TRAVEL MEDICINE ADVISOR

Your Monthly Supplement of Travel Medicine Literature

THOMSON
AMERICAN HEALTH CONSULTANTS

INSIDE

Volume 14, No. 8
August 2004

Travel Medicine Advisor® is published monthly by Thomson American Health Consultants, 3525 Piedmont Rd. NE, Six Piedmont Center, Suite 400, Atlanta, GA 30305. Periodicals postage paid at Atlanta, GA. POSTMASTER: Send address changes to *Travel Medicine Advisor®*, P.O. Box 740059, Atlanta, GA 30374.
Customer Service:
1-800-688-2421.
Subscription Information:
Travel Medicine Advisor® Update is a bimonthly supplement to *Travel Medicine Advisor®* looseleaf service. Price: $429 (includes *Travel Medicine Advisor* looseleaf reference manual plus one-year subscription to *Travel Medicine Advisor® Update*.) To subscribe, **call 1-800-688-2421.**

The Re-emergence of Wild Poliovirus in Africa

ABSTRACT & COMMENTARY

Synopsis: *Travel Medicine providers must be aware of the need for continued surveillance of their patients for an adequate polio immunization status given the following developments in Africa.*

Sources: CDC. Wild Poliovirus Importations—West and Central Africa, January 2003-March 2004. *MMWR.* 2004;53(20):433-435.

WORLD HEALTH ORGANIZATION POLIO EXPERTS WARN OF LARGEST EPIDEMIC in recent years, as polio hits Darfur. (WHO Press Release 22 June 2004. Available at http://www.who.int/mediacentre/releases/2004/pr45/en.)

Wild poliovirus (WPV) was imported into 8 countries that were previously felt to be polio-free in West Africa (Benin, Burkina Faso, Cote d'Ivoire, Ghana, Togo) and Central Africa (Cameroon, Central African Republic, Chad) from January 2003 to March 2004. The polio-free period before these recent importations ranged from 28 to 55 months. The MMWR summarized 63 cases, which were all shown to be poliovirus type 1 and linked to strains that circulate in endemic regions of Nigeria and Niger. Nigeria and Niger reported 497 cases of polio type 1 or type 3 during the same period. Two of the 8 index patients in the 8 countries had recent travel to a polio-endemic country, and the other 6 lived near centers where foreign trade with polio-endemic countries occurred. In spite of the supplementary immunization activities (SIAs) organized in all 8 countries, 4 continued to have WPV transmission after at least 2 rounds of immunizations.

In addition, the WHO press release reported re-infection with polio in Sudan, which had been polio-free for 3 years. The report warns of a spreading epidemic of polio through west and central Africa. Apparently, the number of children paralyzed in west and central Africa in 2004 is 5 times those which occurred in the same period in 2003.

COMMENT BY LIN H. CHEN, MD

Poliomyelitis is caused by 3 serotypes of poliovirus, which are enteroviruses transmitted via the fecal-oral route. Acute poliovirus infection can be asymptomatic or present as acute poliomyelitis, which is a nonspecific febrile illness followed by aseptic meningitis and/or paralysis.[1] Paralysis can be classified as spinal, bulbar, or spino-bulbar disease. Post-polio syndrome, characterized by muscle pain and weakness or paralysis, may develop decades later in up to 40% of persons who had paralytic poliomyelitis in childhood.[1] Infection with 1 serotype of poliovirus does *not*

confer immunity to the other serotypes. An inactivated polio vaccine (IPV, Salk vaccine) became available in the United States during 1955, and was widely used until oral polio vaccine (OPV, Sabin vaccine) became available in the 1960s. The introduction of the polio vaccine rapidly reduced the incidence of poliomyelitis.

