



Summary Technical Report:

Schistosomiasis Control in Yemen: Progressing from Control of Morbidity to Elimination as a Public Health Problem

4th July 2014

1. Summary

Schistosomiasis is widespread in Yemen, with both the intestinal and urogenital forms of the disease prevalent. The Yemen Ministry of Public Health and Population (MoPHP) are implementing a nationwide control programme against schistosomiasis and soil-transmitted helminthiasis, involving the collaboration of partners the World Bank, the World Health Organization and the Schistosomiasis Control Initiative.

Over the first three years of the programme more than **18 million treatments** against schistosomiasis and soil-transmitted helminthiasis to **10 million** individuals have been distributed.

The original objective of the programme was the control of schistosomiasis- and STH-related morbidity. Results from the nationwide re-mapping of the country and from the Impact Evaluation study suggest that in the large majority of areas, this aim has now been achieved.

The recommendation is that the programme now transitions from an aim of controlling morbidity to one of eliminating schistosomiasis as a public health problem, in line with the recommendations of the World Health Assembly Resolution 65.21 ("Elimination of schistosomiasis")¹, with the goals set in the WHO NTD Roadmap for 2020 and 2025², and with the WHO's Schistosomiasis Progress Report 2001-2011 and Strategic Plan 2012-2020³.

2. Background

Both urogenital schistosomiasis (caused by *Schistosoma haematobium*) and intestinal schistosomiasis (caused by *S. mansoni*) are known to be widespread in Yemen. More than 3 million people are estimated to be infected, with approximately 13 million people at risk of infection, and at least three-quarters of a million suffering from severe, chronic morbidity.

The Yemen National Schistosomiasis control Programme (NSCP) was initiated in 2010. The programme, financed primarily through a US\$25 million grant from the World Bank comprises a partnership between the Ministry of Public Health and Population (MoPHP), the World Health Organization (WHO), the World Bank, and the Schistosomiasis Control Initiative (SCI). The aim of the programme, which is due to run from 2010-2015 inclusive, is the control of schistosomiasis-and soil-transmitted helminthiasis (STH)-related morbidity nationwide. This aim is being targeted via the

distribution of praziquantel (against schistosomiasis) and albendazole/mebendazole (against STH) combined with social mobilization and health education activities.

The drug administration is conducted using a combination of both fixed (schools, mosques, health facilities) and temporary sites (mobile teams) for distribution. This approach has been demonstrated to be effective in reaching the programme’s key target groups of enrolled and non-enrolled school-age children, and adults where targeted.

3. Three Years of Implementation

The programme has now completed three years of programmatic activities. In that time it has expanded to become one of the largest schistosomiasis and STH control programmes currently operating worldwide. The summary results for each campaign and in each year of implementation are outlined below in table 1.

In total, in the first three years of the programme the MoPHP have distributed more the **18 million** doses of praziquantel against schistosomiasis and albendazole/mebendazole against STHs to approximately **10 million** unique beneficiaries. This has utilised over **45 million** tablets of praziquantel and **18 million** tablets of albendazole/mebendazole.

Year	Campaign	Districts	Overall Targeted	Overall Treated	Overall Coverage	SAC Targeted	SAC Treated	SAC Coverage
1	1 – Dec 2010	37	2.7m	2.1m	77.6%	1.2m	1.02m	85.0%
	2 – Apr 2011	44	2.6m	1.85m	71.1%	1.2m	0.94m	78.3%
	3a – May 2012	36	2.5m	1.9m	77.1%	1.10m	0.99m	90.2%
	3b – Jul 2012	22	0.196m	0.138m	70.5%	0.086m	0.066m	76.7%
2	1 – Mar 2013	263	12.88m	9.6m	74.5%	6.43m	5.42m	84.3%
	2 – May 2013							
3	1 – Nov 2013	51	2.1m	1.47m	70.0%	1.59m	1.38m	87.0%

Table 1. Summary results of treatments across the three operational years to date. N.B. there was a suspension of the programme between Campaigns 2 (April 2011) and 3a (May 2012) in the first operational years due to civil and political unrest in the country. m = million. SAC = school-aged children (encompassing both enrolled and non-enrolled).

