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Mapping, monitoring, and surveillance of neglected tropical diseases: towards a policy framework

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As national programmes respond to the new opportunities presented for scaling up preventive chemotherapy programmes for the coadministration of drugs to target lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminthiasis, and trachoma, possible synergies between existing disease-specific policies and protocols need to be examined. In this report we compare present policies for mapping, monitoring, and surveillance for these diseases, drawing attention to both the challenges and opportunities for integration. Although full integration of all elements of mapping, monitoring, and surveillance strategies might not be feasible for the diseases targeted through the preventive chemotherapy approach, there are opportunities for integration, and we present examples of integrated strategies. Finally, if advantage is to be taken of scaled up interventions to address neglected tropical diseases, efforts to develop rapid, inexpensive, and easy-to-use methods, whether disease-specific or integrated, should be increased. We present a framework for development of an integrated monitoring and evaluation system that combines both integrated and disease-specific strategies.

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Introduction

Recent policy papers have emphasised the rationale for linking control programmes for lymphatic filariasis, onchocerciasis, schistosomiasis, trachoma, and soil-transmitted helminthiasis, in co-implemented packages that have rapid effect.[1–3] These diseases affect the poorest communities that are supported by the weakest health infrastructures. In 2006, WHO published a strategy for preventive chemotherapy in human helminthiasis[2] to guide countries in the implementation of this integrated approach to control neglected tropical diseases. This preventive chemotherapy strategy needs the wide-scale delivery of drugs, either alone or as a package, at regular intervals. Since 2007, the US Government, the UK Government, and the Bill & Melinda Gates Foundation have pledged new funding to lend support to the implementation of preventive chemotherapy programmes, and the pharmaceutical companies Merck, GlaxoSmithKline, Pfizer, Johnson & Johnson, and MedPharm have also committed to continued large donations of drugs.[4] As national programmes respond to these opportunities and to the challenges posed by co-implementation of preventive chemotherapy control strategies, many tactical issues arise that need to be addressed.[5] These issues include identification of the most cost-effective ways to rapidly map areas at high risk of neglected tropical diseases, establishment of the most appropriate monitoring systems, and development of postintervention surveillance strategies as the programmes for lymphatic filariasis, onchocerciasis, and trachoma reach the elimination phase. This report compares the present disease-specific protocols for mapping, monitoring, and surveillance for the diseases targeted by the preventive chemotherapy approach. It draws attention to the challenges and opportunities of integration, outlines innovative solutions being proposed to meet these challenges, and offers a conceptual framework to address these issues.

Successes, challenges, and opportunities posed by integration

The neglected diseases being targeted with large-scale preventive chemotherapy are caused by diverse infective agents (helminthic parasites and bacteria) with very different epidemiological characteristics. Although the aim of programmes for soil-transmitted helminthiasis and schistosomiasis is disease control, lymphatic filariasis, onchocerciasis, and trachoma are being targeted for elimination. Additionally, interventions to eliminate trachoma involve more than preventive chemotherapy. Programmes targeting these infections have up until now usually worked separately, and therefore have evolved their specific methods and instruments to achieve their goals.

As new financing opportunities allow disease-control programmes to scale up rapidly, a review of the methods and instruments available for mapping, monitoring, and surveillance is needed, together with a discussion about if, how, and when these methods can be integrated to achieve increased cost-effectiveness. The table provides an overview of the mapping, monitoring, and surveillance methods developed for each disease-control programme, and we will outline the opportunities and challenges posed by integration and possible solutions.

Mapping

Mapping of disease prevalence and distributions is crucial for any control efforts. Although the geographic distribution of the targeted neglected diseases is widely known,[34–38] detailed mapping information is needed to allow planning for implementation.

