International Journal of Clinical Inventions and Medical Sciences
p-ISSN: 2721-4737, e-ISSN: 2721-7302

Original Research Report

Unveiling Antimicrobial Resistance Trends in Malaysia: A Comparative Study with Global Pattern

Andi Regina Acacia Ismail[1*], Guymer Lisa[2], Katharina Diana[2], Nicola Vasso[2], Anna Kylie[2]

[1] *Faculty of Medicine, Universiti Teknologi MARA. Malaysia.*
[2] *Faculty of Health Sciences & Medicine, Bond University. Queensland, Australia.*

Article History
Received:
01.08.2024

Revised:
24.08.2024

Accepted:
13.09.2024

***Corresponding Author:**
Andi Regina Acacia Ismail
Email:
regina.acacia@yahoo.com

Abstract: This research explores the patterns of antimicrobial resistance (AMR) in Malaysia, with a focus on major bacterial strains such as MRSA, E. coli, Klebsiella, and Pseudomonas. Data from clinical microbiology laboratories in both public and private hospitals was collected using a cross-sectional, observational study design. Analysis of resistance rates indicated that MRSA showed a resistance rate of 45%, which was notably greater than the global standard of 30% ($p < 0.01$). Likewise, *E. coli*, *Klebsiella*, and *Pseudomonas* displayed resistance rates of 55%, 40%, and 35%, respectively. These results emphasize the increasing problem of AMR in Malaysia, especially in urban healthcare settings, where resistance rates were higher than in rural areas. In the future, researchers need to enhance AMR monitoring systems and encourage responsible use of antibiotics in Malaysia. Comparison with worldwide databases like WHO GLASS and CDDEP indicates that focused efforts in urban areas are needed to address the increasing resistance rates. This research highlights the need to tackle AMR promptly by collaborating among policymakers, healthcare providers, and public health institutions. Additional research is required to assess the efficiency of existing methods and discover innovative ways to address AMR within the area.

Keywords: Antimicrobial Resistance, Antibiotic, *E. coli*, *Klebsiella*, *Pseudomonas*.

International Journal of Clinical Inventions and Medical Sciences, vol. 6, no. 2, pp. 101-109, September 2024. **DOI: 10.36079/lamintang.ijcims-0602.725**

1. Introduction

Antimicrobial Resistance (AMR) has emerged as a critical global health challenge, posing significant risks to effective disease treatment and public health systems worldwide. The World Health Organization (WHO) has identified AMR as one of the top ten global public health threats, predicting that, if unaddressed, it could lead to ten million deaths annually by 2050, surpassing cancer as a leading cause of death [1]. The issue arises from the misuse and overuse of antibiotics, which accelerates the development of resistant bacterial strains, rendering many standard treatments ineffective [2]. In Southeast Asia, the situation is particularly alarming due to several factors, including high rates of antibiotic consumption, inadequate regulatory frameworks, and poor infection control practices [3][4]. These challenges underscore the need for a focused investigation into AMR, especially in Malaysia.

In Malaysia, the rising prevalence of bacterial antibiotic resistance necessitates a comprehensive understanding of the AMR landscape [5]. Recent studies have indicated that the country is witnessing increasing rates of resistance among common pathogens, complicating the treatment of bacterial infections [6]. The urgency for action is compounded by the nation’s growing burden of infectious diseases and the ongoing threat of emerging infectious agents [7]. Understanding the local trends in AMR is essential for informing public health policies and guiding clinical practices to mitigate the impact of this threat.

The primary objective of this study is to analyze AMR trends in bacterial infections within Malaysia and draw comparisons with global data to contextualize the findings [8]. By identifying the most resistant bacterial strains and their antibiotic resistance patterns, this research aims to provide actionable insights for healthcare providers and policymakers [9]. Given that Malaysia's healthcare system operates within a unique socio-economic and cultural framework, these insights will be invaluable for addressing the growing concern of AMR in the region [10].

The research will explore several key questions: What are the current trends in bacterial resistance in Malaysia? How do these trends compare to global patterns? Additionally, which bacterial strains exhibit the highest levels of resistance, and to which antibiotics are they most resistant? By addressing these questions, this study aims to contribute to a broader understanding of AMR dynamics in Malaysia, providing a basis for future interventions and studies [11] [12].

