

Insect And Tick Bite Avoidance

Protection from insect and tick bites is essential to help prevent vector-borne diseases such as malaria, yellow fever and Zika

Key Messages

Insect bites are relatively common in travellers, usually causing only minor irritation, but they can result in local skin trauma, allergic reactions, secondary skin infections or transmission of infectious disease such as malaria, yellow fever, and Zika.

For many vector-borne diseases, avoiding bites is the only means of prevention.

Where vaccines or malaria tablets are recommended, travellers should seek a pre travel appointment with their health care provider.

Protection from insect and tick bites is best achieved by avoiding infected habitats, together with personal protective measures such as wearing protective clothing, using insect repellent and sleeping under impregnated bed nets.

Travellers should pack appropriate equipment for their destination; this may include protective clothing, repellents, mosquito nets, fine tipped tweezers and a first aid pack.

Travellers with a high fever of 38°C or more or other worrying symptoms should seek prompt medical advice. Malaria symptoms may occur up to a year after travel.

Overview

Insect and tick bites are relatively common in travellers, usually causing only minor irritation. However, bites can result in local skin trauma, allergic reactions (ranging from small local reactions to life-threatening systemic reactions), secondary skin infections or transmission of infectious disease (vector-borne diseases) (see Table 1) [1 - 4].

Vector-borne diseases account for more than 17 percent of all infectious diseases. Every year diseases such as malaria, dengue, yellow fever, and Japanese encephalitis cause more than 700,000 deaths globally [5]. The highest burden of disease occurs in tropical and subtropical areas where the poorest populations are disproportionately affected.

Vaccines or medications are available to help prevent a number of these diseases, but for many, bite avoidance is the only way to prevent infection.

Insect bites and stings

Insects and arachnids are invertebrates (they have no backbone) and are classified within the phylum Arthropods (arthropods have an external skeleton, often with a segmented body, and paired jointed legs). Insects have six legs and include mosquitoes, gnats and flies. Arachnids have eight legs and include spiders, mites and ticks [3]. The term 'insect' will be used here to include both insects and arachnids.

Insect bites or stings generally occur as a result of insect feeding (e.g. mosquitoes, bed bugs) or defence (e.g. bee and wasp stings or spider bites), and can range from being immediately painful to completely unfelt.

Insect bites

Insects may bite by puncturing the skin with their mouthparts (e.g. mosquitos, fleas and bed bugs). This may cause little trauma and may not be noticed straight away. Other insects (e.g. horseflies and midges) take blood by lacerating the skin and lapping up blood in the wound. These bites are usually painful and are noticed immediately. Biting insects inject various substances such as anticoagulants (to prevent blood clotting) and vasodilators (to open blood vessels) in their saliva during feeding to ensure a flow of blood. The presence of these substances in the saliva can lead to local skin reactions, and rarely, systemic reactions (symptoms felt throughout the body) [3].

Insect stings

Bees, wasps and hornets are stinging insects, injecting venom into the skin. Stings are usually painful immediately. Venom from stings may cause reactions ranging from mild localised pain to severe systemic reactions including anaphylaxis (serious allergic reaction). The antigenic substances in the venom from bees, wasps and hornets are more likely to cause severe systemic sensitivity reactions than bites from most other insects. The risk of potentially life-threatening systemic reactions to insect stings have been estimated to occur in 0.4 - 0.8 percent of children, and up to 3 percent of adults [3]. In the UK, insect stings are the second most common cause of anaphylaxis outside of medical settings [3].

Insect vectors and diseases they transmit

Mosquitoes

Mosquito borne diseases include [malaria](#), [yellow fever](#), [japanese encephalitis](#), [dengue](#) and [Zika](#) (there are many others not listed here).

The female mosquito requires a blood meal to reproduce. There are many species of mosquitoes,

some which bite during daylight hours (e.g. *Aedes* spp), others are more active from dusk to dawn (e.g. *Anopheles* spp). However, biting times of some mosquitoes can also vary between species (e.g. *Anopheles* mosquitoes which transmit malaria). In Africa for example, several malaria vectors have peak biting times at and just after midnight whereas in many parts of South America and SE Asia, the greatest risk of being bitten by malaria vectors is in the evening [6].

Mosquitoes are attracted by several factors, including the presence of carbon dioxide (from skin and breath), heat (from skin), odours (including fragrances from perfumes and soaps), lactic acid and movement. [7].

