Gastrointestinal Illnesses among French Forces Deployed to Djibouti: French Military Health Surveillance, 2005–2009

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Abstract. Despite an increase in foreign tourism and in the numbers of foreign military personnel deployed to Djibouti, little is known about the risk of gastrointestinal illness in this country in eastern Africa. To assess risk and to describe common features of gastrointestinal illnesses, reports of illness derived from military health surveillance data collected during 2005–2009 among French service members deployed to Djibouti were reviewed. Diarrhea was the most common problem; it had an annual incidence ranging from 260 to 349 cases per 1,000 person-years. The risk was higher among soldiers deployed short-term (four months) than among soldiers deployed long-term (two years). This five-year review of French health surveillance data documents a significant burden of diarrhea among French soldiers in Djibouti. The identification of factors associated with risk may permit efficient targeting of interventions to reduce morbidity from gastrointestinal illness.

INTRODUCTION

Acute infectious diarrhea is one of the most common illnesses among international travelers, which affects up to 60% of short-term travelers.¹ Among travelers, at least 20% become bedridden for a portion of their trip, and 40% change their itinerary because of diarrhea.¹

Soldiers deployed overseas may be considered travelers, although some authorities note a distinction in risk between short-term travelers and those populations living overseas for longer periods, including expatriates, students, people working for non-governmental organizations, and soldiers.² Gastrointestinal diseases have historically resulted in a significant reduction in operational readiness of military personnel,^{3,4} and outbreaks of gastrointestinal diseases have continued to afflict military forces despite the provision of safe food and water, education about hygiene, and appropriate waste disposal.^{5–13}

French soldiers have had gastrointestinal diseases while deployed to areas around the world, including Africa.^{14,15} In addition to being present in the Djibouti, French soldiers have been stationed for many years in Senegal, the Côte d'Ivoire, the Central African Republic, Gabon, Chad, Mayotte, La Reunion, and until 2008, Cameroon.

Djibouti has recently seen an increase in the number of foreigners visiting and residing in the country. Foreign tourism is expanding in Djibouti because of interest in its coastal areas and opportunities for recreation. Similarly, the number of foreign military personnel is also increasing. In addition to the presence for many years of French, German, and American forces, recent counter-piracy efforts near the Somalia coast have led to an increase in the presence of other foreign military personnel.

The purpose of this report is to review and summarize cases of diarrhea and other gastrointestinal diseases and of foodborne illness outbreaks reported among French forces

deployed to Djibouti during 2005–2009 to conduct an assessment of the absolute risk posed to travelers and military personnel in the region, to compare this risk against that of military personnel in other areas in Africa, and to identify risk factors for illness suitable to intervention.

MATERIALS AND METHODS

Surveillance setting. Djibouti, located on the Gulf of Aden and the Red Sea in the Horn of Africa, is bordered by Eritrea, Ethiopia, and Somalia. It is an important regional crossroad for trade and exchange. It is a small (23,200 km²) and sparsely populated (approximately 819,000 inhabitants living mainly in Djibouti City, the capital) developing country.¹⁶ The region is hot (average maximum temperature = 45°C), dry (less than 20 mm of rain annually), and sandy. There are two wet seasons (May–June and September–October) and one dry season (June–September) marked by Khamsin, a hot and sandy desert wind.¹⁷

Surveillance population. Deployment to Djibouti may be of two durations: short-term, lasting approximately four months; and long-term, lasting approximately two years. Those deployed short-term (typically arriving during the end of February, June, and October) do so without their families; those deployed long-term (typically arriving during July and August) may choose to be accompanied by their spouse and children. There is minimal (1–2 weeks) overlap as forces rotate in and out of their deployments, thus resulting in a relatively stable population throughout the year. During 2005–2009, at any given time approximately 2,900 French soldiers were deployed each year in Djibouti, as shown in Table 1, and approximately 12,000 were deployed each year to other locations in Africa.

