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Address for correspondence:

Gözde Acıduman Subaşıay,
Independent Researcher,
Munich, Germany
Phone: +90 544 885 97 95
E-mail:
acidumangozde@gmail.com

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Guinea Worm Disease in Medieval Islamic Medicine: ‘İrku al-Madani and Early Insights into a Public Health Challenge

İD Gözde Acıduman Subaşıay,¹ İD Abdullah Yıldız,² İD Pınar Aysert Yıldız,³
İD Ahmet Acıduman²

¹Independent Researcher, Munich, Germany

²Department of History of Medicine and Ethics, Ankara University Faculty of Medicine, Ankara, Türkiye

³Department of Infectious Diseases and Clinical Microbiology, Gazi University Faculty of Medicine, Ankara, Türkiye

ABSTRACT

Objective: Guinea worm disease, a neglected tropical disease caused by the parasite *Dracunculus medinensis*, is referred to as “İrku al-Madani” in medieval Arabic medical literature. This study examines Guinea worm disease, or “İrku al-Madani,” through an analysis of medieval medical texts written in the Islamic world between the 9th and 12th centuries. Understanding its historical context provides valuable insights into the development of parasitology and public health in premodern medical traditions.

Materials and Methods: Relevant sections from the works of prominent medieval Islamic physicians, including Thābit b. Qurra, Abū Bakr Muḥammad b. Zakariyyā’ al-Rāzī, ‘Alī b. al-‘Abbās al-Majūsī, Abū l-Qāsim Khalaf b. ‘Abbās al-Zahrāwī, Abū ‘Alī Ibn Sīnā, and Abū Marwān ‘Abd al-Malik b. Zuhr, were examined to analyze how “İrku al-Madani” was described, diagnosed, and treated. The findings were compared with one another and with contemporary medical knowledge and literature on Guinea worm disease.

Results: The analysis highlights overlapping, complementary, and divergent perspectives on the disease’s etiology, pathogenesis, diagnosis, and treatment, all situated within the framework of humoral pathology. In addition to the use of medicinal substances, surgical intervention was also documented as part of therapeutic practice.

Conclusion: Insights from the examined medieval Islamic texts largely align with earlier knowledge about the disease. Although some observations and findings correspond with contemporary approaches, key differences emerge, particularly in the conceptualization and interpretation of the disease.

Keywords: Guinea worm disease, history of medicine, Islamic medicine, medieval, neglected tropical diseases, waterborne diseases.





Figure 1. Section on “*Irq al-Madani*” in Thābit b. Qurra’s *Kitāb al-Dhakhira fi ‘Ilm al-Ṭibb*, located in the Directorate of National Palaces, Topkapı Palace Museum, Library of Ahmed III, no. 2098¹⁵ (Courtesy of the Directorate of National Palaces, İstanbul, Türkiye).

INTRODUCTION

Dracunculiasis, also known as dracontiasis or Guinea worm disease, is nearing global eradication. An estimated 3.5 million cases were reported worldwide in the 1980s, primarily in African countries. However, as a result of eradication campaigns conducted by the World Health Organization (WHO), the United States Centers for Disease Control and Prevention (CDC), the United Nations Children’s Fund (UNICEF), and the Carter Center, disease transmission has been significantly reduced, with reported human cases decreasing to only 13 in 2024.^{1,2} The Carter Center reported 10 human cases in 2025.³ It is classified among the neglected tropical diseases, a group of parasitic, viral, and bacterial illnesses that includes leprosy, rabies, trachoma, Chagas disease, leishmaniasis, African sleeping sickness (trypanosomiasis), and lymphatic filariasis. These diseases impair physical and cognitive development in low-income regions, increase maternal and child mortality,

reduce productivity, and affect more than one billion people in health, social, and economic terms.⁴⁻⁶ The disease affects impoverished communities in remote areas of Africa that lack access to safe drinking water supply.⁶ According to the WHO, the disease remains endemic in Angola, Chad, Ethiopia, Mali, and South Sudan.²

The causative agent of this disease is the nematode *Dracunculus medinensis*, commonly known as the Guinea worm or Medina worm.⁶⁻⁸ Infection occurs in humans—the primary or definitive host—through the ingestion of unfiltered water containing *Cyclops* (water fleas).^{6,8,9} *Cyclops* is a genus of crustaceans from the subclass Copepoda and serves as the secondary or intermediate host.^{9,10} Approximately one year after infection, in most cases, a blister with a burning sensation typically appears on the leg, and the adult worm emerges. When the patient immerses

