REVIEW PAPER

Epidemiology of Upper Respiratory Tract Infections in Saudi Arabia: A Systematic Review

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ABSTRACT
Background: Upper respiratory tract infections (URTIs) are among the most common infectious conditions worldwide and represent a substantial burden on healthcare systems. This systematic review aimed to synthesize current evidence on the epidemiology, etiological agents, seasonal patterns, and risk factors associated with URTIs in Saudi Arabia.
Methods: A comprehensive literature search was conducted in PubMed, Scopus, Web of Science, and Google Scholar for studies published up to December 2025. The review was performed in accordance with the PRISMA 2020 guidelines. Observational studies reporting epidemiological or etiological data on URTIs in Saudi Arabia were included.
Results: Eighteen studies met the inclusion criteria. URTIs were predominantly viral in origin, with rhinoviruses, influenza viruses, respiratory syncytial virus, and endemic coronaviruses most frequently identified. The burden of disease was highest among children and during mass gatherings, particularly Hajj and Umrah. Consistent seasonal peaks were observed during winter months. Across studies, inappropriate antibiotic prescribing for URTIs was commonly reported.
Conclusions: URTIs in Saudi Arabia are largely driven by viral pathogens and exhibit clear seasonal and population-specific patterns. The high rate of inappropriate antibiotic use highlights the need for strengthened antimicrobial stewardship, alongside improved surveillance and targeted public health interventions.
Keywords: Upper respiratory tract infection; Saudi Arabia; epidemiology; respiratory viruses; systematic review

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INTRODUCTION

Upper respiratory tract infections (URTIs) comprise a group of infectious conditions affecting the nasal cavity, pharynx, larynx, and paranasal sinuses, including the common cold, acute pharyngitis, and sinusitis. These infections are predominantly viral in origin and represent the most frequent cause of acute illness worldwide, accounting for a substantial proportion of outpatient visits and healthcare utilization [1]. Although typically self-limiting, URTIs contribute significantly to morbidity, absenteeism, and healthcare costs, particularly in vulnerable populations such as young children and older adults.

The etiological landscape of URTIs is dominated by respiratory viruses, with rhinoviruses, influenza viruses, respiratory syncytial virus (RSV), and endemic human coronaviruses being the most commonly implicated pathogens [7–9]. While bacterial infections account for a smaller proportion of cases, they remain clinically important in specific conditions such as streptococcal pharyngitis, which may require targeted antibiotic therapy. However, the predominance of viral etiologies underscores the limited role of antibiotics in routine URTI management.

In Saudi Arabia, the epidemiology of URTIs is influenced by a unique combination of environmental, demographic, and socio-cultural factors. The Kingdom hosts millions of international visitors annually during the Hajj and Umrah pilgrimages, creating conditions of high population density and close interpersonal contact that facilitate the rapid transmission of respiratory pathogens [2–4]. These mass gatherings represent one of the largest recurrent global public health events and are consistently associated with increased incidence of respiratory infections.

In addition to mass gatherings, environmental factors such as dust storms, air pollution, and climatic variability may further influence respiratory health and susceptibility to infection [5]. Seasonal fluctuations in temperature and humidity are also known to affect viral transmission dynamics, contributing to the observed winter peaks in respiratory infections across the region. Furthermore, population-level factors, including high prevalence of chronic diseases such as diabetes and asthma, may increase vulnerability to respiratory infections and their complications.

Despite the high burden of URTIs and the presence of these distinctive epidemiological drivers, the available literature in Saudi Arabia remains fragmented. Individual studies have examined specific aspects of URTIs, including viral epidemiology, seasonal trends, and antibiotic prescribing practices; however, these findings have not been comprehensively synthesized

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within a single framework. In particular, there is a need to integrate evidence across clinical, microbiological, and public health domains to better understand the overall burden and determinants of URTIs in the Saudi context.

Another important consideration is the persistent issue of **inappropriate antibiotic use** in the management of URTIs. Multiple studies conducted in Saudi Arabia have reported high rates of antibiotic prescribing for conditions that are predominantly viral, often driven by diagnostic uncertainty, patient expectations, and healthcare system factors [11–15]. This practice contributes to the emergence of antimicrobial resistance, which is recognized as a major global health threat.