	Mapping	Monitoring	Postintervention surveillance
Lymphatic filariasis	Survey in children older than 15 years and adults with antigen detection card test to establish whether implementation unit is greater than 1% infection prevalence.[6–10] Administrative unit varies, but usually done within districts[10]	Reported coverage.[10] Validate reported coverage with household surveys.[10] Sentinel and spot-check sites (night bleeds and clinical examinations) every 2 years.[10] LQAS cluster ICT survey in schoolchildren after five to six rounds of MDA.[10] Entomological studies[11]	China and Korea instituted surveillance to confirm elimination. Surveillance in Suriname, Costa Rica, Trinidad and Tobago, and Solomon Islands to confirm transmission has ceased.[12,13] Post-MDA and postelimination surveillance being developed in countries completing five to seven rounds of MDA[12,13]
Onchocerciasis	For APOC in 19 African countries, mapped at village level by REMO[14–16] then REA[17] to establish onchocercal nodule prevalence. APOC projects undertake CDTI in hyperendemic or mesoendemic communities defined by nodule prevalence >20% (hypoendemic areas not treated).[15] In the Americas, OEPA identifies endemic foci in all endemic countries by parasitological studies—all endemic foci treated[18]	Reported coverage.[19] Various methods for measuring coverage through household visits.[20,21] Sentinel sites every 4–5 years (effect on transmission [skin snips], effect on eye and skin lesions, clinical examinations, entomological studies at MDSC).[22,23] Sustainability of drug delivery after withdrawal of APOC funding[24]	Surveillance in OCP areas to assess recrudescence-DNA testing of parous flies.[25] In Americas (OEPA), 3 years after intervention surveillance before certification of elimination and the continued surveillance[26]
Schistosomiasis	Mapped within villages and communities by school-based cluster or prevalence survey.[27,28] Stool and urine samples or questionnaire on blood in urine.[28] Communities classified as high, medium, or low prevalence to establish frequency of treatment and age groups to be targeted[29]	Reported coverage in schoolchildren.[28,30] Prevalence and intensity surveys of egg counts in urine and stool samples; prevalence of blood in urine.[29,30] Ultrasound to measure pathological changes in bladder and liver[31]	..
Soil-transmitted helminthiasis	Mapped within villages and communities by school-based prevalence survey.[28] Stool samples.[28] Communities classified by prevalence and intensity of infection to establish frequency of treatment and age groups to be targeted[29]	Treatment coverage in schools.[28,30] Prevalence and intensity surveys of egg counts in stools; morbidity (severe anaemia, stunted growth, school attendance)[29,30]	..
Trachoma	A cluster-sample household survey determines whether the prevalence of TF is high enough for the entire district population to be treated. If prevalence is somewhat lower, each community is assessed separately.[32] Determine intervention strategy (SAFE) on the basis of prevalence of disease based on clinical examination: TF in children and TT in adults[32]	Reported antibiotic coverage; progress towards ultimate intervention goals; reported number of TT cases receiving surgery; number of communities receiving health promotion and proportion of households with sanitation.[32] Reassess prevalence of clinical signs after at least 3 years of SAFE interventions[32]	Periodic surveys to establish whether prevalence remains below target threshold.[32,33] Postelimination surveillance guidelines being developed

LQAS=lot quality assurance sampling. ICT=immunochromatographic card test. MDA=mass drug administration. APOC=African Programme for Onchocerciasis Control. REMO=rapid epidemiological mapping of onchocerciasis. REA=rapid epidemiological assessment. CDTI=community-directed treatment with ivermectin. OEPA=Onchocerciasis Elimination Programme for the Americas. MDSC=multidisease surveillance centre. OCP=Onchocerciasis Control Programme. TF=trachomatous inflammation follicular. SAFE=surgery, antibiotics, facial hygiene promotion, and environmental improvements. TT=trachomatous trichiasis.

Table: **Summary of mapping, monitoring, impact assessment, and surveillance methods developed, by disease**

