Review Article

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Dracunculiasis: An Emerging Challenge of A Neglected Tropical Helminthic Zoonosis

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Abstract

Helminthic zoonoses are a significant source of morbidity and mortality in humans as well as in animals. These diseases are prevalent in developing and developed nations of the world resulting in public health and economic concern. Dracunculiasis, also known as Guinea-worm disease, is a helminthic zoonosis that is caused by the nematode *Dracunculus medinensis*, which affects primarily the humans and occasionally animals. It has long been a debilitating parasitic disease in rural, underserved regions where access to safe drinking water is limited. Once affecting millions annually across Africa, Asia and the Middle East, the disease is now on the brink of eradication, with only a handful of human cases per year globally. Transmission occurs when humans (and increasingly animals) ingest water containing infected copepods (water fleas) or possibly aquatic transport hosts, leading to larvae migration, maturation, and eventual emergence of adult female worms through the skin roughly 10–14 months later. Symptoms are painful, incapacitating, and often associated with secondary bacterial infections; no vaccine or routine anthelmintic treatment exists. Control and eradication efforts have relied on a combination of safe-water access, water-filtering, larvicide application, surveillance, case containment, and recently, animal-reservoir management under a One Health framework. While human cases have declined dramatically from millions to double-digits annually, animal infections (notably in domestic dogs) now pose a major challenge. The detection of disease in dogs indicates that it should be considered as a reverse zoonosis. Hitherto, there is no conclusive evidence of direct transmission of *D. medinensis* infection from animals to humans. This paper reviews the lifecycle, clinical presentation, epidemiology, diagnosis, treatment, prevention and control of dracunculiasis, and discusses the implications of emerging zoonotic pathways for the final push toward eradication.

Keywords: Dracunculiasis, Guinea worm disease, One Health, Reverse zoonosis, Transmission, Water

Introduction:

Zoonotic diseases whether new re-emerging or long-neglected are caused by many different types of infectious agents. These include viruses (avian influenza, monkey pox, severe acute respiratory syndrome, swine flu, and rabies), bacteria (anthrax, brucellosis, leptospirosis, salmonellosis, and tuberculosis), fungi (blastomycosis, cryptococcosis, dermatophytosis, histoplasmosis, and sporotrichosis), rickettsiae (ehrlichiosis, murine typhus, Q fever, rickettsial pox, and scrub typhus), algae (chlorellosis, and protothecosis), prions (bovine spongiform encephalopathy), chlamydial organisms (chlamydiosis), actinomycetes (dermatophilosis and nocardiosis), protozoa (amoebiasis, cryptosporidiosis, leishmaniasis, toxoplasmosis, and trypanosomiasis), helminths (ascariasis, capillariasis, diphyllobothriasis, schistosomiasis, and taeniasis), and ectoparasites (linguatuliasis, scabies, and tungiasis) (Pal, 2007). Currently, over 300 zoonoses have been documented affecting humans as well as animals (Pal, 2013). These diseases are important from public health and economic point of view; and account for more than 60% of known infectious pathogens in humans, and approximately 75% of emerging infectious diseases are zoonotic in origin (Pal, 2013). The transmission of zoonotic diseases occurs through several routes including ingestion, direct contact, inhalation, bite of animals, abraded skin/wound, transfusion of infected blood, intrauterine/transplacental, and bites of arthropods (Pal, 2005; Pal, 2007). As their spread involves complex links between humans, animals, and the environment, successful control depends on applying One Health principles (Pal et al., 2014).

Dracunculiasis, also referred as dracontiasis, Guinea-worm disease, Medina worm disease) is a debilitating parasitic zoonosis caused by the nematode *Dracunculus medinensis* (Pal, 2007) that belongs to the genus *Dracunculus* and family Dracunculidae (Simontti et al., 2023). Historically, widespread across Africa, Asia, and the Middle East, dracunculiasis afflicted an estimated 3.5 million people annually during the 1980s (WHO, 2025). However, despite dramatic reductions to fewer than 20 human cases per year, new infections in animals,

especially domestic dogs now pose a significant threat to eradication efforts (Hopkins et al., 2024).