Given these considerations, a comprehensive synthesis of the available evidence is essential to inform clinical practice and public health policy. This systematic review aims to summarize current evidence on the epidemiology of URTIs in Saudi Arabia, with a focus on etiological agents, seasonal variation, risk factors, and healthcare-related practices, including antibiotic use. By consolidating findings across diverse study settings and populations, this review seeks to provide a clearer understanding of URTI patterns in the Kingdom and to identify key areas for future research and intervention.

METHODS

Study Design and Reporting Framework

This systematic review was conducted in accordance with the **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines** [6]. The methodology was developed a priori to ensure transparency, reproducibility, and methodological rigor.

The objective of this review was to synthesize available evidence on the epidemiology of upper respiratory tract infections (URTIs) in Saudi Arabia, including etiological distribution, seasonal variation, risk factors, and healthcare-related practices such as antibiotic use.

Given the anticipated clinical and methodological heterogeneity across studies, including variations in study populations, designs, diagnostic methods, and outcome definitions, a **quantitative meta-analysis was not planned**. Instead, a **narrative synthesis approach** was adopted to summarize findings across studies.

Search Strategy

A comprehensive and systematic literature search was conducted across PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar (for supplementary search and citation tracking). Studies published from database inception to December 2025 were included, with no restrictions on publication date to ensure comprehensive coverage of the literature.

Search terms were developed using a combination of controlled vocabulary (e.g., MeSH terms in PubMed) and free-text keywords. The core search strategy combined terms related to upper respiratory infections with geographic identifiers for Saudi Arabia. An example PubMed search strategy is provided below:
("upper respiratory tract infection" OR "URTI" OR "respiratory infection" OR "common cold" OR "pharyngitis" OR "sinusitis") AND ("Saudi Arabia" OR "KSA") AND
("epidemiology" OR "prevalence" OR "incidence" OR "seasonality" OR "respiratory viruses")
Boolean operators ("AND", "OR") were used to refine search results. Where applicable, filters were applied to limit results to **human studies and peer-reviewed articles**.

In addition to database searching, **manual screening of reference lists** of relevant articles was performed to identify additional eligible studies. Citation tracking was also conducted using Google Scholar to capture potentially missed studies.

Eligibility Criteria

Eligibility criteria were defined a priori based on the **Population, Exposure, and Outcome framework** relevant to the review objectives.

Inclusion Criteria

Studies were included if they met all of the following criteria:
Studies were included if they met predefined eligibility criteria. Eligible studies were conducted in Saudi Arabia or included populations residing in Saudi Arabia, including subgroups such as children, adults, pilgrims, and healthcare workers. Observational study designs were included, specifically cross-sectional, cohort, case–control, and surveillance-based studies.

Eligible studies reported on upper respiratory tract infections (URTIs) or acute respiratory infections involving the upper airway. Included studies were required to report at least one outcome of interest, such as epidemiological measures (including prevalence, incidence, or disease burden), etiological agents, seasonal patterns, risk factors, or antibiotic prescribing practices and healthcare utilization. Only peer-reviewed articles published in English were considered.

Exclusion Criteria

Studies were excluded if they were case reports, small case series, editorials, or opinion pieces. Review articles without primary data were excluded, although they were used for contextual interpretation where appropriate. Non-human studies were excluded, as were studies focusing exclusively on lower respiratory tract infections (e.g., pneumonia or bronchiolitis without a URTI context). Studies conducted outside Saudi Arabia

without extractable Saudi-specific data and non-English publications were also excluded.

Study Selection Process

A total of 276 records were identified through database searching. After removal of duplicates, 198 unique records remained. Following title and abstract screening, 164 records were excluded due to irrelevance to the study objectives. The full texts of 34 articles were assessed for eligibility. Of these, 16 studies were excluded for the following reasons: not conducted in Saudi Arabia (n = 6), not reporting relevant epidemiological or etiological outcomes (n = 5), focusing exclusively on lower respiratory tract infections (n = 3), and non-primary studies (n = 2). Ultimately, 18 studies met the inclusion criteria and were included in the final synthesis.