The creation of easy-to-use methods for the lymphatic filariasis and onchocerciasis elimination programmes has enabled their rapid expansion.[39] To identify priority areas for mass distribution of ivermectin, the African Programme for Onchocerciasis Control[40] developed the rapid epidemiological mapping of onchocerciasis (REMO) risk assessment instrument, on the basis of the proximity of probable *Simulium* breeding sites.[14–16] A subsample of communities in areas identified as high risk by REMO are subsequently screened with the rapid epidemiological assessment (REA) method[17] to estimate onchocercal nodule prevalence—a surrogate for the more invasive skin-snip methods. Mapping of loaisis, caused by the filarial parasite *Loa loa*, became increasingly important with the discovery that serious adverse events can develop in heavily infected individuals after treatment with ivermectin (Mectizan; Merck, Whitehouse Station, NJ, USA) for onchocerciasis.[41] To identify areas at high risk of loaiasis, approaches were developed on the basis of remote sensing images to define high-risk areas,[42] and a non-invasive method, rapid assessment procedures for loaisis (RAPLOA), was implemented that uses a survey questionnaire asking for the patient's history of eye worm.[43] The lymphatic filariasis programme has used immunochromatographic card tests[44] to replace the need for microscopy of night-time blood specimens to detect infection. These test cards, which can be used at any time of the day, together with the development of standardised cost-effective sampling strategies (with lot quality assurance sampling and spatial sampling grids) have enabled the rapid mapping of lymphatic filariasis.[6–10]

The table summarises guidelines for mapping schistosomiasis and soil-transmitted helminthiasis. Whereas the simple questionnaire designed to ask schoolchildren about the presence of blood in urine has been proposed as a quick, inexpensive, and reliable method for identification of schools at high risk for *Schistosoma haematobium* infection,[45–47] the logistics needed in getting a stool sample from children when using the Kato-Katz technique for the diagnosis of *Schistosoma mansoni* and soil-transmitted helminthiasis makes this method less rapid. Brooker and colleagues[48] have proposed alternative methods for schistosomiasis mapping. Although these alternatives need validation, they could well prove to be valuable to assist the planning of mass distributions of praziquantel. The first uses the lot quality assurance sampling technique, which reduces the number of stool samples needed to identify the prevalence of *S mansoni* infection in a school and is thus a cheap and quick approach.[48,49] The second method is for the rapid diagnosis of *S mansoni* through the detection of circulating cathodic antigens (CCA) in the urine with a CCA-based dipstick that is both highly

sensitive and specific but costly in identification of at-risk communities in high-transmission settings.[50,51]

The simplified trachoma-grading system that is used to identify clinical signs of trachoma and is recommended for mapping and monitoring has inherent, although acceptable, disadvantages related to the reliability of the examiners' findings.[32,52,53] Additionally, clinical indicators of trachoma do not always correlate well with the presence of ocular chlamydia.[53,54] So far, no additional guidelines have been published for the programmatic use of various laboratory assays to verify clinical findings, and further assessment is needed to review the usefulness and role of a rapid point-of-care assay to detect *Chlamydia trachomatis* during surveillance activities.[55]

The existing disease-specific mapping protocols (table) are all designed to acquire essential information needed for programme implementation—ie, the mapping protocols are designed to produce so-called actionable maps that can identify populations that should be targeted for intervention. These protocols, however, vary in terms of the sampling strategy used, the amount of classification needed, the implementation unit, and the diagnostic methods used. For example, mapping protocols for lymphatic filariasis and trachoma are designed to initially identify districts in which the whole population is treated.[10,32] Once a district is above the specified prevalence threshold, then all people in the district are defined as being at risk of infection and are targeted for intervention. However, these two programmes differ since WHO guidelines for trachoma control recommend further assessment of communities within districts that are initially identified as being at low risk.[32] Additionally, trachoma indicators are based on two age groups: children aged 1–9 years, and children older than 14 years and adults. The mapping methods for onchocerciasis, schistosomiasis, and soil-transmitted helminthiasis are more detailed than are those for lymphatic filariasis and trachoma, since treatment decisions are made separately for each village or community, and further stratification of communities by prevalence is needed to identify what age groups should be targeted for treatment and the frequency of treatment.

In addition to these alternatives, rapid-mapping procedures, with remote sensing, geo-statistics, and climate-based risk models have been developed that might be useful to guide control efforts nationally by excluding areas in which little or no transmission occurs.[56] So far, remote sensing has been effectively used to identify areas at risk of serious adverse events from loasis where onchocerciasis programmes are being implemented, and in development of risk maps for schistosomiasis endemicity. The potential for increased use of geographical information systems and remote-sensing techniques in mapping the distribution of neglected tropical diseases remains to be fully exploited. Integrated approaches, particularly those linking knowledge of co-endemicity to allow more effective and efficient programme planning and integration, will be crucial. Ideally this information should be accessible to all via an internet-based portal, incorporating not only data for prevalence but also progress in control activities.

