

Malaria and travel : where does it come from?

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- How common are cases like this?
- Could we get an outbreak in the UK

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Malaria kills BA steward and leaves two se

The death of a cabin crew member raises concerns that a change in drugs staff at risk

By Jane Merrick, Political Editor

Sunday, 1 February 2009

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Britain's largest union demanded an urgent investigation yesterday after a British Airways cabin crew member died from malaria and two others were left seriously ill from the disease.

A BA air steward caught the most deadly strain of malaria after working on a flight from Heathrow to Ghana. Two more became ill after flying to other destinations. Officials from Unite, which represents cabin crew, raised



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Inquiry into Heathrow malaria case



The disease could have come through Heathrow Airport
A man who works near Heathrow airport has been struck down with malaria.

It is thought the patient, who has not been named, may have contracted the disease from a bite by a mosquito transported to Britain via the airport.

Talking Point

The man has now recovered, but had not been to any country affected by malaria.

Country Profiles In Depth

Programmes

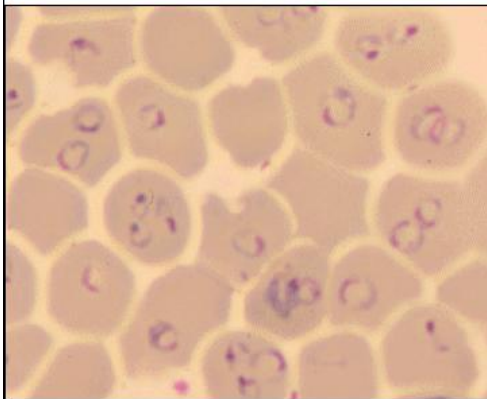
A report on the case in New Scientist magazine says officials from the Public Health

- 16th to 19th century cases in England
 - ‘Ague’, ‘marsh fever’, intermittent fever
- Term ‘malaria’ first used on 19th cent
 - Meaning: ‘bad air’
- Last major outbreak
 - Isle of Sheppey during First World War.
 - Servicemen returning from Macedonia carrying malaria parasites in their blood were billeted on the edge of town.
 - local mosquitoes bit convalescing soldiers.
 - These mosquitoes then went on to infect 32 local people over a period of several years



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- British malaria infection from an aircraft was in July 1983 when two people were infected in a village several miles from Gatwick Airport. A pub landlord and a motorcyclist passing through the village both contracted the disease.
 - “Women seemed to die most frequently, so men from East Anglia used to go to Essex to get new wives”
 - Increased mortality during pregnancy?

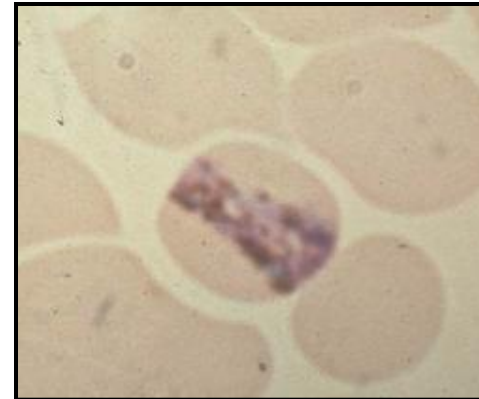
Plasmodium falciparum



(original image provided by Steve Aley)

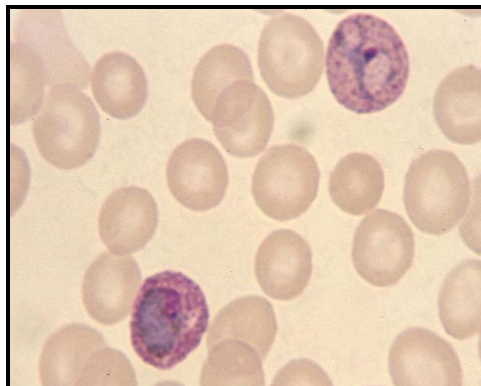
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Plasmodium malariae



Africa
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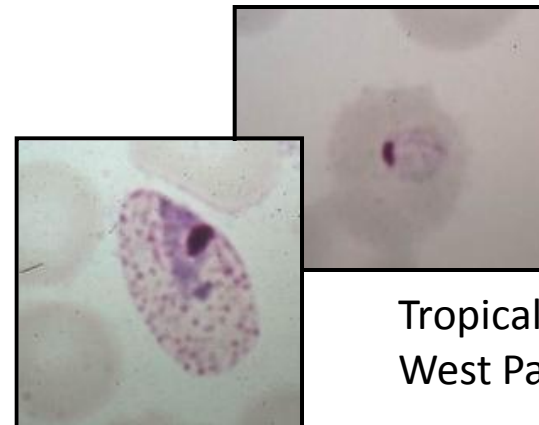
Plasmodium vivax



(original image by Mark Lontie)

