A SYSTEMATIC REVIEW

Volume - 15 | Issue - 06 | June - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

THE GLOBAL THREAT OF CANDIDA (CANDIDOZYMA) AURIS: A SYSTEMATIC REVIEW BASED ON RECENT TREND (2023–2025)

Medical Microbiology

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ABSTRACT

Background: *Candida (Candidozyma) auris* is an emerging yeast causing invasive infections. Unlike most other *Candida* species, *C. auris* demonstrates an unusual combination of traits that make it particularly difficult to control in healthcare settings. These include multidrug resistance, misidentification by routine laboratory methods, persistence on environmental surfaces, and efficient human-to-human transmission. **Objective:** To systematically review recent evidence (January 2023–September 2025) on *C. auris* epidemiology, antifungal resistance, and infection prevention. **Methods:** Systematic search of PubMed, PubMed Central (PMC), and official health sources like United States Centers for Disease Control and Prevention (CDC), European Centre for Disease Prevention and Control (ECDC), and UK Health Security Agency (UKHSA) was conducted. **Results:** Of 1142 records identified, 31 were included. U.S. surveillance reported 4,523 clinical cases in 2023; globally, C. auris has been reported in more than 60 countries. Mortality in invasive infections ranged 30–72%. Studies demonstrated emerging patterns of echinocandin tolerance and heteroresistance, raising concern for treatment failure and limited therapeutic options. Infection prevention and control (IPC) recommendations highlighted early laboratory identification, contact screening, and strict cleaning measures, particularly in high-risk settings (dialysis, long-term care).**Conclusion:** Transmission is expanding with evolving resistance. Strengthened surveillance and IPC are essential.

KEYWORDS

Candida auris; Candidozyma, Candida, Antifungal

INTRODUCTION

Candida (Candidozyma) auris is an opportunistic yeast that has rapidly emerged as a global health threat since its first description in 2009. Unlike most other *Candida* species, *C. auris* demonstrates an unusual combination of traits that make it particularly difficult to control in healthcare settings. These include multidrug resistance, misidentification by routine laboratory methods, persistence on environmental surfaces, and efficient human-to-human transmission. [1] By 2023, *C. auris* had been reported in more than 60 countries across all inhabited continents.[2,3] In the United States, the Centers for Disease Control and Prevention (CDC) classified *C. auris* as an urgent threat pathogen, citing a rapid increase in cases; more than 4,500 clinical cases were reported in 2023.[4] Globally, the organism has become endemic in some healthcare systems, and its presence in long-term care facilities and dialysis units underscores its ability to exploit vulnerable patient populations.[5] Mortality associated with invasive infections such as candidemia remains alarmingly high, ranging between 30% and 72%.[6] Compounding this problem is its antifungal resistance profile: while most *Candida* species remain susceptible to echinocandins, *C. auris* isolates have demonstrated elevated tolerance, heteroresistance, and in some cases, outright resistance.[7,8] Reports of clade-specific variability further complicate global treatment guidelines.[9]

From an infection control standpoint, *C. auris* presents unique challenges. Unlike bacteria, fungal outbreaks in healthcare settings are relatively rare; however, *C. auris* has demonstrated prolonged survival on surfaces, resistance to common disinfectants, and the ability to colonize patients for months or even years. These characteristics render traditional outbreak containment measures less effective, requiring enhanced laboratory diagnostics, active screening, strict isolation protocols, and rigorous environmental cleaning.[9]

Despite growing recognition of this pathogen, most available literature prior to 2023 consisted of regional outbreak reports or general reviews. With the rapid rise in global incidence during 2023–2025, coupled with emerging evidence on antifungal resistance and updated infection prevention strategies, a timely evaluation of recent findings is urgently needed.The aim of this systematic review is to summarize the most recent (2023–2025) literature on *C. auris*, with a focus on three critical areas: epidemiology (global spread, incidence, and mortality trends), antifungal resistance (mechanisms, clade differences, and clinical impact), and infection prevention and control (IPC) with special emphasis on updated strategies and real-world containment effectiveness.

By consolidating these findings, this review seeks to inform clinicians, researchers, and policymakers about current challenges and guide future interventions against *C. auris.*

Material and methods

Study design and search strategy

This systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. A comprehensive literature search was performed across **PubMed, PubMed Central (PMC), the CDC website, Morbidity and Mortality Weekly Report (MMWR) reports, the European Centre for Disease Prevention and Control (ECDC), and UK Health Security Agency (UKHSA) publications**. The time frame for inclusion was **January 2023 to September 2025** to capture the most recent developments in the epidemiology, antifungal resistance, and infection prevention of *Candida auris*. The following search terms were applied either individually or in combination: *"Candida auris", "multidrug resistance", "antifungal resistance", "epidemiology", "infection control", "outbreak", "emerging fungal pathogen"*. Boolean operators (AND/OR) were used to optimize results.

