

# Knowledge gaps in the diagnosis and management of patients with tropical diseases presenting to Canadian emergency departments: are the gaps being met?

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## ABSTRACT

**Objective:** We conducted a needs assessment to identify knowledge gaps in the management of tropical diseases by Canadian emergency physicians and identify available, related continuing medical education (CME) resources.

**Methods:** A literature review was conducted to summarize challenges in the management of commonly encountered tropical diseases. An anonymous online survey was administered to Canadian emergency physicians using the Canadian Association of Emergency Physicians survey deployment service in July and August 2012. The survey identified self-reported gaps in knowledge and assessed knowledge using case-based vignettes. A list of CME resources was generated from a review of major academic emergency medicine journals, online cases, and conference topics from emergency medicine associations during 2010–2011. Two independent reviewers assessed the relevance of the resources; differences were resolved by consensus.

**Results:** From 635 citations, 47 articles were selected for full review; the majority (66%) were retrospective chart reviews, few (10.6%) had an emergency medicine focus, and fewer still were Canadian (8.5%). In total, 1,128 surveys were distributed, and 296 (27%) participants were included in the study. Most respondents reported “no” (52.4%) or “some” (45.9%) training in tropical medicine. Most (69.9%) rated their comfort in managing patients with tropical diseases as “low.” Few (11.1%) respondents reported a tropical disease being misdiagnosed or mismanaged; 44.1% indicated malaria. The perceived need for further training was high (76.7%). Conference workshops were the most highly requested CME modality, followed by case studies and podcasts. Correct answers to case vignettes ranged from 30.7 to 58.4%. Although 2,038 CME titles were

extracted from extensive searches, only 6 were deemed relevant.

**Conclusions:** Most Canadian emergency physicians have had minimal training in tropical diseases, reported a low comfort level in their management, and identified a high need for CME opportunities, which are lacking.

## RÉSUMÉ

**Objectif:** L'étude visait à réaliser une évaluation des besoins en ce qui concerne les lacunes en matière de connaissances sur la prise en charge des maladies tropicales par les urgentologues au Canada et à relever les ressources existantes en formation médicale continue (FMC).

**Méthodes:** Nous avons procédé à un examen de la documentation afin de résumer les difficultés rencontrées dans la prise en charge des maladies tropicales les plus fréquentes. Un questionnaire d'enquête en ligne, anonyme a été envoyé aux urgentologues, au Canada, par l'intermédiaire du service de transmission des enquêtes de l'Association canadienne des médecins d'urgence, en juillet et en août 2012. L'enquête a permis de relever les lacunes déclarées par les intéressés en matière de connaissances et d'évaluer les connaissances à l'aide de scénarios fondés sur des cas. Une liste de ressources en FMC a été dressée à partir d'un examen des principales revues médicales spécialisées en médecine d'urgence, de cas en ligne, et de sujets de congrès organisés par des associations de médecine d'urgence en 2010 et en 2011. Deux examinateurs ont évalué, chacun de leur côté, la pertinence des ressources; les divergences d'opinion ont été résolues par consensus.

**Résultats:** Quarante-sept articles ont été sélectionnés en vue d'un examen complet, à partir de 635 citations. La majorité (66%) de ces articles consistait en un examen rétrospectif de

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dossiers médicaux; un faible pourcentage (10.6%) concernait la médecine d'urgence et un pourcentage encore plus faible se rapportait à des études canadiennes (8.5%). Au total, 1128 questionnaires d'enquête ont été envoyés et 296 participants (27%) ont été retenus dans l'étude. La plupart des répondants ont fait état d'aucune formation (52.4%) ou d'une certaine formation (45.9%) en médecine tropicale. La majorité (69.9%) se sentait peu à l'aise dans le traitement des maladies tropicales. Un faible pourcentage de répondants (11.1%) a déclaré qu'une maladie tropicale avait fait l'objet d'un diagnostic erroné ou d'une prise en charge inappropriée; 44.1% ont indiqué le paludisme. Il y avait une forte perception du besoin d'une formation accrue en la matière (76.7%). Les ateliers offerts pendant les congrès a été la formule de FMC mentionnée le plus souvent, suivie des

études de cas et de la baladodiffusion. Le taux de bonnes réponses dans les scénarios fondés sur des cas et présentés dans le questionnaire variait de 30.7% à 58.4%. Sur 2038 titres de FMC tirés de la documentation à partir de recherches approfondies, 6 seulement ont été considérés comme pertinents.

