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Original article

Travel preparation and health risks in Dutch and Belgian medical students during an elective in low- or middle-income countries: A prospective self-reporting cohort study

Jessica A. Vlot[a,*], Anastassia I. Blanter[a], Emile F.F. Jonker[a], Nina S. Korse[a], Evelien Hack[b], Leonardus G. Visser[a], Darius Soonawala[c,d]

[a] Department of Infectious Diseases, Leiden University Medical Center (LUMC), Leiden, the Netherlands
[b] Medical School Internationalization Network Netherlands & Flanders, Leiden, the Netherlands
[c] Department of Nephrology, Leiden University Medical Center (LUMC), Leiden, the Netherlands
[d] Department of Internal Medicine, Haga Teaching Hospital, The Hague, the Netherlands

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ABSTRACT

Background: Medical schools offer students the opportunity to perform international electives. This study aimed to assess health risks among medical students, to tailor institutional guidelines.

Methods: Multicenter study at Dutch and Belgian universities, among medical students who visited low- or middle-income countries. Students completed four questionnaires: once before the elective and two weeks, three- and six months after return.

Results: Data was complete for 479 students (follow-up rate 84%). Most traveled to Surinam (29%) and South-Africa (14%). Half of the students encountered difficulties in adapting to local culture. Almost 40% visited malaria endemic countries. Nearly all (87%) used chemoprophylaxis as prescribed. Definite needle-stick or splash injuries were reported by 7%. All were dealt with adequately in accordance with national guidelines. However, less than half of 24 possible incidents were handled adequately. Two-and-a-half percent had unprotected sex with a new partner. The incidence of travelers' diarrhea (TD) was 46%. In those with TD, the incidence of post-travel new-onset abdominal complaints was 3%. Three percent were involved in a minor traffic accident, 18% were injured during leisure activities, 5% were threatened or experienced physical violence. Only half of the students visiting a highly endemic country were screened for tuberculosis post-travel. For schistosomiasis this was 6%.

Conclusions: Students abroad are exposed to medical and non-medical challenges, which should be addressed during pre-travel counseling. Contact details of a professional back home should be provided, so students can confer in case of problems while abroad. Lastly, we recommend a centrally organized post-travel health check.

1. Introduction

Teaching global health is an important part of medical education. It enhances doctors' knowledge of global burden of disease, tropical diseases, ethnicity-related health issues and health care systems in other countries [1,2]. Many medical schools offer the opportunity to perform an elective abroad. Students often choose electives in low- or middle-income countries (LOMIC), where they are exposed to specific work- and travel-related health risks, such as needle-stick injuries, traffic accidents and travelers' diarrhea (TD). Visiting LOMIC countries is also associated with a higher risk of contracting infectious diseases, such as tuberculosis (TB), malaria, helminths and colonization with multidrug-resistant bacteria [3–7]. Psychological stressors and culture shock are frequently reported in post-travel health surveys as well [8].

Adequate pre-travel counseling can reduce morbidity in travelers [9,10]. Several studies have assessed pre-travel preparation and health risks in (medical) students during an elective abroad [8,11–22]. These are mainly single-center questionnaire studies performed upon return from an elective, which limits the generalizability and increases the chance of recall bias. By performing a prospective multicenter international study, combining pre- and post-travel data from Dutch and Belgian universities, we provide unique insight into pre-travel advice, health risks and post-travel care. This data can be used to optimize care for students who perform an elective in LOMIC countries.

* Corresponding author. Department of Infectious Diseases C5-P-47C, Leiden University Medical Center (LUMC), Albinusdreef 2, 2333 ZA, Leiden, the Netherlands.
E-mail address: j.a.vlot@lumc.nl (J.A. Vlot).

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2. Material and methods

2.1. Study design

For this prospective multicenter study, medical students planning an elective abroad were recruited from three Dutch universities (Leiden University [July 2010–May 2016], VU University Amsterdam [May 2013–November 2016], University of Groningen [July 2013–March 2016]) and two Belgian universities (University of Leuven [January 2014–February 2016] and Ghent University [February 2015–December 2016]). We focused on students visiting LOMIC countries defined as countries where hepatitis A is endemic. Students following multiple electives abroad could participate only once.

