RAPID RISK ASSESSMENT

Multiple reports of locally-acquired malaria infections in the EU

20 September 2017

Main conclusions and options for response

Five events of local transmission of malaria have been reported recently in the EU. Three of these events were associated with either mosquito-borne transmission around an imported case (introduced malaria) or an imported infected mosquito (airport malaria), in Greece and northern Cyprus (*P. vivax*), and in France (*P. falciparum*), and two were most likely associated with nosocomial transmission of *P. falciparum,* in Italy and in Greece, either mosquito-borne or iatrogenic.

The following options should be considered for preventing and controlling mosquito-borne transmission of malaria:

- Increasing awareness of risk and bite avoidance for travellers and residents in areas of the EU where introduced malaria has been reported.
- Increasing awareness among clinicians about the sporadic occurrence of locally-acquired malaria cases in the EU.
- Consideration of malaria infection by health practitioners in the EU/EEA Member States in the differential diagnosis in symptomatic persons returning from affected areas in countries with recent recording of local mosquito-borne malaria transmission.
- Rapid notification of cases to ensure the timely implementation of appropriate public health measures. in areas with competent vector populations.
- Implementation by EU Member States of safety measures defined in the EU Directives 2006/17/EC and 2004/33/EC [1,2] and the technical guide to the quality and safety of organs for transplantation [3]. EU member States with locally transmitted infections may apply blood safety measures as suggested in the ECDC expert opinion [4]. EU Member States may decide whether to implement preventive measures for persons returning from the affected areas in non-endemic countries taking into account the measures currently being implemented by the local blood safety authorities.

Healthcare providers should be aware of the risk of nosocomial transmission of malaria and enforce standard precautions to prevent them. The risk of further spread of malaria in the EU associated with these events is considered very low.

The following options should be considered for preventing nosocomial transmission of malaria:

- Strict application of standard precautions in healthcare settings for patients presenting with malaria.
- Application of measures to prevent vector-borne transmission around hospitalised cases of malaria while parasitaemic, such as mosquito-nets, the use of repellents or insecticides in areas with competent an active vector populations.
- The triggering of an immediate investigation of the infection control practices related to blood-borne transmission when a nosocomial transmission of malaria is suspected.

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Public health issue

In the context of five recent events of local transmission of malaria in the EU, we assess the risk of spread of malaria in EU.

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All experts have submitted declarations of interest and a review of these declarations did not reveal any conflict of interest.

Experts from WHO reviewed this risk assessment, however the views expressed in this document do not necessarily represent the views of WHO.

Disease background information

Malaria is caused by *Plasmodium* parasites transmitted by the bites of infected females of various *Anopheles* mosquito species. Among *Plasmodium* parasites, *P. falciparum* can lead to life-threatening infection and is the most prevalent malaria parasite on the African continent. In addition, *P. vivax* infection can lead to malaria relapses and commonly infects humans in many countries outside of sub-Saharan Africa. All EU MS are considered free of *P. falciparum* and *P. vivax* malaria. More information about malaria is available in the ECDC malaria factsheet.

Surveillance of malaria in the EU

Malaria is a notifiable disease in the EU. The EU case definition requires the presence of fever or a history of fever, and the presence of parasites detected in a blood film or the detection of *Plasmodium* nucleic acid or *Plasmodium* antigen in blood.

In the EU/EEA countries, 31 966 cases of malaria were reported between 2012 and 2016, corresponding to a yearly average of around 6 400 cases (range: 5 272 cases in 2012 to 7 147 cases in 2016). Infection occurred in malaria endemic countries for 99.8% of the cases. The notification rate increased from 0.8 per 100 000 population in 2012-2013 to 1.0 per 100 000 population in 2014-2016.

In 2016, 10 cases were reported to ECDC as locally acquired: six cases in Greece, two in France, and one in each of Spain and Lithuania. These cases are considered sporadic and result from transmission by a local mosquito infected from an imported case (introduced malaria) or by an infected mosquito that was transported by aircraft from a malaria-endemic country (airport malaria). No sustainable locally acquired transmission of malaria was reported in the EU/EEA in 2016.

