Surveillance report.

Travel health: Malaria reported in Scotland in 2018

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Background

Malaria is a serious febrile disease caused by infection with one or more of at least five species of protozoan parasite of the genus *Plasmodium*, transmitted by mosquitoes of the genus *Anopheles*. The parasite's life history in humans is complex, beginning in the cells of the liver and proliferating through repeated cycles in the red blood cells. Disease[1] tends to be most severe in children and non-immune adults. Frequent exposure to *Plasmodium* spp from an early age tends to lead to stronger immunity[2] and resistance to severe malaria.[3]

According to the 2018 World Malaria Report (giving the most recent data from 2017) about half of the world's population is at risk of malaria,[4] which now occurs mainly in the tropical and sub-tropical zones.[5] However, malaria should not be considered a tropical disease as its range has included northern Europe, with the Netherlands gaining malaria-free status as recently as 1970.[6] In general, malaria has declined steeply in the northern and southern extremities of its range and transmission is greatly reduced in some tropical countries. The entire World Health Organisation European Region is now formally free of endemic malaria, although very rare cases linked to introduction of infection are known to occur.

Current Situation

There were about 219 million cases of malaria in 2017, increased from 217 million cases in 2016. Despite this increase, the overall trend is downward with 239 million cases having been recorded in 2010.[4]

Of malaria reported in 2017, 92% of cases were in the WHO African Region followed by 5% in the WHO South-East Asian Region (which includes India) and 2% in the WHO Eastern Mediterranean Region (which includes part of East Africa). Ninety-three percent of the global total of 435 000 deaths from malaria occurred in the WHO African Region. Total mortality for 2017 represents a decline of 3.7% from 2016 when there were 451,000 deaths. All WHO regions except the Americas report a falling trend of mortality from 2010 to 2017. The greatest declines have been in South East Asia (54%), Africa (40%) and the Eastern Mediterranean (10%).

At a global level, nearly all deaths from malaria are due to *Plasmodium falciparum,* which accounts for 99.7% of cases in sub-Saharan Africa. This makes great demands of countries facing other major health and social challenges.[7]. *P. vivax* is widespread outside Africa and causes over 3100 deaths. It is the commonest malaria parasite in the Americas, where it accounts for 74% of malaria cases. In South-East Asia, 37% of malaria is *P. vivax*. In the WHO Eastern Mediterranean region, 31% of cases are *P. vivax*. While *P. falciparum* is undoubtedly

the most dangerous malaria parasite, infection with any species of *Plasmodium* can occasion lead to serious outcomes. In parts of South East Asia, eg Borneo *P. knowlesi*, usually a parasite of monkey, is recognised as the most common cause of serious malaria in humans.[8]

Surveillance and outcomes

Malaria surveillance supports malaria prevention among travellers to or from malarious countries by collating information on geography, demographics and behaviour associated with risk. Health Protection Scotland (HPS) continuously reviews local, national and international data on epidemiology, outbreaks and drug resistance to produce evidence-based malaria prevention guidance in conjunction with the Scottish Malaria Advisory Group. This guidance, with accompanying maps, is published on TRAVAX (www.travax.nhs.uk) and fitfortravel (www.fitfortravel.nhs.uk).

Methods

Scottish malaria reports are monitored to ensure relevance and quality. From 2013 to 2018, all malaria specimens in Scotland were referred to the Scottish Microbiology Reference Laboratories (SMiRL) for confirmation and follow-up. Data on age, sex, diagnosis, parasite species, country of origin, travel, prophylaxis and ethnicity are routinely collated. Only speciated reports confirmed by PCR or microscopy are included in the data. Note that from the beginning of 2019, most specimens are not confirmed at the reference laboratory, but in local hospital laboratories unless confirmation is challenging.

The Scottish data is submitted to the Malaria Reference Laboratory (MRL) in London which collates all data on malaria imported into the United Kingdom. Any reports from Scotland where the patient gave an address elsewhere are allocated to the appropriate part of the UK, and any Scottish residents diagnosed elsewhere are allocated to Scotland. The Scottish data for 2018 was analysed using Microsoft Excel.

Some data headings were merged. People who identified as Indian, Bangladeshi or Pakistani were combined in the Indian Subcontinent ethnicity group. Where Ethnicity, Country, Geographic region or Reason for Travel were Blank or Not Stated, these were merged with Unspecified.

In addition to the latest data from 2018, data since the beginning of enhanced surveillance in 2013 are considered here. The United Kingdom malaria total for 2018 will be reported elsewhere.