Inclision and exclusion criteria

Eligibility criteria were defined prior to screening. Studies were included if they: (1) reported clinical or epidemiological data on *Candida auris* during January 2023– September 2025; (2) described antifungal susceptibility or resistance mechanisms; (3) addressed infection prevention or outbreak control strategies; and (4) were published in peer-reviewed journals or issued as official reports by recognized health agencies. Exclusion criteria included: non-English language publications, case reports with fewer than five patients, conference abstracts without full data, and articles not specific to *C. auris*.

Data extraction

Two independent reviewers screened all retrieved titles and abstracts, followed by full-text assessment of potentially relevant studies. Discrepancies were resolved through discussion with a third reviewer. Data were extracted focussing on geographical region, antifungal susceptibility testing, resistance patterns, and infection prevention strategies.

RESULTS

The initial search retrieved 1,142 PubMed/PMC, 78 CDC/MMWR, and 36 ECDC/UKHSA records. Duplicate removal across databases

and agency portals yielded 217 duplicates, leaving 1,039 unique records for screening. Out of 1039 title/abstracts, 812 were excluded at screening (outside scope/time window, non-English, not *C. auris*–specific, conference abstracts without full data, case reports with n<5). 227 **underwent full-text review** of which 196 were excluded with reasons (such as outside 2023–2025 analytic focus; insufficient epidemiology/resistance/IPC data; commentary/editorials only; overlapping datasets without added analysis). Finally, a total of 31 **studies** met eligibility and were included in the qualitative summary as shown in Figure 1. These can be grouped into four key domains: (1) surveillance and epidemiology, (2) outbreak investigations, (3) antifungal resistance mechanisms, and (4) innovative detection methods.

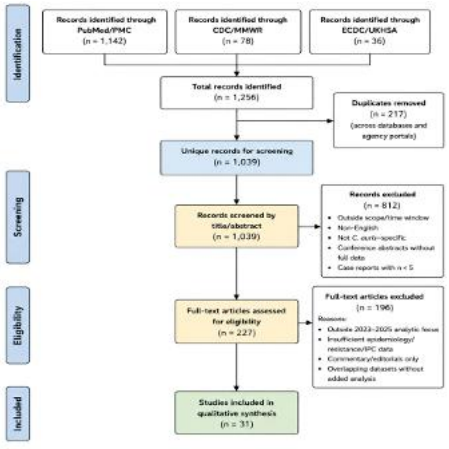

Figure 1. PRISMA flow diagram for systematic review on *Candida auris*

1. Surveillance and epidemiology

Surveillance data continue to underline a strong upward trend. In the United States, clinical cases of *C. auris* surged to 4,523 in 2023, highlighting continued geographic spread and rising burden within healthcare systems.[4] England reported 178 *C. auris* cases in 2024 alone (its highest annual total) with a cumulative count of 637 cases from 2013 to 2024.[10] European Union (EU)/European Economic Area (EEA) surveillance compiled by ECDC reported 4,012 cumulative cases during 2013–2023, including 1,346 in 2023, with multiple countries transitioning to regional endemicity within 5–7 years of first detection, highlighting rapid establishment, absent robust surveillance and notification systems.[11] Jackson Health System in Florida noted a dramatic increase in clinical cultures; from 5 in 2019 to 115 in 2023. All isolates sequenced belonged to clade III (South African), with universal resistance to fluconazole and retained susceptibility to amphotericin B and echinocandins.[12]

2. Outbreak investigations

A multicentric retrospective outbreak study in Mexico (Sept 2020–Dec 2023) reported 37 cases across multiple hospitals in Monterrey. Notably, 32.4% of colonized patients progressed to infection. Fluconazole resistance was widespread, while susceptibility to other antifungals varied. The study also noted prolonged ICU and hospital stay, with an overall mortality of 40.5%.[13] In a study done by Pyrpasopoulou A *et* al from Greece, *C. auris* was implicated in 15.6% of candidemia cases in 2023 and 25.2% in 2024, following its first local detection in 2022. This marked increase in bloodstream infections correlates with persistently high mortality—79.4% in 2023 and 71.3% in 2024—underscoring its lethal impact. [14]

3. Antifungal resistance mechanisms

Laboratory research continues to unveil complex resistance mechanisms. Rasouli Koohi S *et* al. (2023) demonstrated that *C. auris* exhibits antifungal tolerance—a transient, slow-growing drug-tolerant phenotype that reverts to susceptibility over time. Crucially, combining standard antifungals with the adjuvant chloroquine reduced or eliminated both tolerance and resistance in patient-derived isolates.[15] This suggests possible augmentation strategies for current antifungal regimens.

4. Innovative detection methods

Emerging approaches in early detection have also been explored. A CDC-led study by Chavez J *et* al in Utah (2022–2023) showed that wastewater surveillance, using culture, qPCR, and sequencing, detected *C. auris* introduction before clinical cases emerged. This illustrates the potential of community-level surveillance to pre-empt outbreaks and guide timely interventions.[16]

DISCUSSION

This systematic review emphasizes the accelerating global expansion of *Candida auris* as a serious healthcare concern, with recent data from 2023–2025 illustrating its growing epidemiological footprint and persistent clinical challenges.This systematic review emphasizes the accelerating global expansion of *C auris* as a serious healthcare concern, with recent data from 2023–2025 illustrating its growing epidemiological footprint and persistent clinical challenges.The results collectively show that *C. auris* has entrenched itself as a pathogen of international concern, particularly in healthcare facilities, where it thrives under conditions of high antimicrobial use, prolonged hospitalization, and intensive care.