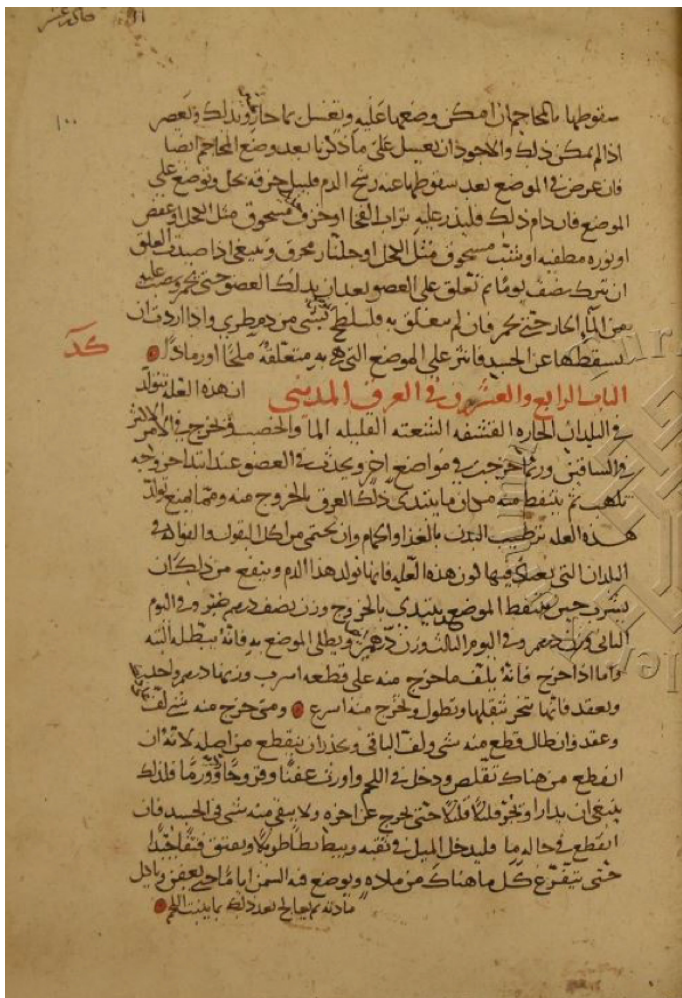


Figure 2. Section on “*Irq al-Madani*” in al-Rāzī’s *Kitāb al-Manşūrī fī l-Ṭibb*, located in the Presidency of Türkiye Manuscripts Institution, Nation’s Library, Feyzullah Efendi Collection, no. 1327¹⁷ (Courtesy of the Türkiye Manuscripts Institution, İstanbul, Türkiye).

the affected area in water to relieve the pain, the worm releases its larvae into the water, where they are ingested by *Cyclops*, thus completing the parasite’s life cycle.²

Now nearing eradication, the disease has historically affected communities in several parts of the world. As Simonetti et al.¹¹ stated in the title of their article, this disease is caused by “a parasite unfamiliar to the West.” Galen (126–216 AD), Soranus (1st–2nd century AD), Rufus of Ephesus (1st–2nd century AD), Paul of Aegina (c. 625–690 AD), Abū Bakr Muḥammad b. Zakariyyā ‘al-Rāzī (865–925 AD), Abū I-Qāsim Khalaf b. ‘Abbās al-Zahrāwī (c. 936–1013 AD), Abū ‘Alī Ibn Sīnā (980–1037 AD), and other authors are known to have

written about this disease, and their works were translated and used in the West.^{11–13} To contribute to the existing knowledge of this disease and address a gap in the history of medicine literature, this study was designed to examine in detail selected medical texts produced in the Islamic world during the Middle Ages, analyzing how the disease was described and managed.

MATERIALS AND METHODS

In this study, sections on “*Irq al-Madani*” were examined and compared across the works of prominent physicians from the medieval Islamic world, more specifically between the 9th and 12th centuries. These physicians and their works are considered prominent because they lived and wrote during the so-called Golden Age of the Islamic world, a period corresponding to the Middle Ages in the West, and had a significant influence on Western medicine. These works include Thābit b. Qurra’s (836–901 AD) *Kitāb al-Dhakhīra fī ‘Ilm al-Ṭibb* (*The Book of Treasure in the Science of Medicine*) (Fig. 1);^{14,15} Abū Bakr Muḥammad b. Zakariyyā al-Rāzī’s *Kitāb al-Manşūrī fī l-Ṭibb* (*Book of Medicine for al-Manşūr*) (Fig. 2)^{16,17} and *Kitāb al-Ḥawī fī l-Ṭibb* (*The Comprehensive Book on Medicine*);¹⁸ ‘Alī b. al-‘Abbās al-Majūsī’s (930–994 AD) *Kāmil al-Şinā‘at al-Tibbiyya* (*The Complete Book of the Medical Art*) (Fig. 3);^{19–21} Abū I-Qāsim Khalaf b. ‘Abbās al-Zahrāwī’s *al-Taşrīf li-man ‘ajiza ‘an al-ta‘līf* (*The Arrangement of Medical Knowledge for One Who Is Not Able to Compile a Book for Himself*);²² Abū ‘Alī Ibn Sīnā’s *al-Qānūn fī l-Ṭibb* (*The Canon of Medicine*);²³ and Abū Marwān ‘Abd al-Malik b. Zuhri’s (1094–1162 AD) *Kitāb al-Taysīr fī l-Mudāwāt wa l-Tadbīr* (*Easy Guide to Therapy and Dietetics*).²⁴ Because these works were originally written in Arabic, they were translated by the authors when English or Turkish translations were not available. The examined works are provided in the References section.

