GUIDELINES FOR IMMIGRANT HEALTH

Appendix 8: Intestinal parasites – *Strongyloides* and *Schistosoma*: evidence review for newly arriving immigrants and refugees

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ABSTRACT

Background: An estimated one third of the world's population harbours intestinal parasites. Most of these infections can only be sustained through repeated infectious exposures, however strongyloidiasis and schistosomiasis are two parasitic infections that can persist for years to decades after a single exposure. These infections can persist sub-clinically, evade detection if insensitive diagnostic tests are used, and if left untreated, lead to life threatening complications. Consequently, these infections have considerable public health relevance to populations emigrating from developing areas of the world – where these parasites are prevalent – to industrialized areas of the world where they are non-endemic.

Methods: We conducted an evidence review to estimate the burden of strongyloidiasis and schistosomiasis in populations emigrating from developing areas of the world. We then systematically assessed evidence on the diagnosis and treatment of these two intestinal parasitic infections including: benefits and harms, applicability, clinical considerations and implementation issues. Quality of the evidence was assessed using the GRADE approach.

Results: Evidence for an increased burden of parasitic infection is greatest in refugee populations originating from Southeast Asia and Africa (i.e. strongyloidiasis), and Africa (i.e. schistosomiasis). Serologic testing is the most sensitive modality currently available to detect either parasite. Short courses of ivermectin and praziquantel are well tolerated and highly effective in treating strongyloidiasis and schistosomiasis respectively.

Interpretation: Strongyloidiasis and schistosomiasis are sufficiently prevalent to warrant targeted screening of newly arriving (i.e. within five years), high-risk refugee populations. Early detection and treatment of infected individuals can avert future morbidity and death.

Competing interests: None declared.

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The cases

Charles is a 32 year old engineer from Liberia who is in the process of immigrating to Canada as a refugee, and plans to resettle in Toronto. He discusses living in a refugee camp in nearby Ghana for several years during the civil war in Liberia.

Su Lin is a 15 year old refugee from Myanmar who is landing in Canada with her family and is planning to attend school in Saskatoon. She states she is healthy.

How would you approach these patients?

Introduction

Approximately one third of the world's population is infected with intestinal parasites,[1] most of which are sustained through cycles of repeated exposure from the environment. When populations emigrate from parts of the world where intestinal parasites are endemic and resettle in countries where they do not exist, most infections will clear without treatment within a few years of immigrating. Two intestinal parasitic infections – strongyloidiasis and schistosomiasis – are notable exceptions in that they can persist for decades as sub-clinical infections or as low-grade disease with non-specific clinical manifestations. In the presence of immunosuppression, strongyloidiasis can rapidly evolve into life-threatening disseminated disease (i.e. hyperinfection), while schistosomiasis can result in serious complications causing future morbidity and death. We conducted an evidence review to guide primary care practitioners in the early detection and treatment of strongyloidiasis and schistosomiasis for newly arriving refugees. Recommendations for screening and treating these parasites are found in Box 1.

Methods

We used the 14-step methods approach developed by the Canadian Collaboration for Immigrant and Refugee Health. We constructed a clinician summary table to highlight the population of interest, epidemiology, clinical considerations and potential key clinical actions (Appendix 3). We then constructed a logic model (see Figure 1: Logic Model) to define the clinical preventive action, outcomes, and key questions.

Search strategy for systematic reviews, guidelines and population-specific literature

Together with an information specialist, we developed a search strategy to identify systematic reviews, guidelines,

Box 1: Recommendations on screening for strongyloidiasis and schistosomiasis from the Canadian Collaboration for Immigrant and Refugee Health

Strongyloidiasis

Screen refugees newly arriving from low-income countries in Southeast Asia and Africa with serology for strongyloidiasis and treat if positive with ivermectin (first line) or albendazole (if contraindications to ivermectin).

Basis of recommendation

- **Balance of benefits and harms:** Strongyloidiasis is estimated to affect 100 million people worldwide. Among immigrant populations, refugees from Southeast Asia and Africa appear to have the highest risk of infection. Sub-clinical infections or low-grade disease can persist for decades after immigration and in the presence of immunosuppression may transform into life-threatening disseminated disease. Serology is the most sensitive diagnostic modality currently available. Treatment with ivermectin is of short duration, is highly effective, (NNT 2, CI ~1 to 3) and has a favourable side effect profile.
- **Quality of evidence:** Moderate
- **Values and preferences:** The committee attributed more value to the availability of a highly sensitive and specific serologic test and effective treatment options to prevent potentially life-threatening disseminated disease than to the potential limitations of serology in distinguishing current from remote infection in high-risk newly arriving refugees.