Different species of mosquito may prefer to bite different parts of the body, related to skin temperature and sweat gland activity. Different individuals may also be more attractive to mosquitoes than others. [7].

Mosquito bites usually appear as small, red raised papules that itch.

Table 1. Examples of diseases transmitted to humans by mosquitoes, ticks and other vectors [5]

Vector	Vector-borne diseases	
Mosquitoes	<i>Anopheles</i> spp	Malaria Lymphatic filariasis
	<i>Aedes</i> spp	Chikungunya Dengue fever Eastern equine encephalitis La Cross encephalitis Lymphatic filariasis Rift Valley fever Ross River virus Yellow fever Zika
	<i>Culex</i> spp	Japanese encephalitis Lymphatic filariasis Ross River virus St Louis encephalitis West Nile virus
Ticks	Babesiosis Borreliosis Crimean Congo haemorrhagic fever	

	Lyme disease Rickettsial diseases (spotted fever, Q fever) Rocky mountain spotted fever Tick-borne encephalitis Tularemia
Flies	African trypanosomiasis (tsetse flies) Leishmaniasis (sandflies) Onchocerciasis (black flies)
Fleas	Plague Murine typhus
Reduviid bug	American trypanosomiasis (Chagas disease)
Lice	Louse-borne relapsing fever Typhus
Chigger Mites (Trombiculid mites)	Scrub typhus

Ticks

Ticks can transmit a number of different diseases such as Lyme disease, [tick-borne encephalitis](#), Crimean Congo haemorrhagic fever and babesiosis.

Ticks typically live on the ground in long grassy areas and usually feed on small mammals. They become attached to humans after brushing against grass, after which they crawl on skin or clothing until they find a suitable place to attach and feed, often at a skin fold in the groin, under the arm, at the scalp line or at the edge of underclothes. The bite is generally painless [8]. Prompt removal of ticks may prevent transmission of some infectious diseases; it is therefore important to check for ticks on the body after outdoor activities.

Flies

Black flies transmit [onchocerciasis](#) (river blindness): they bite during daylight hours and live close to fast-flowing water.

Sandflies transmit [leishmaniasis](#): they are found in many areas of the world and are most active between dusk and dawn; however they do bite during daylight hours if disturbed. Sandflies usually feed close to the ground.

Tsetse flies transmit [African trypanosomiasis](#) (sleeping sickness) and inhabit dense vegetation and savannah areas of sub-Saharan Africa. They are attracted to dark, contrasting colours, particularly the colour blue, and to moving objects such as cars, canoes, animals and people [9].

Fleas

A number of different species of fleas can feed on humans. Fleas can transmit [plague](#) and flea-borne rickettsiosis.

Reduviid bug (Triatome bugs)

Reduviid bugs transmit [American trypanosomiasis](#) (Chagas disease). They live in cracks in the walls and roof of buildings constructed from mud or thatch in Latin America. The infection is transmitted following contact with the faeces of an infected bug.

Chigger mites (Trombiculid mites)

Scrub typhus (also called Bush typhus) is transmitted to humans through the bite of infected larval trombiculid mites (known as chigger mites). The mites live mainly in rural areas between woods and clearings, although certain endemic areas can be sandy, semi-arid and mountain deserts [10].

Bed bugs

There has been a resurgence of bed bug infestations in recent years, particularly in developed countries, possibly related to the increase in international travel and resistance to insecticides [11].

Bed bugs are small blood sucking insects which live in cracks in and around beds, often under the mattress or headboard. They tend to crawl out at night to feed on blood from exposed skin. Bites are painless but can cause itchy red bumps or in more severe cases, rashes [12].

There is no evidence that bed bugs transmit disease-causing pathogens, but reactions from bites can cause irritation. There are few published studies investigating the role of insect repellents in protecting against bed bug bites [13].

Travellers should be encouraged to inspect their sleeping accommodation for bed bugs on mattresses and bedding, which might present as blood spotting on linens; keep suitcases or rucksacks off the floor when not in use and inspect clothing before replacing them in luggage [11].

Midges

Midge bites look similar to mosquito bites, and can cause small red lumps which can be painful and itchy [12].

Risk for travellers

The risk of bites and of contracting a vector-borne disease for travellers varies according to exposure to insects. This will be determined by destination, season and rainfall patterns, as well as

activities undertaken, length of stay and measures taken to avoid bites. Destination specific information on some of the diseases spread by insects can be found on the [Country Information pages](#).