Data Extraction

Data were extracted using a standardized form and included study characteristics such as first author and year of publication, study location (region within Saudi Arabia), study design, population characteristics, sample size, and study setting (e.g., primary care, hospital, or mass gathering). Additional data included reported etiological agents and key outcomes, including prevalence, seasonal variation, and antibiotic use.

Risk of Bias Assessment

The methodological quality of included observational studies was assessed using the Newcastle–Ottawa Scale (NOS), which evaluates study quality across three domains: selection (0–4 points), comparability (0–2 points), and outcome or exposure assessment (0–3 points). Total scores range from 0 to 9, with studies categorized as low (7–9 points), moderate (4–6 points), or high (≤3 points) risk of bias. These assessments were used to guide interpretation of the findings but were not used as criteria for study exclusion.

RESULTS

Study Selection

The database search identified 276 records. After removal of duplicates, 198 records remained for title and abstract screening, of which 164 were excluded. A total of 34 full-text articles were assessed for eligibility. Sixteen studies were excluded due to predefined criteria, including non-Saudi populations, lack of relevant outcomes, focus on lower respiratory tract infections, or non-primary study design. Eighteen studies were included in the final synthesis. The study selection process is illustrated in Figure 1

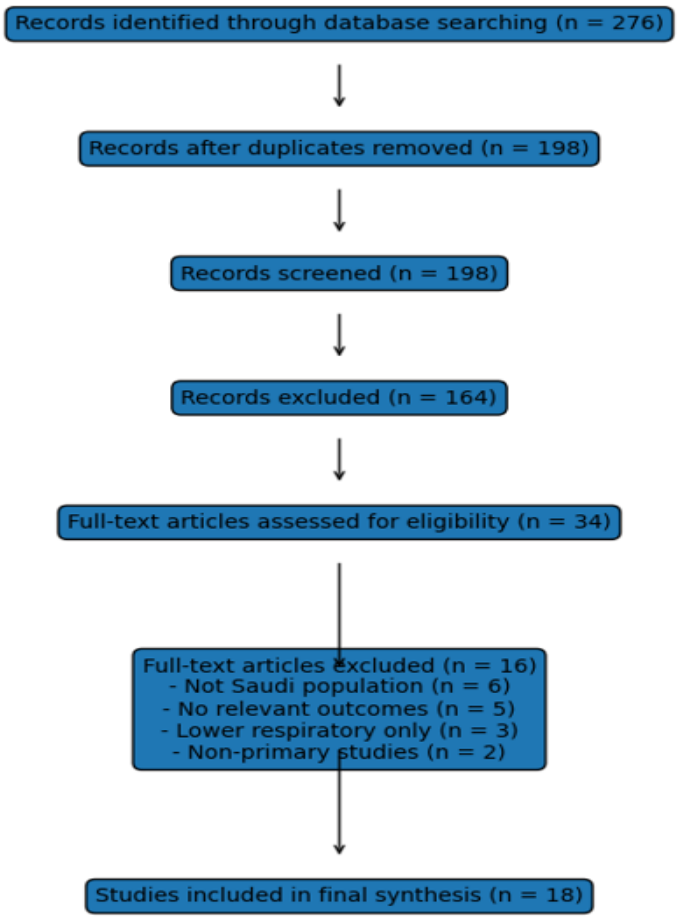

Figure 1. PRISMA flow diagram of study selection.

Study Characteristics
The included studies were conducted between 1999 and 2024 and covered multiple regions of Saudi Arabia, including Riyadh, Makkah, Jeddah, the Eastern Province, Qassim, and Madinah, with several studies incorporating data from mass gatherings such as Hajj and Umrah. Study populations varied and included children, adults, healthcare providers, and international pilgrims.

Most studies were observational in design, with cross-sectional studies being the most common. Sample sizes ranged from fewer than 200 participants in single-center studies to over 1,000 participants in national or surveillance-based analyses. A subset of studies focused specifically on viral pathogen identification using laboratory-confirmed methods, while others relied on clinical diagnoses or self-reported symptoms.

Burden of Disease
URTIs were frequently reported as a leading cause of healthcare utilization in Saudi Arabia, particularly in primary care settings. Studies focusing on community and primary healthcare populations demonstrated that URTIs account for a substantial proportion of outpatient visits, especially among pediatric populations.

