NATIONAL PUBLIC
HEALTH ORGANIZATION

ANNUAL EPIDEMIOLOGICAL SURVEILLANCE REPORT

Malaria in Greece, 2018

Introduction

Malaria is a parasitic infection, transmitted through the bite of the infected female *Anopheles* mosquito. Five species of Plasmodium cause disease to humans: *Plasmodium falciparum, P. vivax, P. ovale, P. malariae* and *P. knowlesi*. *P. falciparum* and *P. vivax* are the most common.

The most common symptoms of malaria (chills, high fever, sweating, malaise, headache and muscle aches) manifest usually 1-4 weeks after infection with the parasite, while relapses of the disease are usually observed in short intervals but up to five -and in extreme cases even up to eight- years after *P. vivax* and *P. ovale* infections (if not properly treated). A number of effective anti-malarial drugs are available to treat the infection; starting the treatment promptly is essential in avoiding complications and interrupting the transmission of the disease in the community.

Ongoing transmission of malaria is currently recorded in 87 countries around the world (WHO, World Malaria Report, 2018), mainly in sub-Saharan Africa, Asia and Latin America. Until the mid-twentieth century, several countries in Europe and North America were malaria endemic, but -after intense malaria control programs- it was eliminated.

Malaria surveillance in Greece

Data are derived from the reports of laboratory-confirmed malaria cases and the enhanced surveillance systems of the National Public Health Organization (NPHO, former Hellenic Center for Disease Control and Prevention, HCDCP). The Department of Epidemiological Surveillance and Intervention undertakes a verification procedure through communication with the treating physicians, the hospital and the reference laboratory for malaria. Case, focus and environmental investigation are undertaken by the staff of the Department of Epidemiological Surveillance and Intervention, with the collaboration of local public health authorities, for every locally acquired malaria case throughout Greece. In addition, in specific areas with recorded cluster of locally acquired malaria cases over the last years, systematic pro-active detection of malaria cases, door-to-door, is implemented (see below).

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Malaria surveillance data in Greece, 2009 – 2017

Malaria was eliminated from Greece in 1974, following an intense control program (1946- 1960). Since then and up to 2017, several (20-110 cases) imported cases were reported annually to the HCDCP (currently NPHO) referring to patients infected abroad (returning travelers or migrants from malaria endemic countries). Increased numbers of imported malaria cases are expected due to the increase of travels and population movements worldwide, and are observed in all developed countries. According to the European Centre for Disease Control and Prevention (ECDC), in 2016 more than 7,000 malaria cases were recorded in EU/EEA countries (https://ecdc.europa.eu/sites/portal/files/documents/AER_for_2016-malaria.pdf).

Additionally, since 2009 a number of locally acquired/introduced *P. vivax* malaria cases have been recorded in various areas of the country (i.e., among patients without travel history to a malaria endemic country), mainly as sporadic introduced cases but also in clusters (in 2011- 2012). Most areas where locally acquired cases were recorded over the last years were rural close to wetlands with high number of persons from endemic countries. In addition, in 2017 one sporadic locally acquired *P.falciparum* malaria case was recorded, for which the most likely place of exposure was a heath care facility (the exact mode of transmission was not possible to be defined).

The number of malaria cases in Greece reported to the HCDCP/ NPHO by year of symptom onset (for imported cases) or infection (for locally-acquired cases) and by epidemiological case classification (imported/ locally-acquired) is presented in Table 1. Table 2 presents locally acquired *P. vivax* malaria cases by probable Region and Regional Unit of exposure, years 2009-2017.

Table 1: Reported malaria cases by year of symptom onset[1] (for imported cases) or infection (for locally-acquired cases) and by epidemiological case classification (imported/ locally-acquired), Greece, 2009 - 2017[2].

Year	Case classification	
	Imported cases	Locally-acquired/ introduced cases[3]
2009	44	7
2010	40	4
2011	54	42
2012	73	20
2013	22	3
2014	38	0
2015	79	8
2016	111	6
2017	100	7

1. Cases with no information regarding symptom onset were classified according to the year of hospitalization or notification to the HCDCP/NPHO.
2. Known reported relapses and two locally-acquired *P.malariae* cases (2012), that were attributed to former transmission periods, and two malaria cases "of undetermined classification" (2016) are not included.
3. All were *P.vivax* cases, except one *P.falciparum* case in 2017.