Among the works examined, *Kitāb al-Ḥawī fī l-Ṭibb* includes quotations from al-Rāzī’s predecessors alongside his own commentary. These quotations were drawn from [‘Abdallāh b. Yaḥyā al-Barmakī]’s *al-Ikhtīşārāt* (*Abridgements*); Qusṭā [b. Lūqā]’s *Kitāb fī l-Balgham* (*Book on Phlegm*); Būlus’ (Paul of Aegina) [*al-Kunnāsh* (*Compendium*)]; [Jālīnūs’ (Galen)] *Kitāb al-‘Alāmāt* (*Book of Signs*); al-Yahūdī’s [*Kunnāsh* (*Compendium*)]; *Kitāb Majhūl* (*Anonymous Book*); Ibn Māsawayḥ; Ḥunayn’s *Ikhtiyārāt* (*Selections*); al-Kindī’s *Ikhtiyārāt* (*Selections*); and Jālīnūs’ (Galen) *al-A‘dā‘ al-‘Alīma* (*On the Affected Parts*). Because of the journal’s reference limitations, it was not possible to cite all these works separately; therefore, they were cited as *al-Ḥawī*.

The findings are presented as paragraphs in the Results section and grouped under the following categories: regions where the disease was observed, signs and symptoms, views on the

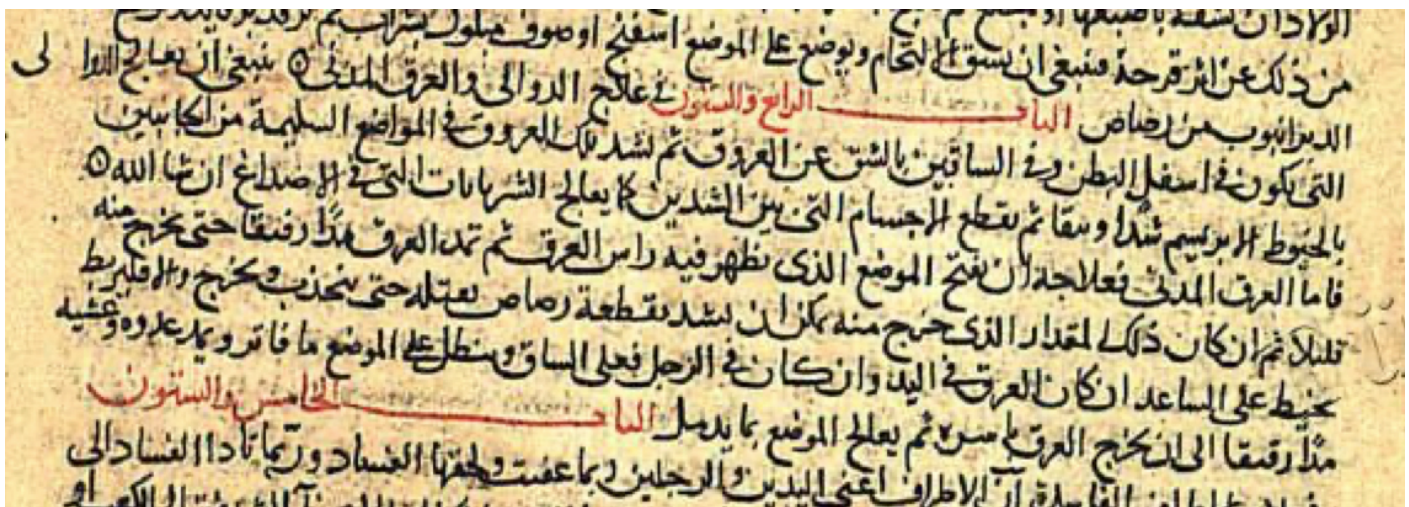


Figure 3. Section describing the removal of “*Iraq al-Madani*” in ‘Ali b. al-‘Abbās al-Majūsī’s *Kāmil al-Şinā ‘at al-Ṭibbiyya*, located in the Presidency of Türkiye Manuscripts Institution, Süleymaniye Manuscript Library, Murad Molla Collection, no. 1482²¹ (Courtesy of the Türkiye Manuscripts Institution, İstanbul, Türkiye).

causative agent and predisposing factors, and methods of treatment and prevention. The literature review and existing knowledge are presented in the Discussion section.

RESULTS

In the works examined, the disease is referred to by various names, such as *Iraq al-Madani*, *Iraq al-Madīnī*, *Iraq Madīnī*, and *Urūq al-Madaniyya*. According to these texts, the disease is most commonly observed in hot,^{14,16–19,22,25} dusty,¹⁴ parched, and poorly fertile lands.^{16,22,25} It has most frequently been reported in Medina,^{23,26} Indian countries,^{18,19} Egypt,^{18,19,23,26} Abyssinian countries,¹⁹ the Hejaz,^{22,25} lands of Arabs,²⁵ Khuzestan,^{23,26} the Sudan,²⁴ and Mecca.¹⁸

This disease is attributed to several causes, including thick humor,²⁴ foods that produce bad chyme,²⁰ consumption of fruits and vegetables in regions where the disease is common,^{16,22} corruption of the nerves, dryness of the blood, drinking bad water or the presence of hot boiling phlegm, sticky and thick blood, excessive heat,¹⁸ hot, bad, and melancholic blood or burnt phlegm, and certain foods and waters that cause the disease.^{23,26} Exhaustion is considered a cause of the disease in individuals unaccustomed to fatigue.^{14,20} Some sources report that the disease was suspected to involve actual animals generated beneath the skin or a thickened, damaged nerve branch.^{23,26} The origin of the disease has also been described as “corruption taking place beneath the skin in the same way that round-worms and worms and gourd-worms arise in the inward parts of the body; also the worms that are generated between the skin and the flesh.”²⁵