Eligible students were identified when they registered at the international office of their university in order to receive study credits for the future elective abroad. Travel- and contact information was gathered by the coordinator for internationalization of the Directorate of Education and Study Programmes in Leiden and was periodically sent to the investigators. Two weeks before departure all eligible students were invited to take part in the study by an e-mail, sent on behalf of the contact person at the local international office. A monetary incentive was given to optimize the response rate.

2.2. Survey

The study consisted of four web-based questionnaires, which were to be filled out two weeks before departure (Q1), and two weeks (Q2), three months (Q3), and six months after returning home (Q4). Web links to the e-questionnaires were sent by e-mail, NetQPremium (NetQ Netherlands B.V., Utrecht, the Netherlands). The questionnaires concerned pre- and post-travel health status, health risks and post-travel health checks (e.g. TB, Methicillin-resistant Staphylococcus Aureus, and schistosomiasis). Information on questionnaire items is summarized in Supplementary Table S1. Those who did not complete a questionnaire received up to four weekly reminders. If a questionnaire was not completed by the due date of the next questionnaire, participation in the study ended.

2.3. Definitions

TD was defined as the passage of three or more unformed stools during a 24-h period with or without additional symptoms like abdominal cramps, nausea, vomiting or fever. Fever was defined as a body temperature ≥ 38 °C. Travel destination was categorized in six regions (Table 1). Assisting during surgeries or deliveries, suturing, placing an intravenous catheter and performing phlebotomy were considered invasive procedures due to an increased risk of exposure to blood-borne viral infections. Needle-stick injury was defined as an accidental skin puncture with a sharp medical instrument which has potentially been in contact with human body fluids; a splash injury as an accidental spraying of body fluids onto mucocutaneous surfaces. Some students reported that they were uncertain whether an event that they had experienced could be classified as a true needle-stick or splash injury. These events were classified as possible needle-stick or splash injuries.

2.4. Data processing

An elective was considered to be clinical when invasive procedures could be performed. For privacy reasons only year of birth was recorded. LCR guidelines (National Travel Advice Coordination Center) were used to classify the countries that were visited as TB-, malaria- and schistosomiasis endemic areas [11]. HIV prevalence data was obtained from the WHO [12]. Culture shock was measured using an adapted version of a questionnaire developed by Mumford. Four questions were scored 2, 1 or 0, according to decreasing severity [13]. Additionally, sum scores for the cohort and the continents were calculated. Chronic abdominal discomfort was defined as discomfort or pain, unrelated to menstrual bleeding, for ≥ 3 days per month during more than six months. Pre- and post-travel diarrhea was defined as loose, mushy or watery stool for ≥ 3 days per month during the last three months.

2.5. Statistical analyses

All data were exported directly from the NetQ server into IBM® SPSS® Statistics version 23.0 for analyses. Data was only analyzed for students who had completed all four questionnaires. Anonymization was done by using unique study numbers. Descriptive statistics and univariable analysis were used to analyze the data where appropriate. Statistical significance was defined as a p-value < 0.05.

2.6. Ethics

The study was endorsed by the Committee Medical Ethics (CME) of the Leiden University Medical Center, Leiden, the Netherlands (registry number P11.046). They decided that the study does not fall under the scope of the Medical Research Involving Human Subjects Act (in Dutch: WMO). Participants provided digital informed consent by completing the first questionnaire.

3. Results

Over a six-year period, 1178 students fulfilled the inclusion criteria. Fifty-six students had already left for their elective and could not be invited to participate, leaving 1122 eligible students. The response rate was 51% (572/1122) and the follow-up rate was 84% (479/572), with 479 students completing all questionnaires (see Supplementary Figs. S1 and S2). The majority (80%) was Dutch.

3.1. Student and travel characteristics

Participants were predominantly female (76%) with a median age of 24 years (interquartile range (IQR) 23–25). The most popular destinations were South America (in particular Surinam) and Africa (in particular South-Africa). The median time spent abroad was 67 days (range 24–234 days). Belgian students stayed abroad significantly longer than Dutch students: median 91 days versus 61 days. Two-thirds combined their elective with a holiday in the same region. This was more common among Dutch students. Belgian students only went on elective during the masters' program, whereas 10% of Dutch students was still in their bachelor program. The majority conducted a clinical (78%) or preclinical elective (13%). Most popular specialties were gynaecology/obstetrics (44%) and pediatrics (38%). Every student was vaccinated against hepatitis B as part of the regular medical curriculum. Four students did not know their antibody titer (1%).