Table 2: Locally acquired/ introduced *P. vivax* malaria cases by probable Region and Regional Unit of exposure and year of infection, Greece, 2009-2017.

Region	Regional Unit	Year of infection								
		2009	2010	2011	2012	2013	2014	2015	2016	2017
Peloponnese	Lakonia	6	1	36	10	0	0	1	0	0
Attica	East Attica	1	1	2	4	0	0	2	0	0
Sterea Ellada (Central Greece)	Boeotia (Viotia)	0	2	1	2	0	0	1	0	1
	Euboea (Evoia)	0	0	2	0	0	0	0	0	0
Thessaly	Karditsa	0	0	0	2	1	0	0	0	1
	Larisa	0	0	1	0	0	0	3	1	0
	Trikala	0	0	0	0	0	0	1	0	0
	Magnesia & Sporades	0	0	0	0	0	0	0	1	0
East Macedonia & Thrace	Xanthi	0	0	0	2	0	0	0	0	0
	Evros	0	0	0	0	2	0	0	0	0
Central Macedonia	Thessaloniki	0	0	0	0	0	0	0	2	0
Western Greece	Achaea (Ahaia)	0	0	0	0	0	0	0	1	1
	Elis (Ileia)	0	0	0	0	0	0	0	1	2
	Aetolia-Acarnania	0	0	0	0	0	0	0	0	1
Total		**7**	**4**	**42**	**20**	**3**	**0**	**8**	**6**	**6**

This case classification is based on epidemiological criteria (e.g. history of travel within the last three years to a malaria endemic country). However, recent *Plasmodium* genotyping results suggested that a number of cases previously classified as "imported" were actually locally acquired. These cases concerned immigrants from malaria endemic countries in 2011 (n=9) and 2012 (n=11), who were residing in the Municipalities of Evrotas Lakonia and Sofades Karditsa (Spanakos G, Snounou G, Pervanidou D, et al., 2018).

You can find more information regarding epidemiological malaria data at the NPHO website (www.keelpno.gr).

Malaria surveillance data, Greece, 2018

In 2018, a total of fifty five (55) laboratory diagnosed malaria cases have been reported to the NPHO/ former HDCP (Table 3);

- Forty four (44) cases were classified as imported (i.e., were infected abroad), including: 28 (64%) cases among immigrants from malaria endemic countries and 16 cases among travellers (returning from Africa). Of the 28 cases in immigrants from malaria endemic countries:
  - 17 were immigrants from the Indian Subcontinent/ South Asia and 11 from Africa,
  - six cases concerned immigrants visiting friends and relatives at their country of origin,
  - four cases were recorded among immigrants/refugees residing in camps/ reception centers in Aegean islands.

- Ten (10) cases were classified as introduced (1st generation transmission); nine *P.vivax* cases and one *P.non-falciparum*. Case investigation of these introduced cases suggested the following:

- One *P.vivax* case was probably exposed at the Municipal Unit of Tichero, Municipality of Soufli, Regional Unit (RU) of Evros, with onset of symptoms in week 34/2018 (20-26/08/2018),

- One *P.vivax* case was probably exposed at the Municipal Unit of Feres, Municipality of Alexandroupoli, RU of Evros, with onset of symptoms in week 33/2018 (13- 19/08/2018). In another village of the same Municipal Unit of Feres, two locally-acquired malaria cases were also recorded in 2013.
- Eight cases (seven *P.vivax* and one *P.non-falciparum)* were probably exposed at the Municipal Unit of Echedoros, Municipality of Delta, RU of Thessaloniki, with onset of symptoms of the patients within weeks 37 and 40/2018 (15/09-05/10/2018). All cases of this cluster are considered introduced, i.e. 1st generation transmission from an imported case (as the time interval between symptom onsets of the cases was limited, within three weeks).

- One *P.vivax* case to a patient of foreign nationality was characterized as "of undetermined classification" (reported travel to an endemic country some years ago).

Figure 1. Areas of probable exposure of introduced malaria cases (1st generation transmission), Greece, 2018.

Table 3 presents the reported malaria cases in Greece by epidemiological case classification (imported/ introduced), status (immigrants/ returning travellers) and *Plasmodium* species.