Vaccines are available to help protect against some of the diseases, but may not be suitable for all travellers, placing them at higher risk of disease. Avoiding bites from insects and ticks may be the only methods to avoid infection.

Before travel

Travellers should research their destination to determine possible risks for vector-borne diseases (see our [Country Information pages](#)). Vaccinations and/or malaria tablets may be recommended, in which case a pre-travel appointment should be booked with a health care provider ideally at least four to six weeks before departure. An appointment is still worthwhile for those with less time.

Travellers should consider if they need to pack protective clothing, insect repellents, insecticide treated bed / cot nets, plug-in insecticides and a first aid pack with items to manage insect bites.

During travel

Personal protection against insect and tick bites can be achieved by avoiding their habitats, and using protective clothing, sleeping under impregnated bed nets and applying insect repellent. A combination of these measures is considered the most effective way to prevent bites.

Where possible, travellers should avoid areas of stagnant or standing water which are ideal breeding grounds for mosquitoes. Those living or staying in areas with vector-borne diseases can reduce mosquito breeding sites around the home by removing any pools of water in ditches, plant pots, gutters, drains and rubbish collected in the area.

Tick bites may be reduced by keeping to footpaths and avoiding wooded and bushy areas with high grass.

Key points to reduce insect and tick bites:

- **Avoid areas of stagnant or standing water, where mosquitoes are likely to breed**
- **Keep to footpaths and avoid long grass when walking to avoid tick bites**
- **Wear loose-fitting clothing, with long sleeves, long trousers, tucked into socks**

- **Light coloured clothing will help see ticks and other insects**
- **Clothing can be sprayed or impregnated with insecticide (e.g. permethrin); insect repellents such as DEET can be applied to natural fibres**
- **Use insect repellents on exposed skin: DEET based repellents are considered the most effective currently available**
- **Avoid using products with strong perfume (e.g. soaps) which might attract insects**
- **In areas with vector borne diseases, use air conditioning where available or sleep in screened accommodation, under a mosquito net impregnated with insecticide**
- **Insecticide vaporisers can be used to inhibit mosquito bites and mosquito coils can be used outdoors**
- **Check body for ticks after outdoor activity and remove them promptly (see below)**

Clothing

When travelling in areas with malaria it is advisable to wear loose-fitting clothes with long trousers and long sleeves and socks if out of doors after sunset. Where there is a risk of disease transmitted by *Aedes* mosquitoes (e.g. yellow fever, Zika virus, dengue, chikungunya), travellers should cover up during the daytime where possible, as *Aedes* spp mosquitoes generally bite between dawn and dusk. Mosquitoes can bite through thin or fitted clothing. Ticks can access skin around the ankles, so trousers should be tucked into socks.

Light coloured clothing will make it easier to see insects which might have landed or crawled onto clothing, although there is no evidence that the colour of clothing is relevant to mosquitoes [6]. Those travelling to Africa in areas where tsetse flies exist should avoid dark blue clothing [9].

Clothing can be sprayed or impregnated with an insecticide (e.g. permethrin), which kills insects, including ticks, on contact. Permethrin is available in formulations designed to be sprayed on to clothing and this provides protection against mosquitoes, ticks, fleas, lice, sand flies, triatomine bugs and tsetse flies [14]. Insect repellents such as N, N-diethyl-m-toluamide (DEET) can also be applied to natural fibres such as wool and cotton, but can destroy artificial fibres or plastic.

Insect repellents

DEET

DEET (N, N-diethyl-m-toluamide) has been used as an insect repellent for more than 50 years and has been widely tested in field conditions. A number of studies have concluded that the risk of adverse effects from DEET are low when applied according to the product instructions [6, 14].

DEET based repellents are considered to be the most effective repellents currently available, and are recommended for protection against malaria and other vector-borne diseases [6, 14]. A number of different concentrations are available as well as a variety of preparations, including sprays and slow release polymers [6].

Concentrations of 20 percent have been shown to offer protection for 1 - 3 hours, up to 6 hours for 30 percent and up to 12 hours for 50 percent DEET. As the duration of protection plateaus at concentrations higher than 50 percent, there is no need to use repellents with concentrations greater than this [6]. Intervals between applications of DEET will vary according to activity as well as formulation and concentration used.

