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# Travel Medicine and Infectious Disease

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## Hospital-based care and/or death followed by repatriation in Dutch travelers: The HAZARD study

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### ABSTRACT

**Background:** Travelers can experience health problems while abroad. This descriptive study aimed to quantify the disease burden leading to hospital-based care, repatriation or death in Dutch travelers during a stay in a foreign country, including Europe.

**Methods:** Retrospective study of demographic and clinical data from three medical assistance centers (MACs) and the Dutch Ministry of Foreign Affairs on Dutch travelers receiving hospital-based care or who died abroad in the years 2010–2014. Diagnoses were coded according to the International Classification of Diseases (ICD) and classified using the Global Burden of Disease tool.

**Results:** Data was available for 77,741 travelers' incidents: 75,385 medical consultations and 2,356 deaths. Four in five travelers received inpatient care, of which 36% concerned older travelers (65+) who had significantly longer hospital stays. Overall the top three diagnoses were: injuries (29%), infectious diseases (17%), and cardiovascular diseases (17%). Mental illness was reported in nearly 1.5% of the travelers. Incidence proportions were highest in South-Eastern Asia, with enteric infections as most common diagnosis. Injuries and communicable diseases occurred most often in South-Eastern Asia, while non-communicable diseases were mostly reported in South America. One in five travelers who consulted a physician was repatriated back home, mostly on a scheduled flight with or without medical escort. Cardiovascular diseases and injuries were the leading causes of death.

**Conclusions:** Not only communicable diseases, but also injuries and chronic diseases (in particular cardiovascular diseases) frequently affected travelers' health while staying abroad and frequently necessitated hospital-based care. This should be addressed during the pre-travel counseling.

### 1. Introduction

Travelers may experience a variety of health problems while being abroad, ranging from infectious diseases, trauma or exacerbation of a pre-existing disease. Most illnesses are self-limiting, but travelers may be hospitalized and may require repatriation (air or ground) to their home country. These situations can be costly for the traveler, as not all costs are always covered by insurance [1,2]. Incidences of reported health problems in travelers vary between 40% and 80% in previous studies

[3–6]. Siikamaki et al. reported that Finnish travelers were more frequently hospitalized for infections (49%), than for injuries (18%) or vascular diseases (9%) [6].

The most serious health outcome is death. Frequent causes of death in travelers are natural causes (such as cardiovascular events) and injuries (e.g. motor vehicles, drowning, falls, and burns) [7–11]. Studies report that travelers to low- or middle-income countries (LOMIC) are twice as likely to be involved in a road traffic accident than in their home country as they are more at risk due to unfamiliarity with local traffic [7, 8,12]. It is relatively uncommon for travelers to die from an infectious

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**List of abbreviations**

LOMIC	low- or middle-income countries
MAC	Medical Assistance Center
EuroTravNet	European Travel and Tropical Medicine Network
HAZARD	reasons for <u>H</u> ospit <u>A</u> lizations, <u>R</u> epatriation and causes of <u>D</u> eath among Dutch travelers
ANWB	Royal Dutch Touring Club
MoFA	Dutch Ministry of Foreign Affairs
ICD	International Classification of Diseases
WHO	World Health Organization
GBD	Global Burden of Disease
UN	United Nations
UNWTO	World Tourism Organization
IT	Information Technology
SPSS	Statistical Package for the Social Sciences
CME	Committee Medical Ethics
LUMC	Leiden University Medical Center
IQR	interquartile range
RTI	respiratory infection
RTA	road traffic accident
SD	standard deviation
VFR	visiting friends and relatives

disease abroad, partly because serious outcome and death can be effectively prevented (e.g. malaria) or treated (e.g. respiratory tract infections) [6,7].

Home country-based medical assistance centers (MACs) play a crucial role in case of health problems abroad by providing (medical) support for travelers and their travel companion(s) abroad or their family at home. Depending on the travelers' insurance coverage, MACs provide medical advice, information on quality of local health care, perform medical evacuations and repatriations, and repatriate mortal remains.

Worldwide, there are several data surveillance networks such as the GeoSentinel Surveillance Network [13] and the sub-network European Travel and Tropical Medicine Network (EuroTravNet) [14] that register travel-related morbidity in returning international travelers who present themselves, mostly post-travel, to a participating travel clinic in their home country. However, to our knowledge limited data is available on travelers who received medical help, or even died, during their stay abroad. Therefore, the aim of our descriptive study was to quantify the disease burden leading to hospital-based care, repatriation or death in Dutch travelers during their stay in a foreign country, including Europe. The outcome of this study could be used as background information to support the risk-based pre-travel health advice worldwide, which ideally should not be restricted to tropical diseases alone.

## 2. Material and methods

### 2.1. Study design and participants

We conducted a retrospective study of health problems in Dutch travelers who received medical assistance abroad (HAZARD: HospitAlizations, Repatriation and causes of Death among Dutch travelers). Data were collected from the case records of three MACs with an office based in the Netherlands (Eurocross Assistance, Royal Dutch Touring Club [ANWB] and International SOS). Together, these centers cover more than 50% of all insured Dutch residents. We included all pseudonymized case records of all subsequent Dutch travelers who were hospitalized or who died abroad between January 1st, 2010 and December 31st, 2014. We approached the Dutch Ministry of Foreign Affairs (MoFA) to include Dutch nationals who might not appear in the MACs records, for example

because of insufficient insurance or death under special circumstances. Only digitally available MoFA data from the years 2013 and 2014 was included.

Available information consisted of demographic (age, gender), travel-related (destination, duration, travel purpose), and medical characteristics (main diagnosis, duration of hospital stay, type of repatriation, medical expenses of repatriation, and cause of death). This data is routinely collected by the MACs during their contact with the traveler and their treating physicians abroad. Exclusion criteria were: travel duration less than three days, travelers with foreign nationality, expatriates, and travelers specifically traveling abroad for medical treatment such as medical tourists and border residents.

### 2.2. Classification of diseases

Reasons for medical assistance and cause of death were coded according to the International statistical Classification of Diseases and related health problems (ICD) of the World Health Organization (WHO) [15]. Both ICD-9 and ICD-10 were used by the MACs. To allow uniform grouping of data from the different MACs, the cause-ICD codes map GBD 2019 of the Global Burden of Disease (GBD) collaborative network was used. We mainly used three of the four available levels of diseases and injuries of the GBD list (Supplemental Table S1) [16,17]. If the ICD code was not registered, we retrieved open field texts and classified accordingly. Cases with missing ICD codes and insufficient information in the open text fields or unclear diagnoses were grouped as 'unknown' and 'unclassified symptoms and signs'.

### 2.3. Definitions

Travel destinations were categorized according to geographical regions of the United Nations (UN) Statistics Division (Supplemental Table S2) [18]. Travel duration was categorized in short-term (3–30 days) and long-term travel ( $\geq 31$  days). Purpose of travel was defined as leisure or business. Inpatient care was defined as a hospital admission with at least one overnight stay. Hospital-based care without overnight stay was defined as outpatient care. Air ambulance transportation was defined as all other than regular flights deployed by the MACs in case of a medical indication (i.e. seriously ill patients in need of specialized hospital care in their home country or a very high oxygen demand not feasible on a regular flight) or for logistical reasons (i.e. no other way of transportation possible).

### 2.4. Data processing

The total number of Dutch travelers visiting individual countries during the study period was obtained from the World Tourism Organization (UNWTO). This data was based on arrivals of Dutch travelers at destination countries [19]. Age of the affected traveler was calculated using the year of birth and the date of the incident and categorized as children (0–4 and 5–19 years), young adults (20–39 years), middle-aged adults (40–64 years) and older adults (65 years and above). Travelers who were re-admitted for other medical conditions were counted as separate cases. Incidence proportions of illnesses or injuries were calculated as follows: (numerator: number of cases in the specific GBD group)/(denominator: total number of Dutch travelers visiting the specific UN region between 2010 and 2014) \* 10,000. Type of repatriation was categorized as unescorted flight, escorted by nurse or physician, by air ambulance, by (winter)shuttle flight or by road. To protect commercially sensitive information, data of the participating MACs were merged and analyzed jointly.

### 2.5. Statistical analyses

All data were retrieved by the IT department of the respective MACs, pseudonymized and stored in Excel-files. These files were imported into

IBM® SPSS® Statistics version 25 (IBM Corp) for analyses. Descriptive statistics and univariable analysis were used where appropriate. Statistical significance was defined as a p-value <0.05. Data of the MoFA is analyzed separately due to different type of travelers.

