



Strongyloidiasis: Challenges in a developed country and a One Health approach for control

**Strongyloides
Australia**

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BACKGROUND

- Strongyloidiasis is a chronic, potentially fatal, parasitic disease caused by *Strongyloides stercoralis* (Fig. 1)
- Due to autoinfection (Fig. 2) it can cause a life-long infection
- Globally, an estimated 614 million people are infected¹
- Strongyloidiasis is endemic in many rural and remote First Nations/Indigenous Australian communities, with prevalence of up to 60% in some geographical areas (Fig. 3)
- There are no public health strategies to eliminate strongyloidiasis in Australia⁹
- Scientists and researchers with diverse interests and expertise have formed this voluntary group to tackle this neglected disease

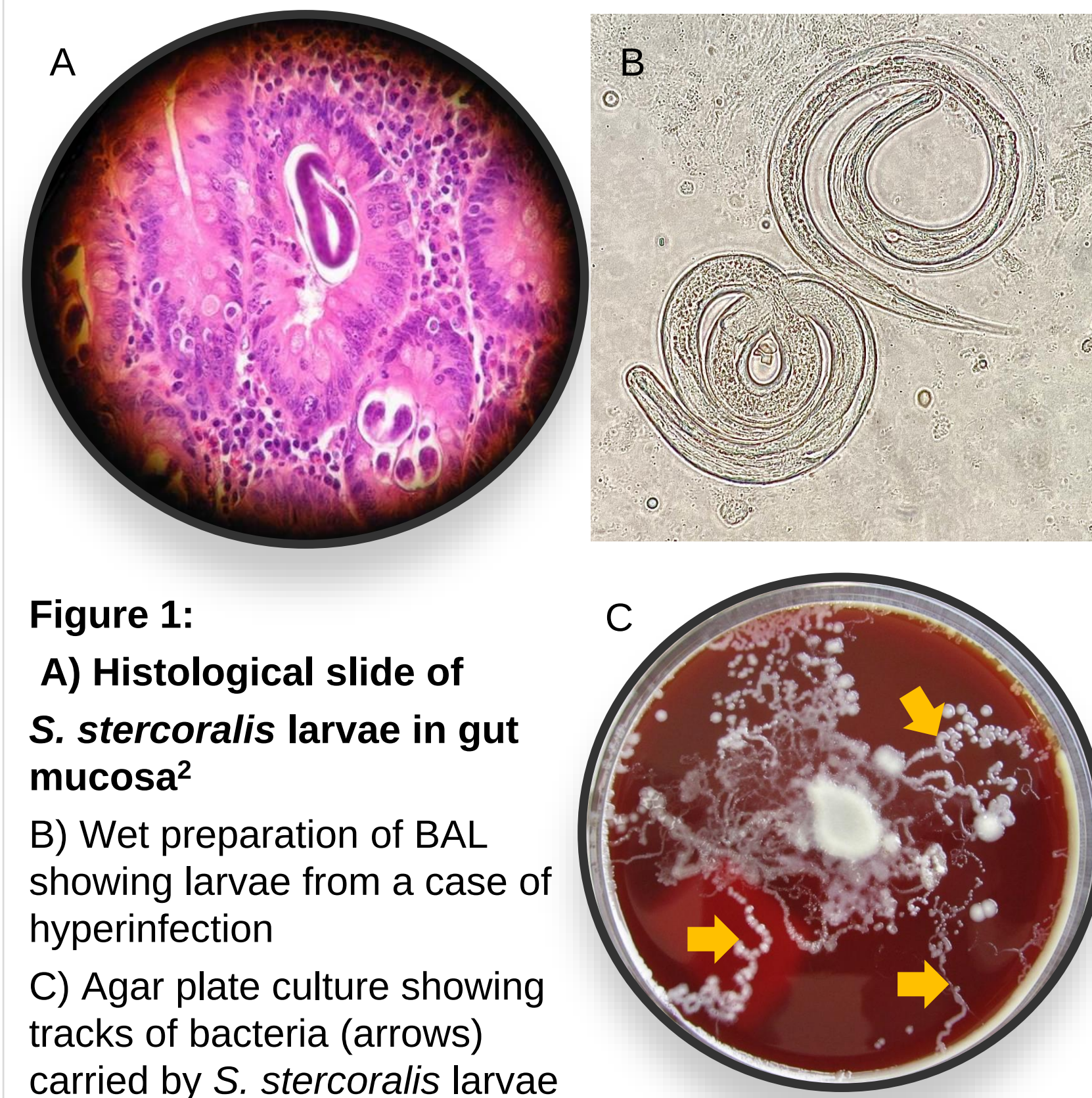


Figure 1:
A) Histological slide of *S. stercoralis* larvae in gut mucosa²
B) Wet preparation of BAL showing larvae from a case of hyperinfection
C) Agar plate culture showing tracks of bacteria (arrows) carried by *S. stercoralis* larvae