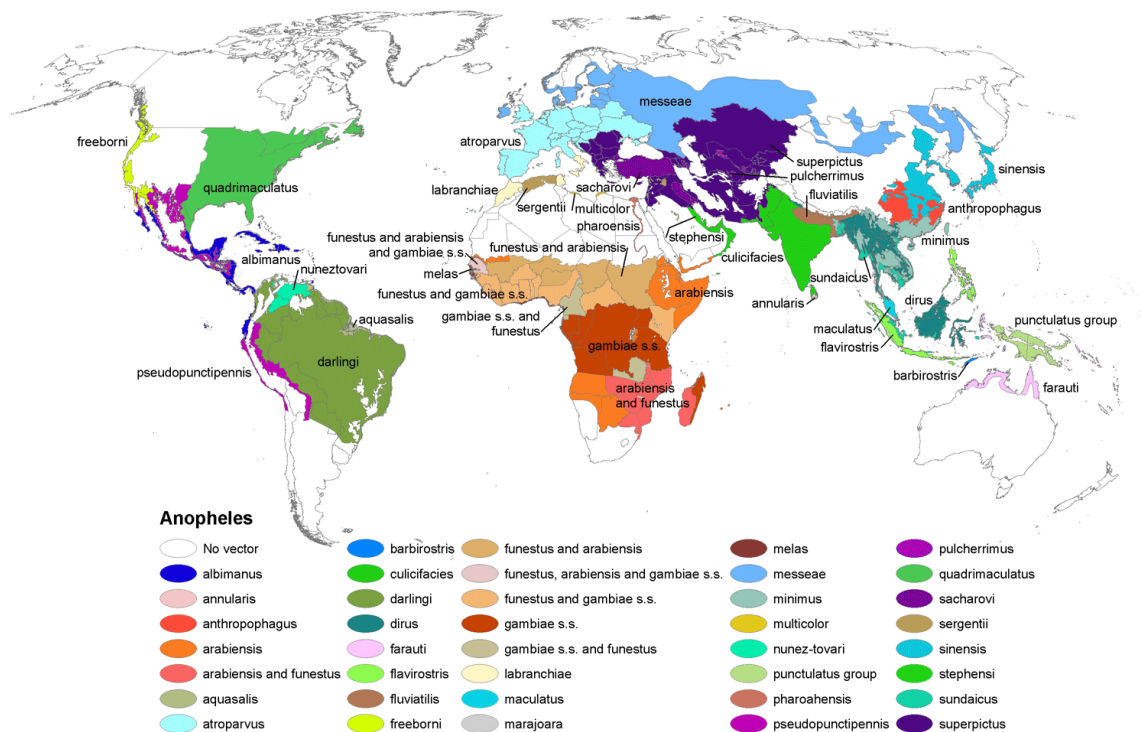
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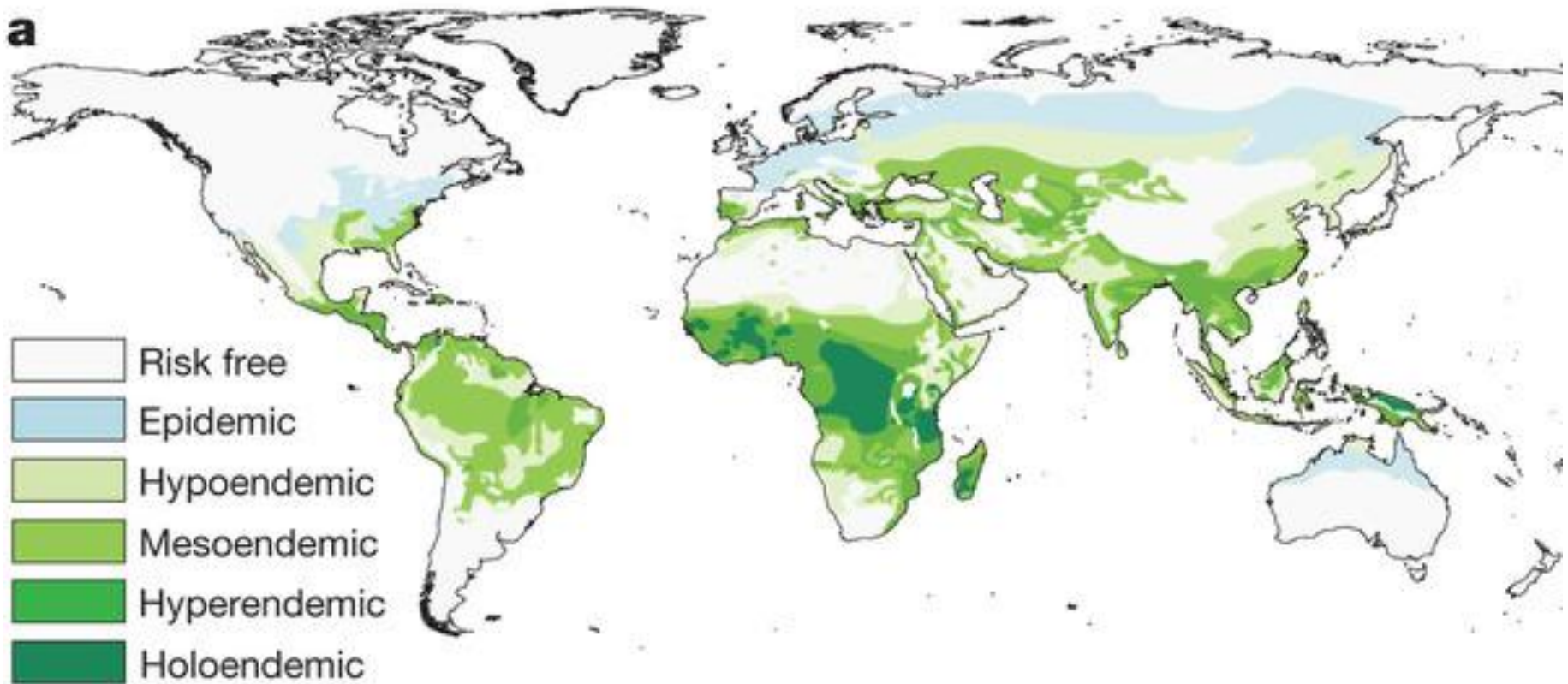
Plasmodium ovale



Tropical Africa
West Pacific

- The malaria parasite is transmitted by *Anopheles* mosquitoes
- Many different species – in total approx 70 out of 420 species are able to transmit the parasite

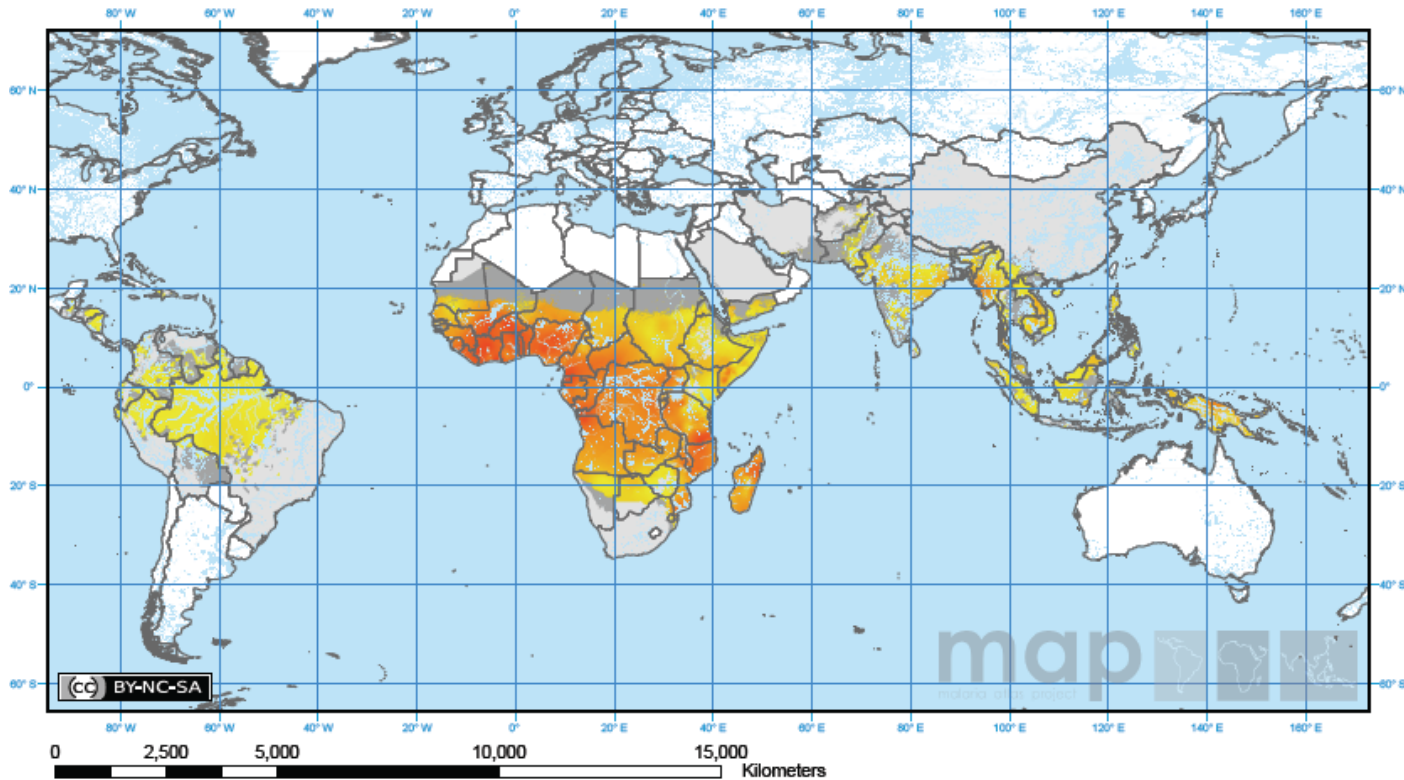




Gething et al Nature 2010

Prevalence of *P.falciparum* in 2007

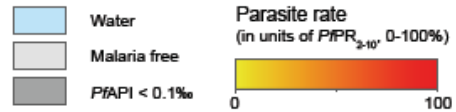
The spatial distribution of *Plasmodium falciparum* malaria endemicity in the World



Copyright: Licensed to the Malaria Atlas Project (MAP; www.map.ox.ac.uk) under a Creative Commons Attribution 3.0 License (<http://creativecommons.org/>)

Citation: Hay, S.I. et al. (2009). A world malaria map: *Plasmodium falciparum* endemicity in 2007. *PLoS Medicine* 6(3): e1000048.

