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Review article

Antimicrobial Resistance in Iraq: A Public Health Emergency in the Shadow of Conflict

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Abstract
Antimicrobial resistance (AMR) is now a serious public health issue in Iraq, with high rates of multidrug-resistant bacteria and significant mortalities associated with it in different healthcare and community settings. Key contributors include the widespread issue of easy over-the-counter access to antibiotics, systemic failures in antibiotic management practices and diagnostic support, and critical gaps in infection prevention and control practices. Furthermore, decades of prolonged conflict have deeply devastated the healthcare infrastructure, displaced medical professionals, and introduced unique environmental contaminants that accelerate resistance development. The absence of a strong, standardized national surveillance system further impedes understanding of the crisis's true scope and evolution. To effectively counter this multifaceted challenge, a coordinated national strategy based on the 'One Health' approach is urgently needed. Policy recommendations include strengthening health system infrastructure and capacity, strictly enforcing antibiotic prescription regulations, implementing national antibiotic management initiatives, enhancing infection prevention and control (including vaccination programs), expanding public education and awareness initiatives, and developing strong national surveillance and research systems. Ultimately, while combating AMR in Iraq requires a profound national commitment, its success equally depends on sustained international collaboration, technical aid, and financial support. International assistance extends beyond simple humanitarian aid. It represents an essential strategic necessity for global health security, unequivocally showing our collective responsibility to combat a widespread problem that threatens every corner of the world. This paper explores the main factors behind the AMR crisis in Iraq and proposes viable resolutions.
Keywords: *Antimicrobial resistance; Iraq; Sensitivity; Conflict; One Health.*

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Introduction

Antimicrobial resistance (AMR) is a rapidly escalating global health crisis, acknowledged as a critical challenge for the 21st century and one of the most critical challenges to modern medicine [1]. Projections indicate that if current trends in antibiotic resistance continue, it could lead to 10 million annual deaths globally and a $100 trillion economic cost by 2050 [2, 3]. In Iraq, this crisis has intensified to emergency levels, with an estimated 3,400 deaths directly attributable to AMR and 12,400 associated deaths in 2019 alone [4]. This makes AMR a more significant cause of mortality in Iraq than various other public health concerns, including self-harm, interpersonal violence, unintentional injuries, maternal and neonatal disorders, transport injuries, and neurological disorders [4]. A multifaceted interaction of factors exacerbates the severity of Iraq's AMR crisis. These include easy access to over-the-counter antibiotics, inadequate antibiotic stewardship and diagnostic support, critical gaps in infection prevention and control practices (IPC), extensive damage to the healthcare system from prolonged conflict, and underdeveloped national surveillance and reporting systems. While AMR is a global challenge affecting countries regardless of their economic development or progress, in Iraq, the problem has reached emergency proportions largely due to years of instability and widespread antibiotic misuse.

This paper aims to review Iraq's current AMR crisis, the key factors involved, and potential solutions, factors associated with such an issue, and find means for Iraq to control AMR by changes to the health system, stronger regulation and stewardship, education, and working together with other countries. This is in line with Iraq's One Health National Action Plan (NAP) on AMR [5].

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The emergency proportions of AMR in Iraq

In Iraq, the AMR crisis has reached particularly acute and emergency proportions, profoundly impacting the nation's public health landscape. The human cost is substantial, with an estimated 3,400 deaths directly attributable to AMR and 12,400 deaths associated with AMR recorded in 2019 [4]. This alarming burden highlights the critical necessity for intervention. To contextualize this burden, it is important to note that AMR-related mortality in Iraq surpasses that from other major public health concerns, including self-harm and interpersonal violence, unintentional injuries, maternal and neonatal disorders, transport injuries, and neurological disorders [4]. These numbers highlight how urgently Iraq needs targeted intervention.

A critical factor contributing to Iraq's severe AMR burden is its history of prolonged conflict. This historical context is not merely a backdrop; it is a fundamental driver of the current crisis. Indeed, the combined impact of decades of wars and instability, leading to destroyed healthcare infrastructure, inappropriate antimicrobial therapies, limited resources, significant heavy metal contamination in both humans and the environment, and inadequate water, sanitation, and hygiene services, has likely been pivotal in the catastrophic rise of antibiotic resistance in Iraq, with serious implications for its spread regionally and globally [6]. While AMR in other places may stem from medical overuse, Iraq’s case is different—decades of instability have made the crisis worse [6].