ECONOMICS

- Research and commitment by funding bodies is required in various fields to control this NTD
- Testing including investment in newer approaches
 - Research funding into many aspects of the infection
 - Drugs (including new drugs) need to be discovered and funded
 - Ongoing Mass Drug Administration needs to be considered to reduce transmission
 - Environmental research in reducing transmission (from soil to humans)

This group is involved in a number of these projects.

SOCIAL

- Being a neglected disease of poverty (WHO NTD), social aspects are as important as medical aspects and research. Our group is addressing a number of important issues and has shown that strongyloidiasis is indeed a disease of poverty:
- Housing/living conditions: density of living needs to be reduced. Lobbying for more/better housing for people living in sub-standard conditions
 - Hygiene including functional toilets and sewerage systems: *S. stercoralis* has a soil-gut-faeces cycle. Education regarding transmission and use, adequate funding by government bodies and maintenance of housing and closed toilets is critical and should be ongoing
 - Education regarding the disease in a language understood by those affected (see Fig. 4)

ENVIRONMENT

Wastewater/environmental testing

- Wastewater testing has been used for COVID-19 testing and represents a non-invasive method to determine presence of the parasite in a household or community⁶
- Environmental sources of *Strongyloides* include ruminants, cats, rodents, insects, water, soil, as well as fruit and vegetables.

ANIMALS

Potential zoonosis

Dogs have cultural significance for First Nation Australians and people in remote Indigenous Communities live closely with these companion animals. An opportunistic mapping survey of *Strongyloides* spp. prevalence in dogs in several such communities found a prevalence of 21.9%. The degree to which dogs are involved as reservoir for the maintenance and transmission of *S. stercoralis* infections in remote Indigenous Australian communities requires further investigation

In summary:

- It is not clear if *S. stercoralis* represents a zoonosis acquired from cats and dogs
- Genotyping of *Strongyloides* spp. from dogs, cats, non-human primates (NHP) and humans has identified that *S. stercoralis* likely originated in dogs and adapted to human hosts⁵
- Two distinct genetic clades of *S. stercoralis* exist, one restricted to dogs (lineage A) and another infecting humans, NHPs, dogs and cats (lineage B)

