

Poverty as a disease trap

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A woman bathes in the Senegal River, while her children play nearby. Common livelihoods, daily chores, hygiene practices and children's play depend on the waterway, where residents are repeatedly exposed to reinfection by the parasitic worms that cause schistosomiasis. Credit: Andrea Lund

No drug can cure a paradox. That basic truth is at the heart of a new Stanford-led study highlighting how poverty traps make it impossible to

eradicate a potentially deadly disease with current approaches.

The study, published in the *American Journal of Tropical Medicine and Hygiene*, looks at why years of mass drug administration in Senegal have failed to dramatically alter infection rates of schistosomiasis, a [parasitic disease](#) that lurks in waterborne snails and affects more than 200 million people worldwide. It finds that neither drugs nor people's relatively sophisticated understanding of [disease](#) risks can overcome the inevitable exposure caused by imperatives of subsistence living. The researchers call for greater focus on the role of socio-economic and [environmental systems](#), and engaging communities in the design of disease control programs.

"The field of tropical medicine has focused primarily on mass drug administration programs," said lead author Andrea Lund, a Ph.D. student in the Emmett Interdisciplinary Program in Environment and Resources within Stanford's School of Earth, Energy & Environmental Sciences. "These have worked in many places, but there are persistent hot spots where you need to come at the problem from social and environmental angles too."

Although charity evaluation services consistently rank mass drug administration programs among the most effective developing world public health interventions, the efforts often fail to eradicate disease in the long run. That's because they don't address the root causes that lead to reinfection time after time, according to Lund.

Obstacles to a cure

Schistosomiasis is a disease caused by a parasitic worm and transmitted to humans by freshwater snails that serve as the parasite's intermediate host. The disease is widespread across tropical latitudes, with the vast majority of cases in sub-Saharan Africa. The snails release infective

larvae into freshwater, where they burrow into people's skin. Symptoms range from abdominal pain and diarrhea to infertility, permanent organ damage and bladder cancer. Chronic schistosomiasis can affect cognitive development and labor productivity, according to some studies.

Nearly 40 years after being introduced, praziquantel—a drug used to clear schistosome parasites from people—has yet to make a dent in the global burden of the disease. That's because treated people often re-enter contaminated water, repeatedly exposing themselves to reinfection.

Lund is part of a team that has been trying to understand the obstacles to a cure and ways around them. Led by Stanford disease ecologist Susanne Sokolow and biologist Giulio De Leo (both co-authors on the study), the group has shown that ecological tactics aimed at controlling schistosomiasis are the most effective way to reduce the disease's prevalence. The team received early funding from the Stanford Woods Institute for the Environment for a project to reintroduce native snail-eating prawns to local water sources, and has since established the Program for Disease Ecology, Health and Environment at Stanford with a grant from the Stanford Institute for Innovation in Developing Economies. The program, supported by Woods and the Stanford Center for Innovation in Global Health, focuses on finding sustainable ecological solutions to a range of diseases.

Sophisticated understanding

For the study, Lund and her colleagues surveyed residents of villages along the Senegal River, a region with persistently high rates of schistosomiasis despite yearly school-based mass administration of praziquantel since 1999. People explained how life in their rural, resource-poor area is inextricably intertwined with the river. Common livelihoods, such as agriculture and fishing, depend on contact with the waterway. So do chores, such as washing clothes, and hygiene practices,

such as bathing and children's play.

A 53-year-old man from one riverside village who spoke with one of the researchers summed up the catch-22: "That water, we cannot touch it. We cannot abandon it. If we abandon it, we will all become unemployed."

"There is a feeling of inevitability around schistosomiasis infection, given the constraints of poverty," said Sokolow, a senior research scientist at Woods. "That jibes with the experience of the many years of efforts to distribute pills and carry out educational campaigns in the region without a huge drop in schisto transmission or infection. It's the quintessential wicked problem."

Residents expressed a relatively sophisticated knowledge about the environmental nature of schistosomiasis, including the fact that infection risks increase at midday—an observation borne out by the tendency of snails to release free-swimming parasite larvae into the water at the same time of day. With this knowledge, some residents had developed personal strategies or village-wide policies—enforceable by fines—to minimize exposure by avoiding the river at certain times.

Good leadership and community engagement were among the strongest indicators of success in overcoming these obstacles. This capacity to organize suggests that communities could take the lead in implementing environmental and social interventions—ranging from prawn re-introduction to the construction and maintenance of water and sanitation facilities or behavior change programs. This would ensure interventions are locally acceptable and can be sustained over time. This type of engagement with communities could reduce the amount of parasite transmission in the environment and improve outcomes of mass drug administration in areas where they have had limited success, according to the researchers.

"Ultimately, I see these findings making a case for further investment in environmental solutions—such as prawn re-introduction," Lund said.

"This may be the only way to reduce the risk of schistosomiasis in settings where the disease burden remains high even in the presence of treatment programs."

More information: Andrea J. Lund et al. Unavoidable Risks: Local Perspectives on Water Contact Behavior and Implications for Schistosomiasis Control in an Agricultural Region of Northern Senegal, *American Journal of Tropical Medicine and Hygiene* (2019). [DOI: 10.4269/ajtmh.19-0099](https://doi.org/10.4269/ajtmh.19-0099)

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