Alignment with Iraq’s One Health National Action Plan (NAP)

Recognizing the complex and interconnected nature of AMR, Iraq has proactively developed a NAP to combat this threat [5]. This plan aligns with the internationally recognized "One Health" approach, which recognizes that solving AMR requires cooperation across human, animal, and environmental health, food and agriculture sectors to prevent thoughtless antimicrobial use and slow down resistance [5]. This original plan focused on five priorities: improving understanding, strengthening surveillance and research, reducing infections through better sanitation and hygiene, optimizing how antimicrobials are used in both human and animal health, and encouraging investment in new diagnostic and treatment tools [5].

Continuing this effort, Iraq recently released its updated NAP for 2026–2030, an important step in its fight against AMR [7]. This new plan, put together during a national workshop with many different groups, including ministries, UN agencies, and private businesses, again show the importance of the One Health approach. It ensures that efforts are coordinated across human, animal, and environmental health sectors [7]. The workshop also made sure the updated NAP is technically sound, relevant to Iraq's local situation, and practical with clear, measurable goals, showing Iraq's sustained dedication to integrated, multi-sectoral actions against the growing AMR crisis.

Prevalence of multidrug-resistant (MDR) organisms in Iraqi healthcare settings

Iraq encounters a substantial challenge with multidrug-resistant (MDR) organisms, which are difficult to treat and often lead to poor patient outcomes. A study from hospitals in Najaf found extremely high rates of resistant bacteria. The analysis demonstrated an exceptionally high prevalence of MDR bacteria, reaching 88% [8]. Furthermore, the study identified a concerning presence of extensively drug-resistant (XDR) bacteria at 23% and pan-drug-resistant (PDR) bacteria at 2%, indicating pathogens resistant to nearly all available antibiotics. Specifically, Methicillin-resistant Staphylococcus Aureus (MRSA) was found in 73% of patients infected with Staphylococcus bacteria, while Extended-spectrum beta-lactamase (ESBL)-producing Enterobacteria were present in 56% of infected patients. Carbapenem resistance was also noted in 25% of patients with various bacterial infections. The study also found that people with higher education were less likely to have MDR infections [8]. A recent study from Duhok investigating E. coli in urine samples found that 96.14% had at least one antibiotic resistance, and among these, 57% were MDR, 42% were XDR, and 1% were PDR [9].

In both hospitals and communities, Iraq has big issues with MDR organisms that are difficult to treat, leading to deleterious outcomes. For example, hospitals encounter numerous MRSA and Gram-negative "superbugs" infections while community clinics experience urinary and respiratory infections that don't respond to treatment [10, 11]. Such high levels of resistance make it harder to treat infections and increase mortality. The wide range of resistance mechanisms and pathogens involved calls for a broad and flexible approach to intervention strategies.

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Methicillin-resistant Staphylococcus aureus (MRSA)

The study in Najaf Province, as previously discussed, identified MRSA in 73% of patients infected with Staphylococcus bacteria [8]. Further evidence comes from a combat support hospital in Baghdad, where data from 2005 to 2009 showed that approximately 46.1% of S. aureus isolates were MRSA, with an increasing trend over the years [12]. This particular study also observed that MRSA was isolated more frequently from U.S. military personnel and, significantly, that most of these MRSA infections were community-acquired, with limited spread within healthcare settings [12]. Nasal carriage of S. aureus may be associated with surgical site infections [13]. A 2017 study in Kurdistan region found that 22.5% of healthcare workers were S. aureus carriers compared with 18.7% of non-healthcare workers. In the same study, 61% of healthcare worker strains were MRSA compared with 21.6% from non-healthcare workers [14]. Expanding on these examples, a systematic review examining MRSA prevalence across the Kurdistan Region, which included studies from Zakho, Duhok, Erbil, Sulaimani, and Kirkuk, confirms these varying but often high rates of MRSA, particularly among patients with urinary tract infections (UTIs), diabetic foot infections, and infections among healthcare workers [15]. This review further highlighted the genetic characteristics of MRSA in the region, identifying the mecA gene as the predominant resistant gene in 52% of isolates, alongside other virulence genes such as nuc (24%), PVL (21%), and icaA (3%) [15]. The distribution of MRSA was also found to be unequal across cities, with Duhok reporting the highest incidence (approximately 700 cases), followed by Erbil (442 cases), Kirkuk (300 cases), and Sulaymaniyah showing the lowest number of reported cases (100) [15]. This shows that fighting AMR needs action not just in hospitals but also in the community.

