td>□</td>
<td>HF on multi-stop route</td>
</tr>
<tr>
<td>▲</td>
<td>HF referring to Test Facility Direct</td>
</tr>
<tr>
<td>▲</td>
<td>HF Served by Neighbour Counties</td>
</tr>
<tr>
<td>□</td>
<td>Neighbour County HF's Served by Makueni routes</td>
</tr>
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</table>

Routes
Counties included in Integrated Sample Referral System design

**KEY**

- **Hard to reach counties:**
  - 5 county group
  - 10 county group

- **Moderate to reach counties:**
  - 5 county group
  - 10 county group

- **Easy to reach counties:**
  - 5 county group
  - 10 county group

**Easy to reach counties:** strong partner support, large cities and high placement of Xpert machines;

**Moderate counties:** less intense partner support, considerable distances between Dx and treatment sites and generally have 2 to 3 Xpert machines per county;

**Hard to reach counties:** no partner support, poor road infrastructure, security concerns, poor coverage by courier services, poor connectivity and harsh climatic conditions
Scope and outputs of sample transport system design

**VEHICLE ROUTE OPTIMIZATION**

5 counties
Baringo, Garissa, Makueni, Nakuru, Siaya

- Allocation of HFs to Xpert sites and hubs
- Estimated sample transport budget
- Detailed multi-stop routes
- HF-level decision on whether direct or multi-stop

**MULTI-STOP ESTIMATION**

10 counties
Bomet, Busia, Isiolo, Kiambu, Mandera, Marsabit, Migori, Tana River, Turkana, Wajir

- Allocation of HFs to Xpert sites and hubs
- Estimated sample transport budget
Key Input Assumptions

- **Sample Pickup Frequency**: 2 times per week (100 times per year) for Hard-to-Reach counties; 5 times per week (250 times a year for Easy and Moderate Counties)

- **Motorcycle Average Travel Speed**: 40 km/h

- **Business hours of HFs**: 8am-5pm

- **Maximum Duration of Route**: 1 Day (no overnight allowed): 10 hours maximum in Easy and Moderate Counties; 9 hr maximum i.e. Working Day only (8am to 5pm) in Hard-to-reach counties

- **Stopping time**: 25 minutes per stop for motorcycle at each HF for sample receiving and other processes

- **Cost per km**:
  - For motorcycle (all-inclusive OpEx e.g. charged by 3PL) = 25 KSh per KM
  - For Courier = 25 KSh per KM
  - For personal transport = 25 KSh per KM
Other design questions

- Can Xpert machines in your county conduct tests for HFs from outside your county?
- Can HFs in your county be served by Xpert sites from other counties?
- Can you allow multi-stop routes operating from Xpert sites in your county to cross county borders? Or only allow outside county HFs to send samples direct (point-to-point, not Xpert) Only point-to-point for cross-county
- Will you allow all HFs to refer EID and Viral Load samples (and arrange for transport from all HFs)?
- How much of the EID testing demand will be tested at GeneXpert sites (and how much referred on to regional labs)?
  - In Hard-to-Reach counties, EID will be tested at TB GeneXpert sites.
  - In Easy and Moderate Counties, EID will be referred to national labs (or tested at separate dedicated EID GeneXpert machines in Siaya)

- Average GX utilization for TB is between 51% - 142% in ETR and MTR and 22% - 56% in HTR counties
- All HTR counties have sufficient spare capacity on GX to add EID testing
Majority (73%) of tests done are HIV VL, Xpert MTB/RIF 18% and EID, 9%, but significant variation in volumes and proportions across counties.
... so one size does not fit all

Map Legend
- Transportation Stops
- Status - include
Detailed route maps: multi-stop & direct routing

- Motorbike riders, with transport hub at sub-county hospital in the South of county
- Use public transport (bus) for long transport legs – more cost efficient

- Island health facilities – refer direct to Xpert site (on demand, but need allocated budget)
- V. high demand at some Xpert sites – contingency to allow Xpert>Xpert referral

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<td>🌟</td>
<td>Neighbour County HF’s Served by Garissa routes</td>
</tr>
</tbody>
</table>

Routes
Direct vs. Multi-Stop Routes

- Overall, the number of HFs selected for direct transport within county is quite low. Even if HFs have low demand it makes sense to include them on route if they are close to high-demand facilities or fall on the path of the route.
- Only facilities that have combination of low demand and that are at a distance from others are left out of routes.
- Sparse counties with low demand have proportionally more direct shipping (Garissa, Baringo) and dense counties with high demand have proportionally less direct shipping (Nakuru, Siaya, Makueni).
- All Cross-County flows are to be planned as direct shipping (no multi-stop routes for cross-county referrals).

