

Armed Forces Pest Management Board
Disease Vector Ecology Profile

Chad



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Preface

Disease Vector Ecology Profiles (DVEPs) are concise summaries of vector-borne and other militarily significant diseases that occur in specific countries. DVEPs focus on vector-borne diseases and emphasize essential epidemiology, vector bionomics, behavior, and pesticide resistance. Selected bibliographies of pertinent diseases and disease vector literature is included.

DVEPs are compiled from unclassified literature and are intended to provide a historical profile of arthropod-borne disease epidemiology in the recent past for selected geographical areas.

The epidemiology of arthropod-borne disease is constantly changing, especially in Third World countries undergoing rapid development and ecological change and those areas experiencing migrations of large refugee populations as a result of civil strife. DVEPs should be supplemented with recent information on foreign public health status and medical developments.

Current disease risk assessments and additional information on parasitic and infectious diseases, and other aspects of medical intelligence can be obtained from the National Center for Medical Intelligence, Fort Detrick, Frederick, MD 21701, 301-619-7574, DSN 312-343-7574, ncmi_ops@dodiis.mil, <https://www.ncmi.dodiis.mil/>.

DoD Component Medical Department Activities may have updated regional information for their areas of responsibility.

Taxonomic support assistance and identification keys might be available from the Walter Reed Biosystematics Unit (WRBU), Museum Support Center, MRC-534, Smithsonian Institution, 4210 Silver Hill Road, Suitland, MD 20746-2863 USA, (301) 238-1123 or (301) 238-1069, general enquiries nmnh-wrbu@si.edu. DVEPs are designed to complement documents obtained from NCMI and NEHC. Every effort is made to ensure their accuracy. Please provide your additions, corrections, or suggestions to Chief, Strategy and Information Division, Armed Forces Pest Management Board, USAG Forest Glen, Silver Spring, MD 20910, 301-295-7476, DSN 295-7476, osd.pentagon.ousd-atl.mbx.afpmb@mail.mil, <https://www.acq.osd.mil/eie/afpmb/>.

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Introduction

Chad is located in northwest Africa, is the largest landlocked country in Africa. It is bordered on the north by Libya, on the east by Sudan, on the south by the Central African Republic and Cameroon, and on the west by Nigeria and Niger. Its area is essentially equivalent to the combined states of Texas, Oklahoma, and New Mexico covering 1,284,634 sq. km. or 496,000 sq. mi. The estimated population is 4,453,000 in 2016 with an annual growth rate of 2.5%. Its capital, N'Djamena had an estimated population of 951,418 in 2009.

The terrain ranges from desert and mountains in the north to a large arid central plain to fertile lowlands in the extreme southern region. Climate in the northern region is very dry throughout the year, the central plain is hot and dry, with a brief rainy season mid-June to mid-September, and the southern lowlands is warm and more humid with seasonal rains from late May to early October.

In area and population Chad is the largest country of former French Equatorial Africa. It is shaped like a shallow basin rising from 750 ft. above sea level at Lake Chad in the west to more than 12,000 ft. in the Tibesti Mountains in the north. Rivers of the southern watershed flow into Lake Chad. The northern half of the country is within the Sahara Desert and rain is exceedingly rare.

There are approximately 200 ethnic groups in Chad including Toubou, Arabs, Fulbe, Kotoko, Hausa, Kanembou, Baguirmi, Boulala, Zaghawa, Hadjerai and Maba, most of whom are Muslim, in the north and central area. Non-Muslim Sara, Moudang, Moussei and Massa are in the south. The principal languages are French and Arabic with approximately 200 Chadian languages among the population.

Industry include agriculture, livestock, and processing plants such as textile mills, slaughterhouses, cotton gins and breweries. Per capita income in 2019 was \$710 US\$.

Map of Chad



Source: <https://www.worldatlas.com/maps/chad>

Disease Risk Summary

Vector-borne Diseases with Potentially High Impact on Military Operations

MALARIA: Malaria, a protozoan infecting red blood cells and is transmitted year-round by *Anopheles* mosquitoes. The malaria incidence rate in Chad is 167.6 per 1000 people. Chad averaged 1789 deaths due to Malaria from 2013 to 2017. Approximately 80% of all cases reported were *Plasmodium falciparum*.

SCHISTOSOMIASIS: Schistosomiasis, both urinary and intestinal disease, is caused by a blood fluke (trematode) and both are found in Chad. Chad is considered one of the world's major foci for the disease, with the prevalence estimated at 45% in 2015. Humans acquire the infection when wading, swimming, or by drinking water containing the cercariae of the schistosome. Snails are intermediate hosts.

RABIES: Rabies virus is a zoonotic disease that can be spread to humans through the saliva of infected animals. Chad is considered a high risk for importing dog from since rabies infected dogs are commonly found in Chad

DENGUE: Dengue, also called Break-bone Fever, is caused by 4 types of viruses and transmitted by female *Aedes aegypti* and *Ae. albopictus* mosquitoes.

Vector-borne Diseases with Potentially Intermediate Impact on Military Importance

ZIKA VIRUS: This disease is caused by a virus spread by *Aedes* mosquitoes. This disease has been rarely found in Chad since its peak in 2016.

CHIKUNGUNYA: This viral disease is caused by a bite from infected *Aedes aegypti* and *Ae. albopictus* mosquitoes.

TRYPANOSOMIASIS: Also called Sleeping Sickness, is a protozoan spread by the bite of a tsetse flies. Low endemicity is presumed. Current incidence data are not available but 340 cases were reported in 1988. Foci occur in the Logone and Chari River valleys in the southwest

CUTANEOUS & VISCERAL LEISHMANIASIS: Leishmaniasis is caused by protozoa transmitted through the bite of infected sandflies. Endemicity is presumed low. Both cutaneous (oriental sore) and visceral (kala-azar) forms of leishmaniasis are present in Chad. The disease has been reported in the area around Lake Chad, with vectors exhibiting peak abundance from April to November.