Routine vaccines administered to all French military personnel include vaccines against poliomyelitis and hepatitis A. Before deployments, vaccine against typhoid fever is also administered. Vaccination against cholera is not required.

French forces health surveillance system. Approximately 60 diseases and syndromes are reportable to French forces health surveillance officials. The list of illnesses is periodically

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TABLE 1

French soldiers assigned to Djibouti, by deployment length, 2005–2009

Year	Short-term, no. (%)	Long-term, no. (%)	Total, no. (%)
2005	1,209 (42.1)	1,660 (57.9)	2,869 (100.0)
2006	1,240 (41.8)	1,728 (58.2)	2,968 (100.0)
2007	1,168 (39.8)	1,751 (60.2)	2,919 (100.0)
2008	1,179 (40.5)	1,731 (59.5)	2,910 (100.0)
2009	1,277 (43.0)	1,694 (57.0)	2,971 (100.0)

revised, taking into consideration reportable diseases in the French civilian health surveillance system and diseases or syndromes of military significance. Nine gastrointestinal diseases are reportable and each has a specific case definition: amebiasis, cholera, typhoid fever, paratyphoid fever, hepatitis A, hepatitis E, listeriosis, poliomyelitis, and shigellosis. Diarrhea and clinical illness from suspected foodborne disease outbreaks are also reportable. Additionally, any other condition constituting a public health risk to French forces and potentially requiring a coordinated response is also reportable, even if excluded from the list. Military medical practitioners report each case weekly among French military personnel. In the field, they report syndromes through a near real-time web-based surveillance system.¹⁸ Since 2003, a public health physician assigned to the French forces has directed health surveillance efforts, which includes foodborne illness outbreak investigations, in coordination with biologists, veterinarians, and medical practitioners. Suspected foodborne illness outbreaks are investigated by using case-control or retrospective cohort methods, and specimens are obtained where feasible from clinical cases and tested against suspected contaminated food items by using French laboratory resources.

French medical resources in Djibouti. Approximately 10 French medical professionals are deployed each year to Djibouti. Routine laboratory testing is performed within the microbiology unit of the Bouffard French Military Hospital. A stool examination is usually performed when diarrhea is associated with blood, fever, or constitutional symptoms; lasts more than five days after symptomatic treatment; or when a parasitologic etiology is suspected. Stool specimens are collected at reporting medical facilities and transported to the microbiology unit for testing.

Standard microbiologic methods are used to identify *Salmonella*, *Shigella*, and *Campylobacter* spp., and *Vibrio cholerae*. Laboratory procedures include streaking onto MacConkey agar, *Salmonella-Shigella* agar, thiosulfate citrate bile salts sucrose agar, and *Campylobacter* blood agar plates, and inoculation into alkaline peptone water and mannitol selenite broth for enrichment. Isolates from mannitol selenite broth are subcultured onto MacConkey and *Salmonella-Shigella* SS agar within 18 hours after overnight incubation at 37°C. Cultures in alkaline peptone water are subcultured onto thiosulfate citrate bile salts sucrose agar for isolation of *Vibrio* spp. The *Campylobacter* blood agar plates are incubated at 42°C for 72 hours in a microaerophilic atmosphere. Cultures are examined for *Salmonella*, *Shigella*, *Campylobacter*, *Escherichia coli*, and *V. cholerae*. Pathovars of *E. coli* are not identified. Standard procedures are used, which include conventional screening sets of Kligler iron agar, motility-indole-ornithine medium, and sucrose semi-solid agar. Polymerase chain reaction and enzyme-linked immunosorbent assay are

not routinely performed. The presence of protozoa and helminthic parasites is determined by microscopic examination of fresh stools and specimens concentrated with 10% formalin. Fecal leukocytes are detected by examination of fecal smears stained with methylene blue. Antibiotic resistance is determined by the disk susceptibility method for enteropathogens.