## 2.6. Ethics

The study was endorsed by the Committee Medical Ethics (CME) of the Leiden University Medical Center (LUMC), Leiden, the Netherlands (registry number C15.067). Written informed consent was not required as the study did not fall under the scope of the Medical Research Involving Human Subjects Act (in Dutch: WMO). The study was registered in the Netherlands Trial Register under NL5377 (NTR5478).

## 3. Results

### 3.1. Data from medical assistance centers (MACs)

Over a 5-year period, MACs provided assistance to 76,816 travelers: 75,385 medical consultations and 1,431 deceased travelers without receiving hospital-based care. The number of cases remained relatively constant over the years 2010–2014. According to the UNWTO data, the total number of Dutch travelers in this study period was 141,581,550. Demographic and travel characteristics are presented in [Table 1](#).

#### 3.1.1. Characteristics of travelers in need of inpatient and outpatient care

Leisure was the main reason (96%) for travel for the 75,385 travelers. The majority (73%) of trips were short-term. The median age was 56 years (interquartile range (IQR) 35–68 years). Most medical consultations occurred in Europe (particularly Western [France] and Southern Europe [Spain]) and Asia (in particular Western Asia [Turkey] and South-Eastern Asia [Thailand]), which is consistent with the major travel destinations according to the UNWTO data (84% and 9% for Europe and Asia, respectively). The median length of hospital stay was 4 days (IQR 2–7 days). Admission to an intensive care unit was reported in 2,035 travelers (3%). Almost one-fifth of cases received outpatient care (13,791/75,000, 18%). Four out of five children between 0 and 19 years (81%) were admitted. Gender distribution was equal in outpatient cases, however more male travelers were hospitalized (54% vs 46%,  $p < 0.001$ ) ([Table 1](#)).

#### 3.1.2. Burden of disease categories

Almost half of all medical consultations (45%) were for non-communicable diseases, of which 40% was outpatient ([Table 1](#)). The top five causes for inpatient treatment were injuries (31%), cardiovascular diseases (19%), digestive system diseases (10%), enteric infections (9%), and respiratory tract infections (RTIs, 7%). For outpatients the top five were injuries (31%), enteric infections (17%, predominantly gastroenteritis), cardiovascular diseases (17%), digestive system diseases (7%, e.g. inguinal hernia, inflammatory bowel diseases, diverticulitis) and other non-communicable diseases (7%, e.g. urinary tract infections, kidney stones, allergic reactions) ([Table 2](#)).

For both injuries and communicable diseases the incidence proportions were highest in South-Eastern Asia (3.3 and 6.7 per 10,000 travelers respectively), whilst for non-communicable diseases this was highest in South America (7.8 per 10,000 travelers) ([Fig. 1](#), [Supplementary Table S3](#), [Supplementary Table S4](#)).

Only a minority of medical consultations ( $n = 746$ , 1.1%) was due to tropical diseases such as dengue fever (626/746, 84%, mostly in Asia) or malaria (93/746, 13%, mostly in Africa) ([Table 2](#)). The incidence for tropical diseases was highest for travelers to Asia (71%, mainly

Indonesia and Thailand), followed by the Americas (16%, mainly Surinam) and Africa (11%, mainly Kenya and Ghana). Overall, these travelers were relatively young with a median age of 36 years (IQR 25–58 years). More than 90% of travelers with a tropical disease were admitted to hospital. One traveler died due to cerebral malaria during hospitalization in Ghana (data not shown).

Nine hundred and ninety-one travelers (1.4%) received medical assistance for mental disorders ([Table 2](#)), primarily for schizophrenia and delusional disorders (24%), depression (15%), and anxiety (11%). Nearly half of the mental disorders were unspecified (46%). Median age was 42 years (IQR: 30–52 years); more males received medical help (57% vs 43% females). Most of the mental diseases were diagnosed closer to the home country: Germany (13%), France (10%), Belgium (9%), but not all (Turkey 13%, Spain 9% and Morocco 4%) (data not shown).

Almost a third of all travelers (29%) were injured, of which 82% needed inpatient care ([Table 1](#)). Injuries were as frequently reported in male (51%) as female travelers (49%). Most injuries were acquired in Europe (77%) and Asia (14%). An identifiable cause was reported for 23% of the injured travelers (5,029/21,755). One in four travelers was involved in a road traffic accident (RTA), either as motor vehicle occupant, motorcyclist or cyclist. Accidental falls were the main reason for unintentional injuries for all destinations (62%) ([Table 3](#)). They occurred in and around the accommodation or during sport activities such as winter sports activities, hiking, swimming or horseback riding. One or more fractures were reported in almost 60% of the injuries, and contusions in 5%, including concussion (data not shown). One hundred and sixty-one travelers (161/3,295, 5%) had burns. A minority (232/3,295, 7%) were injured after animal contact (i.e. bites or stings), of which two-thirds in travelers aged 20–59 years. Insect bites and stings (e.g. by wasps or bees) occurred in 106 travelers (46%) and led to local allergic or toxic reactions in almost one-third of these cases. Thirty-five travelers (15%) had contact with venomous animals such as snakes. Thirty-one travelers (13%) were bitten by a dog; half of them concerned older travelers. Hands and arms were the most common bite locations. Three travelers had been exposed to an avalanche: two rockslides (Switzerland and Spain) and one snow avalanche (Austria). Self-harm and interpersonal violence represented 3% of the injuries of which two resulted in death ([Table 3](#)).

#### 3.1.3. Older versus younger travelers

Overall the largest groups requiring medical assistance (47%) were travelers aged 20–59 years. However, inpatients were older than outpatients (median age 57 vs 51 years,  $p < 0.001$ ). Older travelers required longer hospital stay than younger travelers (mean: 6.3 [SD 7.0] vs 4.6 days [SD 6.3] ( $p < 0.001$ ) ([Table 1](#)).

Older travelers (65+) also differed from younger (65-) travelers in type of diseases for which medical assistance was received: of all reported communicable diseases (excluding maternal and neonatal disorders), only 28% were seen in older travelers. Whereas, RTIs occurred more frequently in the older group (54% vs 28%), the opposite was true for enteric infections (35% vs 58%). Almost one third of the travelers, mainly between 50 and 64 years of age, presented with a cardiovascular disease. No age difference was seen for involvement in RTAs or unintentional injuries (5% and 18% vs 6% and 16%, respectively). Mental disorders were primarily seen in younger travelers (5% vs 0.7%) ([Table 4](#), [Supplementary Table S5](#)). Diseases and injuries among children are presented in [Supplemental Table S6](#).

Direct fatal injuries (without receiving medical assistance) occurred less frequently in older travelers (RTAs 7% vs 25%, unintentional injuries 6% vs 13%, self-harm 0.2% vs 4.2% and interpersonal violence 0%

**Table 1**

Demographic and travel characteristics of 75,385 Dutch travelers contacting their MAC while receiving medical assistance and possibly followed by death between 2010 and 2014.