Malaria in Scotland, 2018: results

Scottish Demographics

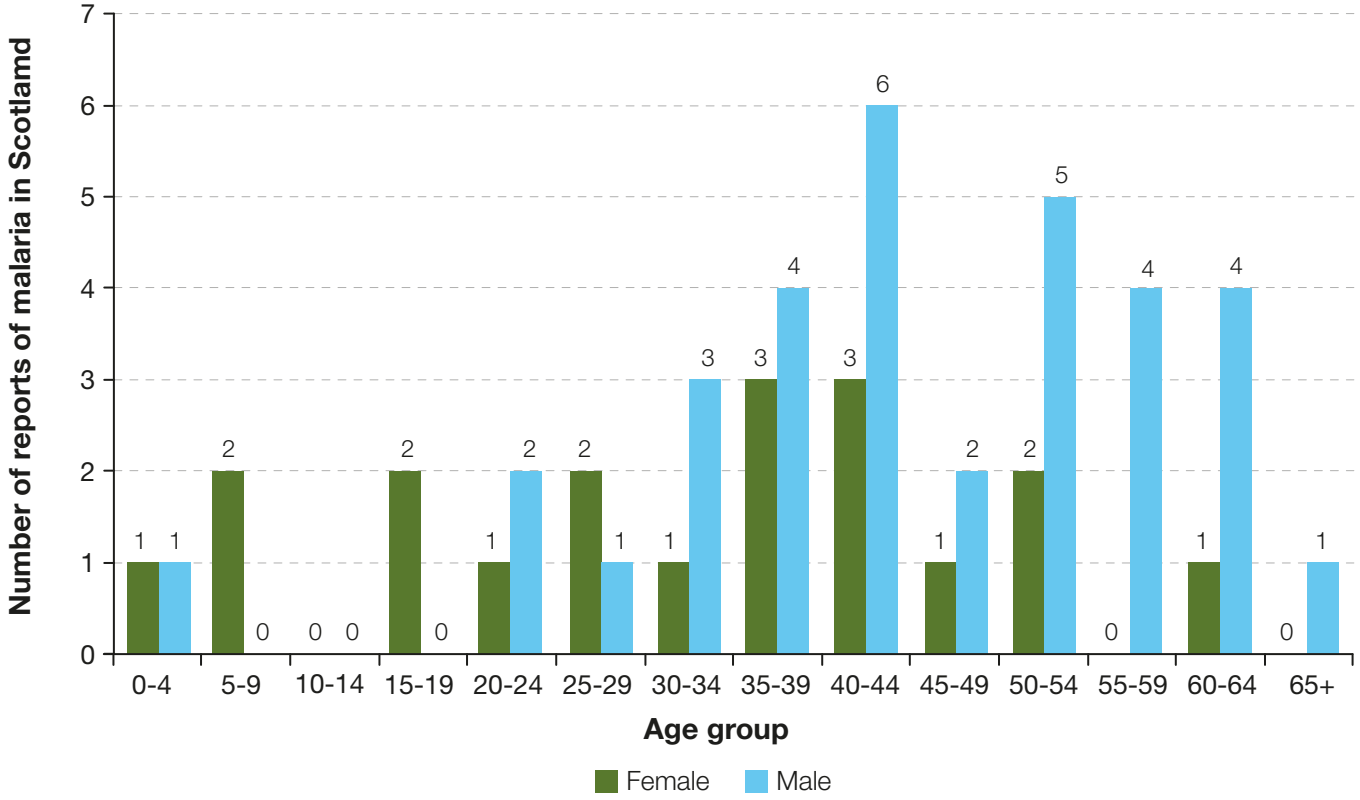
In 2018, there were 52 reports of malaria in Scotland, an increase of 4% from the 2017 total (N=50) (Table 1).

Table 1: *Plasmodium* species by region and country 2018.

Region and Country	*P. falciparum*	*P. ovale*	*P. vivax*	*P. knowlesi*	*P. malariae*	*Mixed P. falciparum/P. ovale*	Total
West Africa	**21**	**2**				**1**	**24**
Nigeria	16	1				1	**18**
Ghana	3	1					**4**
Côte D'Ivoire	1						**1**
Sierra Leone	1						**1**
Southern Africa	**5**	**1**					**6**
Angola	2						**2**
Botswana	1						**1**
Malawi	1						**1**
Mozambique	1	1					**2**
Central Africa	**5**						**5**
Cameroon	2						**2**
Congo	2						**2**
Chad	1						**1**
East Africa	**3**						**3**
Sudan	3						**3**
Africa Unspecified	**2**						**2**
Africa Unspecified	2						**2**
Asia (not Far East or South East)	**1**		**2**				**3**
India	1		2				**3**
Far East and South East Asia				**1**			**1**
Malaysia				1			**1**
Unspecified	**5**	**1**	**1**		**1**		**8**
Unspecified	5	1	1		1		**8**
Total	**42**	**4**	**3**	**1**	**1**	**1**	**52**

Age and sex were recorded for 52 individuals of whom 63.46% were male (N=33) and 36.54% female (N= 19) (Figure 1). Mean age for all reports was 40.15 years (SE±2.27). Mean age for females was 32.37 years (SE±3.82) and for males 44.64 years (SE±2.55). Reports peaked at 40-44 years for males (N=6). Females peaked across two groups at 30 – 34 years (N=3) and 35-39 years (N=3) Peak age group for total reports was 40-44 years (N=9).

Figure 1: Age distribution of Scottish malaria episodes reported in 2018, by sex.



Species

P. falciparum was most common at 80.77% (N=42), followed by *P. ovale* at 7.69% (N=4) and *P. vivax* 5.77% (N=3). *P. knowlesi* 1.92% (N=1), *P. malariae* 1.92% (N=1) and mixed *P.falciparum*/*P. ovale* 1.92% (N=1) infection made up the remainder of the reports (Table 1).