A military veterinarian assigned to the French forces in Djibouti is responsible for food hygiene and water sanitary quality control. He or she conducts scheduled sanitary assessments of military canteens and of water resources used for sanitary needs. In the event deficiencies are noted, they advise the local command regarding implementation of corrective actions. At military canteens and during field deployments, French soldiers drink only bottled water because water provided by the municipal systems do not meet French sanitary standards. However, while in garrison, French forces are not subject to off-base restrictions and are able to consume local food and beverages, particularly during non-duty hours.

Statistical analysis. Data from reported cases of gastrointestinal illness and cases identified during investigations were entered into a spreadsheet. Comparisons in incidence were made against cases reported among French forces deployed elsewhere in Africa, and relative risk statistics and 95% confidence intervals (CIs) were calculated. Incidence rates and annual proportions of soldiers on short-term and long-term deployments were compared by using Poisson regression. Temporal data were tested by using the chi-square test for trend. Statistical significance was two-tailed and set at $P < 0.05$ for each analysis, and Bonferroni correction was used for multiple comparisons. STATA version 9.0 (StataCorpLP, College Station, TX) was used for all analyses.

RESULTS

Deployed population composition. The annual proportion of soldiers assigned to Djibouti on either long-term or short-term deployments did not vary significantly during the 2005–2009 surveillance period ($P = 0.09$) (Table 1).

Reportable gastrointestinal illnesses. During 2005–2009, reportable gastrointestinal illnesses represented chronologically 68.0% (1,059 of 1,557), 71.1% (798 of 1,122), 76.4% (833 of 1,091), 70.8% (1,018 of 1,437), and 68.7% (820 of 1,166) of all cases reported among French soldiers deployed to Djibouti. There was no significant annual trend in proportion ($P = 0.18$). Total numbers of cases reported and annual incidence rates for gastrointestinal illnesses, are shown in Table 2.

Diarrhea. During 2005–2009, 773–1,002 cases of diarrhea were reported annually, which represented 94.6–99.1% of all reportable gastrointestinal illnesses annually. The annual incidence rate ranged from 260.2 to 349.3 cases per 1,000 person-years. By year, the annual incidence rate of diarrhea was lowest in 2006 and 2009 ($P < 0.001$). Each year, the incidence rate was significantly higher among soldiers on short-term deployments than among those on long-term deployments ($P < 0.001$ each year).

Examining five years of incidence data by week, a common incidence peak occurred between calendar week 39 and calendar week 50 among both groups (Figure 1). Among soldiers on short-term deployments, two others annual peaks could be distinguished: one during February–March, and another approximately four months later during July–August, each corresponding to a period a few weeks after arrival of new

TABLE 2

Reported cases and incidence rate of gastrointestinal illnesses among French soldiers deployed to Djibouti, by deployment length, 2005–2009*

Illness	2005		2006		2007		2008		2009		Total	
	Cases	IR	Cases	IR	Case	IF	Cases	IR	Case	IR	Cases	IR
Diarrhea												
Short term	480	397.0	467	376.6	389	333.0	578	490.2	472	369.6	2,386	392.9
Long term	522	314.5	308	178.2	435	248.4	395	228.2	301	177.7	1,961	229.0
Total	1,002	349.3	775	261.1	824	282.3	973	334.4	773	260.2	4,347	297.0
Amebiasis												
Short term	24	19.9	13	10.5	2	1.7	0	0	0	0	39	6.4
Long term	15	9.0	3	1.7	4	2.3	1	0.6	0	0	23	2.7
Total	39	13.6	16	5.4	6	2.1	1	0.3	0	0	62	4.2
Shigellosis												
Short term	9	7.4	0	0	3	2.6	14	11.0	4	3.2	29	4.8
Long term	2	1.2	7	4.1	6	3.4	4	2.3	1	0.6	20	2.3
Total	11	3.8	7	2.4	9	3.1	18	6.2	5	1.7	49	3.3

* IR = incidence rate. Incidence rate is per 1,000 person-years.

soldiers on short-term deployments and the departure of those they had replaced. Among soldiers on long-term deployments, there was an apparent increase in the incidence of diarrhea observed during July–August during and after the time of arrival of new soldiers on long-term deployments.