	All cases		Outpatient cases <sup>a</sup>		Inpatient cases <sup>a</sup>	
	N = 75,385		N = 13,791	(18.4)	N = 61,209	(81.6)
<b>General information</b>						
Gender (N = 75,324, information missing N = 61)	75,324	(99.9)	13,768	(9.8)	61,171	(99.9)
Female	35,299	(46.9)	6,880	(50.0)	28,261	(46.2)
Male	40,025	(53.1)	6,888	(50.0)	32,910	(53.8)
Age, years, median (IQR)						
(N = 75,283, information missing N = 102)	56	(36–68)	51	(29–65)	57	(37–69)
Age group in years						
(N = 75,348, information missing N = 37)	75,348	(99.9)	13,775	(99.9)	61,188	(99.9)
0–4	1,692	(2.2)	148	(1.1)	1,544	(2.5)
5–19	5,031	(6.7)	1,150	(8.3)	3,865	(6.3)
20–39	14,510	(19.3)	3,532	(25.6)	10,894	(17.8)
40–59	20,697	(27.5)	4,118	(29.9)	16,441	(26.9)
60–64	7,772	(10.3)	1,284	(9.3)	6,451	(10.5)
65–69	8,871	(11.8)	1,340	(9.7)	7,501	(12.3)
70–74	7,282	(9.7)	1,074	(7.8)	6,176	(10.1)
75–79	5,133	(6.8)	643	(4.7)	4,468	(7.3)
80–84	2,860	(3.8)	330	(2.4)	2,509	(4.1)
≥85	1,500	(2.0)	156	(1.1)	1,339	(2.2)
<b>Travel details</b>						
Travel duration (N = 68,167, information missing N = 7,218)	68,167	(90.4)	12,119	(87.9)	55,816	(91.2)
Short-term travel (3–30 days)	49,937	(73.3)	9,738	(80.4)	40,055	(71.8)
Long-term travel (≥31 days)	18,230	(26.7)	2,381	(19.6)	15,761	(28.2)
Purpose of travel (N = 38,485, information missing N = 37,410)	38,485	(51.1)	3,243	(23.5)	35,174	(57.5)
Leisure	36,846	(95.7)	3,084	(95.1)	33,718	(95.9)
Business	1,639	(4.3)	159	(5.2)	1,456	(4.1)
Destination (N = 75,384, information missing N = 1)						
<b>America<sup>b</sup></b>	6,081	(8.1)	1,111	(8.1)	4,917	(8.0)
Caribbean	1,523	(25.0)	300	(27.0)	1,210	(24.6)
Northern America	2,033	(33.4)	473	(42.6)	1,531	(31.1)
Central America	442	(7.3)	92	(8.3)	347	(7.1)
South America	2,083	(34.3)	246	(22.1)	1,829	(37.2)
<b>Europe<sup>c</sup></b>	46,076	(61.1)	7,234	(52.5)	38,680	(63.2)
Northern Europe	1,646	(3.6)	221	(3.1)	1,419	(3.7)
Western Europe	24,905	(54.1)	3,669	(50.7)	21,139	(54.7)
Southern Europe	17,897	(38.8)	3,083	(42.6)	14,766	(38.2)
Eastern Europe	1,628	(3.5)	261	(3.6)	1,356	(3.5)
<b>Africa<sup>d</sup></b>	4,380	(5.8)	860	(6.2)	3,492	(5.7)
Northern Africa	3,051	(69.7)	608	(70.7)	2,432	(69.6)
Sub-Saharan Africa	1,329	(30.3)	252	(29.3)	1,060	(30.4)
<b>Asia<sup>e</sup></b>	18,423	(24.4)	4,517	(32.8)	13,767	(22.5)
Western Asia	11,284	(61.2)	3,516	(77.8)	7,676	(55.8)
Central Asia	11	(0.1)	3	(0.1)	8	(0.1)
South-Eastern Asia	5,656	(30.7)	807	(17.9)	4,821	(35.0)
Eastern Asia	621	(3.4)	72	(1.6)	534	(3.9)
Southern Asia	851	(4.6)	119	(2.6)	728	(5.3)
<b>Oceania<sup>f</sup></b>	424	(0.6)	69	(0.5)	352	(0.6)
<b>Disease specification according GBD</b>						
Communicable, maternal, neonatal and nutritional diseases	14,955	(19.8)	3,220	(23.3)	11,684	(19.1)
Non-communicable diseases	33,662	(44.7)	5,416	(39.3)	28,057	(45.8)
Injuries	21,755	(28.9)	3,902	(28.3)	17,739	(29.0)
Unclassified symptoms and signs	4,721	(6.3)	1,145	(8.3)	3,549	(5.8)
Unknown	292	(0.4)	108	(0.8)	180	(0.3)
Duration hospital stay (N = 75,000, information missing N = 385)	75,000	(9.5)	13,791	(100)	61,209	(100)
Median (IQR)	3	(2–6)	1	(1–1)	4	(2–7)
Mean (SD)	5.2	(6.6)	1	(0.02)	6.2	(6.9)
<b>Repatriation</b>						
Repatriation performed after receiving medical assistance						
No	59,795	(79.3)	12,252	(88.8)	47,275	(77.2)
Yes	14,874	(19.7)	1,398	(10.1)	13,385	(21.9)
Scheduled flight without medical escort	4,389	(29.5)	556	(39.8)	3,826	(28.6)
Scheduled flight with medical escort	3,028	(20.4)	176	(12.6)	2,840	(21.2)
Air ambulance	676	(4.5)	57	(4.1)	616	(4.6)
(winter)shuttle flight	818	(5.5)	39	(2.8)	779	(5.8)
Ground ambulance	1,697	(11.4)	56	(4.0)	1,641	(12.3)
Method unknown	4,266	(28.7)	514	(36.8)	3,683	(27.5)
<b>Death</b>						
Died after receiving medical assistance	701	(0.9)	141	(1.0)	550	(0.9)
RMR	496	(70.8)	101	(71.6)	392	(71.3)
Buried or cremated locally	205	(29.2)	40	(28.4)	158	(28.7)
Repatriation, unknown level of hospital-based care	18	(0.02)	–	–	–	–

Data are presented as N (%), unless otherwise specified. MAC: medical assistance center; IQR: interquartile range; GBD: global burden of diseases and injuries; RMR: repatriation of mortal remains.

<sup>a</sup> Information about patient status is missing for N = 385. Overall total for in- and outpatient columns is therefore N = 75,000.

<sup>b</sup> **Caribbean:** Netherlands Antilles N = 931 (61%), Dominican Republic N = 443 (29%), Cuba N = 85 (6%); **Northern America:** United States of America N = 1,740 (86%), Canada N = 290 (14%); **Central America:** Mexico N = 274 (62%), Costa Rica N = 85 (19%), Guatemala N = 34 (8%); **South America:** Surinam N = 1,193 (58%), Peru N = 341 (17%), Brazil N = 178 (9%).

<sup>c</sup> **Northern Europe:** Norway N = 397 (24%), United Kingdom N = 311 (19%), Sweden N = 281 (17%), Great Britain N = 228 (14%), Denmark N = 142 (9%), Ireland N = 113 (7%), Finland N = 74 (5%), Iceland N = 29 (2%) **Latvia** N = 24 (2%), Lithuania N = 17 (1%), Estonia N = 9 (0.6%), Guernsey N = 4 (0.2%), Jersey N = 1 (0.1%); **Western Europe:** France N = 7,140 (32%), Germany N = 6,213 (28%), Austria N = 5,988 (27%), Belgium N = 1,519 (7%), Switzerland N = 1,348 (6%), Luxembourg N = 168 (1%), Monaco N = 33 (0.1%), Liechtenstein N = 3 (1%); **Southern Europe:** Spain N = 10,306 (62%), Italy N = 2,141 (13%), Greece N = 1,929 (12%), Portugal N = 1,456 (9%), Croatia N = 37 (2%), Malta N = 170 (1%), Serbia N = 115 (0.7%), Bosnia Herzegovina N = 77 (0.5%), Slovenia N = 73 (0.4%), Andorra N = 40 (0.2%), Macedonia N = 32 (0.2%), Montenegro N = 13 (0.1%), Kosovo N = 6 (0.1%), Albania N = 4 (0.1%), Gibraltar N = 2 (0.1%), Former Yugoslavia N = 2 (0.1%); **Eastern Europe:** Poland N = 392 (25%), Czech Republic N = 318 (21%), Hungary N = 304 (20%), Bulgaria N = 252 (16%), Russia N = 120 (8%), Romania N = 83 (5%), Ukraine N = 38 (3%), Slovakia N = 32 (2%), Belarus N = 5 (0.3%), Moldova N = 3 (0.2%).

<sup>d</sup> **Northern Africa:** Morocco N = 1,835 (62%), Egypt N = 883 (30%), Tunisia N = 252 (14%), Algeria N = 3 (0.1%), Libya N = 3 (0.1%), Sudan N = 3 (0.1%); **Sub-Saharan Africa:** **Middle Africa:** Angola N = 8 (35%), Cameroon N = 6 (27%), Congo N = 5 (23%), Chad N = 1 (5%), Equatorial-Guinea N = 1 (5%), Gabon N = 1 (5%); **Western Africa:** Ghana N = 69 (27%), Gambia N = 47 (18%), Cape Verde N = 38 (15%), Nigeria N = 33 (13%), Senegal N = 22 (9%), Togo N = 15 (6%), Benin N = 7 (3%), Burkina Faso N = 7 (3%), Ivory Coast N = 5 (2%), Sierra Leone N = 4 (2%), Guinea N = 2 (0.8%), Liberia N = 2 (0.8%), Mali N = 2 (0.8%), Mauritania N = 1 (0.4%), St. Helena N = 1 (0.4%); **Eastern Africa:** Kenya N = 218 (55%), Tanzania N = 37 (9%), Uganda N = 33 (8%), Mauritius N = 32 (8%), Ethiopia N = 22 (6%), Zimbabwe N = 10 (3%), Malawi N = 9 (2%), Mozambique N = 9 (2%), Zambia N = 7 (2%), Eritrea N = 5 (1%), Burundi N = 3 (0.8%), Seychelles N = 3 (0.8%), Reunion N = 2 (0.5%), Rwanda N = 2 (0.5%), Somalia N = 2 (0.5%), Madagascar N = 1 (0.3%); **Southern Africa:** South Africa N = 612 (93%), Namibia N = 33 (5%), Botswana N = 8 (1%), Swaziland N = 2 (0.3%).

