

1 **Article Type:** Original article

2 **Title:** Factors Affecting Pre-Travel Health Seeking Behaviour and Adherence to Pre-
3 Travel Health Advice: A Systematic Review

4

5 **Authors:** Dylan Kain,¹ Aidan Findlater,² David Lightfoot,³ Timea Maxim,⁴ Moritz U.G.
6 Kraemer⁵, Oliver J. Brady⁶, Alexander Watts,⁴ Kamran Khan,^{1,4} Isaac I. Bogoch^{1,7,*}

7

8 **Affiliations:**

9 1. Department of Medicine, University of Toronto, Toronto, Canada

10 2. Department of Medicine, McMaster University, Hamilton, Canada

11 3. Health Sciences Library, St. Michael's Hospital

12 4. Li Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, Canada

13 5. Department of Zoology, University of Oxford, Oxford, UK

14 6. Centre for the Mathematical Modelling of Infectious Diseases, London School of
15 Hygiene & Tropical Medicine, London, UK

16 7. Divisions of General Internal Medicine and Infectious Diseases, University
17 Health Network, Toronto, Canada

18 ***Corresponding Author:** Isaac I. Bogoch, Division Infectious Diseases, Toronto

19 General Hospital, 14EN 209, 200 Elizabeth Street, Toronto, ON, Canada M5G 2C4. E-

20 mail: isaac.bogoch@uhn.ca

21 **Keywords:** Travel; Pre-travel advice; Vaccination; Chemoprophylaxis; Malaria;

22 Adherence; Systematic review

23 **Word count:** 3598

24 **Tables: 4**

25 **Tables in Appendix: 2**

26 **Figures: 1**

27

28 **Abstract**

29 *Background:* Recent years have seen unprecedented growth in international travel.
30 Travellers are at high risk for acquiring infections while abroad and potentially bringing
31 these infections back to their home country. There are many ways to mitigate this risk by
32 seeking pre-travel advice (PTA), including receiving recommended vaccinations and
33 chemoprophylaxis, however many travellers do not seek or adhere to PTA. We conducted
34 a systematic review to further understand PTA-seeking behaviour with an ultimate aim to
35 implement interventions that improve adherence to PTA and reduce morbidity and
36 mortality in travellers.

37 *Methods:* We conducted a systematic review of published medical literature selecting
38 studies that examined reasons for not seeking PTA and non-adherence to PTA over the
39 last ten years. 4,484 articles were screened of which 56 studies met our search criteria
40 after full text review.

41 *Results:* The major reason for not seeking or non-adherence to PTA was perceived low
42 risk of infection while travelling. Side effects played a significant role for lack of
43 adherence specific to malaria prophylaxis.

44 *Conclusions:* These data may help clinicians and public health providers to better
45 understand reasons for non-adherence to PTA and target interventions to improve
46 travellers understanding of potential and modifiable risks. Additionally, we discuss
47 specific recommendations to increase public health education that may enable travellers
48 to seek PTA.

49

50

51 **Introduction**

52 The number of travellers to international destinations continues to grow year after year
53 (1). In 2018, there were over 1.4 billion international travellers and almost half of the
54 destinations were to low and low-middle income countries (LMIC) (1). This represents
55 the ninth consecutive year of sustained travel growth since 2009 (1). Most travellers do
56 not seek pre-travel advice (PTA), and those who do infrequently adhere to the PTA they
57 receive. PTA may include several recommendations such as dietary advice, vaccinations,
58 and chemoprophylaxis for infections such as malaria. This lack of adoption to PTA has
59 been illustrated repeatedly in many settings, for example, in Canada, where only 15% of
60 travellers visiting countries with a high burden of hepatitis A received vaccination for this
61 infection (2), in the US, where only 46% of travellers to developing countries at Boston
62 Logan International Airport had sought PTA (3), and in Australia, where only 31% of
63 travellers to low-income countries sought PTA (4). Such low rates of obtaining PTA may
64 increase morbidity from infectious diseases related to travel.

65

66 Further, PTA may have broader public health implications; infected travellers may import
67 disease back to their country of origin, and can place a large number of individuals at risk
68 of infection (5). Illness while travelling is common; in 2016, Vilkmán et al. reported that
69 76% of travellers experienced illness while abroad, and 25% still had ongoing symptoms
70 or new complaints within two days of returning home (6). Other studies have found
71 similar results, with one study demonstrating 64% of American travellers reporting
72 illness while travelling or after returning, and another finding 70% of Israeli travellers
73 reporting infectious symptoms (2, 7).

74

75 To date there have been several prospective studies examining access and adherence to
76 PTA (6), but much of the literature is comprised of retrospective studies of patients
77 seeking medical advice after they have returned with an illness (2, 4, 7, 8), or travellers
78 departing from only a few specific countries or cities. As such, the current literature
79 demonstrates a wide variability in the type of traveller and the rationale behind different
80 rates of access and adherence to pre-travel recommendations. The goal of this systematic
81 review is to consolidate current evidence to better understand reasons for individuals to
82 not seek or adhere to PTA. A better understanding of these factors may allow for targeted
83 interventions from both primary care providers and policy makers with the goal of
84 reducing morbidity and mortality in travellers, and potentially decreasing the likelihood
85 of importing new diseases to non-endemic settings (9).

86

87 **Methods**

88 A systematic review was performed to better understand factors that affect seeking and
89 adhering to PTA. Reporting conformed to PRISMA (Preferred Reporting Items for
90 Systematic Reviews and Meta-Analyses) guidelines (10). Ovid MEDLINE and Ovid
91 EMBASE were searched for English-language articles published from 2007 to October
92 2017 that matched keywords for travel, communicable diseases, and adherence (see
93 Appendix 1 for specific search terms). The past 10 years was chosen to reflect more
94 modern trends in travel (e.g. destinations and types of travellers) and PTA. The results
95 were deduplicated, then reviewed by two reviewers (DK, AF) for inclusion, with
96 disagreements resolved by a third reviewer (TM). Inclusion criteria included quantitative

97 observational studies of people travelling from a high-income country to a lower-income
98 country (as defined by the World Economic Situation and Prospects) (11) with the
99 intention of returning. Studies included those that investigated PTA, malaria
100 chemoprophylaxis, vector avoidance, respiratory precautions, and other risk behaviours
101 including dietary advice and safe sexual practices. Participants included business
102 travellers, vacationers, people visiting friends and relatives (VFR), missionary workers,
103 and the military, and excluded studies related to immigration or refugee migration.
104 We excluded randomized trials (in which adherence is likely to be grossly
105 overestimated), case reports and studies of routine childhood vaccination. Retrospective
106 studies looking at populations exclusively presenting following illness were also
107 excluded as these were likely biased towards lower compliance rates with seeking and
108 adhering to pre-travel advice.
109
110 Full-text review was performed by two reviewers (DK, AF), with data extraction for
111 country of origin, destination country, type of travel (business, vacation, VFR, or
112 military), whether PTA was sought, the sources of PTA (including primary care
113 physicians, travel clinics, or other healthcare provider, and the internet), rates of PTA
114 adherence, factors affecting PTA adherence, and reasons for non-adherence to PTA. The
115 results were separated into pre-specified categories of PTA including malaria
116 chemoprophylaxis, vector avoidance, respiratory precautions, and risk behaviours, though
117 one study could be included within several categories. Within each category, the included
118 studies were summarized in tables in order to highlight common themes. Given the
119 heterogeneity of the studies, with respect to behaviour assessed, type of traveler,

120 definition of compliance and a multitude of other factors, a meta-analysis was not
121 conducted.

122

123 **Results**

124 The pre-specified search criteria identified 4,484 articles after removing duplicates, of
125 which 56 were included in the review (Figure 1).

126

127 *Pre-Travel Advice:* Our review was not designed to capture all articles related to the rates
128 of seeking PTA, but instead to articles that examined factors associated with seeking PTA
129 and the behaviours that influenced adherence. Review of the papers related to PTA is
130 summarized in Table 1. Adherence rates varied across the studies, from as high as 92.4%
131 of travellers receiving PTA (12) to as low as only 32.4% (13).

132

133 Sources of PTA varied between studies: primary care providers (PCP) were the most
134 widely used resource, but other sources included travel specialists, travel agents,
135 employers, books, religious leaders, pharmacists, friends and relatives, and the internet.

136 One study (30) found that most travellers (68.3%) considered PCPs to be the most
137 trustworthy source of PTA, but 34.7% and 27.3% respectively, believed television and
138 the internet were reliable sources as well. Factors consistently associated with lower rates
139 of adherence with seeking PTA from the studies included being foreign-born (relative to
140 the country of departure), VFR travellers, business travellers, more frequent travellers,
141 being male, and a shorter duration of travel. Additionally, travellers to destinations with
142 higher risk of infections were more likely to seek PTA (Table 1).