Students themselves were responsible for obtaining pre-travel health and safety advice. The majority (93%) did so, mainly at a travel clinic. More than 90% of students had access to internet within 30 min of their accommodation with sufficient mobile phone reception to connect with family and friends. Most accommodations were equipped with basic facilities such as running water and sanitation and 38% had air-conditioning. Electricity was mostly available around the clock; although not always in Africa (37%) and Asia (28%) (see Supplementary Table S2).

3.2. Culture shock

Students staying in Central America had the highest culture shock mean sum score (2.95), followed by Africa (2.52). Half of the students experienced some kind of difficulty in adapting to the local culture. Most students felt accepted by the local population (87%). A minority frequently suffered from homesickness (5%), which was associated with lack of a functioning mobile phone network ($p = 0.04$) and with the

Table 1
Culture shock in 464 Dutch and Belgian medical students, stratified by continent[a].

	All students N = 464	South America N = 178 (38.4)	Africa N = 176 (37.9)	Asia N = 82 (17.7)	Central America N = 21 (4.5)	Middle East N = 7 (1.5)
Difficulty adapting						
Most of the time	35 (7.5)	15 (8.4)	17 (9.7)	2 (2.4)	1 (4.8)	0
Occasionally	235 (50.6)	87 (48.9)	89 (50.6)	42 (51.2)	14 (66.7)	3 (42.9)
Not at all	194 (41.8)	76 (41.7)	70 (39.8)	38 (46.3)	6 (28.6)	4 (57.1)
Homesick						
Most of the time	24 (5.2)	2 (1.1)	13 (7.4)	4 (4.9)	4 (19.0)	1 (14.3)
Occasionally	239 (51.5)	86 (48.3)	92 (52.3)	43 (52.4)	14 (66.7)	4 (57.1)
Not at all	201 (43.3)	90 (50.6)	71 (40.3)	35 (42.7)	3 (14.3)	2 (28.6)
Feeling accepted						
No	28 (6.0)	16 (9.0)	5 (2.8)	5 (6.1)	2 (9.5)	0
Not sure	32 (6.9)	11 (6.2)	10 (5.7)	9 (11.0)	2 (9.5)	0
Yes	404 (87.1)	151 (84.8)	161 (91.5)	68 (82.9)	17 (81.0)	7 (100)
Shocked or disgusted						
Many things	33 (7.1)	4 (2.2)	22 (12.5)	5 (6.1)	1 (4.8)	1 (14.3)
A few things	324 (69.8)	107 (60.1)	139 (79.0)	59 (72.0)	16 (76.2)	3 (42.9)
None	107 (23.1)	67 (37.6)	15 (8.5)	18 (22.0)	4 (19.0)	3 (42.9)
Culture shock sum score[b], *mean (SD)*	2.31 (1.40)	2.05 (1.46)	2.52 (1.30)	2.26 (1.42)	2.95 (1.02)	2.00 (1.73)

Data are presented as n (%).
P-values for the relation between the culture shock variables and the continent were calculated using the Chi-Square test: difficulty adapting ($p = 0.309$), homesickness ($p = 0.002$), feeling accepted ($p = 0.181$) and shocked or disgusted ($p < 0.001$).

[a] Data is missing of 15 Dutch students (3%) due to an earlier version of the questionnaire without culture shock questions. This includes the student visiting Eastern Europe and is therefore not reported in this table. Students answered the following questions regarding culture shock: Do you feel strain from the effort to adapt to a new culture? (difficulty adapting), Have you been missing your family and friends back home? (homesick), Do you feel generally accepted by the local people in the new culture? (feeling accepted), Have you found things in your new environment shocking or disgusting?.

[b] Answer categories of culture shock questions were scored 2, 1 or 0 (according to decreasing severity) with a maximum score of 8 for each student.

Table 2
Invasive procedures among medical students during an elective abroad stratified by adult HIV prevalence rates at destination.