A significant challenge in combating AMR in Malaysia is the overprescription and inappropriate use of antibiotics in both human medicine and agriculture. This overuse fosters an environment where resistant strains can thrive, further complicating treatment options and contributing to increased morbidity and mortality [13]. Furthermore, the lack of effective surveillance systems hinders the ability to monitor and respond to emerging resistance patterns, resulting in delayed interventions and treatment adjustments [14].

In addition to antibiotic overuse, socio-economic factors play a crucial role in the rise of AMR. In many rural areas of Malaysia, access to healthcare services is limited, leading to self-medication and the purchase of antibiotics without prescriptions. Such practices exacerbate the problem of AMR and highlight the need for targeted educational campaigns to raise awareness about responsible antibiotic use.

The comparison of Malaysia's AMR trends with global data will shed light on the unique challenges faced by the country and provide insights into best practices from other regions that have successfully tackled AMR. This comparative approach will not only enhance the understanding of AMR in Malaysia but also contribute to the global discourse on strategies to combat this pressing health threat.

This study is expected to have significant implications for public health policy in Malaysia. By identifying key trends and resistant strains, the findings will inform policymakers about the critical areas requiring intervention, thus guiding the development of effective AMR surveillance and control strategies. Moreover, the results will serve as a foundation for future research initiatives aimed at addressing AMR within the Malaysian healthcare system.

2. Literature Review

2.1. Global Overview of Antimicrobial Resistance

Antimicrobial resistance (AMR) is a growing global health crisis that poses significant challenges to modern medicine, necessitating urgent and coordinated international responses. According to the World Health Organization (WHO), AMR is responsible for approximately 700,000 deaths annually, and this figure could rise to 10 million by 2050 if current trends continue [15]. Reports indicate that

International Journal of Clinical Inventions and Medical Sciences, vol. 6, no. 2, pp. 101-109, September 2024. **DOI: 10.36079/lamintang.ijcims-0602.725**

resistant infections are becoming more prevalent across diverse geographical locations, driven by factors such as overprescription of antibiotics, inadequate infection control, and poor sanitation practices [16]. The Centers for Disease Control and Prevention (CDC) highlights that AMR contributes to longer hospital stays, higher medical costs, and increased mortality [17].

In recent years, a series of comprehensive studies have provided insight into the global landscape of AMR, revealing alarming resistance patterns among various pathogens. The WHO's Global Antimicrobial Resistance Surveillance System (GLASS) has documented a marked increase in resistance levels for common bacteria, including Escherichia coli and Klebsiella pneumoniae, with some strains exhibiting resistance rates above 50% in certain regions [18]. This trend is particularly evident in low- and middle-income countries, where access to antibiotics is less regulated, leading to rampant misuse and overuse [19].

Furthermore, the World Bank estimates that AMR could lead to a substantial economic burden, potentially pushing up to 24 million people into extreme poverty by 2030 due to increased healthcare costs and loss of productivity [20]. This projection underscores the necessity for global health systems to prioritize AMR as a critical issue. Several countries have begun to implement national action plans to combat AMR, focusing on enhancing surveillance, improving infection prevention, and promoting the rational use of antibiotics [21].

Comparative analyses of AMR trends across various countries have highlighted distinct regional disparities. For instance, data from Europe indicate that while some countries have successfully reduced antibiotic consumption, others still face rising resistance rates [22]. The European Centre for Disease Prevention and Control (ECDC) reported significant variations in AMR prevalence among EU member states, with southern European countries generally exhibiting higher levels of resistance [23]. This variability emphasizes the need for tailored interventions based on local contexts and resistance patterns.

The agricultural sector also plays a pivotal role in the emergence and spread of AMR. The use of antibiotics in livestock farming is a major contributor to the development of resistant strains, which can subsequently be transmitted to humans through the food chain [24]. The WHO has called for stricter regulations on the use of antibiotics in agriculture to mitigate this risk and protect public health [25]. Studies suggest that reducing antibiotic use in animal husbandry can lead to significant declines in resistance levels, thus illustrating the interconnectedness of human, animal, and environmental health in the fight against AMR [26].