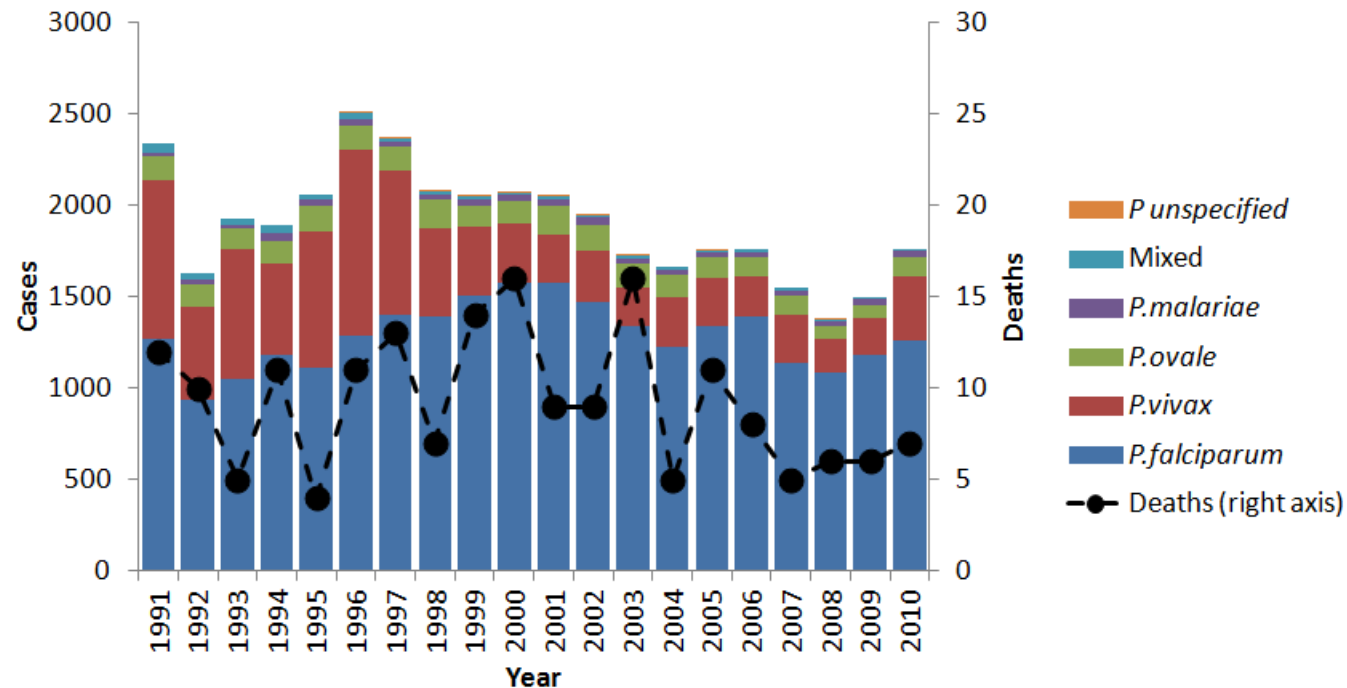
Note: The scalebar is a guide and accurate only at the equator. Projection: Plate carree.



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- Travellers from the UK who visit malaria endemic areas may contract malaria
 - Treated abroad
 - Report symptoms when arrive back in the UK
 - Visitors to the UK may be infected with malaria
 - May be more likely to have some immunity
 - Delays in reporting
 - Reporting is of symptoms only, so case numbers are believed to be underrepresentative

- Vast majority of travellers to affected areas are not affected.
- ~2,000 cases *reported* per year
- Majority *P. falciparum* – most likely to be symptomatic
- ~5-10 deaths per year



Data source: Health
Protection Agency

Advice to travellers

The ABCD of Malaria Treatment

A: be **A**ware of the risk of malaria if you are travelling to a foreign country.



B: avoid mosquito

Bites by taking appropriate measures. Reducing the number of Bites reduces the chances of getting malaria.



C: **c**omply with the appropriate prophylactic drug regimen for the area you are visiting. This is vitally important since failure to comply places you at great risk. Studies have shown that there is a reduced risk of contracting malaria even if you take the wrong regimen.



- Many online sources of information
- Many suppliers of prophylactic drugs
- Variable adherence

D. Awareness of the residual risk, and prompt **D**iagnostics and treatment of clinical malaria

- Choices depend on resistance profile
- Can be very expensive
- Require pre- and post- exposure adherence
- <http://www.cdc.gov/malaria/travelers/drugs.html>

You searched for city named **Bangkok**, in the province of **Bangkok Metropolis**, in the country of **Thailand**

NOTE: Malaria information generally available only for the province and country in which the city is located

Malaria in Province:

Province Name	Malaria in Province	Prophylaxis for this State/Province/District
Bangkok Metropolis	None	Not applicable

Malaria in Country:

Country Name	Malaria in Country	Drug Resistance	Malaria Type	Prophylaxis for Areas with Malaria
Thailand	Rural, forested areas that border Cambodia, Laos, Burma (Myanmar). Rural, forested areas in districts of Phang Nga and Phuket. None in cities of Bangkok, Chang Mai, Chang Rai, Pattaya, Koh Samui, Koh Phangan, Phang Nga, and Phuket.	Chloroquine Mefloquine	<i>P. falciparum</i> 50% (up to 75% some areas), <i>P. vivax</i> 50% (up to 60% some areas), <i>P. ovale</i> remainder	Atovaquone/proguanil or doxycycline.

Severe disease

- *P. falciparum* associated with hospitalisation and fatalities
- Study of admissions in UK showed protective effect of previous exposure and

Table 2. Multivariate analysis of factors associated with the risk of severe falciparum malaria, according to the World Health Organization definition of severity.

Variable	OR (95% CI)	P
Ethnic group		<.001
Black	1.00 (reference)	
Asian	8.05 (2.93–22.1)	
White	8.20 (2.94–22.9)	
Previous malaria		.01
No	1.00 (reference)	
Yes	0.35 (0.15–0.80)	
Parasitemia		<.001
<2%	1.00 (reference)	
≥2%	4.93 (2.22–11.0)	
Hemoglobin level	0.75 (0.63–0.90)	.002
WBC count	1.39 (1.15–1.68)	.001
Platelet count ^a	0.47 (0.31–0.72)	<.001
Creatinine level ^b	13.1 (2.73–63.1)	.001

NOTE. The final regression model was based on 408 patients with available data (of a total of 482 patients).