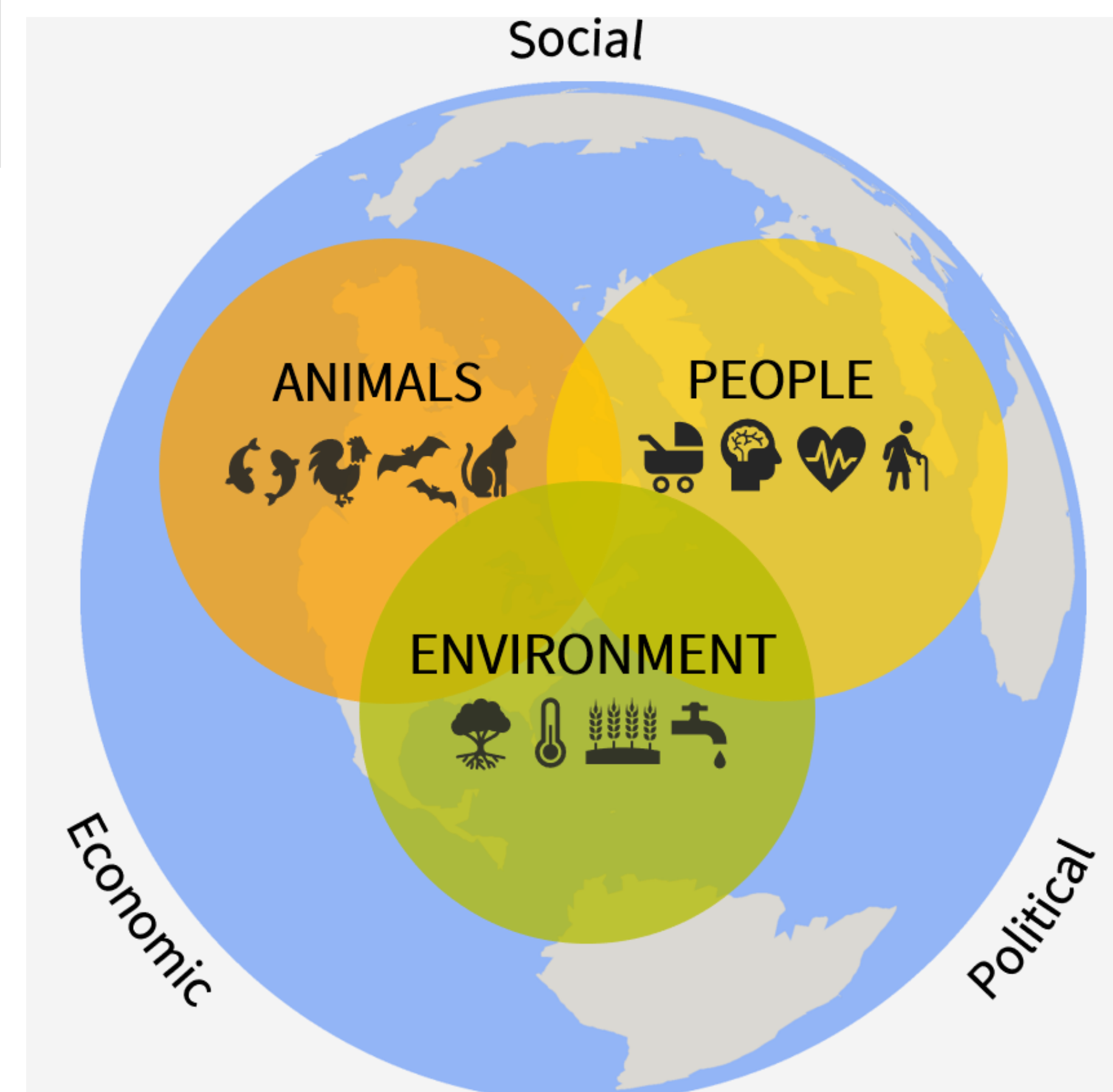
PEOPLE

HTLV-1 co-morbidity

HTLV-1 is an important co-morbidity of *S. stercoralis*, with a global prevalence of 5-10 million, and shares the same endemic area in Central Australia as *S. stercoralis*²

Members of this group⁴ have found:

- HTLV-I is a lifelong retroviral infection that infects T-cells, causing dysregulation of the immune system
- It is linked with dissemination and hyperinfection of *S. stercoralis* leading to bacterial sepsis – commonly lethal
- Inadequate treatment of *S. stercoralis* patients co-infected with HTLV-I has led to patient mortality