Schistosomiasis:

Screen refugees newly arriving from Africa with serology for schistosomiasis and treat if positive with praziquantel.

Basis of recommendation

- **Balance of benefits and harms:** Schistosomiasis is estimated to affect 200 million people worldwide, of whom approximately 85% live in Africa. Among immigrant populations, refugees from Africa have the highest risk of infection. Sub-clinical infections or low-grade disease can persist for decades after immigration and may cause future morbidity or death. Serology is the most sensitive diagnostic modality currently available. Treatment with praziquantel is of short duration, is highly effective, (NNT 4, CI ~1 to 124) and has a favourable side effect profile.
- **Quality of evidence:** Moderate
- **Values and preferences:** The committee attributed more value to the availability of a highly sensitive and specific serologic test and effective treatment to prevent future morbidity or death than to the limitations of serology in distinguishing current from remote infection in high-risk newly arriving refugees.

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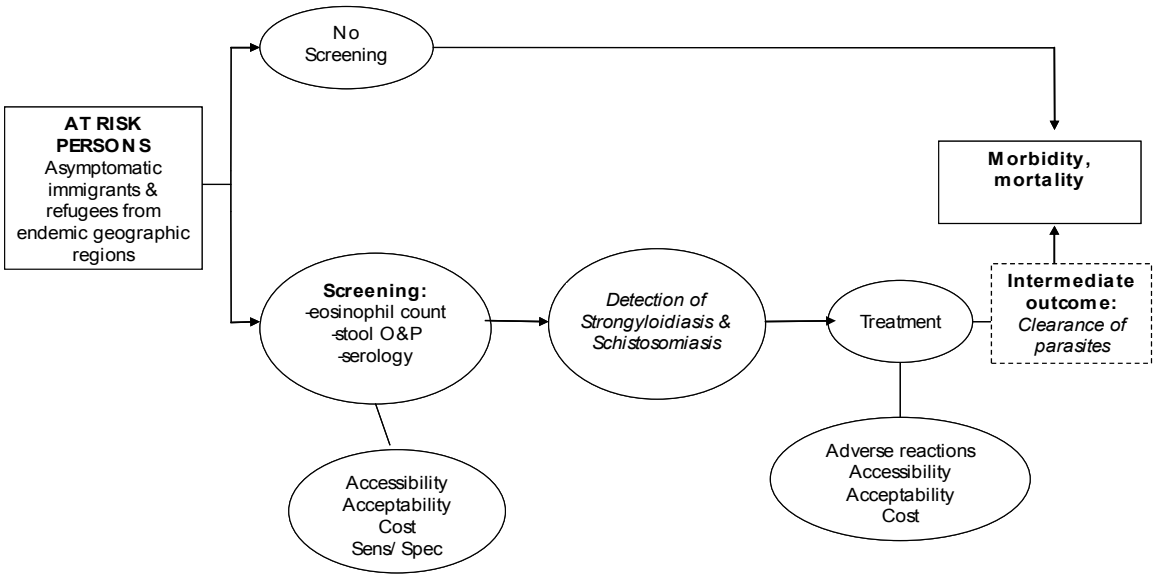
Figure 1: Logic model



peer reviewed and non-peer reviewed medical literature in order to evaluate evidence regarding:

a) *Diagnostic methods to detect strongyloidiasis and schistosomiasis in immigrant and refugee populations*

b) *Treatment for strongyloidiasis and schistosomiasis and its effect on long-term morbidity and mortality*

In addition to a systematic search on diagnostic methods and treatment, our team performed a non-systematic, but rigorous search on the burden and epidemiology of strongyloidiasis and schistosomiasis in populations around the world. The following electronic databases were searched: MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, Cochrane CRCT, Cochrane DSR, ACP Journal Club, Cochrane MR, DARE, HTA, NHSEE (date ranges: January 1,1988- January 1, 2010 (screening); January 1, 1980-January 1,2010 (treatment)). In addition, the following databases and resources were hand searched for screening guidelines (using a combination of key words including schistosomiasis, strongyloidiasis, *Schistosoma*, *Strongyloides*, screen, immigrant, refugee, asylee, depending on the database): TRIPdatabase (Turning Research Into Practice), Canadian Task Force on Preventive Health Care, U.S. Preventive Services Task Force, National Guidelines Clearinghouse, NICE Clinical Guidelines, Canadian Agency for Drugs and Technologies in Health, National Library of Guidelines Specialist Library (UK), Canadian Medical Association Infobase, WHO Health Evidence Network, CDC. The findings were independently assessed for inclusion by two team members, first by title and then by abstract content, based on eligibility criteria determined *a priori*. Manuscripts that were deemed relevant based on abstract content were then retrieved and reviewed by multiple team members.