^a OR is given for a 50-U change in the explanatory variable.

^b Variable was analyzed on a log scale.

- Increasing travel to malaria endemic countries
- No large changes in number of cases
- Suggest good adherence to protective measures by most groups

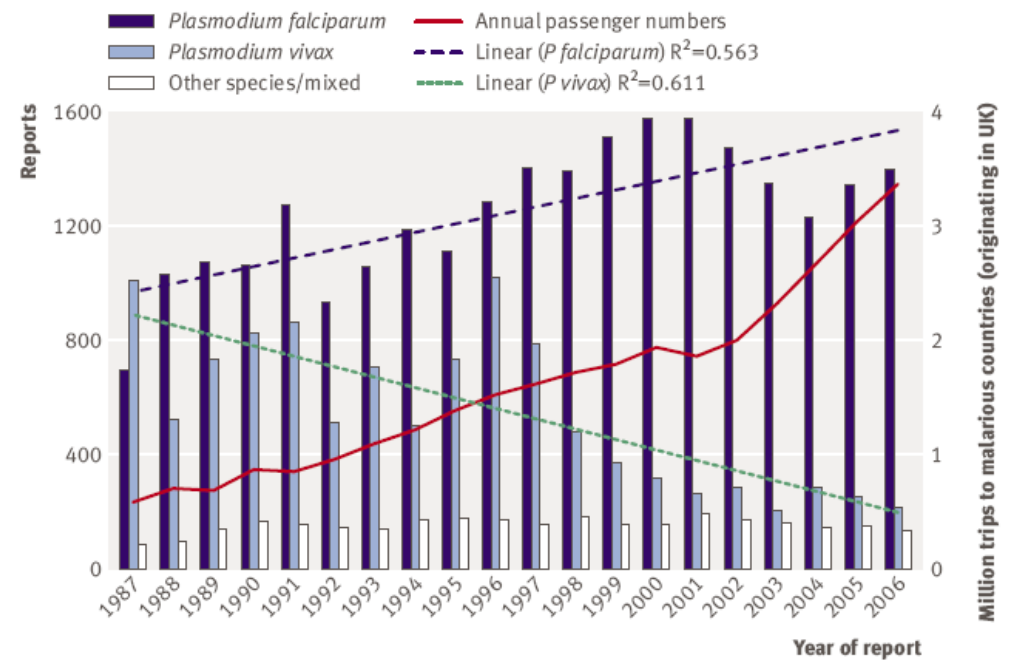
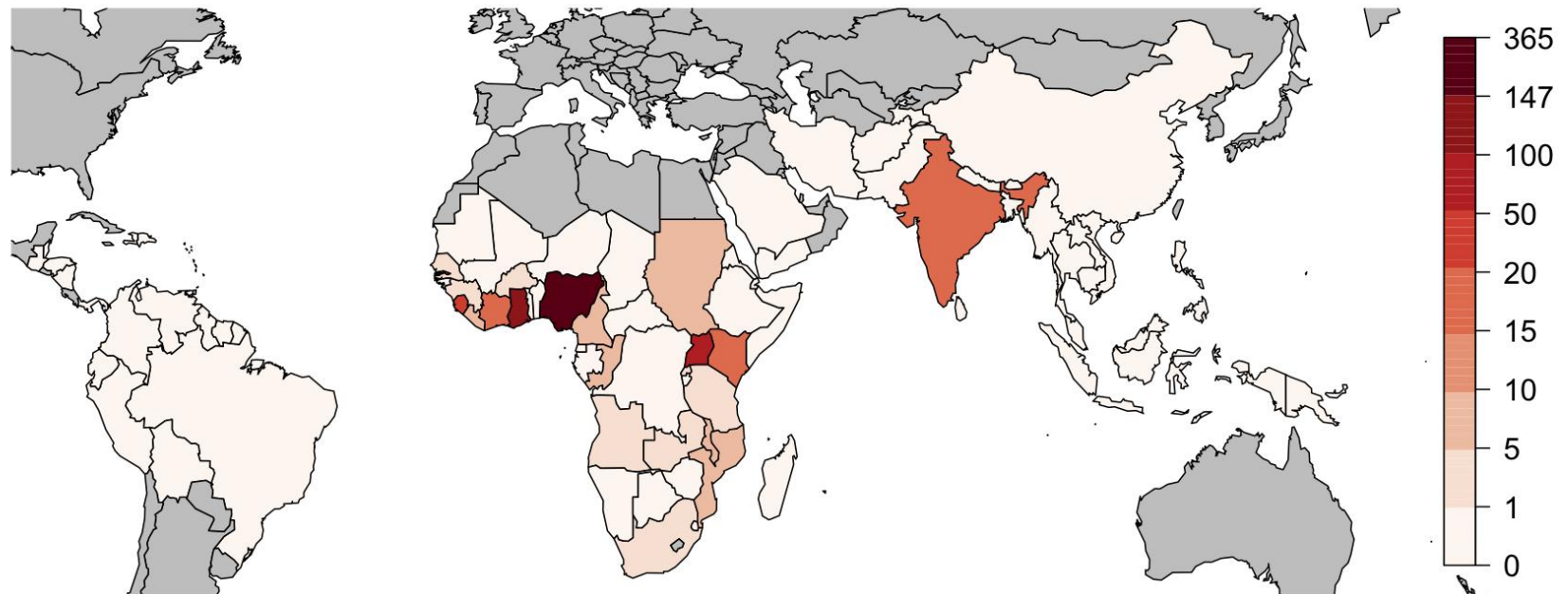