SANDFLY FEVER: Also called Pappataci Fever, has low endemicity. It occurs near Lake Chad and can appear in epidemic form to newcomers to the area. The virus is transmitted by sand flies. This viral flu-like disease is not serious, but large-scale outbreaks can cause tactically significant

morbidity in military personnel.

YELLOW FEVER: Yellow Fever is a viral infection transmitted by *Aedes sp.* mosquitoes. Chad is in the yellow fever Endemic zone. Although no cases have been reported in recent years, Chad is regarded as a high- risk country and yellow fever immunizations should be considered for all who are assigned to the country.

FILARIASIS: Also called Elephantiasis. It is caused by a nematode worm transmitted by mosquitoes. The disease is endemic in Chad but no recent outbreaks have been reported.

ONCHOCERCIASIS: Also called River Blindness, is caused by infection with a parasitic worm transmitted by infective blackflies. This disease is considered moderately endemic in Chad along the southern border but the incidence is uncertain.

LOIASIS: This disease is caused by a parasitic worm transmitted by *Chrysops* flies. The disease may be endemic throughout southern Chad in the moist tropical areas which would support harborage for its vectors.

TICK-BORNE RELAPSING FEVER: This disease is caused by a *Borrelia* bacteria and transmitted by ticks. This disease is reported to be present but the incidence is uncertain.

BOUTONNEUSE FEVER: This disease is caused by a bacteria spread by ticks. The disease is endemic to the entire country and may occur year- round.

Disease Summaries

Malaria

INFECTIOUS AGENTS: *Plasmodium falciparum* accounts for approximately 80% of all cases. *P. vivax* and *P. malariae* are also present.

RESERVOIR: Humans are the only important reservoir of malaria.

MODE OF TRANSMISSION: From bite of an infective female *Anopheles* mosquito, or from blood transfusion from an infected person.

CLINICAL FEATURES:

Incubation Period: Usually 12 to 30 days.

Symptoms: Acute febrile illness characterized by chills, fever, headache, sweating, muscular ache, and general malaise. Symptoms with *P. falciparum* infection may include severe anemia, jaundice, renal failure, shock, loss of orientation, convulsions and coma. Symptoms are most severe in *P. falciparum* malaria. Case fatality rates among non-immune adults and children exceeds 10%

Resistance of *P. falciparum* to chloroquine and mefloquine has been reported from the southwestern corner of the country including the N'Djamena area.

SEASONAL INCIDENCE: Risk of infection exists throughout the year in Chad.

GEOGRAPHIC DISTRIBUTION: Area of risk is countrywide but risk is higher in the southern half of the country. The southern part of the country has more rainfall and is more suitable for mosquito breeding.

PREVALENCE/INCIDENCE: The malaria incidence rate in Chad is 167.6 per 1000 people. Chad averaged 1789 deaths due to Malaria from 2013 to 2017. Approximately 80% of all cases are *P. falciparum*, followed by *P. vivax* and *P. malariae*.

PRIMARY VECTORS:

Anopheles gambiae, a small, shallow, open, sunlit pool breeder is one of the most effective and rapid transmitters of malaria in the world, is responsible for most of the country's malaria transmission. Although extensive dry periods occur during the year, malaria is transmitted year-round by this vector. In these drier times it utilizes less favorable breeding sites such as along river fringes and irrigation ditches. It feeds on humans, mostly indoors, with a peak biting period from 2 a.m. to 4 a.m. It rests in dark places and outdoors.

Additionally, both *An. pharoensis* and *An. funestus* are present and breed in large, somewhat shaded to sunlit water bodies and, therefore, are less affected by seasonal variations of rainfall. *An. funestus* is an open country mosquito and is considered a primary vector of malaria. *An. pharoensis* is considered a secondary vector. Both species feed at night on humans, mostly indoors, and, after feeding, rests indoors near the feeding site.

PREVENTION/CONTROL: Control of the vector by elimination of mosquito breeding places and/or appropriate larviciding or adulticiding measures. Personal protective measures to include proper wearing of clothing, and use of netting and repellent in sleeping areas are effective, especially where mosquito control is difficult. Chemoprophylaxis may be recommended prior to and during deployment in endemic malarious areas.

Schistosomiasis

SYNONYMS: Bilharziasis, snail fever, blood fluke

INFECTIOUS AGENT: Blood flukes (trematodes); *Schistosoma mansoni* (intestinal form) and *S. haematobium* (urinary form) are the major species causing human disease in Chad. Medical surveys to date have shown that every human community infected with *S. mansoni* is also infected with *S. haematobium*.

RESERVOIR: Humans are the principal reservoir.

MODE OF TRANSMISSION: Contact with water infested with schistosome cercariae (infective motile stage) which have emerged from snails (the intermediate host).

CLINICAL FEATURES:

Incubation Period: Initial acute symptoms may begin 2-6 weeks after exposure for *S. mansoni* but are less likely for *S. haematobium*.

Symptoms: Late afternoon fever, night sweats, prodromal diarrhea, enlarged tender liver, epigastric distress, pain in the back, groin, and/or legs, and urticaria. Schistosomiasis accounted for 432 deaths in 2018. Mortality can occur in extreme infections in children.

SEASONAL INCIDENCE: It occurs year-round along Lake Chad, but elsewhere mainly during the dry season (November to April).

GEOGRAPHIC DISTRIBUTION: The urinary form appears to be focally distributed in the southern half of Chad, particularly along the southeastern shore of Lake Chad (Bol area) and the southwest (Logone and Chari Basins). The intestinal form may occur in the Logone and Chari basins but current data are not available.