**Conclusions:** La plupart des urgentologues au Canada ont fait état d'une formation minimale en maladies tropicales, d'un faible degré d'aise dans leur prise en charge, et d'un besoin important de FMC en la matière, formation qui fait défaut actuellement.

**Keywords:** education, emergency medicine, imported diseases, tropical diseases

Today it takes less than 36 hours to circumnavigate the world and people are on the move more than ever before. In 2001, an estimated 800 million people 'traveled': international travelers (698 million), migrant workers (7080 million), refugees and uprooted people (22 million), undocumented migrants (1015 million), and migrant victims of human trafficking (0.7 million). Canada is a major immigrant-receiving and tourist destination country.<sup>1</sup>

Imported tropical illnesses, such as malaria, dengue, and typhoid, are acquired in endemic regions and diagnosed when symptoms present in nonendemic countries.<sup>2</sup> Returning travellers, family and friends visiting from abroad, and immigrants arriving from tropical regions are at highest risk for presenting with such diseases.<sup>3</sup> With the global rise in immigration and travel, there has been a re-emergence of tropical diseases over the past 30 years in nonendemic countries.<sup>2,4-7</sup> This trend has resulted in challenges for emergency physicians, who are often the first point of contact for patients presenting with symptoms of tropical diseases.

The literature from nonendemic countries demonstrates major gaps in the diagnosis<sup>2,8-33</sup> and management of tropical diseases.<sup>2,3</sup> Diagnostic difficulties in identifying these diseases are often due to nonspecific symptoms and laboratory findings.<sup>3,9,14,19,33-37</sup> Many studies have demonstrated that misdiagnosis and delays in diagnosis result from a lack of awareness of these tropical diseases among clinicians in nonendemic regions<sup>15-19,35,38</sup> and the failure of the treating physician to elicit a travel history.<sup>2-4,9,11,15,17,39-41</sup> Physicians often provide incorrect treatment for tropical diseases due to either misdiagnosing patients or not possessing the

knowledge to prescribe evidence-based management.<sup>3,22,35,42-47</sup>

Given that emergency physicians are a common point of first contact into the health care system, it is imperative that they correctly identify and manage these patients as misdiagnosis and mismanagement can lead to prolonged illness or serious adverse events. We conducted a multifaceted needs assessment to identify knowledge gaps in the management of tropical diseases by Canadian emergency physicians and to identify available continuing medical education (CME) resources.

## METHODS

Knowledge gaps were assessed through three methods: a literature review, an online survey administered to Canadian emergency physicians, and an identification and evaluation of currently available educational tools pertaining specifically to tropical diseases.

### Literature review

A review was conducted to identify the literature examining the knowledge among emergency physicians in nonendemic Western countries in the diagnosis and management of commonly encountered tropical diseases. The search was conducted using the following databases: *Ovid MEDLINE In-Process & Other Non-Indexed Citations*, *Ovid MEDLINE* (1948 to August 2011), and *EMBASE* (1980 to August 2011). The following search terms were used as subject headings or key terms: emergency medicine, hospital emergency service, or emergency medical services;

tropical or travel; and diarrhea, enterotoxigenic *Escherichia coli*, *E. coli* infections, travellers' diarrhea, dengue, dengue virus, typhoid fever, *Salmonella typhi*, malaria, *Plasmodium*, tuberculosis, *Mycobacterium*, or communicable diseases.

Titles and abstracts were initially reviewed by a single reviewer (S.M.) and retained for full-article review if they were found to assess either the diagnosis or treatment of tropical diseases in nonendemic Western countries, including Canada, western Europe, and the United States. Articles published in English, French, or Spanish were included. Review articles providing general disease management were excluded. Case reports were considered if there was a paucity of literature on one of the included disease entities. The list of relevant articles was reviewed independently by a second reviewer (N.M.) to determine articles to be retrieved for full-text assessment. Differences were resolved through discussion. The findings are summarized below.