143

144 Nine studies examined the reasons for not seeking PTA. While these results varied
145 significantly in the way in which data was captured, all nine studies found that the
146 majority of travellers did not seek PTA for several reasons, including that travellers did
147 not perceive any risk during travel, already felt well-enough informed, or just did not
148 consider seeking PTA. These perceptions accounted for 38.9% to 86.0% (17, 20) of
149 traveller's reasons for not seeking PTA. Three studies demonstrated that time limitations
150 were an additional reason for not seeking PTA, ranging from 5.0% to 18.9% of travellers
151 (3, 20, 26). Further studies demonstrated other reasons for not seeking PTA including
152 perceiving oneself of already being up to date with vaccines (one study with 31.5% of its
153 travellers (26)) and finally excessive cost (two studies with 5.0% and 7.2% of travellers
154 (3, 26)).

155

156 ***Pre-Travel Vaccination:*** There is high variability in vaccine adherence ranging between
157 1.0% for rabies vaccination (31), to as high as 100.0% for meningococcal vaccination for
158 Hajj pilgrims, where vaccination is mandatory for travel (18). Other mandatory vaccines
159 including yellow fever vaccines had similarly high vaccination rates (32). Anthrax
160 vaccination for many United States soldiers is mandatory but one study (33) found that
161 overall there was only a 68.2% acceptance rate for the vaccine in UK soldiers where it is
162 not mandatory, but strongly recommended. The two vaccinations with the lowest uptake
163 despite a recommendation from a Travel Medicine specialist were Japanese Encephalitis
164 (JE) and rabies vaccinations (15, 31, 34). Results are summarized in Table 2.

165

166 Along with high variability due to the type of vaccine other factors that influenced
167 adherence included type of PTA, with the highest rate of vaccination from travel
168 specialist clinics (14, 15, 18, 24, 35) and the lowest from those who did not see a health
169 care specialist before travel. Business travellers were also found to have a lower rate of
170 vaccination in one study evaluating influenza vaccination (36), but a higher rate for
171 meningococcal vaccine (12) and hepatitis B (37). Age and sex had differing effects with
172 several studies showing improved adherence to vaccination in younger travellers (12, 15)
173 and others showing improved adherence in older individuals (18, 21, 35, 36). Women
174 were found to have a higher rate of vaccine adherence in two studies (38, 39) and men in
175 one study (37). VFR travellers were found to have lower rates of vaccine adherence in
176 two studies (26, 34).

177

178 Our study identified 13 articles that discussed reasons driving decision making for
179 vaccine acceptance. These are also summarized in Table 2. The majority of reasons for
180 low vaccine adherence related to a lack of perceived risk of acquiring the disease for
181 which the recommended vaccine was intended to protect against. Specifically with the JE
182 vaccine, a lack of awareness the vaccine may contribute to its lower rates of adherence
183 (15).

184

185 ***Malaria Chemoprophylaxis:*** The studies investigating adherence with malaria
186 chemoprophylaxis (CP) are summarized in Table 3. There is a wide variation in malaria
187 chemoprophylaxis adherence rates among different studies, ranging from 10.5% (42) to
188 99.7% (43). Additionally, there is a wide range of CP choices recommended. Studies

189 encompassed many different types of travellers including military, business, missionaries
190 VFR and tourists.

191

192 Factors that were associated with either increased risk for poor acceptance of CP or
193 adherence to CP after starting were pregnancy (44), long duration of travel (17, 35, 44,
194 45, 46, 47), alcohol and smoking (48), experiencing side effects from CP (17, 49), VFR
195 status (26, 29), business travellers (28, 29), younger age (26, 28, 50) and being male (26).
196 Adherence was increased in those travelling to higher malaria risk countries (35, 42, 51),
197 those with a higher perceived threat of acquiring malaria (17, 48, 50), missionaries or
198 volunteers (42, 47), seeing a travel specialist for PTA (17, 28, 47, 52, 53) as well as peer
199 reinforcement among the travellers (48).

200

201 ***Anti-Vector Protective Measures (AVPM):*** While many papers examined adherence
202 with AVPM, there were few that examined factors that influenced traveller adherence
203 with these measures and none of the articles examined the reasons for lack of adherence.
204 Those included as summarized in Appendix 1, Table 1. Adherence rates differed
205 significantly throughout the studies based on the type of AVPM, the type of traveller, and
206 importantly the way in which the study defined adherence. Some included any use of the
207 intervention, some regular use and others required 100% adherence with the intervention.
208 Adherence ranged from as low as 1.0% for bed nets and 4.0% for repellent use (57) to as
209 high as 98.5% for air-conditioned rooms (58). Average rates of adherence for repellent
210 use was 45.1%, 40.0% for long sleeves and pants and 35.3% for bed net use. Air
211 conditioning use was significantly higher at 83.4% adherence.

212

213 Factors positively linked to increased adherence include travelling to areas of higher risk
214 for vector-acquired illnesses (47, 59, 60), increased age (60), requirement from military
215 command (61) and personal or family history of malaria infection (60). Only one study
216 discussed any potential reasons for not adhering with AVPM finding that 29.9% of flight
217 attendants or pilots did not use repellent due to concerns over toxicity of the product or
218 for the smell of the product, while almost all (98.5%) used an air-conditioned room that
219 was contracted directly from the airline company.

220

221 ***Respiratory Precautions:*** Respiratory precautions are not routinely recommended for
222 most travellers, however they are occasionally recommended for those travelling to mass
223 gatherings such as pilgrimages. Three studies met inclusion criteria and discussed factors
224 influencing adherence with respiratory precautions in travellers. All three examined Hajj
225 pilgrims travelling to Saudi Arabia. Overall, adherence with hand hygiene was higher
226 than with facemasks. Adherence was even lower for the suggested practices of social
227 distancing and contact avoidance. These results are summarized in Appendix 1, Table 2
228 (62, 63, 64).

229

230 ***Risk Behaviors: Food, Water, Sex and Safety:*** Three studies (46, 65, 66) examined
231 people's adherence with food and water safety and explicitly evaluated factors
232 influencing adherence to prevention of food and water-borne infections (Table 4).
233 Adherence to food and water precautions was low for travellers with trip durations on the
234 longer or shorter end of the spectrum. For example, in long-term travellers, precautions

235 tended to decrease further in those travelling for more than six months (65). Younger
236 travellers (18-35 years old) were less likely to adhere to low-risk behaviours such as
237 drinking bottled water, avoiding undercooked meats and other similar precautions (66).
238 None of these studies explored reasons for lower adherence rates in specific traveller-
239 types (Table 4).

240

241 Four studies (45, 46, 65, 66) examined the effect of travel on drug and alcohol use while
242 travelling. Among included studies, men were more likely to report increased alcohol
243 intake while traveling, while women reported increased smoking (Appendix 1, Table 2).

244

245 Six studies (45, 46, 65, 66, 67, 68) examined sexual behaviors while travelling. Rates of
246 new partners while travelling varied from 4.0% (65) to as high as 50.2% (45). There was
247 variability in barrier protection (e.g. condom use), ranging from 50.0% (46) to 85.6%
248 (67). Additionally, there was variability by country of origin, destination country, type of
249 traveller, and duration of travel. Men were significantly more likely to report new sexual
250 partner in two studies (45, 65). However, these studies both found that women were less
251 likely to use condoms. Those who did not bring condoms were less likely to have new
252 sexual partners, but more likely to not use condoms if they did (67). One study (68) found
253 that 78.9% of sexual encounters took place after alcohol or drug use, and that men were
254 more likely to have encounters with local partners. The study also found more condom
255 use if travellers brought condoms (OR 5.4), read STI information (OR 3.3) and used
256 condoms with casual encounters at home (Table 4).

257

258 **Discussion**

259 There is a steady increase in international travel volumes with approximately half of
260 travellers visiting low and middle-income countries. Individuals are regularly exposed to
261 infectious diseases while travelling and may potentially transmit these infections to others
262 upon their return home. Many of these infections are preventable through vaccination,
263 chemoprophylaxis, or other measures. All of these are typically addressed at pre-travel
264 medical consultations, yet most travellers do not seek PTA or adhere with recommended
265 precautions. A deeper understanding of the reasons for failing to seek or adhere to PTA
266 may enable better strategies to ensure traveler health and safety.

267

268 Prior to conducting this review it was our belief that the major barriers to seeking and
269 adhering to travel related recommendations would pertain to cost and inconvenience of
270 access. Instead we found that, despite the wide range of domains examined (e.g. PTA,
271 malaria CP, vaccines, AVPM etc.) and type of travelers examined (e.g. business, VFR,
272 vacation, military etc.), a lack of perceived risk was the most highly linked to seeking and
273 adhering to PTA.