Al-Rāzī reported observing the disease in individuals with muscular and thin bodies, but not in those who were accustomed to bathing and soaking in water, drinking wine, and consuming a varied diet.¹⁸ Ibn Sīnā also noted that the disease was less common in individuals with moist body constitutions, those who bathed frequently, consumed fresh foods, and drank appropriate amounts of fluids.^{23,26}

The disease is mostly reported in the calves,^{14,16,18,25} initially presenting with a burning sensation,^{14,22} followed by blister formation and the emergence of a structure piercing through the skin.^{14,16,18,22,23,25,26} This emerging structure has been described as a vein,^{14,16,18,22,25} resembling a nerve,²⁴ a plant stem, or a vein like an animal.²⁵ It has also been described as moving,¹⁸ like a worm,^{19,23,26} and as resembling the flowing movement of a serpent beneath the skin.¹⁸ The disease has been reported in the wrists, arms, and thighs.^{18,20} In addition, it may occur in other body parts,²⁵ such as the hands^{23,26} and flanks, particularly in children.^{18,23,26} Al-Zahrāwī also stated that when the vein emerges in the feet or ankles, it branches out and exits through multiple openings.²⁵

The treatment of the disease appears to be classified into stages before and after the emergence of the vein. During the early stages of the disease, it is stated that the affected area should be anointed with stock/gillyflower, lily, or castor oil to facilitate the emergence and visibility of the vein. Before the vein emerges, cooling substances should be applied to the swelling, a leech should be placed on the area, and barley flour, purslane, aloe, rose oil, and similar substances should be applied.¹⁸ Once emergence begins following the burning

sensation, drinking aloe and rubbing it on the skin are said to eliminate the disease.^{16,18,22,23,26} It is also recommended that the area be dressed and cooled using the two types of sandalwood, camphor, and similar rubs.¹⁸ Dressings should have cooling and moisturizing properties.^{23,26}

It has been reported that the piercing vein should be pulled out without breaking it.^{14,16,18,22–25} A piece or stick of lead should be tied or wrapped around it to ensure that it emerges slowly.^{14,16,18,20,22–25} Some sources also report that if it becomes too long after being wrapped around the lead, the excess should be cut off and the remaining part tied again.^{16,25} It has been stated that a dressing should be applied until the vein has fully emerged.²⁰ Substances such as cooled sap, cold seed water, and oils should also be applied to facilitate its emergence.^{23,26} Once it has fully emerged, it should be treated with a cold ointment, such as ceruse ointment.¹⁸ It was also reported that cutting it off may lead to putrefaction and sores, necessitating a long incision.^{18,20,25} The wound should then be treated with butter and substances that promote flesh growth,^{16,20} or the area should be allowed to suppurate and treated as an abscess.²⁵ Hot¹⁸ or sharp medicines should be avoided.^{23,26}

It is explained that if it is difficult to bring the disease to the surface, the area can be softened using various oils, and an ointment made from pitch may be applied. If needed, an incision can be made to remove it completely; if this is not easily achieved, alternative methods include allowing it to putrefy with butter, applying hot medicines, rubbing the area with salt, or anointing it with softening oils. If complete surgical removal is necessary, the incision should be made obliquely beneath the affected area without cutting the vein.^{23,26}

Moisturization through warm baths and diet is considered beneficial for this illness.^{14,16,20,22} Anointing the limb,²⁰ applying compression,¹⁸ and pouring hot water over the affected area are also recommended.^{18,20,23,26} If inflammation or fever affects the entire body, bloodletting^{14,18,20,23,26} and softening remedies, such as fruit juices, barley water, and other cooling and moisturizing treatments, are recommended.^{14,20} If the inflammation is localized to the site where the vein is piercing, the bowels should be loosened,¹⁴ and an infusion of aloe with chicory juice should be administered.^{14,20}

To prevent the occurrence of the disease, the humors should be matured and softened using *ʿunṣūlī* oxymel [oxymel prepared with squill^{27,28}] mixed with hot water, after which the thick humor should be discharged.²⁴ Consuming myrobalan and dates,¹⁸ as well as myrobalan, senna, common fumitory, and *qūqiyā* [a paste composed of myrrh, *bināsb*, hyacinth, saffron, cinnamon, cassia, geranium flowers, *Acorus calamus*,

bdellium, raisins, and honey²⁹] tablets, is also recommended for preventing this disease.^{23,26} The use of *qūqiyā* tablets is also mentioned in *al-Ḥāwī*.¹⁸

DISCUSSION

The Ebers Papyrus, a medical text written in ancient Egypt around 1550 BC, describes a condition believed to involve Guinea worms in the arms and legs. The Egyptians interpreted this as a foreign body reaction rather than a natural human structure and reported the removal of this “foreign material” as treatment for the condition.⁸ A disease called *ṣagbānu*, which emerged from a clear vesicle on the foot, was also known in the Assyrian civilization (2025–612 BC), which existed in the northern region of Mesopotamia. Because ancient Mesopotamians could easily recognize insect larvae and used nonparasitic larvae to cleanse tissue, and given that this disease was assigned a specific name, Adamson suggests that “it was a disease diagnosable by Assyrian physicians.”⁸