In 1988, the World Health Assembly established the goal of global polio eradication by 2000. Although the deadline has been postponed until 2005, much progress has been made. Three of the 6 WHO regions (Americas, Europe, and Western Pacific) have been certified polio free, and only 6 countries were considered polio endemic in 2003: Afghanistan, Egypt, India, Niger, Nigeria, and Pakistan.[2] On the one hand, transmission has become limited within the Eastern Mediterranean Region and South--East Asian Region (*see Table*).2 On the other hand, the situation has deteriorated in Africa, where an additional 10 countries have reported polio cases in 2003 to 2004, including the 8 countries in West and Central Africa noted in the CDC report, as well as Sudan and Botswana

Laboratory surveillance has demonstrated importation of viruses from Nigeria/Niger into most of the other African countries. Furthermore, genomic sequencing demonstrated the poliovirus in Lebanon in 2003 originated in India; the poliovirus found in Zambia during 2002 was imported from Angola.[3]

The current situation reflects a trend associated with routine vaccination coverage in the endemic coutries. In Niger and Nigeria, the extent of coverage with 3 doses of oral poliovirus vaccine was estimated to be 25% in 2002, whereas the vaccine coverage was 48% in Afghanistan, 63% in Pakistan, 70% in India, and 97% in Egypt.[2] In India, polio vaccine coverage in 2002 was low in the states where polio commonly circulated, Bihar and Uttar Pradesh (21% and 41%, respectively).[4]

The 144 indigenous cases of polio reported in the United States since 1979 were due to vaccine-strain virus of the live oral poliovirus vaccine (OPV); only 6 additional cases were imported (1979-1993).[5] A more immunogenic vaccine, the enhanced-potency IPV was initially licensed in the United States in 1987.[6] In 1997, the Advisory Committee on Immunization Practices recommended sequential IPV-OPV for routine childhood immunization.[6] In 1999, the recommendation changed to an all-IPV schedule in order to eliminate the potential risks of vaccine-associated paralytic polio (VAPP).[1,5]

The risk of acquiring polio during travel is low. In the 1990s, polio was estimated to occur at an incidence of 1 symptomatic case and 20-1000 asymptomatic cases per 1,000,000 non-immune travelers visiting developing

Table

Wild Polio Cases (Data from references 2, 3, 8)

Country	2002	2003	2004 *
African Region			
Benin	0	2	3
Botswana	0	0	5
Burkina Faso	1	11	2
Cameroon	0	2	0
Central African Republic	0	1	0
Chad	0	25	4
Cotes d'Ivoire	0	1	3
Ghana	0	8	0
Niger	3	40	12
Nigeria	202	355	133
Sudan	0	0	1 (June 2004)
Togo	0	1	0
Zambia	2	0	0
Eastern Mediterranean Region			
Afghanistan	10	8	2
Egypt	7	1	0
Lebanon	0	1	0
Pakistan	90	103	12
Somalia	3	0	0
South-East Asian Region			
India	1603	225	8
Worldwide	1921	784	185

*January-April, unless otherwise specified

countries for 1 month.[7] By comparison, 3000-6000 per 1,000,000 travelers may contract hepatitis A, 800-2400 travelers may contract hepatitis B, 30 travelers may contract typhoid, and 3 may contract cholera.[7]

The estimated risk of polio in travelers should be lower at preset, given the global reduction of polio in the past decade. However, travelers visiting any polio-epidemic or polio-endemic areas should be current with their polio immunization: Children should have had their routine polio immunizations (at 2, 4, and 6-18 months, followed by a booster at 4 to 6 years of age), and adults should receive a polio booster (given at age 18 or older) before their trip.[1] The progress in polio elimination in the Eastern Mediterranean Region and South-East Asian Region continues to reduce the risk of exposure to polio for travelers visiting these areas. Nonetheless, long-term carriage of polioviruses has been documented in immunodeficient individuals, and questions remain as to whether these rare carriers of poliovirus can reintroduce poliovirus circulation into the population. In summary, given the recent spread of polio in the African Region, travelers visiting the area should continue to ascertain that their polio immunizations are up to date, or receive a booster dose of inactivated polio vaccine (IPV). ■

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Rabies Infections in Organ Donor and Transplant Recipients