Selection Criteria

Diagnostic Studies

a) Reports on at least strongyloidiasis or *intestinal* schistosomiasis
b) Population comprised of immigrants, refugees or asylum seekers
c) Setting(s) where strongyloidiasis and schistosomiasis are non-endemic
d) Evaluates sensitivity, specificity, or predictive value of eosinophil counts, stool examinations for ova and parasites, and/or serology
e) Sample size of at least 100 *individuals*
f) Date range: 1988-2009

Treatment Studies

a) Investigates effect of treatment with albendazole or ivermectin for strongyloidiasis and praziquantel for *intestinal* schistosomiasis
b) Evaluates outcomes on morbidity or mortality at least 12 months after treatment
c) Sample size of at least 100 *individuals*
d) Date range: 1980-2009

Note: These searches were not limited to systematic reviews, guidelines, or meta-analyses.

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Justification of selection criteria

In our literature review of diagnostic modalities, we included only those studies involving immigrant or refugee populations resettling in countries where strongyloidiasis and schistosomiasis are non-endemic. We did this because i) a greater intensity of parasitic infection among individuals living in endemic countries could influence the sensitivity of diagnostic tests, ii) the experience of persons performing diagnostic tests such as stool microscopy may be greater in parasite endemic countries, and iii) the cycle of reinfection in endemic countries could complicate interpretation of the value of diagnostic tests.

In our review of treatment modalities, we included studies conducted in both parasite endemic and non-endemic countries. Studies in endemic countries were considered because a demonstration of treatment effectiveness in such settings implies that treatment in non-endemic settings should be at least comparable, and potentially more effective (i.e. since the cycle of reinfection in non-endemic countries would be interrupted). We focused on studies that had at least one year of follow up post-treatment in order to fully evaluate the longer-term effects of treatment on morbidity or mortality. For both our diagnostic and treatment reviews, we restricted our searches to include studies with at least 100 *individuals* (i.e. not 100 specimens) in order to draw robust conclusions.

Synthesis of evidence and values

We synthesized the evidence from systematic reviews, guidelines and treatment studies using GRADE summary of findings tables, which assesses both the relative and absolute effects of interventions. We also appraised the quality of evidence for each outcome using the GRADE quality assessment tool, which assesses study limitations, directness, precision, consistency, and publication bias across all studies (Box 2). In the review of clinical considerations we report on implementation issues. Finally, we identify leading gaps in the research evidence base.

Results

Our search strategy for a systematic review of the literature yielded 5039 articles, while an additional 150 articles were identified through an open-ended search process. The titles of all 5189 articles were reviewed, from which 445 abstracts were evaluated for their potential relevance to this review. 437 abstracts were subsequently eliminated because they did not fulfil our search strategy's inclusion criteria (Appendix 1). Of the remaining 8 manuscripts, 5 pertained to the diagnosis of strongyloidiasis[2-5] or schistosomiasis[6], while the remaining 3 pertained to their treatment.[7-9] Although our search did not identify any systematic reviews on the diagnosis of either parasite or the treatment of strongyloidiasis, we found a systematic review pertaining to the treatment of schistosomiasis.[8] Furthermore, we found two major health guidelines pertaining to the evaluation and management of parasitic infections in newly arriving refugees.[10,11]

What is the burden of strongyloidiasis and schistosomiasis among immigrant populations?

Quantifying the parasitic burden of infection is challenging since existing studies do not involve systematic or random testing of immigrant populations. Most estimates of burden were derived from small observational studies and primarily included refugees from selected countries. Furthermore, a significant number of these studies utilized stool microscopy – a diagnostic test known to have limited sensitivity in the detection of either parasite.

In the case of strongyloidiasis, existing data are primarily derived from refugee populations originating from Southeast Asia and Africa (Appendix 2). Studies using stool microscopy have reported prevalences of infection between 0.8% and 4.3%,[12-17] with the highest burden identified in refugees from Southeast Asia.[12,18] Studies using serologic enzyme immunoassays have reported significantly higher prevalences of infection between 9% and 77%,[19-26] with the highest burden identified in refugees from Southeast Asia[27-29] and Africa.[30-32]

Approximately 85% of the global burden of schistosomiasis is believed to exist in Africa.[33] Studies using stool microscopy to detect schistosomiasis in African refugee populations have reported prevalences from 0.4% to 7%.[34-37] In contrast, studies using serologic enzyme immunoassays have reported significantly higher prevalences[38-46] ranging from 2.2% in East African pediatric populations[47] to 64% and 73% in Sudanese and Somali refugees respectively.[48,49]

Does screening for strongyloidiasis or schistosomiasis decrease morbidity?