<sup>e</sup> **Western Asia:** Turkey N = 10,269 (93%), Cyprus N = 260 (2%), Israel N = 166 (2%), United Arab Emirates N = 122 (1.1%), Jordan N = 35 (0.3%), Armenia N = 30 (0.3%), Lebanon N = 23 (0.2%), Iraq N = 18 (0.2%), Saudi Arabia N = 17 (0.2%), Georgia N = 16 (0.1%), Oman N = 14 (0.1%), Qatar N = 7 (0.1%) Azerbaijan N = 5 (0.1%), Syria N = 5 (0.1%), Yemen N = 4 (0.1%), Kuwait N = 4 (0.1%), Bahrain N = 2 (0.1%), Palestinian Authority N = 1 (0.1%); **Central Asia:** Kazakhstan N = 7 (64%), Kyrgyzstan N = 2 (18%), Uzbekistan N = 1 (9%), Tajikistan N = 1 (9%); **South-Eastern Asia:** Thailand N = 2,741 (49%), Indonesia N = 1,870 (34%), Vietnam N = 226 (4%), Malaysia N = 22 (4%), Philippines N = 215 (4%), Singapore N = 171 (3%), Cambodia N = 111 (2%), Laos N = 13 (0.2%), Myanmar N = 6 (0.1%), Nation of Brunei N = 3 (0.1%); **Eastern Asia:** China N = 322 (52%), Hong Kong N = 200 (32%), Republic of Korea N = 34 (6%), Japan N = 32 (5%), Taiwan N = 23 (4%), Mongolia N = 6 (1%), Macau N = 1 (0.2%), Democratic People's Republic of Korea N = 1 (0.2%); **Southern Asia:** India N = 398 (47%), Nepal N = 174 (20%), Sri Lanka N = 116 (14%), Iran N = 68 (8%), Pakistan N = 37 (4%), Afghanistan N = 33 (4%), Bangladesh N = 18 (2%), Maldives N = 6 (1%).

<sup>f</sup> **Oceania:** Australia N = 264 (62.3%), New Zealand N = 150 (35.4%), French Polynesia N = 3 (0.7%), New Caledonia N = 2 (0.5%), Fiji N = 2 (0.5%), Cook Islands N = 1 (0.2%), Papua New Guinea N = 1 (0.2%), Vanuatu N = 1 (0.2%).

vs 1.1%). More older travelers died following a cardiovascular disease (80% vs 50%). No differences were observed in other causes of death (data not shown).

### 3.1.4. Repatriation

Twenty percent of travelers receiving medical assistance were repatriated (14,874/75,385), of which at least 90% after inpatient care. Most repatriations were with a scheduled flight without (4,389/14,874, 30%) or with (3,028/14,874, 20%) a medical escort (nurse or physician). Travelers repatriated with a medical escort concerned more males ( $p = 0.002$ ), older travelers ( $p < 0.001$ ), and for the diagnoses RTIs ( $p = 0.002$ ) cardiovascular conditions ( $p = 0.014$ ), neoplasms ( $p < 0.001$ ), mental disorders ( $p < 0.001$ ), chronic respiratory diseases ( $p = 0.010$ ), neurological disorders ( $p < 0.001$ ), and diabetes and kidney diseases ( $p = 0.034$ ). In addition, it mostly concerned travelers from destinations in the Americas ( $p = 0.021$ ). Injuries, independently of the cause, are mainly repatriated with a scheduled flight without a medical escort (Supplemental Table 7). A ground ambulance was frequently used for repatriations in Europe. An air ambulance was used in 5% of the repatriations (Table 1), mainly conducted from Europe and the Southern Mediterranean. This type of repatriation was mostly for injured travelers (211/676, 31%) or for non-communicable diseases (365/676, 32%). Older adults accounted for half of the cases (52%) of this repatriation method (data not shown). The exact repatriation type is unknown for about one-third of the cases, although the involved traveler was mostly transported on a stretcher or by adapted seat conditions (e.g. business class instead of economy class for additional leg or arm space).

### 3.1.5. Cause of death in deceased travelers without receiving hospital-based care

Demographic and travel characteristics are presented in Supplemental Table S8. The leading cause of death were cardiovascular diseases (51%), of which most due to out-of-hospital cardiac arrest (329/724, 45%), myocardial infarction (210/724, 29%), or stroke (64/724, 9%). Injuries were the second largest group (19%), of which most as a result of RTAs (53%, e.g. motor vehicle injuries) or unintentional accidents (35%) (such as accidental falling (43/94, 46%) or drowning (28/

94, 30%)). Twenty travelers (20/1,431, 1.4%), mostly males between 20 and 59 years of age, committed suicide. Seven travelers (7/1,431, 0.5%) were murdered. A minority (19/1,431, 1.3%) died after an infectious disease. Most fatal injuries occurred in 65+ travelers. One in-flight death during commercial air travel was reported without reported cause of death (Table 5).

### 3.2. Dutch Ministry of Foreign Affairs

A total of 925 records of deceased Dutch travelers was handled by MoFA in the years 2013 and 2014, including 197 victims (21%) of the MH17 plane crash in eastern Ukraine, Europe in July 2014. The median age of the remaining 728 travelers was 63 years (IQR: 51–71 years); 81% were men. Almost two thirds of all deaths were caused by non-communicable diseases (33%, mostly cardiovascular diseases) or injuries (26%, mostly caused by self-harm). Most deaths occurred in South-Eastern Asia (30%, mainly Thailand [70%] and Philippines [13%]), followed by Western- and Southern Europe (both 15%) (Supplementary Table S9). Three travelers in Africa died of malaria. Fifty-five travelers (8%) committed suicide. Thirty-one travelers (4%) were killed by interpersonal violence. Most of these cases occurred in the Caribbean, South America and Africa (Supplementary Table S10).

## 4. Discussion

In this large retrospective study we explored the disease burden in over 77,000 Dutch travelers who received hospital-based care abroad or who died before reaching the hospital. Western (33%) and Southern Europe (24%), and Western Asia (15%) were the top three regions where travelers sought medical care. Injuries, cardiovascular diseases, and the classical traveler's diseases (enteric infections and respiratory tract infections (RTIs)) were the leading diagnoses. One in every three medical consultations concerned older travelers (65+). Cardiovascular conditions accounted for half of the causes of death, followed by road traffic accidents (RTAs). Repatriation was necessary for one in five travelers, mostly for non-communicable diseases (e.g. cardiovascular diseases) or injuries.

**Table 2**

Travelers receiving medical assistance between 2010 and 2014 presented by the GBD cause list levels one and two and in- or outpatient status reported by MACs.