Between 2009 and 2017, the Hellenic Centre for Disease Control and Prevention has recorded 95 locally acquired *P. vivax* malaria cases resulting from an introduction in an area with a competent vector population areas: 76 cases between 2009 and 2013, none in 2014, eight in 2015, six in 2016 and five in 2017 (as of 17 August). Following a peak of local malaria transmission in the years 2011- 2012 in Greece, the number of locally acquired malaria cases declined steadily in the following years, with the reporting of only sporadic introduced cases. This coincided with the implementation of intense public health interventions with the collaboration of various stakeholders at the national, regional and local level, which contributed to the successful prevention of the re-establishment of malaria in Greece [5,6].

Modes of transmission of malaria

For epidemiological surveillance, malaria cases are classified as imported if the transmission of the parasite occurred outside of the EU, or indigenous if the transmission of the parasite occurred in the EU. In addition, *Plasmodium vivax* and *Plasmodium ovale* may cause relapses of malaria several months or years after the initial transmission event and the first episode of malaria.

Indigenous malaria may result from different modes of transmission:

- **Airport malaria** or **suitcase malaria**: the transmission results from the bite of an infected mosquito imported in the EU in an aircraft [7]. Airport malaria remains a rare event with limited numbers of cases being reported in past years.
- **Introduced malaria**: the transmission results from the bite of a local mosquito infected by an imported case. In the EU/EEA countries, several areas experienced introduced malaria foci: in Greece since 2009 [6,8-10] ; in France (Corsica) in 2006 [11] and in Spain in 2010 [12].
- **Induced malaria**: the transmission results from the introduction of the parasite into a person through artificial means, usually of iatrogenic origin, including blood transfusion, organ transplant, or the shared use of needles or syringes contaminated with blood. Malaria may also be transmitted from a mother to her unborn infant before or during delivery. Induced malaria cases have been reported occasionally in the EU.

WHO defines a malaria focus as follows [13,14]:

- An active focus is an area where indigenous case(s) have been detected within the current calendar year.
- A residual non active focus is an area where no indigenous transmission within past three years.
- A cleared-up focus is an area with no indigenous transmission for more than 3 years.

Although uncommon, nosocomial transmission of *P. falciparum* malaria, vector-borne or iatrogenic, has been previously documented. In most instances, transmission occurs from an admitted imported patient to other patients in the same ward, the parasite strains are found similar by molecular analysis but vector borne transmission is considered unlikely by the investigators. Although transmission has been associated with needle stick injuries [15], incorrect capillary blood sampling technique for blood-glucose measurement [16] and contaminated gloves [17], the mode of transmission remained unestablished in the majority of cases [18-20]. The most common hypothesised mode of transmission of healthcare-associated *P. falciparum* infections remains an unidentified breach in infection control when transfusion and needle stick injury are ruled-out by the investigations. In Germany in 2016, a patient who had shared a room for less than 24 hours with a malaria case in a hospital ward developed malaria subsequently. Malaria strains for both patients showed identical DNA patterns. Vector transmission was ruled-out as transmission occurred in wintertime. The mode of nosocomial transmission was not elucidated [21]. In Italy, a nosocomial transmission of malaria was ascertained to be likely to be due to patient-to-patient transmission via a contaminated blood glucose metre [16]. Several additional cases of suspected nosocomial transmission have been reported [15,17-20,22,23].

Malaria parasites may be transmitted through substances of human origin (SoHO) when a donor is an asymptomatic carrier of *Plasmodium* spp. [24-26]. In addition, most available malaria screening tests, including nucleic acid testing (NAT), have limited sensitivity to detect very low levels of parasites in blood sufficient to transmit malaria. To date, there is no evidence-based guidance for malaria screening methods for blood donation in malaria-endemic areas. In non-endemic countries, the application of blood safety measures has been successful in keeping the incidence of transfusion-transmitted malaria low, and the rejection rate of donors for malaria risk in various countries has been estimated to be 0.003-0.43% of all donations [27]. Similar safety measures that are applied to donors of cells, tissues and organs, may also effectively reduce the unnecessary deferral of donors but cannot be considered to exclude completely the possibility of malaria transmission by donations from donors that are asymptomatic carriers of *Plasmodium* spp. The highest risk of malaria transmission is through contaminated erythrocyte-containing blood components and peripheral blood stem cells. Transmission has also been reported through kidney, liver and heart transplantation, as well as through cortical bone, cornea, and epidermis.