Galen referred to this disease as *drakontia*^{30,31} and stated that he had not personally seen it,^{18,31} nor did he know its cause or origin. However, he knew individuals who had seen the disease^{8,12,31} and believed that it appeared similar to a nerve, although it resembled a worm in color and thickness.^{12,31} Paul of Aegina described the worms known as *dracunculi* in India and Upper Egypt. He noted that they appeared in muscular parts of the body, such as the arms, thighs, and calves, and in children, beneath the skin along the sides, and that they moved. He stated that once the worm emerged, a lead weight should be tied to it to facilitate removal by its own weight. He also noted that applying hot water would help the worm emerge further, allowing it to be gently pulled out with the fingers. However, according to Soranus, it was not an animal but a nervous concretion, although it appeared to be mobile. He also reported that it could be induced to fall out using warm water, digestive cataplasms, and plasters. In cases of suppuration, the skin should be incised, the contents evacuated, a tent inserted, and appropriate treatment for suppuration applied.¹³

In this study, which examined various works by leading physicians of the medieval Islamic world, some of the causes attributed to the disease known as “*ʿIrq al-Madani*” were found to be consistent with humoral pathology. These include thick humor, bad chyme, dryness of the blood, hot boiling phlegm, sticky and thick blood, excessive heat, hot, bad, and melancholic blood, and burnt phlegm. According to humoral pathology, the body, as the microcosm, is composed of four humors—blood, phlegm, yellow bile, and black bile. These humors move as a reflection of the heavens, or the macrocosm, and correspond to the elements—air, water, fire, and earth—each of which has its own properties: blood is hot and moist, phlegm is cold and moist, yellow bile



Figure 4. Extraction of a Guinea worm from a patient's leg using a stick. Source: CDC, PHIL, public domain.³⁸

is hot and dry, and black bile is cold and dry. Under certain conditions, these humors can transform into one another, such as phlegm into blood, blood into yellow bile, and blood into phlegm, whereas black bile does not transform into any other humor. When the balance of these humors is disrupted in favor of one, disease occurs, and treatments are applied to reduce the excess humor.^{32,33} Additionally, because of its structural resemblance to veins and nerves, the disorder was believed to be associated with these anatomical structures. Although it was likened to a worm because of its mobility, no direct association with the causative agent was established. Al-Rāzī's view, cited from *Kitāb al-Ikhtisārāt*,¹⁸ authored by 'Abdallāh b. Yaḥyā (9th century AD),^{30,34} that the disease could be caused by bad water aligns with the current understanding of its mode of infestation. This idea is not included in the other sources examined in this study. Conversely, in the works quoted in *al-Ḥāwī*, including 'Abdallāh b. Yaḥyā's *Kitāb al-Ikhtisārāt*, the emergence of the disease is attributed to disturbed or imbalanced humors in the body.

The association between the parasite and water sources has been recognized since ancient times, although debates have persisted over whether it enters the body through ingestion of water or by penetrating the skin. Rufus of Ephesus described a disease named *ofis* (*ὄφις*), meaning tendon (*νεῦρον*) in Greek, and remarked that it affected those who "drank the water suffered from this disease."¹¹ In the 18th century, the Swedish botanist Carl Linnaeus (1707–1778), in his work *Systema Naturae*, classified the worm named *Filaria medinensis* among intestinal worms and noted that it enters the feet of those who walk barefoot.³⁵ In 1869, the Russian helminthologist Aleksej Fedchenko (1844–1873) dissected *Cyclops* from water and discovered larvae, which he identified

as intermediate stages of the Guinea worm.^{36,37} He proposed that humans become infected by drinking water containing these organisms.³⁷ The British helminthologist Robert Thomson Leiper (1881–1969) elucidated the life cycle of the parasite during his explorations in West Africa.^{36,37} In addition to describing the parasite's life cycle, Leiper proposed several methods to prevent its transmission.³⁷

As stated in the literature, the nematode generally exits the skin through the lower extremities. A vesicle forms, the skin is pierced, and the parasite exits the body. Emergence from the abdomen and flanks is also observed in children. The nematode's need for contact with water to release its larvae² is consistent with the information in the examined texts, which states that pouring water on the affected area facilitates its emergence. A notable treatment method involves tying a lead object to the emerging vein to allow it to exit slowly and completely without breaking. Similarly, today, the nematode is gradually extracted each day and tied to a stick (Fig. 4)³⁸ to prevent it from re-entering the body. Surgical removal of the nematode is also possible,³⁹ which is consistent with the information in the sources examined. The ointments, plasters, and oral medications applied were intended to regulate humoral balance; in accordance with the perceived causes of the disease and the principles of humoral pathology, they were used as cooling and moisturizing agents. Similarly, in cases of generalized inflammation, bloodletting, softening remedies, and cooling and moisturizing treatments were recommended, whereas loosening the bowels was advised for localized inflammation. According to humoral pathology, such practices aimed to restore humoral balance, either through diet or through the evacuation of excess humor using methods such as phlebotomy, cupping, and purging.³²