Diagnosis	All <sup>a</sup>		Outpatient cases		Inpatient cases		Unlabeled cases	
	N = 70,372	(93.4)	N = 12,538	(17.8)	N = 57,480	(81.7)	N = 354	(0.5)
<i>Communicable, maternal, neonatal and nutritional diseases</i>	14,955	(21.3)	3,220	(25.7)	11,684	(20.3)	51	(16.6)
Enteric infections	7,235	(10.3)	2,174	(17.3)	5,045	(8.8)	16	(4.5)
Respiratory infections and tuberculosis	4,974	(7.1)	691	(5.5)	4,259	(7.4)	24	(6.8)
Maternal and neonatal disorders	986	(1.4)	185	(1.5)	795	(1.4)	6	(1.7)
Other infectious diseases <sup>b</sup>	932	(1.3)	113	(0.9)	816	(1.4)	3	(0.8)
Neglected tropical diseases and malaria	746	(1.1)	44	(0.4)	700	(1.2)	2	(0.6)
Nutritional deficiencies	47	(0.1)	11	(0.1)	36	(0.1)	–	
HIV, AIDS and STI	35	(0.1)	2	(0.02)	33	(0.1)	–	
<i>Non-communicable diseases</i>	33,662	(47.8)	5,416	(43.2)	28,057	(48.8)	189	(61.4)
Cardiovascular diseases	13,016	(18.5)	2,103	(16.8)	10,865	(18.9)	48	(13.6)
Digestive system diseases	6,612	(9.4)	870	(6.9)	5,720	(10.0)	22	(6.2)
Other non-communicable diseases <sup>c</sup>	3,791	(5.4)	818	(6.5)	2,952	(5.1)	21	(5.9)
Musculoskeletal disorders	1,823	(2.6)	305	(2.4)	1,505	(2.6)	13	(3.7)
Skin and subcutaneous diseases	1,601	(2.3)	243	(1.9)	1,352	(2.4)	6	(1.7)
Chronic respiratory diseases	1,566	(2.2)	211	(1.7)	1,340	(2.3)	15	(4.2)
Neurological disorders	1,361	(1.9)	240	(1.9)	1,118	(1.9)	3	(0.8)
Neoplasms	1,342	(1.9)	157	(1.3)	1,170	(2.0)	15	(4.2)
Mental disorders	991	(1.4)	126	(1.0)	841	(1.5)	24	(6.8)
Diabetes and kidney diseases	794	(1.1)	102	(0.8)	672	(1.2)	20	(5.6)
Sense organ disease	643	(0.9)	196	(1.6)	446	(0.8)	1	(0.3)
Substance use disorders	122	(0.2)	45	(0.4)	76	(0.1)	1	(0.3)
<i>Injuries</i>	21,755	(30.9)	3,902	(31.1)	17,739	(30.9)	114	(22.1)
No clearly identifiable cause	16,726	(23.8)	2,416	(19.3)	14,264	(24.8)	46	(13.0)
Unintentional injuries	3,555	(5.1)	1,098	(8.8)	2,421	(4.2)	36	(10.2)
Road traffic injuries	1,321	(1.9)	347	(2.8)	949	(1.7)	25	(7.1)
Self-harm	43	(0.06)	9	(0.07)	33	(0.06)	1	(0.3)
Interpersonal violence	110	(0.16)	32	(0.26)	72	(0.13)	6	(1.7)

Data are presented as N (%). GBD: global burden of diseases and injuries; MACs: medical assistance centers; HIV; human immunodeficiency virus, AIDS; acquired immunodeficiency syndrome, STI; sexually transmitted infections.

<sup>a</sup> No further subdivision possible for 5,013 cases in various GBD groups: unclassified (N = 4,721) and unknown (N = 292).

<sup>b</sup> Such as sepsis, meningitis, encephalitis, varicella and herpes zoster and acute hepatitis.

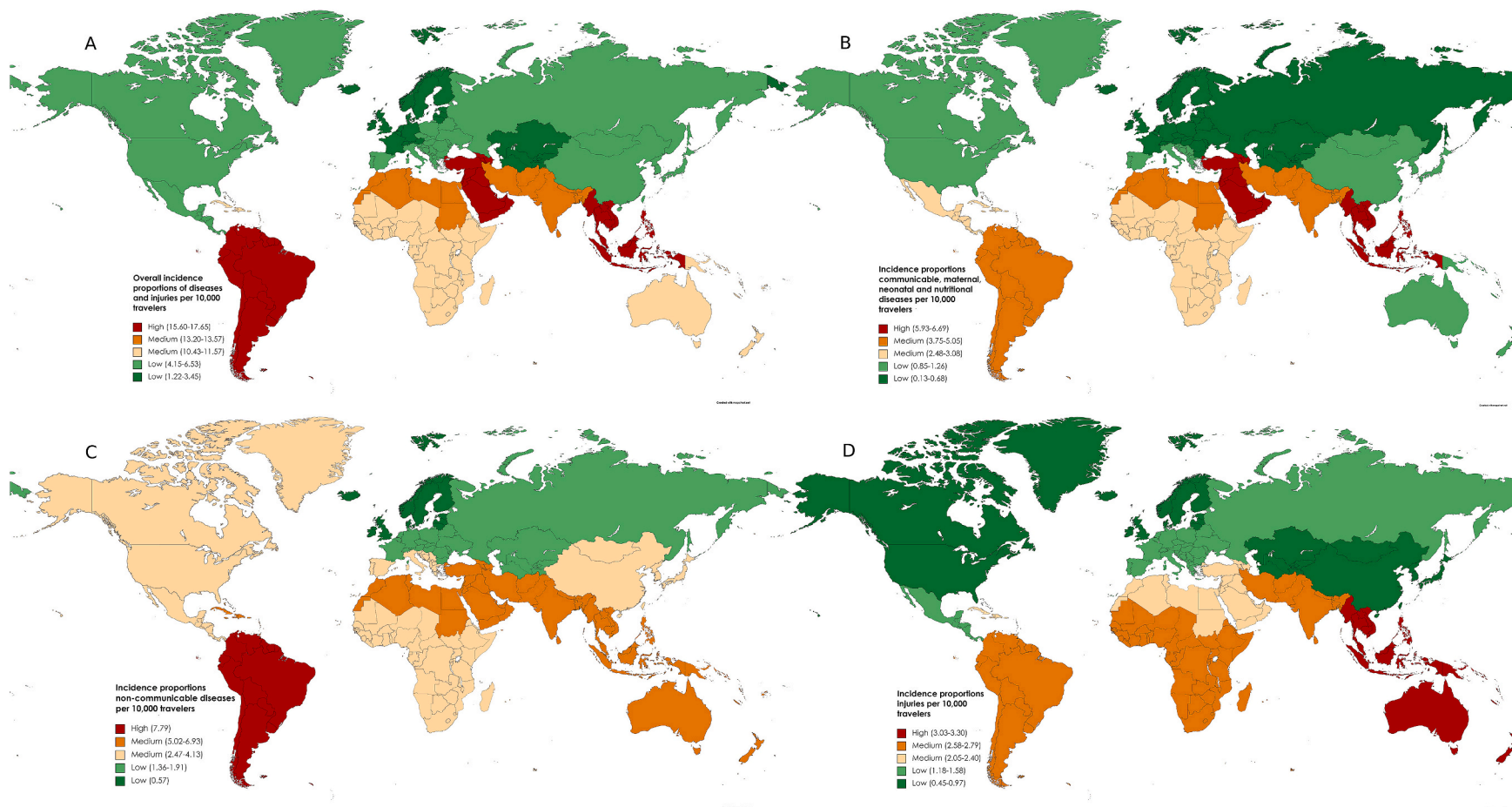
<sup>c</sup> Such as urinary tract infections, kidney stones and allergic reactions.

Our findings regarding the occurrence of enteric infections and RTIs are in line with earlier findings [20–22]. However, our results differ in the associated hospitalization rates for these infectious diseases with respect to a Finnish study with a comparable study design: Finnish travelers were more frequently hospitalized for a RTI than for an enteric infection, while the opposite was seen in our study [20]. Inpatient cases accounted for 82% of our study population and this is much higher than the 16% reported in another Finnish study. In addition, Finnish travelers in need of medical help seemed overall younger than the Dutch [6]. Both studies have a large sample size, so it could be that Finnish travelers with health complaints consulted a physician in an earlier stage than the Dutch and outpatient care sufficed. The majority of medical assistance was provided to Dutch travelers in Western and Southern Europe and Western Asia, whilst top locations were Europe and Eastern Mediterranean and South-Eastern Asia in the Finnish study [6]. More Finnish than Dutch travelers visited Southern Mediterranean countries, and the number of medical consultations is more than twice as high (54% vs 24%). Most of our Western Asia travelers visited Turkey (94%), probably due to the large number of ‘visiting friends and relatives’ (VFR, as the Turkish-Dutch population is the largest immigrant population in our country) and the huge range of cheap package holidays in the coastal regions. Further comparison of our data with previous studies is limited due to the differences in classifications of key variables, such as the used medical diagnosis classification methods (ICD vs GBD) [6,20,23].