Blood safety measures for malaria

Blood safety measures depend on whether an area where blood or tissue donation is taking place has known ongoing malaria transmission events. In non-endemic areas or countries, according to EU Directive, individuals with a history of malaria should be temporarily deferred from blood donation for three years following cessation of treatment if they are asymptomatic and an immunologic or molecular genomic test is negative [2]. The directive also specifies deferral periods and/or laboratory screening for individuals who have lived in an endemic area within the first five years of life, for asymptomatic visitors returning from malaria endemic areas or for individuals with a history of undiagnosed febrile illness during or within six months of a visit to an endemic area.

In a case of locally transmitted malaria in non-endemic countries, blood safety measures could be applied to an administrative geographic unit that covers an area of a radius of 2–6 km around the places of reported transmission(s) taking into account the geomorphology of the area [4]. Measures comprise identification of donors at risk, the deferral of donors and/or cessation of collection activities in the affected areas or the laboratory screening of donations, reinforcing post donation information and pathogen inactivation of whole blood or all blood components if available. The measures should continue until the end of the mosquito season without new cases reported. At this point, measures may be ceased, although, mindful of incubation periods in relation to season length, the laboratory screening of donated blood should continue at least until the start of the next season of mosquito activity [4]. Based on a risk assessment, EU Member States may decide whether to implement preventive measures for persons returning from the affected areas in non-endemic countries taking into account the measures currently being implemented by the local blood safety authorities.

Cells and tissues from potential deceased donors should be rejected from donation if there is evidence of the risk factors for malaria based on the risk assessment, taking into consideration travel and exposure history and local malaria prevalence. For living donors of cells and tissues, laboratory testing may be required depending on the donor's history and the characteristics of the tissues and cells donated [1].

Organ donors at risk of malaria infection should be laboratory tested. Parasitaemic donors are usually rejected by transplant centres. Organs from donors who have been successfully treated and recovered from malaria may be used with some exceptions e.g. liver donation. Prophylactic treatment of recipients may also be considered. Consultation of a transplant and malaria/tropical medicine specialist is recommended [3].

Competent mosquito vectors in the EU

Several *Anopheles* mosquito species competent for malaria transmission are present in Europe. In south-western Europe *Anopheles atroparvus* is the historical vector of *P. falciparum* and *P. vivax* [28]. However, the species is refractory to tropical strains of *P. falciparum*.

In central and eastern Europe, *Anopheles messeae* and *Anopheles maculipennis s.s.* are historical vectors of *P. vivax* [28,29]. Other possible vectors are *Anopheles claviger* for *P. vivax* and *Anopheles plumbeus* for *P. falciparum*. Both species are generally scarce but *Anopheles plumbeus* can be found in high densities in some spots such as around inoperative farms. *Anopheles plumbeus* presents moderate to high receptivity for *P. falciparum* in laboratory conditions [30].

In the Mediterranean region, *Anopheles atroparvus* can act as a malaria vector in the Iberian Peninsula. *Anopheles labranchiae* and *Anopheles superpictus* can act as malaria vectors in parts of Italy. *Anopheles labranchiae* can act as a malaria vector in Corsica whereas *Anopheles sacharovi* can act as a malaria vector in the Balkans [31]. In the Peloponnese region, Greece, *Anopheles maculipennis s.s.*, *Anopheles sacharovi*, *Anopheles hyrcanus* and *Anopheles superpictus* have been identified as competent vectors [31]. Throughout eastern Greece, *Anopheles sacharovi* and *Anopheles superpictus* have been implicated as the probable dominant vectors [8,32]. In Cyprus, competent vectors *Anopheles claviger* and to a lesser extent *Anopheles algeriensis*, *Anopheles sacharovi* and *Anopheles superpictus* are present [33].

Event background information

Since May 2017, France, Italy, Greece and the United Kingdom have reported malaria cases infected within the EU (Table 1).

Table 1: Number of cases of locally acquired malaria in the EU, by country of report, May-September 2017.

Country of report	N	*Plasmodium* species	Date of onset	Suspected mode of transmission, place of infection	Date of report
France	2	*P. falciparum*	26 August	Mosquito-borne, Allier, France	7 September
Greece	5	*P. vivax*	2 May-22 July	Mosquito-borne, regions of Dytiki Ellada and Sterea Ellada, Greece	18 May, 21 July, 17 August
	1	*P. falciparum*	17-23 July	Mosquito-borne or nosocomial, region of Ipeiros, Greece	17 August
Italy	1	*P. falciparum*	29 August	Mosquito-borne or nosocomial, Trento l, Italy	5 September
The United Kingdom	3	*P. vivax*	29 August	Mosquito-borne, northern part of Cyprus	8 September

Italy

On 5 September, Italy reported a fatal case of malaria in a four-year-old girl with no travel history to a malaria endemic country [34]. She was admitted on 13 August 2017 to a hospital in the Veneto region and diagnosed with diabetes mellitus. After returning from the Veneto region, she was admitted to a Trento hospital for her diabetes from 16 to 21 August and consulted for pharyngitis on 31 August 2017.