ABSTRACT & COMMENTARY

Synopsis: *The Centers for Disease Control (CDC) has confirmed the diagnosis of rabies in 4 recipients of transplanted organs and their common donor. All 4 transplant recipients presented with rapidly progressive encephalitis within 21 to 27 days after receiving their transplant and all subsequently died. What are the implications for solid organ transplant recipients worldwide, particularly when the sources of transplanted organs are not always carefully regulated.*

Source: Investigation of Rabies Infections in Organ Donor and Transplant Recipients- Alabama, Arkansas, Oklahoma, and Texas, 2004. *MMWR. Dispatch* 2004;53:586-589.

UPDATE: INVESTIGATION OF RABIES INFECTIONS IN Organ Donor and Transplant Recipients-Alabama,

Arkansas, Oklahoma, and Texas, 2004 53 (*Dispatch*).

On June 30, 2004 the CDC confirmed the diagnosis of rabies in 3 transplant recipients, all of whom died with a diagnosis of encephalitis of unknown etiology. The common organ donor was an Arkansas resident who presented in Texas with severe mental status changes and low grade fever. A diagnosis of subarachnoid hemorrhage was suggested following neurologic imaging. The hemorrhage expanded resulting in cerebral herniation and death. The patient's family agreed to donation of his organs, and there appeared to be no contraindication to donation based on standard screening and testing. On May 4, the liver and kidneys were transplanted into 3 recipients at a transplant center in Texas.

The patient who received the donor liver was a man who, 5 days after uncomplicated transplant surgery, was discharged to home. However, 21 days after transplant, he was readmitted to the hospital with tremors, lethargy and anorexia, but without a fever. His neurologic status worsened rapidly; a lumbar puncture showed a lymphocytic pleocytosis and mildly elevated protein. Magnetic resonance imaging (MRI) of the brain initially showed increased signal in the cerebrospinal fluid and a second MRI 6 days after admission showed progression to diffuse encephalitis. His neurologic status continued to worsen and he subsequently died.

The first kidney recipient was a woman who presented 25 days after transplant with right-sided flank pain and underwent an appendectomy. Two days postoperative, she began having diffuse muscle twitching and mental status changes. Initial computed tomography (CT) and MRI studies were normal, yet she continued to deteriorate with seizures, hypotension, and respiratory failure. Repeat CT imaging, 14 days after admission, indicated severe cerebral edema, and she subsequently died.

The last organ recipient, who received the second kidney, presented 27 days after transplant with a change in mental status and myoclonic jerks. He was also afebrile. An initial MRI was normal. The lumbar puncture had a lymphocytic pleocytosis and mildly elevated protein. A second MRI 10 days after admission showed diffuse edema. He continued to deteriorate neurologically, and subsequently died.

The diagnosis of rabies was confirmed in all 3 cases at the CDC by immunohistochemical testing, and by the detection of rabies virus antigen in fixed brain tissue by direct fluorescent antibody tests. Pathology of the brain tissues of all 3 patients showed encephalitis with viral inclusions suggestive of Negri bodies. In addition, rabies virus antibodies were demonstrated in the blood from 2 of the 3 recipients, as well as the donor. Detecting antirabies antibodies in the donor suggests that he was the likely source of rabies transmission to the transplant recipients. Additional investigation and testing of the donor specimens is ongoing.

However, it has now been determined by Dr. Frank Wilson at the Arkansas Department of Health, that the donor had reported being bitten by a bat. In addition, a fourth case of rabies appears to be related to this outbreak in that an additional liver transplant recipient died of rabies encephalitis. In this fourth case, the source was not his liver donor, but appears to have been a stored segment of iliac artery recovered from the donor who had been determined to have had rabies. It had been stored at the facility for potential use in future liver transplants.