The scope and analytic horizon of existing studies prevents establishment of a direct link between screening for strongyloidiasis or schistosomiasis and an improvement in health outcomes. The association can be made indirectly however, since highly sensitive and specific diagnostic tests are currently available to detect

each parasite and effective treatment is known to mitigate the risk of future morbidity or death.

Screening

Stool microscopy for ova and parasites is the only definitive way to confirm the presence of intestinal infection with either parasite, however this diagnostic modality has suboptimal sensitivity. Although overall sensitivity can be improved by increasing the number of stool specimens examined, the costs associated with this approach can be substantial and patients are frequently reluctant to provide healthcare providers with multiple specimens. While the sensitivity of a single stool examination to detect *Strongyloides* is estimated at just 30%, it increases to over 90% when seven specimens are examined.[50]

By contrast, serologic testing is the most sensitive diagnostic modality to detect strongyloidiasis and schistosomiasis, making them ideal screening tools. Although these tests can produce false positive results due to cross-reactions with other helminth parasites, they do have a high degree of specificity. Serological testing for schistosoma is limited in that it cannot discriminate between species typically causing intestinal disease (e.g. *S. mansoni, S. japonicum*) and *S. hematobium*, which causes disease of the bladder and urinary system. While a positive serologic test can indicate infection with *S. hematobium*, confirmation requires urine examination for ova and parasites. The National Reference Centre for Parasitology in Montreal – which performs serologic tests for both parasites in Canada – estimates that their enzyme immunoassays have a sensitivity and specificity of 100% and 88% (*Strongyloides stercoralis*) and 96% and 82% (*Schistosoma mansoni*). While several studies have reported *Strongyloides* antibody levels declining post-treatment[51-55] – suggesting that serologic positivity is indicative of current infection – this has not been a universal finding.[56] By contrast, *Schistosoma* antibody levels do not appear to decline post-treatment.[57] Nonetheless, given the potential for these infections to persist for decades and cause potentially life-threatening disease, it is generally presumed that a positive serologic

Table 1 Ivermectin compared to pyrvinium pamoate for strongyloidiasis

Patient or Population: Patients with strongyloidiasis
Settings: Okinawa, Japan
Intervention: Ivermectin
Comparison: Pyrvinium pamoate

Outcomes	Absolute Effect		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk of treatment with pyrvinium pamoate	Difference with treatment with ivermectin (95% CI)				
Cure rate	**233 per 1000**	**969 per 1000** (610 to 1000)	**RR 4.16** (2.62 to 6.59)	127 (1 study)	**moderate**[1]	(NNT 2, CI ~1 to 3)
Common adverse effects with treatment **(pruritis, fever, lymph node tenderness)**						Pre-treatment assessment for *Loa loa* infection is recommended in any patient emigrating from endemic areas (West and Central Africa); serious and/or fatal encephalopathy has been reported (rarely) during treatment in patients with loiasis.

CI: Confidence interval; **RR:** Risk ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1] Not randomized, no blinding

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test for either parasite in high-risk newly arriving (i.e. within five years) refugee populations – without a history of recent effective treatment – represents current infection.

Role of eosinophilia in detection of intestinal helminths

In some instances the diagnosis of strongyloidiasis and schistosomiasis (i.e. and other helminth infections) may be implied by the presence of peripheral blood eosinophilia. Although eosinophilia can result from a number of different etiologies, in immigrants and refugees newly arriving from areas of the world where intestinal parasites are prevalent, it is frequently a sign of a helminth infection. Given that eosinophilia typically occurs in response to tissue invasion by a parasite, it occurs intermittently and may be missed if a single complete blood count (CBC) is examined. Since CBCs are frequently performed, the sensitivity of eosinophilia as an indirect marker of helminth infection can be increased by examining a patient's white blood cell count differentials over time.

Relative benefits and harms of treatment

The detection and subsequent treatment of strongyloidiasis and schistosomiasis can prevent future morbidity and potentially life-threatening complications. A two-day course of ivermectin (200 μg/kg orally once daily) is the preferred treatment strategy for strongyloidiasis, however among refugees from *Loa loa* endemic areas of the world, a seven-day course of albendazole (400 mg orally twice daily) should be used. This is because cases of encephalopathy have been reported with ivermectin use during large-scale treatment campaigns in parts of West and Central Africa, where *Loa loa* is endemic (see Table of *Loa loa* endemic countries in the following reference).[10,58] This rare but potentially serious event may occur in persons who have a high load of *Loa loa* microfilaria, which are rapidly killed with ivermectin. Alternatively, since ivermectin is the most effective treatment option available for strongyloidiasis, healthcare providers may screen refugees at risk for *Loa loa* infection with day microfilaria blood levels and treat with ivermectin if high-level microfilaremia is not identified. For schistosomiasis species found in Africa (i.e. *S. mansoni, S. intercalatum* and *S. hematobium*), a one-day course of praziquantel (40 mg/kg divided in two doses) is the preferred treatment strategy. Treatment with ivermectin or praziquantel in patients with underlying neurocysticercosis can lead to an acute inflammatory reaction and precipitate seizure activity. Thus, these drugs should not be used in persons with known neurocysticercosis or an unexplained seizure disorder. Otherwise, ivermectin, albendazole and praziquantel each have a generally favourable side effect profile.[59]