In the most affected districts, individuals have received up to three doses of praziquantel once per year. In compliance with WHO recommendations, one tablet of albendazole or mebendazole has been co-administered to treat STHs, which are widely distributed in the country.

In order to ensure these campaigns are effective, extensive training and health education components have been implemented. As an example, in March and May 2013, approximately 9.6m school-aged children and adults were treated for both schistosomiasis and STH in two separate four-day campaigns. To do this, Yemen mobilized 30,000 health officials and community members in 263 districts and 20 governorates.

All of the reported coverage results above have been verified by an independent auditor.

The overall cost per person treated per year, including drugs, has been estimated as US\$0.51.

4. Prevalence Mapping

4.1. Baseline Prevalence Mapping

Prevalence mapping is used to determine the distribution of infection across the country and, subsequently, to set the treatment approach at the district level.

At baseline in 2010, prior to the first treatment campaign, a small-scale mapping survey was carried out in areas without previous mapping data. The results from these surveys (120 schools in 9 governorates) were combined with mapping surveys conducted from 2002-2010, along with ecological information relevant to schistosomiasis transmission obtained from the literature. All of these data combined were then used to produce a prevalence risk map which guided the treatment approach in each district of the subsequent campaigns (Figure 1A).

All the districts in Yemen were classified into the following groups:

- **High-endemic:** districts where prevalence of infection with any form of schistosomiasis was estimated to equal or exceed 40 percent
- **Meso-endemic:** districts where prevalence of infection with any form of schistosomiasis was estimated to be between 10 percent and 40 percent
- **Low-endemic:** districts where prevalence of infection with any form of schistosomiasis was estimated to be below 10 percent
- **Suspected-endemic:** a fourth category was also created, encompassing suspect endemic districts, that is, districts that have not been surveyed yet but from which cases of schistosomiasis have been reported by the national surveillance system

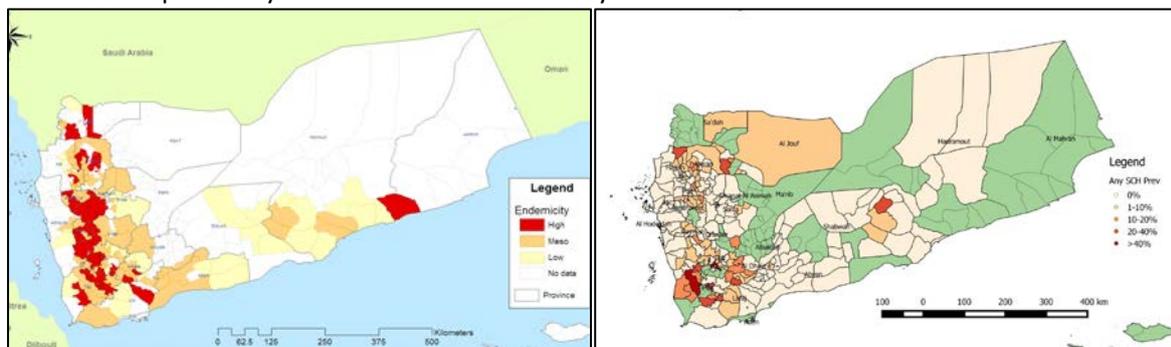


Figure 1. Prevalence map showing distribution of infection in A) 2010 at Baseline, and B) 2014, following three years of implementation. The darker red the higher the risk/burden of infection

4.2. Prevalence Re-Mapping

Following three years of implementation, a national re-mapping campaign was conducted in order to understand the change in infection distribution and to set the treatment approach for the remaining period of the programme. This was implemented in the first quarter of 2014 and collected information on the distribution of schistosomiasis (both intestinal and urogenital), STHs, and anaemia.

A statistically-derived sample size was calculated to ensure the results were accurate estimations of the district level. In each district, 35 school-aged children (evenly split between males and females)

were sampled from 8 schools. Twenty five teams (each of five people) from the Universities of Sana'a and Aden were recruited and trained on the concepts and technical approaches. In total, over **80,000 children**, aged between 10-14 years were surveyed from approximately **2,600 schools in 332 districts** across the country (one district was too insecure to undertake field activities with its infection level categorised according to the level of the districts surrounding it and its level at baseline).