Almost a third of all medical consultations were due to an injury, either unintentional or as a result of a RTA. Injuries were mainly sustained in South-Eastern and Southern Asia, Australia and New Zealand. Literature shows that traffic injuries among international travelers consistently accounts for more travel-related morbidity and mortality than infectious diseases [24]. Stewart et al. described that travelers have a more than ten-fold risk of dying from an injury than due to an infection [8]. RTA are reported to be more common in LOMIC-countries and in

countries with opposite driving conditions (i.e. left-hand vs right-hand driving). Our data identifies that twice as many cyclists, motorcyclists and pedestrians as motor vehicle occupants were injured, which corresponds with existing literature [8,9,24]. Sapsirisavatt et al. reported that well-known risk factors such as night-time driving and alcohol use doubled the risk of hospitalization after a RTA [25]. Unfortunately, of all injured travelers in the HAZARD study an identifiable cause was only reported in 23% of the cases. Of these, older travelers (65+) accounted for half (50%) of the reported injured pedestrians in the HAZARD study. This is consistent with the literature that older travelers represent a large group of fatalities among pedestrian victims [24]. In the pre-travel consultation, personal safety (e.g. wearing a seatbelt, renting a vehicle with a qualified driver, wearing a bike helmet, crossing roads safely as a pedestrian) should be emphasized [9,24]. Dutch travelers can register themselves pre-travel at the information service tool of the MoFA to be informed about (changes in) the local security situation [26]. The Dutch travelers who were killed during the plane crashes in Tripoli, Libya in May 2010 and in Ukraine in July 2017 (MH17) accounted for 1.3% of the deceased travelers of the MACs study population and 21% of the MoFA data, respectively. Due to this exceptional cause of death, the large group of MH17 victims were excluded from the analysis as they would influence the results (e.g. lower the median age as many young families were involved).

Nearly 1.5% of the consultations concerned travelers with a mental illness, mostly receiving medical assistance in countries close to their home country. It is unknown if this condition was pre-existing. Individuals with known or high risk for mental illness can travel, but are strongly advised to discuss their travel plan with a mental health professional [27,28]. Rofaief et al. [29] reported that very few mental health patient organizations have pre-travel information available online, while travel can have both negative and positive effects on (mental) health [30]. It is estimated that 10–20% of all repatriations concerned



**Fig. 1.** Incidence proportions of diseases and injuries in Dutch travelers between 2010 and 2014 per UN regions reported by MACs.

Abbreviations: UN, united nations; MACs, medical assistance centers. Data source: [Supplementary Table S3](#) and [Supplementary Table S4](#). **A:** Overall incidence proportions of diseases and injuries per 10,000 Dutch travelers; **B:** Incidence proportions of communicable, maternal, neonatal and nutritional diseases per 10,000 travelers; **C:** Incidence proportions of non-communicable diseases per 10,000 Dutch travelers; **D:** Incidence proportions of injuries per 10,000 Dutch travelers.



**Table 3**

Type of injuries of 21,755 Dutch travelers reported by MACs presented by the GBD cause list levels two and three where possible.

	All <sup>a</sup>		Africa <sup>b</sup>		America <sup>c</sup>		Asia <sup>d</sup>		Europe <sup>e</sup>		Oceania <sup>f</sup>	
	N = 21,755		N = 853	(3.9)	N = 1,052	(4.8)	N = 2,966	(13.6)	N = 16,773	(77.1)	N = 111	(0.5)
<i>Road traffic injuries</i>	1,321/5,029	(26.3)	79/244	(32.4)	112/378	(29.6)	196/995	(19.7)	925/3,386	(27.3)	9/26	(34.6)
Road injuries	1,262/1,293	(97.6)	77/78	(98.7)	99/100	(99.0)	186/190	(97.9)	891/916	(97.3)	9/9	(100)
Pedestrian road injuries	37	(2.9)	1	(1.3)	4	(4.0)	9	(4.8)	23	(2.6)	-	
Cyclist road injuries	375	(29.7)	3	(3.9)	16	(16.2)	9	(4.8)	346	(38.8)	1	(11.1)
Motorcyclist road injuries	312	(24.7)	10	(13.0)	14	(14.1)	83	(44.6)	205	(23.0)	-	
Motor vehicle road injuries	442	(35.0)	57	(74.0)	61	(61.6)	60	(32.3)	256	(28.7)	8	(88.9)
Undefined	96	(7.6)	6	(7.8)	4	(4.0)	25	(13.4)	61	(6.8)	-	
Other traffic injuries	31/1,293	(2.4)	1/78	(1.3)	1/100	(1.0)	4/190	(2.1)	25/916	(2.7)	-	
<i>Unintentional injuries</i>	3,555/5,029	(70.7)	154/244	(63.1)	252/378	(66.7)	763/995	(76.7)	2,370/3,386	(70.0)	16/26	(61.5)
Falls	2,034/3,295	(61.7)	69/142	(48.6)	81/244	(33.2)	333/685	(48.6)	1,540/2,209	(69.7)	11/15	(73.3)
Animal contact <sup>g</sup>	232/3,295	(7.0)	15/142	(10.5)	26/244	(10.7)	74/685	(10.8)	115/2,209	(5.2)	2/15	(13.3)
Exposure to forces of nature <sup>h</sup>	209/3,295	(6.3)	14/142	(9.9)	67/244	(27.5)	87/685	(12.7)	40/2,209	(1.8)	1/15	(6.7)
Fire, heat and hot substances <sup>i</sup>	161/3,295	(4.9)	12/142	(8.5)	7/244	(2.9)	28/685	(4.1)	113/2,209	(5.1)	1/15	(6.7)
Environmental heat and cold exposure	150/3,295	(4.6)	10/142	(7.0)	16/244	(6.6)	53/685	(7.7)	71/2,209	(3.2)	-	
Adverse effects of medical treatment	140/3,295	(4.2)	6/142	(4.2)	10/244	(4.1)	27/685	(3.9)	97/2,209	(4.4)	-	
Other unintentional injuries	137/3,295	(4.2)	3/142	(2.1)	12/244	(4.9)	30/685	(4.4)	92/2,209	(4.2)	-	
Foreign body	106/3,295	(3.2)	7/142	(4.9)	7/244	(2.9)	23/685	(3.4)	69/2,209	(3.1)	-	
Poisonings	65/3,295	(2.0)	4/142	(2.8)	8/244	(3.3)	19/685	(2.8)	34/2,209	(1.5)	-	
Drowning	43/3,295	(1.3)	2/142	(1.4)	10/244	(4.1)	8/685	(1.2)	23/2,209	(1.0)	-	
Exposure to mechanical forces	18/3,295	(0.5)	-		-		3/685	(0.4)	15/2,209	(0.7)	-	
<i>Self-harm and interpersonal violence</i>	153/5,029	(3.0)	11/244	(4.5)	14/378	(3.7)	36/995	(3.6)	91/3,386	(2.7)	1/26	(3.8)
Self-harm	43/144	(29.9)	1/11	(9.1)	3/13	(23.1)	6/33	(18.2)	33/86	(38.4)	-	
Interpersonal violence	99/144	(68.8)	8/11	(72.7)	10/13	(76.9)	27/33	(81.8)	53/86	(61.6)	1	(100)
Conflict and terrorism	2/144	(1.4)	2/11 <sup>j</sup>	(18.2)	-		-		-		-	

Data are presented as N (%). MACs: medical assistance centers; GBD: global burden of diseases and injuries.

<sup>a</sup> Inpatient cases N = 17,739 (81.5%), outpatient cases N = 3,902 (17.9%), missing N = 114 (0.5%). For N = 16,726 travelers (77%) no cause was identified.<sup>b</sup> Northern Africa N = 522 (61.2%), Sub-Saharan Africa N = 331 (38.8%).<sup>c</sup> Caribbean N = 289 (27.5%), Northern America N = 339 (32.2%), Central America N = 80 (7.6), South America N = 344 (32.7%).<sup>d</sup> Western Asia N = 1,650 (55.6%), South-Eastern Asia N = 1,058 (35.7%), Southern Asia N = 175 (5.9%), Eastern Asia N = 81 (2.7%), Central Asia N = 2 (0.07%).<sup>e</sup> Western Europe N = 11,431 (68.2%), Southern Europe N = 4,220 (25.2%), Northern Europe N = 602 (3.6%), Eastern Europe N = 520 (3.1%).<sup>f</sup> Australia and New Zealand N = 111 (100%).<sup>g</sup> Of which at least 35 with a venomous animal (Africa N = 5, America N = 4, Asia N = 4, Europe N = 18, Oceania N = 2): snakes N = 20, scorpions N = 4, spiders N = 3, ocean animals N = 3, unspecified N = 3 (8%), bees or wasps N = 2. Four travelers were bitten by a monkey, one traveler was scratched by a monkey, and four travelers were bitten by a cat.<sup>h</sup> Travelers experienced atmospheric and hydrostatic pressure-related side effects like decompression illness N = 40 (19%) and mountain sickness N = 56 (27%).<sup>i</sup> Location of the burns were known for 75% of the cases (N = 121): lower extremities N = 42 (34.7%), upper extremities N = 26 (21.5%), face, head and neck N = 18 (14.9%), multiple regions N = 18 (14.9%), trunk N = 17 (14.0%).<sup>j</sup> Bomb attack in Marrakech, Morocco in 2011.