Although opportunities for integrated mapping are limited by the geographical overlap of the infections and by the maturity of the disease-control programmes, innovative approaches to integrated mapping have been undertaken in several countries. In Cameroon, rapid assessment procedures for loaisis and rapid epidemiological assessment surveys for onchocerciasis were co-implemented.[57] The investigators noted that this approach was helped by the fact that the two surveys have many similarities in their methodological approaches (they target the same population, and sample sizes are not conflicting). They showed that one examiner could execute both the interview for rapid assessment procedures for loaisis and nodule palpation for rapid epidemiological assessment with great efficiency, and reported both cost and time savings. Similar efficiencies are reported from integrated surveys of neglected tropical diseases undertaken in Togo, Equitorial Guinea, and southern Sudan (unpublished data). In Nigeria, addition of trachoma mapping to school surveys for schistosomiasis had the important advantage, compared with the usual district-wide cluster sample survey, of identifying villages needing intervention in districts in which prevalence of trachomatous inflammation follicular was less than 10% in children.[58] In Ethiopia, combined malaria and trachoma surveys[59] have shown that prevalence estimates, indicators, and risk factors for both diseases could be obtained for the cost of undertaking one disease survey. However, the investigators noted that the integrated survey needed much more planning and coordination than did only one disease survey. Conversely, Richards and colleagues[60] reported that combined mapping for schistosomiasis and lymphatic filariasis in Nigeria was difficult, resulting in fewer states being mapped and subsequently treated for schistosomiasis.

We conclude that if advantage is to be taken of opportunities to treat these neglected tropical diseases, efforts to develop rapid, inexpensive, and easy-to-use mapping methods should be stepped up, and the feasibility of integrated mapping should be assessed for different scenarios.

Monitoring

Once target populations have been identified through mapping, intervention programmes should be implemented. Monitoring should then aim to assess programme progress. For this report we have used the term monitoring to encompass both routine monitoring of indicators and periodic or one-time evaluations.

Treatment coverage has been used as a key indicator across disease-control programmes (table) to monitor programme results. However, the information sources for denominators (programme registers or census bureau

***Panel:* Summary of different stakeholder requirements for information**

- Policy makers, both within endemic countries and internationally, need information for setting priorities. They need to assess the burden of disease and the cost-effectiveness of interventions for neglected tropical diseases compared with other health programmes to allocate scarce resources and advocate for additional funding. They should also be able to position control programmes for these diseases in the context of the country's health system and to monitor progress in developing national plans and establishing budget lines.
- National programme managers need information for programme planning to enable them to make informed decisions about use of resources. Thus they need knowledge of the geographical distribution of the diseases to plan drug distribution; assessment of drug coverage; identification of areas needing strengthened social mobilisation and strategies for information, education, and communication; and in some cases the identification of areas requiring focal retreatment or enhanced operations for mass drug administration. Furthermore, the programmes have to work within the defined goals of WHO disease-control and elimination policy and in accordance with the relevant World Health Assembly resolutions. The challenge, therefore, is to establish information and reporting systems responsive enough to serve both national and global requirements now and for future implementation of postintervention surveillance.
- Donor community need information that will show achievements and lend support to advocacy for continued funding. Information will relate to audits and accountability to ensure value for money and leveraging of additional resources with a view to sustainability. For drug donors in particular, detailed information is needed for forecasting drug needs (and production) to scale up programmes, to report to regulatory authorities,[41,67,75,76] and to monitor for changes in drug effectiveness.[68,77,78]

data) and definitions of denominators (including eligible population, target population, total population, and ultimate treatment goal) are not uniform. Such challenges to integration are compounded by different donor requirements, disease programme reporting forms, and reporting channels. Progress towards integration, therefore, must lie in standardisation of definitions of coverage and creation of agreed common reporting forms that will enable comparability of data across countries and diseases. Thus, WHO has developed a useful online interactive databank providing results for lymphatic filariasis, schistosomiasis, and soil-transmitted helminthiasis, along with endemic country profiles.