During 13 weeks from mid-June to the end of October 2008, an outbreak occurred among French forces forward deployed to northern Djibouti logistically supporting Djiboutian Armed Forces combat operations during a frontier conflict with Eritrea. Near real-time surveillance highlighted that diarrhea incidence increased among forward deployed French soldiers in the northern region of Djibouti approximately six weeks after the beginning of the conflict (Figure 2). Field investigations demonstrated that consumption of local food bought to supplement that provided by French forces and the establishment of a number of non-official canteens (7 serving 70 soldiers by the end of the deployment) contributed to the increase in incidence, which at its peak approached 1 in 10 per week.

Shigellosis. During 2005–2009, shigellosis represented 0.6–1.7% of all reportable gastrointestinal illnesses. The incidence rate ranged from 6.2 to 1.7 cases per 1,000 person-years without a significant annual trend ($P = 0.80$). Most (39 of

54) shigellosis cases occurred in the first and fourth calendar quarters.

Amebiasis. In 2005, 39 amebiasis cases were reported. The incidence of amebiasis decreased steadily during the period ($P < 0.001$). No cases were reported in 2009.

Foodborne disease outbreaks. Four confirmed outbreaks of foodborne illness occurred during the period, one each in 2005 and 2008, and two in 2009.

In 2005, a foodborne disease outbreak occurred among three squadrons of the Army. The investigation was conducted on 8 affected soldiers and 17 non-affected soldiers. Contaminated spring rolls obtained from a local restaurant were strongly associated with illness. Microbiologic analysis of the spring rolls identified a fluoroquinolone-resistant *Salmonella enterica* isolate.

In 2008, a foodborne disease outbreak occurred three days after a barbecue organized by fire fighters. The attack rate among attendees was 54.0% (27 of 50). *Shigella sonnei* was identified in the stool of two patients. An investigation showed that leftover prepared food items had been left at ambient temperature (approximately 35°C) for a prolonged period before being refrigerated for later consumption. The investigation determined that the odds of illness was 1.4 (95% CI = 1.1–1.8) times higher among those who had consumed leftover food items.

In January 2009, a foodborne disease outbreak occurred among a 15-member special forces group after field training. The attack rate was 60.0% (9 of 15). *Shigella* species was identified in the stool of three patients. The investigation could not

FIGURE 1. Mean weekly incidence rate of diarrhea reported among French forces deployed to Djibouti, 2005–2009, by deployment duration.

FIGURE 2. Incidence rate of diarrhea reported among French Forces forward deployed in support of combat operations, northern Djibouti, 2008.

identify a causative food item, but the consumption of frozen meat stored in a non-hermetic isothermal tin trunk during training and the consumption of mayonnaise and suspected rotten meat at a local restaurant before returning to camp were suspected.

In July 2009, a foodborne disease outbreak occurred among soldiers of a helicopter squadron after lunch at their canteen. The attack rate was 30.9% (17 of 55). The risk of illness was 11.6 times higher among those who had eaten roast veal with mushroom sauce (95% CI, 1.7–79.3) than among those who had not. The investigation demonstrated that food was not being stored and served in accordance with regulations: hot dishes were kept at a temperature < 63°C, and cold dishes were kept at a temperature > 8°C. Clinical symptoms, the average 12-hour incubation time, the absence of organisms in samples of stool, and the high fat content of the food were suggestive of toxin contamination with *Clostridium perfringens* or *Bacillus cereus*.

Other notifiable illnesses. During 2005–2009, no other notifiable gastrointestinal illness (botulism, brucellosis, cholera, typhoid fever, paratyphoid fever, hepatitis A, hepatitis E, listeriosis, and poliomyelitis) were reported among French soldiers deployed to Djibouti.