Reverse zoonosis also called as zooanthroponosis is an infectious disease that is transmitted from humans to animals (Pal, 2007; Pal, 2024). Very recently, Pal (2025) mentioned that several infections can be acquired by the animals from humans thus establishing their potential role as reverse zoonoses. The recent recognition of animal reservoirs suggests a possible reverse zoonotic cycle; complicating traditional assumptions that *D. medinensis* transmission occurred exclusively between humans. Direct animal-to-human transmission has not been conclusively demonstrated. One study conducted in Chad (Africa) indicated that paratenic hosts like frogs, may allow transmission of Guinea worms to humans as well as dogs through the ingestion of raw or poorly cooked food (Eberhard et al., 2016). Understanding the lifecycle, clinical features, epidemiology, diagnosis, treatment, and prevention of dracunculiasis is, therefore, essential as global programs approach the final stages of eradication (Hopkins et al., 2024). Dracunculiasis is one of the few parasitic diseases targeted for eradication, without relying on a vaccine or specific drug treatment (Smalley et al., 2025). For many decades, it was regarded as a strictly human-host disease (anthroponosis). However, recent evidence reveals animal infections (especially dogs), which complicate eradication efforts and shift classification toward zoonosis (WHO, 2025).This paper aims to present a mini review of dracunculiasis, covering its lifecycle, clinical symptoms, epidemiology, diagnosis, treatment, prevention and control, and concluding remarks on current challenges and future directions.

Lifecycle:

The lifecycle of *D. medinensis* is classic and well-documented, although recent findings suggest added complexity with animal hosts. Humans become infected by ingesting water containing tiny crustacean copepods (commonly *Cyclops*) infected with *D. medinensis* larvae (Ruiz-Tiben and Hopkins, 2006; Pal, 2007). Ingested copepods are killed by stomach acid, releasing larvae that penetrate the host's intestinal wall and migrate into the abdominal cavity and retroperitoneal tissues. After maturation and mating (males die), fertilised female worms (often 60–100 cm or more in length) migrate subcutaneously, typically toward the lower limbs (≈90 % of cases). Approximately, 10-14 months after ingestion, the female worm induces a blister on the skin surface, ruptures it, and when the affected person with blister in limb enters water, the worm releases thousands of first-stage larvae into the water (Ruiz-Tiben and Hopkins, 2006; WHO, 2025). These larvae survive a few days, are ingested by copepods, where they develop into infective third-stage larvae over about two weeks, and the cycle continues. Recent data indicate transmission may also involve animals (dogs, cats, baboons), which become infected and can contaminate water sources (WHO, 2025).

Clinical symptoms:

Symptoms of dracunculiasis follow a long incubation (pre-patent) period of approximately 10–14 months after infection (WHO, 2025). The first clinical sign is usually a burning sensation, pain or discomfort in the affected area, often the lower leg or foot. A blister forms on the skin, then ruptures to produce an ulcer from which the white filamentous adult worm gradually emerges over days to weeks (CDC, 2024). It is mentioned that in 90 of cases, the blister develops on the lower leg (WHO, 2025). During this emergence, the patient may experience fever, nausea, vomiting, swelling, pruritus, diarrhoea, dizziness, and secondary bacterial infection of the ulcer (Pal, 2007; Gulanikar, 2012; WHO, 2025). Constrictive pericarditis resulting from dracunculosis has been reported by Kinare and co-workers (1962). Recently, Darkase and co-investigators (2023) recorded two cases of dracunculiasis in women with unusual cutaneous manifestations (Figure1 and 2).

Emergence of the worm frequently disables affected persons, causing inability to walk or work for weeks or months. In some instances, when the worm emerges near joints, there may be joint effusion, arthritis, or long-term disability. If the worm is accidentally broken during extraction, severe inflammatory reactions and heavy disability can follow (MSD, 2025). While mortality is rare, morbidity and socio-economic impact are substantial (WHO, 2025). In acute stage, complications like cellulitis, abscesses, septic arthritis, and septic shock can occur, while in late-stage calcification of worm and joint deformities are noticed (Gulanikar, 2012). Long-term disability due to dracunculiasis has been described by Hours and Cairncross (1994). As natural infection due to *D. medinensis* cannot produce immunity, hence, the relapses may occur (CDC, 2024). It is suggested that further work should be conducted to stop the recurrence of infection.

Epidemiology:

Dracunculiasis is a chronic debilitating parasitic zoonotic diseasewith long incubation period that most frequently occurs in subtropical and tropical regions, particularly in Africa and Asia (Muller, 1979; Pal, 2007; WHO, 2025).It is not a fatal disease but carries high morbidity in the affected patients (Darkase et al., 2023). Disease has afflicted impoverished, rural populations dependent on stagnant or open water sources, causing prolonged disability during worm emergence and interfering with livelihoods (WHO, 2025).At its height in the mid-1980s, dracunculiasis was endemic in approximately 20 countries (17 African and 3 Asian) with around 3.5