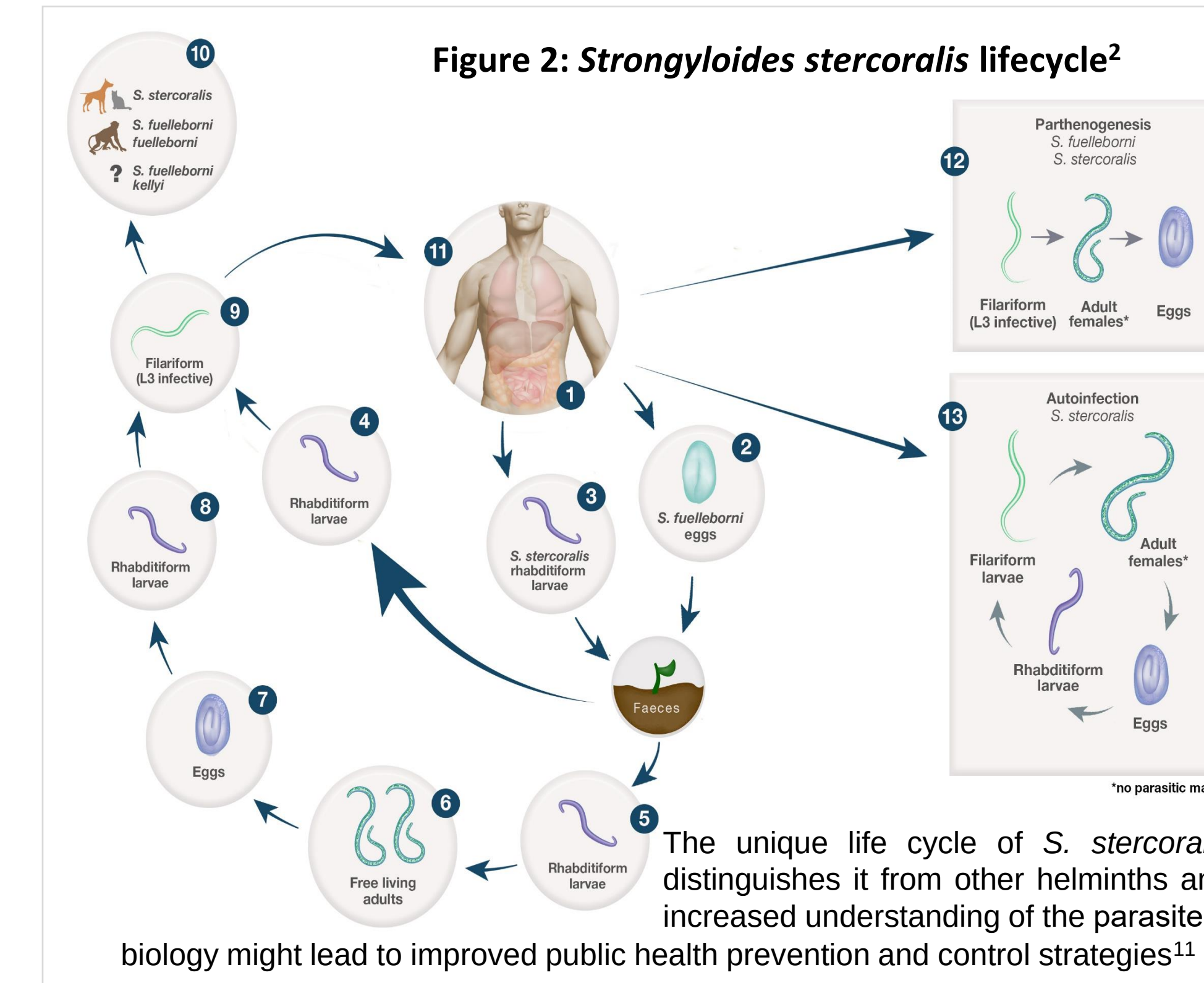
POLITICAL WILL

Call for strongyloidiasis to be nationally notifiable

Strongyloidiasis meets the 12 criteria required for a disease to be included in the Australian National Notifiable Disease List (NNDL) under the *National Health Security Act 2007* (Commonwealth)⁷