Repellents should be reapplied at regular intervals, after swimming and in hot, humid conditions when they may be removed by perspiration. The effectiveness of repellent is reduced by evaporation and absorption from the skin surface and sweating.

There is no current evidence that any group (including pregnant and breastfeeding women) are at increased risk from using 50 percent DEET. DEET is also considered suitable for all individuals over 2 months of age (unless allergic to the product) [6].

DEET and sunscreen

A number of studies have shown that DEET decreases the protection of SPF 15 sunscreen, although there is no evidence that sunscreen reduces the efficacy of DEET when used at concentrations above 33 percent [6]. When both are required, DEET should be applied after the sunscreen, and 30 to 50 SPF sunscreen should be used to compensate for the reduction in SPF induced by DEET [6, 15].

Alternatives to DEET

If DEET is not tolerated (or unavailable) and travellers are visiting areas where malaria or other vector-borne diseases are present, Icaridin (Picaridin) at concentrations above 20 percent, or Lemon eucalyptus preparations (PMD or chemical name: para-menthane-3,8-diol) are the most useful alternatives [6, 14].

Icaridin (Picaridin)

Icaridin has repellent properties similar to DEET with a comparable duration of protection when both are used at 20 percent. If used for mosquito bite prevention against malaria, at least a 20 percent preparation is advised [6].

Lemon eucalyptus (p-menthane 3,8 diol) or PMD

Thousands of plants have been tested for their insect repellent properties. Although none of the plant-derived chemicals so far tested demonstrate the broad level of effectiveness and duration of DEET, a few do show repellent activity. Lemon eucalyptus (PMD) provides similar protection to 15 percent DEET but provides a shorter period of protection [6].

Oil of citronella based products do have repellent properties but provide short lived protection [6]. They are not recommended for protection against malaria by the Advisory Committee for Malaria Prevention for UK Travellers (ACMP), and Citronella has been withdrawn in Europe.

Use of Insect Repellents in pregnancy and breastfeeding

Avoidance of mosquito bites is extremely important in pregnancy as pregnant women are particularly attractive to mosquitoes [6].

The use of 20 percent DEET during the second and third trimesters of pregnancy was not associated with adverse effects on the infants in pregnancies followed up for up to 12 months after birth [6, 14]. Because malaria is a serious disease in pregnancy, DEET based repellents in concentrations up to 50 percent are recommended for all pregnant women, at any stage of pregnancy, travelling to areas where malaria or other insect-borne diseases are a risk [6, 16].

Icaridin and PMD are alternatives to DEET. However, there are no data concerning exposure in human pregnancy, although animal studies have not demonstrated any features of maternal or developmental toxicity [16].

DEET may also be used in concentrations up to 50 percent in breastfeeding. Nursing mothers should wash repellents off their hands and breast skin before handling infants.

Use of insect repellents in infants

Recommendations on the use of DEET in young children vary between countries. According to Public Health England Advisory Committee on Malaria Prevention (ACMP) DEET may be used at a concentration of up to 50 percent in infants and children aged over 2 months. DEET is not recommended for infants under 2 months of age [6]. Manufacturer's instructions on application should be followed. Infants under 2 months should be protected with protective clothing and insecticide treated nets draped over cots and prams secured around the edges to avoid gaps.

Children should not be allowed to handle repellents as they may inadvertently ingest them or get them in their eyes. Adults should apply repellent to their own hands, then onto the child's skin, and

avoid applying to children's hands.

How to use insect repellents safely:

- **Use on exposed skin only, not under clothing.**
- **Do not use over cuts, irritated or inflamed skin.**
- **Do not apply directly to the face - apply repellent to hands, then to the face to avoid contact with lips and eyes. Wash hands after application.**
- **Do not apply to children's hands.**
- **Apply and re-apply repellents according to manufacturers' instructions.**
- **Remove with soap and water when repellent no longer needed.**
- **Ensure repellents are not ingested or inhaled.**
- **DEET can be used in concentrations of up to 50 percent in pregnant and breastfeeding women, and in infants and children older than 2 months (unless allergic).**
- **When sunscreen and DEET are needed, DEET should be applied after sunscreen (use 30 - 50 SPF sunscreen to compensate for reduction in SPF induced by DEET).**
- **Combined sunscreen and repellent should usually be avoided.**
- **DEET may damage plastics and artificial fibres so care is needed to avoid contact. DEET does not damage natural fibres such as wool, linen or cotton.**
- **Picardin and lemon eucalyptus extract or PMD are available for those who prefer not to use DEET-based products. Picardin should be used in concentrations of at least 20 percent.**