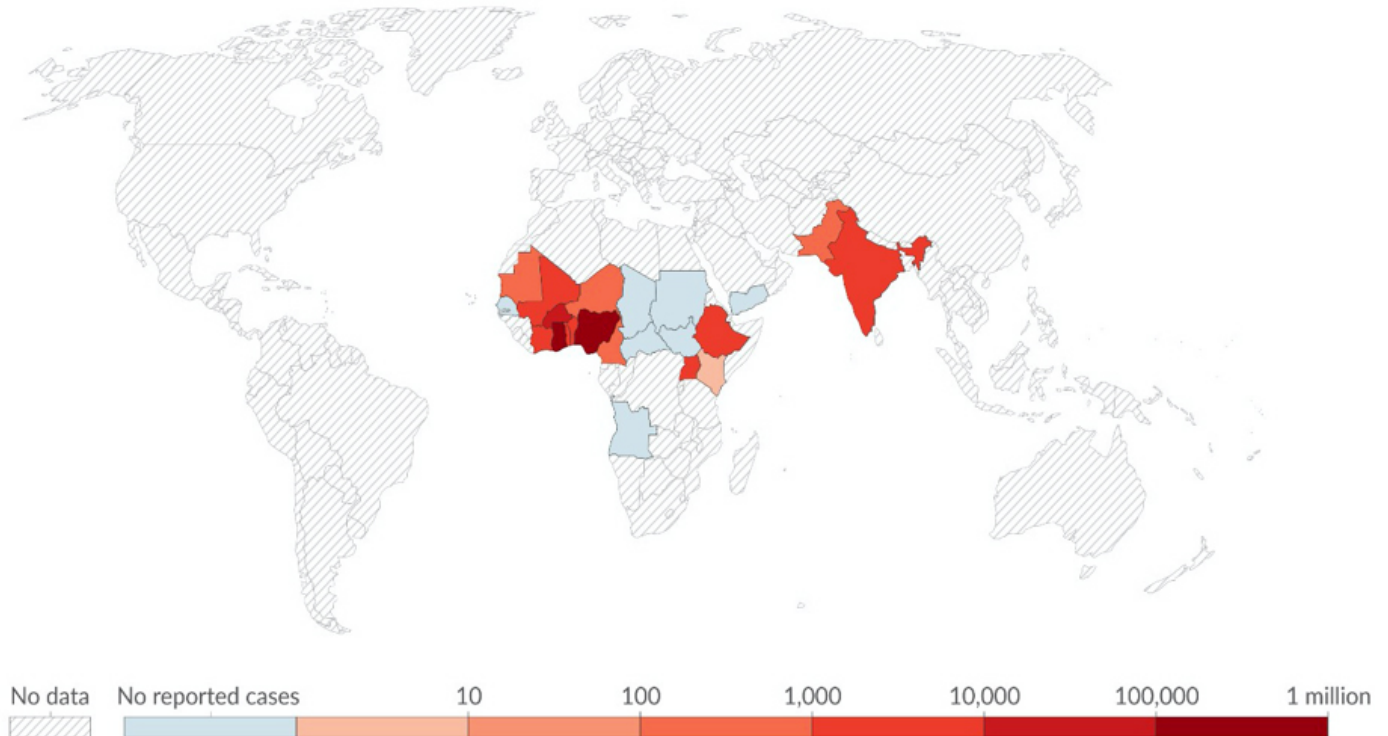
The protective methods described in the works examined in this study, such as the maturation and softening of the humors and dietary recommendations, were also intended to maintain humoral balance in accordance with the principles of humoral pathology. Today, preventive measures against the disease include restricting infected or infested individuals from accessing drinking water sources, installing filters at water tank inlets, using filtered straws for drinking, and implementing vector control.^{11,39}

The regions where the disease was historically reported are consistent with those where it has been observed in the recent past, before elimination efforts succeeded (Fig. 5).⁴⁰ Definitive hosts other than humans, such as dogs, cats, and baboons,² were not mentioned in the examined texts, which appears to be consistent with the relatively recent recognition that this disease also involves nonhuman animal hosts.

Reported cases of guinea worm disease, 1989

Our World
in Data

Reported annual cases of guinea worm disease¹. Guinea worm disease is a painful and debilitating disease caused by a parasitic worm spread through contaminated water.



Data source: World Health Organization (2025)

OurWorldinData.org/eradication-of-diseases | CC BY

Note: Due to limited surveillance capacity, particularly during past outbreaks, the number of reported cases can be lower than the actual number of infections.

Figure 5. World map showing countries with reported cases of Guinea worm disease by the end of the 1980s. Source: Our World in Data, CC BY.⁴⁰

CONCLUSION

In the works examined, the causes of *ʿIrq al-Madanī* and its nonsurgical treatments were addressed within the medical paradigm of the period, namely humoral pathology. Nevertheless, observation-based descriptions of the disease, along with its primary treatment—the physical removal of the parasite—were commonly found in the examined documents and align with current medical knowledge. Because of the nature of the organism, parasite removal, which remains the standard treatment today, was also the primary and effective treatment approach used in the past. Al-Rāzī’s suggestion—cited from *Kitāb al-Ikhtisārāt*—that the disease could be associated with water is a notable insight absent from the other sources examined. With a paradigm shift and the discovery of the disease’s true etiology and the parasite’s life

cycle, the disease could cease to be a public health challenge through the implementation of appropriate measures.