COMMENT BY MARY-LOUISE SCULLY, MD

Rabies is an acute, fatal encephalitis caused by neurotropic viruses in the genus *Lyssavirus*, family *Rhabdoviridae*. Bites of rabid mammals cause the majority of rabies cases.[1] It is very rare for nonbite exposures, such as scratches, contamination of open wounds, or direct mucous membrane contact with rabies infected material to cause rabies. Human-to-human transmission of rabies is extremely rare, but documented cases have been reported in 8 recipients of transplanted corneas in 5 countries.[2] However, this is the first documented occurrence of rabies transmission among solid organ transplants. It is likely that infection occurred via infected neuronal tissue in the transplant organs, since rabies is not spread hematogenously.

This report has generated a wave of appropriate questions and concerns regarding rabies postexposure prophylaxis (PEP) in both domestic and healthcare contacts of rabies infected patients, as well as hospital personnel who may have had contact with the rabies infected organs. In the domestic setting, rabies can be transmitted when infectious material, such as saliva, enters a wound, a break in the skin, or mucous membranes, (eg, eyes, nose, or mouth). Therefore, domestic exposures to rabies patients that includes bites, sexual activity, exchanging kisses on the mouth, sharing, eating, or drinking utensils, or cigarettes, warrant rabies PEP.

There are no documented cases of rabies transmission to healthcare workers caring for patients with rabies.[3] Adherence to Standard Precautions for contact with blood or body fluids (eg, gloves, gown, mask goggles, or face shield, as indicated for the

type of patient contact) prevents rabies transmission.[4] However, rabies PEP is recommended for health care workers who have been exposed to saliva, nerve tissue, or cerebral spinal fluid of a rabies patient. In addition, rabies PEP is recommended to healthcare workers after percutaneous injuries (needlesticks or scalpel cuts) because potentially infectious nerve material could be contained in the bore of the needle following tissue penetration in a rabies patient. Therefore, the recommendation is related to the possibility of exposure to infected nerve tissue not just blood exposure. Exposure to feces and urine are not considered a risk for rabies transmission.

Despite over 20,000 transplants being performed every year, no human rabies cases associated with solid organ transplants have previously been reported. Donor eligibility is determined through donor physical examination, laboratory data for organ dysfunction, and testing for selected bloodborne viral pathogens and syphilis. In addition, a series of questions are posed to the family and contacts of the donor. Presently, no testing for rabies is performed. In this case, the donor's death was attributed to a noninfectious cause since imaging studies showed a subarachnoid hemorrhage and subsequent cerebral herniation. Clearly, the challenge ahead is striking a balance between the need for donor testing to minimize the risk of such infectious disease transmissions without adversely affecting the access and availability of organs for transplantation. Currently, the CDC is working with federal and organ procurement agencies to review donor screening practices. More information regarding rabies in transplant organ recipients, and the indications for rabies PEP in healthcare and domestic contacts is available from the CDC at http://www.cdc.gov/ncidod/dvrd/rabies. ■

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Endurance Runners and Travel

ABSTRACT & COMMENTARY

Synopsis: *Why are so many Olympic level endurance athletes from East Africa? A demographic review of Ethiopians suggests that both heritage and habit are important. Travel medicine providers can provide customized care to runners to protect them from particular risks during international travel.*

Source: Scott RA, et al. Demographic Characteristics of Elite Ethiopian Endurance Runners. *Medicine and Science in Sports and Exercise*. 35:1727-1732, 2003.

SUMMARY: THREE GROUPS OF ETHIOPIAN ATHLETES (long distance runners, shorter distance runners, sprinters, and field events contestants) were compared with an otherwise similar population of non-athletes. Distance runners were more likely to be from particular highland geographical areas (Arsi and Shewa), to have a specific minority ethnicity (primary language of Cushitic origin), to have longer daily commutes to school, and to run to and from school.

■ COMMENT BY PHILIP FISCHER, MD, DTM&H

This summer, Olympic spirit takes our minds toward international cooperation, foreign travel, and athletic involvement. Already, *Travel Medicine Advisor* has historical links to distance running. The current editor successfully completed the Washington Marine Corps Marathon a decade ago. The former managing editor ran a marathon on an Atlantic island. With another of the associate editors, I ran between tea fields in Kenya earlier this year. What can we learn from international distance runners that would help us all here at home, and what particular cares should we provide to runners who present for pre-travel consultation?