On 2 September, she was admitted and diagnosed with *P. falciparum* malaria and subsequently transferred to the tropical diseases reference centre in Brescia where she died on 4 September. Epidemiological investigations identified that two patients infected with *P. falciparum* were hospitalised in the same ward during her stay in the Trento hospital from 16 to 21 August. The investigation in Trento hospital did not identify breaches in medical procedures that could result in an iatrogenic transmission.

Entomological investigations in the area of Trento did not reveal the presence of *Anopheles* mosquitoes. Entomological surveys in Bibione, where the girl spent her holidays, are ongoing. Molecular sequencing of the *Plasmodium* strain from the girl and from the other two children hospitalised concomitantly is ongoing to assess the link among cases.

Greece

As of 17 August 2017, Greece reported five locally-acquired cases of *P. vivax* malaria acquired via vector-borne transmission. Four of the cases were likely to have been exposed in the regions of Dytiki Ellada in Western Greece and one case was likely to have been exposed in Sterea Ellada in Central Greece [6]. Greece considers these cases as introduced, resulting from a first-generation local transmission following a recent introduction of *P. vivax* in the area. The dates of onset of the cases range from 2 May to 22 July 2017.

In addition, Greece reported one locally acquired case of *P. falciparum* in the region of Ipeiros, in the north-west of Greece with date of onset of symptoms between 17 and 23 July 2017. The case, who has no recent travel history to a malaria endemic area, was recently hospitalised in a ward where a patient was treated for *P. falciparum* malaria. The date of onset of symptoms is compatible with a vector borne transmission through a mosquito infected in the ward. The investigation concluded that the case could result of either a nosocomial vector-borne transmission or a nosocomial transmission of iatrogenic origin, but not related to blood transfusion. Response measures were promptly implemented for both possible modes of transmission. Entomological investigations in the area did not reveal the presence of *Anopheles* mosquitoes. However, this targeted investigation could not rule-out the previous or current presence of *Anopheles* mosquitoes in the area. No further locally acquired malaria cases have been reported in the area despite the enhanced raising awareness of the local clinicians.

United Kingdom ex. the northern part of Cyprus

On 8 September, the United Kingdom reported through the Early Warning and Response System (EWRS), three cases of *P. vivax* malaria in travellers returning from Esentepe, the northern part of Cyprus. Two of the cases were 12-year-old siblings that travelled independently from the third case. The three cases stayed in the northern part of

Cyprus for two to three weeks in August and developed symptoms on 29 August. They were laboratory confirmed upon returning to the UK.

France

On 7 September, France reported two locally acquired cases of malaria. Both cases attended a wedding that took place between 11 and 16 August 2017 in Moulins, Auvergne-Rhône-Alpes region, France. On 30 August 2017, the first case was hospitalised in southwest of France for a 4-day course of fever, chills and sweats for which he was found positive for *P. falciparum* malaria. The patient did not travel abroad and had no risk factor for induced malaria. The only recent travel identified was to Moulins and its surrounding area to attend the wedding. On 1 September, a second case who attended the same wedding was diagnosed upon return to his home country outside the European Union. The case had onset of symptoms on 26 August 2017 and had neither exposure to induced malaria nor recent travel history to a malaria-endemic area.

None of the wedding attendees reported a recent travel history to a malaria endemic country or symptoms compatible with malaria. The Regional Health Agency of Auvergne-Rhône-Alpes implemented active case-finding in the neighbouring laboratories and hospitals. A case of *P. falciparum* malaria imported from Burkina Faso was identified in an individual who stayed in Moulins and its surroundings for several days within the two weeks preceding the wedding.

Entomological investigations conducted on 5-7 September in the area visited by the imported and the locally acquired cases showed evidence of the presence of *Anopheles maculipennis s.l.* (under investigation for species identification) and *Anopheles claviger s.s.* but did detect the presence of *Anopheles plumbeus*. Human landing catches revealed that these mosquitoes are not aggressive for human and are probably zoophilic in this area where many cattle and horses are present. The French National Reference Centre for malaria is gathering samples for molecular typing to assess the link between the imported and the two locally acquired cases.