Relative incidence in Djibouti compared with that in Africa.

The risk of diarrhea was consistently higher among French soldiers deployed to Djibouti than among those deployed to other countries in Africa, as summarized in Table 3.

Assessing country data individually, we found that the rate of diarrhea and other gastrointestinal illness was higher in Chad than in Djibouti; during 2005–2009, it ranged from 697.2 to 1,413.7 cases per 1,000 person-years, which was 2–5 times higher than in Djibouti during the same period.

During 2005–2009, the rate of amebiasis decreased among French soldiers in Djibouti but remained stable among French soldiers in other countries in Africa. The risk of amebiasis was significantly higher in 2005 and 2006 in Djibouti than in other countries in Africa. The risk of shigellosis was similarly higher in Djibouti in 2006 and 2008.

DISCUSSION

This five-year review of medical surveillance data clearly documents that diarrhea was the most common reportable medical problem affecting French forces deployed to Djibouti. To our knowledge, our study is the first report describing the incidence of gastrointestinal illnesses and of the relative risk of gastrointestinal illnesses among French soldiers deployed

to Djibouti compared with those deployed to other countries in Africa.

Although this study found that annual incidence of diarrhea was relatively constant at 260–349 cases per 1,000 person-years, closer analysis and supporting epidemiologic field investigations showed an underlying seasonal, demographic, and epidemic nature to many of the cases.

Although several studies have highlighted an increase in reported diarrhea during initial combat phases of deployments compared with pre-combat and post-combat periods,^{2,19,20} such findings may be less pertinent in explaining findings in the stable, non-combat environment of Djibouti.

This study found two seasonal patterns of increased diarrhea risk: among new military personnel after their arrival, and among all soldiers after calendar week 39. This increase in diarrhea risk at the end of the year had been previously noted among reports of local cases submitted to civilian health authorities in Djibouti, which suggests increased transmission of pathogens during the rainy season.^{21,22}

This study also found that military personnel on long-term deployments were at consistently lower risk than those on short-term deployments. These findings may be best explained by the anecdotal observation that short-term military personnel are more likely to eat local off-base food than those deployed long-term; these soldiers typically eat at home and are therefore more likely to observe basic hygienic recommendations. Supporting this hypothesis are several studies that have found an association between time spent off base and diarrhea: among U.S. personnel during Operations Iraqi Freedom and Enduring Freedom and during support operations in Egypt, diarrhea was more likely to be reported as the spent off base increased, which suggests increased consumption of locally prepared foods and drinks.^{8,23–25}

These observations may also explain why the rate of diarrhea was so high among French forces in Chad, where during the period of this study, soldiers were exclusively deployed short-term. An unpublished study (Pommier de Santi V, unpublished data) conducted in Chad during October 2007–February 2008 demonstrated that the incidence of diarrhea among French forces decreased during a period of combat between Chadian forces and rebels, when off-base travel was limited, mandating the consumption of pre-packaged meals ready to eat.

Possibly as a result of the preventive functions of French military veterinary sanitary inspections, among four foodborne disease outbreaks reported during 2005–2009, only one, among military personnel of the helicopter squadron, occurred in a military canteen.

TABLE 3

Incidence rate among French soldiers deployed to Djibouti and relative risk of gastrointestinal illnesses compared with those deployed to other areas of Africa, 2005–2009*