People run for lots of reasons. Initially, distance runners were messengers. Biblical runners were said to have "beautiful feet" as they carried news of salvation.[1] The legendary (and likely fictional) Pheidippides died as he presented military news at the conclusion of what some think was the original 26.2 mile marathon to Athens. Eric Lidel of *Chariots of Fire* fame ran because he felt God's pleasure, while others choose to run for either endorphin surges or ego satisfaction. More and more, however, non-elite athletes run marathons, and they often claim health benefits as a motivating influence.

The lay press laments the American obesity epidemic,[2]

and many sources urge us all to get frequent, regular aerobic exercise.[3] This usually translates into something new to add to our already full schedules. The Ethiopian study, however, reminds us that regular exercise can be incorporated into our daily activities rather than simply added on. Most of us already spend time commuting; why not commute by foot? A study comparing Kenyans and Scandinavians showed that adolescents who walk or run to school, even without formal athletic training, have 30% more efficient oxygen use than do their sedentary colleagues; intense training in adolescence further increased exercise capacity.[4] Perhaps as a practical beginning, we could walk up stairs rather than use elevators, and we could walk through airports rather than using moving sidewalks. Whether we ever want to run a marathon or not, incorporating regular aerobic activity into our lives can lead to improved physiology. "Travel" medicine can be relevant to "journeys" of even a few steps.

What can we suggest to runners who travel internationally? How might we provide them specific input as they seek pre-travel consultation? Does travel impede athletic performance? There is some evidence that travel across 6 or more time zones is linked to decreased running performance, strength, and endurance,[5,6] and that there are differences in tolerance of east-to-west vs west-to-east travel.[7] Part of the "home field advantage" in American sports might also relate to decreased performance of visiting athletes who had traveled eastward, and performance potentials do not fully normalize until 5 days after arrival in the new time zone.[8]

One runner wanted to get some exercise while waiting between legs of flights in Addis Ababa. Leaving his carry-on bags with friends, he took his passport and boarding pass and left the airport for a bit of exercise. Everything went smoothly until he tried to rejoin his traveling companions—he had neglected to carry cash to pay the departure tax for those entering the airport to leave the country. We should remind traveling runners to make sure they carry necessary documentation and money during layover runs, and that they allow adequate time to complete security and immigration procedures after running.

Whether on a layover or relocating, how can travelers find good places to run in other countries? I asked a woman at the information desk in Amsterdam's Schiphol airport how far it was on the ubiquitous bicycle trails from the airport to the city center. "Impossible," she replied. "You can't get there from here on foot." Exploring by trial and error, I have since learned that it is possible to run from Schiphol to the downtown train station for a ride back to the airport, and there are plenty of other fine places to run in Holland as well. Schiphol also has showers (free in the restrooms near the business center but you need your own soap and towel and might not have hot water; about $12 with comfort, space, soap, and shampoo at the Hotel Mercure near the F concourse) for post-run refreshment before getting back on the plane.

Stretching my legs in the back of a 747 headed to Japan, I read the airline's copy of the May 2004 issue of *Runner's World*. It had a nice article about places to run in Tokyo. That was great, but I was only spending 2 hours at the Narita airport on my way to Beijing. Besides asking at hotels and launching out adventurously, where is there information about running routes? The internet, at http://runtheplanet.com, lists peer-recommended routes in most countries and major cities of the world. This web site also provides some contacts of potential running companions.

I've seen American women running with pants on under their long skirts in central Africa, and I thought they looked pretty funny. This, however, was acceptable to the local population—many of whom would have been highly offended to see women wearing shorts or even "just" pants on their legs in public. *Travel Medicine Advisor's* Culturegram information sheets give good background information on what sorts of attire and recreational activities are common and appropriate in specific foreign settings.