### **Survey administered to Canadian emergency physicians**

A modified Dillman methodology was used to develop the survey tool.<sup>48</sup> Using the results of the literature review and input from emergency physicians with training and expertise in global health and tropical diseases, the accepted minimum standard in the management of patients with tropical diseases was identified to develop case vignettes for the questionnaire. The survey was pilot tested with 10 emergency physicians from both academic and community hospitals in the Greater Toronto region, and revisions were completed based on feedback. The final survey is provided in the Appendix. Ethics board approval was obtained for survey deployment. The online, anonymous national survey was administered to emergency physicians across Canada using the Canadian Association of Emergency Physicians (CAEP) survey deployment service. As the survey addressed training to date and CME opportunities for fully qualified physicians, medical students and residents were excluded. The survey identified self-reported knowledge gaps and assessed tropical disease knowledge through responses to case-based diagnosis and management questions. The survey was deployed in July and August 2012 using one original survey deployment followed by two reminders. The results are summarized using descriptive statistics.

### **Evaluation of current CME educational resources**

The final component of the study was to identify up-to-date resources currently available to provide education in tropical disease to emergency physicians working in Western countries. A list of resource titles was generated from major Western academic emergency medicine journals (*Annals of Emergency Medicine*, *Canadian Journal of Emergency Medicine*, *Academic Emergency Medicine*, and *Journal Watch Emergency Medicine*) from September 2010 to September 2011, Medscape CME articles from April 2011 to September 2011, and topics from two major emergency medicine conferences commonly attended by Canadian emergency physicians (CAEP and American College of Emergency Physicians [ACEP]) for the years 2010 and 2011. Two independent reviewers (Y.K., P.C.) assessed the relevance of the listed resources identifying resources related to global health and narrowed to resources geared toward tropical diseases. Differences were resolved by consensus. The resources available for education in this area are summarized descriptively.

## **RESULTS**

### **Literature review**

A total of 635 and 882 articles were retrieved from MEDLINE and EMBASE, respectively, with 1,270 reviewed after removal of 247 duplicates. Forty-seven articles were included in the final literature review. The articles included retrospective chart reviews (66%), case series or reports (12.8%), prospective observational studies (10.6%), survey or questionnaire studies (4.3%), literature reviews (4.3%), and database studies (2.1%). Only four (8.5%) of the studies were Canadian, and only five (10.6%) had an emergency medicine focus. The majority of the articles discussed malaria, with 28.0% addressing the other tropical diseases searched.

A number of studies suggested that delays in diagnosis<sup>2,8–29</sup> and misdiagnosis<sup>3,9–11,19,20,30–33</sup> of tropical diseases, especially malaria, are common in nonendemic countries. The literature demonstrated major gaps in the diagnosis and management of tropical diseases.<sup>2,3</sup> Nonspecific symptoms,<sup>3,9,14,19,33–37</sup> a lack of awareness of the diseases in nonendemic regions,<sup>15–19,35,38</sup> and the failure of physicians to elicit a travel history<sup>2–4,8,11,15,17,40,41</sup> were reported to lead to both delays in diagnosis and misdiagnoses. Incorrect

treatment and absence of necessary monitoring led to inappropriate management<sup>3,22,35,42-47,49</sup>

Of the five studies with an emergency medicine focus, three studies showed missed or delayed diagnosis of malaria by emergency physicians in 38.0 to 47.0% of cases, with hepatitis, gastroenteritis, and viral illnesses accounting for the most common misdiagnoses.<sup>3,19,34</sup> One study reported a typhoid misdiagnosis rate of 85.7%.<sup>33</sup> A United Kingdom-based questionnaire study reported correct diagnosis of imported tropical disease rates by emergency physicians of 22%.<sup>40</sup> All four Canadian studies addressed malaria management, and none reported findings on other diseases.<sup>8,12,15,46</sup>

## Survey

### Participants' baseline characteristics

In total, 1,128 surveys were distributed to emergency physicians across Canada through the CAEP survey deployment service. Of the 1,128 surveys distributed, 315 individuals responded, 19 of whom were current medical trainees and excluded, and 296 participant responses were included in the study, for a response proportion of 27.0%.