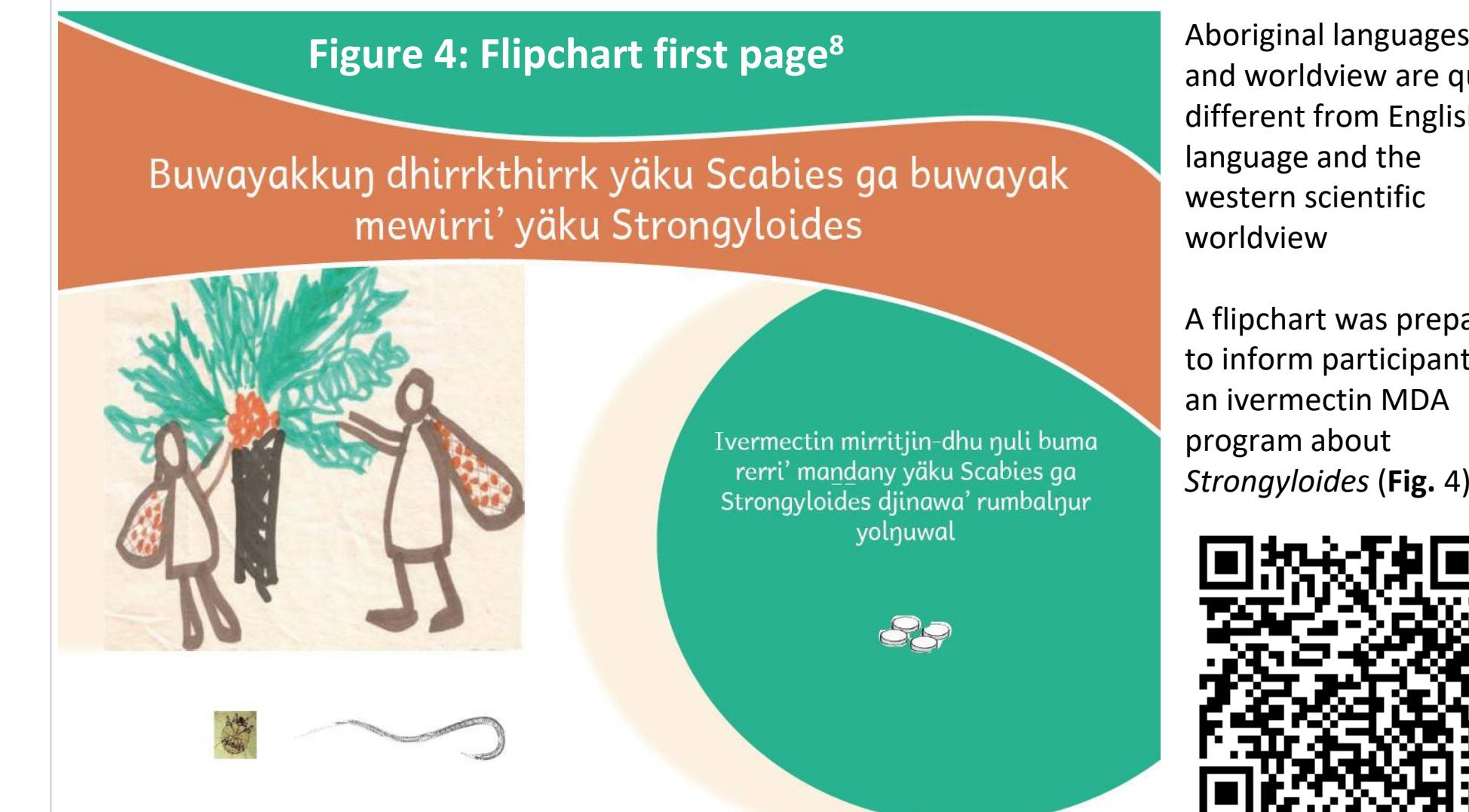
- The disease is important to Indigenous health, and closing the health inequity gap between Indigenous and non-Indigenous Australians is a priority
- A public health response is required to detect cases of strongyloidiasis and to establish the true incidence and prevalence of the disease
- There is no alternative national surveillance system to gather data on the disease

This group has been lobbying the authorities to make it notifiable



- A range of diagnostic assays are in use for diagnosis of active infections and past exposure in endemic settings. All have limitations⁷
- Microscopy, although used widely, is insensitive (<70%), and varies with phase of infection, therefore requiring multiple specimens
- Nucleic acid amplification tests (NAAT or PCR) are more sensitive than microscopy, but mainly used in research settings due to cost and technical expertise required. Also varies with phase of infection.
- Serological assays for antibodies to *S. stercoralis* antigens are highly sensitive (≥90%) and moderately specific (60-90%), serving as the current diagnostic test of choice. However, the variety of antigens used in various assays does not allow direct comparison.
- Rapid, point-of-care diagnostic tests are needed and are currently under development¹⁰. This group is engaged with researchers to trial such tests.

EDUCATION



PREVALENCE

There are **no national prevalence surveys** in Australia despite endemicity and known health risks.

- ELISA antibody test data from 6 of 7 Australian testing laboratories was obtained for 81,777 people 2012-2016³
- Overall, 32 (95% CI: 31-33) people per 100,000 of population were seropositive
- Positive cases were detected across all states and territories, with the highest (260-996/100,000 and 17-40% of those tested) in regions across northern Australia, north-east New South Wales and north-west South Australia (Fig 3)³