For more about the **WHO preventive chemotherapy databank** see http://www.who.int/neglected_diseases/preventive_chemotherapy/databank/en/index.html

Since donors also need to report the overall progress of integrated programmes for neglected tropical diseases, new indicators need to be created and defined that will sum numbers across the disease programmes—eg, the total number of treatments delivered through the preventive chemotherapy approach and the percentage of people at risk of these diseases reached would be useful for advocacy purposes. Programme managers would also benefit from a range of resources that enable them to monitor programme inputs and processes.

In addition to routine measurement of treatment coverage based on data contained in drug distributor registers, a survey done after mass drug distribution can be used to validate reported coverage rates.[10,61] Such survey approaches can be used to track sex inequities, access of school-aged children to treatment, effectiveness of social mobilisation, drug distributor adherence to guidelines, and co-implemented drug-delivery logistics. A cluster survey designed to validate reported coverage rate for the four drugs (ivermectin, albendazole, praziquantel, and azithromycin) distributed by preventive chemotherapy programmes has been created and implemented in several countries.[62] Challenges in development of affordable integrated survey instruments include establishment of a sampling framework which recognises that the diseases do not overlap completely within countries or even districts, and balancing the need for a sample size large enough to give the required precision against having a cheap and easy-to-use instrument. Furthermore, because people are asked to differentiate between different treatments that they received, the issue of recall after the intervention should be addressed.

Infection, morbidity, and nutritional indicators have been used by individual disease-control programmes to show the impact that programmes are achieving.[63–66] These indicators also draw attention to areas in which treatment strategies need to be modified. Challenges to integration of the monitoring of programme impact are similar to those encountered with mapping—eg, in having indicators that are often measured in different populations (communities *vs* schools), in use of different sampling strategies, and with little overlap in the diagnostic methods or procedures used (table).

In addressing these challenges, one strategy is to focus on potential cross-cutting indicators such as anaemia, disability, and blindness, although none of these indicators is associated with all diseases targeted with a preventive chemotherapy approach. An alternative approach is to draw on the existing disease-specific indicators of impact to develop a small set of indicators—selected for their acceptability, ease of collection, and cost—which could be used in different combinations depending on the overlapping disease endemicity. With this approach, the logistics of data collection can be integrated; one technical team (either a group representing the different disciplines or a specially trained multiskilled staff) gathers data from surveys in schools or communities, or both, sampling the same individuals for several diseases when appropriate. Sites are then followed up at defined time intervals dependent on the indicator requirements of the