Fig 1 | Reported cases of malaria, 1987 to 2006

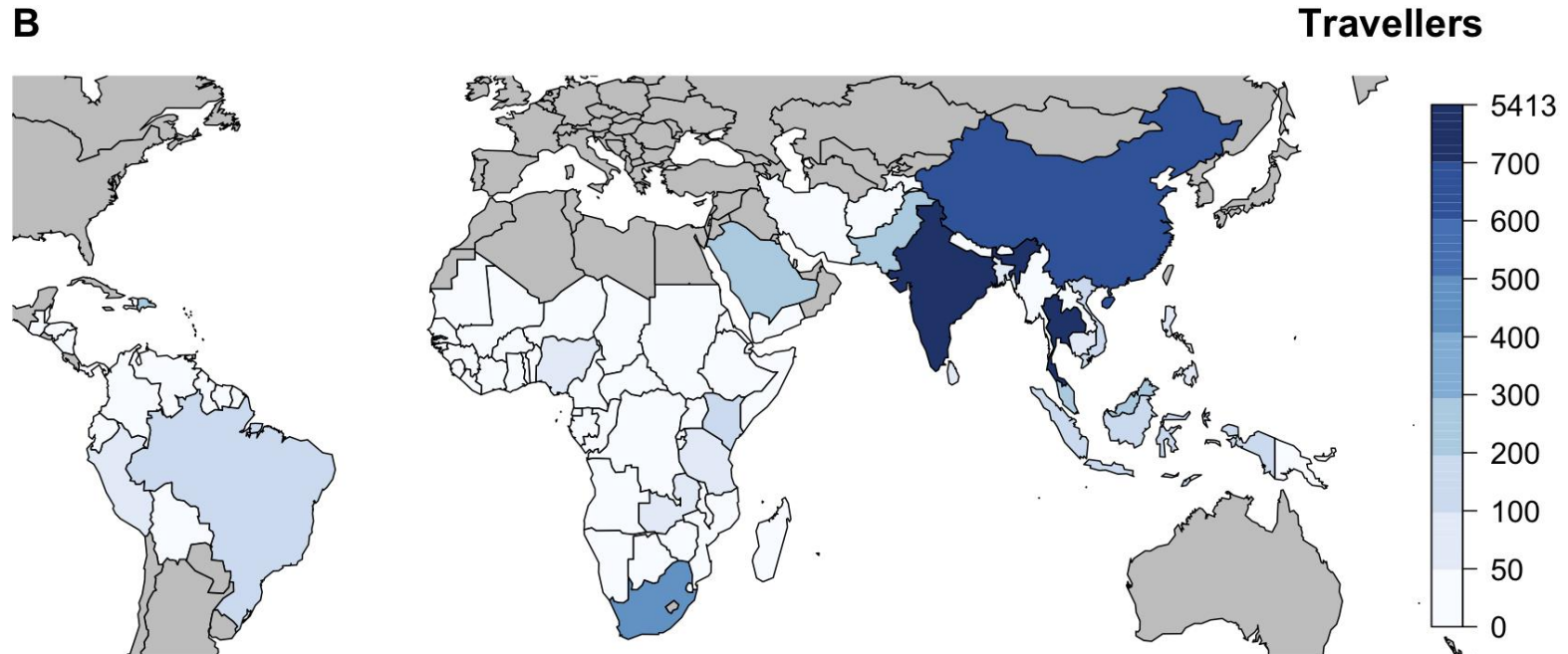
Source: Smith *et al* BMJ 2008

- Majority of cases are from West Africa, particularly Nigeria

A

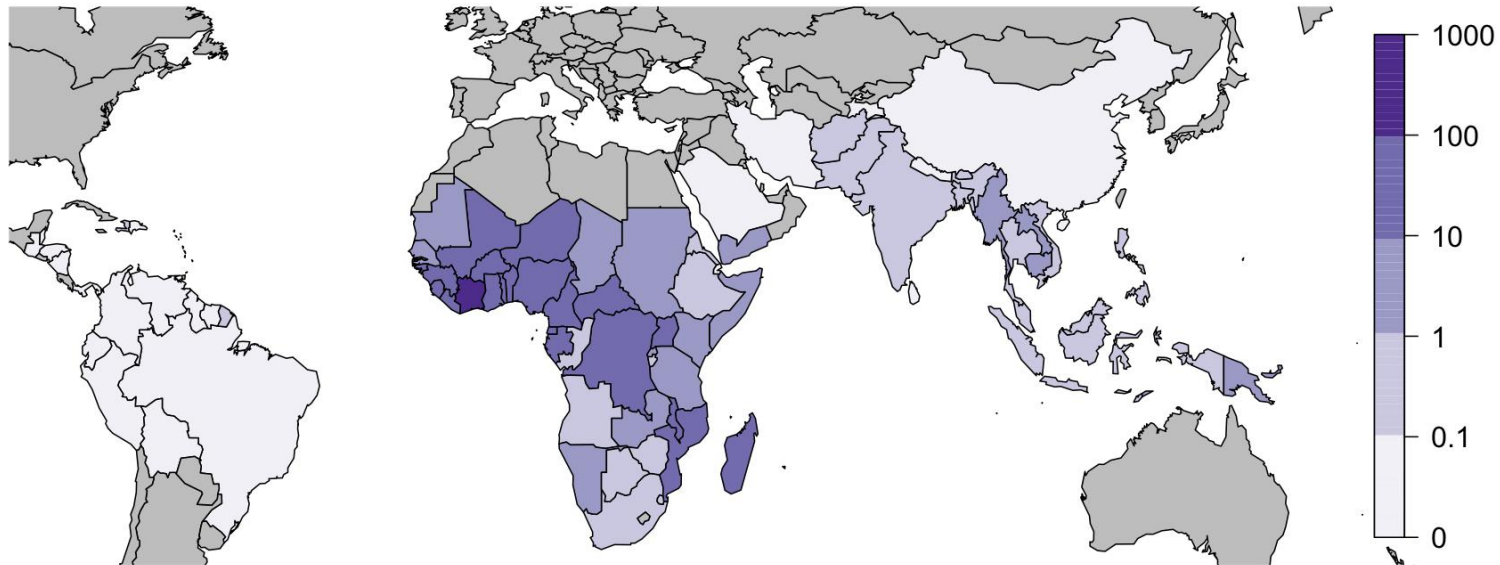


- Highly variable depending on country visited

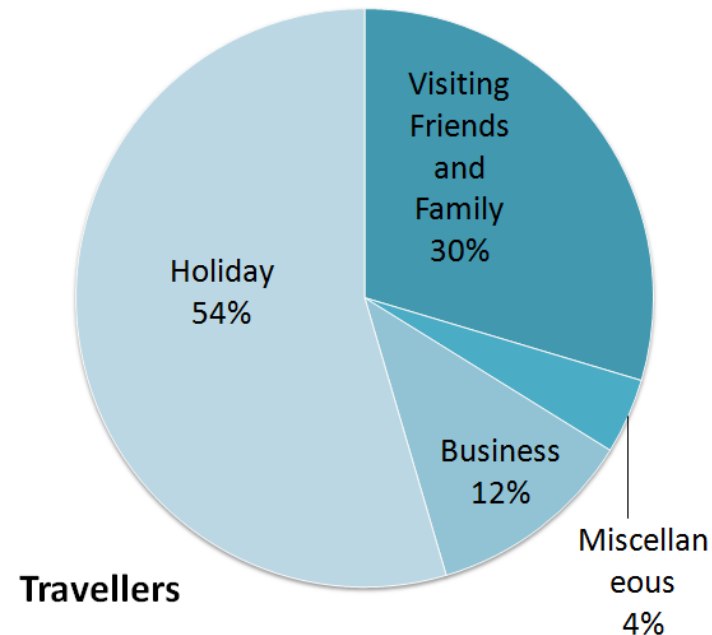
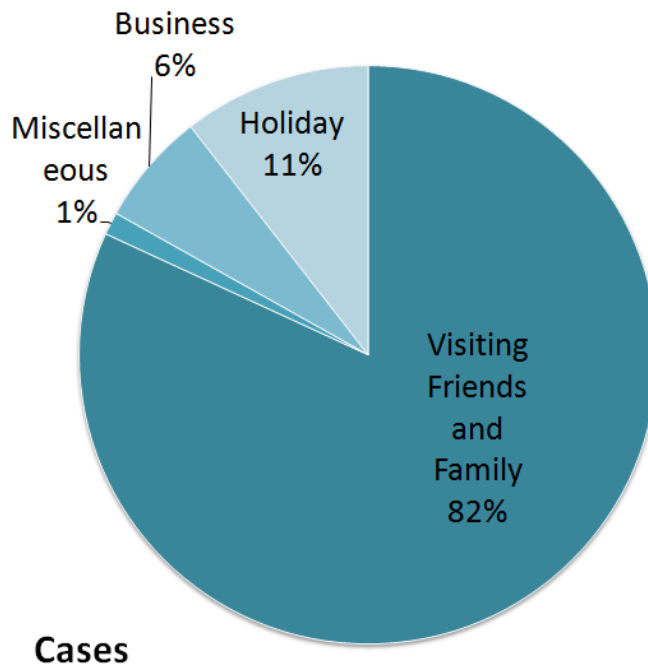


