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

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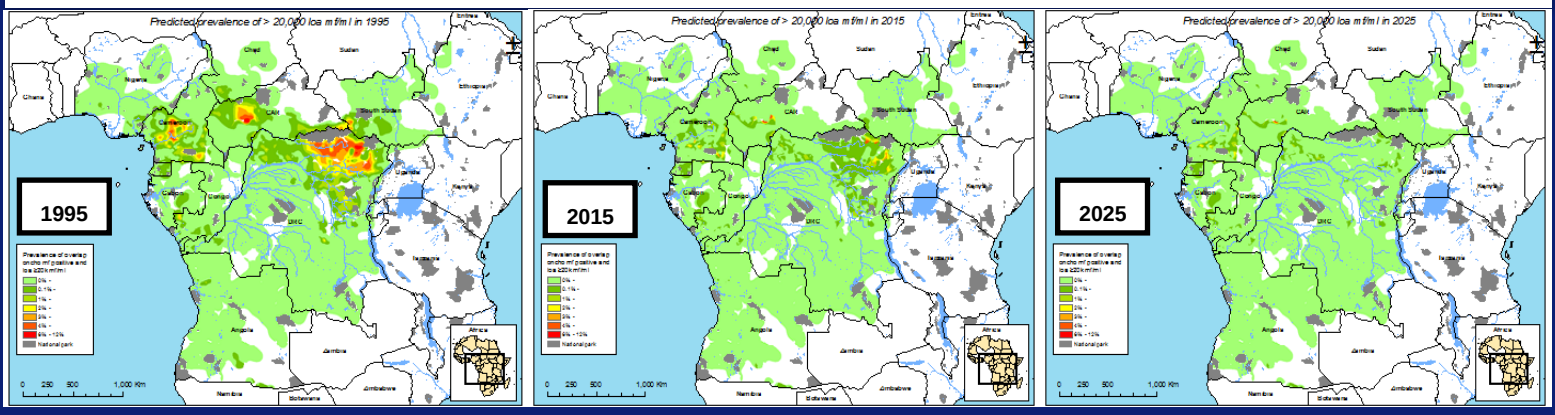
BACKGROUND AND OBJECTIVE: The elimination of onchocerciasis through mass drug administration (MDA) with ivermectin is hampered due to co-endemicity of *Loa loa* in West and Central Africa, as people with high *L. loa* microfilaraemia (≥20,000 microfilariae (mf) /mL of blood) can develop potentially fatal serious adverse events (SAEs). To understand the need for alternative treatment strategies (e.g. safe drugs or test and treat strategies) and support their planning, we estimated the number of individuals co-infected with onchocerciasis and high-intensity *L. loa,* in 14 African countries, for the years 1995, 2015 and 2025.

Figure 1. Maps showing the prevalence of co-infection of onchocerciasis and very high-intensity *L. loa* infection (≥20,000/mL blood) for 1995, 2015, and 2025.

