



Case study: Precision mapping for schistosomiasis: Better intervention targeting for scale-up, equity and future proofing essential drug delivery systems at times of crisis

Schistosomiasis is an aggregated disease such that across a typical rural landscape the prevalence of infection school-by-school or village-by-village varies extensively, exhibiting strong geographical focality. Conventional mapping of schistosomiasis for initial application(s) of preventive chemotherapy is spatially crude as only a small fraction of locations is sampled (i.e. < 10% within a district). This level of geographical granularity is insufficient and leads to two long term programmatic shortfalls; unnecessary waste of praziquantel, and hindering the local application of epidemiological frameworks to monitor interruption of transmission essential for the success and sustainability of integrated approaches. The concept of precision mapping is to build upon conventional mapping and with progressive iterations provide much finer geographical detail. Precision mapping not only supports the goal of universal health access but also at times of international donor crisis, provides quality evidence to advocate, mobilize and focus vital resourcing for the national control programme.

COUNTDOWN researchers within Cameroon are advancing the concept of precision mapping for schistosomiasis in Cameroon by demonstrating the significance and impact of precision mapping for equitable scale-up of preventive chemotherapy. This is done by examining the fine-scale geographical distribution of schistosomiasis, estimating the at-risk status of currently overlooked groups and highlighting the cost-effectiveness of better geographical targeting. These steps are essential for navigating from basic control towards interruption of schistosome transmission. The latter is essential for exploring real prospects for local elimination of schistosomiasis as a public health problem and at times of abrupt donor crisis, enables best prioritisation of locations for essential drug delivery.

Study Design and Findings

- Precision map of *Schistosoma guineensis* in Edea District (sampling 126 schools, 7,470 children)
- Precision map of *Schistosoma mansoni* in Ndikinimeki District (sampling 108 schools, 3,463 children)
- Impact assessment of expanded access to treatment in vulnerable groups

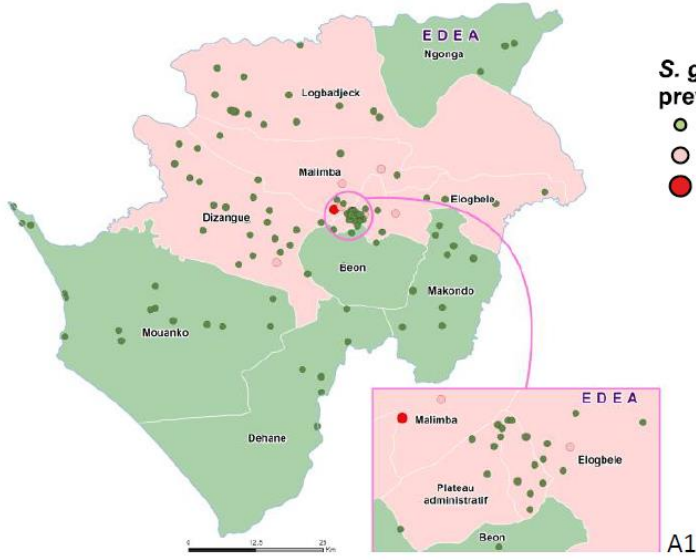


Limitations of the current mapping design for Schistosomiasis control

Schistosomiasis has a highly focal distribution and its transmission depends on several epidemiological and ecological factors including the climatic and physical conditions, the type of water bodies (lakes, streams, dams, irrigation systems, etc.), the species of snail involved in transmission and their population dynamics, the impact of reservoir hosts, and the intensity of human water contacts (1-3). In current WHO guidelines for basic mapping of schistosomiasis, in each health district (i.e. the lowest current preventative chemotherapy implementation unit) a sub-sample of up to five schools (i.e. < 10% of all schools in a district) and 50 children per school are usually selected for parasitological examination(s) (4).

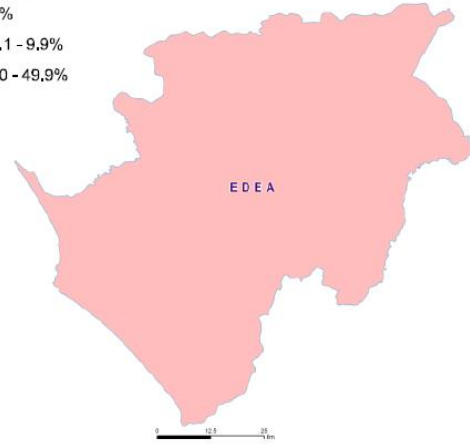
The eligibility of the district for mass preventative chemotherapy is then determined by the mean prevalence to classify the entire district as: non-endemic or low, moderate or high-risk (4). Although suitable for initial application(s) of preventive chemotherapy, it is currently not suitable for achieving the goal of schistosomiasis elimination or progressing towards WHO roadmap targets, and bottlenecks better allocation donated praziquantel. The selection of too few schools leads to misclassification errors that either result in district-wide over-treatment but more importantly under-treatment or no treatment at all in locations that need it most, such as focal transmission hot-spots (see Figs 1 & 2).

