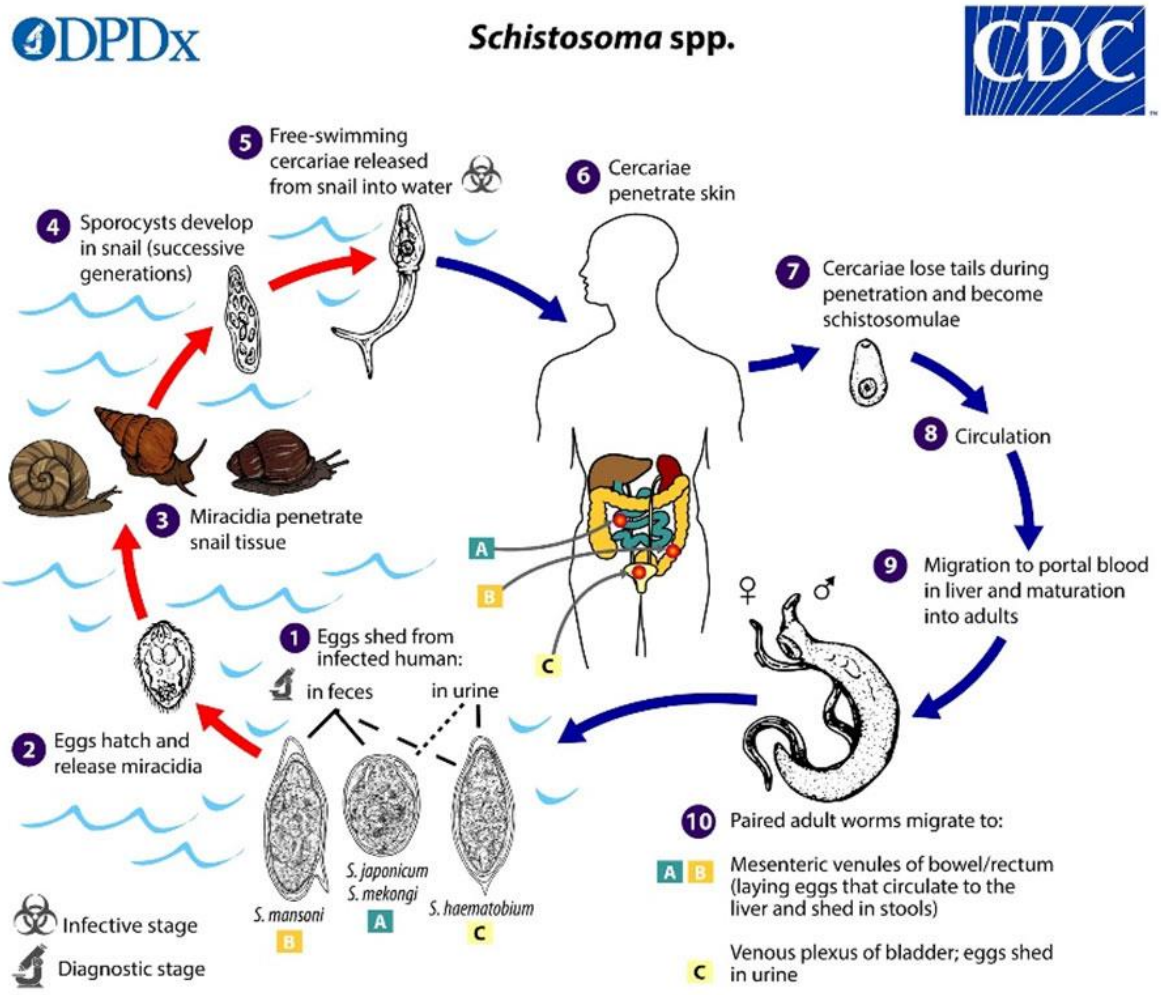
CLINICAL CONTEXT
Schistosomiasis



Schistosoma *spp. life cycle*

Schistosomiasis are zoonoses due to the infection by hematophagous trematodes of the Schistosoma genus, that live in the circulatory system. Six species are pathogenic for humans: S. haematobium, S. mansoni, S. japonicum (the 3 main species), S. mekongi, S. intercalatum and S. guineensis. They are responsible of three forms of infection: intestinal, urogenital or arteriovenous.

The different species have a similar life cycle. They differ by the nature of their intermediate hosts, aquatic snails which plays a determining role in the epidemiology of the disease. The different species also differ in the physiopathology of the disease in its chronic phase (urinary schistosomiasis for S. haematobium, arterioveinous for S. japonicum and S. mekongi, intestinal for the others). Every species has its own endemic region, but several species may be found in the same area.

Recent breakthroughs have shown that schistosomes can breed with worms of other Schistosoma species (Kincaid-Smith et al., 2021), leading to hybrid forms, for instance

urinary schistosomiasis with S. mansoni eggs. These kinds of hybridization raise unsolved questions, including the possible reservoirs of such hybrids (Le Govic et al., 2019).