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REFERENCES

- Hopkins DR, Weiss AJ, Yerian S, Sapp SGH, Cama VA. Progress Toward Eradication of Dracunculiasis - Worldwide, January 2022-June 2023. *MMWR Morb Mortal Wkly Rep* 2023;72(45):1230-6. [CrossRef]
- World Health Organization. Dracunculiasis (Guinea-worm disease). [https://www.who.int/news-room/fact-sheets/detail/dracunculiasis-\(guinea-worm-disease\)](https://www.who.int/news-room/fact-sheets/detail/dracunculiasis-(guinea-worm-disease)) Accessed May 13, 2026.
- Satub E. The Carter Center. Guinea Worm Disease Reaches All-Time Low: Only 10 Human Cases Reported in 2025. <https://www.cartercenter.org/news/guinea-worm-announcement/> Accessed May 13, 2026.
- World Health Organization. Neglected tropical diseases. <https://www.who.int/health-topics/neglected-tropical-diseases> Accessed May 13, 2026.
- Centers for Disease Control and Prevention. Neglected Tropical Diseases Fact Sheet. https://www.cdc.gov/parasites/resources/pdf/NTD_FactSheet_2024.pdf Accessed May 13, 2026.
- Centers for Disease Control and Prevention. Guinea Worm Disease. About Guinea Worm. <https://www.cdc.gov/guinea-worm/about/index.html> Accessed May 13, 2026.
- Dill MG. Dracontiasis. Dissertation. Edinburgh: The University of Edinburgh; 1909.
- Adamson PB. Dracontiasis in antiquity. *Med Hist* 1988;32(2):204-9. [CrossRef]
- Centers for Disease Control and Prevention. DPDx - Laboratory Identification of Parasites of Public Health Concern. Dracunculiasis. <https://www.cdc.gov/dpdx/dracunculiasis/index.html> Accessed May 13, 2026.
- Encyclopedia Britannica. copepod. <https://www.britannica.com/animal/copepod> Accessed May 13, 2026.
- Simonetti O, Zerbato V, Di Bella S, Luzzati R, Cavalli F. Dracunculiasis over the centuries: the history of a parasite unfamiliar to the West. *Infez Med* 2023;31(2):257-64.
- Adams F. Commentary. The Seven Books of Paulus Aegineta: Translated from the Greek: With a Commentary, Embracing a Complete View of the Knowledge Possessed by the Greeks, Romans, and Arabians, on All Subjects Connected with Medicine and Surgery. London: The Sydenham Society; 1846.p.151-3.
- Paulus Aegineta. On Dracunculus, or the Guinea-Worm. The Seven Books of Paulus Aegineta: Translated from the Greek: With a Commentary, Embracing a Complete View of the Knowledge Possessed by the Greeks, Romans, and Arabians, on All Subjects Connected with Medicine and Surgery. London: The Sydenham Society; 1846.p.150-1.
- Thābit b. Qurra. The Book of Al Dakhīra. Sobhy G, editor. Cairo: Government Press, 1928.p.126. Arabic.
- Thābit b. Qurra. Kitāb al-Dhakhīra fī 'Ilm al-Ṭibb [The Book of Treasure in the Science of Medicine]. Directorate of National Palaces, Topkapı Palace Museum, Library of Ahmed III, nr. 2098.f.90r. Arabic.
- Muḥammad b. Zakariyyā al-Rāzī. Al-Manṣūrī fī at-Ṭibb [Book of Medicine for al-Manṣūr]. Al-Bakry Al Siddiky H, editor. Kuwait: Institute of Arab Manuscripts; 1987.p.333. Arabic.
- Abū Bakr Muḥammad b. Zakaria Ar-Rāzī. Kitāb al-Manṣūrī fī at-Ṭibb [Book of Medicine for al-Manṣūr]. Presidency of Türkiye Manuscripts Institution, Nation's Library, Feyzullah Efendi Collection, nr. 1327.f.100a. Arabic.
- Abū Bakr Muḥammad b. Zakaria Ar-Rāzī. Kitābu'l-Hawī fī't-Ṭibb (Rhazes Liber Continens) (An Encyclopaedia of Medicine), Part XI, (On the Diseases of the Intestinal Worms, Piles, Gout, Varicose, and Elephantiasis). Escorial Ms. No. 813, Madrid, Edited & Collated with the MSS. of the National Museum, Delhi and The Maulana Azad Library, Muslim University, Aligarh. Printed Under the auspices of the Ministry of Scientific Research and Cultural Affairs. Government of India, Under the Supervision of Dr. M. 'Abdul Mu'id Khan, Director, Dairatu'l-Ma'arif il-Osmania. 1st ed. Hyderabad, India: The Dairatu'l-Ma'arif-Osmania (Osmania Oriental Publications Bureau), Osmania University; 1962.p.290–296. Arabic.
- Alī b. al-'Abbās al-Majūsī. Kāmil al-Şinā'at al-Ṭibbiyya [The Complete Book of the Medical Art]. Vol. 1. Būlāq: al-Maṭba'at al-Kubrā al-'Āmira; 1877.p.313–315. Arabic.
- Alī b. al-'Abbās al-Majūsī. Kāmil al-Şinā'at al-Ṭibbiyya [The Complete Book of the Medical Art]. Vol. 2. Būlāq: al-Maṭba'at al-Kubrā al-'Āmira; 1877.p.209–210, 491–492. Arabic.
- Alī b. al-'Abbās al-Majūsī. Kāmil al-Şinā'at al-Ṭibbiyya [The Complete Book of the Medical Art]. Presidency of Türkiye Manuscripts Institution, Süleymaniye Manuscript Library, Murad Molla Collection, nr. 1482.f.340a. Arabic.
- Abū al-Qāsim Khalef b. 'Abbās Al-Zahrāwī. Al-Taşrif mawsū'a ṭibbiyya min al-qarn al-'āşir al-milādī. Ḥaḳḳaḳaḳaḳu wa tarjamahu: al-Duktūr Şubḫī Maḥmūd Ḥamāmī [Al-Taşrif, a medical encyclopedia from the 10th century CE.]. Mu'assasat al-Kuwayt lil-taqaddum al-'ilmī; 2004.p.980–981. Arabic.