Region and country of transmission

Geographic regions historically used by HPS are again used here. Region of transmission was recorded for 84.62% (N=44) of the Scottish reports in 2018 (Table 1). Of those 44, West Africa accounted for 54.55% (N=24). Within West Africa, 79.17% (N=19) originated from Nigeria. Ghana 16.67% (N=4). Côte d' Ivoire and Sierra Leone provided 4,17% (N=1) each. The proportion reported as coming from East Africa was 6.82% (N=3) of those where region was recorded. All three of the East African reports came from Sudan.

Six reports (13.64%) came from Southern Africa. Of these 50% (N=3) came from Angola, 33.33% (N=2) from Mozambique and 16.67% (N=1) each from Botswana and Malawi.

Central Africa provided 11.36% (N=5) of reports where region of transmission was recorded. Within Central Africa, 2 reports (40%) came from Cameroon, 2 (40%) came from Congo and 1 (20%) came from Chad.

Of the total for 2018, 2 reports (4.55%) came from unspecified parts of Africa. Three reports (6.82%) came from Asia (not South East or Far East): all of these came from India. One report (2.27%) came from South East Asia and Far East (Malaysia).

Region of transmission was recorded for 88.10% (N=37) of 42 reports of *P. falciparum,* of which 56.76% (N=21) came from West Africa. Central Africa and Southern Africa each contributed 13.51% (N=5). Three reports (8.11%) were from East Africa. The remaining reports were 2 (5.41%) from an unspecified part of Africa and 1 (2.7%) from Asia (not South East or Far East).

Region of transmission was recorded for 3 (75%) of 4 reports of *P. ovale*. Of these, 66.67% (N=2) came from West Africa and 33.3% (N=1) came from Southern Africa.

Region of transmission was recorded for 66.67%% (N=2) of 3 reports of *P. vivax*. Both of these came from Asia (not South East or Far East).

One mixed infection (*P. falciparum*/*P. ovale*) came from West Africa and one *P. knowlesi* came from South East Asia and Far East.

Reason for travel

Thirty-seven individuals (71.15%) out of 52 gave a reason for travel (Table 2). Of these, people visiting friends and relatives (VFR) accounted for 32.43% (N=12), while 21.62% (N=8) were business/professional travellers. New entrants to the UK made up 16.22% (N=6) of reports where reason for travel was recorded. UK residents abroad and foreign visitors to the UK each contributed 3 reports (8.11%). Civilian sea/air crew and holiday travellers each contributed 5.41% (N=2) and one foreign student (2.7%) accounted for the remainder.

Ethnicity

Ethnicity was recorded for 88.46% (N=46) of 52 individuals. People of Black African ethnicity comprised 41.3% (N=19) of those whose ethnicity was specified. A further 7 (15.22%) individuals were recorded as being of African descent (Table 3). Thirteen individuals (28.26%) were recorded as White British. There where 4 (8.7%) reports where the individual was of Indian Subcontinent ethnicity. The remaining ethnicities represented were South East Asian, Other White and Other Black, with one (2.17%) of each reported.

Chemoprophylaxis

Twenty-six (50%) reported that they took no chemoprophylaxis (Table 4). Twenty (38.46%) individuals did not specify if chemoprophylaxis was used. Of the 6 remaining reports where prophylaxis was reported as taken, 4 (66.67%) reported taking doxycycline and 2 (333%) did not specify which drug they took.

Table 2: Region of transmission and reason for travel, 2018.

Reason for travel	West Africa	Southern Africa	Central Africa	East Africa	Africa Unspecified	Asia (not Far East or South East)	Far East and South East Asia	Unspecified	Total
Visiting Friends and Relatives	4	1	1	3			1	2	**12**
Business/Professional	4	2	2						**8**
New entrant UK	4					2			**6**
UK citizen abroad	2	1							**3**
Foreign visitor	1	1				1			**3**
Civilian sea/air crew	1		1						**2**
Holiday travel	1	1							**2**
Foreign student	1								**1**
Unspecified	6		1		2			6	**15**
Total	**24**	**6**	**5**	**3**	**2**	**3**	**1**	**8**	**52**

Table 3: Ethnicity and reason for travel, 2018.

Reason for travel	Black African	African descent	White British	Unspecified	Indian Subcontinent	Other Black	Other White	SE Asian	Total
Unspecified	4	5		5	1				**15**
Visiting Friends and Relatives	8	2				1		1	**12**
Business/Professional	1		7						**8**
New entrant UK	4				2				**6**
UK citizen abroad			3						**3**
Foreign visitor	1			1	1				**3**
Civilian sea/air crew			1				1		**2**
Holiday travel			2						**2**
Foreign student	1								**1**
Total	**19**	**7**	**13**	**6**	**4**	**1**	**1**	**1**	**52**

Table 4: Chemoprophylaxis and reason for travel, 2018.