Clinical considerations

This review proposes that refugees emigrating from areas of the world known to be endemic for strongyloidiasis and schistosomiasis, be screened for these parasites within five years of their arrival into Canada. With limited data on the burden of these two parasites in non-refugee immigrant populations, there is currently insufficient evidence to justify universal screening of non-refugee populations even though some high-risk groups may be missed.[60] However, clinicians should consider testing foreign-born persons for strongyloidiasis and/or schistosomiasis if they have lived in areas of the world where these parasites are endemic and (i) have compatible signs and/or symptoms of infection (independent of the time elapsed since their arrival into Canada) and/or (ii) have evidence of peripheral blood eosinophilia.[71] While this review focuses on refugees arriving from regions of the world where there is strong evidence of an elevated burden of infection, further research is needed to better identify the specific geographic origins of populations at greatest risk. Clinicians should also be aware that persons infected with the retrovirus HTLV-1 have a modified immune response that complicates the treatment of *Strongyloides*. Since some areas of the world are endemic for both *Strongyloides* and HTLV-1, clinicians should consider screening persons for HTLV-1 if they (i) test positive for *Strongyloides* and originate from high prevalence areas for HTLV-1 (i.e. South America, the Caribbean Islands, Japan, and Africa) and/or (ii) have persistent *Strongyloides* infection that responds poorly to anti-parasitic treatment.

Finally, while studies in this review primarily involved adult refugees, children are well known to be at risk of infection with intestinal parasites. Consequently, screening newly arriving refugees of all ages from areas of the world endemic for strongyloidiasis and schistosomiasis is suggested. However, treatment with albendazole is not recommended in children under one year of age, ivermectin in children weighing less than 15kg or less than 90cm in length, and praziquantel in children under four years of age. Infected children in these circumstances should be referred to a practitioner experienced in the management of intestinal parasitic infections in pediatric populations.

Since serologic tests for strongyloidiasis and schistosomiasis are processed at the National Reference Laboratory for Parasitology in Montreal, practitioners

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Table 2: Praziquantel compared to placebo for schistosomiasis

Patient or population: Patients with schistosomiasis
Settings: Sudan, Zambia, Burundi, Democratic Republic of Congo, Kenya, Tanzania, Philippines, China, Republic of Congo and Niger
Intervention: Praziquantel
Comparison: Placebo

Outcomes	Absolute Effect		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Control group	Difference with treatment (95% CI)				
	Placebo	Praziquantel				
Parasitological cure			**RR 28.3** (1.8 to 441.6)	69 (1 study)	**moderate**[1]	(NNT 4, CI ~1 to 124)
Side effects (1%-10%) dizziness, headache, malaise, abdominal pain)	**Study population**		**RR 6.0** (2.9 to 12.5)	436 (1)		
	60 per 1000	**361 per 1000** (173 to 750)				
	Medium risk population					
	60 per 1000	**361 per 1000** (173 to 750)				

CI: Confidence interval; **RR:** Risk ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1] No details on randomization or blinding

may experience delays between the time of specimen collection and receipt of test results. If patients require treatment for strongyloidiasis with ivermectin or albendazole, these drugs must be obtained via Health Canada's Special Access Program. Instructions on how to obtain these medications can be found on Health Canada's website.[61] By contrast, praziquantel can be obtained locally via a physician prescription.

Serologic testing post-treatment for schistosomiasis is not recommended to evaluate treatment success, as these antibodies tend to persist over time. By comparison, several studies have reported declining *Strongyloides* antibody titres six to twelve months after successful treatment,[62-66] and hence have advocated the use of serology as a marker for clearance of this parasite. Although there is a body of evidence demonstrating this post-treatment effect,[67-71] this finding has not been universally observed.[72] While a practice of post-treatment serologic testing may be considered by practitioners, at a minimum all treated individuals should be followed prospectively for clinical signs and symptoms of persistent infection and to ensure that eosinophil counts remain within or return to normal limits within six-months of receiving effective treatment. If patients have persistent symptoms and/or eosinophilia after six months, further investigations – including the option of repeat *Strongyloides* serology – should be pursued.

