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CURRENT WHO PROTOCOLS FOR MASS DRUG ADMINISTRATION IN HELMINTH CONTROL

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Current WHO protocols for mass drug administration in helminth control

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Soil transmitted helminths (STH), comprising *Ascaris, Trichuris, Strongyloides* and the hookworms remain a significant cause of morbidity amongst people in many parts of the world, including Australia. Other important helminth infections include lymphatic filariasis (LF), schistosomiasis and onchocerciasis. Preventive chemotherapy (mass drug administration [MDA]) campaigns are frequently conducted for these helminth infections in endemic areas, but the target population groups, duration of campaigns, cointerventions (e.g. vector control) criteria for inclusion, drugs used and doses of drugs differ.

The benefits of deworming individuals, especially children, who are infected with soil-transmitted helminths and schistosomiasis, include reduction in anaemia and improved growth. Rarer, but more severe presentations, such as intestinal obstruction with *A. lumbricoides* and rectal prolapse due to *T. trichiura* infection, will also be reduced[1]. Treatment for filariasis and onchcocerciasis in childhood will prevent the development of later severe consequences of these diseases including lymphoedema, hydrocoele, elephantiasis and blindness.

In situations of moderate to high endemicity, it has been considered more efficient and cost-effective to treat the entire eligible population in particular age groups or communities for these diseases, rather than first testing individuals to determine who is infected. The goals of such MDA are morbidity control in some cases and interruption of transmission through vectors in others. For these reasons, MDA for STH is usually undertaken for school age children, while for schistosomiasis, MDA is performed either in children or in eligible people of all ages, depending on the endemicity level.

For the insect borne helminths, onchocerciasis and LF, the goal is transmission interruption and the entire community is eligible for MDA.

The frequency of MDA for STH in school-age children is dependent on the prevalence of infections in a given population (Table 1). Current WHO protocols for STH control recommend MDA with a single oral dose of albendazole (400 mg), mebendazole (500 mg) or levamisole (80 mg)[1]. Mebendazole is more effective than albendazole for *T. trichiura*, whilst albendazole is slightly more effective against hookworm than mebendazole. The two drugs have equally

Table 1. Current recommended regularity of mass drug administration (MDA) for helminth (STH) infections in school-age[A] children (adapted from WHO 2011)[1].

Prevalence[B]	Regularity of MDA
For control of soil-transmitted helminth (STH) infections	
≥50%	Twice per year, or every 4 months if at the high end of prevalence
≥20 and <50%	Once yearly
<20%	Treat on case-by-case basis
For control of schistosomiasis	
≥50%	Once per year, or every 4 months if at the high end of prevalence
≥10 and <50%[B]	Once every 2 years
<10%	Treat on case-by-case basis

[A]Usually defined as children between 5 and 14 years of age.
[B]As determined by parasitological methods; cut-off is ≥30% if based only on questionnaires for visible haematuria.

Figure 1. A Solomon Islander researcher undertaking a community wide STH prevalence survey as part of an integrated STH control program (photograph by Richard Bradbury).

high efficacy when used against *Ascaris lumbricoides*[1]. Despite these differences, in practice when administered biennially over a number of years, either drug used on its own is effective for overall STH control[1].

Onchocerciasis control and/or elimination requires annual or biannual treatment with ivermectin for many years (up to 20 in some cases), while lymphatic filariasis uses annual administration with albendazole and either ivermectin or diethylcarbamazine (DEC) with at least 65% population coverage for at least five years. Thus ivermectin and/or albendazole administration may occur in some communities annually or biannually as part of onchocerciasis or LF elimination programs. Where this occurs, STH control programs should be harmonised to ensure that there is a 6 month delay between albendazole administrations[1]. In communities with endemic schistosomiasis, the addition of praziquantel (40 mg/kg) is recommended (Table 1). Reductions in the frequency of MDA may be considered after 5–6 years of consistent >75% population coverage, after testing of the residual prevalence of helminths in that population. Such a decision is based on several factors, specific details of which may be found in the World Health Organization guide for managers of control programmes[1].

Reliance on albendazole and mebendazole in WHO recommendations for MDA will result in a lower impact on the clearance of *Strongyloides stercoralis*, for which ivermectin and thiabendazole are more effective drugs[2]. Thiabendazole was discontinued in Australia in 2003 and due to the lower rate of side effects, ivermectin has been recommended by some as the treatment of choice[2]. Due to the auto-infective cycle of this helminth, some authors have recommended re-treatment at one and two months to ensure elimination[3]. Only one randomised trial has been performed thus far, in which treatment twice at 2 weeks apart was found to have no

greater benefit than a single dose[4]. Both the authors of this paper and others[2] recommend further studies into the optimal dose schedules for ivermectin in the control of Strongyloidiasis within a larger cohort of participants.