My own recent 18-week marathon training program coincided with enough foreign travel that I was able to take training runs on 4 different continents. Did my running put me at risk for any particular illness? Only in the United States has a dog bitten me during a run, but I have had dogs chase me through streets in Bangladesh and India. In China recently, the Pekingese I noticed were all calm and leashed, but a local paper still listed rabies high on a list of important health problems. Runners, even on short trips to urban areas of developing countries, could be considered to be at increased risk of rabies and should consider immunization—with careful instruction, as well to also seek immediate medical care in the event of a bite.

Lacking data comparing travel-related health symptoms in runners and non-runners, one might imagine that runners fare better than more sedentary travelers. Regular exercise seems to help some people adapt more quickly to new time zones, and it would be interesting to know if runners experience less jet lag than non-runners. Similarly, runners are keenly aware of the need to be carefully attentive to food and fluid intake, and one might postulate that they are able to more easily comply with hygienic advice designed to prevent travelers' diarrhea.

Perhaps this summer's Olympic travel and athleticism will stimulate further study of the relative risks of travel health problems in athletes. ■

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Travelers Returning to Italy with Fever

ABSTRACT & COMMENTARY

Synopsis: *Seven percent of more than 2,000 hospital admissions to the Division of Infectious Tropical Diseases at the Luigi Sacco Hospital, University of Milan, were due to fever in travelers and migrants returning from the tropics. Malaria was the most frequent diagnosis.*

Source: Spinello A, et al. Prospective Observational Study of Fever in Hospitalized Returning Travelers and Migrants from Tropical Areas, 1997-2000. *J Travel Med.* 2004;11:135-142.

ALL PATIENTS PRESENTING WITH FEVER AND A history of travel and /or residence in a tropical country during the 6 months prior to admission were enrolled in a study to identify the prevalence of febrile travelers, the causes of fever in his group, and the usefulness of laboratory testing performed to evaluate them. Ninety-one men and 56 women were enrolled (147 total); 107 individuals resided in Italy (n =101) or other European nations (n = 6), and 40 were migrants. Of those presenting with illness, 67.3% occurred in persons in the 20-39 year age group. Travelers had returned from Africa (61%), Asia (22%), Central and South America (13%), and the Middle East (2%).

Fever was present in 7% of all those admitted (147/2074). Data

Table

Primary Diagnosis at Discharge in 147 Subjects Admitted to Hospital with Fever after Returning from Tropical Countries

Diagnosis	Italian or European Citizens	Extra-European Citizens	Total (%)
Malaria			70 (47.6%)
P. falciparum	25	27	52
P. vivax	11	3	14
P. ovale	3	—	3
P. malariae	—	1	1
Viral hepatitis			13 (8.8)
Type A	11	—	11
Type B	—	1	1
Type E	—	1	1
Gastroenteritis	7	—	7 (4.8)
Schistosomiasis			7 (4.8)
Katayama fever	2	—	2
Urinary schistosomiasis	3	1	4
Intestinal schistosomiasis	—	1	1
Typhoid fever	5	1	6 (4.1)
Dengue fever	5	—	5 (3.4)
Respiratory infections	3	1	4 (2.7)
UTIs	2	—	2 (1.4)
Disseminated tuberculosis	—	1	1 (0.7)
Leptospirosis	—	1	1 (0.7)
Rickettsiosis	1	—	1 (0.7)
Toxoplasmosis	1	—	1 (0.7)
Cysticercosis	1	—	1 (0.7)
Self-limiting fever (presumed viral)	—	18	18 (12.2)
Viral infections	2	—	2 (1.4)
Sepsis	1	—	1 (0.7)
Miscellaneous noninfective	6	1	7 (4.8)
Total	107	40	147

that were available on 142 patients revealed that antimalarial prophylaxis was taken by 32 patients: 29/106 Italian or European subjects and only 3/38 migrants. Thirteen patients either discontinued malaria chemoprophylaxis before the scheduled time or they had been prescribed an inappropriate regimen for their destination. Most persons were admitted for their illness within 2 weeks after their return. The Table shows the microbiological diagnoses obtained for 115 patients.