Epidemiological expansion. The sharp rise in *C. auris* incidence across diverse geographies reflects its ability to establish long-term environmental persistence and patient colonization. The United States reported 4,523 cases in 2023, a significant increase compared to earlier years [4], while England recorded its highest annual incidence in 2024 with 178 new cases. [10] Local outbreaks, such as the one in Florida with a significant increase in detection between 2019 and 2023 (from 5 in 2019 to 115 in 2023) [12], and the Monterrey outbreak in Mexico [13], underscore how rapidly *C. auris* can escalate once introduced. The Greek experience, where candidemia attributable to *C. auris* rose from 15.6% in 2023 to 25.2% in 2024 [17], demonstrates how quickly bloodstream infection rates can climb once the pathogen becomes established in hospitals. These findings echo earlier WHO concerns that *C. auris* poses "critical" risk to public health infrastructure, especially where infection control resources are limited.

High mortality and healthcare burden.

Mortality rates remain alarmingly high. Outbreak investigations in Greece documented crude mortality upto 70% [17] while the Mexican multicenter series reported a 40.5% fatality rate.[13] Such outcomes reflect the intrinsic virulence of *C. auris* and the difficulties in timely diagnosis and treatment. The prolonged ICU and hospital stays associated with infection also highlight the economic burden, compounding direct mortality with resource depletion in already strained healthcare systems..[18-20]

Resistance and therapeutic challenges.

Resistance patterns remain consistent with earlier reports, with near-universal fluconazole resistance and variable susceptibility to other antifungals.[10,21-32] The Jackson Health System, Florida experience, where all isolates were resistant to fluconazole but susceptible to amphotericin B and micafungin, exemplifies this emerging resistance pattern.[13]Yet beyond classical resistance, recent research emphasizes the concept of antifungal tolerance, wherein a subpopulation of cells grows slowly despite antifungal pressure, potentially seeding future resistance. The work by Rasouli Koohi S *et* al. (2023) showing that chloroquine reduced both tolerance and resistance in clinical isolates is a particularly significant development , suggesting that drug repurposing may play a future role in mitigating resistance.[15]

Innovations in detection and surveillance.

A notable finding in the reviewed literature is the use of wastewater surveillance for early *C. auris* detection. The Utah study demonstrated that environmental monitoring can reveal pathogen introduction before clinical cases emerge, thereby serving as a valuable adjunct to hospital-based surveillance.[16] This approach has major implications for public health preparedness, as it allows pre-emptive infection control measures at a community level.

Infection prevention and control (IPC)

The reviewed studies reinforce the message that prevention remains the cornerstone of *C. auris* containment. Given the organism's ability to persist in the environment and colonize patients for months, rigorous IPC interventions—hand hygiene, environmental decontamination, patient cohorting, and rapid screening—are indispensable.[33-35] The Mexican outbreak highlighted the link between colonization and subsequent invasive infection, underscoring the importance of early detection and isolation of colonized patients.[13]

Limitations

This systematic review has several limitations. First, it was restricted to English-language sources, which may have excluded relevant studies published in other languages. Second, the database search was limited to PubMed, PMC, and selected public health agency websites, so some evidence from other sources may not have been captured. Third, because of heterogeneity in study design and reporting, a formal meta-analysis could not be performed.

Future perspectives.

Taken together, the 2023–2025 evidence suggests that the epidemiology of *C. auris* is shifting from isolated outbreaks toward endemicity in certain healthcare settings. This trajectory necessitates sustained global surveillance, investments in rapid diagnostics, and antifungal stewardship programs tailored to *C. auris*. Furthermore, translational research on tolerance mechanisms and adjuvant therapies offers new avenues for expanding the currently limited treatment options against *C. auris*. Wastewater surveillance represents a promising adjunct to traditional reporting systems, though its implementation will require standardization and integration into public health frameworks.

CONCLUSION

This systematic review demonstrates that *Candida auris* has transitioned from an emerging pathogen to a global health threat, with cases and outbreaks rising sharply between 2023 and 2025. The evidence shows sustained epidemiological expansion across multiple regions, persistently high mortality rates, and widespread antifungal resistance, particularly to fluconazole. Novel insights into antifungal tolerance highlight the need for innovative therapeutic strategies, including drug repurposing approaches such as chloroquine adjuvant therapy. Advances in surveillance, notably wastewater monitoring, illustrate promising tools for early detection and outbreak prevention, though their integration into public health systems requires further evaluation.

The cumulative findings emphasize that early recognition, strict infection prevention and control, and continuous global surveillance remain the cornerstones of containment. Without intensified efforts to standardize diagnostics, expand antifungal stewardship, and invest in novel therapeutics, *C. auris* will continue to pose a major challenge to healthcare systems worldwide. Coordinated international action is urgently needed to mitigate its impact and prevent endemic establishment in vulnerable regions.

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