Recently, there has been discussion about the outcomes and optimal age range for MDA programs to control STH and more evidence on the impacts is required[5–7]; this controversy is outside the scope of this review. A novel concept of elimination of STH by MDA 'one village at a time' rather than by wide-scale MDA has been proposed for remote areas with low populations, such as many remote Australian Aboriginal communities. This approach is currently being trialled in a remote area of the Solomon Islands[8]. It advocates allowing individual communities to act as autonomous units and to employ control options specifically tailored to the geographic, cultural, economic, aetiological and environmental factors influencing STH transmission in their own community[8] (Figure 1).

Deworming of school-age children has been a mainstay of helminth control for many years. Discussion continues on the optimal method of MDA for this purpose. In some cases, such as where high rates of strongyloidiasis or onchocerciasis are present, the addition of other drugs may be warranted. Further consideration of new therapies, combination therapies, the reconsideration of use of the use of 'old' anti-helminthic therapies have all been postulated as mechanisms by which to improve absolute cure rates in MDA programs and to reduce the possible development of antihelminthic resistance[9]. Ways to improve MDA participation, as well as paediatric formulations of praziquantel for schistosomiasis prevention in pre-school children may also be added to this list. The current WHO protocols for MDA provide an important baseline guide to those undertaking MDA for helminth control in endemic areas.

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Biographies

Dr Richard Bradbury is an Australian Parasitologist with an interest in all fields of parasitology. He was recently appointed as the Team Lead in the Parasite Diagnostics and Biology Laboratory of the Centers for Disease Control and Prevention in Atlanta, USA. He is writing this work in both his personal capacity and in his capacity as an adjunct academic at Central Queensland University.

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Zoonotic tissue parasites of Australian wildlife

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Increasing use of bushlands for recreational, commercial and scientific activities fosters movement across the urban-bushland interface. This may facilitate the transmission of parasitic diseases from wildlife to humans (zoonoses). The fashionable trend to consumption of game meats such as feral pig and crocodile, and raw fish such as sushi, sashimi and pickled herring has exacerbated the zoonotic potential of parasites of wildlife.

Transmission from wildlife to humans

Angiostrongyliasis

Angiostrongylus cantonensis is a nematode parasite of the pulmonary arteries and right ventricle of *Rattus rattus* and *R. norvegicus* in Australia[1]. It is the causative agent of eosinophilic meningoencephalitis, a zoonotic infection of humans. The life cycle includes an obligatory period of larval development in terrestrial or aquatic snails and slugs, and also may involve a range of paratenic or transport hosts (freshwater prawns, land crabs, planarians, frogs, lizards), which feed on gastropods. Rats become infected by ingesting intermediate or paratenic hosts. In the rat, the nematode undergoes an obligatory migration through the spinal column and brain en route to the final site in the pulmonary arteries of the lungs. Humans become infected by accidentally or deliberately eating infected gastropods or paratenic hosts, or unwashed salad greens containing these. The parasite has been reported from domestic and zoo animals, mammalian and avian wildlife and humans in Brisbane and Sydney[2–4]. The clinical signs of headache, vomiting, paralysis and sometimes death are induced as a consequence of the obligatory period of development of the parasite in the central nervous system. This occurs in young children who deliberately or accidentally ingest snails or slugs containing infective larvae[5–7], or foolish young adults who do so for a bet[8,9].

Muspiceoidosis

Haycocknema perplexum is a minute muspiceoid nematode living as adults inside individual skeletal muscle cells of humans in Australia[10]. Eight cases have been documented, 4 in Tasmania and 4 in north Queensland[11–13] Gasser (*personal communication*). Eight to twelve eggs hatch inside the uterus of the female, develop to third-stage infective larvae and burst from the head region killing the adult, an efficient mechanism for auto-re-infection. Escaped larvae invade uninfected muscle cells. The occurrence of *H. perplexum* in intramyofibres results in eosinophilic polymyositis but no reaction within the invaded cell itself[11]. Progressive myopathy occurs and infection becomes life threatening. Early human diagnosis by muscle biopsy is imperative in cases of progressive myopathy associated with blood eosinophilia and elevated creatine kinase levels. Steroid