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## Twenty-five years: GeoSentinel's impact on travel-related surveillance and its vision for the future

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Hepatitis E; animal exposures; healthcare; surveillance

GeoSentinel (<https://www.istm.org/geosentinel>) is an international network of healthcare sites and providers dedicated to the surveillance of infectious and selected non-infectious travel-related health issues among travelers and migrants. Sites provide routine clinical care to ill travelers and contribute demographic, travel and clinical surveillance data to a central electronic database. The GeoSentinel Network tracks travel-related diseases of potential global impact and helps advance the field of travel medicine, by keeping clinicians and public health practitioners up-to-date on the epidemiology and clinical presentation of key travel-related illnesses, thus improving the understanding of the spread of these illnesses across international borders.

GeoSentinel began in 1995 as a collaboration between the U.S. Centers for Disease Control and Prevention and the International Society of Travel Medicine.<sup>1</sup> Since the 1990s, GeoSentinel has grown to include diverse international sites, improved its data collection processes by including a common electronic database and more clinical variables and expanded beyond just sentinel surveillance to include enhanced surveillance to better answer questions about specific illnesses and subgroups of travelers.<sup>2,3</sup>

GeoSentinel has been successful in advancing public health and clinical practice since its inception. In 2011, GeoSentinel identified a cluster of the rare disease human muscular sarcocystosis among travelers to Malaysia, which resulted in the attribution of sarcocystosis as a cause of eosinophilic myositis among travelers.<sup>4</sup> The GeoSentinel Network has published over 110 peer-reviewed publications,<sup>3</sup> on both disease-specific topics, including leishmaniasis<sup>5</sup> and measles,<sup>6</sup> and population-specific topics, including student travelers<sup>7</sup>

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Author contributions

K.A. performed all writing and assessment.

Conflicts of interest

The author has no declared conflicts of interest but does participate in GeoSentinel and was a co-author on both mentioned papers.

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and an analysis of travel-associated infections among travelers to the USA.<sup>8</sup> The rapid dissemination of clinically relevant data from GeoSentinel through the Network listserv and ProMed has been used to improve the health care of ill travelers. GeoSentinel data have also been used to inform pre-travel preparation strategies for healthcare providers and immigrant health policies and services.

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In this issue, there are two GeoSentinel papers—a disease-specific manuscript on hepatitis E by Nicolini *et al.* describing its epidemiology among returning travelers and the accessibility of hepatitis E diagnostic testing, and a population-specific manuscript by Muehlenbein *et al.* about travelers with animal exposures. Both manuscripts use GeoSentinel data to help fill in the gaps in global surveillance and clinical information.

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Over 20 years of GeoSentinel hepatitis E data contribute to our understanding of the global epidemiology of hepatitis E. The authors show that high numbers of co-infections with other food or waterborne diseases were reported among patients with hepatitis E. Most previous studies featuring causes of diarrhea among travelers focus on bacterial pathogens diagnosed using predominantly culture-based stool studies and highlighting bacterial enteric co-infections.<sup>9</sup> However, until now, available reports have not identified large numbers of travelers co-infected with both bacterial enteric pathogens and food- or waterborne-acquired viral hepatitis, which, in certain settings, may be more common than previously thought. A reason for this finding may be that a typical workup for diarrhea includes stool studies looking for bacterial pathogens but not for additional pathogens, or the lack of diagnostic capacity for hepatitis E virus infection. Interestingly, less than three-quarters of GeoSentinel sites, which are specialized sites with travel and tropical medicine expertise, had access to hepatitis E serology testing and just over half have access to molecular testing. There is likely global underreporting of hepatitis E infection, especially when it occurs as a co-infection with bacterial enteric pathogens. Increased availability of hepatitis E diagnostics, and integration of hepatitis E testing as part of a travelers' diarrhea workup may help identify hepatitis E cases and improve the healthcare and outcomes of ill travelers.

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Hepatitis E infection in pregnant women can be severe with a reported mortality rate of up to 30% for women infected during the third trimester and is associated with complications such as hemorrhage, coagulopathy and intrauterine fetal death.<sup>10</sup> Only one pregnant woman with hepatitis E was reported by Nicolini *et al.* This is likely an artifact of GeoSentinel reporting because only one GeoSentinel site (part of a general care clinic in Hong Kong) regularly evaluates pregnant women and pregnant women with severe or life-threatening infection are more likely to report to obstetric hospitals which are outside of GeoSentinel's surveillance catchment.

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Muehlenbein *et al.* reported exposures to 33 different types of animals, ranging from the common, (e.g. monkeys and dogs) to the rare (e.g. ligers and coati), some requiring rabies post-exposure prophylaxis. This report reinforces that travelers, and particularly tourists, are likely having intentional exposures, suggested by the number of exposures to tamed or slow-moving animals that may be low or no risk for rabies but may still cause injury or infection (e.g. salmonellosis), such as horses, sloths and turtles. These presumed intentional exposures as well as most unintentional exposures are preventable with education and

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behavioral modification. A recurring theme in most GeoSentinel publications is that a low percentage of travelers receive a pre-travel consultation with a healthcare provider where prevention education could be discussed before departure. In these two reports, 51% of travelers with hepatitis E and 63% of travelers with an animal exposure did not have a pre-travel consultation. These findings reinforce the usefulness of GeoSentinel in identifying areas of potential disease mitigation pre-travel—attending pre-travel consultations and also possibly pre-travel vaccination with rabies pre-exposure prophylaxis (PrEP), which eliminates the need for post-exposure rabies immune globulin (RIG) and shortens the course of post-exposure vaccination in the event of an international animal exposure.

Cases of hepatitis E and animal exposure among travelers that were reported to GeoSentinel occurred most frequently among tourists (50 and 76%, respectively) and travelers to Asia (78 and 71%, respectively). Improving our understanding about which travelers might be at a higher likelihood of acquiring a specific illness or having a particular exposure will lead to improvements in the health of travelers. Although data collected through GeoSentinel cannot be used routinely to determine risk, these data provide destination-specific epidemiologic information that can help travelers, including those who travel to Asia, learn about potential hazards and infectious disease threats during travel.

As our understanding of specific travel-related infections (such as hepatitis E), and our management of specific sub-populations of travelers (such as those with animal exposures) improves, GeoSentinel's efforts should shift to the development and implementation of focused interventions. These might include improving diagnostic capacity for hepatitis E to reduce underreporting, assessing factors that trigger the use of rabies PrEP, RIG or post-exposure vaccination, or prospectively following cohorts of tourist travelers to identify exposure risks. Although GeoSentinel has contributed significantly to public health and the understanding of travel-associated diseases, the Network is adapting to the dynamic field of travel medicine and the changing needs of travelers. In the GeoSentinel Network, in addition to ongoing surveillance, efforts are underway to collect enhanced data and to conduct travelers' health research that is more generalizable, representative and clinically relevant.

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