- Entomological Innoculation Rate (EIR) – number of infectious bites per person per year

C

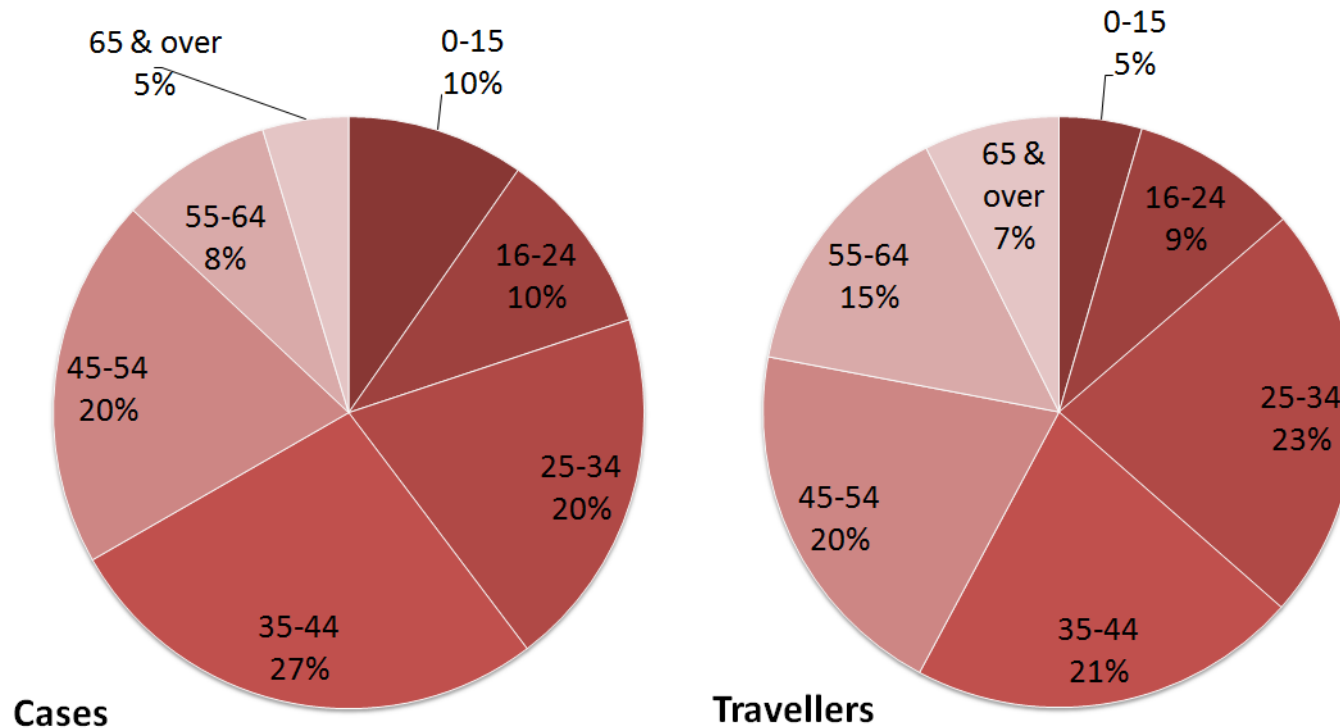


- *P. falciparum* cases in UK residents in 2007
 - Data from the Malaria Reference Laboratory
 - Excluding visitors to the UK



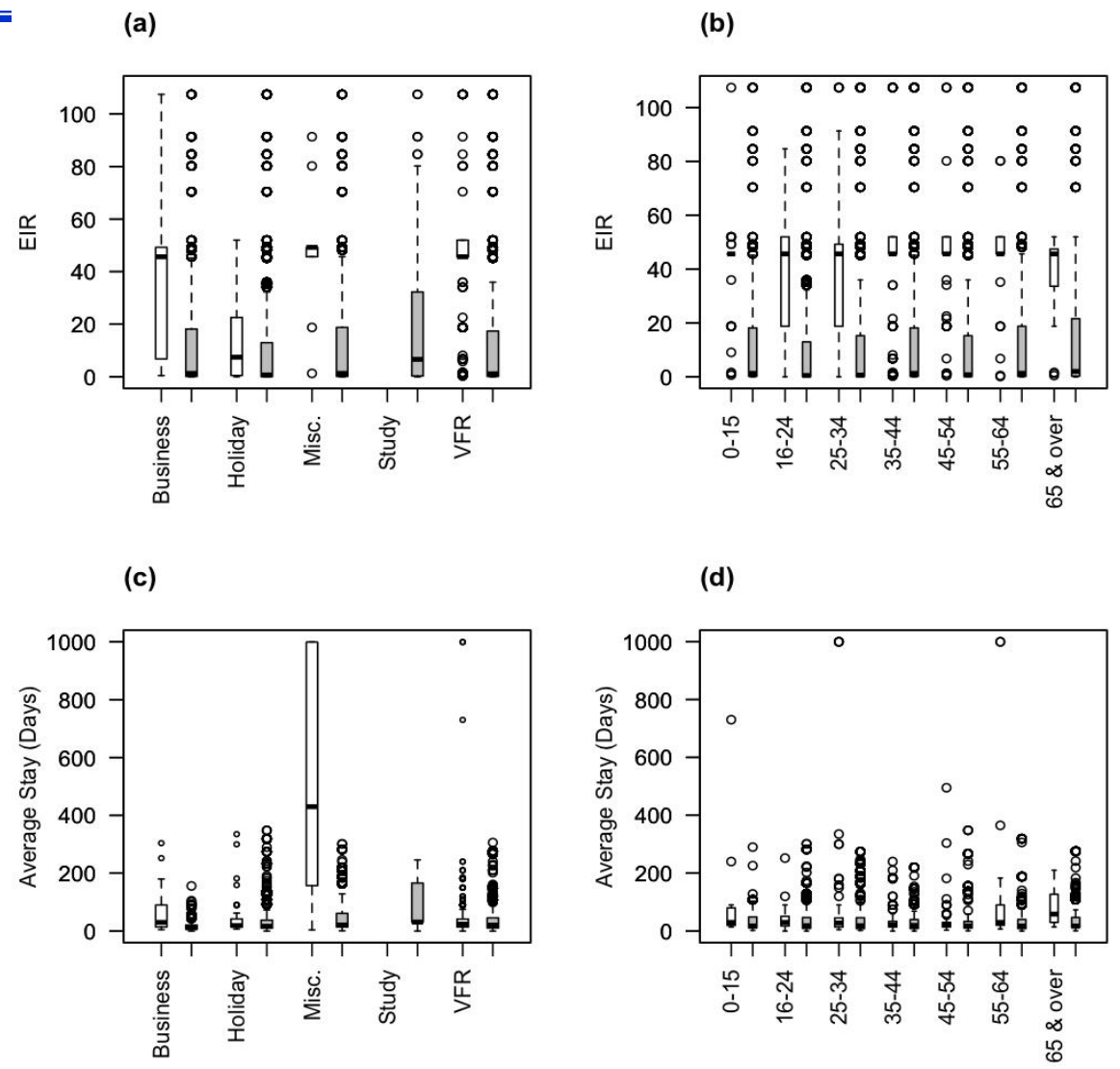
Source: Pinsent *et al* under review.