Table 3. Malaria cases by epidemiological case classification, status and *Plasmodium* species, Greece, 2018 (n=55)

Epidemiological case classification and status		*Plasmodium* species					
		P.vivax	***P.falciparum***	***P.ovale***	***P.malariae***	***P. non-falciparum***	**Total**
Imported cases	**Immigrants**	18	6	3	1	0	28
	Travelers	0	15	0	1	0	16
Introduced cases		9	0	0	0	1	10
Undetermined classification		1	0	0	0	0	1

The number of malaria cases per epidemiological case classification (imported/introduced), status and place of residence (for the imported cases) or probable exposure (for the introduced cases) is described in Table 4.

Table 4. Malaria cases by epidemiological case classification, status and Regional Unit (RU) of residence/probable exposure, Greece, 2018 (n=54*).

Regional Unit of residence (imported) or probable exposure (introduced)	Classification of malaria cases			
	Imported			Introduced
	Immigrants	Travellers	Total	
Central Section of Athens	5	2	7	0
Western Section of Athens	0	1	1	0
Southern Section of Athens	0	1	1	0
Piraeus and Islands	0	2	2	0
Argolis	1	0	1	0
Arcadia	1	0	1	0
Achaea (Ahaia)	1	0	1	0
Boeotia (Viotia)	2	0	2	0
Evros	0	0	0	2
Elis (Ileia)	1	0	1	0
Heraklion	2	0	2	0
Thessaloniki	1	2	3	8
Ioannina	1	0	1	0
Kalymnos	0	1	1	0
Corfu	0	1	1	0
Lakonia	3	0	3	0
Larisa	1	0	1	0
Lasithi	3	0	3	0
Lesvos	2	1	3	0
Magnesia & Sporades	0	1	1	0
Messinia	0	1	1	0
Samos	1	0	1	0
Chania	1	1	2	0
Chios	1	0	1	0
Unknown	1	2	3	0
Total	**28**	**16**	**44**	**10**

* One case characterized as “of undetermined classification” residing in the RU of Achaea (Ahaia) is not included.

Activities for the management of malaria

Since 2012 NPHO/ former HCDCP has developed and continuously implements an Action Plan for the Management of Malaria, which was updated for 2018. In addition, in 2015 the Ministry of Health published the "National Action Plan for the Management of Malaria".

According to these plans, a series of activities are implemented nationwide for the prevention and management of malaria, with the collaboration of national, regional and local authorities, including:

I. **Risk assessment for the re-emergence of malaria:** All areas (Regions, Municipalities) are assigned a Risk Level from 0-3, taking into consideration the locally acquired/ introduced malaria cases reported since 2009, and other local risk factors (entomological, environmental and demographic data). The area Risk Level defines the activities to be implemented.

II. **Enhanced malaria surveillance and intervention activities:**

- **Case finding:** In order to promptly detect all malaria cases, awareness raising among local health professionals and active case detection activities in high risk areas are implemented, as well as support for the laboratory diagnosis of malaria.
- **Case investigation:** NPHO investigates all notified malaria cases. For locally-acquired/ introduced cases, an in-depth interview with the patient is conducted, in order to identify the probable place of exposure and the risk for further local transmission.
- **Immediate communication to stakeholders and health professionals** at national and local levels, after the reporting of each locally-acquired/ introduced malaria case to the NPHO:
  i. Hierarchy of the Ministry of Health (MoH),
  ii. Regional public health authorities,
  iii. Municipalities,
  iv. MoH Committee for the Prevention and Management of Tropical Diseases,
  v. Working Group for the designation of vector-borne disease (VBD) affected areas,
  vi. National Centre for Blood Donation, responsible for the relevant blood safety measures,
  vii. Physicians practicing in the affected area, to raise their awareness for investigating suspect cases.
- **Focus investigation – reactive case detection**: NPHO investigation teams are deployed after the notification of each locally acquired/ introduced case to perform a "focus investigation", in an area indicated by the epidemiological, entomological and environmental investigation. In this activity, all individuals in the focus are screened for malaria compatible symptoms and tested for malaria accordingly.