The baseline characteristics of survey respondents are summarized in Table 1. The majority of respondents had more than 1 year of experience as an emergency physician (90.3%), and 48.9% had been practicing emergency medicine for more than 11 years. In terms of training, 46.6% of survey participants were CCFP(EM)-trained

physicians, 31.1% were FRCP(EM)-trained physicians, and 16.9% were family physicians. A similar proportion of respondents reported “no” training or “some” training in tropical diseases (52.4% and 45.9%, respectively), and only 1.7% of respondents reported “extensive” training. The majority of training was reportedly obtained during medical school (46.6%), during residency (26.4%), and through self-directed learning (14.2%).

### Needs assessment

The majority of participants (69.9%) rated their comfort level in managing patients with tropical diseases as “low,” whereas only 2.4% self-reported a “high” comfort level. In terms of history taking, 56.8% of emergency physicians reported always asking their patients who present with a fever about recent travel, whereas 41.2% asked this question “sometimes.” Approximately 11.1% of participants had been involved in or had heard of a misdiagnosed or mismanaged tropical disease case in the past year. Of these, 44.1% involved malaria management, with the cases involving misdiagnosis due to untimely screening tests or incorrectly arriving at an alternative diagnosis. Other identified diseases were dengue (11.8%), typhoid (8.8%), and tuberculosis (5.9%). Less common diseases were reported in 20.6% of cases: schistosomiasis, measles, dysentery, leishmaniasis, and neurocysticercosis. The perceived need for further training was high, with 76.7% of participants asking for more CME activities centred on tropical disease training. In terms of CME activities that participants would use, most participants requested workshops at conferences (71.6%), with fewer choosing case studies (64.7%) and podcasts (40.2%) as the preferred mode of training.

### Case vignette responses

Case vignettes were included as part of the survey to assess knowledge in terms of the diagnosis and management of tropical diseases. A total of 274 respondents (92.5%) completed this section of the survey. Complete results are presented in Table 2. Correct answers to the case vignettes ranged from 30.7 to 58.4% (mean 45.5%). Those unsure of the answers ranged from 7.7 to 47.8% (mean 29.3%).

### CME resources evaluation results

CME titles (2,038) were extracted and independently reviewed by two reviewers, with resource titles retained

**Table 1. Baseline characteristics of survey respondents**

Baseline characteristic	Answer options	%
Years of practice as an emergency physician	< 1	9.5
	1–5	20.7
	6–10	20.7
	11–20	24.8
	> 20	24.1
Emergency medicine training	Family physician	16.9
	CCFP(EM)	46.6
	FRCP(EM)	31.1
	Other	5.4
Tropical medicine training	No training	52.4
	Some training	45.9
	Extensive training	1.7
Tropical medical training obtained in/by*	Medical school	46.6
	Residency	26.4
	Self-directed learning	14.2

\*Percentages do not add to 100%.



Table 2. Case vignette results		
Question	Answer options	%
Case 1: A young man returns from a brief trip to sub-Saharan Africa's Zambezi River complaining of malaise and occasional diarrhea of 2 weeks' duration. Screening laboratory work shows mild anemia, eosinophilia, and 2+ red blood cells on dipstick. What is the most likely diagnosis?	Malaria	5.5
	<i>Schistosomiasis</i>	52.2
	Hookworm	6.6
	Onchocerciasis	4.0
	I am not sure	31.8
Case 2: A refugee is sent to your ED from the nursing home where he volunteers because in a routine medical screening, he was found to have a positive tuberculin skin test (which you confirm on visual inspection). He has no cough, and his x-ray is normal. Is it safe to discharge him and allow him to resume his duties?	Yes	58.4
	No	21.2
	I am not sure	20.4
Case 3: A 68-year-old male who immigrated to Canada 2 years ago from a malaria-endemic country and has recently returned from a 1-month visit back home presents to hospital feeling generally unwell with intermittent fever of 5 days' duration. He is brought in by his family, who report that he has been intermittently confused on the day of presentation. At present, he is alert, oriented, and behaving appropriately, looks well, his vital signs are stable and within the normal range. Which of the following statements is true?	The cause of the patient's fever and confusion cannot be malaria as those living in endemic areas develop immunity to malaria	0.7
	A thin and thick blood smear should be sent. If negative, malaria is ruled out.	28.8
	The patient should be put on oral antimalarial medication and followed up at an infectious disease clinic	14.6
	<i>The patient has severe malaria and requires admission</i>	48.2
	I am not sure	7.7
Case 4: You have an HIV-positive patient from eastern Africa who comes to your emergency department with a decreased level of consciousness. He has recently obtained refugee status in Canada. He is not on antiretroviral medications, and his last CD4 count was 53 cell/ $\mu$ L. His noncontrast CT scan is normal. You perform an LP. Which of the following are you most likely to find when testing his CSF?	<i>Positive CSF Indian ink stain</i>	30.7
	Positive <i>Salmonella typhi</i> culture	1.1
	Positive PCR for dengue	1.1
	Positive antibody assay for toxoplasmosis	28.5
	I am not sure	38.7
Case 5: A patient presents to the ED with fever, constipation, and malaise. She returned from India 3 weeks ago after working in an urban area. She lived there for 1 year. As far as she knows, before she left for India, she updated all the recommended immunizations for travel to India, including typhoid vaccine. Is it possible for this patient to have typhoid fever?	No, as typhoid immunization provides protection for 2 years	4.0
	<i>Yes, as typhoid immunization provides only 50% protection</i>	38.0
	No, as typhoid fever is not an issue in urban areas	0.7
	Yes, as typhoid vaccine provides protection only for 6 months	9.5
	I am not sure	47.8