million cases annually (WHO, 2025). Since then, a massive global campaign has reduced human cases to double-digits: for example, 13 human cases were reported globally in 2024 (WHO, 2025).The remaining endemic countries include Chad, South Sudan, Mali, Ethiopia, and Angola (WHO, 2025). Dracunculiasis has been reported in humans as well as in dogs from India (Lalitha and Anandan, 1980; Choubisa et al., 2010; Darkase et al., 2023). Most case of dracunculiasis are reported to occur as sporadic (Gulanikar, 2012; Darkase et al., 2023). However, Edungbola and Watts (1984) recorded an outbreak of dracunculiasis in a peri-urban community of Ilorin, Kwara State, Nigeria.Human dracunculiasis has also been documented from Japan (Kobayashi et al., 1986), China (Wang et al., 1995), and Saudi Arabia (Hakim and Khan, 2007). Spearman and co-investigators (1998) reported imported dracunculiasis in the United States. Very recently, *D. medinesnsis* infection was diagnosed in a patient by radiology in a non-endemic region by Alsaleh and co-investigators (2025).

Transmission is determined by reliance on stagnant open water sources (ponds, step-wells), by climatic seasonality and by behaviours that bring infected limbs into water (WHO, 2025). McDonald and others (2020) have described that domestic dogs (Canis familiaris) act as an emerging reservoir of *D. medinensis* infection. Recent epidemiology reveals a growing animal reservoir: in 2024, 661 animals infected (dogs, cats, baboons) across the endemic countries were reported (WHO, 2025). The emergence of these animal cases has raised the classification from purely human disease to reverse zoonosis, complicating eradication. In this context, Galán-Puchades (2021) described that *D. Medinensis* infection in dogs represents a case of reverse zoonosis, which obstructs in the eradication programme of disease. Though the infection has been encountered in animals, there is no conclusive evidence of direct transmission of *D. Medinensis* infection from animals to humans (Pal, 2007). The role of animals in the epidemiology of dracunculiasis should be further elucidated.

It is cited that water sources, such as ponds, pools, cisterns, step well and temporary hand dung wells are recognized as the common sites, which may serve as source of transmission of infection (Cairncross et al., 2002).The people who consume drinking water from a pond or other stagnant water source contaminated with infected copepods is at higher risk for acquiring *D. medinensis* infection (CDC. 2024). It is described that ingestion of transport hosts like fish and paratenic hosts, such as frogs can cause the infection in the susceptible individual; and hence, dracunculiasis should be considered as a food-borne zoonosis (Galán-Puchades, 2020). It is emphasized that the factors, which contribute to the persistence of disease in the endemic regions should be studied.

Figure 1: A41-year-old female housewifeshowing serpiginous swelling with intermittent break-up over the medial aspect of her right ankle and Achilles tendon due to *Dracunculus medinensis*.

Source: Darkase and others (2023)

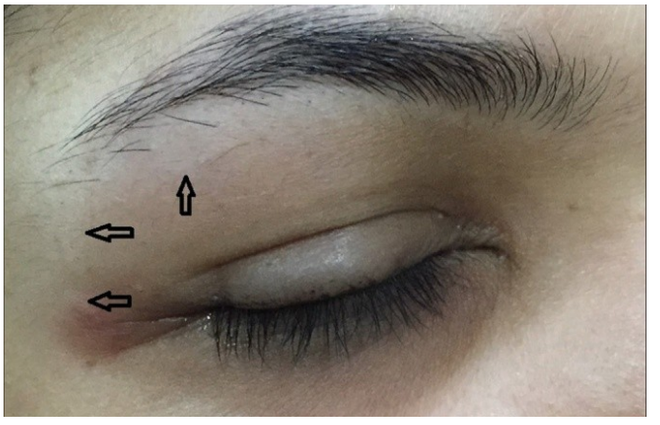

Figure 2: An adult women aged 40-year with no history of travel and traumatic injury exhibiting erythematous, oedematous, and non-indurated periorbital swellingwith a worm-like serpiginous outline the lateral canthus of the right eye.
Source: Darkese and co-investigators (2023)

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Diagnosis:

Diagnosis of dracunculiasis is largely clinical and straightforward, thanks to the characteristic appearance of the adult worm emerging from a skin blister or ulcer (CDC.2024). There is no widely available serologic test for early infection, and pre-patent human infections are, therefore, not routinely diagnosed (CDC, 2024). In case the parasite does not reach the skin, it disintegrates or becomes calcified, which can be easily located on the x-ray examination (Menon, 2011).

Radiological examination that includes X ray, computed tomography (CT) and Magnetic resonance imaging (MRI) may reveal in locating the calcified worms in tissues, and thus help in diagnosing the disease (Pal, 2007; Menon, 2011; Alsaleh et al., 2025; MSD, 2025). In this context, Alsaleh and co-investigators (2025) described a case of dracunculiasis in a 75-year-old woman from a non-endemic region, and the diagnosis was confirmed with pelvic radiography and computed tomography. These authors suggested that parasitic infections should be included in the differential diagnosis of intramuscular calcifications.