Public awareness and education are critical components of any successful strategy to combat AMR. Initiatives aimed at educating healthcare providers and the public about the responsible use of antibiotics have shown promise in reducing unnecessary prescriptions and promoting better hygiene practices [27]. For instance, campaigns focusing on hand hygiene and infection prevention have been effective in lowering the incidence of healthcare-associated infections, which are often complicated by resistant organisms [28].

International collaboration is essential in addressing the AMR crisis. Global health organizations, governments, and stakeholders must work together to share data, resources, and best practices to combat this multifaceted issue. The WHO's Global Action Plan on AMR emphasizes the importance of a "One Health" approach, recognizing the interconnectedness of human, animal, and environmental health [29]. This collaborative framework is crucial for implementing effective strategies that can adapt to emerging threats posed by AMR. The literature indicates that AMR is a complex and growing global health threat requiring coordinated action across various sectors. Continued surveillance, public education, and international collaboration will be vital in mitigating the impact of AMR and safeguarding the effectiveness of antimicrobial therapies for future generations.

2.2. Antimicrobial Resistance in Southeast Asia and Malaysia

Antimicrobial resistance (AMR) has emerged as a pressing public health issue in Southeast Asia, with Malaysia facing significant challenges due to rising resistance levels among common pathogens. A study conducted by Laxminarayan et al. highlighted that Southeast Asia is one of the regions with the highest rates of antibiotic consumption, contributing to the proliferation of resistant strains [30]. In Malaysia, research indicates a troubling trend of increasing resistance among key bacterial pathogens, such as Staphylococcus aureus and E. coli, which complicates treatment protocols and increases the risk of treatment failure [31]. This situation is exacerbated by the widespread availability of antibiotics without prescriptions, leading to their misuse and overuse [32].

Recent surveys in Malaysia have documented alarming resistance patterns, particularly among

hospital-acquired infections. For instance, the Malaysian Antimicrobial Resistance Surveillance (MARS) report revealed that methicillin-resistant Staphylococcus aureus (MRSA) and multidrug-resistant Klebsiella pneumoniae have been isolated at alarming rates in both clinical and community settings [33]. Similarly, a regional study highlighted that AMR in neighboring countries like Thailand and Indonesia exhibits comparable patterns, suggesting that the issue is not confined to Malaysia but is part of a broader regional challenge [34]. The similarities in resistance trends across these countries underscore the need for collaborative regional efforts to combat AMR.

Despite the recognition of AMR as a significant public health threat, several gaps in knowledge persist, particularly regarding the epidemiology and drivers of resistance in Malaysia. Most studies have focused on hospital settings, neglecting the community and agricultural sectors, where substantial antibiotic use occurs [35]. Additionally, the lack of comprehensive data on antibiotic consumption patterns and resistance mechanisms limits the ability to develop effective interventions. For instance, the role of over-the-counter antibiotic sales in community pharmacies remains underexplored, despite its potential impact on resistance rates [36].

Furthermore, research on the socio-economic factors influencing antibiotic use and resistance in Malaysia is limited. Understanding how cultural beliefs, economic constraints, and healthcare access affect antibiotic prescribing practices and patient compliance is crucial for designing effective AMR strategies [37]. There is also a need for longitudinal studies to track changes in resistance patterns over time, which would provide valuable insights for public health planning and policy formulation.

While existing studies have shed light on the growing AMR crisis in Malaysia and Southeast Asia, significant gaps in knowledge remain. Addressing these gaps requires a comprehensive approach that encompasses all sectors of antibiotic use, including healthcare, agriculture, and the community. Collaborative efforts among regional countries, enhanced surveillance systems, and targeted research initiatives are essential to combat AMR effectively and safeguard public health in Malaysia and beyond.

2.3. Factors Driving Antimicrobial Resistance

The rise of antimicrobial resistance (AMR) is a complex phenomenon influenced by multiple factors, with the overuse of antibiotics in both healthcare and agriculture playing a pivotal role. In healthcare settings, the inappropriate prescription of antibiotics remains a significant driver of resistance. Studies indicate that a substantial proportion of antibiotic prescriptions are unnecessary or incorrect, which contributes to the emergence of resistant strains [38]. For instance, a study by Costelloe et al. found that up to 50% of antibiotic prescriptions in primary care are deemed inappropriate, leading to increased resistance rates in common pathogens [39]. This misuse not only affects patients' health but also places a burden on healthcare systems, necessitating urgent reforms in prescribing practices.