INCIDENCE/PREVALENCE: Schistosomiasis is highly endemic with an estimated 45% of its population infected in 2015. In 1955, a study by a public health directorate showed a range of schistosomiasis prevalence from 16% to 87% in adults and 24% to 70% in children. Rates are highest where the environment is suitable for the maintenance of the intermediate snail host. Salty soils restrict the growth of the intermediate snail hosts. *Bulinus truncatus* is present in all temporary or permanent water bodies whose salinity is low or absent. *Biomphalaria pfeifferi* is limited to the permanent watercourse on the southwest and to the springs of the Ouaddai massif. Both *Bulinus* and *Biomphalaria* are absent from the main channel of the Logone and Chari, but are present in large numbers in small branches and pools after the annual flood.

VECTOR: The intermediate host for *S. haematobium* is the snail *B. truncatus*. The intermediate host for *S. mansoni* is the snail *B. pfeifferi*.

PREVENTION/CONTROL: Wearing of uniform properly to block penetration of cercariae; avoidance of contact with suspect bodies of water whenever possible; avoidance of recreational swimming; sanitary disposal of human feces and urine to prevent viable eggs from reaching bodies of fresh water containing the snail intermediate host; and use of molluscicides. The U. S. Army is currently field-testing topical formulations of niclosamide which has proven highly effective in inhibiting skin penetration by cercariae, and this material may be approved for use by military personnel in the near future.

Rabies

The rabies virus usually spreads within animals and is spread to humans by the saliva of infected animals. The disease affects the human nervous system and is fatal if untreated. Symptoms occur within 3 days to 3 months and can be fever and pain at site. An inflammation of the brain occurs with corresponding convulsions, delirium, paralysis of muscles and coma. Humans die with 1 – 2 weeks of symptoms appearing. Prevention includes reducing contact with wild animals. If bitten or scratched by an animal seek medical immediately. A rabies vaccination is available and recommended to those working with wildlife. On July 14, 202, the Centers for Disease Control and Prevention, US issued a temporary suspension of imported dogs from high-risk countries, including Chad.

Dengue

The infectious agent is group B arbovirus of the family Flaviviridae. Four serotypes occur but the predominant type in Chad is unknown. Humans are the reservoir. The incubation period is 4 to 6 days. Symptoms include sudden fever of 3-5 days (rarely more than 7), intense headache, pain behind the eyes, severe muscle and joint pain, prostration, and a rash from 3-4 days after onset of fever. Mortality is low (<2%) unless it progresses to a severe hemorrhagic form with shock, which often is fatal. No recent incidents of the disease have been reported

and endemicity is presumed low. Outbreaks among nonimmune populations introduced into Chad are possible, primarily in southern Chad since the disease has occurred in neighboring countries. *Aedes aegypti*, a domestic species closely associated with man, is the primary vector. This synanthropic species breeds in fresh water in artificial containers such as tires, cans, rain barrels, or cisterns. Adults prefer to feed on humans during the day, especially for the 2 hours after sunrise and 2 hours before sunset. The adult flight range is frequently no more than 100 meters from the breeding site.

Zika Fever

The Zika Virus is a flavivirus spread primarily by *Aedes aegypti* and secondarily by *Ae. albopictus* mosquitoes. Transmission can also occur to the fetus of an infected woman, sexual contact with an infected person and blood transfusion.

Most infected people are asymptomatic. Mild symptoms include fever, headache, rash, red eyes and joint pain. These symptoms may last a few weeks. Zika virus in pregnant woman can cause severe birth defects in the fetus including swelling of the brain and brain defects. The infected person develops immunity to future infections. There is no known vaccine and preventing mosquito bites is the most effective. Infection has been in decline since its peak in 2016 probably due to herd immunity in previously endemic regions.

Chikungunya

This viral disease is caused by a bite from infected *Aedes aegypti* and *Ae. albopictus* mosquitoes. The symptoms are asymptomatic in most persons infected. Symptoms can occur 3-12 days following infection and include fever, rash, muscle and joint pain, Chikungunya is rarely fatal but joint pain may occur for several months. Due to presence of mosquito vectors, Chikungunya has the potential for outbreaks. There is no vaccine available for this disease. Preventing mosquito bites is the best methods of acquiring this disease.

Trypanosomiasis

SYNONYMS: Sleeping sickness, African human trypanosomiasis

INFECTIOUS AGENT: A systemic hemoflagellate protozoan, *Trypanosoma brucei gambiense* and *T. b. rhodesiense*.

RESERVOIR: Humans are the major reservoir for *T. b. gambiense*. Wild animals, especially bushbuck and antelopes, and domestic cattle are the principal animal reservoirs of *T. b. rhodesiense*.

MODE OF TRANSMISSION: By the bite of an infective *Glossina* spp., the tsetse fly. The tsetse fly is infected by taking blood from an infected host. The parasite multiplies in the tsetse fly for 12 to 30 days until infective metacyclic forms develop in the salivary glands. Once infected, the tsetse fly usually remains infective for life, but no transovarian infection occurs.

CLINICAL FEATURES:

Incubation period: *T. b. rhodesiense* infection usually requires 3 days to 3 weeks; *T. b. gambiense* infections may require several months to years.

Symptoms: A red sore or chancre (Winterbottom's Sign), often occurs at the infective bite site. Initial symptoms include appetite loss, enlarged lymph nodes, muscle and joint pain. Symptoms progress to insomnia, weight loss, slurred speech, seizures and mobility issues. In the later stages, the central nervous system is involved giving rise to meningoencephalitis. The Rhodesian form is acute and often fatal, while the Gambian form is more chronic. However, once the central nervous system is involved, the disease is usually fatal if untreated.

SEASONAL INCIDENCE: Due to the mild climate, the disease may occur year-round.