The results from this remapping survey show a significant reduction in the number of districts harbouring any infection and, importantly, those that have high and meso infection. The map of infection is shrinking substantially (Figure 1B), with much of the east of the country effectively schistosomiasis-free, and much lighter infection in many other places. Table 1 below compares the classification of districts in 2010 and 2014. The number of districts evaluated to be highly infected has fallen from 51 in 2010 to just 3 in 2014 (even when the definition of high infection has changed from over 40% in 2010 to over 30% in 2014). The number of districts evaluated to have meso-infection (defined as 10-40% prevalence at baseline, 10-30% at 2014) has reduced from 183 to 24. Correspondingly, the number of districts evaluated to have low infection (<10% prevalence) has increased from 41 to 189, reflecting the reduced level of infections nationwide. The proportion of infected districts that are low has risen from 14.9% in 2010 to 87.1% in 2014 indicating that the large majority of the county is now classified as low infection.

District Classification	2010	2014
High*	51	3
Meso	183	25
Low	41	189
All Infection	275	217
Uninfected	58	116
Total	333	333

Table 1. Classification of Yemen's 333 districts by infection category in 2010 and 2014*High endemicity classified as over 40% prevalence of schistosomiasis in 2010, and over 30% in 2014

5. Impact Evaluation

Alongside the mass drug administration campaigns themselves, an impact evaluation component has been implemented in order to be able to measure the changes in infection and health markers resulting from treatment.

As part of this, a cohort of 8,000 individuals (6,500 school-aged children and 1,500 adults) from 36 representative districts across the country were sampled for demographic and parasitological markers at baseline prior to intervention and following treatment.

An initial analysis of approximately 2,000 individuals in selected sentinel sites has demonstrated an over 50% reduction in infection markers (both prevalence and intensity) following two rounds of treatment. Infection with either species of schistosomiasis has fallen from **19.8%** at baseline to **8.3%**, following two rounds of treatment, with less than **4%** now harbouring heavy infections (and who are those most likely to develop severe morbidity)(Table 2).

Governorate	<i>S. haematobium</i>		<i>S. mansoni</i>		Either Schistosomiasis	
	Baseline	Follow-Up	Baseline	Follow-Up	Baseline	Follow-Up
Ibb	2.4%	0%	4.3%	3.6%	6.6%	3.6%
Sana'a	8.6%	4.4%	16.6%	13.6%	22.6%	17.1%
Dhamar	0.5%	0%	5.7%	10.3%	6.1%	10.3%
Rimah	0.5%	0%	4.5%	1.8%	5.0%	1.8%
Amran	30.8%	6.3%	21.3%	0%	44.9%	6.3%
Hajjah	20.4%	2.9%	5.5%	2.0%	24.3%	4.6%
TOTAL	12.1%	2.6%	10.9%	6.0%	19.8%	8.3%

Table 2. Reduction in prevalence of infection of both *S. haematobium* and *S. mansoni* in those areas that have been followed-up.

These results are further broken down to show the change in infection at each of the sentinel sites that have been followed up, for both *S. haematobium* and *S. mansoni*. These are shown below in Tables 3 and 4 respectively. It can be seen that the prevalence of heavy infection (and the prevalence of heavy and medium infection) has fallen in the large majority of the sites surveyed. This is important as individuals with heavy or medium infection are those most likely to develop schistosomiasis-related morbidity.

To confirm these results, and to determine whether they are reflected elsewhere, a full round of impact evaluation in all 36 districts will be implemented in September 2014 prior to the next treatment campaign. In addition, a further impact evaluation will be implemented in the first quarter of 2016 in order to estimate the overall health impact of the entire programme.