274

275 In order to be able to receive many of the subsequent interventions recommended for
276 travel, travellers first need to seek PTA. Lack of perceived risk while travelling was the
277 predominant reason for not seeking PTA, despite the fact that morbidity may be high
278 when risk is perceived is low (2, 6, 7). Surprisingly cost was not a significant barrier to
279 seeking PTA in much (but not all) of the literature reviewed.

280

281 Vaccine adherence in the reviewed studies varied significantly, likely due to
282 heterogeneity of the vaccine recommendations (e.g. some, like yellow fever, were
283 mandatory for travel), but despite this heterogeneity, perceived risk remained the
284 strongest predictor of vaccine uptake in virtually all of the studies. Cost and side effects
285 did not significantly affect reported adherence to recommended vaccines. Once again
286 perception of risk was found to not correlate with actual risk, as illustrated by one study
287 (12) that found that only one third of travellers to Sub-Saharan Africa recognized a risk
288 of meningitis when traveling.

289

290 Of note there were particularly low rates of vaccine uptake for Japanese Encephalitis (JE)
291 and rabies, with 11.3% (15) and 1% (31) respectively. This is despite the potential for
292 severe outcomes with infection and high efficacy of vaccination. A recent study by
293 Connor *et al.* (69) suggests a low perceived risk of JE may be driving this finding despite
294 the changing epidemiology of this infection, with increasing risk compared to historical
295 data. Marano *et al.* (70) also shows a low perceived risk driving low rabies vaccine
296 uptake. Cost was noted in only 14% of travellers for not receiving rabies vaccination,
297 despite HCP believing it accounts for 61% of the reason. One recent study (71)
298 specifically looking at last minute travellers (those obtaining PTA < 7 days prior to
299 departure) showed that they were much more likely to list lack of time as the major
300 reason for not obtaining vaccines that required multiple injections, such as JE (52% listed
301 time as reason for lack of vaccination) and rabies (41% listed time as reason for lack of
302 vaccination). This suggests that accelerated vaccines schedules for JE and rabies may
303 have beneficial effects in vaccine uptake and that systems that improve earlier PTA

304 consultation could also improve uptake of these vaccines.

305

306 Unlike vaccinations, malaria CP adherence was affected primarily by side effects of the
307 medications, especially with medications such as doxycycline and mefloquine (17, 18,
308 54, 56) and in long-term travellers (44, 45, 46). Despite the larger role of side effects in
309 adherence, lack of perceived risk and perceived high baseline knowledge of infectious
310 threats continued to play the major role in lack of adherence with malaria CP. With
311 respect to AVPM there was significant heterogeneity in the studies that limited
312 comparison between them. However it was noted that most of the studies demonstrated a
313 trend towards increased adherence in those travelling to higher risk countries suggesting
314 that travellers were more likely to take precautions if they were at a higher risk. Other
315 domains examined in this study, including respiratory precautions and risk behaviours
316 (e.g. food, water and sexual safety), did not have sufficient information to draw
317 meaningful conclusions as to the reasons for lack of adherence and relationship with risk
318 perception.

319

320 Improving travellers' perception of risk to better reflect ones actual risk would better
321 allow for individuals to make informed decisions, and likely would improve adherence
322 with travel recommendations. Interventions should be targeted to help close this gap. One
323 possible intervention includes using online tools. The majority of travellers book their
324 trips through online booking websites (72) and this could allow focused interventions to
325 improved risk perception. For example, after booking a flight on a travel website,
326 automatic messages could provide accurate information about the potential risks in the

327 destination country to allow travelers to make informed decisions about risk mitigation.
328
329 PCPs were the most widely used resource for PTA, however travellers also sought other
330 reliable (e.g. travel specialist) and less reliable (e.g. internet) resources as well. Travellers
331 who sought PTA had significantly more accurate perceptions of risk (16, 28). This
332 finding has potential implications to improve traveller health; for example, as it is unclear
333 what the quality of PTA is from PCPs, strategies focused on training PCPs may improve
334 the quality of PTA provided. PCPs could have access to additional training in PTA and
335 access to vaccines to help facilitate pre-travel health assessments. Additionally, PCPs
336 may have additional training to recognize when a timely referral to travel specialist is
337 warranted should they not have the capacity to conduct the pre-travel assessment. An
338 interesting and related finding is that all of the studies evaluating alcohol consumption
339 and sexual behavior found that travellers increased their use of alcohol and had greater
340 frequencies of higher-risk (e.g. condomless) sexual behavior, especially in men. Potential
341 interventions from those providing PTA should include counseling to help mitigate these
342 risks, and PCPs typically have experience in this realm.

343

344 Large gaps were seen in traveller's knowledge about risk pertaining to vaccine
345 preventable illnesses. The source of PTA also was an important factor for adherence to
346 recommended vaccinations, with travel clinics having the highest uptake of vaccination
347 (14, 15, 18, 24, 35), suggesting that not only is obtaining PTA important, but the quality
348 of PTA is also critical for risk mitigation. Further highlighting this is the observation that
349 those who were better informed of malaria risks were more likely to adhere with malaria

350 CP (26, 47, 52, 73).

351

352 There are several limitations to this study. Given the significant heterogeneity of study
353 design, we could only qualitatively analyze data. There are also several subject areas with
354 insufficient studies to draw meaningful conclusions. Our paper also excluded studies
355 that looked at only travellers who presented for medical attention after travelling. This
356 was because these travellers had already become sick and so the samples were biased to
357 those who would have been less likely to comply with recommendations. These studies,
358 however, may still provide meaningful data if interpreted within a limited context.

359 Overall this heterogeneity makes it more difficult to draw definitive conclusions but does
360 allow broader applicability given that certain trends still emerge, namely the gap between
361 travellers' low perceived risk of acquiring an infection and the actual risk of acquiring an
362 infection. This knowledge and perception gap appears to drive the lack of adherence
363 across a wide range of domains including seeking PTA, accepting vaccines, and reliably
364 using malaria CP or AVPM. This knowledge and perception gap is also well documented
365 over a wide spectrum of travellers, including VFR, business travellers, military
366 personnel, and humanitarian workers.

367

368 A greater understanding of factors affecting adherence to pre-travel advice may help with
369 the design of programs to ensure travellers obtain proper care prior to departure, with the
370 goal to maintain traveler health and prevent the spread of emerging infections.

371

372

373

374 **Funding:** This study was unfunded.

375

376 **Conflicts of Interest:** D.K., A.F., D.L., O.B., and MUGK declare no conflicts of
377 interest. K.K. is the founder of BlueDot, a social benefit corporation that builds digital
378 health applications for infectious diseases. A.W. is employed by BlueDot. T.M. and I.B.
379 have consulted to BlueDot.

380

381 **Author Contributions:** The concept and design of this study were performed by D.K.,
382 A.F., K.K., A.W., and I.B. Data collections was done by D.K., A.F., D.L., and T.M. Data
383 analysis and interpretation was done by D.K. The manuscript was prepared by D.K. and
384 critically appraised by A.F., K.K., I.B., O.B., A.W., T.M., and MUGK. All authors
385 agreed and approved the final manuscript.

386 **References**

387

388

1. United Nations World Tourism Organization: World Tourism Barometer. 2018:

389

International tourist arrivals worldwide reach 1.4 billion two years ahead of

390

forecasts. Vol. 17 Advanced Release January 2019. Available at:

391

http://cf.cdn.unwto.org/sites/all/files/pdf/unwto_barom19_01_january_excerpt.pdf

392

. Accessed 6 June 2019

393

2. Hill DR. Health problems in a large cohort of Americans traveling to developing

394

countries. *J Travel Med.* 2000;7(5):259-266

395

3. LaRocque RC, Rao SR, Tsibris A., *et al.* Pre-travel Health Advice-Seeking

396

Behavior Among US International Travelers Departing From Boston Logan

397

International Airport. *J Travel Med.* 2010;17(6):387-91

398

4. Winer L, Alkan M. Incidence and precipitating factors of morbidity among Israeli

399

travelers abroad. *J Travel Med.* 2002;9(5):227–32.