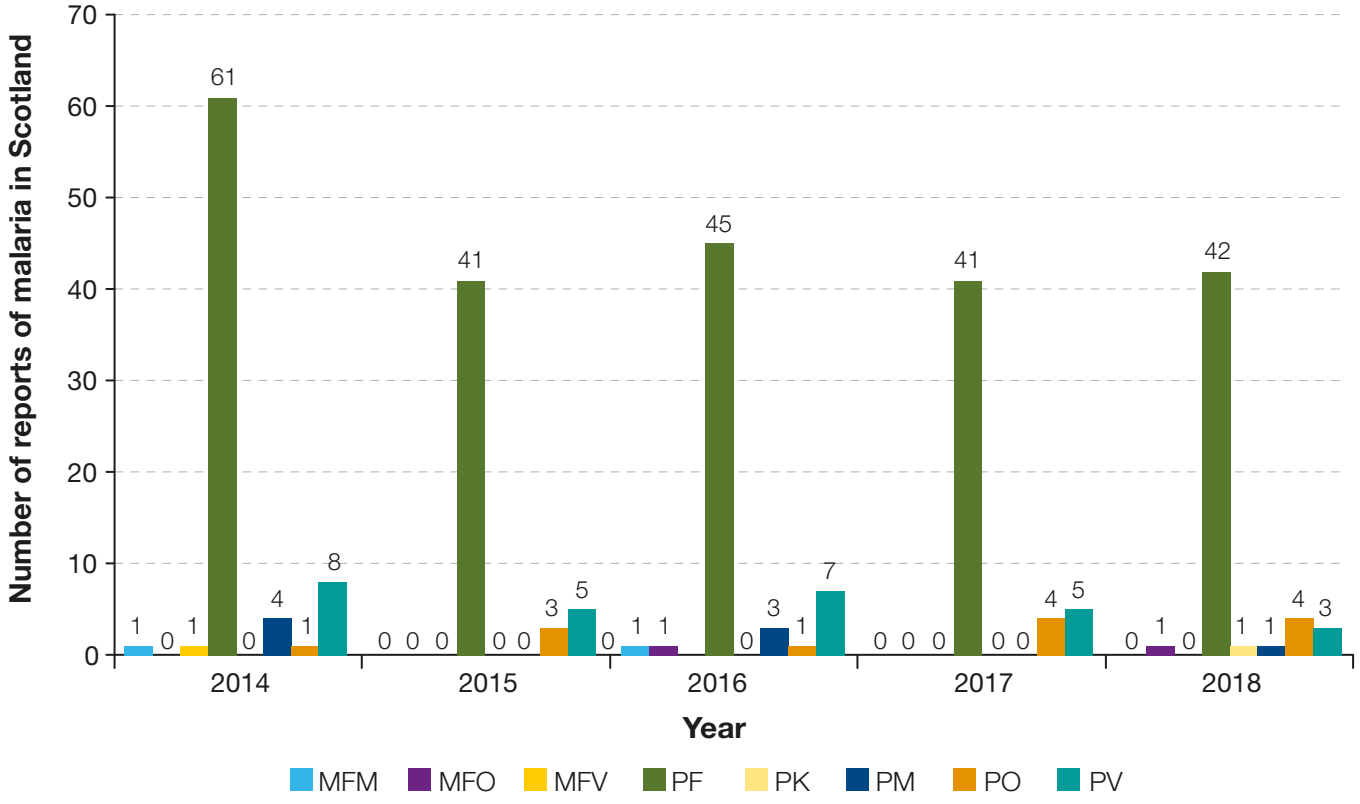
Reason for travel	No	Not stated	Doxycycline	Yes, but did not specify which antimalarial taken	Total
Visiting Friends and Relatives	6	3	2	1	**12**
Business/Professional	6	2			**8**
New entrant UK	5	1			**6**
UK citizen abroad	1	1	1		**3**
Foreign visitor	1	1	1		**3**
Civilian sea/air crew	2				**2**
Holiday travel		1		1	**2**
Foreign student		1			**1**
Unspecified	5	10			**15**
Total	**26**	**20**	**4**	**2**	**52**

