Costs and Cost-effectiveness of LLIN distribution strategies in sub-Saharan Africa

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February 6, 2018
Introduction

2015 MAP Estimates of ITN Coverage and Continental-level time series of estimated ITN coverage indicators for the years 2000–2013. (A) % HH one ITN; (B) % HH 1 per 2; (C) % pop. access; (D) % pop. slept; (E) 'ownership gap'. Source: MAP and Bhatt et al 2015.

- Successful scale up in coverage since 2000
- Heterogeneity
- Imperfect coverage
- Sustainability of coverage

- Sawtooth coverage over time
- What are the implications of gaps
- What will it cost to fill them
Costs and Cost-effectiveness of LLIN distribution strategies in sub-Saharan Africa

Intro
Costing case-series
Meta-analysis and review
Effectiveness
Cost-effectiveness
Conc.

Overall Study Design

1. Case series of costing for CD strategies
   - Schools
     1. Tanzania
     2. Ghana
   - ANC/EPI
     1. Ghana
     2. Tanzania
     3. Mali (+ 2 regional Mass campaigns)
   - Community
     1. Zanzibar

2. Review and meta-analysis of existing data (plus new data)

3. Simulation of effects using OpenMalaria

4. Cost-effectiveness comparisons
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Costing case-series results

Total and Distribution Costs

- **International Donor Distribution Costs**
  varied - some CD systems higher and some lower than campaigns
  LLINs still largest line item

- **Annual Economic Cost per TNY**
  Donor + country contribution generally higher in CD
  Country contributions much higher in CD
Review and Meta-analysis methods

- MeSH search terms used were (malaria OR falciparum OR plasmodium) AND (cost OR effective OR effectiveness OR benefit)
- Abstracts reviewed for the potential to contain primary cost data
- Reference lists of identified studies reviewed and experts consulted
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- Two existing (relatively) recent reviews - Eisele et al 2012 and White et al 2011 (One Older - Kolaczinski and Hanson 2006)
- Different methods and different inclusion criteria

Step 1: Database* keyword search
- MeSH search terms: (malaria OR falciparum OR plasmodium) AND (cost OR effective OR effectiveness OR benefit)
- Publication date: January 1, 2010- May 31, 2017
n=5,629 articles fit criteria

Step 2: Search of reference lists of all articles selected in Step 1.
- n=7 articles screened

All articles, dissertations, and grey literature containing primary cost data related to insecticide-treated nets published between January 1, 2010 and May 31, 2017 were selected.
- n=13

Studies included in White (2011) or Eisele (2012) were excluded.
- n=1

Cost only studies
- n=7
Cost effectiveness only studies
- n=1
Cost and cost effectiveness studies
- n=4

Step 3: Internet search and request for unpublished reports from malaria researchers.
- n=X articles screened

*PubMed; Google Scholar; African Journals Online, Social Science Research Network, Bath Information and Data Services (BIDS)
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**Review and Meta-analysis results - Costs of delivery**

**Cost of Delivery (Economic)**

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Cost of Delivery (USD)</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD</td>
<td>3.21 (USD)</td>
<td>2.55-3.86</td>
</tr>
<tr>
<td>Cam.</td>
<td>2.34 (USD)</td>
<td>1.63-3.04</td>
</tr>
</tbody>
</table>

- $N = 39$
- $p = 0.08$ for difference
- Financial costs - Region, Year and CD vs. Campaign delivery all significant sources of heterogeneity.

**Cost of Delivery (Financial)**

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<tr>
<td>CD</td>
<td>2.97 (USD)</td>
<td>1.91-4.04</td>
</tr>
<tr>
<td>Cam.</td>
<td>2.02 (USD)</td>
<td>1.10-2.95</td>
</tr>
</tbody>
</table>

- $N = 62$
- $p = 0.173$ for difference
- Econ. costs - no significant predictors were found.
Baseline Scenarios

- Vector biology, demographics, seasonality, treatment seeking: as per Briët and Penny 2013
- Variants: 7
- EIR: 1, 2, 4, 8, 16, 32, 64
- Three baseline scenarios - 100 Year equilibration, 15 years baseline monitoring, then interventions with 30 years of monitoring:
  1. No intervention
  2. Three mass distributions at five year intervals
  3. Five mass distributions at three year intervals

Figure: Population use of LLIN resulting from distribution scenario 1. Black: baseline scenario 1; Red: baseline scenario 2; Blue: baseline scenario 3
Population use of LLIN resulting from distribution scenarios

**Figure:** UC Mass campaign every 5 years

**Figure:** Single UC Mass campaign followed by ANC/EPI + schools

**Figure:** Single UC Mass campaign followed by schools only

**Figure:** UC Mass campaign every 5 years + ANC/EPI + small schools in non-campaign years
Intervention Scenarios

1. A) NO LLINs (any distributions ceases)
2. B) Single UC Mass campaign followed by ANC/EPI only
3. C) Single UC Mass campaign followed by ANC/EPI + community
4. D) Single UC Mass campaign followed by ANC/EPI + schools
5. E) Single UC Mass campaign followed by community only
6. F) Single UC Mass campaign followed by schools only
7. G) UC Mass campaign every 3 years
8. H) UC Mass campaign every 3 years + ANC/EPI
9. I) UC Mass campaign every 3 years + ANC/EPI + small schools in non-campaign years
10. J) UC Mass campaign every 5 years
11. K) UC Mass campaign every 5 years + ANC/EPI
12. L) UC Mass campaign every 5 years + ANC/EPI + small schools in non-campaign years
Cost-effectiveness methods

- Cost-effectiveness frontier estimated using plot method to show expansion path.

Image source: Hassmiller Lich et al Prev Chronic Dis 2017
Example above is base model and baseline is 5 UCC over fifteen year period.

- Nets cost similar amounts but delivery more expensive through CD systems.
- Costs discounted at 3% to Present Value.

Expansion path depends on transmission context (and what has already been done).
Conclusions

- Current information indicates that CD strategies can be effective at delivering nets/sustaining coverage.
- Cost of CD systems (per net) not statistically significantly higher than campaigns in review despite higher mean (high variability).
- CD involves more country resources than campaigns.
- CD systems in many cases are competitive in terms of ICER to campaign only approach.
- Distribution of costs within programs has not changed drastically over time (LLIN still biggest cost driver).
- Expansion path (intervention choice as budget expands) in most cases is:

\[
\text{NONE} \Rightarrow UCC + ANC \Rightarrow (UCC + SCHOOL \parallel COMM) \parallel UCC3 \\
\Rightarrow UCC + ANC + SCHOOL \parallel COMM
\]
Acknowledgments

- ZAMEP
- Tanzania NMCP
- Ghana NMCP
- PSI/Mali
- Swiss TPH
- VectorWorks
- PMI TZ

- JSI/DELIVER
- PMI Mali
- Mali PNLP
- Communicate for Health Ghana
- Peace Corps Ghana
- PSI/Tanzania
- PMI Ghana