400

5. Angelo KM, Kozarsky PE, Ryan ET, *et al.* What proportion of international

401

travellers acquire travel-related illness? A review of the literature. *J Travel Med.*

402

2017;24(5):1-8

403

6. Vilkinan K, Pakkanen SH, Lääveri T, *et al.* Travelers' health problems and

404

behavior: prospective study with post-travel follow-up. *BMC Infectious Diseases.*

405

2016;16(308):1-14

406

7. Tomasello D and Schlagenhauf P. Chikungunya and dengue autochthonous cases

407

in Europe, 2007-2012. *Travel Med Infect Dis* 2013;11:274–84

408

8. Schlagenhauf P, Weld L, Goorhuis A, *et al.* Travel-associated infection

409

presenting in Europe (2008–12): an analysis of EuroTravNet longitudinal,

- 410 surveillance data, and evaluation of the effect of the pre-travel consultation.
411 Lancet Infectious Disease. 2015;15(1):55-64
- 412 9. MacFadden DR, Bogoch II, Browstein JS, *et al.* A Passage from India:
413 Association between air traffic and reported cases of New Delhi Metallo-beta-
414 lactamase 1 from 2007 to 2012. Travel Med Infect Dis. 2015;13(4):295-9
- 415 10. Moher, D, Liberati, A, Tetzlaff, J, *et al.* Preferred Reporting Items for Systematic
416 Reviews and Meta-Analyses: The PRISMA Statement. PLOS Medicine.
417 2009;6(7):1-6
- 418 11. Developed and non-developed specifically defined based on World Economic
419 Situation and Prospects. World Economic Situation and Prospects. 2014. As
420 accessed at:
421 <[https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_](https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf)
422 [country_classification.pdf](https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf)>
- 423 12. Goodman AL, Aumatell CM, Halbert J, and Zuckerman JN. Awareness of
424 meningococcal disease among travelers from the United Kingdom to the
425 meningitis belt in Africa. Am J Trop Hyg. 2014;91(2):281-286
- 426 13. Heywood AE, Zhang M, MacIntyre CR and Seale H. Travel risk behaviours and
427 uptake of pre-travel health preventions by university students in Australia. BMC
428 Infect Dis. 2012;12(43):1-9
- 429 14. Heywood AE, Watkins RE, Iamsirithaworn S, *et al.* A cross-sectional study of
430 pre-travel health-seeking practices among travelers departing Sydney and
431 Bangkok airports. BMC Public Health. 2012;12(321):1-9

- 432 15. Duffy MR, Reed C, Edelson PJ, *et al.* A survey of US travelers to Asia to assess
433 compliance with recommendations for the use of Japanese encephalitis vaccine. *J*
434 *Travel Med.* 2013;20(3):165-170
- 435 16. Wynberg E, Toner S, Visser LG, *et al.* Business travelers' risk perception of
436 infectious diseases: Where are the knowledge gaps, and how serious are they? *J*
437 *Travel Med.* 2013;20(1):11-16
- 438 17. Ropers G, Du Ry van Beest Holle M, Wichmann O, *et al.* Determinants of malaria
439 prophylaxis among German travelers to Kenya, Senegal, and Thailand. *J Travel*
440 *Med.* 2008;15(3):162-171
- 441 18. Alqahtani AS, Wiley KE, Tashani M, *et al.* Exploring barriers to and facilitators
442 of preventive measures against infectious diseases among Australian Hajj
443 pilgrims: Cross-sectional studies before and after Hajj. *Int J Infect Dis.*
444 2016;47:53-59
- 445 19. Piyaphanee W, Wattanagoon Y, Silachamroon U, *et al.* Knowledge, attitudes, and
446 practices among foreign backpackers toward malaria risk in southeast Asia. *J*
447 *Travel Med.* 2009;16(2):101-106
- 448 20. Namikawa K, Iida T, Ouchi K, and Kimura M. Knowledge, attitudes, and
449 practices of Japanese travelers on infectious disease risks and immunization
450 uptake. *J Travel Med.* 2010;17(3):171-175
- 451 21. Yanni EA, Marano N, Han P, *et al.* Knowledge, attitudes, and practices of US
452 travelers to Asia regarding seasonal influenza and H5N1 avian influenza
453 prevention measures. *J Travel Med.* 2010;17(6):374-381

- 454 22. Behrens RH and Alexander N. Malaria knowledge and utilization of
455 chemoprophylaxis in the UK population and in UK passengers departing to
456 malaria-endemic areas. *Malaria Journal*. 2013;12(461):1-8
- 457 23. Rolling T, Mühlenpfordt M, Addo MM, *et al*. Pre-travel advice at a crossroad:
458 Medical preparedness of travellers to South and Southeast-Asia - The Hamburg
459 Airport Survey. *Travel Med Infect Dis*. 2017;18:41-45
- 460 24. Heywood AE, Nothdurft H, Tessier D, *et al*. Pre-travel advice, attitudes and
461 hepatitis A and B vaccination rates among travellers from seven countries. *J*
462 *Travel Med*. 2016;24(1):1-8
- 463 25. Zwar N, and Streeton CL. Pretravel advice and hepatitis A immunization among
464 Australian travelers. *J Travel Med*. 2007;14(1):31-36
- 465 26. Baggett HC, Graham S, Kozarsky PE, *et al*. Pretravel health preparation among
466 US residents traveling to India to VFRs: importance of ethnicity in defining
467 VFRs. *J Travel Med*. 2009;16(2):112-118
- 468 27. Baer A, Libassi L, Lloyd JK, *et al*. Risk factors for infections in international
469 travelers: An analysis of travel-related notifiable communicable diseases. *Travel*
470 *Med Infect Dis*. 2014;12(5):525-533
- 471 28. Lopez-Velez R, and Bayas JM. Spanish travelers to high-risk areas in the tropics:
472 airport survey of travel health knowledge, attitudes, and practices in vaccination
473 and malaria prevention. *J Travel Med*. 2007;14(5):297-305
- 474 29. Genderen P, Thiel P, Mulder P and Overbosch D. Trends in the knowledge,
475 attitudes and practices of travel risk groups towards prevention of malaria: results

- 476 from the Dutch Schiphol Airport Survey 2002 to 2009. *Malaria Journal*.
477 2012;11(179):1-10
- 478 30. Tashani M, Alfelali M, Azeem MI, *et al*. Barriers of vaccinations against serious
479 bacterial infections among Australian Hajj pilgrims. *Postgrad Med*.
480 2016;128(6):541-547
- 481 31. Altmann M, Parola P, Delmont J, *et al*. Knowledge, attitudes, and practices of
482 French travelers from Marseille regarding rabies risk and prevention. *J Travel*
483 *Med*. 2009;16(2):107-111
- 484 32. Caillet-Gossot S, Laporte R, Noël G, *et al*. Family compliance with counseling for
485 children traveling to the tropics. *J Travel Med*. 2013;20(3):171-176
- 486 33. Murphy D, Marteau T, Hotopf M, *et al*. Why do UK military personnel refuse the
487 anthrax vaccination? *Biosecur Bioterror*. 2008;6(3):237-242
- 488 34. Hagmann S, LaRocque RC, Rao SR, *et al*. Pre-travel health preparation of
489 pediatric international travelers: Analysis from the Global TravEpiNet
490 Consortium. *J Pediatric Infect Dis Soc*. 2013;2(4):327-334
- 491 35. Muller JM, Simonet AL, Binois R, *et al*. The respect of recommendations
492 provided in an international travelers' medical service: Far from the cup to the
493 lips. *J Travel Med*. 2013;20(2):78-82
- 494 36. Pfeil A, Mütsch M, Hatz C, and Szucs TD. A cross-sectional survey to evaluate
495 knowledge, attitudes and practices (KAP) regarding seasonal influenza
496 vaccination among European travellers to resource-limited destinations. *BMC*
497 *Public Health*. 2010;10(402):1-7

- 498 37. Yaita K, Yahara K, Sakai Y, *et al.* Hepatitis B vaccination status among Japanese
499 travelers. *The Hurume Medical Journal*. 2017;63(3):69-76
- 500 38. Barasheed O, Rashid H, Heron L, *et al.* Influenza vaccination among Australian
501 Hajj pilgrims: Uptake, attitudes, and barriers. *J Travel Med*. 2014;21(6):384-390
- 502 39. Keles H, Sonder GJ, and van den Hoek A. Predictors for the uptake of
503 recommended vaccinations in Mecca travelers who visited the Public Health
504 Service Amsterdam for mandatory meningitis vaccination. *J Travel Med*.
505 2011;18(3):198-202
- 506 40. Schilthuis HJ, Goossens I, Lifthelm RJ, *et al.* Factors determining use of pre-
507 travel preventive health services by West African immigrants in The Netherlands.
508 *Trop Med Int Health*. 2007;12(8):990-998
- 509 41. Murphy D, Marteau T, Hotopf M, *et al.* Why do UK military personnel refuse the
510 anthrax vaccination? *Biosecur Bioterror*. 2008;6(3):237-242
- 511 42. Namikawa K, Kikuchi H, Kato S, *et al.* Knowledge, attitudes, and practices of
512 Japanese travelers towards malaria prevention during overseas travel. *Travel Med*
513 *Infect Dis*. 2008;6(3):137-141
- 514 43. Nicosia V, Colombo G, Consention M, *et al.* Assessment of acceptability and ease
515 of use of atovaquone/proguanil medication in subjects undergoing malaria
516 prophylaxis. *Ther Clin Risk Manag*. 2008;4(5):1105-1110
- 517 44. Cunningham J, Horsley J, Patel D, *et al.* Compliance with long-term malaria
518 prophylaxis in British expatriates. *Travel Med Infect Dis*. 2014;12(4):341-348