CSF = cerebrospinal fluid; CT = computed tomographic; ED = emergency department; HIV = human immunodeficiency virus; LP = lumbar puncture.  
Italics indicate correct answers.

if they related to global health. Disagreement on 21 items was resolved through discussion and consensus. Forty-two of the extracted items were found to be educational resources in the field of global health available to emergency physicians. Six conference presentations were identified as educational resources with a single focus on tropical diseases. No journal articles with a focus on tropical diseases were identified.

## DISCUSSION

This multifaceted needs assessment is the first to describe and quantify the status of existing knowledge gaps and the need for dedicated tropical disease CME

among Canadian emergency physicians. The majority of survey respondents were experienced emergency physicians, yet most had minimal or no specific training in the management of tropical diseases that commonly present to the ED. Canadian emergency physicians reported an unacceptably low level of comfort when faced with patients presenting with tropical diseases in the ED. Objective knowledge assessment in this study demonstrated that Canadian emergency physicians incorrectly diagnosed or managed clinical cases of tropical diseases 40.0% of the time. In comparison, a United Kingdom-based questionnaire study using five clinical cases showed incorrect diagnosis of imported tropical disease rates by emergency physicians of 78%.<sup>40</sup>

This national educational needs assessment study demonstrates a strong perceived need for dedicated CME materials focused on tropical disease training among respondents. Canadian emergency physicians indicated that they would like to receive general reviews and approaches to specific tropical diseases, particularly in the form of workshops, case studies, and podcasts. Our search of the currently published emergency medicine literature indicates that minimal resources are available in this domain. To fill this unmet educational need in the face of an increasing incidence of tropical diseases presenting to Canadian EDs, it is important that Canadian emergency medicine organizations, journals, and academic institutions focus their efforts on generating dedicated educational resources geared specifically toward Canadian emergency physicians. In the meanwhile, all emergency physicians should make efforts to obtain a detailed travel history in all patients with fever and consider malaria, typhoid, dengue, and tuberculosis as part of their differential diagnosis. The Centers for Disease Prevention and Control (CDC) *Yellow Book* provides an overview of imported tropical diseases based on travel site,<sup>50</sup> and for the more common diseases, such as malaria and dengue, the CDC maps can be used as a quick reference.<sup>51,52</sup>

There are a number of limitations to our study. First, although a structured literature review was conducted, only two databases were included. No attempt was made to capture the grey literature, and methodological quality was not reported. The CAEP survey deployment tool targets members only, and non-CAEP member emergency physicians would not have been able to participate. Our survey response proportion was low, which may have resulted in sampling bias. There may be a few explanations for the low response rate: the survey was conducted in the summer, which may have been influenced by vacation absence. Although we sent out three survey reminders by email, no regular mail surveys were distributed and incentives were provided.

## CONCLUSION

This multifaceted needs assessment was the first to describe and quantify that most Canadian emergency physicians have had minimal training in tropical diseases, perceived a low comfort level in managing such cases, and identified a high need for CME

opportunities. This identified gap warrants further research and new efforts to improve CME opportunities for Canadian emergency physicians in this domain. Several specific educational resources were identified.