23. Abū 'Alī Ibn Sīnā. Kitāb al-Qānūn fi l-Ṭibb [The Canon of Medicine]. Romae: In Typographia Medicea; 1593. [4] p.76-77. Arabic.
24. Abū Marwān 'Abd al-Malik Ibn Zuhr. Kitāb al-Taysīr fi l-mudāwāt wa-l-tadbīr [Easy Guide to Therapy and Dietetics]. al-Rūdānī M b. 'Abd A, editor. Rabat: Maṭbū'āt Akādamiyyat al-Mamlakat al-Maghribiyya; 1991.p.393–395. Arabic.
25. Albucasis. Book Two. Chapter Ninety-One: On the extraction of the Medina vein. Spink MS, Lewis GL, editors and translators. On Surgery and Instruments: A Definitive Edition of the Arabic Text, English Translation and Commentary. London: The Wellcome Institute of the History of Medicine; 1973.p.600-3.
26. Tokadī ME. 'Irq-ı Medenī Beyānındadır. Koç M, Tanrıverdi E, editors. Tahbüzü'l-mathûn, el-Kânûn Fi't-Tıb Tercümesi. Vol. 5: Cüz'iyât. 1st ed. İstanbul: Türkiye Yazma Eserler Kurumu Başkanlığı; 2018.p.337-40. Turkish.
27. Hacı Paşa, Celâleddin Hızır b. Ali el-Konevî el-Aydinî. Et-Teshîl fi't-Tıb [Facilitation in Medicine]. İstanbul: Süleymaniye Manuscript Library, Nuruosmaniye Collection, nr. 3575.f.75a. Turkish.
28. Redhouse JW. عنصل 'unşûl. A Turkish and English Lexicon. Constantinople: A. H. Boyajiyān; 1890.p.1325.
29. Tokadī ME. kûfâ. Koç M, Tanrıverdi E, editors. Tahbüzü'l-Mathûn, el-Kânûn Fi't-Tıb Tercümesi. Vol. 6: Akrahâdîn - Sözlük. 1st ed. İstanbul: Türkiye Yazma Eserler Kurumu Başkanlığı; 2018.p.419. Turkish.
30. Ullmann M. Pathology. Islamic Medicine. 1st ed. Edinburgh: Edinburgh University Press; 1978.p.72-85.
31. Siegel RE. Galen on the Affected Parts; translation from the Greek text with explanatory notes. New York: S. Karger; 1976.p.174.
32. Pormann PE, Savage-Smith E. Medical Theory. Medieval Islamic Medicine. Pormann PE, Savage-Smith E, editors. 1st ed. Edinburgh: Edinburgh University Press; 2007.p.41-79. [CrossRef]
33. Bayat AH. Humoral Patoloji Teorisi. Tıp Tarihi. Expanded 3rd ed. İstanbul: Merkezefendi Geleneksel Tıp Derneği; 2016.p.122-7. Turkish.
34. Sezgin F. Geschichte des arabischen Schrifttums [History of Arabic Literature]. Vol. 3. Leiden: E. J. Brill; 1970.p.257. German.
35. Linnaeus C. Vermes Intestina. Systema Naturæ per regna tria naturæ, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio decima tertia, aucta, reformata. Lugduni: J. B. Delamolliere; 1789.p.3029-98. Latin. [CrossRef]
36. Roberts JD. A brief history of Guinea worm research in the modern period, 1698-1931. Infez Med 2024;4(32):544-53. [CrossRef]
37. Tayeh A, Cairncross S, Cox FEG. Guinea worm: from Robert Leiper to eradication. Parasitology 2017;144(12):1643-8. [CrossRef]
38. US Centers for Disease Control and Prevention. Public Health Image Library (PHIL). 1968. <https://phil.cdc.gov/details.aspx?pid=1342> Accessed May 13, 2026.
39. Nigeria Centre for Disease Control and Prevention. Guinea Worm Disease. <https://ncdc.gov.ng/diseases/info/G> Accessed May 13, 2026.
40. Dattani S, Spooner F. Our World in Data. Guinea worm disease is close to being eradicated - how was this progress achieved? <https://ourworldindata.org/guinea-worm-path-eradication>. Accessed May 13, 2026.