  Following the report of the introduced malaria cases in 2018, the NPHO, in collaboration with local public health authorities, organized and performed focus investigations, as well as communication activities for health professionals and the public in the areas. Active case detection remains ongoing for the 2019 period in the area of the RU of Thessaloniki (where the cluster of introduced cases was recorded), with the collaboration of the NPHO and regional public health authorities.
- **Environmental and vector investigation** is performed in the area after the recording of each locally acquired malaria case (or imported case in a receptive area), in collaboration with regional and local authorities, in order to identify *Anopheles* breeding sites and other risk factors for local transmission.

- **Proactive malaria case detection (PACD) in Evrotas Municipality, Lakonia:** The NPHO/ former HCDCP, in collaboration with the Region of Peloponnese, the Municipality of Evrotas, the University of Thessaly (www.malwest.gr) and Doctors Without Borders (2012), supported from 2011-2014 a field team in the area for the active detection of malaria cases. Since 2015, the field team -with staff from the University of Thessaly and field coordination from the NPHO/HCDCP- is supported by the Region of Peloponnese to continue the PACD programme, undertaking also the radical treatment and focus investigation of all recorded malaria cases. A significant number of immigrants from malaria endemic countries (mainly Pakistan) live and seasonally work in Evrotas. During the field visits, health promotion information is provided for protection against mosquitoes and fever screening and/or testing for malaria is performed regularly. In April to December 2018, fever screening visits were performed every 7-15 days in immigrants and other high risk groups in the particular area.

III. **Enhancing laboratory diagnosis of malaria:** Since 2012, NPHO/former HCDCP has distributed Rapid Diagnostic Tests (RDTs) for malaria to Hospitals and Health Centers in areas with recently recorded malaria transmission, and in areas with large populations of immigrants from endemic countries (i.e., large urban centers, in refugee/migrant camps and the nearby Health Units), aiming at prompt diagnosis and treatment of malaria cases. In 2017 and 2018, NPHO provided RDTs to a total of >180 Health Units/facilities nationwide. RDTs have contributed significantly to the early detection of malaria cases in our experience and have been proven a valuable field tool.

In addition, NPHO recommends the transportation of samples from any laboratory in Greece to the reference laboratory (Department of Parasitology, Entomology and Tropical Diseases of National School of Public Health) for verification of diagnosis and further identification (and genotyping) of *Plasmodium* species.

IV. **Case management - Standardization of the malaria treatment in Greece,** according to treatment guidelines developed by the NPHO/HCDCP with the input of experts in infectious diseases. NPHO infectious diseases specialists are available for counseling. NPHO also maintains a stockpile of anti-malarial medicines (e.g., the national stockpile of artesunate for parenteral injection for severe cases) for timely distribution to Health Units in cases of emergency.

V. **Increase awareness amongst health professionals** for the diagnosis and management of malaria. NPHO staff delivers presentations and organizes seminars -as necessary- for health professionals in Health Centers/Hospitals in areas with recently recorded locally acquired/ introduced cases. NPHO communicates annually to all Hospitals, Health Centers and Medical Associations about malaria (letters sent in May 2018 for the 2018 period).

VI. **Communication to the public** on malaria and personal protection measures against mosquitoes:

- **Educational material** on malaria and protective measures against mosquitoes is available on the NPHO/HCDCP website.
- **Information material** (leaflets, posters, multi-lingual brochure) is distributed according to the needs. In areas with introduced cases recorded, the NPHO field team -in collaboration with local authorities- informed the local population, and raised awareness about malaria and the necessary protective measures against mosquitoes, during the focus investigations.

VII. **Designation of affected areas - Blood safety and haemovigilance measures:** An inter-sectoral Working Group (WG) on the designation of VBD affected areas (under the MoH Committee for the Prevention and Management of Tropical Diseases) considers all available epidemiological and

laboratory data for each locally-acquired case and decides on the characterization of malaria affected areas in Greece. This designation is then used by the National Centre for Blood Donation to issue guidance on blood safety. The list of affected municipalities is published on our website (www.keelpno.gr) and updated regularly according to recorded locally acquired cases. Post donation and post transfusion information to donors and other haemovigilance measures are in place following relevant guidance from the Coordinating Haemovigilance Centre/ NPHO.