Malaria was the most common diagnosis. Of the 70 patients with malaria, only 14 had received antimalarial prophylaxis. Of note, 5 patients who had been taking mefloquine developed malaria, 4 due to *Plasmodium vivax* and 1 due to *Plasmodium falciparum* acquired in Tanzania. Fifty-one of 52 patients with *P. falciparum* infection, had contracted it in Africa. Malaria was also the most common diagnosis in persons who presented with fever more than 30 days after return form the tropics. The most useful diagnostic tests performed were direct microscopic examination and PCR of peripheral blood for malaria parasites for the evaluation of fever. They were positive in about 65% of the cases in which they were requested.

Positive microbial cultures ranged from 4% of stool to 21% of urine specimens; blood cultures were positive in all diagnosed cases of typhoid fever and in 1 case of sepsis due to *Escherichia coli*. Hepatitis A and dengue were the most frequent viral diagnoses, accounting for 12% of diagnoses in all febrile travelers. Nearly 5 % of patients received a diagnosis of schistosomiasis. Serology for typhoid fever, brucellosis, and rickettsiosis were not helpful in the majority of cases.

COMMENT BY MARIA D. MILENO, MD

Few of the prospective studies which were cited in this paper had addressed the relatively common problem of fever in returning travelers. In this observational study, 80% of patients were hospitalized within 2 weeks of return home and 50% within 5 days. Of the 7% who had fever and required hospitalization, it is not surprising that malaria was the most common diagnosis. Other reviews of outpatients who return with illness suggest that more common diagnoses are responsible for their illnesses, yet the message remains—malaria must be excluded first in all persons with fever who return from malarious areas.

Several interesting points were raised. Kenya remains the most popular destination for Italian travelers, resulting in high risk of exposure to *P. falciparum,* and yet there was a very low rate of compliance with malaria chemoprophylaxis. Migrants, in particular, hardly participated in a chemoprophylaxis regimen. All persons who presented 1 month after their return to Italy had malaria, with late onset illness observed in 4 of 5 persons with *P. vivax*, despite mefloquine prophylaxis, as might be expected.

Caring for febrile returned travelers can be quite challenging. Thoughtful testing directed to identification of *P. falciparum* and other likely causes of fever can uncover the majority of diagnoses in this group. More reports examining trends in specific groups of returned travelers should be undertaken. ■

CME Questions

1. **One of the following statements regarding poliomyelitis is *false:***
   a. Poliovirus infection can present with acute paralysis as well as asymptomatic infection.
   b. Patients with paralytic polio may develop a post-polio syndrome decades later.
   c. Acute poliomyelitis has been eliminated from the WHO Region of the Americas, the European Region, and the Western Pacific Region.
   d. Adults traveling to polio-epidemic and polio-endemic countries should be immunized with a booster of polio vaccine, if none has been given in adulthood.
   e. Polio has been eradicated from all areas of the world.

2. **Which of the following statements regarding rabies is *incorrect*?**
   a. Domestic exposures to rabies patients that warrant rabies PEP include bites, sexual activity, exchanging kisses on the mouth, direct mucous membrane contact with saliva, sharing, eatin, or drinking utensils, or cigarettes.
   b. Exposure urine or feces is not considered a risk for rabies transmission.
   c. Rabies virus is also transmitted hematogenously.
   d. Rabies PEP is recommended for healthcare workers who have been exposed to saliva, nerve tissue, cerebral spinal fluid, and percutaneous injuries from rabies patients.
   e. Rabies transmission to transplant patients mostly likely occurred via neuronal tissue contained in the transplanted organs.

3. **In a pre-travel consultation, a runner should be advised:**
   a. to avoid running during the first 3 days in a new time zone.
   to consider rabies immunization.
   c. to generally ignore local dress standards in favor of comfort.
   d. to run only indoors (on a treadmill) in foreign settings.

Answers: 1. (e); 2.(c); 3. (b)