- 519 45. Dahlgren AL, Deroo L, Avril J, *et al.* Health risks and risk-taking behaviors
520 among International Committee of the Red Cross (ICRC) expatriates returning
521 from humanitarian missions. *J Travel Med.* 2009;16(6):382-390
- 522 46. Hammer DH, Ruffing R, Callahan MV, *et al.* Knowledge and use of measures to
523 reduce health risks by corporate expatriate employees in western Ghana. *J of*
524 *Travel Med.* 2008;15(4):237-242
- 525 47. Pistone T, Ezzedine K, Gaudin AF, *et al.* Malaria prevention behaviour and risk
526 awareness in French adult travellers. *Travel Med Infect Dis.* 2010;8(1):13-21
- 527 48. Creach MA, Velut G, de Laval F, *et al.* Factors associated with malaria
528 chemoprophylaxis compliance among French service members deployed in
529 Central African Republic. *Malaria Journal.* 2016;15(174):1-8
- 530 49. Dia A, Gautret P, Adheossi E, *et al.* Illness in French travelers to Senegal:
531 Prospective cohort follow-up and sentinel surveillance data. 2010;17(5):296-302
- 532 50. Frickmann H, Schwarz NG, Holtherm HU, *et al.* Compliance with antimalarial
533 chemoprophylaxis in German soldiers: A 6-year survey. *Infection.*
534 2013;41(2):311-320
- 535 51. DePetrillo JC, Singer C, Bergagnini IA, *et al.* Assessment of adherence to
536 atovaquone-proguanil prophylaxis in travelers. *J Travel Med.* 2010;17(4):217-220
- 537 52. Berg J, Breederveld D, Roukens AH, *et al.* Knowledge, attitudes, and practices
538 toward malaria risk and prevention among frequent business travelers of a major
539 oil and gas company. *J Travel Med.* 2011;18(6):395-401
- 540 53. Pistone T, Guibert P, Gay F, *et al.* Malaria risk perception, knowledge and
541 prophylaxis practices among travellers of African ethnicity living in Paris and

542 visiting their country of origin in sub-Saharan Africa. *Trans R Soc Trop Med*
543 *Hyg.* 2007; 101(10):990-995

544 54. Brisson M, and Brisson P. Compliance with antimalarial chemoprophylaxis in a
545 combat zone. *Am J Trop Med Hyg.* 2012;86(4):587-590

546 55. Stoney RJ, Chen LH, Jentes ES, *et al.* Malaria prevention strategies: Adherence
547 among Boston area travelers visiting malaria-endemic countries. *Am J Trop Med*
548 *Hyg.* 2016;94(1):136-142

549 56. Peragallo MS, Sarnicola G, Boccolini D, *et al.* Risk assessment and prevention of
550 malaria among Italian troops in Afghanistan, 2002 to 2011. *J Travel Med.*
551 2014;21(1):24-32

552 57. Saunders DL, Garges E, Manning JE, *et al.* Safety, tolerability, and compliance
553 with long-term antimalarial chemoprophylaxis in American Soldiers in
554 Afghanistan. *Am J Trop Med Hyg.* 2015;93(3):584-590

555 58. Selent M, de Rochars VM, Stanek D, *et al.* Malaria prevention knowledge,
556 attitudes, and practices (KAP) among international flying pilots and flight
557 attendants of a US commercial airline. *J Travel Med.* 2012;19(6):366-372

558 59. Lalani T, Tun H, Tribble D, *et al.* A comparison of compliance rates with anti-
559 vectorial protective measures during travel to regions with dengue or chikungunya
560 activity, and regions endemic for *Plasmodium falciparum* malaria. *J Travel Med.*
561 2016;23(5):1-12

562 60. Sagui E, Resseguier N, Machault V, *et al.* Determinants of compliance with anti-
563 vectorial protective measures among non-immune travellers during missions to
564 tropical Africa. *Malaria Journal.* 2011;10(232):1-9

- 565 61. Vickery JP, Tribble DR, Putnam SD, *et al.* Factors associated with the use of
566 protective measures against vector-borne diseases among troops deployed to Iraq
567 and Afghanistan. *Mil Med.* 2008;173(11):1060-1067
- 568 62. Alqahtani AS, Wiley KE, Mushta SM, *et al.* Association between Australian Hajj
569 Pilgrims' awareness of MERS-CoV, and their compliance with preventive
570 measures and exposure to camels. *J Travel Med.* 2016;23(5):1-5
- 571 63. Alqahtani AS, Sheikh M, Wiley K and Heywood AE. Australian Hajj pilgrims'
572 infection control beliefs and practices: Insight with implications for public health
573 approaches. *Travel Med Infect Dis.* 2015;13(4):329-334
- 574 64. Balaban V, Stauffer WM, Hammad A, *et al.* Protective practices and respiratory
575 illness among US travelers to the 2009 Hajj. *J Travel Med.* 2012;19(3):163-168
- 576 65. Cabada MM, Mozo K, Pantenburg B, and Gotuzzo E. Excessive alcohol
577 consumption increases risk taking behaviour in travellers to Cusco, Peru. *Travel*
578 *Med Infect Dis.* 2011;9(2):75-81
- 579 66. Vilkmann K, Pakkanen SH, Lääveri T, *et al.* Travelers' health problems and
580 behavior: prospective study with post-travel follow-up. *BMC Infect Dis.*
581 2016;16(328):1-14
- 582 67. Lewis CT, and Wildt G. Sexual behaviour of backpackers who visit Koh Tao
583 and Koh Phangan, Thailand: A cross-sectional study. *Sex Trans Infect.*
584 2016;92(6):410-414
- 585 68. Crougns M, Van Gompel A, de Boer E, and Van Den Ende J. Sexual risk
586 behavior of travelers who consulted a pretravel clinic. *J Travel Med.*
587 2008;15(1):6-12

- 588 69. Connor BA, Davidson HH, Kozarsky P, *et al.* Japanese encephalitis vaccine for
589 travelers: risk-benefit reconsidered. *J Travel Med.* 2019:1-3
- 590 70. Marano C, Moodley M, Melander E, *et al.* Perceptions of rabies risk: a survey of
591 travellers and travel clinics from Canada, Germany, Sweden and the UK. *J Travel*
592 *Med.* 2019;26(1):S3-9
- 593 71. Yates JA, Sowmya RR, Walker AT, *et al.* Characteriztics and preparation of the
594 last-minute traveler: analysis of vaccine usage in the Global TravEpiNet
595 Consortium. *J Travel Med.* 2019:1-6
- 596 72. Chipkin, H. (2014, August 11). Consumer trends 2014: The growing influence of
597 TripAdvisor. Retrieved from [http://www.travelweekly.com/Travel-News/Online-](http://www.travelweekly.com/Travel-News/Online-Travel/The-growing-influence-of-TripAdvisor/)
598 [Travel/The-growing-influence-of-TripAdvisor/](http://www.travelweekly.com/Travel-News/Online-Travel/The-growing-influence-of-TripAdvisor/)
- 599 73. Wieten RW, Harting J, Biemond PM, *et al.* Towards improved uptake of malaria
600 chemoprophylaxis among West African travellers: identification of behavioural
601 determinants. *Malaria Journal.* 2013;12(360):1-8

Table 1: Studies examining adherence to PTA and reasons for non-adherence.