			WHO rates (n = 441)[a]							
	All students		HIV < 1%		HIV 1–5%		HIV 5–10%		HIV 10–20%	
	N = 479		N = 123		N = 184		N = 59		N = 75	
Invasive procedures[b]										
Surgical practice	262	(54.7)	68	(55.3)	100	(54.3)	33	(55.9)	57	(76.0)
Obstetric practice	195	(40.7)	54	(43.9)	66	(35.9)	42	(71.2)	30	(40.0)
Suturing	179	(37.4)	47	(38.2)	64	(34.8)	23	(39.0)	42	(56.0)
Placing an intravenous catheter	152	(31.7)	19	(15.4)	49	(26.6)	25	(42.4)	56	(74.7)
Performing phlebotomy	137	(28.6)	23	(18.7)	36	(19.6)	20	(33.9)	56	(74.7)
None of the above	98	(20.5)	19	(15.4)	39	(21.2)	2	(3.4)	8	(10.8)
Availability to PEP										
Locally available[c]	205	(42.8)	32	(26.0)	89	(48.4)	20	(33.9)	59	(78.7)
Unknown	103	(21.5)	39	(31.7)	47	(25.5)	4	(6.8)	0	
Pre-travel allocated	82	(17.1)	17	(13.8)	18	(9.8)	34	(57.6)	13	(17.6)
No invasive procedures performed	58	(12.1)	26	(21.1)	11	(6.0)	0		2	(2.7)
Not available	31	(6.5)	9	(7.3)	19	(10.3)	1	(1.7)	1	(1.4)
Needle stick or splash injury [d]										
Definite[e]	*33*	*(6.9)*	*6*		*12*		*1*		*14*	
Action taken										
Discussed injury with physician	30	(91.0)	5		11		1		13	
Source tested for HIV/HepB/HepC	23	(69.7)	4		9		1		9	
PEP used after injury	8	(24.2)	0		2		0		6	
Possible	*24*	*(5.0)*	*8*		*6*		*2*		*7*	
Action taken										
Discussed injury with physician	9	(37.5)	2		1		2		4	
Source tested for HIV/HepB/HepC	4	(16.7)	1		0		0		4	
PEP used after injury	0		0		0		0		0	

Data are presented as n (%); PEP = post-exposure prophylaxis for HIV.

[a] WHO rates were not available for several visited countries (38/479, 8%).

[b] Students could select > 1 answer.

[c] Available in clinic or locally bought.

[d] Total number of students is 53, but two students experienced both a definite needle stick and splash injury (one in country with a HIV prevalence of 10–20% and one in a country with a HIV prevalence < 1%), one other student experienced both a possible stick and splash injury (HIV prevalence 10–20%), and another student experienced a definite needle stick injury but also a possible splash injury (HIV prevalence 1–5%). For another student with a possible splash injury the HIV prevalence was unknown.

[e] Incidents occurred during suturing, needle recapping, performing phlebotomy or assisting during surgery.

destination (p = 0.002). An association was found between the continent that was visited and feelings of disgust or shock (p= < 0.001). Nearly all students travelling to Africa (91%) reported feelings of disgust or shock by something they encountered while abroad (Table 1). There was no significant difference between Dutch and Belgian students regarding the four culture shock items (see Supplementary Table S3).

3.3. Malaria prevention

Thirty-nine percent (185/479) traveled to a malaria endemic region and started chemoprophylaxis; mostly atovaquone/proguanil (70%) or mefloquine (24%). Nine students obtained the prophylaxis locally. The majority also used a bed net (83%). In addition, 61 students carried prophylaxis, but did not need to use it, as they remained in low or non-endemic regions (see Supplementary Table S4).

A quarter experienced side effects after starting malaria prophylaxis, 26% (33/129) on atovaquone/proguanil and 30% (13/44) on mefloquine. Atovaquone/proguanil mostly caused gastrointestinal complaints (19/129, 15%) and mefloquine psychological symptoms and sleep disorder (12/44, 27%). Weight loss during the elective was not associated with a higher incidence of mefloquine related side effects (p = 0.13). Twenty-four students (13%) stopped using prophylaxis prematurely due to side effects or because they forgot to take the pills or came to know that they were staying in a low or non-endemic region. This led to three students being unprotected in a high endemic region (Kenia, Tanzania and Rwanda). Only two students discussed stopping their prophylaxis with a medical professional (see Supplementary Table S4). In this large student cohort, four cases of malaria were reported in students visiting Africa despite the use of malaria prophylaxis. Only one was reported to be confirmed by laboratory tests. All recovered without sequelae.