Children were identified as the most affected group, with higher incidence rates and frequent recurrent infections. This increased burden among children was attributed to both biological susceptibility and increased exposure in school and household settings. In adult populations, URTIs were also common but generally associated with lower healthcare utilization unless complicated by comorbid conditions.

In the context of mass gatherings, respiratory symptoms consistent with URTIs were among the most frequently reported health complaints among pilgrims, further emphasizing the high burden in these settings.

Etiological Agents
Across studies that reported microbiological data, viral pathogens were identified as the predominant cause of URTIs. The most frequently detected viruses included rhinoviruses, influenza viruses, respiratory syncytial virus (RSV), and endemic human coronaviruses.
Rhinovirus was consistently reported as the leading pathogen, particularly in pediatric populations. Influenza viruses were also commonly identified, especially during seasonal outbreaks. RSV was primarily associated with infections in younger children, while coronaviruses were detected across multiple age groups.

Although bacterial pathogens were less frequently reported, *Streptococcus pyogenes* was identified in cases of acute pharyngitis, representing an important subset of URTIs with implications for antibiotic use. However, the overall proportion of bacterial infections remained substantially lower than viral infections in studies utilizing laboratory confirmation.

Seasonal Patterns
A consistent seasonal trend was observed across multiple studies, with peak incidence of URTIs occurring during the winter months (typically November to February). This pattern was evident in both pediatric and adult populations and was supported by surveillance data from Riyadh and other regions.

Seasonal increases in influenza and RSV activity contributed significantly to these peaks. In contrast, lower incidence rates were observed during the summer months, although sporadic cases continued to occur year-round. The observed seasonal variation aligns with known patterns of respiratory virus transmission influenced by climatic conditions and behavioral factors such as indoor crowding.

Risk Factors
Several studies identified key risk factors associated with increased susceptibility to URTIs. These included age-related vulnerability, particularly among children under five years and older adults; the presence of chronic comorbidities such as asthma and diabetes; environmental exposures, including air pollution and dust storms; smoking exposure, including passive smoking; and crowded living conditions that facilitate person-to-person transmission. Furthermore, studies conducted in mass gathering settings highlighted close physical proximity and prolonged contact as important drivers of transmission.

Mass Gatherings and Transmission Dynamics
Mass gatherings, particularly Hajj and Umrah, were identified as significant drivers of URTI transmission. Studies involving pilgrims consistently reported high rates of respiratory symptoms, often developing shortly after arrival or during the pilgrimage.

The convergence of large populations from diverse geographic regions creates an environment conducive to the rapid spread of respiratory pathogens. Evidence from surveillance and cohort studies indicates that viral respiratory infections are highly prevalent during these events, with transmission occurring through respiratory droplets and close contact.
These findings highlight the importance of preventive measures in mass gathering settings, including vaccination, respiratory hygiene, and crowd management strategies.

Antibiotic Use and Prescribing Patterns
A consistent finding across multiple studies was the high rate of antibiotic prescribing for URTIs, despite their predominantly viral etiology. Studies conducted in primary healthcare settings and hospitals reported that antibiotics were frequently prescribed for conditions

such as the common cold, acute pharyngitis, and nonspecific upper respiratory symptoms.

Physician-related factors contributing to this pattern included diagnostic uncertainty and perceived patient expectations, while patient-related factors included misconceptions regarding the effectiveness of antibiotics for viral infections.
Additionally, self-medication with antibiotics was reported in several studies, further contributing to inappropriate antibiotic use. This practice was influenced by ease of access, lack of awareness, and cultural factors.
Overall, the evidence indicates that inappropriate antibiotic use remains a widespread issue in Saudi Arabia, with implications for antimicrobial resistance and healthcare costs.

Summary of Key Findings
Across the included studies, URTIs in Saudi Arabia were characterized by a predominantly viral etiology, a disproportionately high burden among children and during mass gatherings, consistent seasonal peaks during the winter months, multiple modifiable and non-modifiable risk factors, and a persistently high prevalence of inappropriate antibiotic use.

DISCUSSION

This systematic review provides a focused synthesis of the epidemiology of upper respiratory tract infections (URTIs) in Saudi Arabia, highlighting key patterns in etiology, seasonality, transmission dynamics, and antibiotic use. Overall, the findings indicate that URTIs in Saudi Arabia are predominantly viral, exhibit consistent seasonal variation, and are strongly influenced by population-specific factors, particularly mass gatherings.