Malaria in Scotland, 2014-2018: results

Demographics

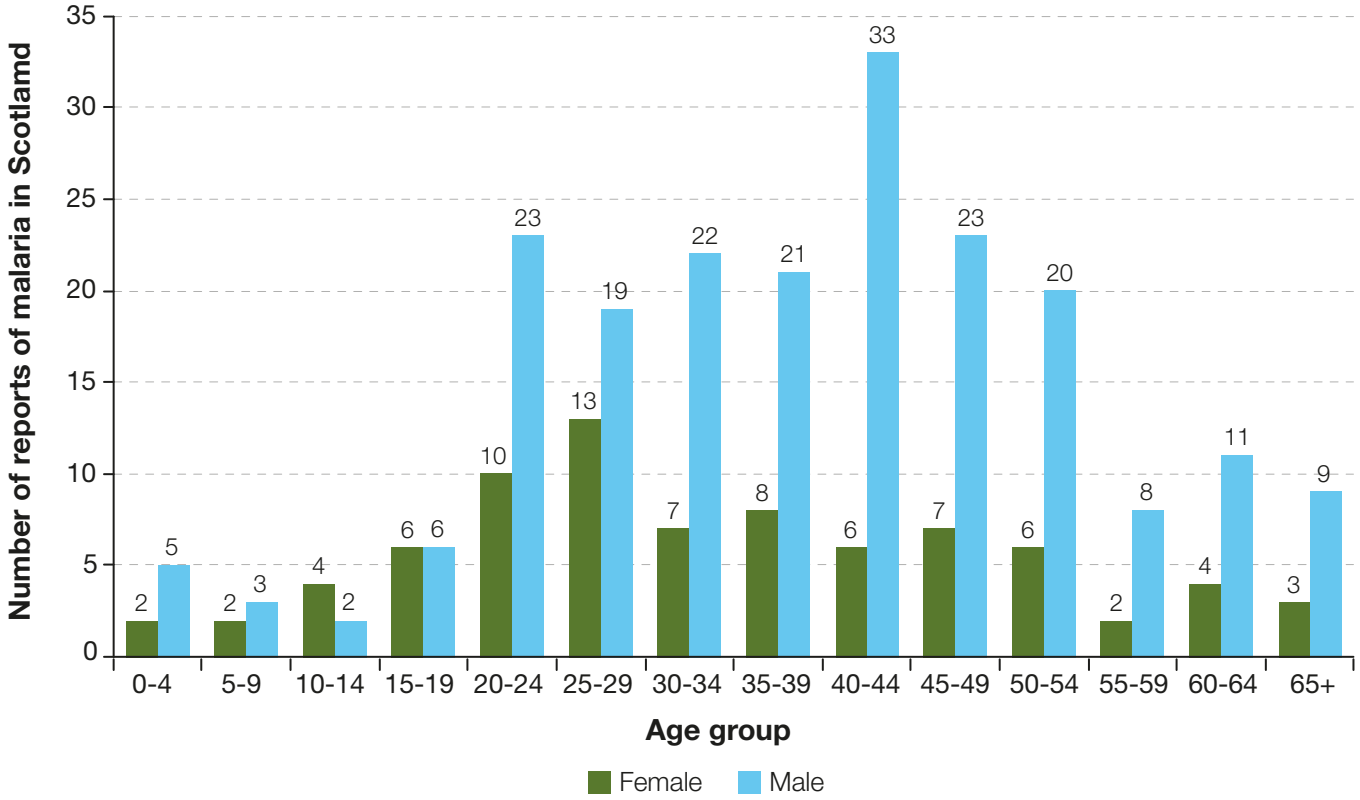
In the five years from 2014 to 2018, there were 285 reports of malaria in Scotland. There were 76 (26.67%) reports in 2014, 49 (17.19%) in 2015, 58 (20.35%) in 2016, 50 (17.54%) in 2017 and 52 (18.25% in 2017 (Figure 2).

Figure 2: Reports of malaria (all species) by year for Scotland, 2014-2018.



Age and sex were recorded for all reports, of which 71.93% (N=205) were male and 28.07% (N=80) were female. Mean age for males was 38.69 years (SE=1.05) and for females 34.29 years (SE=1.81). Age distribution peaked at 25-29 years for females (N=13) and at 40-44 years for males (N=33). Total reports peaked at 40-44 years (N=39) (Figure 3).

Figure 3: Age distribution of malaria episodes reported in Scotland, 2014-2018, by sex.



Species

Two hundred and thirty reports (80.7%) were *P. falciparum* while 9.82% (N=28) were *P. vivax. P. ovale* at 4.56% (N=13) and *P. malariae* at 2.81% (N=8) were less frequently seen. A single case of P. knowlesi (0.35%) was recorded. Mixed infections were also seen. There were 5 mixed infections comprising 2 *P. falciparum* / *P. malariae* (0.7%), 2 *P. falciparum* / *P. ovale* (0.7%) and 1 *P. falciparum* / *P. vivax*. (0.35%) (Figure 2).

Mortality

There was one death from *P. falciparum* in Scotland in 2018.

Region and country of transmission

Region of transmission was recorded for 253 (88.77%) reports (Table 5). Of these, West Africa contributed 54.94% (N=139). Within West Africa, of the 139 reports where country was recorded, Nigeria and Ghana contributed the greatest number, with 57.55% (N=80) and 16.55% (N=23) respectively. East Africa was the next greatest regional source of reports comprising 14.23% (N=36). Within East Africa, country was recorded for 35 reports. Of these, the largest contributions came from Kenya and Sudan, each with 8 (22.86%) reports. Southern Africa provided 28 (11.07%) reports. Within Southern Africa, Angola and Mozambique were the largest contributors with 13 (46.43%) and 8 (28.57) reports respectively. Twenty-three (9.09%) reports were from Central Africa. Of these, the greatest proportion came from Cameroon with 18 (43.48%) reports and Congo with 8 (34.78) reports.

Asia (Not Far East or South East) provided 15 reports (5.93%) of malaria. Of these Pakistan 66.67% (N=10) was the source of the greatest number, with India contributing 33.33% (N=5).

Region of transmission was recorded for 90% (N=207) out of 230 reports of *P. falciparum,* of which total 59.90% (N=124)) came from West Africa.

Table 5: *Plasmodium* species by region and country, 2014-2018.