Ref.	Country of Study	Pre-Travel Advice	Sources of Pre-Travel Advice	Factors Influencing Adherence and Reasons for not Adhering
3	United States	259/476 (54.4%)	43.4% Internet, 19.5% CDC website, 38.1% PCP, 29.7% TS, TA 9.1%, Book 10.4%, Employer 2.8%	VFR had higher rate of PCP (57.0% vs 35.2%). Lower rates if foreign born (OR 2.29), travelling alone (OR 1.91), < 14 d (OR 3.14), vacation (OR 2.19). 55.6% not concerned, 32.2% didn't think of it, 5.0% too expensive and 4.9% too inconvenient.
14	Australia	415/843 (49.2%)	79.5% PCP, 4.2% TS, 19.2% internet, 13.5% TA	Age > 55 (OR 2), female (OR 1.75), not married (OR 1.81), resident of birth country (OR 2.03), travelling with others (OR 2.56), length of stay > 2 weeks (OR 1.8) > 3 months (OR 2.63), number of countries visiting (OR 2.38)
15	United States	969/1691 (57.3%)	56.0% HCP	VFR less likely to see HCP (33.3% vs 60.0%), high-risk travellers more likely to see HCP (79.1% vs 49.2%)
12	United Kingdom	279/302 (92.4%)	71.2% PCP, 8.9% TS, 12.3% internet	VFR less likely (p=0.046), backpackers were more likely to see TS (p=0.014) or internet (p=0.002)
16	Netherlands	232/328 (70.7%)	83.4% company TS, 17.0% external source	Study of business travellers only. Top reason for non-adherence was: 49.1% who "Knew what to do." Those who saw company TS had more accurate risk perception.
17	Germany	811/1001 (81.0%)	47.9% PCP, 22.1% TS, 9.3% public health offices, 6.4% FR, 5.1% internet, 4.1% pharmacies, 4.2% TA	Kenya 89.0%, Senegal 81.9%, and Thailand 70.2% sought PTA. Last minute travellers, and age <40 sought non-medical advices more often. Reasons for not seeking advice were that individuals considered themselves sufficiently informed (70.0%) or that they perceived no risk at their destination (16.0%). Did not differ with purpose of travel.
18	Australia	236/356 (66.3%)	57.0% PCP, 23.9% TS, 12.1% specific website for Hajj, 16.8% internet. 235/356 Hajj travel leaders, 161/356 from FR	Being 34-49 most likely to get PTA (OR 2.5). 47.0% did not recognize the need for advice, 32.2% preferred to use other sources i.e. family and friends, 14.1% reliance on previous experience, 6.9% previous negative experience with PTA.
19	Thailand	323/434 (74.4%)	64.8% PCP or TS, 38.0% internet, 26.3% FR, 26.0% Guidebook, 22.8% Pharmacist	Study of backpackers only. Mean travel knowledge was much higher for those who received PTA from PCP or TS than for those who did not (p<0.001).
20	Japan	117/302 (38.7%)	64.1% internet, 54.7% guidebook, 28.2% TA, 17.1% FR, 14.5% tourist office, 5.0% TS, 0.9% other physician	18.9% said they were too busy, 38.9% said they already knew the health risks, 16.2% considered that there was no risk to their health, and a third (32.4%) stated that they were unaware of the need to seek any health information.
21	United States	236/548 (43.1%)	53.3% internet, 50.1% PCP and 20.5% TS, 18.8% VR.	US born travellers more likely to use internet, and more common to seek pre-travel (OR 3.1). Non-VFR (OR 2.77), Caucasians more likely OR 3.17, Companions (OR 1.88), Flu shot (OR 1.88)
22	United Kingdom	813/1047 (77.7%)	93.3% TS or PCP and 6.7% other	40.0% of Nigerians had professional PTA, compares to 22-23% of Ghana and Kenya. Nigerians travel more repeatedly.
23	Germany	468/975 (48.0%)	66.5% PCP, 22.4% TS, 12.1% Other	More frequent travellers were less likely to seek PTA (68.2% to 35.0% from 0 to > 5 trips). Odds ratio of carrying SBET: Other 1.7, PCP 2.65, TS 7.83.
24	Multiple	16904/19817 (85.3%)	82.2% HCP, 17.8% non-HCP (travel website most common)	78.1% in Canada, 57.9% Sweden from HCP. Vaccination rate from TS was 80.2%, HCPs was 67.3%, from non-HCP was 52.3% and no PTA was 31.0%.
25	Australia	168/503 (33.4%)	87.8% PCP, 12.2% TS	More likely if visiting high Hep A endemic country, longer trip and less frequent travellers. Perceived lack of risk: 34.4% 'safe country,' 17.1% 'uneventful last visit,' 14.3% 'no need,' 8.1% 'others told was safe,' 9.8% 'staying with family' and 2.4% 'didn't think about it.'

26	United States	525/1302 (40.3%)	78.2% PCP, 21.8% TS	Less likely in VFR, South Asian ethnicity, males, younger age, non-US citizens, persons who had traveled to India in the previous 5 years, and those with at least a college education. Reasons: 58.5% did not think needed, 31.5% vaccines up to date, 12.9% time limitations, 7.3% cost, 2.3% did not know facility.
27	United States	113/259 (43.6%)	47.7% PCP, 32.8% TS and 19.5% internet	Lower adherence if male (OR 1.8), foreign born (OR 2), < 2 weeks to trip (OR 4.8), duration of travel < 7 d (OR 7.9), > 2 trips per year (2.7). Reasons: 47.5% not aware of need, 34.5% already knew what to do. Cost not listed.
28	Spain	886/1212 (73.1%)	81.5% HCP, 13.6% TA, 4.5% personally obtained	Less likely if Age > 50, travelling to South America, business travellers (80.7% of vacation and 37.7% of business), previously visited (88.2% vs 33.3%). Much lower perceived risk if informed by TA vs HCP (50.4% vs 20.4%)
13	Australia	269/829 (32.4%)	84.4% PCP, 20.9% internet (such as government website), 5.5% TS, 8.3% university	Domestic students more likely than foreign students (38.2% vs 12.4%, OR 4.4), Those 17-20 and those who had only travelled once in the past 12 months were more likely to see a HCP. VFR significantly less likely to see HCP than other sources (OR 0.5). Those that had sought PTA were more likely to be aware of vaccine for Hep A, B and measles. Overall risk perception low. Those who perceived high risk of Hep A were more likely to get PTA (OR 1.5).
29	Netherlands	1994/3045 (65.5%)	For high risk: 27.8% TS, 11.8% PCP For low risk: 51.0% TS and 10.2% PCP	High-risk destination 84.7% vs 59.6%. Elderly travellers less likely to get PTA, but overall KAP similar. Solo travellers less preparation, despite travelling to higher risk locations. Business travellers less frequently sought PTA (p<0.0005). VFR also less PTA (p=0.031 for high risk and p<0.0005 for low risk).

604 TS = Travel Specialist, PCP = Primary Care Provider, TA = Travel Agent, FR = Friends
605 and Relatives, PTA = Pre-travel advice, HCP = Health Care Providers, KAP =
606 Knowledge, Attitudes and Practice
607 *NB:* The numbers listed in column 4 will not always add up to 100% as some studies
608 allowed participants to select more than one possible answer.
609

610
611
612

Table 2: Studies examining vaccination recommendations and reasons for non-adherence.

Ref.	Country of Study	Adherence Rate	Factors Influencing Adherence	Reasons for not Adhering
14	Australia	100/843 (11.9%)	Those who saw TS vc PCP were more likely to receive a pre-travel vaccine (58.3% vs 20.3%).	Not listed.
36	Switzerland	119/869 (13.7%) Influenza Vaccine	Increased age (OR 1.03) and previous seasonal flu vaccine (OR 12.91) increased rate. Business negatively correlated (OR 0.39)	37.1% vaccinated for business reasons, 20.9% vaccinated for age and 8.4% vaccinated for trip. No vaccine because felt not at risk (43.5%), missed recommendations by GP (19.2%) or did not see relevance of vaccine (23.0%). Other reasons included rare/never affected by influenza (5.7%), vaccine is not effective enough (4.5%) and bad experiences with vaccine/side-effects of vaccine (4.1%). Most travellers would consider vaccination if they would feel in bad general health (47.3%), followed by a recommendation of the family physician (37.7%) and travel to regions with known high risk of influenza (35.1%).
15	United States	47/415 (11.3%) received JE vaccine	Of those who would be high risk for JE, more likely to get if younger (mean age 34 vs 41 among non-adherent). Higher rate if saw TS vs other HCP.	60.2% were unaware of or had not been advised to receive the vaccine, 27.8% did not think they needed JE vaccine for their trip, 4.0% vaccines costs, 2.0% inadequate time and <1% concerns about possible SEs. 45.1% had seen HCP.
12	United Kingdom	91/294 (30.1%) Meningococcal Vaccine	Highest in those <35 years, backpackers, business travellers, and those who had previous visits to SSA. Increased adherence in those that knew meningitis was a risk of travelling to SSA.	Traveller thought vaccine not needed (28.7%), GP advised vaccine not needed (24.8%), already vaccinated (24.2%), thought would take a risk (5.1%), TS advised not needed (3.2%), did not have time (2.5%), too expensive (2.5%).
30	Australian	19/133 (16.8%) for Pneumococcal and 16/133 (14.1%) for DTP	Not discussed: Only examining Hajj pilgrims	Not aware of it (42.8%), reliance on natural immunity (6.25%), was not required (6.25%), didn't think was important (5.35%), too busy (2.7%), remainder no answer (36.7%)
18	Australian	100.0% meningococcal (mandatory), 297/356 (83.4%) other vaccines	Age > 40 increased vaccination (OR 2.5), university education also increased vaccination (OR 3.4). PTA from PCP had positive effect on vaccination (OR 1.9) and tour group leader (OR 2.5).	"I didn't know about them" (56.3%), "I won't get sick, I'm under Allah's protection" (31.7%), "I don't have chronic diseases" (30.1%), "I don't worry about getting sick" (25.9%). Reasons for getting: "I don't want to get sick" (73.0%), "tour group leader recommended" (64.4%), "my doctor advised me" (52.8%), "vaccine effective at protecting me" (44.8%).
40	Netherlands	69.2% (202/292)	Male (OR 1.98), from Ghana (OR 2.54), had health insurance (OR 2.48), VFR (OR 6.69).	Short notice (18.9%), Expensive (16.7%), Never take (15.6%), get medication there (12.2%), up to date (10.0%), from there (8.9%), don't get sick easily (7.8%)
32	France	118/167 (70.7%)	VFR Children. Varied with vaccine proposed (YF 100.0%, HepA 75.0%, Typhoid 75.0%, and BCG 36.0%).	Cost (36.0%), fear of adverse events (36.0%), neglect of vaccine (16.7%), perceived inefficacy of vaccine (11.1%) and lack of time before departure (5.5%) reasons for not adhering.
37	Japan	152/233 (65.2%) for HepB vaccination, but only 60.1% completion of series	Factors positively associated with HepB vaccination age, male, business (OR 16.9) or accompanying family (OR 7), travelling to Asia (OR 3.3), duration of travel > 1 month (OR 20.4), patient's company paid for vaccine (OR 21.5)	Did not discuss.