The predominance of viral pathogens, including rhinoviruses, influenza viruses, respiratory syncytial virus (RSV), and endemic coronaviruses, is consistent with both regional and global epidemiological data [1,7–9]. This reinforces the understanding that most URTIs are self-limiting infections for which antibiotics offer limited clinical benefit. However, the persistence of antibiotic prescribing in these settings highlights a disconnect between evidence and clinical practice. This gap has also been observed in multiple Saudi studies, suggesting that prescribing behavior may be influenced by patient expectations, diagnostic uncertainty, and time constraints in primary care settings [11–15]. Addressing this issue remains critical, as inappropriate antibiotic use contributes directly to antimicrobial resistance, a growing public health concern both regionally and globally.

Seasonal variation represents another consistent finding across the included studies, with peaks observed during the winter months. This pattern likely reflects a combination of environmental and behavioral factors, including lower temperatures, increased indoor crowding, and changes in viral stability and transmission efficiency [8]. While similar trends are reported globally, the magnitude and consistency of winter peaks in Saudi Arabia suggest that climate-specific factors may play a role. Additionally, environmental exposures such as dust storms and air pollution may exacerbate respiratory vulnerability, although the direct relationship between these factors and URTI incidence requires further investigation [5].

A defining feature of the Saudi epidemiological context is the impact of mass gatherings, particularly Hajj and Umrah. These events create conditions of extreme population density and close interpersonal contact, facilitating rapid transmission of respiratory pathogens [2–4,10]. The international nature of these gatherings further increases the risk of global dissemination of infections. The evidence reviewed here supports previous findings that respiratory infections are among the most common illnesses affecting pilgrims. This underscores the importance of targeted preventive strategies, including vaccination campaigns, public health education, and infection control measures tailored to mass gathering settings.

The burden of URTIs is particularly high among children, who experience higher infection rates and contribute significantly to transmission within households and communities. This is consistent with global epidemiological patterns and reflects both biological susceptibility and social factors such as close contact in schools and childcare environments [7,9]. The implications for healthcare utilization are substantial, as pediatric URTIs account for a large proportion of primary care visits.

Despite the insights provided by this review, several limitations should be considered when interpreting the findings. First, the included studies were predominantly observational and varied in design, population, and outcome definitions, which limits comparability. Second, there is a relative lack of large-scale, nationally representative surveillance data, making it difficult to estimate the true burden of disease at the population level. Third, heterogeneity in diagnostic methods, particularly the use of clinical versus laboratory-confirmed diagnoses, may affect the accuracy of reported etiological patterns.

Future research should focus on strengthening national surveillance systems, incorporating standardized diagnostic approaches, and expanding longitudinal studies to better understand temporal trends. In addition, interventional studies evaluating antimicrobial stewardship programs and public health strategies in the Saudi context are needed. Given the unique challenges posed by mass gatherings, further research on targeted prevention and control measures in these settings is particularly important.

In conclusion, URTIs in Saudi Arabia are characterized by a predominantly viral etiology, clear seasonal patterns, and unique transmission dynamics influenced by mass gatherings. Addressing antibiotic misuse and strengthening surveillance and preventive strategies should be prioritized to reduce the burden of disease and improve healthcare outcomes. These findings are particularly relevant given the high burden of URTIs in primary care settings and the increasing emphasis on antimicrobial stewardship in Saudi Arabia.

Strengths and Limitations

This systematic review provides a focused synthesis of the epidemiology of upper respiratory tract infections (URTIs) in Saudi Arabia, drawing on a diverse body of literature spanning multiple regions, populations, and study designs. A key strength of this review is its **Saudi-specific focus**, which allows for contextualized interpretation of findings in relation to unique epidemiological drivers such as mass gatherings, climatic variability, and healthcare practices. By integrating data from both community-based and mass gathering settings, the review offers a more comprehensive understanding of URTI transmission dynamics within the Kingdom.

