



International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
Canada
+15878858911
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ARTICLE TITLE

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DOI

[https://doi.org/10.31435/ijitss.4\(52\).2026.6696](https://doi.org/10.31435/ijitss.4(52).2026.6696)

RECEIVED

23 July 2026

ACCEPTED

12 October 2026

PUBLISHED

16 October 2026

LICENSE



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HUMAN MYIASIS IN NON-TROPICAL REGIONS: FROM TRAVEL-ASSOCIATED TO HEALTHCARE-ASSOCIATED INFECTIONS - EPIDEMIOLOGY, CLINICAL PRESENTATION, DIAGNOSIS, TREATMENT, AND PREVENTION

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ABSTRACT

Introduction: Myiasis is defined as the infestation of human tissue by the larvae of dipterous flies. While traditionally considered a tropical disease, it represents a growing dual clinical challenge in temperate regions, emerging both as an imported travel-related disease and as a severe nosocomial complication.

Aim of the study: The aim of this review is to systematize current knowledge regarding the changing epidemiology, differences in clinical presentation, modern diagnostics, and strategies for the treatment and prevention of myiasis outside tropical zones.

Materials and Methods: A narrative literature research was conducted using PubMed/MEDLINE and Google Scholar databases, covering the period from 2011 to 2026. A total of 40 peer-reviewed publications were selected, focusing on key reviews, epidemiological studies, and clinical case reports addressing both imported and hospital-acquired infections.

Results: The findings highlight a distinct epidemiological divide. In returning travelers, furuncular myiasis is the most common presentation, typically caused by *Dermatobia hominis* and *Cordylobia anthropophaga*. In contrast, healthcare-associated (nosocomial) myiasis predominantly manifests as wound and cavitary infestations in vulnerable, bedridden patients, caused by cosmopolitan necrophagous flies (e.g., *Musca domestica*, *Lucilia spp.*).

Effective management relies on occlusion methods, mechanical extraction, wound debridement, and the targeted use of ivermectin.

Conclusions: Successfully managing myiasis in temperate regions requires a high index of suspicion. A detailed travel history is essential for accurate, early diagnosis in young travelers to avoid unnecessary antibiotic therapy, while rigorous wound hygiene and environmental vector control are critical to protecting bedridden patients in healthcare facilities.

KEYWORDS

Human Myiasis, Travel Medicine, Nosocomial Infections, Wound Myiasis, *Dermatobia hominis*, *Cordylobia anthropophaga*, Neglected Tropical Diseases

CITATION

Pływak, E. W., Polar, W. P., Sadowska, J., Strzelecka, K., d'Obyrn, Z., Jagodzińska, E., Kamińska, J., Szemberg, A., & Stawicka, M. (2026). Human myiasis in non-tropical regions: From travel-associated to healthcare-associated infections - epidemiology, clinical presentation, diagnosis, treatment, and prevention. *International Journal of Innovative Technologies in Social Science*, 4(52). [https://doi.org/10.31435/ijitss.4\(52\).2026.6696](https://doi.org/10.31435/ijitss.4(52).2026.6696)

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1. Introduction

1.1. Definition and biological background

Myiasis is an invasive disease in which the larvae of insects of the order Diptera infest living or dead human tissue [12]. Depending on the insect's life cycle, this infection may be obligate, facultative, or accidental [24]. Historically, this condition has been inextricably linked to tropical and subtropical climates, where high temperatures and humidity favor the year-round reproduction of these insects [17].

1.2. Changing epidemiology

A dual threat: In recent decades, however, a significant shift in the perspective on this disease has been observed. In temperate-zone countries, myiasis is becoming a growing clinical challenge of a dual nature [37]. On the one hand, the rise of global ecotourism has made it one of the most commonly diagnosed imported skin diseases among travelers returning from Africa and Latin America [19, 37, 38]. On the other hand, the aging of populations in developed countries is resulting in a growing number of geriatric patients, who are often bedridden and have extensive chronic ulcers. This vulnerable group, residing in hospital wards as well as in nursing homes, is particularly susceptible to nosocomial myiasis, caused by cosmopolitan species of flies that infest open wounds [4, 25, 29].

1.3. Purpose of the study

In the medical literature, these two extreme groups of patients are rarely compared. Physicians practicing outside tropical regions often lack adequate clinical vigilance, leading to diagnostic errors and inappropriate treatment [9]. The aim of this review is to systematize current knowledge on human myiasis in non-tropical regions. This study aims to map the changing epidemiology, highlight the clinical differences between imported and nosocomial infections, and provide practical guidance on diagnosis, treatment, and prevention.