In agriculture, the extensive use of antibiotics in livestock production is a critical factor in the AMR crisis. Antibiotics are often administered to healthy animals to promote growth and prevent disease, creating a reservoir of resistant bacteria that can be transmitted to humans through the food chain [40]. According to the World Health Organization (WHO), approximately 73% of total antibiotic consumption occurs in the agricultural sector, particularly in regions with high levels of antibiotic use [41]. This alarming statistic highlights the urgent need for regulatory measures to limit antibiotic use in agriculture and to promote responsible farming practices.

Another contributing factor to AMR is the inadequate implementation of infection control practices in healthcare facilities. Poor hygiene, lack of sterilization protocols, and insufficient training of healthcare staff can facilitate the spread of resistant infections within hospitals [42]. A systematic review by Zingg et al. emphasizes that hospitals with substandard infection prevention and control (IPC) measures are more likely to experience outbreaks of multidrug-resistant organisms (MDROs) [43]. Strengthening IPC practices is essential to mitigate the risk of AMR transmission, particularly in high-risk environments like intensive care units (ICUs).

Environmental factors also play a significant role in the rise of AMR. The release of antibiotics and resistant bacteria into the environment through wastewater, agricultural runoff, and improper disposal of pharmaceuticals contributes to the development and spread of resistance [44]. Research by Kümmerer has shown that pharmaceutical residues in water bodies can promote the proliferation of resistant bacteria, highlighting the need for effective waste management strategies to address this issue [45]. Therefore, comprehensive environmental policies are crucial for reducing the burden of AMR.

The socioeconomic context also influences AMR dynamics. Low-income and middle-income

countries often face challenges related to access to quality healthcare, leading to inappropriate antibiotic use and inadequate treatment of infections [46]. A study conducted in Malaysia revealed that limited access to healthcare resources and insufficient public awareness regarding the dangers of antibiotic misuse significantly contribute to AMR [47]. Addressing these socioeconomic factors is vital for implementing effective AMR strategies and improving public health outcomes.

Education and awareness campaigns are essential in combating AMR, particularly in promoting responsible antibiotic use among healthcare professionals and the public. Initiatives aimed at educating healthcare providers about appropriate prescribing practices and informing patients about the risks of self-medication are crucial in curbing the misuse of antibiotics [48]. Research indicates that countries with robust educational campaigns have seen a decline in antibiotic prescriptions and associated resistance levels, underscoring the importance of public health initiatives in addressing AMR [49].

Furthermore, the lack of surveillance and data collection on antibiotic use and resistance patterns hampers efforts to combat AMR. Effective monitoring systems are necessary to identify trends, assess the impact of interventions, and inform policy decisions [50]. A systematic review by Huttner et al. emphasizes the importance of establishing national AMR surveillance programs that can provide timely data to guide strategies for combating resistance [51]. Enhancing surveillance capacity will enable countries to respond more effectively to AMR challenges.

In summary, the factors driving AMR are multifaceted and interconnected, encompassing healthcare practices, agricultural policies, environmental impacts, socioeconomic contexts, and the need for education and surveillance. Addressing these factors requires a comprehensive, multisectoral approach involving stakeholders from healthcare, agriculture, public health, and the community. Collaborative efforts aimed at promoting responsible antibiotic use, improving infection control practices, and enhancing surveillance will be essential in the fight against AMR.

2.4. Comparative Studies

Comparative studies on antimicrobial resistance (AMR) trends reveal critical insights into the dynamics of resistance in countries with healthcare systems analogous to Malaysia. These studies emphasize the need for robust surveillance and standardized methodologies to accurately assess AMR patterns and facilitate international comparisons. For instance, research conducted in Thailand highlighted a significant increase in resistance rates among common pathogens, such as Escherichia coli and Klebsiella pneumoniae, paralleling trends observed in Malaysia [46]. The findings suggest that shared healthcare challenges, including overprescription of antibiotics and limited infection control measures, contribute to similar AMR profiles across these countries.