Illness and region	2005		2006		2007		2008		2009	
	IR	RR (95% CI)	IR	RR (95% CI)	IR	RR (95% CI)	IR	RR (95% CI)	IR	RR (95% CI)
Diarrhea										
Djibouti	349.3	1.3 (1.2–1.4)	261.1	1.1 (1.0–1.2)	282.3	1.3 (1.2–1.4)	334.4	1.6 (1.5–1.7)	260.2	1.3 (1.2–1.4)
Rest of Africa	264.5	1.0 (Ref)	234.4	1.0 (Ref)	224.2	1.0 (Ref)	211.2	1.0 (Ref)	206.1	1.0 (Ref)
Amebiasis										
Djibouti	13.6	16.5 (8.2–33.0)	5.4	7.4 (3.3–16.8)	2.1	2.4 (0.9–6.7)	0.3	0.5 (0.1–3.5)	0.0	NA (NA)
Rest of Africa	0.8	1.0 (Ref)	0.7	1.0 (Ref)	0.8	1.0 (Ref)	0.8	1.0 (Ref)	0.6	NA (NA)
Shigellosis										
Djibouti	3.8	1.7 (0.8–3.3)	2.4	4.9 (1.6–14.5)	3.1	0.7 (0.3–1.4)	6.2	2.0 (1.1–3.6)	1.7	1.0 (0.4–2.7)
Rest of Africa	2.3	1.0 (Ref)	0.5	1.0 (Ref)	4.4	1.0 (Ref)	3.1	1.0 (Ref)	1.7	1.0 (Ref)

* Incidence rate is per 1,000 person-years. IR = incidence rate; RR = relative risk; CI = confidence interval; Ref = Referent; NA = not available.

Amebiasis was the second most commonly reported gastrointestinal illness. Nearly half (18 of 39) of all cases were linked to an outbreak that occurred in 2005. No results from an epidemiologic investigation were available to identify risk factors. The incidence rate of amebiasis decreased during 2005–2009. Because amebiasis is not reportable to civilian health authorities in Djibouti, comparison against local rates could not be performed.

Vaccination against cholera is not required for French soldiers because infection usually requires ingestion of grossly contaminated water and conditions of poor health. Although no cases of cholera have been reported among French soldiers, several cholera outbreaks caused by *V. cholerae* O1 biotype El Tor have occurred in Djibouti since 1973.^{26,27} The last cholera outbreak occurred during December 2006–April 2007 and was linked to earlier imported cases from Ethiopia; and in 2009, numerous cases of acute watery diarrhea suggestive of cholera also occurred among the population of Djibouti. Interestingly, the rate of diarrhea among French forces was lower in 2006 and 2009 than in the others years, which suggested that fears of imported cholera before and during the early onset of the civilian outbreaks led to improved compliance with basic hygiene recommendations among French personnel. Although the cholera outbreak persisted into 2007, French rates of diarrhea increased slightly compared with the previous year, which suggested that reduced compliance with hygiene recommendations after several months of familiarity with the civilian outbreak.

No case of poliomyelitis has been reported among French soldiers. The last endemic case confirmed in Djibouti was reported in 1992.^{21,22} Four, eight, and six cases of acute flaccid paralysis were reported to civilian health officials in Djibouti in 2007, 2008, and 2009, respectively. All were cases imported among foreigners.

Similarly, no cases of hepatitis have been reported among French soldiers. In 2007 and 2008, approximately 300 cases of hepatitis were reported to civilian health officials in Djibouti.^{21,22} Djibouti has a clinical case definition for reporting cases of hepatitis, but French health surveillance case definitions require laboratory confirmation. The incidence of hepatitis A among French soldiers has decreased since 1995 after targeted immunization of deployed French forces beginning in 1995 and a policy of generalized vaccination for those stationed in France beginning in 1998.²⁸

Diarrhea was the most commonly reported illness but only cases of diarrhea diagnosed by French military practitioners are reported. Many soldiers with diarrhea, like travelers, will not seek care, thus contributing to potentially significant underreporting. In one study, only 20% of long-term travelers with diarrhea sought treatment in a medical facility.² In another study performed in 1998 among French soldiers deployed to Central Africa, fewer than 20% of soldiers with diarrhea episodes sought medical consultation (Michel R, unpublished data). However, during deployment in Iraq and Afghanistan, another study found that approximately 60–80% of U.S. soldiers reporting diarrhea sought medical care at nearby, lower-echelon aid stations (which may differ markedly from French medical facilities), which suggested that variation in perceived accessibility of care may be responsible for some of the measured difference.^{24,29}