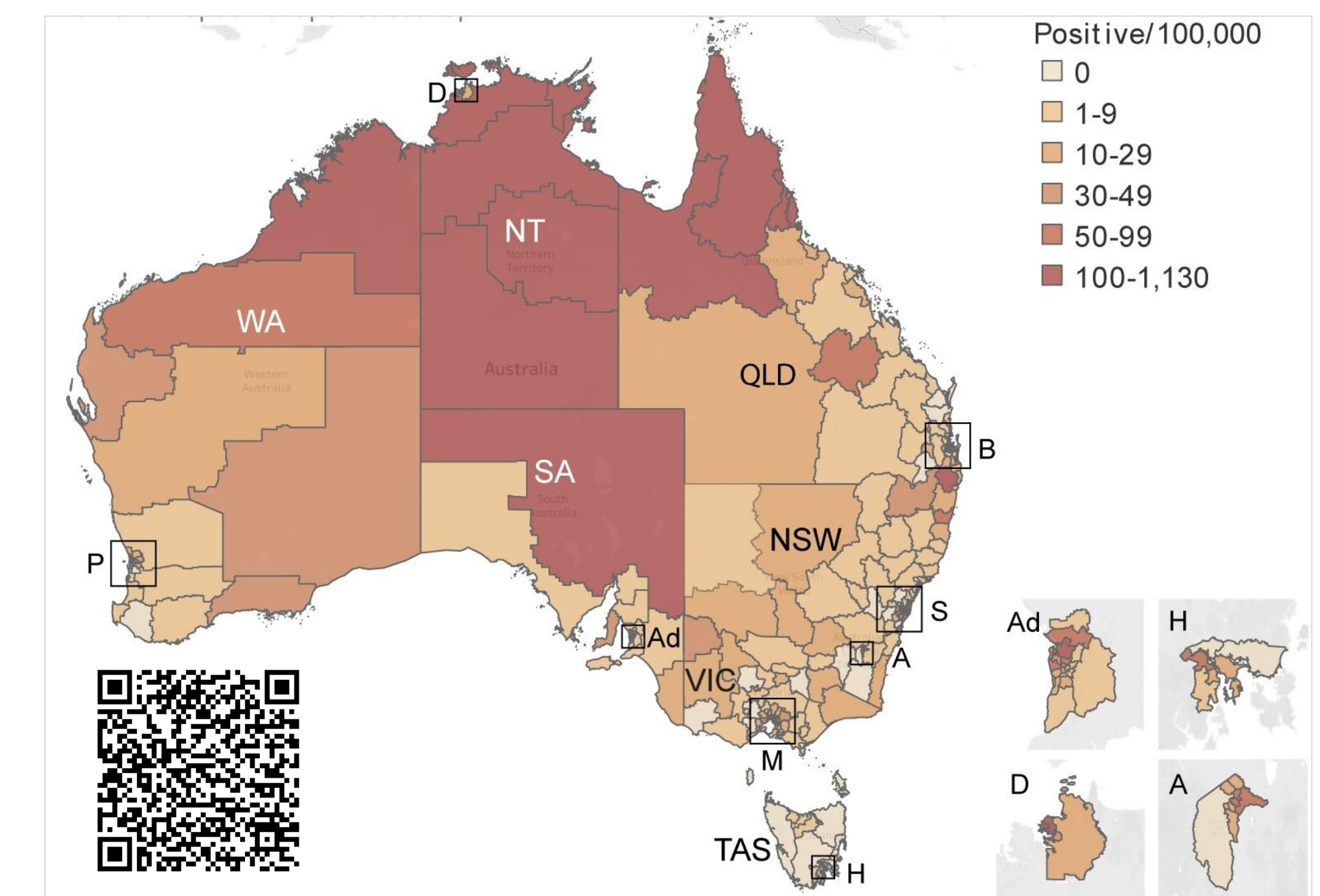


Figure 3: *S. stercoralis* serology: map showing number of people positive per 100,000 population, for each ABS statistical area level 3 (region), 2012-2016, Australia and greater capital cities, including the positive data from all six labs³

TAKE HOME MESSAGES FROM THIS GROUP

- Strongyloidiasis is the most neglected soil transmitted tropical disease
- Diagnosis is challenging, especially in chronic disease, as current faecal diagnostic methods have limited sensitivity
- Serology is useful to measure change in prevalence in control programs
- A One Health approach that includes humans, animals and the environment along with education and novel approaches is crucial to disease control
- Education should be in a language the population most affected can understand
- Lobbying politicians and policy makers for change is essential



USEFUL REFERENCES: (1) Buonfrate D et al. *Pathogens*. 2020; 9(6); (2) Gordon CA et al. *Adv Para* 2021; 111: 119-201; (3) Shield J et al. *PLoS NTDs* 2021; 15(3): e0009160; (4) Einsiedel L et al. *Internal medicine journal* 2008; 38(9): 697-703.; (5) Bradbury RS, et al *IJP* 2021; 51(13-14): 1153-66; (6) White, MAF et al. *Pathogens* 2019; 8(3) 91; (7) Beknazarova M et al. *Trop. Med. and infect. Dis.* 2018; 3(2): 61; (8) Shield JM et al (2018) *Trop. Med. Infect. Dis* 3,15; (9) Ross K. *Phil. Trans. R. Soc. B.* 2023; 20220435; (10) Noordin R et al. *Acta Trop.* 2022; 226: 106251; (11) Page W et al. *Trop. Med. Infect. Dis.* 2018, 3, 53.