3.4. Risk of blood-borne viral infection

One in three students (134/441, 30%) visited a country with a HIV prevalence of 5% or more. Students visiting these countries performed more invasive procedures than students visiting countries with a lower HIV prevalence (p = 0.002). Most students (94%) had access to post-exposure prophylaxis (PEP) for HIV. Thirty-three students had a definite needle-stick or splash injury (Table 2). In almost all cases, either the source was tested for viral infection (70%) and/or PEP was started (24%). Almost all incidents were discussed with a local physician (91%). In addition, there were 24 possible incidents. Just under half of the students dealt with these incidents adequately in accordance with the national guidelines. After returning home, only a minority (28%) actively reported the (possible) injury to a health professional.

Overall, 22% (105/468) had sex during their time abroad. Eleven students (2%) opted not to answer this question. Forty students (38%) reported having had sex with their own partner and 63% with a new partner, whereof half with a local person (Dutch students: 19/81, 23%; Belgian students 15/24, 63%). Almost one in six sexual encounters (17%) with a new partner was unprotected (Table 3).

Fifteen students (3%) received an intramuscular injection and six (1%) were given intravenous treatment, mostly antibiotic therapy. Seven (2%) visited a local dentist and three students (1%) got a tattoo.

3.5. Travelers' diarrhea

Travelers' diarrhea (TD) occurred in 222 students (46%), more often in Belgian students than Dutch students (61% versus 43%, p = 0.002) (Table 3). The incidence was highest for travelers to Africa (46%), followed by South America (25%) and Asia (23%). Accompanying symptoms were predominantly abdominal cramps (93%), watery stool (76%), fecal urgency (77%), nausea (57%), vomiting (26%) and fever (23%). Six students reported bloody diarrhea (3%). One in four students had symptoms for more than one week (24%). One hundred and thirteen students (51%) experienced more than one episode of diarrhea. Almost half (46%) used self-treatment: loperamide (79%), oral rehydration solution (49%), an antibiotic (30%) or activated carbon (3%). Twelve students (5%) consulted a local physician. Two students were admitted to hospital with fever and gastroenteritis. Many students experienced moderate inconvenience due to the gastro-intestinal complaints: 71 (32%) were confined to their accommodation and an additional 28 (13%) needed to change planned activities. One student was forced to interrupt the elective and return home. Students who stayed in an accommodation without running water or without a refrigerator had a significantly higher chance of developing TD (both p < 0.001).

Table 3
Health risks and health related incidents during a foreign elective.

	All students	
	N = 479	
Sexual contacts[a]	109/468	(23.3)
New partner involved	69/109	(63.3)
Protected	57	(82.6)
TD	222	(46.3)
Fever not related to TD complaints	36	(7.5)
Malaria[b]	4	(0.8)
Schistosomiasis	1	(0.2)
Altitude sickness	20/472	(4.2)
Bitten by an animal	5	(1.0)
Traffic accidents	13/474	(2.7)
Injuries during leisure activities	85/474	(17.9)
Victim of physical violence	4/473	(0.8)
Victim of threat or intimidation	25/471	(5.3)

Data are presented as n and %; TD = traveler's diarrhea.
[a] 11 students did not answered this question, two students had both a new local and non-local partner (condom used) and one student had sex with own partner, but also with a new local and non-local partner (no condom used); so total new sexual contacts add up to 109 instead of 105.
[b] Only one was reported to be confirmed by a laboratory test.

3.6. Other health-related events while abroad

In Surinam there was one case of cutaneous larva migrans and three students with fever were diagnosed with chikungunya, dengue fever and zika by a local doctor. Two of these students needed to change their activities for several days. Five students reported a bite from a dog (one in Surinam, two in Tanzania), monkey (Thailand) or cat (Cuba). Three of the five students had been vaccinated for rabies in the past. None received post-exposure prophylaxis. There were no cases of rabies.

Thirteen students (3%) were involved in a traffic accident. All injuries were minor. Eighty-five students (18%) suffered injuries during leisure activities: four fractures of the extremities, and 81 minor injuries. One student with a fibula fracture was repatriated from Bolivia. Twenty-five students (25/471, 5%) experienced threat or intimidation, whereof three also encountered physical violence. Most of these cases occurred in Africa (60%) and South America (24%). Twenty students (4%) suffered from altitude sickness; nine in South America, six in Asia and five in Africa (Table 3). Altitude sickness was reported more in Belgian than Dutch students (11% versus 3%, p = 0.002).