### Table: County vs. Cross County Transport Routes

<table>
<thead>
<tr>
<th>County</th>
<th>Cross County</th>
<th>Direct</th>
<th>Multi-stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>BARINGO</td>
<td>48 (18%)</td>
<td>43 (16%)</td>
<td>171 (65%)</td>
</tr>
<tr>
<td>GARISSA</td>
<td>14 (9%)</td>
<td>36 (22%)</td>
<td>112 (69%)</td>
</tr>
<tr>
<td>MAKUENI</td>
<td>3 (1%)</td>
<td>39 (11%)</td>
<td>307 (88%)</td>
</tr>
<tr>
<td>NAKURU</td>
<td>94 (19%)</td>
<td>37 (7%)</td>
<td>370 (74%)</td>
</tr>
<tr>
<td>SIAYA</td>
<td>18 (8%)</td>
<td>24 (11%)</td>
<td>176 (81%)</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>177 (12%)</td>
<td>179 (12%)</td>
<td>1136 (76%)</td>
</tr>
</tbody>
</table>

Only HF with combination of low TB & HIV demand and far distance from other HFs are left off routes and served by direct on-demand shipping.

Multi-stop routing reduces overall SRS cost by approx. 50% compared with direct shipping from all HF.
**Overall Outputs: 5 Counties - Route Summaries**

<table>
<thead>
<tr>
<th>County</th>
<th>No. Routes</th>
<th>Avg. of In Transit Stops per Route</th>
<th>Average of Route Distance (km)</th>
<th>Average of Qty of Samples per Route*</th>
<th>Minimum Number of Motorcycles Needed</th>
<th>Buffer Motorcycles (for Maintenance and Emergency)</th>
<th>Total Motorcycles (with buffer to ensure reliable network)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BARINGO</td>
<td>19</td>
<td>9</td>
<td>82</td>
<td>9</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>GARISSA</td>
<td>13</td>
<td>8</td>
<td>279</td>
<td>9</td>
<td>6</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>MAKUENI</td>
<td>31</td>
<td>10</td>
<td>91</td>
<td>11</td>
<td>31</td>
<td>5</td>
<td>36</td>
</tr>
<tr>
<td>NAKURU</td>
<td>33</td>
<td>11</td>
<td>58</td>
<td>12</td>
<td>33</td>
<td>5</td>
<td>38</td>
</tr>
<tr>
<td>SIAYA</td>
<td>20</td>
<td>10</td>
<td>54</td>
<td>24</td>
<td>20</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>116</strong></td>
<td><strong>10</strong></td>
<td><strong>95</strong></td>
<td><strong>13</strong></td>
<td><strong>98</strong></td>
<td><strong>18</strong></td>
<td><strong>116</strong></td>
</tr>
</tbody>
</table>

*Sample numbers on individual routes by county are a useful indicator to help size the cooler boxes used by riders*
Flow units reflect the volume of samples to be transported.

**Map Legend**
- Total Flow Units - 1.00 - 10.00
- Total Flow Units - 10.00 - 50.00
- Total Flow Units - 50.00 - 100.00
- Total Flow Units - 100.00 - 250.00
- Total Flow Units - 250.00 - 957.00
- GeneXpert testing site

**Note:**
the map is illustrative and shows straight line distances between health facilities and testing sites, and not actual recommended transport routes.

Refer to the *Practical guide for county operational planning for integrated sample referral systems in Kenya* for guidance on determining route plans.
From network design to scale up & impact

- Implementation of operational plans in 15 counties

- Leverage experience to scale up integrated SRS planning countrywide, using operational planning guide developed through this work
  - Including guidance on network design, planning & budgeting, contracting, M&E

- Share experience of successful SRS implementation, scale up and track progress

- Contribute towards meeting NSP target for SRS aimed at closing the diagnostic gap for TB in Kenya
Thank you

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