Recommendations of other groups

Two sets of national guidelines offer recommendations on the diagnosis and management of intestinal parasites in refugee populations. The U.S. Centers for Disease Control and Prevention "*Guidelines for Evaluation of Refugees for Intestinal and Tissue-Invasive Parasitic Infections during Domestic Medical Examination*"[10] and The Australasian Society for Infectious Diseases "*Diagnosis, Management and Prevention of Infections in Recently Arrived Refugees*"[11] support the use of serology as part of the screening process for strongyloidiasis and schistosomiasis.

The cases revisited

Given his risk profile, Charles is screened for strongyloidiasis and schistosomiasis with serology and both tests come back positive. He is also noted to have an elevated eosinophil count. He remains free of gastrointestinal or other symptoms, but is interested in

treatment to prevent potential future morbidity. Since Liberia and Ghana – two countries where Charles has lived – are not endemic for *Loa loa*[58] he is prescribed ivermectin for the treatment of strongyloidiasis. He is also prescribed praziquantel for the treatment of schistosomiasis. Prospectively, Charles' eosinophil count is monitored and returns to normal levels over the next several months.

Su Lin is tested for strongyloidiasis and her serology comes back positive. Her eosinophil count is within normal limits. She is currently asymptomatic but does have a history of asthma, for which she uses puffers on an as needed basis. She has never been prescribed oral corticosteroids. You wonder if her history of asthma may in fact be a clinical manifestation of strongyloidiasis. After discussing the ability for *Strongyloides* to persist (i.e. through autoinfection) and the possibility of future disseminated disease (i.e. hyperinfection), Su Lin expresses interest in receiving treatment. You contact the Special Access Program at Health Canada to obtain ivermectin and prescribe this to her the following week.

Conclusion and research needs

Intestinal parasitic infections with the potential for long-term persistence such as strongyloidiasis and schistosomiasis are sufficiently prevalent in subgroups of newly arriving refugees to warrant post-arrival screening. Serologic testing is the most sensitive diagnostic modality currently available to detect each parasite. Early treatment of infected individuals can alter the natural history of infection and avert future morbidity or death. More research is needed to better define the burden of infection in immigrant and refugee populations originating from areas of the world where strongyloidiasis is known to exist.

Key points

- Strongyloidiasis and schistosomiasis are parasitic infections that can persist for years to decades and consequently can cause serious morbidity or death long after an immigrant resettles in a new country.
- The burden of strongyloidiasis appears greatest in refugee populations originating from Southeast Asia and Africa, while the burden of schistosomiasis is greatest in refugee populations from Africa.
- Consider testing foreign-born persons for strongyloidiasis and/or schistosomiasis if they have lived in areas of the world where these parasites are endemic and (i) have compatible signs and/or symptoms of infection and/or (ii) have evidence of peripheral blood eosinophilia.
- Detection of strongyloidiasis or schistosomiasis is limited by sub-clinical infection or low-grade disease and by suboptimal sensitivity of stool microscopy. Serologic testing however significantly enhances diagnostic sensitivity.

Box 2: Grading of Recommendations Assessment, Development and Evaluation Working Group grades of evidence (**www.gradeworkinggroup.org)**

High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and could change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

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Clinical preventive guidelines for newly arrived immigrants and refugees

This document provides the review details for the CMAJ CCIRH Intestinal Parasites paper. The series was developed by the Canadian Collaboration for Immigrant and Refugee Health and published at www.cmaj.ca.