Diseases such as shigellosis, whose case definitions require laboratory confirmation, are likewise underreported or reported

simply as diarrhea. Variations in clinical diagnostic and management practices, which may temporally alter the proportion of cases undergoing laboratory confirmation, affect the validity of microscopic case-based surveillance. For example, although facilities exist for *Salmonella*, *Shigella*, *Campylobacter*, *E. coli*, and *Vibrio cholerae* to be identified in each country in Africa where French forces are deployed, stool examinations were likely less commonly performed during combat in Côte d'Ivoire. Diarrhea as a clinical syndrome generates more consistent reporting across locations, although syndromic surveillance provides few insights into causative organisms.

Enterotoxigenic *E. coli*, enteroaggregative *E. coli*, and *Salmonella* spp. are thought to be the predominant pathogens among soldiers deployed overseas.^{2,30} Outbreaks of Norwalk-like viruses are also common.^{5,6} A recent study performed in Djibouti demonstrated that 25% of stools samples collected from adults with sporadic acute diarrhea were positive for human caliciviruses, which were probably contracted in Djibouti.³¹ Within the French military health surveillance framework, enhanced microbiologic detection during foodborne illness outbreak investigations might provide insight into specific causative organisms such as these pathogens, but such methods would not enable ascertainment of the causative organism among more commonly reported diarrhea syndrome cases.

Our study was limited because it did not identify the most common cause of military diarrhea (diarrheagenic *E. coli*) and did not assess for norovirus. Future studies should more systematically determine the actual disease incidence (including persons who report for care and those who not report for care), morbidity (e.g., days lost, medical costs), and microbiologic results for the most important pathogens of interest.

A mainstay preventive medicine intervention to limit gastrointestinal illness during combat deployments is to mandate the consumption only of approved food items, such as meals ready to eat.^{6,26,27} However, during prolonged combat deployments and particularly as interactions with local populations increase, soldiers often improve their living conditions and seek novel foods through the local economy, as was observed during French support of combat operations in northern Djibouti. Maintaining discipline in food hygiene by mandating the consumption only of approved food items, even during the later stages of combat deployments, may serve to preserve critical operational effectiveness.

Similarly, during stability and peace-time deployments, where interaction with local populations are the usual pattern, local foods will often be eagerly consumed by newly arrived personnel, particularly among those for whom their deployment will be of limited duration. In our study, identification of personnel on short-term deployments and the period immediately after arrival as having the highest risk should reinforce the importance of targeting educational messages and hygienic recommendations. Emphasizing to all personnel, but particularly newly-arriving soldiers on short-term deployments, to avoid undercooked food, non-bottled beverages, and non-pasteurized dairy products; to disinfect raw vegetables and fruits with a diluted sodium hypochlorite solution and to peel fruits; to avoid consuming food sold by street vendors, salads, and raw seafood; using bottled water for drinking, making ice cubes, and brushing teeth; and washing hands

with soap and water or alcohol hand sanitizers before each meal are potentially useful,^{19,32} although unproven,³³ educational strategies that may serve to reduce morbidity caused by gastrointestinal illness.

Although the French forces health service has ranked acute diarrhea among its communicable disease priorities since 1997, the results of this study suggest that diarrhea remains a significant problem among deployed French soldiers, particularly those deployed to Djibouti. Although gastrointestinal diseases and diarrhea are seldom clinically complex and almost never fatal, they degrade operational effectiveness and result in substantial morbidity. Our identification of a period of increased risk among newly arrived soldiers on short-term deployments may enable efficient targeting of interventions to reduce morbidity from gastrointestinal illness, such as the reinforcement of educational messages and hygienic recommendations.

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