Region and country	P. falciparum	P. vivax	P. ovale	P. malariae	P. knowlesi	Mixed P. falciparum / P. malariae	Mixed P. falciparum / P. ovale	Mixed P. falciparum / P.vivAx	Total
West Africa	**124**	**1**	**6**	**4**		**2**	**2**		**139**
Nigeria	72		4	2		1	1		**80**
Ghana	21		1	1					**23**
Côte D'Ivoire	11								**11**
Sierra Leone	5	1	1	1					**8**
Gambia	6						1		**7**
Liberia	3					1			**4**
West Africa	2								**2**
Burkina Faso	1								**1**
Gabon	1								**1**
Guinea	1								**1**
Togo	1								**1**
East Africa	**23**	**10**	**2**					**1**	**36**
Kenya	8								**8**
Sudan	3	5							**8**
Uganda	5		2						**7**
Tanzania	6								**6**
Eritrea		4						1	**5**

Table 5 continued overleaf.

Table 5: *Plasmodium* species by region and country, 2014-2018 (continued).

Region and country	P. falciparum	P. vivax	P. ovale	P. malariae	P. knowlesi	Mixed P. falciparum / P. malariae	Mixed P. falciparum / P. ovale	Mixed P. falciparum / P.vivAx	Total
East Africa		**1**							**1**
South Sudan	1								**1**
Southern Africa	**26**		**1**	**1**					**28**
Angola	13								**13**
Mozambique	6		1	1					**8**
Malawi	3								**3**
South Africa	2								2
Botswana	1								**1**
Zambia	1								**1**
Central Africa	22		1						**23**
Cameroon	10								**10**
Congo	7		1						**8**
Chad	2								**2**
Central African Republic	1								**1**
Democratic Republic of the Congo	1								**1**
Rwanda	1								**1**
Asia (not Far East or South East)	**5**	**9**		**1**					**15**
Pakistan	4	5		1					**10**
India	1	4							**5**
Africa Unspecified	**5**								**5**
Africa Unspecified	5								**5**
Far East and South East Asia	**1**	**1**			**1**				**3**
South East Asia	1	1							**2**
Malaysia					1				**1**
Central & South America		**2**							**2**
French Guiana		1							**1**
South America		1							**1**
Oceania	**1**	**1**							**2**
Papua New Guinea	1	1							**2**
Unspecified	**23**	**4**	**3**	**2**					**32**
Unspecified	23	4	3	2					**32**
Total	**230**	**28**	**13**	**8**	**1**	**2**	**2**	**1**	**285**

Southern Africa provided 12.56% (N=26) and East Africa provided 11.11% (N=23) reports of *P. falciparum*. Twenty-two (10.63%) were reported as coming from Central Africa. Seven reports (3.38%) came from Asia, the Far East and South East Asia and Oceania collectively.

Region of transmission was recorded for 85.71% (N=24) of 28 reports of *P. vivax*. Of these, Asia (not South East or Far East) contributed 37.5% (N=9). East Africa provided 41.67% (N=10) of *P. vivax* reports. Two reports (8.33%) came from Central and South America and one (4.17%) from Oceania. One report (4.17%) of *P. vivax* came from West Africa.

Reason for travel

Of the 72.98% (N=208) of reports where a reason for travel was given, people visiting friends and relatives (VFR) were commonest at 33.65% (N=70). This was followed by business/ professional travellers 23.56% (N=49), holiday travellers 11.54% (N=24) and new entrants to the UK 10.1% (N=21). Foreign visitors and foreign students contributed 7.69% (N=16) and 5.77% (N=12) respectively. The remaining 7.69% (N=16) was composed of UK citizens abroad, civilian sea/air crew and British forces (Table 6).

Table 6: Region of transmission and reason for travel, 2014-2018.

Reason for travel	West Africa	East Africa	Southern Africa	Central Africa	Asia (not Far East or South East)	Africa Unspecified	Far East and South East Asia	Central & South America	Oceania	Unspecified	Total
Visiting Friends and Relatives	38	14	3	7	4		1			3	**70**
Business/ Professional	19	7	11	9		1	1	1			**49**
Holiday travel	17		4	1				1	1		**24**
New entrant UK	9	7		1	3					1	**21**
Foreign visitor	7	2	3		1		1		1	1	**16**
Foreign student	10	1			1						**12**
UK citizen abroad	4		5								**9**
Civilian sea/air crew	1			2	1						**4**
British forces	3										**3**
UNSPECIFIED	31	5	2	3	5	4				27	**77**
Total	**139**	**36**	**28**	**23**	**15**	**5**	**3**	**2**	**2**	**32**	**285**

Ethnicity

Ethnicity was recorded in 89.47% (N=255) of 285 reports. Where recorded, the largest groups were of Black African or of African descent 57.25% (N=146) and 28.63% (73) were White British. Those whose ethnicity was recorded as originating from the Indian Subcontinent made up 5.88% (N=15). Other White, Other Asian, South East Asia, Mixed ethnicity, Other Black and Black Caribbean made up the remaining 8.24% (N=21) (Table 7).

Table 7: Ethnicity and reason for travel, 2014-2018.