Appendix 1: Figure 2

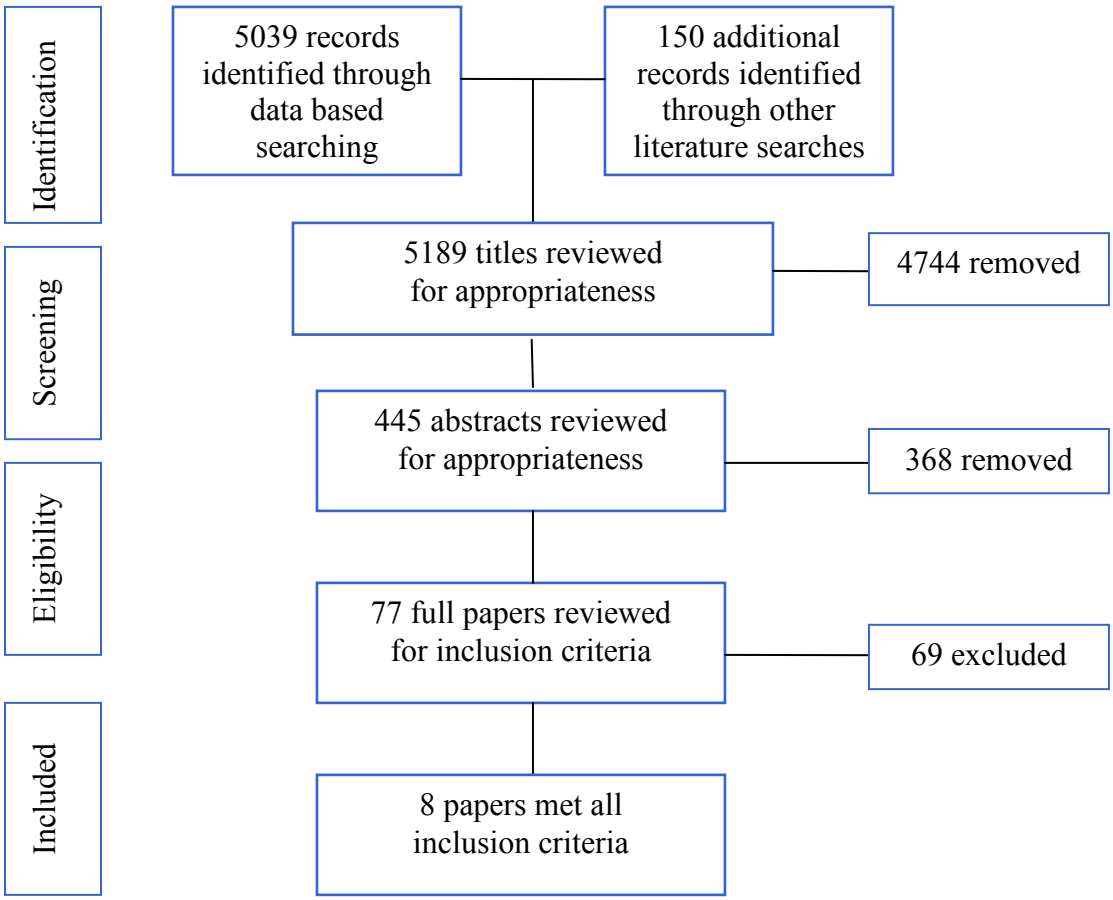

Figure 2: Search and selection flow sheet for screening and treatment articles.