Gram-negative superbugs

Iraqi hospitals frequently encounter these highly resistant organisms known as Gram-negative superbugs such as Pseudomonas aeruginosa and Klebsiella pneumoniae [16, 17]. The study conducted in Najaf Province, as mentioned earlier, reported that ESBLs were prevalent, reaching 56% among patients infected with Enterobacteria [8]. Additionally, carbapenem resistance was observed in 25% of patients with various bacterial infections [8]. Another study conducted at the Central Pediatric Teaching Hospital in Baghdad assessed imipenem resistance among Gram-negative bacteria isolated from pediatric patients. Analysis of 100 clinical samples collected between October 2020 and August 2021 revealed imipenem resistance in Klebsiella pneumoniae (21%), Pseudomonas aeruginosa (19%), and Acinetobacter baumannii (16%) [18]. Furthermore, an investigation conducted in a deployed US military medical facility in Iraq revealed that MDR organisms predominantly came from newly admitted host-nation patients, suggesting a baseline colonization with MDR organisms within the community [19]. Alarmingly, bacteria with genetic patterns matching those from host-nation patients were later isolated from environmental surfaces within the facility. This highlights a continuous cycle of transmission between the community, healthcare settings, and the environment [19]. The most frequently identified resistant strains of bacteria in military wounds from Iraq and Afghanistan include Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter calcoaceticus-baumannii complex [20].
This interconnectedness reinforces the necessity of the "One Health" approach, as environmental reservoirs and community practices directly contribute to the clinical challenge of AMR. Effective control requires breaking transmission chains across all these interconnected domains.

Community-level antibiotic-resistant infections

In community infections like UTIs, research in Najaf shows rising resistance to common antibiotics [21]. E. coli and Klebsiella were identified as the most frequently isolated Gram-negative bacteria, demonstrating the highest resistance rate among all bacteria [21]. The highest resistance was seen with gentamicin and ampicillin, while imipenem and amikacin were found to be the most effective agents [21]. This trend highlights the diminishing efficacy of common first-line treatments for prevalent community-acquired infections. Another study in Duhok identified varying antibiotic resistance patterns among uropathogens and concluded that empirical therapy should be based on local sensitivity patterns [22]. An example of such local data is the randomized controlled trial conducted in Kurdistan region that confirmed similar success rates of clarithromycin- to levofloxacin-based therapy in eradicating H. pylori [23].
Similarly, in respiratory tract infections within Basrah, prevailing parental attitudes often lead to inappropriate antibiotic prescriptions for upper respiratory tract infections, thereby fueling antibiotic resistance [24]. Although most respiratory tract infections are viral, antibiotics are often given unnecessarily, a trend especially noticeable in cases of tonsillitis and the common cold [25]. This kind of misuse puts pressure on bacteria to evolve, spreading resistance beyond hospitals. Table 1 provides a summary of key MDR organisms and their reported prevalence in Iraq.

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Table 1. Key MDR organisms and their prevalence in Iraqi healthcare and community settings.

Organism/resistance type	Prevalence rate	Context and reference
MDR bacteria (overall)	88%	Hospitals, Najaf Province (8)
XDR bacteria	23%	Hospitals, Najaf Province (8)
PDR bacteria	2%	Hospitals, Najaf Province (8)
MRSA	73%	Hospitals, Najaf Province (8)
MRSA	46.1%	Combat support hospital, Baghdad (2005-2009) (12)
MRSA	75.7%	Community UTIs, Zakho, Kurdistan Region (15)
Penicillin resistance (*MRSA)*	>90%	Iraqi hospitals (25)
Erythromycin resistance (*MRSA)*	91.1%	Iraqi hospitals (25)
ESBLs-*Enterobacteria*	56%	Hospitals, Najaf Province (8)
Carbapenem resistance (overall)	25%	Hospitals, Najaf Province (8)
Imipenem resistance (*K. pneumoniae*)	21%	Central pediatric teaching hospital, Baghdad (17)
Imipenem resistance (*P. aeruginosa*)	19%	Central pediatric teaching hospital, Baghdad (17)
Imipenem resistance (*A. baumannii*)	16%	Central pediatric teaching hospital, Baghdad (17)

Factors associated with high AMR in Iraq

We believe the following factors are the main reasons associated with high AMR rate in Iraq.