Gov	Ozlah	District	School	Baseline			Follow-Up		
				Prev.	Intensity	Prev. of heavy	Prev.	Intensity	Prev. of heavy
Ibb	Jabal Omaika	Hobaish	Al-shaheed Al-Zubiri	4.46%	1.51	0.89%	0%	0	0%
Ibb	Jabal Omaika	Hobaish	Marid Al-thawra	6.35%	1.35	0.79%	0%	0	0%
Sana'a	Al- aros	Bany matar	Al-abbas	0%	0	0%	5.00%	0.27	0%
Sana'a	Mekhlaf Aiash	Bany matar	Al-wahdah	0%	0	0%	0%	0	0%
Sana'a	Al-Hadab	Al-Haima Al -dakelia	Al-Faoze	10.00%	7.47	3.33%	6.42%	3.61	3.64%
Sana'a	Al-Hadab	Al-Haima Al -dakelia	Al-Husain bin Ali	20.93%	32.38	11.63%	5.35%	15.83	4.42%
Dammar	Alsalfе	Otoma	Al-Nahda	0%	0	0%	0%	0	0%
Dammar	Taheejer	Otoma	Al-Nasser	0%	0	0%	0%	0	0%
Ryma	Algarsab	Kosma	Abdallah Bn Al-Zubeer	0.75%	0.03	0%	0%	0	0%
Ryma	Alqarsin	Kosma	Al-Wafa	0%	0	0%	0%	0	0%
Amran	Bani Awoof	Al-Madan	Azouberi	12.39%	1.07	0%	0.90%	0.25	0%
Amran	Bani Owf	Al-Madan	7 - jul .	50%	63.14	24.10%	11.70%	5.32	2.70%
Hajjah	Janeb Al- Yemen	Alshahel	Bani jiesh	14.80%	3.85	5.90%	1.90%	2.73	0.96%
Hajjah	Janeb Al- Yemen	Alshahel	Alasara	0.84%	0.08	0%	3.20%	1.2	0.80%
Hajjah	Aljaber	Mabyn	Alkadaf	12.96%	7.31	2.78%	0.90%	0.04	0%
Hajjah	Aljaber	Mabyn	Shama	50.90%	37.51	16.40%	5.35%	5.82	0.89%

Table 3. *S. haematobium*: Change in infection prevalence and in prevalence of heavy infection at sentinel sites followed up. Colour key: Green – Reduction in infection markers. Red: Change in infection not as pronounced as hoped.

Gov	Ozlah	District	School	Baseline			Follow-Up		
				Prev.	Intensity	Prev. of heavy/med	Prev.	Intensity	Prev. of heavy/med
Ibb	Jabal Omaika	Hobaish	Al-shaheed Al-Zubiri	0%	0	0%	3.45%	3.1	0.86%
Ibb	Jabal Omaika	Hobaish	Marid Al-thawra	0.79%	1.81	0.79%	3.70%	4.11	2.78%
Sana'a	Al- aros	Bany matar	Al-abbas	23.10%	20.21	7.69%	34.17%	50.4	10.83%
Sana'a	Mekhlaf Aiash	Bany matar	Al-wahdah	0%	0	0%	1.68%	0.91	0%
Sana'a	Al-Hadab	Al-Haima Al -dakelia	Al-Faoze	23.33%	16	3.33%	13.64%	31.85	10.00%
Sana'a	Al-Hadab	Al-Haima Al -dakelia	Al-Husain bin Ali	27.91%	46.23	14.73%	4.42%	5.95	2.65%
Dammar	Alsalfé	Otoma	Al-Nahda	10.00%	14	8.40%	16.70%	38.2	2.78%
Dammar	Taheejer	Otoma	Al-Nasser	12.90%	14.86	6.40%	4.80%	4.99	0.00%
Ryma	Algarsab	Kosma	Abdallah Bn Al-Zubeer	1.46%	2.28	1.46%	1.47%	0.71	0.00%
Ryma	Alqarsin	Kosma	Al-Wafa	9.41%	5.08	0%	2.38%	7.71	1.18%
Amran	Bani Awoof	Al-Madan	Azouberi	15.90%	9.34	0.90%	0%	0	0%
Amran	Bani Owf	Al-Madan	7 - jul .	43.75%	51.55	18.75%	0%	0	0%
Hajjah	Janeb Al- Yemen	Alshahel	Bani jiesh	0%	0	0%	0%	0	0%
Hajjah	Janeb Al- Yemen	Alshahel	Alasara	0.84%	0.91	0%	0%	0	0%
Hajjah	Aljaber	Mabyn	Alkadaf	0.93%	1.11	0%	0.90%	0.42	0%
Hajjah	Aljaber	Mabyn	Shama	3.60%	5.45	0%	7.10%	4.07	0.89%

Table 4. *S. mansoni*: Change in infection prevalence and in prevalence of heavy infection at sentinel sites followed up.

