Projected number of people with onchocerciasis-loiasis co-infection in Africa, 1995-2025

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Natalie Vinkeles Melchers, MSc. MPH.
What is the problem?

Loa loa: prevalence of history of African eye worm

Onchocerciasis: prevalence of palpable nodules

Zouré et al (2014) Parasites & Vectors 7 (326)
Study aim

To estimate the number of individuals with onchocerciasis and *Loa loa* co-infections in Africa in 2015 and 2025, who are at risk for serious adverse events after treatment with ivermectin.

At risk-for serious adverse events: threshold of $\geq 20,000$ *Loa* microfilariae/mL
Loa loa: estimate prevalence of high-intensity loiasis infection

Based on:
Wanji 2001 UNDP
Takougang et al Bull WHO 2002
Onchocerciasis: estimate *O. volvulus* mf prevalence

Pre-control prevalence of palpable nodule: model-based geostatistical analysis at 1x1 km resolution

Conversion of nodule prevalence in adult males+20 yrs to mf prevalence in population
Estimating pre-control prevalence of microfilaremic *Loa* infected and co-infected persons
**Loa loa: impact of ivermectin on Loa loa infection**

Marked decrease in *Loa loa* microfilaraemia six and twelve months after a single dose of ivermectin

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Baseline assumption: Ivermectin reduces loiasis prevalence and intensity with first treatment round only

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<table>
<thead>
<tr>
<th>Mf intensity levels pre-treatment</th>
<th>0</th>
<th>1-100</th>
<th>&gt;100-500</th>
<th>&gt;500-2,000</th>
<th>&gt;2,000-10,000</th>
<th>&gt;10,000-30,000</th>
<th>&gt;30,000</th>
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<tr>
<td>0</td>
<td>0.978</td>
<td>0.022</td>
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<tr>
<td>1-100</td>
<td>0.857</td>
<td>0.131</td>
<td>0.012</td>
<td>0.000</td>
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<tr>
<td>&gt;100-500</td>
<td>0.500</td>
<td>0.306</td>
<td>0.139</td>
<td>0.056</td>
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<tr>
<td>&gt;500-2,000</td>
<td>0.365</td>
<td>0.192</td>
<td>0.365</td>
<td>0.077</td>
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<tr>
<td>&gt;2,000-10,000</td>
<td>0.120</td>
<td>0.084</td>
<td>0.169</td>
<td>0.434</td>
<td>0.193</td>
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<tr>
<td>&gt;10,000-30,000</td>
<td>0.060</td>
<td>0.024</td>
<td>0.071</td>
<td>0.167</td>
<td>0.595</td>
<td>0.083</td>
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<tr>
<td>&gt;30,000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.029</td>
<td>0.059</td>
<td>0.485</td>
<td>0.382</td>
<td>0.044</td>
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Onchocerciasis: impact of ivermectin on *O. volvulus* infection

<table>
<thead>
<tr>
<th>Country</th>
<th>Project</th>
<th>APOC/ former OCP</th>
<th>CDTI start year</th>
<th>CDTI frequency per annum</th>
<th>Treatment coverage</th>
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<tbody>
<tr>
<td>CAR</td>
<td>CAR combined project</td>
<td>APOC</td>
<td>2003</td>
<td>1</td>
<td>80%</td>
</tr>
<tr>
<td>CAR</td>
<td>F20CAR</td>
<td>APOC</td>
<td>2016</td>
<td>1</td>
<td>80%</td>
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<tr>
<td>CAR</td>
<td>F5CAR</td>
<td>APOC</td>
<td>2020</td>
<td>1</td>
<td>80%</td>
</tr>
<tr>
<td>Chad</td>
<td>Chad</td>
<td>APOC</td>
<td>2001</td>
<td>1</td>
<td>81%</td>
</tr>
<tr>
<td>Congo</td>
<td>Congo 1</td>
<td>APOC</td>
<td>2007</td>
<td>1</td>
<td>81%</td>
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<tr>
<td>Congo</td>
<td>F20Congo</td>
<td>APOC</td>
<td>2014</td>
<td>1</td>
<td>81%</td>
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<tr>
<td>Congo</td>
<td>F5Congo</td>
<td>APOC</td>
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<td>81%</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>Bandama</td>
<td>former OCP</td>
<td>1990s</td>
<td>1</td>
<td>73%</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>CI Conoe</td>
<td>former OCP</td>
<td>1990s</td>
<td>1</td>
<td>73%</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>CI Lower Sassandra</td>
<td>former OCP</td>
<td>2014</td>
<td>1</td>
<td>73%</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>CI Upper Sassandra</td>
<td>former OCP</td>
<td>1990s</td>
<td>1</td>
<td>73%</td>
</tr>
<tr>
<td>DRC</td>
<td>Bandundu</td>
<td>APOC</td>
<td>2005</td>
<td>1</td>
<td>82%</td>
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</tbody>
</table>