2. Materials and methods

This narrative review is based on medical literature from the PubMed/MEDLINE and Google Scholar databases covering the last 15 years (2011-2026). The search was conducted using the following keywords: “myiasis,” “travel-associated myiasis,” “nosocomial myiasis,” “wound myiasis,” “*Dermatobia hominis*,” “*Cordylobia anthropophaga*,” and “temperate climate.”

Forty peer-reviewed scientific articles were included in the final analysis. The included studies comprise observational studies, case series, and review articles that directly address the changing epidemiology, modern diagnostics (including ultrasonography) [9], targeted treatment (e.g., mechanical extraction and ivermectin) [31], and infection prevention in two key patient groups: healthy travelers returning from abroad and bedridden patients in long-term care facilities and hospitals [4, 25, 37].

3. Dual epidemiology: imported and nosocomial myiasis

3.1. Imported infections (travel-related risk)

Globalization and the growing popularity of ecotourism have significantly altered the epidemiological landscape of myiasis in the temperate zone. It is now considered one of the most common dermatoses diagnosed in travel medicine clinics [37]. The highest risk is observed among travelers returning from highly endemic areas, particularly Sub-Saharan Africa and Central and South America [17, 38]. In this dermatographic group, the infection almost exclusively presents as cutaneous or furuncular myiasis. Patients are typically young, generally healthy, and physically active individuals who become infected during outdoor activities in tropical environments [19].

3.2. Healthcare-associated infections (local Susceptibility)

In stark contrast to imported cases, locally acquired myiasis in non-tropical regions primarily affects patient populations with very high susceptibility. This form of the disease typically occurs in the elderly, bedridden patients, or those with significant neurological deficits, impaired consciousness, or psychiatric disorders [4]. Healthcare-associated (nosocomial) myiasis develops when cosmopolitan species of flies enter hospitals or long-term care facilities, attracted by exposed biological material such as chronic ulcers, neoplastic lesions, or puncture and stoma sites (e.g. PEG gastrostomies) [8, 10]. The occurrence of hospital fly infestation is often considered a sentinel event, indicating potential shortcomings in rigorous wound hygiene and insect control in the medical setting [25, 29].

4. Etiology and microbiology

4.1. Major pathogens in travelers

Travel-associated myiasis is primarily caused by two species of obligate parasites: the human botfly (*Dermatobia hominis*), endemic to Central and South America, and the Tumbu fly (*Cordylobia anthropophaga*), found in Sub-Saharan Africa [14, 21]. In the case of *D. hominis*, a unique biological mechanism known as phoresy occurs. The female captures a blood-feeding vector - most commonly a mosquito or tick, and attaches her eggs to its abdomen. When the vector lands on a human's skin to feed, the host's body heat triggers the eggs to hatch, and the released larvae immediately penetrate the skin [9]. Female *C. anthropophaga*, on the other hand, lay their eggs in contaminated soil or on damp clothing drying outdoors. Upon contact with human skin, the larvae penetrate the intact epidermis, leading to the formation of characteristic furuncle - like lesions [21, 36].

4.2. Opportunistic pathogens in healthcare facilities

In hospitals and long-term care facilities, the etiology shifts toward cosmopolitan species of facultative and necrophagous flies. The most common culprits are the housefly (*Musca domestica*), the green bottle fly (*Lucilia sericata*), and flesh flies (*Sarcophaga spp.*) [29]. Unlike primary tropical pathogens, opportunistic species are unable to penetrate healthy skin. Females are strongly attracted to volatile odorous compounds secreted by necrotic tissue, purulent discharge, and exposed body cavities. They fly into hospital wards, where they lay eggs directly in chronic ulcers, non-healing postoperative wounds, or tracheostomy sites [10, 15]. Hatching larvae feed intensively on necrotic tissue and exudate, which quickly leads to the development of massive wound myiasis.

4.3. Secondary bacterial infections and vector-borne pathogens

Mechanical tissue damage caused by burrowing larvae creates a direct entry point for secondary bacterial infections, which significantly complicates wound treatment [12]. Necrophagous flies are also increasingly recognized as mechanical vectors of rare, emerging bacterial pathogens. Recent literature highlights the role of these insects in transmitting bacteria such as *Wohlfahrtiimonas chitiniclastica* and species of the genus *Ignatzschineria*. These highly virulent zoonotic pathogens can cause severe, life-threatening bloodstream infections (bacteremia) and sepsis, especially in immunocompromised patients and geriatric patients with hospital-acquired myiasis [1, 18, 32].