- *P. falciparum* cases in UK residents in 2007
 - Data from the Malaria Reference Laboratory
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Risk groups

- Those visiting friends are relatives (VFR)
 - Go to high risk areas
 - Stay longer
 - Regard risk as lower
 - Less likely to take prophylaxis and other protective measures



- An interval censored proportional hazards model was used.
- Infection was assumed to have occurred at any point during the reported visit to a malarial endemic country and the daily hazard of infection is determined by the EIR.
- Baseline hazard of infection was estimated by including the reported travel patterns of all UK residents in addition to the reported cases (even distribution of under reporting assumed)
- Two covariates were considered – age and reason for travel.
- The probability of acquiring malaria is:

$$p = 1 - e^{-\lambda E d}$$

- Where d = the duration of stay, E = is the EIR in that country and lambda = the hazard of infection given exposure.
-
- Lambda is determined by the log linear model:

$$\ln \lambda = \alpha + \sum_i \beta_i X_i + \sum_j \gamma_j Y_j$$

- Parameter estimation was performed using an expectation maximization algorithm.

	Hazard Ratio (95% confidence interval)	<i>p</i>	Adjusted hazard ratio (95% confidence interval)	<i>p</i>
<u>Purpose</u>	<0.0001*		<0.0001*	
VFR	6.1 (5.9-7.2)	<0.0001	8.2 (6.4-10.8)	<0.0001
Miscellaneous	0.47 (0.45-0.53)	<0.0001	0.47 (0.29-0.57)	<0.0001
Business	2.4 (1.9-3.2)	<0.0001	3.6 (2.7-4.9)	<0.0001
Holiday	1		1	
<u>Age (years)</u>		<0.0001*		<0.0001*
0-15	1		1	
16-24	0.21 (0.14-0.24)	0.002	0.28 (0.21-0.37)	<0.0001
25-34	0.15 (0.13-0.18)	<0.0001	0.19 (0.15-0.25)	<0.0001
35-44	0.13 (0.10-0.17)	<0.0001	0.12 (0.08-0.15)	<0.0001
45-54	0.30 (0.28-0.34)	<0.0001	0.44 (0.32-0.59)	<0.0001
55-64	0.33 (0.23-0.39)	<0.0001	0.52 (0.38-0.68)	<0.0001
65 & over	0.47 (0.35-0.62)	<0.0001	0.41 (0.32-0.54)	<0.0001

Table 1 Key determinants of incubation period for *P. falciparum*. The acceleration factor indicates the proportional increase (>1) or decrease (<1) in the median time from infection to onset of symptoms.

Factor	Acceleration Factor		p-value
	Estimate	(95% confidence interval)	
Self reported previous malaria			
No	1.00	Reference	
Yes	99	(2.7-3560)	0.012
Ethnic Origin			
African	1.00	Reference	
Asian	0.15	(0.0022-9.8)	0.37
Caucasian	0.40	(0.0037-4.2)	0.70
Use of antimalarials			
No	1.00	Reference	
Yes	13	(0.56-320)	0.11

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The death of a cabin crew member raises concerns that a change in drugs staff at risk

By Jane Merrick, Political Editor

Sunday, 1 February 2009

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Inquiry into Heathrow malaria case



The disease could have come through Heathrow Airport. A man who works near Heathrow airport has been struck down with malaria.

It is thought the patient, who has not been named, may have contracted the disease from a bite by a mosquito transported to Britain via the airport.

Talking Point

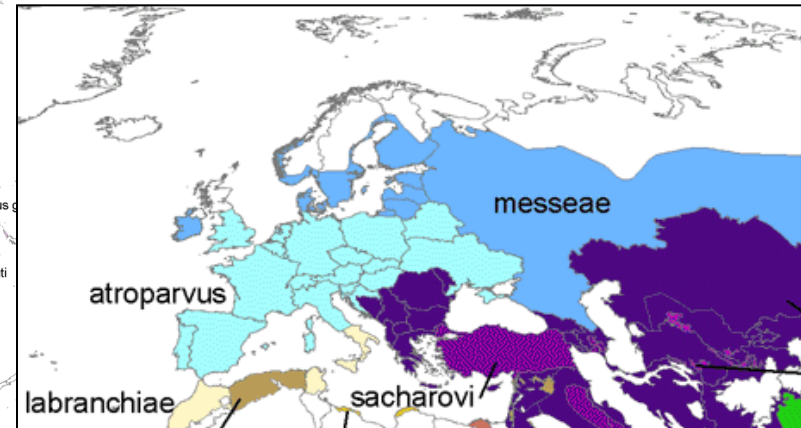
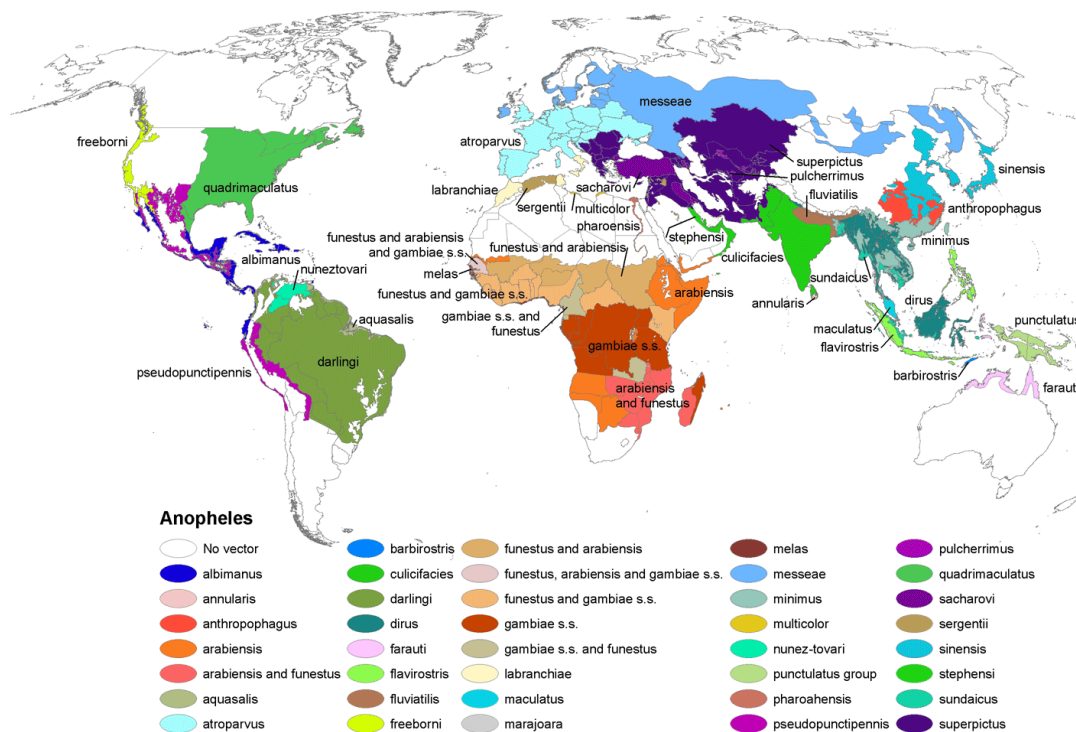
The man has now recovered, but had not been to any country affected by malaria.