VIII. Vector surveillance and control activities:

- **Raising awareness and guidance to Regional and Municipal Authorities:** NPHO communicates regularly (workshops, meetings, letters and technical guidance) with all Regional Authorities in Greece recommending the timely planning, organization and implementation of integrated vector control programmes particularly in high risk areas. NPHO/former HCDCP sent relevant awareness letters in February 2018 underlying the high risk areas, and recommending the intensification of vector control in areas with risk factors for local transmission. In addition, following an initiative of the General Secretary of Public Health, Ministry of Health, workshops of the national and regional public health authorities were organized regarding the appropriate preventive actions for vector borne diseases.
- **Monitoring of the vector control programme implementation across the country**.
- **Distribution and placement of Long Lasting Insecticide-treated Nets (LLINs):** According to WHO and ECDC guidance, NPHO/ HCDCP distributed (in 2013) LLINs to immigrants, in the Municipality of Evrotas, Lakonia, under a special license from the Ministry of Rural Development and Agriculture. Since then, in each transmission period, the distribution, placement and monitoring of the proper use of the nets is implemented by the PACD field team, which conducts the active case detection in the area.
- **Participation in the implementation of indoor residual spraying (IRS):** The Region of Peloponnese implements every summer indoor residual spraying (IRS) in migrant residences in the area of Evrotas. The PACD field team participates in the activity by indicating migrant residencies in the area. NPHO continues to recommend this vector control method in this area.
- **Entomological surveillance**: The NPHO/former HCDCP, in collaboration with the Department of Parasitology, Entomology and Tropical Diseases of the National School of Public Health (NSPH), the Benaki Phytopathological Institute, the MALWEST project (2012-2014), Universities, Regions, local authorities and subcontractors of the local mosquito control programmes has implemented, participated or coordinated active vector surveillance programme from 2010 to 2015. NPHO recommends that local authorities should perform vector surveillance annually, especially in areas with risk factors for local malaria transmission (e.g. rural areas with large populations of persons from malaria endemic countries) and tries to collect the available vector surveillance data.

IX. Communication with international public health stakeholders: The NPHO communicates frequently for exchange of knowhow and information on malaria cases and activities with the ECDC and WHO, as well as with a number of European and international agencies and networks.

In addition, due to the increased **migrant/ refugee population residing in the country** in reception and accommodation camps, a series of targeted activities have been organized in these camps, including: strengthening malaria surveillance and diagnosis, distribution of rapid diagnostic tests to the camp

clinics and nearby Health Units, recommendation for systematic entomological surveillance in the area, risk assessment (collection of available entomological, environmental and demographic data) and, if necessary, intensification of mosquito control measures, personal protection measures against mosquitoes for the hosted migrants.

Conclusions

As indicated by the malaria surveillance data, the risk of re-appearance of the disease in specific vulnerable and receptive areas of the country exists, especially where the presence of adequate numbers of *Anopheles* mosquitoes (the competent vector of the disease) is combined with the presence of malaria patients coming from endemic countries.

Following a peak of locally acquired malaria cases between 2011-2012, their number declined steadily in the following years. This decrease was the result of a number of intense and costly public health interventions uninterrupted implemented since 2011, with the collaboration of various stakeholders at the national, regional and local level, which have contributed to the successful prevention of the re-establishment of malaria in Greece.

However, sporadic introduced malaria cases or small clusters of introduced cases were still recorded over the last years, up to 2018, in few vulnerable and receptive areas, indicating the need to sustain malaria activities as a priority for the preparedness of public health authorities.

Early detection and **radical treatment of malaria cases, together with appropriate investigation** and **effective integrated vector control measures** represent the main components of the public health strategy to prevent *P.vivax* reintroduction in high risk areas of the country. In this context, high level of preparedness and awareness of health and public health services should be maintained. In addition, important determinants for the prevention of local malaria transmission in Greece include the continued offer of free access to health services for migrants for the timely diagnosis and treatment of malaria, the open communication with the migrant population and achieving a minimum standard for their living conditions and well-being.

Advice for travelers in Greece:

The NPHO, based on the surveillance data available until now and the implemented prevention measures in the areas where introduced *P.vivax* malaria cases have been reported, maintains that **the risk to travelers for malaria infection in Greece is very low**. **Chemoprophylaxis for malaria is not recommended for visitors** to areas where locally acquired/ introduced malaria cases have occurred until today. Nevertheless, personal protective measures against mosquitoes are strongly encouraged during the mosquito circulation season (given also the possible seasonal circulation of West Nile virus in the country).