2017



S. guineensis prevalence

- 0%
- 0,1 - 9,9%
- 10 - 49,9%



2010



1985

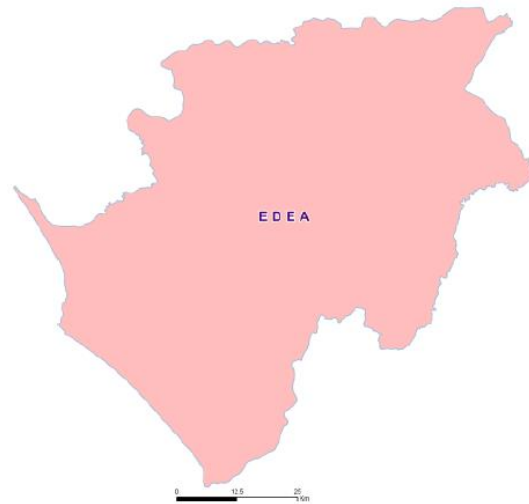
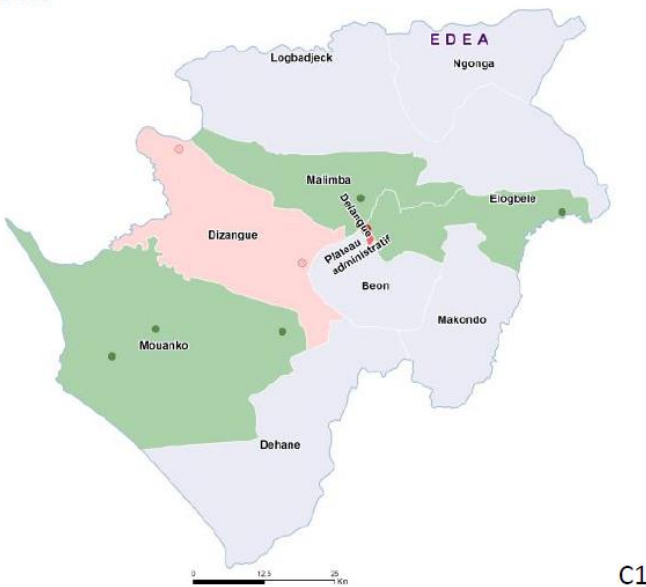
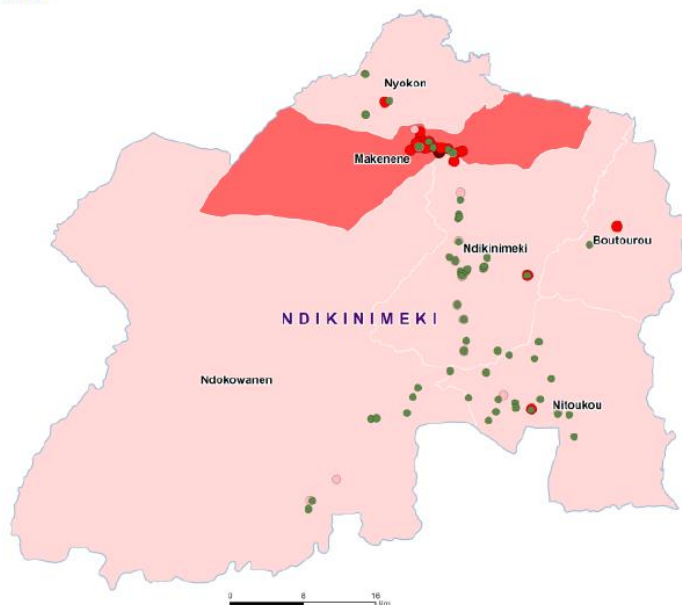


Fig. 1. Comparison of precision and conventional maps, and mean prevalence of schistosomiasis prevalence in the health district of Edea, Cameroon. The precision map (A) provides more accurate information on the distribution of schistosomiasis prevalence within the district, and precision on sub-districts requiring preventative chemotherapy. Difference of sub-district prevalence between 1985 and 2010 mapping further illustrate the uncertainties of conventional mapping (B and C).