GEOGRAPHICAL DISTRIBUTION: Primarily in the south and southwest sectors. Foci occur in the Logone and Chari River valleys in the provinces of Logone Oriental, Logone Occidental, and Moyen-Chari.

PREVALENCE/INCIDENCE: Current data are not available but resumption of screening activities in 1985 found a high of 340 cases in 1988. Foci occur along the provinces of Logone Oriental, Logone Occidental and Moyen-Chari. Historical data indicate the risk may exist as far north as N'Djamena. Due to increased control efforts, cases have dropped and endemicity is low.

VECTORS: *Glossina morsitans*, *G. fuscipes*, and *G. tachinoides*. Females larviposit in shaded locations in forests or thickets (*G. morsitans* and *G. tachinoides*); or near watering holes, rivers, streams and similar habitats, (*G. fuscipes*) is found where soil moisture and temperature permit pupation. Adults (*G. morsitans* and *G. tachinoides*) feed on a wide range of game animals and cattle. All three species are rapid fliers, attaining speeds up to 30 miles per hour. They frequently follow large moving objects such as animals or inanimate objects, and will enter windows of moving vehicles. Tsetse flies are daytime feeders.

PREVENTION/CONTROL: Destroy tsetse fly habitats. Treat the infected population. Institute fly control by using biconical traps and pesticide treatment around work sites and other habitations.

Cutaneous Leishmaniasis

SYNONYMS: Baghdad or Delhi boil, Oriental sore, Aleppo boil

INFECTIOUS AGENT: *Leishmania tropica*, a protozoan

RESERVOIR: Humans, and canines are important reservoir hosts. Wild rodents may also serve as reservoirs.

MODE OF TRANSMISSION: Bite of an infective sand fly; also, from direct human to human contact of abraded skin (urban leishmaniasis, *L. tropica*).

CLINICAL FEATURES:

Incubation Period: at least a week to several months.

Symptoms: A disease of the dermal tissues characterized by ulcerating lesions which may be single, multiple, or diffuse. The disease begins with a papule which enlarges to a painless ulcer. Lesions may heal spontaneously within weeks to months, or last for a year or more resulting in lasting immunity. Infection mainly involves the exposed extremities. Most commonly, the disease is mild and self-limiting; moderate and severe disease resulting in major pain, disfigurement and fatalities may occur with diffuse and mucocutaneous forms of the disease.

SEASONAL INCIDENCE: Vectors appear in peak numbers from April to November.

GEOGRAPHICAL DISTRIBUTION: Both forms of the disease have been reported in the area around Lake Chad. The cutaneous form presumably occurs in those provinces bordering Lake Chad. Foci also occur in the eastern area bordering Sudan. The visceral form has been reported from the Lake Chad area through southern Chad.

PREVALENCE/INCIDENCE: Endemicity is presumed low.

VECTORS: *Phlebotomus duboscqi* is a vector of cutaneous leishmaniasis in Chad. *P. bergeroti* is a probable vector in northern Chad.

Habits: Most sand fly species are nocturnal, seeking shelter from the sun during the day by retreating deep into cracks in soil and in loose-rock or masonry construction, crevices in cliffs and rock outcroppings, caves, trees holes, animal burrows, etc. Virtually any protected microhabitat that offers shelter, temperatures between 70-80°F and 70-80% relative humidity will serve well as a resting site for sand flies. In arid environments sand flies disperse from resting and breeding sites after sunset to find sugar (from plants), a blood meal, and/or mate. While male sand flies require only plant sugars, females also require a blood meal from a vertebrate host for egg development. Usual feeding times, on both plant sugar and blood, are from dusk to dawn. Sand flies are rather weak, noiseless fliers, and where vegetation is lacking, usually travel close to the ground (within 1 meter), in short hops, a few inches to a few feet a time. This hopping behavior is a useful field characteristic for identifying sand flies. Their range of movement is usually limited to about 300 m, but in some desert or savanna situations they have been known to fly up to 2300

m (1.5 miles). They bite on exposed parts of the body such as the face, ears, neck, arms, chest, and lower legs. Initially, the bites are painless. After blood feeding, engorged females move to a resting site and later to an oviposition site. They deposit their eggs on damp soil that is rich in organic matter. Unlike mosquito larvae, the almost microscopic, caterpillar-like sand fly larvae do not live in standing water, but in rodent burrows, cracks and crevices in soil, rocks, loose masonry, piles of rubble, etc.

PREVENTION/CONTROL: Vector control with insecticides; eliminate sand fly breeding areas; repellents and the use of very fine mesh sleeping nets, protective clothing, and avoidance of sand fly areas, especially after dark. At present, vaccine and chemical preventives are not available.

Visceral Leishmaniasis

SYNONYMS: Kala-azar

INFECTIOUS AGENT: A protozoan, *Leishmania donovani*

RESERVOIR: Humans, wild rodents, and domestic canines are important reservoir hosts.

MODE OF TRANSMISSION: Bite of infective sand flies of the genus *Phlebotomus*, with *P. orientalis* as the suspected vector.

CLINICAL FEATURES:

Incubation Period: Generally 2 to 4 months; range can be 10 days to 2 years.

Symptoms: A chronic systemic disease characterized by fever with 2 daily peaks, hepatosplenomegaly, lymphadenopathy, anemia with leukopenia, and progressive emaciation and weakness. Untreated cases can have as high as 95% mortality. Transmission via blood transfusion has been reported.

SEASONAL INCIDENCE: Vectors exhibit peak abundance from April to November, the rainy season.

GEOGRAPHICAL DISTRIBUTION: The disease has been reported around Lake Chad and the N'Djamena area.

PREVALENCE/INCIDENCE: Endemicity is presumed low. From 2018 to 2021, 122 cases of Visceral Leishmaniasis were reported in provinces of n'Djamena, Borkou and Tibesti.