6. Capacity Development Activities

All of these activities do not operate in a vacuum. They are based on the expertise and motivation of the staff that run the programme, at the NSCP and their partners at the governorate and district levels. In addition to the main control activities, it is recognised that increasing the in-country capacity of staff at the NSCP is crucial in order to ensure a continued successful and sustainable programme.

To this end, the programme has provided support in order to strengthen the planning, implementation, and evaluation of the control programme. This has included the implementation of strengthened information management systems, using expertise from the EMRO regional WHO office in Cairo. It has also involved the training of NSCP staff and parasitologists from the Universities of Sana'a and Aden in the technical approaches required for the mapping of disease and infection, and the impact evaluation of the programme.

In addition, the NSCP staff have undertaken training in approaches to implement snail control. This included a field trip to Zanzibar to shadow colleagues from the Zanzibari Ministry of Health who are undertaking a trial of the impact of snail control as a means to achieving elimination of infection. The implementation of complementary control activities such as snail control will be powerful tools if the Yemen programme expands to aim for elimination as a public health problem, and eventually even elimination of transmission.

Planned capacity development activities for the next 12 months include training for the NSCP in WHO's NTD Monitoring and Evaluation Database, as well as in the WHO's Data Quality Assurance Tool. In addition, the SCI are planning to offer a capacity development workshop in data cleaning, data analysis, and the use of geographical information systems software to present spatial mapping results.

7. Transitioning to 'Elimination as a Public Health Problem'

The successful implementation of three years of the control programme, especially within the context of a very challenging operational environment, demonstrates the ability of the NSCP team to implement large-scale control activities in the country.

The results from the Prevalence Re-mapping surveys and the Impact Evaluation surveys clearly show the impact that the control programme is having in terms of reducing the distribution of infection across the country, and of reducing the intensity of infection where it still exists. 87.1% of districts with endemic schistosomiasis infection are now classified as 'Low endemic' (up from 14.9% at baseline). Infection levels in districts followed-up have more than halved from 19.8% to 8.3%, and the proportion of heavy or heavy/medium infections has also fallen substantially.

These results help to signal that the programme has been successful in achieving its primary aims of the control of schistosomiasis-related morbidity well before its expected completion in 2016. It is therefore recommended that the programme now transition to a more ambitious target of elimination of schistosomiasis as a public health problem. This aim is in line with the recommendations of the World Health Assembly Resolution 65.21 ("Elimination of schistosomiasis")¹, with the global elimination goals set in the WHO NTD Roadmap for 2020 and

2025², and with the WHO's Schistosomiasis Progress Report 2001-2011 and Strategic Plan 2012-2020³.

According to WHO, schistosomiasis can be considered as eliminated as a public health problem when prevalence of heavy-intensity infection is <1% in all sentinel sites. Heavy-intensity infections are defined as ≥ 400 eggs per gram of faeces for *Schistosoma mansoni*, and ≥ 50 eggs/10ml of urine for *S. haematobium*.

Recently collected data show that elimination as a public health problem has in fact already been achieved in many geographical areas in Yemen as of 2014. It seems reasonable to anticipate that by 2016, such goals can be consolidated where already met, and achieved in all other areas of the country. This can be facilitated by intensifying preventive chemotherapy in line with WHO recommendations on elimination of schistosomiasis, and therefore by expanding target groups and increasing frequency of treatment, especially in those areas where transmission of schistosomiasis has been shown to persist in spite of the efforts implemented.

It is also appropriate to consider extending the Yemen Schistosomiasis Project beyond 2016 with the aim of achieving elimination of schistosomiasis (interruption of transmission) in the country. At least 5 years of intensified preventive chemotherapy (targeting the entire resident population at 6-monthly or 4-monthly intervals), complemented by other public health interventions in residual areas of transmission, including snail control, provision of safe water and improved sanitation, would be necessary to achieve the said goal.

In conclusion, the goals of achieving elimination of schistosomiasis as a public health problem from Yemen by 2016, and interrupting its transmission by 2021-2025, appear feasible, considering the magnitude of the activities implemented and the promising results shown up to date. High-level political commitment and financial resources will be key factors in making it possible.

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