**Predicted trend in prevalence after ivermectin treatment**

(Onchosim simulations for annual treatment at 70% coverage)

Estimating pre-control prevalence (1995) of infected cases

$L.\ loa \geq 20,000 \text{ mf/mL}$

Onchocerciasis - $L.\ loa \geq 20,000 \text{ mf/mL}$
Estimating the current situation (2015) of infected cases

L. loa ≥20,000 mf/mL

Onchocerciasis - L. loa ≥20,000 mf/mL
Estimating the future situation (2025) of infected cases

$L. \ loa \geq 20,000 \text{ mf/mL}$

Onchocerciasis - $L. \ loa \geq 20,000 \text{ mf/mL}$
Sensitivity analysis

Number of co-infected cases with high L. loa mf/mL intensities

- >=8,000-<20,000 Loa mf/mL
- ≥20,000 - <30,000 Loa mf/mL
- ≥30,000 Loa mf/mL

Year: 1995, 2015, 2025

Pre-control: 250,000

1st round Tx: 200,000

Effect: 1995:
- >=8,000-<20,000 Loa mf/mL: 75,000
- ≥20,000 - <30,000 Loa mf/mL: 25,000
- ≥30,000 Loa mf/mL: 50,000

1st round Tx: 2015:
- >=8,000-<20,000 Loa mf/mL: 100,000
- ≥20,000 - <30,000 Loa mf/mL: 50,000
- ≥30,000 Loa mf/mL: 50,000

1st round Tx: 2025:
- >=8,000-<20,000 Loa mf/mL: 75,000
- ≥20,000 - <30,000 Loa mf/mL: 25,000
- ≥30,000 Loa mf/mL: 50,000
Sensitivity analysis

Number of co-infected cases with high L. loa mf/mL intensities

- Pre-control
- 1st round Tx
- Exponential effect

- 1995
- 2015
- 2025

- >=8,000-<20,000 Loa mf/mL
- ≥20,000 - <30,000 Loa mf/mL
- ≥30,000 Loa mf/mL

- 2015

- 2025
Sensitivity analysis

Number of co-infected cases with high *L. loa* mf/mL intensities

- Pre-control
- No effect of ivm
- Effect of ivm
  - 1st round Tx
  - Exponential effect

1995 - 2015 - 2025

- >=8,000-<20,000 Loa mf/mL
- ≥20,000 - <30,000 Loa mf/mL
- ≥30,000 Loa mf/mL

1995:
- Pre-control
- No effect of ivm
- Effect of ivm
  - 1st round Tx
  - Exponential effect

2015:
- No effect of ivm
- Effect of ivm
  - 1st round Tx
  - Exponential effect

2025:
- No effect of ivm
- Effect of ivm
  - 1st round Tx
  - Exponential effect

1995:
- No effect of ivm
- Effect of ivm
  - 1st round Tx
  - Exponential effect

2015:
- No effect of ivm
- Effect of ivm
  - 1st round Tx
  - Exponential effect

2025:
- No effect of ivm
- Effect of ivm
  - 1st round Tx
  - Exponential effect
Conclusion

In 2025:

- \( Loa^+ \) cases \( \geq 20,000 \) mf/mL : 203,900

- Co-infected cases (\( Loa \geq 20,000 \) mf/mL) : 24,600

- % of all co-infected cases in onchocerciasis hypoendemic area: 89.5%

- At-risk population living in areas were MDA with ivermectin is contra-indicated : \(~10\) million
Discussion

**Strategies** for areas that are low endemic for onchocerciasis and co-endemic for *L. loa* (and were MDA in contraindicated)
- New drugs (e.g. macrofilaricides)
- Test-and-(not)-Treat
- Vector control

**Strategic implications**
- R&D: absolute number of individuals
- Policy makers: relative proportion at risk
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