ECDC threat assessment for the EU

Four EU Member States have reported the occurrence of malaria cases due to *P. falciparum* and *P. vivax* acquired in the EU. Greece has reported local transmission of *P. vivax* since May 2017 while other transmission events occurred in July 2017. The risk for spread of malaria in the EU following these events remains very low.

P. falciparum transmission events

Greece and Italy

Two events of nosocomial transmission of *P. falciparum* took place in Italy and in Greece. In both cases, the investigation was not conclusive, as neither breaches in infection control that could have resulted in a iatrogenic transmission were identified nor were *P. falciparum* competent vectors retrieved through entomological investigations. Laboratory investigations are ongoing and may provide additional insights on the link among cases and the origin of the strains.

While transmission to additional individuals at the time of the events may have occurred, it is unlikely that this would have been extensive and the risk of further spread of malaria in these nosocomial contexts is very low. However, these two events suggest the possibility of nosocomial transmission of malaria when preventive measures for mosquito transmission or for iatrogenic transmission are not strictly applied.

France

The epidemiological investigation identified the presence of a case *P. falciparum* malaria in the same area preceding the period of exposure of the two reported cases. Both cases shared an epidemiological link with this imported malaria case in that they stayed in and around the city while attending the wedding event, which may have resulted in a local mosquito-borne transmission. Entomological investigation conducted did not identify mosquito-vectors that could support the hypothesis of a vector-borne transmission by a competent local anopheline mosquito. A cluster of two airport malaria cases therefore remains a possible hypothesis. Molecular typing of the strains should provide further evidence.

While a few additional cases may have been infected at the time of the event in France, the risk for further spread of malaria in this area is very low.

P. vivax transmission events

Greece

Since 2009, Greece has been detecting locally acquired cases of *P. vivax* malaria almost every year following re-introduction in receptive areas (i.e. area with active and competent malaria anophelines vectors). Therefore, the reporting of introduced cases is not unexpected in specific vulnerable and receptive areas. The locations involved were known as receptive and vulnerable areas [8,35]. In 2011, ECDC published a rapid risk assessment on the situation in Greece and reports on successive missions to Greece in 2011 and 2012 [9,10,36].

Epidemiological and entomological investigations in Greece support the hypothesis of recurrent introductions of *Plasmodium vivax* in receptive areas (i.e. area with active and competent malaria anophelines vectors). As the 2017 mosquito season has not yet come to an end, the reporting of additional sporadic introduced cases of *P. vivax* malaria cannot be excluded. However, the risk of *P. vivax* infection for resident and travellers in areas with introduced malaria is very low.

The northern part of Cyprus

This is the first time that cases of malaria acquired in the northern part of Cyprus have been reported among EU travellers in the recent years. Receptive areas are likely to exist in the island of Cyprus due to its Mediterranean climate, the presence of competent vectors for *P. vivax* and historical transmission of malaria prior to 1945. The occurrence of travel-associated cases is unusual and it is presumed that local transmission has occurred in the area where the cases stayed in the northern part of Cyprus. Suitable climatic conditions and the presence of competent mosquito vectors for *P. vivax* in certain areas of Cyprus makes possible the local transmission of *P. vivax* around an imported case (introduced malaria). However, airport malaria cannot be ruled-out as tourists from malaria endemic countries are likely to have visited the country.

Additional similar events may happen in Greece and in Cyprus until the climatic conditions are no longer favourable for the activity of the mosquito vectors. Similar events have been seen in the past in Italy and Spain [12,37]. Therefore, similar introduced malaria events may happen as well in other receptive areas of southern EU where competent vectors are present and climatic conditions are favourable for their activity. No changes in species distribution and abundance of anopheline mosquitoes have been observed in recent years in the EU/EEA.

Through the VectorNet project, ECDC and the European Food Safety Authority (EFSA) are monitoring the distribution of malaria competent vectors in the EU and neighbouring countries to assess the risk of malaria transmission within the EU [38].