38	Australia	Influenza Vaccine 2011: 278/431 (64.5%) 2012: 476/535 (89.0%)	Females more likely to get vaccinated. Receiving previous influenza vaccines increased the likelihood of receiving the vaccine (OR 2.2). 87.9% from PCP, 5.0% from hospitals, 4.1% from workplace and 3.2% from others including TS.	*Reliance on natural immunity (33.3% vs 25.7%), believing they rarely get influenza (17.9% vs 29.1%), too busy (13.0% vs 17.1%), not aware of vaccine (12.2% vs 0.0%), do not like injections (8.3% vs 0.0%), fear of SEs (7.1% vs 1.9%), belief it does not work (7.1% vs 5.2%), thought gives the flu (6.4% vs 4.6%), had to pay (6.0% vs 2.1%). Reasons for: recommended by tour leader (64.6%), flu is serious (33.5%), recommended by doctor (30.4%), recommended by friend (12.1%), protect family (10.2%), offered at workplace (9.1%), working with vulnerable people (7.3%), consider themselves at risk (3.7%), travel to Hajj (2.8%).
31	France	3/300 (1.0%) rabies vaccine, 42.8% stated they would accept if recommended by HCP	Not applicable. KAP of rabies higher in males with university degree. VFR had significantly lower KAP	Reasons for refusal of preventive vaccination were mainly low benefit/risk for rabies (55.0%), high cost (25.7%), and adverse vaccine reaction (8.2%).
21	United States	533/1301 (41.0%) influenza vaccine	Married (OR 1.61), Age 50-64 (OR 1.74), Age > 65 (OR 3.8). Neither the country of birth nor the purpose of travel affected.	Reported reasons for not being vaccinated included not thinking they needed the influenza vaccine (56.8%), fear of becoming ill from the vaccine (13.2%), fear of needles (7.2%), belief that the vaccine had no effect (5.3%), receipt of vaccine >1 year earlier and not thinking they needed it again (4.0%), and not believing in vaccination (4.0%). Cost, access to health insurance and lack of time rarely mentioned.
24	Multiple	11660/19817 (58.8%)	HCP PTA: 9328/13857 (67.3%), non-HCP PTA: 1616/3047 (53.0%), no PTA: 716/2334 (30.7%). Volunteer work had highest rates of seeking PTA and highest rates of adherence with vaccination.	Lack of information (63.3%), cost (11.8%), safety (11.8%), lack of time, require reminder (3.1%), other (35.4%). Partial adherence: lack of information (36.3%), lack of time (27.8%) and need for reminders (24.3%).
34	United States	1533/3332 (46.0%) received routine vaccine, 2766/3332 (83.0%) received pre-travel vaccine	Rabies, JE and meningococcal were most likely to be declines (83.1%, 76.2% and 39.2% respectively). VFR and those with children ≤ 5 were more likely to refuse (OR 2.21 and 1.64)	Not discussed.
39	Netherlands	517/2156 (24.0%)	Women (OR 1.28), second-generation immigrants (OR 1.4), older age, 2+ medical comorbidities (OR 1.8) were more likely to accept dTP vaccine.	Not discussed.
26	United States	HepA: 542/971 (55.8%), Typhoid: 126/971 (13%)	VFR 50.9% and 9.4% for HepA and Typhoid vs non-VFR 68.8% and 36.6% respectively. More likely in those aged 18-39 as well.	Not being advised by their healthcare provider (36%), not being aware of the vaccine (18%) and believing the vaccine unnecessary (21%).
35	France	233/419 (55.6%)	Wide variability with type of vaccine (83.6% DTP, HepA 49.7%, Typhoid 50.8%). Consulted a PCP (74.9% vs 62.0%, OR 1.71). Retirees (83.8% vs 66.8%, OR 2.42)	Unwillingness to be vaccinated against these diseases (68.4%), conflicting medical opinion (9.9%), not enough time (7.6%) and cost (4.1%)
41	United States	3821/5302 (72.1%) Anthrax Vaccine	Individuals deployed later were more likely to refuse the vaccine (59.3% vs 22.1%).	Concern about SEs (88.1%), insufficient/unclear information about vaccine (72.1%), concern it was voluntary (50.9%), adverse publicity (50.9%), did not think there was a risk (50.2%), influence of colleagues (26.8%), influence of FR (15.3%), influence from command (12.7%), previous bad experience (9.0%).

613 JE = Japanese Encephalitis, SE = Side Effects, SSA = Sub-Saharan Africa, MMR =
614 measles, mumps and rubella, DTP = diphtheria, tetanus and polio. *Listed as 2011
615 percentage compared to 2012 percentage.
616

617
618
619

Table 3: Studies examining malaria CP adherence and reasons for non-adherence.

Ref.	Country of Study	Adherence Rate	CP	Factors Influencing Adherence	Reasons for not Adhering
43	Italy (Oil Company Employees)	99.6% (697/700)	100.0% A/P	N/A – sample size who did not comply too small. Very heterogenous population of mostly male oil company workers.	3/3 low perceived risk of malaria.
51	United States	88.5% (92/104)	100.0% A/P	Travelling to SSA correlated with adherence (p=0.0063). Past malarious travel increased adherence (p=0.041).	7/12 did not feel the medication was necessary, 2/12 were told by their tour guides that they did not need to take it, and 3/12 reported adverse effects.
54	United States (Military)	61.3% (211/344)	90.1% Doxy, 3.6% MFQ, 0.9% A/P, 0.2% PMQ	64.6% (195/302) in daily CP group, 38.1% (16/42) in once weekly CP group	39.2% GI upset, 31.8% forgetfulness, 22.3% low perception of risk.
50	Germany	76.9% (1006/1308), 75.0% with MFQ, 78.1% with A/P and 87.2% with Doxy	82.4% MFQ, 13.7% Doxy, A/P 3.4%	Higher adherence was seen with older age (p=0.02), satisfaction with counselling (p=0.02), perceived threat of mosquitoes (p=0.02)	Not discussed.
44	United Kingdom	25.1% (82/327)	55.0% A/P, Doxy 19.9%, 14.7% MFQ, 3.7% CLQ	Trend towards self-reported side effects and adherence. Travel longer than 1 year reduced adherence. Pregnancy reduced the adherence with malaria prophylaxis.	68.7% cited concerns related to long-term side effects as the predominant reason for non-adherence. 36.1% stated not reflecting the practicalities of long-term ex-patriot lifestyle.
17	Germany	76.5% (377/493)	63.1% MFQ, 30.1% A/P, 2.8% CLQ, 2.8% C/P, 2.1% Doxy	Increased adherence if advice from medical professional (PCP or TS), correct malaria risk perception, travel to Kenya vs Senegal.	Reasons for not taking fear of adverse events (51.8%), previous experience of adverse events (25.2%), and “no risk perceived” (29.1%). Reasons for stopping were “absence of mosquitoes” (52.7%) and adverse events (21.6%)
48	France	56.6% (684/1208)	100.0% Doxy	Increased with other AVPM, taking same time each day (OR 2.37), peer to peer reinforcement (OR 1.38), higher perceived risk (OR 1.65). Reduced with alcohol (OR 0.74) and smoking (OR 0.6).	Not discussed.
45	Switzerland	35.5% (144/406)	Not specified	Linearly reduced adherence with increased mission time.	Preference to treatment compared to prophylaxis, use of other protective measures and fear of side effects.
49	France	71.8% (257/358)	76.0% A/P, 16.8% Doxy, 6.1% MFQ	More likely to stop if had GI side effects. More likely to stop if had Doxy compared to A/P.	47.1% found it useless, 44.1% feared the side effects.
46	Various (38% NA, 29% UK, 7% Europe)	57.1% (24/42)	47.6% MFQ, 16.7% C/P, 9.5% Doxy, 7.1% CLQ	Use declines with longer duration at site (81.3% for < 3 mo, 27% for 4-6 mo and 13.3% for > 7 mo).	Side effects, low perceived risk and suggestions from colleagues.
21	Various (62.7% Europe, 19.6% NA)	57.6% (37/65)	55.3% Doxy, 21.1% A/P, 18.4% MFQ, 2.6% CLQ	Not discussed.	Reasons to stop once started: 77.8% side effects, 11.1% forgot, 22.2% though didn't need.
42	Japan	10.5% (21/200)	47.6% did not know, 23.8% MFQ, 9.5% C/P, 9.5% Doxy	Higher rate in those to SSA (20.0%), missionaries and volunteers had higher rates at 26.7% vs 6.6% in tourists. 21.4% use if thought risk high	Don't know how to get (32.8%), low perceived risk (18.3%), side effects (14.4%), don't like taking (10.5%), cost (7.2%), don't work (5.0%).

