Malaria control and elimination: Surveillance-response approaches

Marcel Tanner
Swiss Tropical and Public Health Institute

Basel, 9 Dezember 2016
Content

• The concept of surveillance as intervention and how this leads to tailored surveillance response-approaches/systems in different transmission/elimination settings

• Encourage research and R&D
**FUTURE P. FALCIPARUM ERADICATION PARADIGM**

Three types of people in malaria endemic areas:
- Not infected: Asymptomatic
- Infected: Asymptomatic
- Infected: Symptomatic

**Interventions**
- RDT + ACT + PQ
- LLINs
- IRS + New tools

**Outcomes: Uninfected**

- Complete Prevention (Vector +/- Vaccine)
- Transmission reservoir eradicated
- Goal: Prevent death and severe disease & interrupt transmission

**Target Population**
- ACT + PQ

**Goal:**
- Prevent death and severe disease & interrupt transmission
ACCELERATE TO ZERO

We can accelerate the trajectory to malaria eradication by **concurrently** achieving three goals: 1) Identifying the human reservoir of infection in asymptomatic persons + 2) Eliminating the human reservoir + 3) combined with geographically and temporally targeted transmission prevention and strengthened surveillance and response.

**Complete Detection:** Detect the human parasite reservoir

**Complete Cure:** Eliminate the human parasite reservoir

**Complete Prevention:** Effective transmission prevention

[Diagram showing the combination of Complete Detection, Complete Cure, and Complete Prevention resulting in Eradication]

Mobilize for Action
Strengthening surveillance systems: surveillance systems weakest in places with highest malaria burden

- In 2012, surveillance systems detected 14% of estimated malaria cases globally; increase from 3% in 2000 and 11% in 2010
- Case detection lower in countries with higher estimated cases
- For 2013 WMR, 58/99 countries globally and 26/44 countries in the African Region reported case information from district level
Needs in Health Planning

Minimal Essential Information

- From Users and Providers
  
  Best if established participatory

Timely
Adequate
Precise
Applicable - immediately
Zambia: Malaria intervention coverage increases and child mortality declines 2001-2010
(slide courtesy of MoH/NMCP Zambia/MACEPA)

* Measured percent coverage per DHS and MIS; Child mortality rates per DHS 2001-2 and DHS 2007
Malaria reported case rates (all ages) by district 2011
Classical definition of surveillance: Ongoing systematic collection, analysis, and interpretation of data, usually incidence of cases of disease

WHO GMEP definition: “....surveillance is .. aimed at discovery, investigation, and elimination of continuing transmission, the prevention and cure of infection and final substantiation of claimed eradication”

M&E and surveillance: critical activities to measure program performance, impact and achievement of goals: **Maximally possible versus minimal essential**

Surveillance–resonse (“surveillance as intervention”) to reduce transmission to achieve elimination
Some consequences...

1. As countries consider elimination, monitoring, evaluation (M&E), and surveillance activities will need to shift from measuring morbidity and mortality to **detecting infections / pockets of transmission and measuring transmission**

2. Higher need for diagnostic tools and strategies; particularly feasible, field-ready tools for the detection of asymptomatic infection and possibly DNA-based and/or serological biomarkers for malaria infection and transmission),

3. New/more effective **approaches tracking population dynamics**

4. Effective **field based mapping** linked to data bases

5. **Improved measurements of transmission**

6. Improve the feasibility, efficiency, and cost-effectiveness of new **health information systems**
Some consequences…

From M&E and BAD to MED

GMEP:
- Based on Best Available Data (BAD) – surveillance, surveillance…

Malaria Control Programs – GFATM
- M&E – neglect on surveillance
- Collect maximally possible data – „flood of indicators“
- Challenge of timely evaluation to allow adjustments / actions

Today when moving towards elimination / eradication
- Move from M&E to „surveillance-response“
- Move towards Rapid assessment Procedures
  - Minimal essential data in space and time
  - Data generated, evaluated and fed into decision-making
  - Public health action – response packages - to follow swiftly
  - Less about techniques more about approaches (e- / m-health), but a lot about validation
  - Leads to re-thinking HMIS – elimination of one disease can spearhead process
Figure 3. Potential application of different active surveillance and mass drug administration approaches to reduce transmission.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Active surveillance</th>
<th>Presumptive treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PACD</td>
<td>RACD</td>
</tr>
<tr>
<td>Transmission setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elimination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial/demographic risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undefined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion infections asymptomatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion infections subpatent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PACD – Proactive case detection, RACD – reactive case detection, MDA – mass drug administration, tMDA – targeted mass drug administration. MDA refers to presumptive treatment of pre-defined populations, whereas tMDA involves presumptively treating individuals living in close proximity, or with shared risk factors, to passively or actively detected cases.

http://127.0.0.1:8081/plosmedicine/article?id=info:doi/10.1371/journal.pmed.1001467
The number of malaria cases in 2007–2010

Research on:
- Surveillance-Response approaches
  - What-when-how in time and space
  - Response packages

After Zhou et al. 2012
Box 1. The 1-3-7 Strategy Designed to Guide and Monitor Malaria Surveillance and Response in China

1: Case reporting within one day. Any confirmed and suspected malaria cases by law must be reported to the web-based health information system within 24 hours of diagnosis by the local health-care provider.