Reason for travel	Black African	African descent	White British	ISC	Other White	Mixed ethnicity	Other Black	Black Caribbean	Other Asian	SE Asian	UNSPECIFIED	Total
Visiting Friends and Relatives	49	7	2	4	1	4	1	1		1		**70**
Business/ Professional	6		37		3						3	**49**
Holiday travel	4		15		2	1	1				1	**24**
New entrant UK	18			3								**21**
Foreign visitor	11			1	2				1		1	**16**
Foreign student	11			1								**12**
UK citizen abroad			9									**9**
Civilian sea/air crew			2	1	1							**4**
British forces			2								1	**3**
UNSPECIFIED	27	13	6	5	1		1				24	**77**
Total	**126**	**20**	**73**	**15**	**10**	**5**	**3**	**1**	**1**	**1**	**30**	**285**

Chemoprophylaxis

One hundred and forty four (50.53%) reported taking no chemoprophylaxis. One hundred and five (36.84%) did not specify if chemoprophylaxis was taken. Thirty six (12.63%) reported taking chemoprophylaxis. Of these, 61.11% (N=22) took doxycycline, and 11.11% (N=4) took atovaquone/proguanil. Two (0.7%) reported taking mefloquine.

The remainder comprised 22.22% (N=8) who reported taking unspecified chemoprophylaxis, 5.56% (N=2) who took chloroquine, 2.78% (N=1) who reported taking coartem (possibly an incorrectly reported treatment), 2.78% (N=1) who took proguanil only and 2.78% (N=1) who took deltaprim (Table 8).

Table 8: Chemprophylaxis and reason for travel, 2014-2018.

Reason for travel	No	NOT STATED	Doxycycline	Yes, but did not say which	Atovaquone/Proguanil	Mefloquine	Chloroquine	Coartem	Proguanil	Total
Visiting Friends and Relatives	47	17	3	1		1		1		**70**
Business/ Professional	26	9	9		3	1	1			**49**
Holiday travel	10	6	4	3	1					**24**
New entrant UK	17	4								**21**
Foreign visitor	10	5	1							**16**
Foreign student	9	3								**12**
UK citizen abroad	5	3	1							**9**
Civilian sea/air crew	2		1				1			**4**
British forces	2	1								**3**
UNSPECIFIED	16	57	3						1	**77**
Total	**144**	**105**	**22**	**4**	**4**	**2**	**2**	**1**	**1**	**285**

Discussion

Overview of surveillance

Imported malaria gives only an approximation of travellers' exposure to infection. Some travellers may diagnosed with malaria and treated abroad and will never fall under the view of surveillance mechanisms in this country.

The total of 52 reports of malaria in Scotland for 2018 is unremarkable in comparison to recent years. Most malaria identified in Scotland is African in origin, reflecting the high prevalence of malaria across much of the continent. Once again, West Africa is the most commonly reported region where infection was acquired. *P. falciparum* is the most common malaria parasite in Africa and the species most frequently reported in Scotland. *P. ovale* constitutes a smaller proportion of malaria imported into Scotland from Africa, and in 2018 was the second most frequently reported malaria parasite seen here. *P. vivax* has a widespread distribution outside Africa but reports continue to diminish in number. It is possible that this is influenced by the declining incidence of *P. vivax* malaria in Asian countries. An already small reservoir of infection may be rendered less significant by conditions that are not conducive to infection in visitors or temporary residents.

Groups at risk

Risk of malaria varies according to the traveller's conditions of exposure. Two important elements of this are country of travel and reason for travel, with ethnicity having an influence on both.

In 2018, Black African travellers visiting friends and relatives (VFR) constituted the largest group identified in the Scottish data, as in previous years. The next largest group is White British Business/Professional travellers. People may travel on business at short notice, which means there may be insufficient time to seek appropriate health advice. Those visiting malarious countries on business may work in conditions where there is a risk of exposure to malaria. This may be particularly true of those working in mining and petrochemical industries. Other groups of long-term travellers may have higher exposure to infection without using chemoprophylaxis and may take medication only in the event of illness.

Only 16.67% (N=4) of the 24 diagnosed in Scotland who gave a reason for travel and travelled abroad from the UK in 2018 reported taking chemoprophylaxis. This small proportion indicates the importance of obtaining, understanding and following appropriate prevention advice.

Each year, a proportion of malaria seen in Scotland is diagnosed in those who are new arrivals or overseas visitors. While prevention is outside the capacity of health professionals here, it is important that clinicians should be aware of the possibility of malaria in any febrile traveller arriving from a malarious country. [9]

Malaria from Africa

Of the four species of malaria occurring in Africa *P. falciparum* is the one most likely to kill the infected person. *P. ovale* is not uncommon in Africa although it generally does not cause severe illness. It may occur simultaneously with *P. falciparum*, as was seen in one report here. *P. ovale* infections may relapse long after initial infection. One Scottish report in 2018 was from a person whose last exposure to malaria have been four years prior to diagnosis. *P. vivax* has

traditionally been thought absent from Africa (except parts of the north and east) although this assumption is now questioned.[10] *P. vivax* is rarely seen in UK travellers returning from Africa but it is an unsurprising diagnosis in migrants or refugees from Eritrea, Ethiopia, Somalia and Sudan.[11]

Asia, including South East and Far East

Malaria remains an infrequent diagnosis in travellers arriving in Scotland from any part of Asia. Declining incidence means that antimalarial chemoprophylaxis is no longer routinely recommended for much of Asia, although it should always be considered as part of a traveller's risk assessment. There are three reports of malaria from India in the 2018 data, all of which were people normally resident in India before arriving in Scotland. A single report of *P. knowlesi* was made in Scotland in 2018, the patient having arrived from Malaysia, where *P. knowlesi* is now the most important malaria parasite.