VECTOR BIOLOGY: See Cutaneous Leishmaniasis.

PREVENTION/CONTROL: See Cutaneous Leishmaniasis. Control of vector by eliminating

natural breeding sites; area insecticide control; use of repellents, wearing of protective clothing after dark and use of insecticide-treated fine mesh sleeping nets; avoidance of sand fly infested areas especially after dark. Presently vaccines and chemical preventives are not available.

Sandfly Fever

SYNONYMS: Pappataci fever, Phlebotomus fever, three-day fever

INFECTIOUS AGENT: Bunyaviruses (at least 7 related immunological types)

RESERVOIR: Humans; an animal reservoir is suspected

MODE OF TRANSMISSION: By bite of an infected sand fly, probably *Phlebotomus duboscqi* or *P. orientalis*. Sand flies become infective about 7 days after biting an infected person and are capable of transmission throughout their normal lifespan of about one month.

CLINICAL FEATURES:

Incubation period of 3 to 6 days

Symptoms: Similar to influenza but without inflammation of the respiratory tract. Frontal headache, fever of 38-39.5 °C, photophobia, sore throat, nausea, pain of limbs, neck and back. Leukopenia on 4th-5th day after onset of fever. This is an acute, debilitating disease but it is self-limiting and remits 3 to 5 days.

EFFECTS: This disease is most likely to appear in personnel from non-endemic areas. Local populations generally become immune during childhood. This disease is of great military significance because of its epidemic nature, causing self-limiting but debilitating flu-like febrile illness.

SEASONAL INCIDENCE: Vectors exhibit peak abundance from April to November.

GEOGRAPHICAL DISTRIBUTION: This disease has been reported around Lake Chad.

PREVALENCE/INCIDENCE: Current incidence and distribution data are not available and endemicity is uncertain.

VECTORS: Sand flies of the genus *Phlebotomus*, *P. duboscqi* and *P. orientalis*.
For habits see Cutaneous Leishmaniasis.

PREVENTION/CONTROL: See Cutaneous Leishmaniasis

Yellow Fever

The infectious agent is the virus of yellow fever, a flavivirus. Humans and *Aedes aegypti* mosquitoes are reservoirs in urban areas. In forest areas, monkeys and forest mosquitoes are the reservoirs. Transovarian transmission in mosquitoes may contribute to the perpetuation of the disease. It is an acute infectious viral disease of short duration with varying severity. The mildest is clinically indeterminate. Typical illness is similar in symptoms to dengue with a sudden onset of fever, chills, headache, backache, generalized muscle pain, prostration, nausea and vomiting. Jaundice is moderate early in the disease and intensifies later. Fatalities usually are less than 5% in the native population but may reach 50% among an introduced population during epidemics. Four cases have been detected in Chad since 2013, but Chad is in the yellow fever endemic zone and must be considered a potential disease threat. Chad is surrounded by countries which are considered to be "infected" by the World Health Organization. The disease could be transmitted year-round, and has epidemic potential under ideal conditions.

For vector habits see Dengue. The zoonotic vector is unknown. In endemic zones, yellow fever immunization for all personnel should be considered. Eradication of vector breeding areas in conjunction with a vaccination program is an effective means of control.

Filariasis

The infectious agent is *Wuchereria bancrofti*, long thread-like nematodes. Humans are the reservoir with microfilariae found in the blood. It is transmitted by the bite of mosquito harboring infective larvae.

An allergic and inflammation manifestation may occur one month after infection, but infective microfilariae may not appear in blood for 6 months to a year; the infection may persist for 5 years or more. The vector becomes infective about 2 weeks after the infective blood meal. Infected individuals may develop filarial fever, lymphadenitis and retrograde lymphangitis. Those with chronic signs include hydrocele, and elephantiasis of the limbs, breasts and genitalia. It is endemic to Chad but no recent outbreaks have been reported. Current incidence and distribution data are not available and endemicity is presumed low, but year-round. *Culex pipiens fatigans* is a principal vector, and man is the reservoir. Larvae are generally found in stagnant water in barrels, tubs, cesspools, ditches, ground pools and similar habitats. The life cycle requires about 10-14 days. Adults commonly enter houses and other buildings, and bite in the evening or at night. This is a common mosquito in urban areas of many poor countries where sanitation is lacking and improper disposal of waste water and sewage exists.

Onchocerciasis

It is also known as River Blindness. The infectious agent is *Onchocerca volvulus*, a filarial worm of the Class Nematoda. It is transmitted by infected blackflies. In humans, microfilariae are

usually found in the skin one year or more after the bite of an infected blackfly. This is a chronic, non-fatal disease with fibrous nodules in subcutaneous tissues, particularly of the pelvic girdle and lower extremities. Adult worms occur in the nodules. Female worms discharge microfilariae which migrate through the skin causing an intense pruritic rash, altering pigmentation and causing skin atrophy, a condition known as "leopard skin." Microfilariae frequently invade the eye, causing visual disturbance and blindness. The disease reportedly is moderately endemic along the southern borders of Chad. Fort Lamay, Massenya, Fianga, Baibokoum and Archambault have had reports of the disease. *Simulium damnosum* complex and *S. neavei* complex members vector the disease, and man is the reservoir.

The *S. damnosum* adults lay eggs in fast moving streams and along artificial waterways which disseminates them. Larvae mature in about 5 days and adults may live up to 21 days or more. Flight range is up to 18 miles. The flies prefer feeding on man's lower extremities; but do not enter habitations if they are dark; biting often occurs in shaded areas. The *S. neavei* complex is anthropophilic. Its larvae are found attached to the carapace of the crabs *Potamonautes niloticus*, *P. lueboensis* and *P. lirrangensis*. Larvae pupate on the crabs which are usually found in sun-exposed cascades and rocky falls. Adults have a short flight range of less than one-fourth of a mile. Biting habits are similar to *S. damnosum*. Prevention is by avoidance of bites of Simulium flies by wearing protective clothing and repellents. Insecticides may be used in breeding sites.