				compared to 1.8% if considered low risk.	
52	Netherlands	60.7% (199/328)	44.6% A/P, 21.5% CLQ, 14.8% Proguanil, 14.3% MFQ	Business travellers were more likely to carry CP if saw company doctor.	39.5% had not been advised to take, 22.5% judged is not necessary, 14.0% unsure, 7.1% had a dislike for all tablets.
47	France	Low risk country: 22.2% (619/2788) High risk country: 78.8% (431/547)	Low: 32.5% MFQ, 31.2% C/P, 23.3% CLQ. High: 52.4% C/P, 23.9% MFQ, 12.1% CLQ.	Longer trip duration, single trips and trips undertaken for humanitarian reasons were associated with more appropriate CP use. Awareness that malaria was a serious disease (OR 2.03) and acquiring information from a physician (OR 3.01) improved adherence.	Not discussed.
55	United States	71.6% (265/370)	81.8% A/P, 10.1% CLQ, 5.0% Doxy, 3.1% MFQ.	No significant difference based on sex, birth country, travel destination or duration, daily versus weekly CP and purpose of travel.	Reasons for stopping: 50.3% forgetting to take, 30.6% side effects, 11.1% observing no mosquitoes Reasons for not taking: 50.3% told by someone CP unnecessary, 28.6% thought low risk, 17.1% observed no mosquitoes, 17.1% cost.
53	France	75.5% (80/106)	60.2% C/P, 19.8% CLQ, 14.9% MFQ	Significantly higher use in TC group (86.1%) than TA group (60.0%). Higher adherence and more adequate medications.	Not discussed.
26	United States	21.9% (247/1127)	Not discussed.	VFR significantly lower CP use (16.3% vs 39.4%, OR 0.41), Age < 40 (OR 0.71), Male (OR 0.64), SEA decent (OR 0.26), US citizen (OR 3.2)	VFR had lower perceived malaria risk.
56	Italy	71.4% (4123/5773)	99.1% MFQ	2002-2006 80.9% adherence, 2007-2011 59.5% adherence.	Forgetfulness (26.1%), Side effects (23.0%), Consider unnecessary (5.3%)
28	Spain	34.8% (420/1206)	43.6% MFQ, 17.1% A/P, 16.1% CLQ, 13.5% C/P, 2.7% Doxy	Information received from travel agencies (87.6% vs 50.0% informed by health care professionals, p<0.0000001, travel for business reasons (76.7% vs 63.6% travel for other reasons) (p<0.001), travellers younger than 30 years or older than 39 years (70.3% vs 56.9% travellers 30 – 39 y old) (p < 0.000002)	23.4% stated they would obtain medication at their destination if became ill, 20.3% not obligatory, 20.3% no recommendations made, 14.1% side effects, 14.1% only visiting urban areas.
35	France	76.3% (219/287)	Not discussed	Travel destination of Kenya of Senegal increased adherence to 86.2% vs 73.6%. Trips <15d had 85.0% adherence vs 67.6% for longer.	20.6% side effects, 17.6% forgetting, 17.6% too many pills, 13.3% no mosquitos seen, 11.8% tiredness, 10.3% do not like taking medication, 2.9% too expensive, 1.5% lack of pills.
29	Netherlands	71.0% (503/708)	66.2% A/P, 9.3% MFQ, 4.2% Proguanil, 1.4% Doxy	Business travellers and VFRs had significantly lower protection rates against malaria. Last minute much lower KAP. Increased protection rate over 2002-2009.	Not discussed.

620 A/P - atovaquone and proguanil hydrochloride, Doxy = Doxycycline, MFQ =
621 Mefloquine, PMQ = Primaquine, CLQ = Chloroquine, C/P = Chloroquine plus proguanil,
622 NA = North America, TC = Travellers clinic, TA = Travel agent
623

624
625
626

Table 4: Studies examining adherence to recommendations to food and water safety, sexual safety and drugs and alcohol use.

Ref.	Country of Study	Adherence Rate	Factors Influencing Adherence	Reasons for not Adhering
65	Varied: 16.8% US, 16.1% UK, 7.7% Spain	23.4% (156/667) reported > 3 drinks/d, 26.0% (251/964) report increased drinking. Only 3/1010 reported never consuming a food item at risk for TD. 2.0% used illicit drugs. 4.0% had a new sexual partner while travelling and 16.0% of these did not use condoms consistently.	Women had lower rates of illicit drugs use and new sexual partners (OR 0.3 for each). Lower TDRB in those travelling alone or for shorter time. Alcohol had no effect on rates of TD but did increase the TDRB scores (OR 1.5), new sexual partners (OR 6.5) and illicit drug use (OR 11.7). Did not affect the condom use. Women were more likely than men to inconsistently use condoms (OR 6.4)	Not discussed.
45	80.0% European, 9.4% North American	14% increased alcohol use, 43.4% increased smoking and 10.1% new start, 50.2% had new sexual partner, 35.5% had 2 or 3 partners and 15.5% had ≥ 4 partners. 64.0% always used condoms.	Increased smoking if female, increased alcohol consumption if experiencing exhaustion. Longer missions increased the rates of new sexual encounters. Men more likely to report a sexual relationship (OR 1.38). Women significantly less condom use. Living alone increased the risk for sexual risk behavior (OR 2.56). Older age inversely related to sexual risk behavior.	Not discussed.
46	United States	34.3% reported increased alcohol. 24.4% reported sexual encounters with a local partner (50.0% did not use a condom) 50.0% only boiled or bottled water, 77.6% only well cooked meat, 67.7% avoided ice, 56.0% avoided raw vegetables, N = 42.	52.1% adherence in those ≤ 6 months and 19.9% in those > 6 months.	Not discussed.
67	21.3% UK, 16.8% Germany, 10.3% Canada, France 7.8%, Netherlands 6.1%, Australia 5.8%	39.1% (456/1238) reported a new sexual partner, 14.4% (167/1238) report unsafe sex.	Risk factors for increased unsafe sexual activity include male gender, age 20-24, being from the UK or Sweden, increased trip duration. Those who did not bring condoms were more likely to not use condoms, but less likely to have new sexual partners.	Not discussed.
68	The Netherlands	5.0% (95/1907) had a new partner. 31.1% did not use a condom. 63.2% were local partner.	78.9% of sexual encounters took place after alcohol or drugs. No difference in condom use between men and women, but men were more likely to have a local partner. More condom use if brought condoms (OR 5.4), reading STI information (OR 3.3) and using condoms with casual encounters at home.	Not discussed
66	Finland	5.0% did not use bottled/boiled water, 12.9% ate uncooked meat/fish, 78.8% ate salads, 24.1% had 3+ drinks/day, 14.4% did not always wash hands, 2.0% unprotected sex with local and 71.1% walked barefoot. N = 460	Young adults (18-35 years) were more likely to eat uncooked meat/fish, to have freshwater contact, neglect hand washing, and not to shun salads or eating without utensils. Men consumed more alcohol than women (p <0.001).	Not discussed.

627
628

TD = Travellers Diarrhea, TDRB = Travellers Diarrhea Risk Behavior