References

1. European Commission. Commission Directive 2006/17/EC of 8 February 2006 implementing Directive 2004/23/EC of the European Parliament and of the Council as regards certain technical requirements for the donation, procurement and testing of human tissues and cells 2006 [cited 2016]. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32006L0017.
2. European Commission. Commission Directive 2004/33/EC of 22 March 2004 implementing Directive 2002/98/EC of the European Parliament and of the Council as regards certain technical requirements for blood and blood components, 2004 [cited 2016]. Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:091:0025:0039:EN:PDF.
3. Council of Europe. Guide to the quality and safety of organs for transplantation (6th Edition). Strasbourg2016.
4. Domanovic D, Kitchen A, Politis C, Panagiotopoulos T, Bluemel J, Van Bortel W, et al. Targeting of blood safety measures to affected areas with ongoing local transmission of malaria. Transfusion medicine (Oxford, England). 2016 Jun;26(3):161-5.
5. Hellenic Center for Disease Control and Prevention. Basic information - General description of the situation in Greece [Internet]. Anthens: Hellenic Center for Disease Control and Prevention,; 2017 [cited 2017 Sep 13].
6. Hellenic Center for Disease Control and Prevention. Epidemiological Surveillance report. Malaria in Greece, 2017, up to 17/08/2017. Athens2017 [cited 2017 Aug 17]. Available from: http://www.keelpno.gr/Portals/0/Files/English%20files/Malaria%20reports/MALARIA_REPORT_17_08_%202017_ENG_FINAL.pdf.
7. Isaacson M. Airport malaria: a review. Bull World Health Organ. 1989;67(6):737-43.
8. Sudre B, Rossi M, Van Bortel W, Danis K, Baka A, Vakalis N, et al. Mapping environmental suitability for malaria transmission, Greece. Emerg Infect Dis. 2013 May;19(5):784-6.
9. European Centre for Disease Prevention and Control. Joint WHO–ECDC mission related to local malaria transmission in Greece, 2012 Stockholm2013 [cited 2017 Sep 10]. Available from: https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/Joint-ECDC-WHO%20mission-malaria-Greece-2012.pdf.
10. European Centre for Disease Prevention and Control. Update on autochthonous Plasmodium vivax malaria in Greece Stockholm2011 [cited 2017 Sep 10]. Available from: https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/131003_TER_Malaria_Greece_Risk_Assessment.pdf.
11. Armengaud A, Legros F, D'Ortenzio E, Quatresous I, Barre H, Houze S, et al. A case of autochthonous Plasmodium vivax malaria, Corsica, August 2006. Travel Med Infect Dis. 2008 Jan-Mar;6(1-2):36-40.