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## APPENDIX: SURVEY QUESTIONS

How many years have you practiced as an emergency physician?

- a) < 1 year
- b) 1–5 years
- c) 6–10 years
- d) 11–20 years
- e) > 20 years

What is your training?

- a) Family physician
- b) CCFP(EM)
- c) FRCP(EM)
- d) Other (please specify) \_\_\_\_\_

How much training do you have in tropical diseases?

- a) No training
- b) Some training
- c) Extensive training

Where did you obtain your tropical medical training? (tick all that apply)

- a) Medical school
- b) Part of residency training
- c) Sought out training on my own (please describe in text box below)

Please describe your extra training here. (text box follows)

Please rate your comfort level in managing patients with tropical diseases.

- a) Low
- b) Medium
- c) High

How often do you ask your patients with fever if they have recently travelled?

- a) Never
- b) Sometimes
- c) Always

Do you know of a tropical disease case that you or a colleague misdiagnosed or mismanaged in the last year?

- a) Yes
- b) No

If yes, please provide a brief description of the case and problem(s) encountered.

In your opinion, do you perceive a need for more continuing medical education (CME) activities focused on tropical diseases?

- a) Yes
- b) No

If yes, please briefly describe what you think is needed and why. \_\_\_\_\_

Please choose which of the following CME tools you would use. (tick all that apply)

- a) Case studies (e.g., similar to Medscape CME case studies)
- b) Workshops at conferences
- c) Podcasts
- d) Other (please specify)

### Case-Based Vignettes

1. A young man returns from a brief trip to sub-Saharan Africa's Zambezi River complaining of malaise and occasional diarrhea of 2 weeks' duration. Screening laboratory work shows mild anemia, eosinophilia, and 2+ red blood cells on dipstick. What is the most likely diagnosis?
  - a. Malaria
  - b. Schistosomiasis



- c. Hookworm  
 d. Onchocerciasis  
 e. I am not sure
2. A refugee is sent to your emergency department from the nursing home where he volunteers because in a routine medical screening, he was found to have a positive tuberculin skin test (which you confirm on visual inspection). He has no cough, and his x-ray is normal. Is it safe to discharge him and allow him to resume his duties?
- a. Yes  
 b. No  
 c. I am not sure
3. A 68-year-old male who immigrated to Canada 2 years ago from a malaria-endemic country and has recently returned from a 1-month visit back home presents to hospital feeling generally unwell with intermittent fever of 5 days' duration. He is brought in by his family, who report that he has been intermittently confused on the day of presentation. At present he is alert, oriented and behaving appropriately, looks well, his vital signs are stable and within the normal range. Which of the following statements is true?
- a. The cause of the patient's fever and confusion cannot be malaria as those living in endemic areas develop immunity to malaria  
 b. A thin and thick blood smear should be sent. If negative, malaria is ruled out.  
 c. The patient should be put on oral antimalarial medication and followed up at an infectious disease clinic  
 d. The patient has severe malaria and requires admission
- e. I am not sure
4. You have a human immunodeficiency virus (HIV)-positive patient from eastern Africa who comes to your emergency department with a decreased level of consciousness. He has recently obtained refugee status in Canada. He is not on antiretroviral medications, and his last CD4 count was 53 cells/ $\mu$ L. His noncontrast computed tomographic scan is normal. You perform a lumbar puncture. Which of the following are you most likely to find when testing his cerebrospinal fluid (CSF)?
- a. Positive CSF Indian ink stain  
 b. Positive *Salmonella typhi* culture  
 c. Positive polymerase chain reaction for dengue  
 d. Positive antibody assay for toxoplasmosis  
 e. I am not sure
5. A patient presents to the emergency department with fever, constipation, and malaise. She returned from India 3 weeks ago after working in an urban area. She lived there for 1 year. As far as she knows, before she left for India, she updated all the recommended immunizations for travel to India, including typhoid vaccine. Is it possible for this patient to have typhoid fever?
- a. No, as typhoid immunization provides protection for 2 years  
 b. Yes, as typhoid immunization provides only 50% protection  
 c. No, as typhoid fever is not an issue in urban areas  
 d. Yes, as typhoid vaccine provides protection only for 6 months  
 e. I am not sure