Mosquito nets

If sleeping or resting outdoors or in a room with no air conditioning, travellers should use a mosquito net to avoid being bitten. Nets should be impregnated with insecticide (e.g. permethrin) to improve protection – these will need to be re-impregnated every 6 to 12 months to remain effective, depending on the frequency of washing. Long-lasting impregnated nets are now available and have an expected useful life of at least 3 years [6].

Contact insecticides will kill insects landing on the net and therefore increase their effectiveness.

Mesh size in mosquito bed nets should be no larger than 1.5 mm and nets should be free from tears and tucked in under the mattress. It may be useful for travellers to carry a small sewing kit so that repairs can be made if the net develops a hole. Extra equipment for hanging the net can be helpful including extra string or wire hooks.

Room protection (including air conditioning and screening)

Doors and windows to sleeping accommodation should be screened with fine mesh.

Air conditioning reduces night-time temperature in a building and therefore reduces the likelihood of mosquito bites. Ceiling fans reduce the nuisance from mosquitoes [6].

There is evidence that insecticide vaporisers inhibit mosquito bites and cause mosquito repellence and knockdown [14].

A systemic review demonstrated that mosquito coils can decrease bites by repelling and killing mosquitoes [17]. Coils, which contain synthetic insecticide, may be useful for some travellers but they should only be used outdoors [6].

Measures not recommended for repelling insects [6]

There is no evidence that any of the following products, taken orally, have repellent effect on mosquitoes:

- Garlic
- Vitamin B1
- Vitamin B12
- Yeast extract (e.g. Marmite)

There is also no evidence that tea tree oil or proprietary bath oils provide effective protection against mosquito bites. Citronella oil-based repellents are not recommended due to their short duration of action.

Electronic (ultrasonic) buzzers are considered ineffective as mosquito repellents and should not be used [6].

Management of insect and tick bites

In addition to transmission of infectious diseases, complications from insect bites and stings include local skin trauma, allergic reactions and secondary bacterial infection.

Reactions from most insect bites or stings will resolve within hours or days. The wound should be cleaned with soap and water. Application of a cold compress (if available) to the bite site may provide relief from pain or itching [3, 18]. The pack should have a cloth barrier between the ice and skin to prevent local tissue damage. Applying the ice pack on and off at 15 minute intervals is a common regimen [4].

Mosquito bites should not be scratched and should be kept clean and dry to avoid infection. Antiseptic and basic wound dressings can be helpful if the bite is causing irritation and likely to become infected.

Following an insect sting, if the stinger is still visible in the skin, this should be removed as quickly as possible by scraping sideways with a fingernail or piece of card.

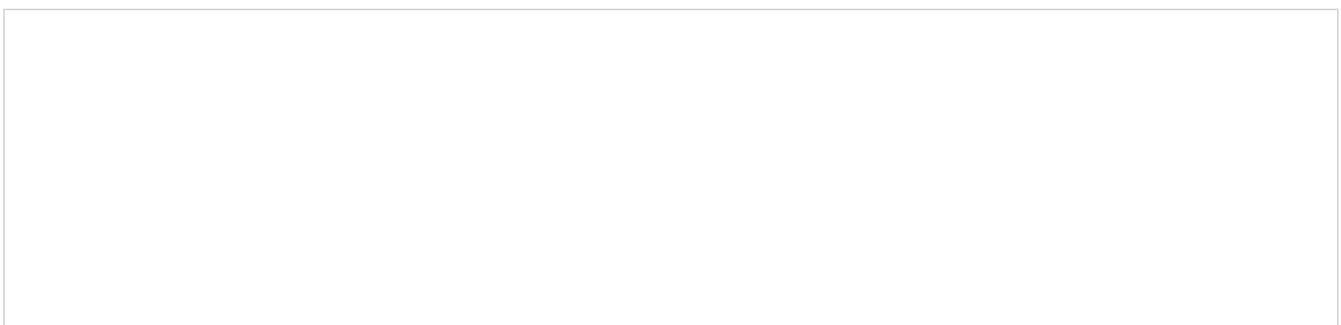
Oral analgesics (e.g. paracetamol and ibuprofen) are often recommended to ease pain, although there is a lack of evidence to support these treatments [3]. Itching may be reduced by taking antihistamine tablets or the topical application of a mild steroid cream, although good quality evidence to support their use is lacking [3].