Some current topics in malaria

Argentina and Algeria were declared malaria-free in 2019, the latter country being the first in the WHO African Region to achieve this status since Mauritius in 1973.[12] India continues to make progress in malaria elimination, with a dramatic fall in case numbers likely in the final analysis of 2018. The World Malaria Report of 2018 reported 844 558 confirmed cases in India for 2017 and it is estimated that the final total for 2018 may be around 403 000, based on data recorded up to October 2018.[13] While total case numbers appear high, incidence is low in a country with such a large population so risk of infection tends to be low in short-term travellers. Thus, malaria is seen only in a small proportion of travellers to India. However, it is important to recognise that malaria incidence in parts of India is be unstable with pockets of higher risk, so the need for chemoprophylaxis varies with location.[14]

While cases of *P. falciparum* and *P. vivax* have declined steeply in number in recent years in South East Asia and the Far East, travellers should be aware of the presence of *P. knowlesi* in South East Asia, notably in Malaysian and Indonesian Borneo. *P. knowlesi* is a zoonotic species usually found in short-tailed macaques but which is now recognised as an important pathogen of humans in areas where human and monkey ecology overlaps.[15]

Venezuela continues to record increasing malaria numbers, influenced by worsening socioeconomic conditions. Malaria case numbers have risen since the beginning of the present decade although actual figures are uncertain. A consortium of five non-governmental organisations is working to ascertain the real total, which for 2018 may be around 1.3 million, including new cases, recrudescences, relapses, self-medication and underreporting.[16] This consideration of malaria beyond new cases recognises the pervasive effects of the disease additional to newly-diagnosed infection. The serious situation in Venezuela has already allowed vector-borne diseases including malaria to spread into neighbouring countries such as Brazil, which has seen an increase in imported malaria in recent years.[17]

In 2017, there were unexpected episodes of apparently mosquito-borne malaria transmission in European countries, but this was not repeated in 2018, except for a case of *P. falciparum* in Malta where neither malaria nor a competent vector are present.[18] In 2019, as in recent years, there has been local transmission of introduced *P. vivax* in Greece.[19] While the sporadic appearance of malaria in an unusual location is always a cause for concern, it should not

be assumed that Europe is suddenly more susceptible to transmission or re-establishment of malaria. A wide area of Europe including the United Kingdom has, at least on occasion, conditions under which malaria might be transmitted. However, environmental conditions the human reservoir of infection and the mosquito vector are currently insufficient for re-establishment in countries with appropriate environmental and public health controls. Indeed, there is no precedent for malaria being re-established in a developed country in which endemic transmission has previously been ended.

Importantly, a new candidate malaria vaccine began clinical trials in Malawi in April 2019. The vaccine 'RTS, S' (GSK) reportedly prevents 4/10 cases of malaria and 3/10 cases of severe malaria[20] and is due to be trialled also in Ghana and Kenya in the near future. Other promising steps in malaria control methods have been made in recent months, with a genetically modified fungus *Metarhizium pingshaense* showing potential in killing insecticide-resistant *Anopheles* mosquitoes in a trial in Burkina Faso. [21]

Advice to travellers

Travellers to malarious countries should always seek and follow pre-travel evidence-based advice[22] from specialist sources and be aware of the malaria risk associated with specific intended destinations. Fitfortravel (www.fitfortravel.nhs.uk) is produced by HPS for members of the travelling public. TRAVAX (www.travax.nhs.uk) provides travel health professionals with evidence-based guidance to advise travellers on prevention in all areas of the world where there is a risk of malaria.[23]

Travellers may have a mistaken belief that their destination is free of malaria. VFR travellers or foreign students visiting or returning to malarious countries after living in the UK may assume they are immune and that there is no risk of malaria. While they may not have experienced serious malaria recently,[24] acquired immunity declines quickly in the absence of exposure, placing the traveller at risk of infection after months or years away. Concerns about adverse effects of antimalarial drugs, possibly following negative publicity, may discourage travellers from taking appropriate medication, or following prescribing advice.[25]

Healthcare providers are encouraged to advise travellers to malarious countries of the risks faced, particularly if they are pregnant or travelling with children. It is important that clinicians should be aware of the possibility of malaria, particularly in a febrile travellers arriving from malarious country, whether the patient belongs to a perceived high-risk group or otherwise.

The Scottish malaria reports confirm the importance of chemoprophylaxis: where this is taken as directed, the risk of malaria is small. Risks associated with VFR and business travel, particularly to Africa, are further confirmed.

All travellers should follow the 'ABCD' of malaria prevention.

- **A** – be **A**ware of the risk
- **B** – prevent mosquito **B**ites
- **C** – take appropriate **C**hemoprophylaxis if required (or advised)
- **D** – early **D**iagnosis can be life-saving

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NHS board abbreviations

AA	Ayrshire & Arran	BR	Borders	DG	Dumfries & Galloway	GGC	Greater Glasgow & Clyde
FF	Fife	FV	Forth Valley	GR	Grampian	HG	Highland
LO	Lothian	LN	Lanarkshire	OR	Orkney	SH	Shetland
TY	Tayside	WI	Western Isles	VV	various NHS boards		

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