Appendix 2: Figure 3

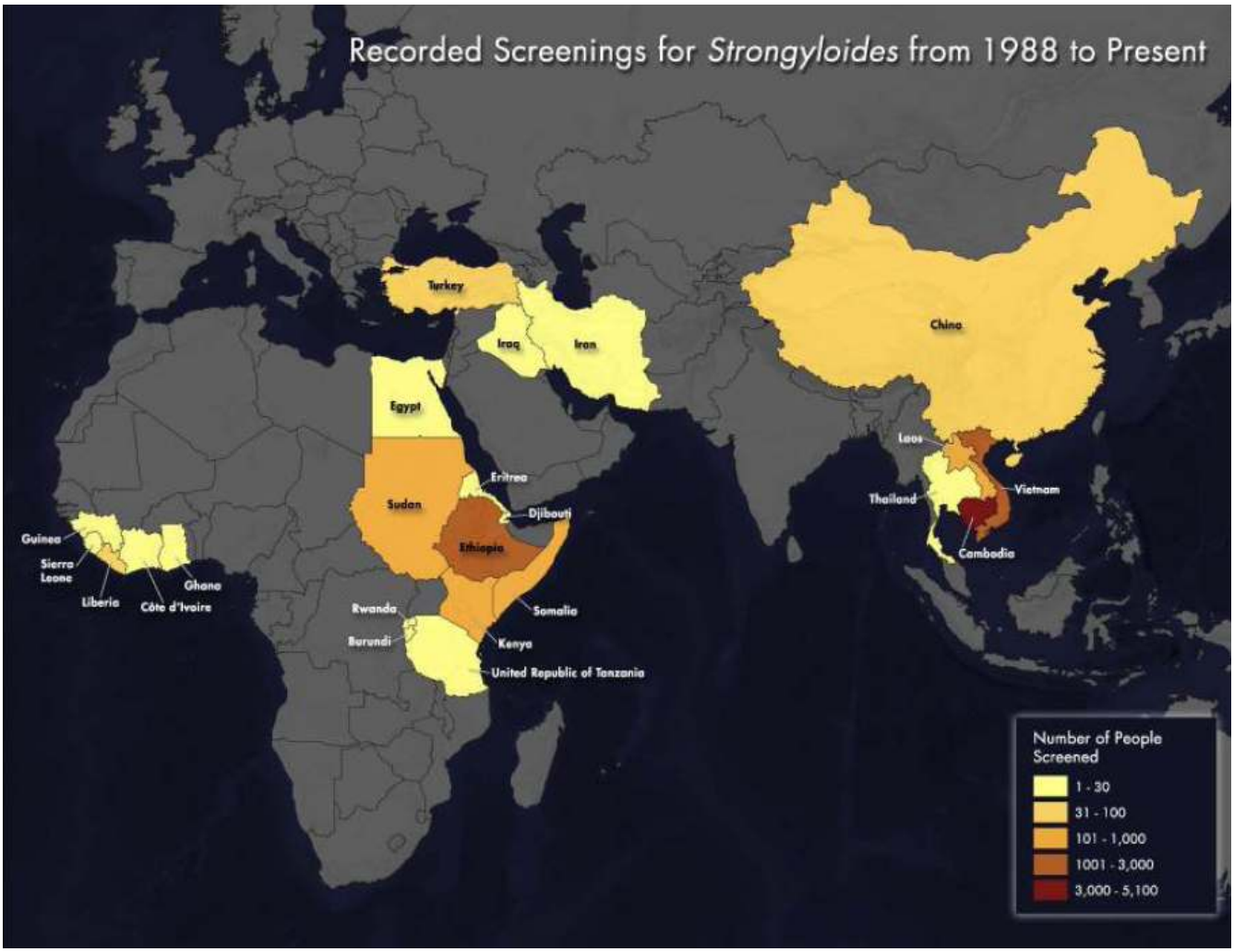

Figure 3: Number of immigrants or refugees screened for strongyloidiasis by birth country as identified in this review of the medical literature from 1988 and 2010.

Appendix 3: Intestinal Parasites Evidence Based Clinician Summary Table

Strongyloidiasis

Screen refugees newly arriving Southeast Asia and Africa with serology for strongyloidiasis and treat if positive with ivermectin (first line) or albendazole (if contraindications to ivermectin).

Schistosomiasis

Screen refugees newly arriving (i.e. within five years) from Africa with serology for schistosomiasis and treat if positive with praziquantel.

Global Burden: Strongyloidiasis is estimated to affect 100 million people worldwide. While the *Strongyloides* parasite can be found throughout the developing world and even in some industrialized countries such as the United States and Australia, its burden appears to be greatest in low-income countries in Southeast Asia and Africa. Schistosomiasis is estimated to affect 200 million people worldwide, of whom approximately 85% live in Africa.

Immigrant Burden: For strongyloidiasis, studies using stool microscopy have reported prevalences of infection between 0.8% and 4.3%, with the highest burden identified in refugees from Southeast Asia. Studies using serologic enzyme immunoassays to detect strongyloidiasis have reported significantly higher prevalences of infection between 9% and 77%, with the highest burden identified in refugees from Southeast Asia and Africa. For schistosomiasis, studies using stool microscopy in African refugee populations have reported prevalences between 0.4% and 7%, while studies using serologic enzyme immunoassays have reported prevalences ranging from 2.2% in East African pediatric populations to 64% and 73% in Sudanese and Somali refugees respectively.

Detection: Both strongyloidiasis and schistosomiasis can persist as sub-clinical infection or low-grade disease with non-specific clinical manifestations for years to decades. Healthcare providers should be particularly mindful of each parasite's clinical spectrum of disease in immigrant and refugee populations, independent of the time elapsed since immigration. Eosinophilia may offer indirect evidence of strongyloidiasis or schistosomiasis.

Diagnostics: Stool microscopy for ova and parasites is the only definitive way to confirm the presence of strongyloidiasis or intestinal schistosomiasis, however this diagnostic modality has suboptimal sensitivity. By contrast, serologic testing is the most sensitive diagnostic modality to detect each parasite. The National Reference Centre for Parasitology – which performs serologic tests for both parasites in Canada – estimates that their enzyme immunoassays have a sensitivity and specificity of 100% and 88% (*Strongyloides stercoralis*) and 96% and 82% (*Schistosoma mansoni*).

Treatment: Treatment for each parasite is of short duration, is highly effective, and is generally well tolerated. Ivermectin is the preferred treatment for strongyloidiasis, while praziquantel should be used to treat schistosomiasis. Ivermectin can be obtained through Health Canada's Special Access Program.

Special Considerations: Individuals with strongyloidiasis who are emigrating from *Loa loa* endemic areas of the world should either (i) be tested for microfilaremia prior to treatment with ivermectin or (ii) be treated with albendazole. Providers may consider post-treatment serologic testing for strongyloidiasis to assess the effectiveness of treatment.

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