After an asexual cycle of the parasite in the snail, humans (definitive host) are infected by transcutaneous penetration of the parasite. The free-ranging infective larva (furcocercariae) enters its host during a bath in freshwater (agricultural work, ablutions…). Adult forms migrate in the veins of their hosts, where the reproduction takes place. Each specie has a specific tropism for certain veins that determines if eggs are released in feces or urine. They hatch in water to liberate the ciliated myracidiae form which infects the snail (Colley et al., 2014)
The first stage of infestation is the cutaneous penetration of the worms, which can induce a local rash called cercarian dermatitis. After several weeks occurs the invasion phase for a couple weeks (toxemia, acute schistosomiasis, Katayama fever) before the chronic phase (location varies according to the species). Clinical signs and prognosis are highly variable depending on the parasite, the individual host and the contamination conditions (massive or progressive, iterative, chronical…). It has recently been shown a higher risk of co-infection with HIV for urogenital schistosomiasis with S. haematobium (LoVerde, 2019)
The WHO estimates that 230 million people present the symptoms of the infection, and that 800 other millions are at risk. Endemic in 74 countries (Subsaharian Africa (92% of cases), oriental Mediterranea, Asia, Latin America and Caribbean), schistosomiasis are more and more often diagnosed worldwide because of migratory flows and tourism (WHO, 2020).
Since 2011, southern Europe is facing reemerging cases of schistosomiases, despite the fact that the parasite was considered eradicated in this region. First cases would be of Corsican origin, due to a new hybrid species between S. haematobium and S. bovis (which is not pathogenic for humans). These recent findings lead to several publications, and are closely followed by health organizations (Moné et al., 2015, Boissier et al., 2015, Holtfreter et al., 2014).
Diagnosis relies on epidemiology, clinical signs, direct parasitology (eggs research in urine or feces, or rectal biopsy depending on the species), imaging (ultrasonography), biological data, antigen research or serology.
Indirect immunofluorescence, indirect haemagglutination and ELISA are the most common techniques. Using natural antigens more or less purified, these techniques can lack sensitivity and specificity .(Gray et. al., 2011)

THE SCHISTO II Western Blot IgG TEST
The Haute Autorité de Santé (HAS) in France as well as the American Center for Disease Control (CDC) recommend the immunoblot for the confirmation of serodiagnoses (Argumentaire HAS, 2017DPDx Schistosomiasis, 2019).
Thanks to its high performances, including in the case of infections by hybrids, Western Blot can be considered as the gold standard for the initial diagnosis of schistosomiasis (Guegan et al., 2019).
In order to meet this demand, we developed a reliable test based on the Western Blot technique. Associated with highly sensitive natural antigens (S. mansoni and S. haematobium), the SCHISTO II Western Blot IgG test is a robust confirmation technique of classical screening tests.

THE SCHISTOSOMA ICT IgG-IgM TEST
Ease of use, fast result obtention and reliability characterize the SCHISTOSOMA ICT IgGIgM screening test. Particularly adapted to first line laboratories and small series, this Point-Of-Care test can advantageously replace the other screening techniques.
Its excellent performance allow the isolated use of the ICT for the screening of patients, before therapeutic campaign instauration for instance, or when confirmation by Western Blot is not possible (Beltrame et al., 2017).

Sensitivity of serological tests according to localisation. (Salas et al., 2023)

To calculate the sensitivity of serological tests according to urogenital or hepatointestinal involvement, only patients with infection in one of the locations were considered.
The results are shown in Table 3. For urogenital schistosomiasis, the sensitivity was 28.6% for IHA, 66.2% for ELISA/NovaLisaTM and 94.2% for ICT/LDBIO. For hepatointestinal schistosomiasis, sensitivities were 100% for IHA, 84.3% for ELISA/NovaLisaTM and 95% for ICT/LDBIO, respectively.

Table 3. Sensitivity of serological tests according to localisation.

	No. Positive/Total Number of Patients Tested (%)	
Diagnostic Test	**Urogenital Schistosomiasi (N=292)**	**Hepatointestinal Schistosomiasis (N=104)**
S. mansoni IgG-ELISA	143/216 (66.2)	70/83 (84.3)
Bilharziose Fumouze IHA®	2/7 (28.6)	1/1 (100)
Schistosoma ICT IgG-IgM®	65/69 (94.2)	19/20 (95)

To determine sensitivity according to Schistosoma species (Table 4), only patients with monoinfections were considered, also excluding patients with biopsy-diagnosed schistosomiasis.
For S. haematobium the sensitivity was 28.6% with IHA, 65.7% with ELISA/NovaLisaTM and 94% with ICT/LDBIO. For S. mansoni the sensitivity was 100% for IHA, 82.1% for ELISA/NovaLisaTMand 93.3% for ICT/LDBIO. For S. intercalatum/guineensis the sensitivity was 100% for all techniques.

Table 4. Sensitivity of serological tests according to Schistosoma species.

	Nº Positive/Total Number of Patients Tested (%)		
Diagnostic Test	**S. haematobium**	**S. mansoni**	**S. intercalatum/guineensis**
S. mansoni IgG-ELISA	119/181 (65.7)	46/56 (82.1)	3/3 (100)
Bilharziose Fumouze IHA®	2/7 (28.6)	1/1 (100)	---
Schistosoma ICT IgG-IgM®	63/67 (94)	14/15 (93.3)	4/4 (100)