Another strength is the inclusion of studies examining **both microbiological and clinical aspects** of URTIs. This enables a more complete assessment of disease patterns, including etiological distribution, seasonal variation, and healthcare utilization. The incorporation of evidence on **antibiotic prescribing practices and patient behavior** further enhances the clinical relevance of the review, particularly in the context of antimicrobial stewardship. In addition, the application of a structured methodology guided by PRISMA principles and the use of a standardized risk-of-bias tool (Newcastle–Ottawa Scale) strengthen the transparency and reproducibility of the review process. The inclusion of studies from diverse regions and settings enhances the external validity of the findings within the Saudi context. Systematic reviews were used only for contextual interpretation and were not included in the primary synthesis.

Despite these strengths, several limitations should be considered. First, the included studies were predominantly **observational in design**, which limits the ability to infer causality and introduces potential sources of bias, including selection bias and residual confounding. Second, there was substantial **heterogeneity across studies** in terms of population characteristics, diagnostic criteria, outcome definitions, and study settings. This variability precluded quantitative synthesis and limited direct comparability between studies.

Third, the **lack of standardized diagnostic approaches** across studies represents an important limitation. While some studies used laboratory-confirmed viral detection methods, others relied on clinical diagnoses or symptom-based definitions, which may lead to misclassification and underestimation of specific etiological agents. Similarly, variability in reporting of outcomes, such as incidence rates or healthcare utilization, limited the ability to derive pooled estimates of disease burden.

Another limitation is the **relative scarcity of large-scale, nationally representative surveillance data**. Most included studies were conducted in specific regions or settings, which may affect the generalizability of findings to the broader Saudi population. In particular, rural populations and certain demographic groups may be underrepresented in the available literature.

In addition, although this review included studies related to mass gatherings, the evidence remains **fragmented and often focused on short-term outcomes**, limiting insights into longer-term transmission dynamics and post-event impacts. The inclusion of systematic reviews and narrative reviews alongside primary studies, while useful for contextual understanding, may also introduce overlap in reported findings.

Finally, the restriction to **English-language, peer-reviewed publications** may have resulted in the exclusion of relevant data published in other languages or in the grey literature, potentially introducing publication bias.

CONCLUSION

Upper respiratory tract infections remain a major public health concern in Saudi Arabia, driven by a combination of viral predominance, seasonal variation, and context-specific transmission dynamics. The findings of this systematic review demonstrate that URTIs are largely caused by viral pathogens, with rhinoviruses, influenza viruses, respiratory syncytial virus, and endemic coronaviruses representing the most commonly identified agents. The burden of disease is particularly high among children and is further amplified during mass gatherings such as Hajj and Umrah, which create unique conditions for rapid transmission.

The consistent seasonal peaks observed during winter months highlight the influence of climatic and behavioral factors on disease patterns, while the identification of multiple risk factors—including age, comorbidities, environmental exposures, and crowded living conditions—underscores the multifactorial nature of URTI transmission in the Saudi context.

A key finding of this review is the persistent **inappropriate use of antibiotics** in the management of URTIs, despite their predominantly viral etiology. This

represents a critical area for intervention, as antibiotic misuse contributes to antimicrobial resistance, increased healthcare costs, and potential adverse effects. Strengthening antimicrobial stewardship programs, improving physician adherence to clinical guidelines, and enhancing public awareness regarding appropriate antibiotic use are essential steps toward addressing this issue.

From a public health perspective, the findings highlight the importance of **strengthening national surveillance systems** to provide more accurate and comprehensive data on URTI burden and trends. Standardization of diagnostic approaches, including increased use of laboratory-confirmed testing, would improve the accuracy of epidemiological assessments and support more targeted interventions.

In the context of mass gatherings, tailored strategies are needed to mitigate the risk of respiratory infection transmission. These may include vaccination programs, health education campaigns, and the implementation of infection prevention measures such as mask use and hand hygiene.

Future research should focus on **large-scale, longitudinal studies** to better characterize temporal trends and identify causal relationships. In addition, interventional studies evaluating the effectiveness of antimicrobial stewardship initiatives and preventive strategies in both community and mass gathering settings are warranted.

In conclusion, reducing the burden of URTIs in Saudi Arabia will require a **multifaceted approach** that integrates improved surveillance, evidence-based clinical practice, targeted public health interventions, and ongoing research. Such efforts are essential to enhance patient outcomes, reduce healthcare burden, and address the growing challenge of antimicrobial resistance.

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