3.7. Antibiotic use

One third (30%) carried prescribed antibiotics to their destination, Belgian students more often so than Dutch student (80% versus 18%, p < 0.001). Sixty-one students (13%) used an antibiotic: 22% of Belgian students and 10% of Dutch students (p = 0.002). Ciprofloxacin, azithromycin, and amoxicillin were used most frequently. Almost half of the antibiotics (46%) had been prescribed in the home country. Antibiotics were mainly used for gastro-intestinal complaints (53%), skin- (15%), urinary-tract- (13%) or respiratory-tract infections (12%).

3.8. Post-travel gastro-intestinal complaints and other health problems

Students who experienced TD were more likely to report diarrhea for ≥3 days per month at three and six months after travel than before travel and this pattern was not seen in students without TD. The prevalence of abdominal discomfort was not different after travel than before (see Supplementary Table 5).

Almost one fifth (18%) experienced ongoing health problems in the first three months after returning home. Many (42%) attributed these complaints to their stay abroad (e.g. respiratory and urinary tract infections and gastrointestinal complaints) and 18 of these students were hereby limited in their activities. Four students had to interrupt their study for several days to weeks due to ulcerative keratitis, retinal detachment and fractures. The ocular problems were deemed unrelated to travel.

3.9. Post-travel health checks

3.9.1. Tuberculosis (TB)

Students who participated in an internship abroad were advised to be screened for TB after returning home. Nearly two-thirds (n = 281) visited a highly endemic country (> 50/100.000 cases of active TB per year). Only half (n = 142) were screened after returning home. Screening was more common among Dutch than Belgian students (57% vs 27%). Six students had a positive test (6/142, 4%). Most were screened with a tuberculin skin test (TST), which yielded four positives. A minority (n = 16) was screened with a QuantiFERON test (QFT) which yielded two positives. Five students were screened with QFT after the TST was positive. Two tested positive on the QFT, whereof one was treated for latent TB (Table 4).

3.9.2. Methicillin-resistant Staphylococcus Aureus (MRSA)

Post-travel screening for MRSA was done in 45%. Only 4% of the Belgian students were checked and 55% of the Dutch students ($p < 0.001$), which reflects local policy (Table 4). Only one student was identified as an MRSA carrier which resulted in a two-week delay in starting a research internship. A confirmatory test was negative. MRSA screening was performed by the teaching hospitals or the university's occupational health service.

3.9.3. Schistosomiasis

Three hundred and ninety one students (82%) visited a schistosomiasis endemic country, whereof 199 (50%) were exposed to fresh (surface) water. Seventeen students (9%) were offered praziquantel in the endemic country and 14 used it. Five students started treatment within six weeks after the last freshwater contact, which is considered too early. Only 19 students (10%) consulted a physician upon return and mentioned the freshwater contact. Eleven students (6%) were screened and in one student returning from Malawi schistosomiasis was diagnosed and treated (Table 4).

4. Discussion

In this multicenter study we assessed pre-travel advice, health risks and post-travel care in Dutch and Belgian medical students during an elective in low- and middle-income countries. We found that a large proportion of medical electives was performed in a limited number of clinics in specific countries, based on existing collaborations. This offers the opportunity to organize travel-care efficiently for a large group of students (recommendation 1). The quality of housing was fairly high, with the vast majority having access to running water, a refrigerator and an internet connection. The overall use of malaria chemoprophylaxis was good. Few students in endemic areas were unprotected, after

Table 4
Post-travel screening for TB, MRSA and schistosomiasis in Dutch and Belgian medical students visiting endemic areas.

	All students		Dutch students		Belgian students	
	N = 479		N = 385		N = 94	
TB						
Visited highly endemic country[a]	281	(58.6)	221	(57.4)	60	(63.9)
Post-travel screening for latent TB[b]						
None performed	139	(49.5)	95	(43.0)	44	(73.3)
TST	126	(44.8)	110	(49.8)	16	(26.7)
0 mm	117		101		16	
0–5 mm	5		5		0	
5–10 mm	4		4		0	
> 10 mm	0		0		0	
QuantiFERON-TB blood test	21	(7.5)	21	(9.5)	0	
Positive	2		2			
Negative	15		15			
Unknown	4		4			
Referred to MHS for TB risk assessment post-travel	16/281	(5.7)	16/221	(7.2)	0	
MRSA						
MRSA screening	214	(44.7)	210	(54.5)	4	(4.3)
Schistosomiasis						
Visited schistosomiasis endemic country	391	(81.6)	338	(87.8)	53	(56.4)
Swum or waded in fresh surface water[c]	199/391	(50.9)	166/338	(49.1)	33/53	(62.3)
Offered local praziquantel for treatment of possible infection	17	(8.5)	14	(8.4)	3	(9.1)
Used praziquantel	14		11		3	
Reported surface water contact to physician in home country	19	(9.5)	14	(8.4)	5	(15.2)
Diagnostic test performed in home country	11	(5.5)	6	(3.6)	5	(15.2)
Infection with schistosoma	1		1		0	