3: Case investigation within three days. All malaria cases should be confirmed and visited by the county-level China CDC, where the case is reported within three days, to determine where the case originated (local or imported).

7: Focus investigation and action within seven days. The focus investigation should be conducted as soon as possible. If local transmission is possible or confirmed, targeted action to seek out other infections and reduce the chance of onward transmission is completed within seven days by the county-level China CDC of the county where the patient resides and/or works.
Surveillance-response system: conceptual framework

Strategies of PCD and ACD linked to predictive mapping and towards decision support systems

After: Kelly et al. 2012
From M&E and BAD to MED Science?
- MED – use M&E (GFATM…)
- Modeling /Sensitivity analyses
- Validation
Application / Product?
- Spatial decision support system

Combine:
- Basic demographics and geography
With:
- Surveillance data – MED
Using:
- GIS/RS - predictive mapping
- m-Health / e-Health

Maps after Kelly et al. 2012
Breeding places: An farauti

Community surveillance
- Breeding sites
- Immigrants
- «Snowball…»
Isabel Province Malaria Elimination
Surveillance - Response Conceptual Framework

1. CASE DETECTION & NOTIFICATION
   - Health facility-based Passive Case Detection
   - Routine Proactive Case Detection (MBS in priority area)

2. EPIDEMIOLOGICAL CASE INVESTIGATION & CLASSIFICATION
   - Effective/appropriate treatment of individual case
   - Case investigation & classification
   - SDSS-based review of local area historical case & vector data
   - Targeted Active Case Detection (FSAT)

3. FOCUS INVESTIGATION & CLASSIFICATION
   - Focus area reviewed, classified & mapped in SDSS
   - Entomological survey & assessment of focus

4. FOCUS SPECIFIC TARGETED ACTION
   - Endemic
   - Residual active
   - New active
   - New potential
   - Residual non-active

SOPs for:
Surveillance - Response

after Kelly et al. 2012
Real time mHealth monitoring of ACT supply chains..

We have good drugs for malaria!

But a continuing challenge of global, national and local responses to antimalarial drug procurement and supply chain system realities.

Current situation in 5,126 public health facilities in Tanzania on Oct 5th, 2012

Red if a stock out this week

Green if in stock this week

Surveillance in place
Modern Approaches
M-Health with incentives
but
Action is lacking

???

Training
Understanding
Management…

Source: SMS for Life Tanzania
System effectiveness of ALU in Rufiji Tanzania

1000 simple malaria fevers

Sought care

Sought care within 24 h

Individual behaviour

Accessed ACT provider within 24 h

Correctly diagnosed or prescribed

Health system behaviour

ACT stocked in

Adhered to treatment

Treatment effective

110 cases successfully treated

101 lost

413 lost

50 lost

12 lost

64 lost

2 lost

890 failures to treat effectively
The systems context

From Efficacy to Effectiveness

Efficacy 80%

- X Access x 80%
- X Targeting Accuracy x 80%
- X Provider Compliance x 75%
- X Consumer Adherence x 75%

= Effectiveness 29%

After: Tanner 1990: Therapeut. Umschau 47, 856-863

- Dynamic **mapping of „pockets“ of transmission and/or reintroduction**
- Capturing **population dynamics**
- Analyses of M&E data and modeling to optimize SRS
  - MED: Parasite – Man – Vectors
  - Sampling in space and time
- Design and **validate** with use of (i) evidence from programs and (ii) modeling (intervention mixes) **effective response packages tailored** to different transmission settings and levels
- Use of **new technologies** (m/e-health, diagnostics)
- Validation, validation, validation…alongside with programs
Surveillance - Response Approaches

Innovative Approaches

Surveillance system(s)
(minimal essential Indicators, data quality, timeliness, resolution, access)

Identification of pockets of transmission

Characterization
Sink/source
Morbidity/mortality

Information, synthesis and decision making tools?

Policies

Interventions
«Packages»

Testing efficacy
Modeling effect

Effectiveness

Analysis of evidence and knowledge for decision making and triggering of public health response

Intervention

Institutional arrangements, partnerships, integration into NMCP, DHP communities

Modified Tanner after: Hetzel Swiss TPH, 2013
Thank you very much...