5. Clinical presentation and anatomical distribution

5.1. Cutaneous and furuncular forms

The furuncular form represents the most typical clinical presentation of infections acquired during travel. Clinically, it mimics a bacterial abscess or an insect bite, and is therefore sometimes misdiagnosed as furunculosis resistant to antibiotic therapy [3]. Patients typically present with a painful, erythematous, and itchy nodule with a small opening visible at its center. This structure enables the larva to breathe by allowing its posterior spiracles to come into contact with air [22, 28]. A symptom of high diagnostic value is the discharge of serosanguineous or purulent fluid from this opening. Additionally, patients often describe a distinct sensation of movement under the skin or intermittent, sharp, stabbing pain, which corresponds to the larva's feeding activity and the movements of its spines [36].

5.2. Wound and cavitory myiasis

In healthcare-associated cases, the clinical presentation can range from isolated nodules to massive infestations of exposed tissues. Wound myiasis typically develops within pre-existing skin defects, such as chronic venous ulcers, pressure ulcers, or diabetic foot ulcers [10]. In hospitalized and bedridden patients, opportunistic larvae most commonly colonize puncture sites and stomas, including the area around percutaneous endoscopic gastrostomy (PEG) tubes and tracheostomy tubes [10, 15]. Advanced, necrotic skin tumors are also particularly susceptible, especially squamous cell carcinomas of the head and neck, where extensive necrosis creates an optimal breeding environment for necrophagous flies [6, 35]. Infestations of this severity lead to rapid tissue destruction, significant patient discomfort, and an intense malodor.

5.3 Rare and severe clinical forms

Although cutaneous and wound forms predominate, myiasis can also affect atypical anatomical sites, which often results in severe complications. Untreated ocular and orbital myiasis (ophthalmomyiasis) carries a risk of globe perforation, vision loss, and even infiltration of intracranial structures [16, 20]. Otolaryngological infections, including nasal and ear myiasis, can lead to extensive destruction of cartilage and bone [31]. Less commonly, in non-endemic regions, physicians encounter myiasis of the genitourinary system, in which wounds of the penis or urinary tract are invaded by rat-tailed maggots [26, 30]. In contrast, accidental ingestion of eggs can cause intestinal myiasis, which manifests as abdominal pain, vomiting, and the passage of live larvae in the stool [33].

6. Diagnosis and differential diagnosis

6.1. Clinical assessment and patient history

The diagnosis of myiasis is primarily based on a thorough clinical evaluation combined with a detailed epidemiological history. In non-tropical regions, particular attention should be paid to potential exposure during travel to endemic areas. A history of recent travel to Africa, Latin America, or other regions where obligate myiasis-causing fly species are endemic may provide important diagnostic clues [19, 37, 38]. In patients with cutaneous myiasis following travel, painful or pruritic lesions resembling boils may develop within days to weeks after returning home.

However, travel history is not the only relevant consideration. In cases of myiasis occurring outside endemic regions, social and environmental factors should also be assessed, including living conditions, personal hygiene, the ability to provide adequate wound care, immobility, and the need for long-term care [4, 10, 29]. Cases of myiasis associated with wounds, surgical sites, and medical devices have been reported, indicating that the absence of travel to tropical regions does not exclude the diagnosis. Particular attention should be paid to patients with chronic wounds, neoplastic lesions, stomas, or recent surgical sites [8, 10, 35].

6.2. Modern diagnostic tools

In most cases, a diagnosis can be made based on the clinical picture and direct identification of the larva. Identification of larvae can be based on an assessment of their morphological characteristics, including the structure of body segments and the posterior spiracles [24].

In selected cases, dermatoscopy may be helpful. It allows for a more detailed assessment of the central opening of the lesion and the structures on the larva's surface, including the posterior spiracles, which may appear as yellowish-white structures [12]. Soft-tissue ultrasonography can be particularly useful when the larva is not directly visible. An ultrasound examination can reveal a moving hyperechoic structure corresponding to the larva, allowing its depth to be determined and facilitating safe removal [9]. Microbiological examination of wound material is also critical in chronic wounds, where the presence of larvae may coexist with severe bacterial infections (e.g., *Wohlfahrtiimonas chitiniclastica*) [18, 32].

6.3. Differential diagnosis in non-endemic regions

In non-tropical regions, the diagnosis of myiasis may be delayed due to its relatively low prevalence. The furuncular form poses a particular diagnostic challenge, as it may resemble bacterial folliculitis, an abscess, or an arthropod bite [3, 19]. If there is no response to standard antimicrobial treatment and a central opening persists within the lesion, the possibility of larval infestation should be strongly considered.

In the case of myiasis associated with wounds, the differential diagnosis is even more challenging. Larvae may be misinterpreted as signs of necrosis or purulent infection. This is particularly relevant in patients with limited self-care abilities or underlying malignancy. The definitive diagnosis should therefore be based on a combination of the clinical presentation, epidemiological history, and identification of the larva [4, 12, 24].