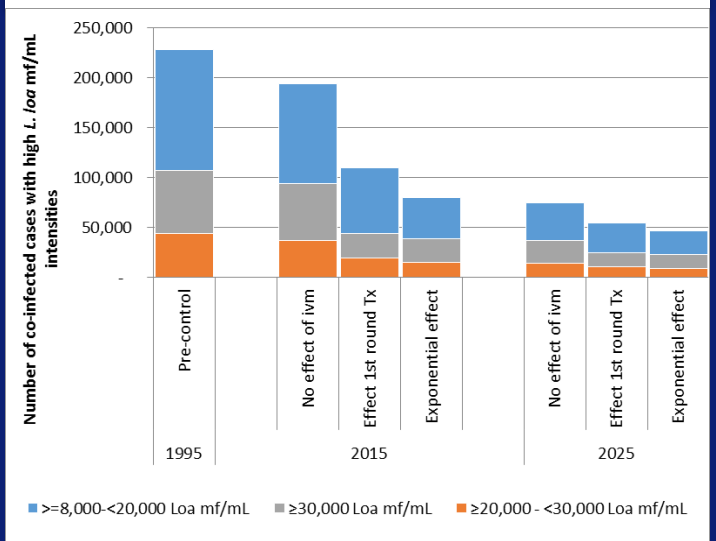


RESULTS: The total pre-control (1995) population size that was included in our analyses was >81 million (people living in *Loa*-mapped areas), of whom 73.7% lived in areas co-endemic for onchocerciasis and loiasis (**Table 1**). Thanks to large-scale implementation of MDA, we predict that the number of cases with *O. volvulus* infection in these areas will decline between 1995 and 2025. Likewise, the number of co-infected people with *Loa* mf ≥20,000/mL will decrease between 1995 and 2025. In 2025, 93.5% of co-infected cases with high *L. loa* mf counts (N=23,000) will live in onchocerciasis hypoendemic areas that are currently not treated through MDA programmes. Some foci in e.g. Gabon, Equatorial Guinea, Democratic Republic of Congo (DRC), and Cameroon will remain at high risk for SAEs by 2025 (**Fig. 1**). The DRC and Cameroon will account for 72% of all remaining cases in 2025. Our sensitivity analyses show that the number of co-infected cases with very high mf intensity in 2025 is barely influenced by assumptions regarding the impact of annual MDA on onchocerciasis and loiasis prevalence (**Fig. 2**), as most cases remain in untreated areas.

Table 1. Overview of the projections for number of *O. volvulus*, *L. loa* and co-infected cases for 1995. 2015 and 2025. Numbers x1.000

	1995	2015	2025
Population size living in *Loa*-mapped areas	81,400	134,900	169,400
Population size in *Loa*-onchocerciasis co-endemic areas	59,800	98,500	123,600
Population size in Loa-onchocerciasis co-endemic areas where MDA cannot be applied	8,185	13,542	16,965
No. of people with *Loa* mf (% of population size in *Loa*-mapped areas)	3,800 (4.7%)	5,200 (3.8%)	6,300 (3.7%)
No. of people with *O. volvulus* mf (% of population size in co-endemic areas)	18,400 (30.7%)	10,900 (11.0%)	3,200 (2.6%)
No. of people with *Loa* mf (% of population size in co-endemic areas)	2,800 (4.6%)	3,500 (3.6%)	4,200 (3.4%)
No. of onchocerciasis- *Loa* co-infected cases with ≥20,000 *Loa* mf/mL (% among all *O. volvulus* cases)	107.0 (0.6%)	44.1 (0.4%)	24.6 (0.6%)
Idem, in areas where MDA cannot be applied (% among total co-infected cases with very high *Loa* mf intensity)	11.7 (10.9%)	18.8 (42.5%)	23.0 (93.5%)

Figure 2. Sensitivity analysis of the impact of ivermectin on the no. of onchocerciasis/*Loa* co-infected cases with high loiasis mf intensity.



METHODS: We overlaid pre-existing geostatistical maps of the baseline prevalence of onchocerciasis[1] and loiasis[2], ivermectin treatment and rural population density data for 1995, 2015 and 2025. Prevalence of co-infection was then estimated for each 1x1 km resolution raster map, assuming that both infections occur independently from each other. We then used mathematical modelling to predict trends in the prevalence of *O. volvulus* infection as a result of MDA[3], using the publicly available model ONCHOSIM[4]. Changes in *L. loa* prevalence after ivermectin intake were modelled using a transition matrix derived from Gardon *et al*.[5]

CONCLUSIONS: We predict that in 2025 over 24,600 people will require treatment for onchocerciasis while being at high risk of SAEs, justifying increased effort in research and development for safer drugs and control strategies. As hypoendemic areas coendemic for loiasis are currently excluded from mass treatment with ivermectin, the number of *O. volvulus* mf-positive cases in these areas is expected to increase over time. Loiasis co-infectivity is a major public health concern for onchocerciasis elimination efforts in these areas, supporting the need for alternative treatment strategy including test-and-(not)-treat.

References: 1. Zouré et al. Parasit Vectors 2014, 22 (7) ; 2. Zouré et al. PLoS NTD 2011, 5(6) ; 3. Kim et al. PLoS NTD 2015, 9(4) ; 4. Stolk et al. Parasit Vectors 2015, 8 (522) ; 5. Gardon et al. *Trans R Soc Trop Med Hyg, 91*

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