Loiasis

It is also known as African eye worm. The infectious agent is *Loa loa*, a nematode. Humans are the reservoir.

The nematode is transmitted by an infected horsefly or deerfly of the genus *Chrysops* (*C. dimidiata*, *C. silacea*, and possibly others). The vector ingests blood containing microfilariae and the larvae develop within 10 to 12 days in the fat body of the fly. The developed larvae migrate to the proboscis of the fly in is transmitted with the next bite.

The adult nematode lives in the subcutaneous tissue of humans and make excursions from place to place under the skin causing itching. The nematodes show a special preference for creeping in and about the eyes, and may move at a rate of an inch in two minutes in warmed skin. The nematode varies in length from 20 to 79 mm. Microfilariae may be present in the blood for as long as 17 years. The fly communicability is from 10 to 12 days after its infection

The warm, moist area in southern Chad probably harbors the disease year-round. Data on affected population in Chad are not available.

Repellents and screening are two protective measures against bites. Usually the breeding areas, moist muddy areas, are too extensive to have effective control with pesticides.

Tick-Borne Relapsing Fever

Only tick-borne relapsing fever, caused by *Borrelia recurrentis*, is reported to be present in Chad. Infections occur by the bite or transfer of coxal fluid by crushing at the bite site. The incubation period is 5 to 15 days. This systemic spirochetal disease produces febrile illness periods lasting 2 to 9 days. These periods of relapse vary from 1 to 10 days. Each febrile period terminates by crisis. Case fatality rate in untreated cases is 2 to 10%. The disease occurs year-round and countrywide, but incidence levels are uncertain. The argasid soft tick, *Ornithodoros moubata* is the vector in Africa. This tick is widely distributed in arid regions where it commonly occurs in the burrows of its hosts, warthogs, antbears and porcupines. This tick species has also become associated with humans and their domestic animals. It lives in the cracks and crevices in walls and in the earth floors of huts. This soft tick remains hidden during the day and feeds at night while the occupants are sleeping, remaining attached for only short periods. Several blood meals are required to reach the adult stage and the adult will take several additional blood meals over its lifetime. Ticks are very resistant to starvation and can survive for long periods in the absence of a host. Wild rodents are reservoir hosts, although ticks may maintain the pathogen through transovarial transmission. Prevention is by use of repellents to protect personnel in the field. Check bedding and clothing for presence of ticks in endemic areas. Drug prophylaxis may be needed after bites are experienced.

Boutonneuse Fever

Synonyms are Mediterranean tick fever, Mediterranean spotted fever, Marseilles fever, and African tick typhus. The infectious agent is *Rickettsia conorii*. The reservoir is wild rodents and dogs. Transmission is by bite of the infected tick (any life stage) or through contamination of skin or eyes by contents of a crushed tick. The disease is enzootic in domestic and wild mammals but transmission to humans is infrequent. The pathogen is maintained in two cycles, a primary one involving wild rodents and their ectoparasites, and a secondary domestic cycle involving dogs and their ticks. The disease is probably countrywide. The incubation period (5 to 7 days) is followed by a mild to severe febrile illness lasting from a few days to 2 weeks. A primary lesion may occur at the tick bite site and is often evident at the onset of the fever. Fatality rates are less than 3% even without treatment. Adult tick activity is greatest during the late spring and fall. Larval and nymphal stages are most active during and early summer. *Rhipicephalus sanguineus*, (the brown dog tick, or kennel tick), is a 3-host tick that feeds on a variety of medium and large mammals. Dogs are commonly a host but humans are not. In buildings frequented by dogs, ticks may hide in cracks in the walls and ceiling. Engorged females lay their eggs either near the floor or in the walls. Outdoors, eggs are deposited under rocks. Under favorable conditions, the life cycle can be completed in as little as two months. To control, use repellents. De-tick dogs and use tick repellent collars on the animals. Chemical treatment of tick habitats is indicated.

Venomous Snakes

Sahara Rock Viper, *Vipera mauritanica*: Is the principal venomous snake found in Chad. It has a blunt snout and relative slender body. It is ground color grayish, reddish or brown with dark blotches that tend to fuse into a zigzag pattern. Average length is 35 to 45 inches long. It hides by day in rock crevices and mine tunnels and is most active at twilight. It is a highly poisonous and dangerous species. It is found in the northern part of Chad.

Egyptian Cobra, *Naja haje*: Adults average over 4 feet in length. The head is broad with a slightly distinct neck. The snout is rounded and the canthus is distinct. The body is moderately slender, slightly depressed and tapered. The neck is capable of expanding into a hood.

Forest cobra, *Naja melanoleuca*: Adults average 6 to 7 feet in length. It is usually a single color of glossy black. The head is sometimes brown in color. The young may bear one or two narrow white cross bands over the posterior part of the body. Chin and belly are creamy white with one or two relatively narrow black bands under the hood. It has a long wedge shaped hood like that of the spitting cobra, but does not "spit". It is seldom aggressive but has a highly toxic venom. It is found in the rain forest and subtropical forest areas.

Spitting cobra, *Naja nigricollis*: Adults average 5 to 6 feet in length. The body color is highly variable ranging from a pinkish tan to black. It is one of the most common of the cobras found in the savannah area and in newly cleared areas. Although it seldom bites, it can spit venom up to 9 feet. The venom does not harm unbroken skin but may seriously injure the eyes.