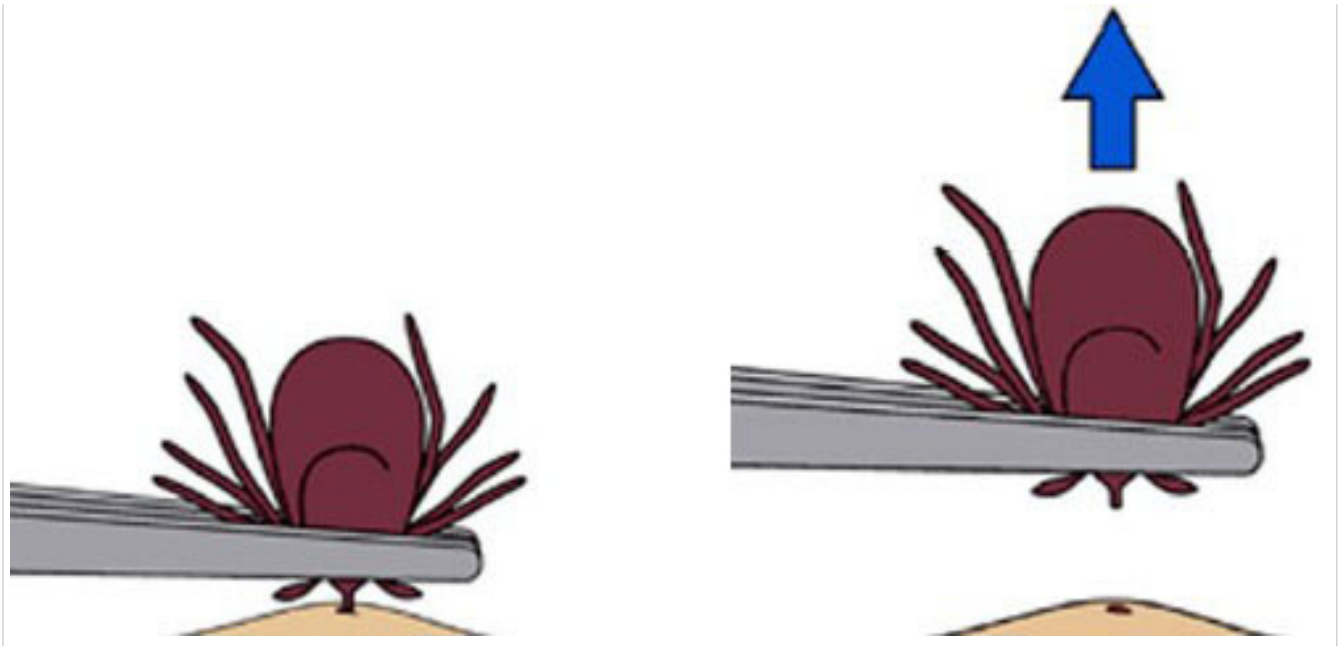
Ticks need to be removed from the skin very carefully. This can be done with fine tipped tweezers or specially designed tick removers (see Figure 1).

The tick should be grasped as close to the skin surface as possible and pulled steadily upwards, taking care not to crush the tick's body or squeeze the stomach contents into the site of the bite. After removing the tick, the bite area should be cleaned thoroughly with soap and water, or iodine / antiseptic if available. If tick mouthparts are not fully removed, persistent nodules (small lumps) can develop [3].

The tick should not be covered with solutions such as nail varnish or petroleum jelly; heat should not be used for tick removal.

Figure 1. How to remove a tick





Source: [CDC. Tick removal](#)

After travel

Those with a fever (38°C or more) or other worrying symptoms after travel should seek prompt medical help. Malaria symptoms can appear up to a year after travel.

If a rash or fever develops within several weeks of removing a tick, medical attention should be sought, providing details of the recent tick bite, including when and where the bite occurred.

Insect bites can sometimes become infected, become swollen, painful and red with pus where the bite occurred. Travellers should contact their GP if they are concerned about the symptoms; antibiotics may be required.

Resources

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- [Public Health England: Ticks and your health](#)
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