Modelling the cost-effectiveness of introducing malaria rapid diagnostic tests in the private retail sector in sub-Saharan Africa

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Our modelling approach

- **Rapid Diagnostic Test (RDT) OR Presumptive Treatment (PT) OR Microscopy Diagnosis (M)**
- **Malaria**
  - **True Positive - Given ACT**
    - **Adheres to Treatment**
      - **Cured (Node 1)**
      - **Treatment Failure (Node 2)**
    - **Does Not Adhere (Node 3)**
  - **False Negative**
    - **Given Antibiotic - Incorrect Drug (Node 4)**
      - **Bacterial Infection**
      - **Viral Infection (Node 5)**
        - **False Negative**
          - **Bacterial Infection (Node 12)**
          - **Viral Infection (Node 13)**
  - **False Positive - Given ACT - Incorrect Drug**
    - **Bacterial Infection (Node 10)**
    - **Viral Infection (Node 11)**
      - **False Positive - Given ACT - Incorrect Drug**
        - **Bacterial Infection**
        - **Viral Infection (Node 9)**

- **Malaria**
  - **True Negative**
    - **Given Antibiotic**
      - **Adheres to Treatment**
        - **Cured (Node 6)**
        - **Treatment Failure (Node 7)**
      - **Bacterial Infection**
        - **Viral Infection (Node 8)**
          - **False Negative**
            - **Bacterial Infection (Node 11)**
            - **Viral Infection (Node 12)**
  - **False Positive - Given ACT - Incorrect Drug**
    - **Bacterial Infection (Node 10)**
    - **Viral Infection (Node 11)**
      - **False Positive - Given ACT - Incorrect Drug**
        - **Bacterial Infection**
        - **Viral Infection (Node 9)**

**Shillcutt et al, 2008**
Our modelling approach

<table>
<thead>
<tr>
<th>Febrile Illness</th>
<th>Seek Treatment</th>
<th>Diagnosis</th>
<th>Test Accuracy</th>
<th>Test Result</th>
<th>Treatment</th>
<th>Treatment Adherence</th>
<th>Treatment Efficacy</th>
<th>Disease Progression</th>
<th>Further Care</th>
<th>Final Health Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Public facility</td>
<td>- Private facility</td>
<td>- CHW</td>
<td>- Pf malaria</td>
<td>- NMFI – AB treatable</td>
<td>- NMFI – not AB treatable</td>
<td>- Co-infection</td>
<td>- RDT</td>
<td>- Positive</td>
<td>- ACT</td>
</tr>
</tbody>
</table>

- Public facility
- Private facility
- CHW
- Pf malaria
- NMFI – AB treatable
- NMFI – not AB treatable
- Co-infection
- RDT
- Positive
- Specificity
- No test
- ACT
- Other antimalarial
- Antibiotic
- ACT + antibiotic
- Other antimalarial + antibiotic
- Other / None
- Not adhere
- Fails
- Complicated
- Severe
- None
- Recover
- Neuro seq
- Death

- Two transmission settings modelled – Low (0%-10% parasite positivity) and Medium/High (10%-90% parasite positivity)
Private retail sector intervention

**Baseline**
- ACTs subsidised in the private retail sector (~85% of manufacturer price)
- No testing in drug shops or pharmacies

**Intervention**
- Introduction of RDTs in pharmacies and drug shops (~40% uptake)
- RDT subsidy (~50% of manufacturer price)
- Continued ACT subsidy
- 3-4 day workshop training
- Monitoring of providers
Initial treatment – parameter estimates

- Based on Cohen et al, 2015 – drug shops study in 6 districts in eastern Uganda (March 2011 – April 2012)
- Treatment in the intervention arm by test result

Assumed baseline treatment is the same as ‘no test’
Results

- Preliminary findings only
### Effects and Costs - eg of 50% parasite positivity

<table>
<thead>
<tr>
<th>Febrile Illness</th>
<th>Deaths / 100,000 cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>Pf malaria</td>
<td>567</td>
</tr>
<tr>
<td>NMFI (AB treatable)</td>
<td>163</td>
</tr>
<tr>
<td>Co-infection</td>
<td>128</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>857</strong></td>
</tr>
</tbody>
</table>

- Incremental provider costs per febrile case presenting at a retail outlet (assuming 5 cases per day) = $0.26, comprising:
  - Programme costs: $0.22
  - RDT subsidy: $0.12
  - Reduced ACT subsidy: ($0.01)
  - Reduced further care costs: ($0.06)

*Costs adapted from sources including Mbonye et al 2015, Hansen et al unpublished, Shillcutt et al 2008, Global Fund AMFm database*
Cost-effectiveness

Medium / high transmission setting (provider perspective)
Deterministic sensitivity analysis

One-way sensitivity – 50% parasite positivity

- Pf malaria becomes severe (0.02/0.08/0.40)
- Number of patients seen per day (1/5/10)
- Death - severe untreated Pf malaria (0.07/0.52/0.92)
- Uptake of RDTs (0.13/0.39/0.73)
- Severe gets inpatient care (0.19/0.48/0.88)
- ACT use with negative test (0.07/0.17/0.32)
- AB treatable NMFI becomes severe (0.04/0.15/0.56)
- ACT ex-manufacturer price (1.00/1.89/4.13)
- Death - severe treated Pf malaria (0.05/0.10/0.15)
- RDT specificity (0.63/0.95/0.96)
- RDT sensitivity (0.93/0.95/0.97)
- Adherence to treatment (0.66/0.70/0.75)
- ACT use with positive test (0.32/0.41/0.51) *
- Death - severe untreated NMFI (0.11/0.42/0.90)
- NMFI is antibiotic treatable (0.05/0.10/0.15)
- Death - severe treated NMFI (0.05/0.10/0.15)

* ACT use with positive test: minimum value not shown as Baseline dominates.
Next steps

• Improve parameter estimates with data from programmes underway
• Enhanced modelling of uncertainty – probabilistic sensitivity analysis (PSA)
• Explore impact of changes in treatment seeking behaviour
• Other interventions

Acknowledgements

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