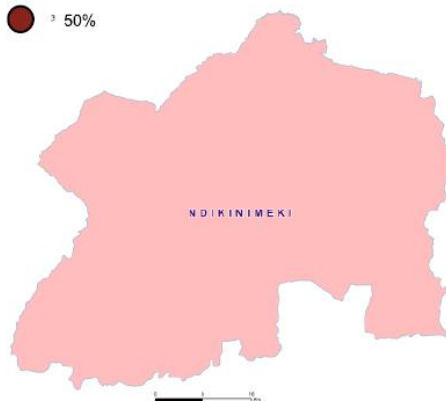
2017



S. mansoni prevalence

- 0%
- 0.1 - 9.9%
- 10 - 49.9%
- ≥ 50%

A1



A2

2010

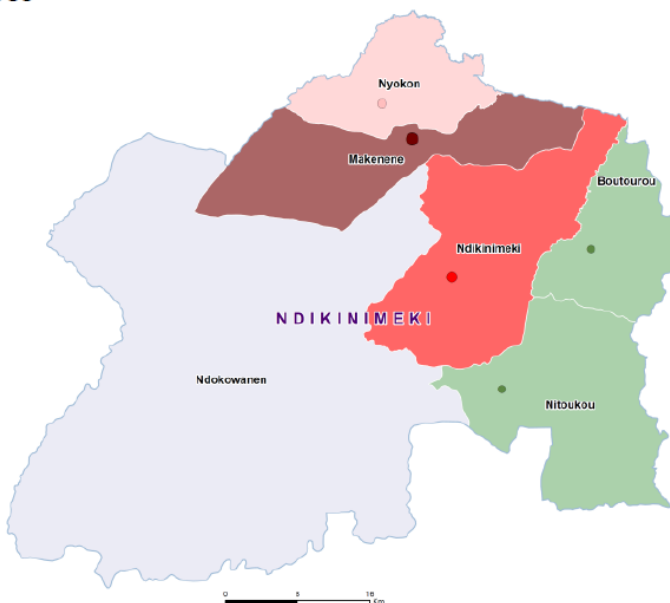


B1



B2

1985



C1



C2

Fig. 2. Comparison of precision and conventional maps, and mean prevalence of schistosomiasis prevalence in the health district of Ndikinimeki, Cameroon. The precision map (A) provides more accurate information on the distribution of schistosomiasis within the district, and precision on sub-districts requiring preventative chemotherapy. Difference of sub-district prevalence between 1985 and 2010 mapping further illustrate the uncertainties of conventional mapping (B and C).

Developing a precision map for Schistosomiasis

To demonstrate the importance of precision mapping, two health districts were selected as exemplars to assess what role this new and innovative approach could play in navigating from basic control towards interruption of transmission. This consisted in an exhaustive geographical sampling of all schools in each of these two districts. School infection prevalence ranged from 0% to 12% in Edea, and up to 50% in Ndikinimeki. The precision maps show significant variations in schistosomiasis prevalence and note that the majority of schools do not require any praziquantel treatment. The comparison of “conventional” and precision mapping shows significant differences throughout, better denoting where high(er) risk zones and specific locations where current or future intensified interventions should be applied to obtain highest impact and long-term value for money investment(s).

Assessing Expanded access of Praziquantel Treatment at Identified Transmission Foci

A key outcome of precision mapping is identification of hot-spots of transmission. In so doing this enables targeting where intensified interventions are both appropriate and clearly needed. COUNTDOWN has specifically used two key transmission foci as context-specific exemplars of urogenital schistosomiasis at the volcanic crater lakes of Barombi Kotto and Mbo for expanded access to praziquantel after precision mapping, and are generating more tailored surveillance data and tracking the impact of expanded access to treatment (8, 9) (i.e. tracking local WASH and snail distributions) alongside qualitative and quantitative social science approaches (i.e. measuring environmental water contact) (10).

Salient WASH interpretations, for example, demonstrate that a ‘blanket’ approach is inferior to a locally ‘tailored’ approach, as certain vulnerable demographical groups are not adequately reached e.g. pre-school-aged children and that prior investments in WASH may have lower expected returns. With specific regard to urogenital schistosomiasis, a gender centred approach is clearly very needed to specifically tackle female genital schistosomiasis (FGS) which is a much under-estimated and stigmatising affliction in adult women and those of child bearing age (14).

Advocacy

COUNTDOWN findings were specifically featured within the March 2017 *‘Towards Elimination of Schistosomiasis: a paradigm shift’* where experts endorsed the precision mapping approach as one of the priority interventions for schistosomiasis control and elimination. From the meeting it was recommended to complete precision mapping to provide high resolution information, at the local level, to better focus and tailor preventative chemotherapy.



Impact

This is the first description of precision mapping of schistosomiasis in Cameroon, demonstrating how over-treatment and unnecessary wastage of praziquantel occurs. In late 2017, these precision maps served as essential evidence for guiding discussion within the health sector at times of abrupt international donor crisis that temporally destabilized the Cameroonian national control campaign and strategy. Following an abrupt withdrawal of USAID funding school-based mass drug administration for schistosomiasis and soil transmitted helminths, evidence from precision maps was used to advocate, mobilize and focus vital resourcing for the national control programme to maintain essential servicing.

By increasing the map granularity and spatial resolution, precision mapping provides the best evidence-based data to guide intensified interventions in targeted transmission zones. This allows better and rational utilization of the donated praziquantel and available resources to marginalized and vulnerable groups, and at times of health system crisis can prioritize intervention areas rapidly.

Key Recommendations

- ✓ Precision mapping can enhance appropriate scale-up of interventions for schistosomiasis with expanded access of praziquantel treatment.
- ✓ A gender centric approach should be developed to better surveillance and management of female genital schistosomiasis within communities and across the health system.
- ✓ Implementation evidence should be used to revise health policies to respond to acute health system crisis and maintain essential service delivery





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