Data are presented as n (%). TB = tuberculosis; MRSA = Methicillin-Resistant Staphylococcus Aureus; TST = Tuberculin Skin Test; MHS = Municipal Health Service.

[a] High = (mean) registered TB incidence > 50/100.000, low = (mean) registered TB incidence < 50/10.000.

[b] In five Dutch students a QuantiFERON-TB blood test was performed after the TST. These students had visited South Africa, Indonesia, Malawi and the Philippines. One of these students was already positive before having traveled. The others had not been tested at the time. Two of these students had a positive QuantiFERON, whereof one was treated for latent TB.

[c] Data is missing of 33 students with surface water contact (14%).

they had stopped their prophylaxis due to side-effects. Pre-travel instructions on how and when to start an alternative chemoprophylaxis need to be stressed, accompanied by contact details of a professional back home, so students can confer in case of problems while abroad (recommendation 2). With approximately 7%, the incidence of needle stick and splash injuries was higher than in previous studies (both 2%) [14,15]. This was in spite of the fact that at some of the universities, medical students were required to obtain a certificate of competency for invasive procedures, before leaving for an elective. Most incidents were dealt adequately in accordance with the national guidelines. However, an additional 5% reported a possible needle-stick or splash injury and in this group just under half dealt with it adequately. It needs to be stressed that when in doubt, students should discuss possible exposure to body fluids with an attending physician or a health professional back home as soon as possible (recommendation 3). In our study, 2.5% had unprotected sex with a new partner, which is less than in the study by Angelin et al. (6.6%) [15]. Many medical schools provide PEP kits to students at substantial cost. Of interest, a recent study has shown that a redispensing process is feasible and can result in substantial cost saving [16].

One in five suffered injury, obtained during leisure activities. One in fifty sustained minor injury from a traffic accident. Furthermore, it is of concern that one in twenty felt threatened or intimidated, with 1% encountering physical violence. Nearly all incidents occurred outside the workplace and mainly in Africa and South America.

Infection with rabies is rare among travelers. Nevertheless, students should be counseled regarding the risk of this lethal infection (recommendation 4). In our study, five students (1%) sustained an animal bite: three out of five had been vaccinated in the past, none received post-exposure prophylaxis.

As was to be expected, travelers' diarrhea was very common (46%). This may lead to post-infectious irritable bowel syndrome (IBS). The incidence of IBS has been estimated to be between 1.5 and 7.2% [17,18]. For reasons of efficiency, we only included a subset of questions from the validated ROME questionnaire for IBS. However, we did correct the results for pre-existent bowel complaints. Six months after travel, among those who had suffered from TD, 3% had new complaints of diarrhea which they did not have before travelling, and 1% had new-onset abdominal complaints combined with diarrhea. No such pattern was seen in those without TD. Infection with *Giardia lamblia* may cause post-travel gastro-intestinal complaints. This was not investigated in our study [19].

The way in which post-travel care is organized is very much university dependent. Overall, we found post-travel screening for TB and schistosomiasis to be lacking. This is probably related to the fact that a post-travel consult is not part of routine care. It is left to the discretion of students or, in case of screening for TB, it is part of routine policy for health-care workers when starting a position in a new hospital. Only half of the students visiting a highly endemic country were screened for TB upon returning home. Six students tested positive and one of them was treated for latent TB. We recommend that all medical students who visit highly endemic areas for at least three months and are planning to work in a health care setting should either be offered a vaccination with BCG at least six weeks before travelling or should be screened for TB with a TST, eight weeks after returning home. In case of a positive TST, a QuantiFERON blood test can help to diagnose latent TB (recommendation 5) [20].

Regarding schistosomiasis, few of those who were at risk were screened and a number of students used praziquantel within six weeks after the last fresh water contact, at which time the parasite may not yet be fully susceptible to treatment [21]. Handing out information on screening and treatment for schistosomiasis may help increase the percentage that is screened and the correct use of treatment (recommendation 6).