Country Profiles In Depth

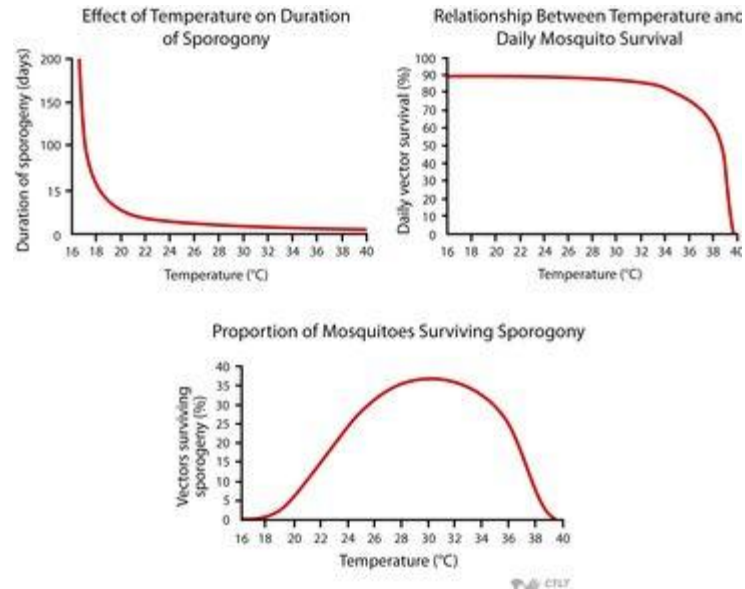
Programmes

A report on the case in New Scientist magazine says officials from the Public Health Agency for Science (HPA) are investigating the

- Britain has five native species of mosquito that can carry a strain of the disease called vivax malaria, which was rife from the 16th to 18th centuries.



- Environment affects dynamics of
 - Vector growth
 - Parasite development



- Using climate models and data from 1917-1918 presence of malaria
- Mapped current climate suitability for malaria
- Correspond to presence of vectors and historic cases

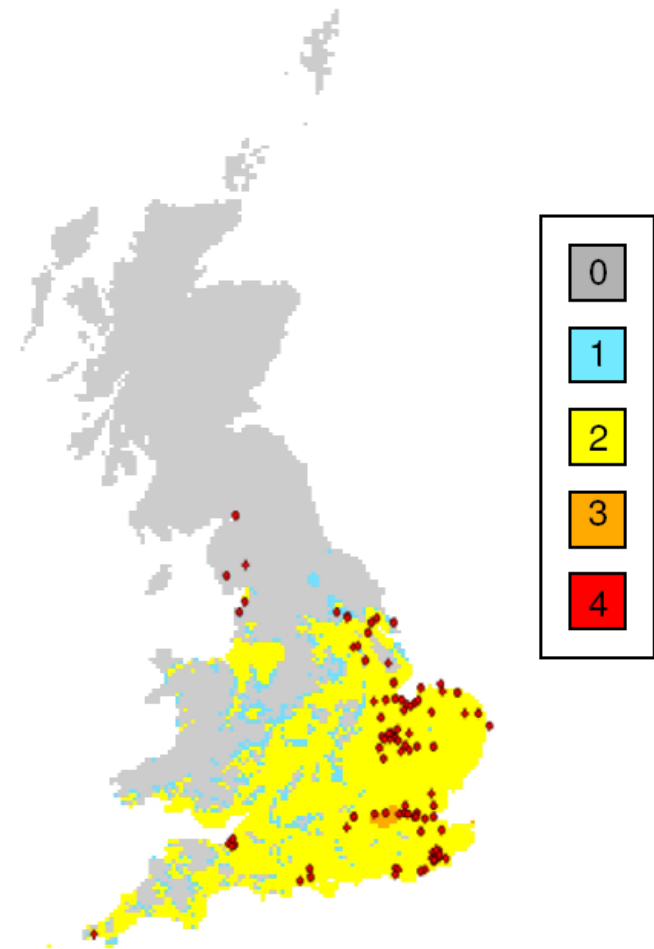


Figure 2 Malaria risk across Great Britain for the 1961-1990. Shading represents the number of months where the climate could support vivax malaria if it were introduced. Red circles show cases of ague (some of which will have been malaria cases) in the 19th Century [31].

- Future climate in the UK is favourable for the transmission of vivax malaria,
- Risk of locally transmitted malaria is considered **low** because of
 - low vector biting rates
 - low probability of vectors feeding on a malaria-infected person.

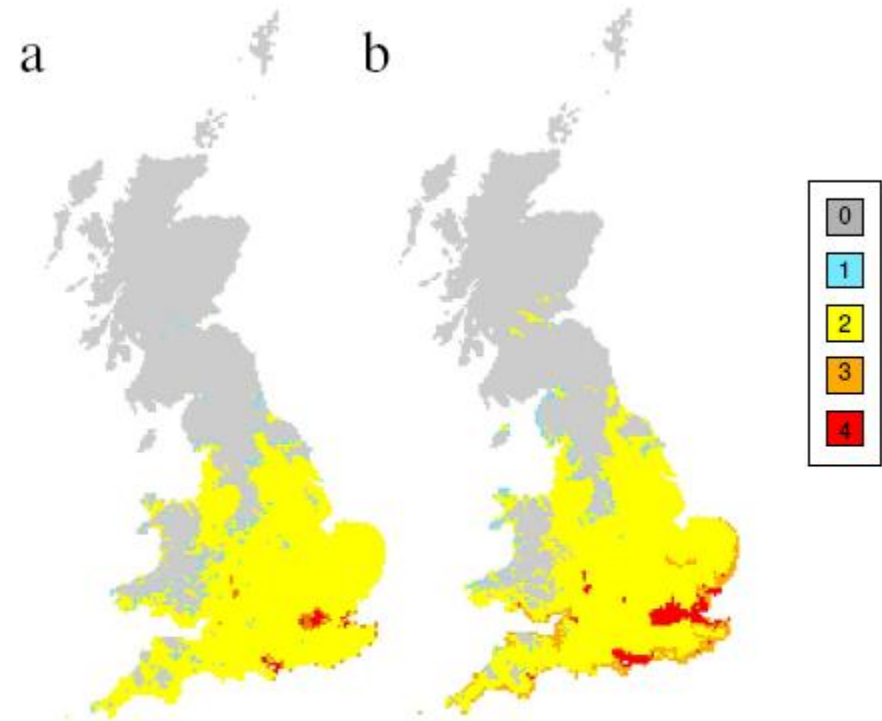


Figure 3 Malaria risk across Great Britain for 2015 (a) and 2030 (b). Shading represents the number of months where the climate could support vivax malaria if it were introduced.

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- These data indicate that malaria, an almost completely preventable disease but one which can be fatal, remains a significant issue for UK travellers.
 - Failure to take prophylaxis is associated with the majority of cases in UK residents travelling to malarial areas.
 - There is continuing evidence that those of African or Asian ethnicity going to visit friends and relatives are at increased risk, and those providing advice should engage with these travellers wherever possible.

HPA Epidemiology of malaria