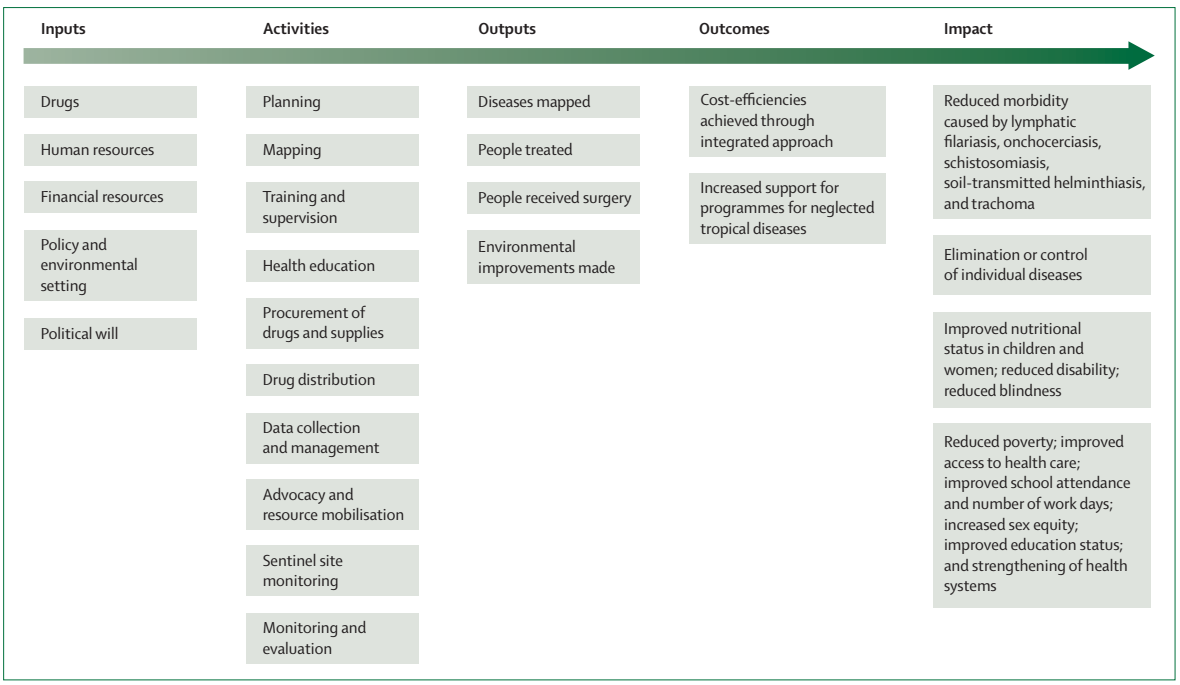

Figure: **Logic framework for programmes for control of neglected tropical diseases targeted with preventive chemotherapy**

disease-specific programmes that were integrated. This approach to measure the effect of co-implemented programmes has been used in Uganda, Burkina Faso, and Niger, and the results will be important for shaping policy development.

In programmes that are treating populations at scale with donated products, pharmacovigilance from the community distributors to the formal health system is needed to ensure that the statutary reporting by manufacturers to regulatory authorities can be instigated in the event of serious adverse events. The reporting of such events has been tested in areas of central Africa, where loasis and onchocerciasis are co-endemic and serious adverse events have occurred.[41] Additionally, since cost savings in drug distribution are attempted through co-administration of the combination of praziquantel, albendazole, and ivermectin, or in trachoma-endemic areas co-endemic for helminth diseases amenable to control through the preventive chemotherapy approach, combination of azithromycin with anthelminthic drugs will need to be assessed, as was done in Zanzibar.[67] Drug effectiveness throughout preventive chemotherapy programmes will also need to be assessed as part of routine monitoring, in view of reports of reduced efficacy and possible resistance.[68] Research into the necessary instruments is a priority, and the need to precisely define drug effectiveness and drug resistance is paramount.

Surveillance

Surveillance is defined as surveillance after intervention activities end and is therefore a key component of the elimination programmes for lymphatic filariasis, onchocerciasis, and trachoma. For lymphatic filariasis programmes, the immunochromatographic card test is the recommended instrument for assessment of progress towards elimination endpoints, especially when used to assess cohorts of children born since the intervention began.[10] This approach has been used in Egypt,[69] and will be widely implemented as other countries seek to stop their mass drug administration and move towards surveillance. Alternative approaches to endpoint assessment and surveillance that are being studied include exposure antibodies in children[70] and PCR methods for xeno-monitoring filarial parasites in mosquitoes.[12,63]

In countries included in the Onchocerciasis Control Programme in west Africa, a surveillance system has been established in onchocerciasis-freed areas on the basis of the molecular detection of *Onchocerca volvulus* infection in blackflies with PCR technology.[65] The Onchocerciasis Elimination Programme for the Americas, which has the objective of regional elimination of onchocerciasis, has reported interruption of transmission in four foci in three countries (Guatemala,[26] Mexico,[71] and Colombia[71]) with criteria established by WHO.[71] Treatment with ivermectin has been stopped in these foci, and they have entered a 3-year post-treatment surveillance phase to monitor for transmission recrudescence. If no evidence is available after 3 years of continued transmission, a certificate of elimination can be issued; however, long-term surveillance should continue. The need for suitably sensitive, specific, rapid, and easy-to-use diagnostic methods to detect recrudescence remains urgent.[25] Instruments now being explored to replace skin snips and simulium dissection

are the Ov16 antibody test[72] (in either a point-of-care test format or a laboratory-based ELISA) and the diethylcarbamazine patch test[73] (based on diethylcarbamazine in Nivea cream that would detect skin microfilariae within 24 h of application). In countries included in the African Programme for Onchocerciasis Control, a high amount of control through sustainable community-directed treatment with ivermectin, rather than elimination, is the target; therefore these countries are unlikely to need post-implementation surveillance instruments.[18] However, in Mali and Senegal (countries previously part of the Onchocerciasis Control Programme) where ivermectin has been used for 15–18 years twice yearly, Diawara and colleagues[74] have reported the complete cessation of transmission. This result has provoked a reassessment of the possibility of elimination of onchocerciasis, and thus future approaches to monitoring and surveillance might change further.