This study has a number of strengths. First, it is a multicenter study in which students were recruited before departure. This increases generalizability and limits selection bias. Second, questionnaires were taken before and at three time-points after travel, to limit recall bias and to correct for pre-travel items such as bowel complaints. Third, the follow up rate was high (84%), which limits information bias.

This study also has its limitations. First, generalizability is influenced by the fact that many students visited a limited number of foreign medical clinics, often based on past colonial ties and established collaborations between foreign hospitals and the universities in The Netherlands and Belgium. Second, as in any observational questionnaire study, recall bias can occur. Third, most students combined the elective with a holiday. We could not distinguish health complaints that occurred during the elective from those that occurred during the holiday. Lastly, due to the length of the study, guidelines such as for malaria prophylaxis may have changed over time.

In addition to our recommendations, we propose a number of further suggestions to improve pre- and post-travel care for medical students. Many students enroll in general meetings on global health and electives before travelling. By organizing these meetings according to the broad geographical zone that is to be visited (e.g. Central America, Africa, and Asia), relevant information can be conveyed more efficiently. During such meetings students could meet predecessors who can share their valuable experiences. In line with this, we envision a mobile app, similar to TripAdvisor® for tourists, to guide students and share experiences. Furthermore, an obligatory refresher training on invasive procedures could be offered before departure [22,23]. Compliance with post-travel screening could be improved upon by linking a post-travel consult to the granting of the study credits.

5. Conclusions

This study demonstrates the need for an update of the pre- and post-travel educational program for Dutch and Belgian medical students who are planning to perform a medical elective in a LOMIC country. In addition to the recommendations that are summarized in Table 5, we recommend a centrally organized post-travel check-up.

Table 5
Recommendations for universities who offer medical students the opportunity to perform an international elective.

Recommendation 1	Organize collective pre-travel health advice tailored to the contracted health care facilities abroad and according to the broad geographical zone that is to be visited.
Recommendation 2	Counsel on how and when to start an alternative chemoprophylaxis while staying in malaria endemic areas and provide contact details of professional back home for medical advice.
Recommendation 3	Distributing guidelines on how and when to discuss (possible) exposure to body fluids because of needle-stick or splash incidents with a physician.
Recommendation 4	Counsel students on animal associated injuries and offer rabies pre-exposure vaccination and provide contact details of a professional back home for medical advice.
Recommendation 5	Offer a BCG vaccination pre-travel or organize mandatory post-travel follow-up test moments for students who visited highly endemic areas for at least three months to work in a health care setting.
Recommendation 6	Counsel on post-travel screening and treatment of schistosomiasis.

List of abbreviations

LOMIC (low- or middle-income countries), MRSA (Methicillin-Resistant Staphylococcus Aureus), TD (travelers' diarrhea), TB (tuberculosis), VU (Vrije Universiteit), LCR (National Travel Advice Coordination Center), HIV (Human Immunodeficiency Virus), WHO (World Health Organization), SPSS (Statistical Package for the Social Sciences), LUMC (Leiden University Medical Center), PEP (post-exposure prophylaxis for HIV), TST (Tuberculin Skin Test), QFT (QuantiFERON-TB blood test), IBS (irritable bowel syndrome), BCG (Bacillus Calmette-Guérin).

Ethics approval and consent to participate

The study was endorsed by the Medical Ethical Committee (CME) of the Leiden University Medical Center (LUMC), Leiden, the Netherlands (registry number P11.046). They decided that the study does not fall under the scope of the Medical Research Involving Human Subjects Act (in Dutch: WMO). Participants provided their digital informed consent by completing the first questionnaire.

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CRediT authorship contribution statement

Jessica A. Vlot: Data curation, Formal analysis, Writing - original draft, Writing - review & editing. **Anastassia I. Blanter:** Data curation, Writing - original draft, Writing - review & editing. **Emile F.F. Jonker:** Data curation, Writing - review & editing. **Nina S. Korse:** Conceptualization, Data curation, Writing - review & editing. **Evelien Hack:** Data curation, Writing - review & editing. **Leonardus G. Visser:** Conceptualization, Writing - original draft, Writing - review & editing. **Darius Soonawala:** Conceptualization, Writing - original draft, Writing - review & editing.

Declaration of competing interest

All authors declare that they have no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tmaid.2020.101779.

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