African Desert Horned Viper, *Cerastes cerastes*: The snake has a broad head and distinct from the neck, a short and broad snout, and a short tail. A long, spinelike horn may be present above the eye but may be short or absent in some species. It is ground color in varying shades. It reaches 20 to 25 inches in length. The bite is painful but not usually fatal. Its range is the Sahara region of Africa, the Arabian Peninsula, and parts of the Middle East. The snake is active primarily active at night and moves with a "sidewinding" type of motion.

Saw-scaled or carpet viper, *Echis carinatus pyramidium*: When disturbed, characteristically inflates body and "hisses" by rubbing lateral scales together. Obtains a length of 75 cm. (less than 3 feet). Coloration is variable, but the color pattern has 40-50 spots on the back. This snake is very adaptable and may be found from barren rocky or sandy desert to dry scrub forest and gardens. It feeds on a wide variety of small animals and insects. It moves rapidly with a sidewinder motion and is active mainly during the night. It is a very aggressive snake. Echis snakes are very dangerous and are abundant over much of their range. The venom is extremely toxic and is responsible for most of the human fatalities over their range.

Saw-scaled viper, *Echis coloratus*: The head is broad and distinct from the neck. Average length is about 30 inches. Found in the Dead Sea area. Common in the desert where it rests in the sands during the day. Most prone to attack. Possesses a highly toxic (hemotoxic) venom and responsible for many deaths.

The literature lists 5 additional species of poisonous snakes that may be present in Chad. They are:

Atractaspis microlepidota

Bitis arietans

Causus rhombeatus, Rhombic Night Adder

C. maculatus, West African Night Adder

C. resimus, Green Night Adder

Symptoms of Venomous Snake Bites

Signs or symptoms of snake bite vary depending on the type of snake, but may include:

- Puncture marks at the wound
- Redness, swelling, bruising, bleeding, or blistering around the bite
- Severe pain and tenderness at the site of the bite
- Nausea, vomiting, or diarrhea
- Labored breathing (in extreme cases, breathing may stop altogether)
- Rapid heart rate, weak pulse, low blood pressure
- Disturbed vision
- Metallic, mint or rubber taste in the mouth
- Increased salivation and sweating
- Numbness or tingling around your face and/or limbs
- Muscle twitching

First Aid for Venomous Snake Bites

Do the following if bitten by a snake:

- Seek medical attention as soon as possible—antivenom is the best treatment for serious snake envenomation, the sooner antivenom can be started, the sooner irreversible damage from venom can be stopped.
- Note the appearance of the snake, and take a photograph of it from a safe distance if possible. Identification of the snake can help with treatment of the snakebite.
- Keep calm.
- Inform someone who can help.

Do the following while waiting for medical attention:

- Lie or sit down with the bite in a neutral position of comfort.
- Remove rings and watches in anticipation of swelling.
- Wash the bite with soap and water.
- Cover the bite with a clean, dry dressing.
- Mark the leading edge of tenderness/swelling on the skin and write the time alongside it.

Do **NOT** do any of the following:

- Do **not** pick up the snake or try to trap it—**NEVER** handle a venomous snake, not even a dead one or a decapitated head, they are still capable of envenomation.
- Do **not** wait for symptoms to appear if bitten, seek immediate medical attention.
- Do **not** apply a tourniquet.
- Do **not** slash the wound with a knife or cut it in any way.
- Do **not** try to suck out the venom.
- Do **not** apply ice or immerse the wound in water.
- Do **not** drink alcohol as a painkiller.
- Do **not** take pain relievers (aspirin, ibuprofen, naproxen, etc.).
- Do **not** apply electric shock or try any "folk therapies."

Source: US CDC, VENOMOUS SNAKES, Symptoms and First Aid, last reviewed: May 31, 2018, <https://www.cdc.gov/niosh/topics/snakes/symptoms.html>, accessed 7 May 2021.

Lists of Medically Important Arthropods Reported from Chad

Species of Mosquitoes Reported from Chad

<i>Aedes aegypti</i>	<i>Culex adairi</i>
<i>Ae. hirsutus</i>	<i>Cx. arbieeni</i>
<i>Ae. vittatus</i>	<i>Cx. duttoni</i>
	<i>Cx. pipiens</i>
<i>Anopheles cinctus</i>	<i>Cx. simpsoni</i>
<i>An. coustani</i>	<i>Cx. theileri</i>
<i>An. d'thali</i>	<i>Cx. tigripes</i>
<i>An. funestus</i>	<i>Cx. univittatus</i>
<i>An. gambiae</i>	
<i>An. hispaniola</i>	<i>Culiseta longiareolata</i>
<i>An. nili</i>	<i>Cu. mediolineata</i>
<i>An. pharoensis</i>	<i>Cu. mimomyiaformis</i>
<i>An. rhodesiensis rupicolus</i>	
<i>An. rufipes</i>	
<i>An. rufipes seneveti</i>	
<i>An. squamosus</i>	
<i>An. squamosus var. cydippes</i>	
<i>An. wellcomei</i>	
<i>An. wellcomei erepens</i>	

Species of Black Flies Reported from Chad

Simulium adersi
S. damnosum
S. griseicolle
S. neavei

Species of Sand Flies Reported from Chad

Phlebotomus adleri
P. africanus
P. bedfordi
P. bergeroti
P. clydei
P. congolensis
P. duboscqi
P. langeroni orientalis
P. orientalis

P. signatipennis
P. squamipleuris

Species of Biting Flies Reported from Chad

Glossina fusca
G. fuscipes
G. morsitans
G. palpalis
G. submorsitans
G. tabaniformis
G. tachinoides