**Table 4**

Medical assistance presented by the GBD cause list level two categorized by younger (65-) and older (65+) travelers reported by MACs.

Diagnosis	All		65-		65+		Age unknown	
	N = 75,385		N = 49,702	(65.9)	N = 25,646	(34.0)	N = 37	(0.05)
<i>Communicable, maternal, neonatal and nutritional diseases</i>	14,955	(19.8)	10,994	(22.1)	3,949	(15.4)	12	(32.4)
Enteric infections	7,235	(48.4)	5,844	(53.2)	1,385	(35.1)	6	(50.0)
Respiratory infections and tuberculosis	4,973	(33.3)	2,845	(25.9)	2,124	(53.8)	4	(33.3)
Maternal and neonatal disorders	986	(6.6)	985	(9.0)	–	–	1	(8.3)
Other infectious diseases	931	(6.2)	644	(5.9)	286	(7.2)	1	(8.3)
Neglected tropical diseases and malaria	748	(5.0)	629	(5.7)	119	(3.0)	–	–
Nutritional deficiencies	47	(0.3)	13	(0.1)	34	(0.9)	–	–
HIV, AIDS and STI	35	(0.2)	34	(0.3)	1	(0.03)	–	–
<i>Non-communicable diseases</i>	33,662	(44.7)	19,484	(39.2)	14,166	(55.2)	12	(32.4)
Cardiovascular diseases	13,016	(38.7)	5,763	(29.6)	7,249	(51.2)	4	(33.3)
Digestive system diseases	6,612	(19.6)	4,557	(23.4)	2,053	(14.5)	2	(16.7)
Other non-communicable diseases	3,791	(11.3)	2,547	(13.1)	1,243	(8.8)	1	(8.3)
Musculoskeletal disorders	1,823	(5.4)	1,233	(6.3)	590	(4.2)	–	–
Skin and subcutaneous diseases	1,601	(4.8)	1,077	(5.5)	523	(3.7)	1	(8.3)
Chronic respiratory diseases	1,566	(4.7)	800	(4.1)	765	(5.4)	1	(8.3)
Neurological disorders	1,361	(4.0)	984	(5.1)	376	(2.7)	1	(8.3)
Neoplasms	1,342	(4.0)	661	(3.4)	681	(4.8)	–	–
Mental disorders	991	(2.9)	889	(4.6)	102	(0.7)	–	–
Diabetes and kidney diseases	794	(2.4)	392	(2.0)	402	(2.8)	–	–
Sense organ disease	643	(1.9)	463	(2.4)	178	(1.3)	2	(16.7)
Substance use disorders	122	(0.4)	118	(0.6)	4	(0.03)	–	–
<i>Injuries</i>	21,755	(28.9)	15,993	(32.2)	5,753	(22.4)	9	(24.3)
No clearly identifiable cause	16,726	(76.9)	12,289	(76.8)	4,432	(77.0)	5	(55.6)
Unintentional injuries	3,555	(16.3)	2,541	(15.9)	1,010	(17.6)	4	(44.4)
Road traffic injuries	1,321	(6.1)	1,019	(6.4)	302	(5.2)	–	–
Self-harm	43	(0.2)	41	(0.3)	2	(0.03)	–	–
Interpersonal violence	110	(0.5)	103	(0.6)	7	(0.12)	–	–
<i>Unclassified symptoms and signs</i>	4,721	(6.3)	3,025	(6.1)	1,693	(6.6)	3	(8.1)
<i>Unknown</i>	292	(0.4)	206	(0.4)	85	(0.3)	1	(2.7)

Data are presented as N (%). GBD: global burden of diseases; MACs: medical assistance centers; HIV; human immunodeficiency virus, AIDS; acquired immunodeficiency syndrome, STI; sexually transmitted infections.

psychiatric emergencies (e.g. due to a pre-existing illness, a first-time event that is triggered by stress or after experimenting with alcohol or drugs) [31]. In our study, this number of repatriated psychiatric travelers was even higher (29%). The difference could be explained by the fact that most of our cases were repatriated from destinations nearby their home country. For 'far-away' destinations the patient should first have clearance to travel (fit-to-fly) before they can be repatriated as this type of transport can differ from other medical repatriations as it depends partly on the patient's cooperation, and the occurrence of aggressive and/or anxiety behavior, and the willingness of an airline company to transport these patients [31]. Therefore, patients are often accompanied by two (para)medical escorts instead of one. Mental health in travelers is a neglected topic and deserves more research [31,32].

A relatively small number of Dutch travelers required medical help after suffering from an animal bite (i.e. dogs, cats, monkeys) [33]. Our numbers are lower than the study of Verdoes et al. [34]. They reported on 691 Dutch travelers who actively contacted their MAC due to an animal-associated injury in a four-year period (2015–2019), with most incidents occurring in South-Eastern Asia. This difference can be explained by the fact that Verdoes et al. analyzed all contact moments with the MAC, while the HAZARD study was limited to contacts concerning in- and outpatient care. According to EuroTravNet, exposure to animals accounted for nearly 3% (2,688/103,739) of all medical consultations in participating clinics during or after travel between 1998 and 2018. Most exposures were in Asia (mainly South-East Asia) and involved bites from dogs, monkeys, cats and bats [35].

A small number of travelers (701/75,385, 0.9%) died despite receiving medical help and as expected, cardiovascular diseases and injuries accounted for the largest proportion. This is in line with previous studies [11,23]. Suicide and interpersonal violence accounted for a small proportion of deaths (n = 113).

Twenty percent of the travelers were repatriated after receiving hospital-based care. This number is much higher compared to that in

Finnish (4%) [6] and Norwegian travelers (13%) [23]. It is possible that repatriations were not always for medical reasons, but due to patient's wishes or due to high costs of hospital care abroad, (FL, personal communication, 13 July 2021). According to a study of Greuters et al. [36] 67% of travelers repatriated by aeromedical transportation concerned mainly older travelers ( $\geq 50$  years) from Europe (often the Mediterranean) due to cardiovascular diseases. This pattern is also seen in our study.

This study has a number of strengths. First, the multicenter design resulted in one of the largest datasets covering a five-year period. Second, all types of travelers were investigated including children and uninsured Dutch travelers (from MoFA) to generate a broader scope of health-related problems during travel in the Dutch travelers population worldwide. In addition, differences in travel-related diseases between older (65+) and young (65-) travelers could be clearly distinguished. Third, using the Global Burden of Disease Study 2019 cause list resulted in a more comprehensive overview of diseases and injuries than the different versions of ICD. We also believe that the ICD classification has some inaccuracies as it is more focused on the organs involved in a disease instead of the etiological origin: ICD categorizes for example a pneumonia as a respiratory system disease, while the GBD classifies it as a RTI.

This study also has its limitations. First, due to high workload of extracting data from the different operating systems not all MAC's in the Netherlands could participate. However, as several large MACs were included this will minimize the chance of bias given the size of the population. Second, the dataset consisted of routinely collected data leading to missing values and/or possible inaccuracies in study variables such as medical diagnosis, travel purpose and length of hospital stay. Records were cross-checked to minimize this where possible. Travelers might have been wrongly classified as 'outpatient' if a traveler died on the day of admission to the hospital. The number of outpatient cases (18%) in the study could therefore be an overestimation. In addition,

**Table 5**

Cause of deaths without medical assistance presented by the GBD cause list levels one and two categorized by younger (65-) and older (65+) travelers reported by MACs.