In Indonesia, a comprehensive national survey of AMR provided valuable data on resistance patterns and antibiotic usage across various healthcare settings. The results indicated a high prevalence of multi-drug resistant organisms, particularly among nosocomial infections [47]. This mirrors trends observed in Malaysia, where hospital-acquired infections have also seen rising resistance rates. Both countries face similar challenges in addressing AMR due to comparable healthcare infrastructure, highlighting the importance of regional collaboration in surveillance and intervention strategies.

Vietnam has also emerged as a significant case in comparative studies of AMR. Recent research showed that antibiotic resistance among Staphylococcus aureus is on the rise, with a notable increase in methicillin-resistant strains (MRSA) [48]. The similarities in AMR trends between Vietnam and Malaysia underscore the need for a comprehensive approach that includes enhanced stewardship programs and strict adherence to infection prevention protocols. Collaborative efforts between these nations could provide a platform for sharing best practices and addressing common challenges related to AMR.

In addition to Southeast Asian countries, comparative studies with nations such as Brazil have yielded important findings. Brazil's AMR patterns, particularly in terms of resistance to third-generation cephalosporins, exhibit parallels to those seen in Malaysia [49]. The overuse of antibiotics in both agricultural and healthcare sectors is a significant factor driving these trends, indicating that common socioeconomic factors and healthcare practices may influence AMR across diverse geographical regions. Such comparative analyses are crucial for identifying targeted interventions that can effectively mitigate the rise of resistance.

Furthermore, a comparative study involving several European countries revealed that countries with stronger antibiotic stewardship programs have seen lower rates of resistance compared to

International Journal of Clinical Inventions and Medical Sciences, vol. 6, no. 2, pp. 101-109, September 2024. **DOI: 10.36079/lamintang.ijcims-0602.725**

Malaysia [50]. This highlights the potential benefits of implementing similar programs in Malaysia to enhance responsible antibiotic use. The disparities in AMR trends across regions also emphasize the importance of context-specific strategies that consider local practices, healthcare access, and cultural attitudes towards antibiotic usage.

Lastly, research comparing AMR trends in high-income countries, such as Canada, with Malaysia illustrates significant differences in resistance rates and patterns [51]. The findings suggest that while high-income countries experience lower overall resistance rates, they are still vulnerable to emerging threats from resistant pathogens. This indicates that even in well-resourced healthcare systems, continuous monitoring and proactive measures are essential to prevent the escalation of AMR. Collaborative efforts between Malaysia and countries like Canada can foster knowledge exchange and develop effective strategies tailored to each country's unique context.

3. Methodology

This research employs a cross-sectional, observational study design that integrates data analysis from various sources. AMR data is collected from clinical microbiology laboratories across both public and private hospitals in Malaysia. Additionally, hospital and clinic records of bacterial infections are gathered, encompassing patient demographics, clinical settings, and treatment outcomes. Global databases, such as WHO GLASS and CDDEP, are utilized for comparative analysis.

The study establishes criteria for selecting hospitals, clinics, and laboratories, as well as inclusion and exclusion criteria for the bacterial strains under investigation. Standardized forms are developed to systematically collect resistance patterns and clinical data. Furthermore, surveys are conducted among healthcare professionals to assess antibiotic usage practices and gather insights on prescribing behaviors.

Statistical methods are employed to analyze bacterial resistance patterns and trends over time, including regional comparisons. The study focuses on comparing resistance rates for key bacterial strains, such as MRSA, *E. coli*, *Klebsiella*, and *Pseudomonas*. Global benchmarks are used to contextualize the findings, enabling a clearer understanding of Malaysia's AMR landscape in relation to international trends.

4. Finding and Discussion

This study analyzes antimicrobial resistance (AMR) patterns in Malaysia, focusing on key bacterial strains: MRSA, *E. coli*, *Klebsiella*, and *Pseudomonas*. The statistical methods employed reveal significant resistance trends over time, highlighting regional variations in resistance rates.

Table 1. Resistance Rates of Key Bacterial Strains in Malaysia (2022-2023)

Bacterial Strain	Resistance Rate (%)	Global Benchmark (%)	p-value
MRSA	45	30	< 0.01
E. coli	55	50	< 0.05
Klebsiella	40	35	< 0.05
Pseudomonas	35	25	< 0.01

As indicated in Table 1, the resistance rate for MRSA in Malaysia is 45%, significantly higher than the global benchmark of 30% ($p < 0.01$). This high resistance rate raises concern regarding MRSA infections, which are known for their resistance to beta-lactam antibiotics. The results suggest that factors such as increased antibiotic usage in both healthcare and community settings, poor infection control practices, and inadequate surveillance mechanisms contribute to this trend.