Laboratory confirmation may be done in specialized settings (e.g. PCR) but is not essential for case management in endemic, resource-limited settings (CDC, 2024). It is mentioned that sequence analysis of the 18rRNAgene can be employed to differentiate *D. medinensis* from *D. insignis* (Bimi et al., 2005). Attempts must be made to develop a simple and cheap method that can be routinely used in the primary health centres to confirm the diagnosis of dracunculiasis both in humans as well as in animals.

Treatment:

Currently, there is no effective anthelmintic drug or vaccine is available for the management of dracunculiasis. Regarding the clinical efficacy of mebendazole in the treatment of dracunculiasis, Kale

(1975) reported that this anthelmintic drug was effective in eradicating the adult worm, and also preventing clinical relapses. However, it did not show substantial improvement of symptoms, subsiding the inflammation and healing of ulcers.

Treatment is essentially mechanical removal of the adult worm (Pal, 2007). The traditional method involves slowly winding the emerging worm around a small stick (or gauze) a few centimetres each day until the entire worm is extracted. Breaking the worm may lead to severe inflammatory reaction and complications. Supportive care includes wound management, antiseptics, pain relief, antibiotics for secondary infection and restriction of contaminated limb from entering water sources to prevent larval release (MSD, 2025).Some surgical extraction may be necessary in complicated cases; anti-inflammatory drugs may reduce pain or assist in wound healing though they do not kill the worm (MSD, 2025).Because the incubation period is long, even treated patients require follow-up surveillance to ensure no further worm emergence and no water contamination.

It is advised that after the surgical removal of the worm, the topical antibiotics, such as bacitracin, mupirocin, neosporin, and soframycin may be applied to prevent the bacterial infections. It is emphasized that in the absence of specific medication, quick recognition, and containment of cases becomes vital to interrupt further transmission of *D. medinensis* infection.

Prevention and control:

Prevention and control of dracunculiasis focus on interrupting the parasite's transmission cycle rather than on treating infected hosts, given lack of specific pharmacotherapy. Key strategies, which helps in the prevention and control of dracunculiasis are mentioned as follows (Pal, 2007; Simontti et al., 2003: CDC, 2024; WHO, 2025)

- *Provision of safe drinking water*: Ensuring access to safe drinking water: provision of boreholes, protected wells, hand-pumps, and eliminating reliance on open, stagnant water sources.
- *Water filtration*: Filtering drinking water with finely woven cloth (≈0.15 mm mesh) or use of pipe filters is useful to remove copepods.
- *Applying larvicide*: Larvicides, such as temephos/abate should be applied in the stagnant or unsafe water sources to kill infected copepods.
- *Health education and behaviour change*: The people should be educated about the use of safe drinking water (boiled or filtered), to avoid entering water sources when blisters/worm-emergence occur; not to discard fish entrails into water; and to report cases early to the health authority.
- *Case containment*: Promptly detecting emerging worms (ideally within 24 hours), preventing the patient from entering water sources, cleaning and dressing the ulcer, and providing health education is imperative.
- *Surveillance*: Active village-based case detection volunteers, cash rewards for reporting cases, monitoring animals, maintaining surveillance for at least 3 years after last human case in a country are essential in eradication programme.
- *Animal-reservoir management*: In recent years, major emphasis has been placed on tethering or isolating infected domestic dogs/cats in endemic areas, preventing them from contaminating water sources, and tracking dog infections via telemetry, modelling, and diagnostics. It is hoped that these combined measures have brought dracunculiasis to the brink of eradication.

Conclusion:

Dracunculiasis is a neglected tropical helminthic zoonosis that exemplifies both the promise and the challenge of disease eradication programmes. Disease primarily affects the people of poor socioeconomic status who do not have easy access to potable drinking water. Besides humans, Natural infection has been rep0rted indogs, cats and baboons. Thanks to coordinated global efforts since the 1980s, human cases have declined from millions to merely dozens annually. The disease's characteristic lifecycle (slow emergence, visible worm, limited hosts, and geography) and the absence of a vaccine or drug meant that simple public-health interventions (water filtration, safe water, larvicide, case containment) could be highly effective. However, the emergence of animal infections, especially in dogs has altered the landscape, requiring refocused surveillance, One Health approaches, and adaptation of eradication strategies. While elimination (cessation of transmission) is within reach, certifying global eradication remains challenging due to the involvement of animals, hard-to-reach settings, population mobility, and resource constraints. Continued vigilance, investment, and innovation will be essential to achieve and sustain a worm-free world. There is a need to undertake comprehensive and systematic studies on the epidemiology, and diagnosis, and chemotherapy of this neglected tropical helminthic zoonosis.

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The authors declare no conflict of interest.

Authors' contribution:

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