	All		65-		65+		Age unknown	
	N = 1,431		N = 489	(34.2)	N = 601	(42.0)	N = 341	(23.8)
<i>Communicable, maternal, neonatal and nutritional diseases</i>	26	(1.8)	10	(2.0)	8	(1.3)	8	(2.3)
Respiratory infections and tuberculosis <sup>a</sup>	9	(34.6)	3	(30.0)	5	(62.5)	1	(12.5)
Other infectious diseases <sup>b</sup>	8	(30.8)	2	(20.0)	2	(25.0)	4	(50.0)
Maternal and neonatal disorders <sup>c</sup>	6	(23.1)	4	(40.0)	–	–	2	(25.0)
Neglected tropical diseases and malaria <sup>d</sup>	2	(7.7)	1	(10.0)	1	(12.5)	–	–
Enteric infections	1	(3.8)	–	–	–	–	1	(12.5)
<i>Non-communicable diseases</i>	780	(54.5)	207	(42.3)	370	(61.6)	203	(59.5)
Cardiovascular diseases	724	(92.8)	191	(92.3)	351	(94.9)	182	(89.7)
Neoplasms	31	(4.0)	9	(4.3)	12	(3.2)	10	(4.9)
Digestive system diseases	8	(1.0)	3	(1.4)	1	(0.3)	4	(2.0)
Chronic respiratory diseases	8	(1.0)	–	–	4	(1.1)	4	(2.0)
Neurological disorders	4	(0.5)	2	(1.0)	1	(0.3)	1	(0.5)
Substance use disorders	1	(0.1)	–	–	–	–	1	(0.5)
Diabetes and kidney diseases	2	(0.3)	–	–	1	(0.3)	1	(0.5)
Other non-communicable diseases	2	(0.3)	2	(1.0)	–	–	–	–
<i>Injuries</i>	266	(18.6)	162	(33.1)	59	(9.8)	45	(13.2)
Road traffic injuries	142	(53.4)	93	(57.4)	32	(54.2)	17	(37.8)
Road injuries	117	(82.4)	71	(76.3)	30	(93.8)	16	(94.1)
Pedestrian road injuries	8	(6.8)	6	(8.5)	1	(3.3)	1	(6.3)
Cyclist road injuries	11	(9.4)	4	(5.6)	6	(20.0)	1	(6.3)
Motorcyclist road injuries	12	(10.3)	9	(12.7)	1	(3.3)	2	(12.5)
Motor vehicle road injuries	58	(49.6)	36	(50.7)	11	(36.7)	11	(68.8)
Undefined	28	(23.9)	16	(22.5)	11	(36.7)	1	(6.3)
Other traffic injuries <sup>e</sup>	25	(17.6)	22	(23.7)	2	(6.3)	1	(5.9)
Unintentional injuries	94	(35.3)	49	(30.2)	26	(44.1)	19	(42.2)
Falls	43	(45.7)	20	(40.8)	14	(53.8)	9	(47.4)
Drowning	28	(29.8)	13	(26.5)	7	(26.9)	8	(42.1)
Fire, heat and hot substances	1	(1.1)	1	(2.0)	–	–	–	–
Environmental heat and cold exposure	1	(1.1)	1	(2.0)	–	–	–	–
Exposure to forces of nature	6	(6.4)	5	(10.2)	–	–	1	(5.3)
Other unintentional injuries	5	(5.3)	4	(8.2)	–	–	1	(5.3)
Undefined	10	(10.6)	5	(10.2)	5	(19.2)	–	–
Self-harm and interpersonal violence	27	(10.2)	20	(12.3)	1	(1.7)	6	(13.3)
Self-harm (i.e. suicide)	20	(74.1)	16	(80.0)	1	(100)	3	(50.0)
Interpersonal violence <sup>f</sup>	7	(25.9)	4	(20.0)	–	–	3	(50.0)
No clearly identifiable cause <sup>g</sup>	3	(1.1)	–	–	–	–	3	(6.7)
Unclassified symptoms and signs	22	(1.5)	10	(2.0)	11	(1.8)	1	(0.3)
Unknown	337	(23.5)	100	(20.4)	153	(25.5)	84	(24.6)

Data are presented as n (%). GBD; global burden of disease; MACs: medical assistance centers.

<sup>a</sup> Pneumonia N = 8.<sup>b</sup> Sepsis N = 4, meningitis N = 3, blood in lungs N = 1.<sup>c</sup> Premature birth.<sup>d</sup> Malaria N = 2, in Thailand and Gambia.<sup>e</sup> Includes plane crash Tripoli, Libya in 2010 (N = 18).<sup>f</sup> By firearm N = 3, by sharp object N = 1.<sup>g</sup> Missing person N = 1, death as a result of injuries by an unknown cause N = 2.

medical tourism (e.g. dental care, elective surgery or fertility treatment) was excluded in the HAZARD study, but this group of travelers is interesting as these kind of trips can be a risky event since the quality of local healthcare can be different from that in the home country [37]. Third, the UNTWO travel data on Dutch travelers did not include an age distribution, making it impossible to calculate incidence proportions for the different age categories. This could have led to a base rate fallacy. However, we think that overestimation of the incidence proportions in the older age group is unlikely because it is improbable that there were more 65+ than 65- travelers in the UNWTO database. Fourth, the use of databases of MACs databases to assess travel-related health problems abroad, will skew the data towards more serious health conditions for which hospital-based care is required. Therefore these study results are not representative of the most common health problems in travelers abroad as most illnesses are self-limiting and medical help is not necessary. However, our results do provide a detailed insight on the most severe travel-related health problems. Fifth, no distinction could be made for the specific VFR group of travelers as they might differ in risk-seeking and travel behavior from holiday makers. Seeking

pre-travel advice is less common in this group of travelers while they often travel to high-risk environments [38]. In our study, 2% was recorded as VFR, but not all MACs defined this specific group separately leading to an underestimation of the total number VFRs. Sixth, information on pre-existing illnesses was not available in the MACs databases. In a study of Wieten et al. 26% of the travelers visiting the travel clinic for pre-travel advice had a medical condition (often cardiovascular); this was doubled in older travelers [39]. However, in a prospective cohort study we found that exacerbations of pre-existing illness as a health problem while being abroad was only rarely reported by older travelers to the tropics [30]. In addition, the post-travel health status of affected travelers was unknown since no (medical) follow up was done by the MAC after discharging from the hospital or after the repatriation. Sometimes travelers needed to be readmitted in a Dutch hospital or rehabilitation facility. It is therefore unknown what the consequences were following the foreign hospitalization, such as the acquisition of multiresistant pathogens [40], resulting in an underestimation of the actual disease burden and associated morbidity. Lastly, due to the mutual contact between the participation MACs it could be

possible that more than one center was involved in special cases resulting in a double included record in the dataset. Given the size of the dataset we believe that these few cases do not affect our results.

## 5. In practice

Data from the HAZARD project can be considered as a proxy for the incidence proportion of serious health problems experienced by Dutch travelers while traveling abroad. Not only the usual suspects communicable diseases such as RTIs and enteric infections are common, but more importantly injuries and non-communicable diseases, such as cardiovascular diseases, have the largest influence on travelers health and itinerary. The pre-travel advice should therefore, also for travelers to destinations within Europe, besides the standard infection prevention topics, provide information about adequate travel insurance, considering the possibility of an unplanned exposure to foreign healthcare and personal (road) safety [25,41–43]. Since injuries are frequently experienced, it would be interesting for MAC's worldwide to expand their current database systems by not only reporting the ICD code, but also record the injury cause instead of the body areas affected. As a result, frequent overviews can be generated with little effort providing important practical information that can be used towards the travelers they represent [23].

## Ethics approval and consent to participate

The study was endorsed by the Committee Medical Ethics (CME) of the Leiden University Medical Center (LUMC), Leiden, the Netherlands (registry number C15.067). Written informed consent was not required as the study did not fall under the scope of the Medical Research Involving Human Subjects Act (in Dutch WMO). The study was registered in the Netherlands Trial Register under NL5377 (NTR5478).

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## CRediT authorship contribution statement

Jessica A. Vlot: Conceptualization, Data curation, Formal analysis, Project administration, Visualization, Writing – original draft, Writing – review & editing. Jim E. van Steenbergen: Conceptualization, Supervision, Writing – review & editing. HAZARD project group: Katie Geary: Data curation, Resources, Writing - review & editing. Floriana S. Lupino: Data curation, Resources, Writing - review & editing. Perry J.J. van Genderen: Writing – review & editing. Leonardus G. Visser: Conceptualization, Supervision, Writing – review & editing.

## Declaration of competing interest

All authors declare that they have no conflicts 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.2022.102329>.

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