7. Treatment and management strategies

7.1. Mechanical and surgical extraction methods

The basis for treating most forms of myiasis is the removal of all live larvae from the affected tissue as quickly as possible. For localized furuncular myiasis, mechanical extraction - usually using tweezers - remains the preferred method. Prior to removal, an occlusive method may be used, which involves sealing the central opening of the lesion with a substance such as petroleum jelly to restrict gas exchange. This prompts the larva to move toward the surface, making it easier to grasp [12, 28].

Extraction should be performed in an atraumatic manner, as tearing the larva and leaving fragments within the tissues can lead to a severe foreign-body inflammatory reaction [36]. In cases of healthcare-associated wound myiasis, treatment should include not only the removal of larvae but also proper surgical debridement of necrotic tissue, which provides a potential environment for further larval development [10, 35]. In cases where larvae are located within body cavities (e.g., nasal cavity, oral cavity, orbit), mechanical extraction may be technically difficult and requires specialized surgical intervention [6, 16, 31].

7.2. Pharmacological interventions

Pharmacological treatment complements mechanical removal, particularly in cases of extensive infestations or hard-to-reach locations. Ivermectin can be administered topically or systemically. Its use has been described in the treatment of nasal myiasis, where topical irrigation with an ivermectin solution was used as an adjunct to eliminate the larvae [31]. However, pharmacotherapy should not automatically replace mechanical extraction.

Antibiotic therapy is not a treatment for the parasitic infestation itself and should not be used routinely solely because of the presence of larvae. Its use must be targeted at clinical or microbiological signs of a secondary bacterial infection. This is critically important if highly virulent bacteria associated with necrophagous flies, such as *Wohlfahrtiimonas chitiniclastica*, are identified in the wound cultures [18, 32].

8. Prevention and infection control

8.1. Pre-travel advice and personal protection

Prevention for travelers to endemic regions should include education on methods to limit contact with vectors. It is recommended to wear protective clothing and use insect repellents [19, 37]. In the case of *Cordylobia anthropophaga* (Tumbu fly), an important aspect of prevention is the proper handling of air-dried clothing. Travelers are advised to thoroughly iron their clothing before wearing it, as high temperatures destroy any fly eggs present on the fabric [12, 19].

8.2. Hospital and long-term care hygiene protocols

In hospital and long-term care settings, the prevention of myiasis requires careful patient care and environmental control. Particular attention should be given to immobilized patients, those with impaired consciousness, and patients with chronic ulcers or stomas [4, 10, 29]. The cornerstone of management is regular assessment of the skin and timely dressing changes to isolate damaged tissue from the external environment. Furthermore, it is necessary to limit insect access to the premises by using mechanical barriers such as insect screens (fly screens) on windows and ensuring the prompt disposal of medical waste and used dressings [25, 29].

9. Discussion

9.1. Clinical pitfalls and the “index of suspicion”

One of the main diagnostic challenges associated with myiasis in non-tropical regions is the limited familiarity with this condition among primary care physicians and dermatologists. A lack of awareness regarding the possibility of a parasitic infestation often leads to the initiation of ineffective antibiotic therapy for presumed boils or abscesses [3, 28]. It is essential to maintain a high index of suspicion and take a thorough travel history, even if several weeks have passed since the patient returned from an endemic area [19, 37]. Conversely, the absence of a travel history should not automatically rule out myiasis in vulnerable, bedridden patients presenting with infested wounds [4, 10, 29].

9.2. Implications of climate change

Climate change and rising average temperatures may affect the geographic distribution of organisms responsible for vector-borne diseases in the future [17]. The potential emergence or establishment of populations of certain fly species in new geographic areas may increase the likelihood of autochthonous cases not associated with prior travel [40]. However, reported cases in Europe and North America are predominantly associated with travel to endemic areas or with hospital environments favoring wound-related opportunistic myiasis.

10. Conclusions

Myiasis in non-tropical regions poses a significant diagnostic and clinical challenge. It should not be viewed solely as a rare imported disease associated with travel to endemic regions. Severe cases frequently occur in hospital and long-term care settings among elderly, bedridden patients with chronic wounds [4, 10, 25]. Early diagnosis in travelers helps avoid unnecessary antibiotic therapy [19, 37], while in hospitalized patients, rapid identification can help limit severe tissue damage [10, 29]. Ultimately, in healthcare settings, the presence of myiasis must be viewed as a sentinel warning sign indicating the urgent need to assess the quality of wound care and environmental vector control [25, 29].

Author Contributions: All authors contributed to the article.

All authors have read and approved the final version of the manuscript and agreed to its submission and publication.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process: In preparing this review, the authors used Google Gemini solely for grammar checking and improving the readability and language of the manuscript. Following the use of this tool, the authors carefully reviewed and edited the generated content as necessary. The authors take full responsibility for the accuracy, integrity, and substantive content of the published manuscript.

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