12. Santa-Olalla Peralta P, Vazquez-Torres MC, Latorre-Fandos E, Mairal-Claver P, Cortina-Solano P, Puy-Azon A, et al. First autochthonous malaria case due to Plasmodium vivax since eradication, Spain, October 2010. Euro Surveill. 2010 Oct 14;15(41):19684.
13. World Health Organization. A framework for malaria elimination 2017 [cited 2017 Sep 19]. Available from: http://apps.who.int/iris/bitstream/10665/254761/1/9789241511988-eng.pdf?ua=1.
14. World Health Organization. WHO malaria terminology Geneva2017 [cited 2017 Sep 15]. Available from: http://apps.who.int/iris/bitstream/10665/208815/1/WHO_HTM_GMP_2016.6_eng.pdf.
15. Alweis RL, DiRosario K, Conidi G, Kain KC, Olans R, Tully JL. Serial nosocomial transmission of Plasmodium falciparum malaria from patient to nurse to patient. Infect Control Hosp Epidemiol. 2004 Jan;25(1):55-9.
16. Moro ML, Romi R, Severini C, Casadio GP, Sarta G, Tampieri G, et al. Patient-to-patient transmission of nosocomial malaria in Italy. Infect Control Hosp Epidemiol. 2002 Jun;23(6):338-41.
17. Piro S, Sammud M, Badi S, Al Ssabi L. Hospital-acquired malaria transmitted by contaminated gloves. J Hosp Infect. 2001 Feb;47(2):156-8.
18. Zoller T, Naucke TJ, May J, Hoffmeister B, Flick H, Williams CJ, et al. Malaria transmission in non-endemic areas: case report, review of the literature and implications for public health management. Malar J. 2009 Apr 20;8:71.
19. Velasco E, Gomez-Barroso D, Varela C, Diaz O, Cano R. Non-imported malaria in non-endemic countries: a review of cases in Spain. Malar J. 2017 Jun 29;16(1):260.
20. Asgari N. A case of hospital acquired malaria in England. Euro Surveill. 2002;6(9).
21. Gruell H, Hamacher L, Jennissen V, Tuchscherer A, Ostendorf N, Loffler T, et al. On taking a different route: an unlikely case of malaria by nosocomial transmission. Clin Infect Dis. 2017 Jun 02.
22. Vermeulen l, De Schrijver k, De Weerdt, T., Deblauwe, I., Demeulemeester J, Van Gompel, A., et al. Malaria tropica in Antwerpen 2016 [cited 2017 Sep 10]. Available from: https://www.zorg-en-gezondheid.be/sites/default/files/atoms/files/VIB_2016-1_malaria-tropica-KoendeSchrijver.pdf.
23. Winterberg DH, Wever PC, van Rheenen-Verberg C, Kempers O, Durand R, Bos AP, et al. A boy with nosocomial malaria tropica contracted in a Dutch hospital. Pediatr Infect Dis J. 2005 Jan;24(1):89-91.
24. Frey-Wettstein M, Maier A, Markwalder K, Munch U. A case of transfusion transmitted malaria in Switzerland. Swiss medical weekly. 2001 Jun 02;131(21-22):320.
25. Kitchen AD, Barbara JA, Hewitt PE. Documented cases of post-transfusion malaria occurring in England: a review in relation to current and proposed donor-selection guidelines. Vox sanguinis. 2005 Aug;89(2):77-80.
26. Brouwer EE, van Hellemond JJ, van Genderen PJ, Slot E, van Lieshout L, Visser LG, et al. A case report of transfusion-transmitted Plasmodium malariae from an asymptomatic non-immune traveller. Malar J. 2013 Dec 05;12:439.
27. Reesink HW. European strategies against the parasite transfusion risk. Transfusion clinique et biologique : journal de la Societe francaise de transfusion sanguine. 2005 Feb;12(1):1-4.
28. Carnevale P, Robert V. Les anophèles, biologie, transmission du Plasmodium et lutte antivectorielle. Marseille: IRD; 2009.
29. Jetten TH, Takken W. Annophelism without malaria in Europe. Waningen: Wageningen Agricultural University.
30. Schaffner F, Thiery I, Kaufmann C, Zettor A, Lengeler C, Mathis A, et al. Anopheles plumbeus (Diptera: Culicidae) in Europe: a mere nuisance mosquito or potential malaria vector? Malar J. 2012 Nov 26;11:393.
31. Ramsdale C, Snow K. Distribution of the genus Anopheles in Europe. European Mosquito Bulletin. 2000;7:1-26.
32. Sinka ME, Bangs MJ, Manguin S, Rubio-Palis Y, Chareonviriyaphap T, Coetzee M, et al. A global map of dominant malaria vectors. Parasit Vectors. 2012 Apr 04;5:69.
33. Violaris M, Vasquez MI, Samanidou A, Wirth MC, Hadjivassilis A. The mosquito fauna of the Republic of Cyprus: a revised list. J Am Mosq Control Assoc. 2009 Jun;25(2):199-202.
34. Sanità ISd. Malaria, le ipotesi in campo 2017 [cited 2017 Sep 7]. Available from: http://www.iss.it/pres/?lang=1&id=1797&tipo=6.
35. Spanakos G, Alifrangis M, Schousboe ML, Patsoula E, Tegos N, Hansson HH, et al. Genotyping Plasmodium vivax isolates from the 2011 outbreak in Greece. Malar J. 2013 Dec 27;12:463.
36. European Centre for Disease Prevention and Control. Joint ECDC/WHO mission related to local malaria transmission in Greece in 2011 Stockholm2012 [cited 2017 Sep 10]. Available from: https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/1203_MER_Malaria-missions-Greece.pdf.
37. Romi R, Boccolini D, Menegon M, Rezza G. Probable autochthonous introduced malaria cases in Italy in 2009-2011 and the risk of local vector-borne transmission. Euro Surveill. 2012 Nov 29;17(48).
38. European Centre for Disease Prevention and Control. European Centre for Disease Prevention and Control (ECDC), European Food Safety Authority (EFSA). VectorNet: A European network for sharing data on the geographic distribution of arthropod vectors, transmitting human and animal disease agents. Stockholm [Internet]. Stockholm2017 [cited 2017 Sep 15]. Available from: http://ecdc.europa.eu/en/healthtopics/vectors/VectorNet/Pages/VectorNet.aspx.