Species of Ticks Reported from Chad

Amblyomma lepidum
Am. nuttalli
Am. sparsum
Am. variegatum

Aponomma flavomaculatum
Ap. latum

Argas persicus
Ar. reflexus
Ar. hermanni

Boophilus annulatus
B. decoloratus

Dermacentor rhinocerinus

Haemaphysalis houyi
Ha. leachii

Hyalomma dromedarii
Hy. impeltatum
Hy. impressum
Hy. rufipes

Ornithodoros erraticus
O. moubata
O. savignyi

Rhipicephalus appendiculatus
Rh. cuspidatus
Rh. evertsi
Rh. fulvus
Rh. sanguineus
Rh. senegalensis

Personal Protective Measures

Personal protective measures are the first line of defense against arthropod-borne disease and may be the only protection for military personnel deployed in the field. Proper wearing of the uniform and appropriate use of repellents can provide high levels of protection against blood-sucking arthropods. The uniform fabric can provide a significant mechanical barrier to mosquitoes and other blood-sucking insects. The uniform should be worn to cover as much skin as possible if weather and physical activity permits. When operating in tick infested areas the pants should be bloused into the boots to prevent access to the skin and other crawling arthropods such as chiggers. Check yourself frequently when walking through tick-infested areas. Upon returning from tick-infested areas, remove all clothing and examine yourself for ticks. Infected ticks may require several hours of feeding before pathogens are transmitted. Therefore personnel who operate in tick-infested areas should check themselves frequently for ticks and remove them as soon as possible. If ticks become attached, the simplest and best method of removal is by a slow, steady pull with a pair of tweezers or forceps. Do not squeeze the body but grasp the tick where the mouthparts enter the skin and pull firmly until the tick is extracted. Be careful not to break off the mouthparts and leave them in the skin. Wipe the bite area with an antiseptic. If the hands have touched the tick during the removal, wash them thoroughly with soap and water or an antiseptic since tick secretions may contain pathogens.

Newly developed repellents provide military personnel with unprecedented levels of protection. Personal repellents available in the Federal stock system:

NSN	Repellent
3740-01-284-3982	Insect Repellent, Personal Application, Lotion, 34.34% DEET, Ultrathon (3M/EPA 58007-1)
3740-01-584-8393	Insect Repellent, Personal Application, Lotion, 30% DEET, liposome formula (SP532-Ultra30/LipoDEET)
3740-01-584-8598	Insect Repellent, Personal Application, Spray, 25% DEET, pump spray bottle (Cutter Backwoods DEET Insect Repellent)
3740-01-619-4795	Insect Repellent, Personal Application, Spray, 20% Picaridin, pump spray bottle (NATRAPEL Insect Repellent)
3740-01-656-7707	Insect Repellent, Personal Application, Spray, 20% IR3535 pump spray bottle (Bullseye Bug Repellent)
3740-01-137-8456	Insect Repellent, Personal Application, Lotion, 5% benzocaine, 10% precipitated sulfur (Chigg-Away)

Approved repellent products may be applied to uniforms, bed nets, and tentage that has not been factory treated. **Permethrin products are not for use on the skin.**

NSN	Product
3740-01-334-2666	Insect Repellent, Clothing Application, Concentrate, Liquid, 40% permethrin, formulated for application with a 2-gallon sprayer (Sawyer Insect/Arthropod Repellent)

	For application by specifically trained or certified personnel only
3740-01-278-1336	Insect Repellent, Clothing Application, Aerosol, 0.5% permethrin (Sawyer Permethrin Arthropod Repellent)
6840-01-692-7397	Insect Repellent, Clothing Application, Spray, 0.5% permethrin, trigger spray dispenser (Sawyer Premium Insect Repellent)
6840-01-345-0237	Insect Repellent, Clothing Application, Individual Dynamic Absorption Application (IDAA) Kit, 40% (pre-dilution) permethrin ("IDA Kit")

Additional information is accessible in [AFPMB Technical Guide No. 36, Personal Protective Measures against Insects and other Arthropods of Military Significance](https://www.acq.osd.mil/eie/afpmb/docs/techguides/tg36.pdf), downloadable at <https://www.acq.osd.mil/eie/afpmb/docs/techguides/tg36.pdf>.

Chemical Control of Pests and Vectors

More detailed recommendations for the selection, application and use of pesticides in field situations worldwide, during contingency operations or military exercises can be found in [AFPMB Technical Guide #24, Contingency Pesticide Usage Guide](#). This guide is a concise reference on: National Stock Number (NSN)-listed pesticides available through military supply channels and designated for contingency use by one or more of the Armed Services; their uses, dosages, and application methods; pesticide dispersal equipment; information on surveillance, trapping, and safety equipment; personal protective equipment against disease vectors; air-transport of pesticides that do not meet transportation requirements; pesticide dilution and dosage formulas; and US military points of contact overseas who can provide information on vector-borne disease control in their respective areas of the world.

Copies of Technical Guide #24, Contingency Pesticide Usage Guide, can be downloaded at <https://extranet.acq.osd.mil/eie/afpmb/cac/techguides/tg24.pdf>.

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Links to Additional Information

AFPMB Technical Guide 24, Contingency Pest Management Guide:

<https://extranet.acq.osd.mil/eie/afpmb/cac/techguides/tg24.pdf>

Other AFPMB Technical Guides, and Pesticide and Equipment lists:

<https://www.acq.osd.mil/eie/afpmb/>

WRBU Insect keys and identification services:

<http://www.wrbu.org/index.html>

VectorMap – Vector and vector-borne distribution maps:

<http://vectormap.si.edu/>

IR Mapper – Insecticide resistance mapping worldwide:

<http://www.irmapper.com/>

Army Public Health Command Entomology and Pest Management – Technical assistance:

<https://phc.amedd.army.mil/topics/envirohealth/epm/Pages/default.aspx>

National Center for Medical Intelligence – Current information about diseases:

<https://www.ncmi.dodiis.mil/>

American Mosquito Control Association – Mosquito and mosquito-borne diseases:

<http://www.mosquito.org/>