Endpoints for elimination of blinding trachoma are based on maintaining a rate of clinical disease at lower than target thresholds for at least 3 years after interventions have ended.[33] Surveillance guidelines are being developed to ensure the sustainability of elimination of chronic, blinding trachoma.

The need for a monitoring and assessment system and framework

Substantial progress has been made in development of monitoring and assessment systems for the individual disease-control programmes. Although full integration of all elements of mapping, monitoring, and surveillance strategies for the diseases targeted through the preventive chemotherapy approach is not feasible, there could be many opportunities for integrated strategies when integration is the best option. As momentum for programmes for neglected tropical diseases increases, the number of national and international stakeholders expands, and efforts have to be made to reduce duplication and streamline information needs of the wide range of stakeholders that often have different, yet overlapping, monitoring and evaluation requirements (panel).

The development of an integrated strategy for monitoring and evaluation would define priorities and include an agreed set of indicators (integrated and disease-specific) that will enable programme managers to gather a standard set of data that will allow comparison of information across time, geographical regions, and diseases.

The figure presents a basic framework that can be used by policy makers to develop a strategy for monitoring and evaluation for programmes for neglected tropical diseases that are based on preventive chemotherapy. It conceptualises the sequence of essential programme elements—from inputs, to activities, outputs, outcomes, and impacts. Many inputs, including financial and human resources, are needed to implement a range of activities. The intended output of these activities is to identify areas for treatment and to obtain high treatment coverage. Ultimately the goal is to achieve programme impact—ie, reduction and elimination of infection and morbidity, improvement of the health of the population, improvement of health systems, and having a positive effect on the broader development challenges embodied in the Millennium Development Goals. With reference to such a framework, specific programme indicators can be created—eg, input indicators measuring the number of drugs and human resources used; process indicators used to count activities such as the number of districts mapped by disease, the number of people trained, and the number and quality of health education activities implemented; output indicators such as treatment coverage; outcome indicators that measure cost-effectiveness and the increased priority and profile of neglected tropical diseases; and impact indicators measuring both the direct effect of the programme on infection and disease and indirect contributions of the programme towards achieving the Millennium Development Goals.

The development of a monitoring and assessment strategy for neglected tropical diseases should embrace existing disease-specific methods and indicators, and develop new approaches. Additionally, although the national health information systems within which control programmes for such diseases function are often weak, opportunities might exist for mutually beneficial linkages.[79,80] For example, intervention coverage questions and impact assessments could be linked to large scale, externally funded surveys with high visibility, such as the Demographic and Health Survey[81] and the Multiple-Indicator Cluster Survey.[82] Results from monitoring and assessment are not only important in establishing, determining, and modifying strategies and reporting public health successes, but are also key for the advocacy for continued support both nationally and internationally.

Contributors

MCB took the lead role in writing the report and coordinating input from co-authors. DHM, EM, FMF, MD, and JDK participated in developing the concepts, writing, and editing the report, and undertook research into the data and references. AG and JBK reviewed the report and participated in providing information about the way national neglected tropical disease control programmes have used mapping, monitoring, and surveillance as a management instrument for decision making. MB participated in developing the concepts, provided references, and reviewed the report. AK and DPS participated in the review of the report and provided input and comments on various drafts.

Conflicts of interest

MCB is employed by the NTD Control Program, which is funded by USAID. AG has received research funding in 2006 from the European Union for project Contrast. DHM is the Executive Secretary of the Global Alliance to Eliminate Filariasis. Since 2000, he has received research grants from the UK Department for International Development, which includes a 25% contribution from GlaxoSmithKline to the Liverpool School of Tropical Medicine. He attends meetings of the Mectizan Donation Program and is supported by GlaxoSmithKline and Merck to provide independent scientific advice to programmes. EM, FM, MD, JDK, AG, JBK, MB, AK, and DPS declare that they have no conflicts of interest.

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