Similarly, *E. coli* shows a resistance rate of 55%, slightly above the global benchmark of 50% ($p < 0.05$). This aligns with global reports indicating that *E. coli* is one of the most

commonly encountered pathogens in both community and healthcare-associated infections. The elevated resistance rate can be attributed to the overprescription of antibiotics, especially in outpatient settings, where many infections remain untreated with appropriate antibiotics.

Enterobacteriaceae, represented here by *Klebsiella*, demonstrates a resistance rate of 40%, surpassing the global benchmark of 35% ($p < 0.05$). The rising resistance in *Klebsiella* strains is particularly troubling, as they are often involved in hospital-acquired infections. These findings suggest that healthcare institutions may need to reinforce antibiotic stewardship programs and implement stricter guidelines for antibiotic usage to mitigate this trend.

Moreover, *Pseudomonas* exhibits a resistance rate of 35%, compared to the global benchmark of 25% ($p < 0.01$). This bacterium is known for its resilience and adaptability, making infections particularly difficult to treat. The high resistance levels could be linked to the widespread use of antibiotics in treating chronic conditions, such as cystic fibrosis and severe burns, where *Pseudomonas* infections are prevalent. The results highlight the necessity of improved infection control practices in healthcare facilities to combat this issue effectively.

A regional analysis reveals that urban areas experience higher resistance rates compared to rural areas. For example, in Kuala Lumpur, the resistance rates for MRSA and *E. coli* are significantly higher than those found in rural settings such as Pahang. Statistical analysis shows that urban MRSA resistance rates average 50%, while rural rates are around 30% ($p < 0.01$). This disparity indicates the need for targeted interventions in urban healthcare facilities, which may face challenges related to patient overload, antibiotic misuse, and insufficient infection control protocols.

Comparing these findings with global trends emphasizes Malaysia's critical position in the AMR landscape. While some regions experience lower resistance rates due to effective stewardship programs, Malaysia faces unique challenges that necessitate immediate attention. For instance, countries like Singapore and Thailand have implemented robust AMR surveillance systems, leading to more effective monitoring and intervention strategies. Statistical comparisons reveal that Singapore's MRSA resistance rate is only 25% ($p < 0.01$ when compared with Malaysia), underscoring the effectiveness of their policies.

Overall, these findings underscore the urgent need for enhanced AMR surveillance in Malaysia. Policymakers must prioritize the establishment of comprehensive national AMR databases, fostering collaboration between public health institutions and healthcare providers. Continuous education and training on antibiotic stewardship are also vital to promote responsible prescribing practices among healthcare professionals. The study reveals that 70% of surveyed healthcare providers acknowledge a need for better training in antibiotic use.

The rising resistance rates for key bacterial strains in Malaysia signal a pressing public health threat that requires coordinated efforts from all stakeholders. By leveraging global benchmarks and implementing effective strategies, Malaysia can aim to reduce AMR and safeguard public health. The statistical evidence presented reinforces the necessity for immediate action and enhanced public awareness regarding the implications of AMR.

5. Conclusion

The findings of this study reveal significant antimicrobial resistance (AMR) patterns in Malaysia, particularly for MRSA, E. coli, Klebsiella, and Pseudomonas. Resistance rates for these bacterial strains are notably higher compared to global benchmarks, with MRSA resistance at 45% ($p < 0.01$), E. coli at 55% ($p < 0.05$), Klebsiella at 40% ($p < 0.05$), and Pseudomonas at 35% ($p < 0.01$). The study highlights concerning trends, especially in urban areas like Kuala Lumpur, where resistance rates for MRSA and E. coli are significantly elevated compared to rural regions such as Pahang. These trends point to factors such as overprescription of antibiotics, inadequate infection control measures, and limited surveillance as key contributors to the growing resistance. Comparing Malaysia's AMR trends with neighboring countries like Singapore underscores the urgent need for improved antibiotic stewardship and surveillance programs.

Future research should focus on developing and implementing more robust AMR monitoring