Easy over-the-counter antibiotic access

One key factor driving AMR in Iraq is the widespread and often ***uncontrolled*** access to antibiotics without a prescription, even though this practice is against the law. This problem is deeply rooted in community habits, with 63% of parents admitting to giving antibiotics to their children without a doctor's order, and 42% discontinuing treatment once symptoms improved [26]. For over half of the people surveyed, pharmacists were the main source of information about antibiotics [26]. Separately, A national survey of Iraqi community pharmacists found that although 61.6% oppose dispensing antimicrobials without a prescription, they frequently do so due to pragmatic pressures [27]. Additionally, 50–74% of patients visiting pharmacies request antibiotics without prescriptions, mainly for colds, flu, and UTIs [27], further driving inappropriate dispensing practices. Most people (82.7%) go to pharmacies instead of doctors for antibiotics because of cost concerns rather than for consultation and diagnostic services [27]. This practice has contributed to a self-reinforcing cycle: public demand for antibiotics—often based on the misconception that they are effective against viral infections—places pharmacists in a difficult position [28]. Many feels pressured to supply antibiotics rather than risk losing business to competitors, which in turn perpetuates inappropriate usage. This dynamic contributes significantly to the development of AMR and reflects a broader systemic and behavioral challenge. This has led to widespread misuse, poor public understanding, and rising resistance within communities.

Poor antibiotic stewardship and diagnostic support

Poor management of antibiotic use and limited diagnostic services are major drivers of AMR in Iraq. Research indicates that most physicians in public hospitals frequently prescribe antibiotics empirically, without relying on culture and sensitivity tests [29]. For instance, a study across three major public hospitals in Baghdad found that only 2% of antibiotic prescriptions were based on bacterial culture and sensitivity testing [27]. Similarly, a point prevalence survey in five main Baghdad hospitals revealed that 98.8% of antibiotics were prescribed empirically, with culture and sensitivity tests conducted for a mere 1.2% of patients [29].

The problem is worsened by the absence of national prescribing guidelines for antibiotics. The availability of such guidelines for antimicrobial prescribing in Iraq ranged from 0% to a maximum of 7%, a sharp contrast to optimal rates like Jordan's 95.8% [30]. Furthermore, the documentation rate for stopping or reviewing prescriptions was approximately 0.4%, and only 1.2% of prescriptions were for targeted antibiotics [30]. This lack of structure means doctors often prescribe antibiotics without clear guidance, leading to overuse. The limited diagnostic capacity, mainly due to technological and resource constraints, directly impedes the rational use of antibiotics [31]. Without proper testing, doctors can't target specific bacteria, increasing the chance of resistance developing. They represent a fundamental barrier to customizing treatment for specific pathogens and their resistance profiles, thus creating immense selective pressure for resistance.

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Infection control gaps

Weak IPC practices in Iraq's healthcare system are making the AMR crisis worse. Many hospitals in the country lack essential IPC measures. During the COVID-19 pandemic, while most hospitals (85%) had implemented IPC measures and accompanying training, one major gap was that ***fewer*** than 60% of patient rooms had visitor restrictions [32]. Healthcare workers in direct contact with patients consistently reported insufficient Personal Protective Equipment (PPE) across all types of facilities. Hospitals generally did not achieve an 80% positive response for preparedness regarding critical infection control procedures such as isolating patients or controlling visitor flow [32].

Studies have also identified considerable gaps in infection control knowledge and practices among nurses. In Erbil, for instance, a study indicated that a majority of ***health*** staff (57%) had only 'Medium knowledge' of infection control, with 38.8% showing 'Good' and 4.3% 'poor' knowledge [33]. Similarly, a large proportion (78.3%) held a 'medium attitude' toward infection control, while only 1.7% demonstrated a 'good attitude' and 20% a 'poor' one [33].

Overcrowding in healthcare facilities, particularly during large events like the Arbaeen pilgrimage (Annual pilgrimage to Karbala), intensifies infection risks, ***imposes*** communicable disease health risks, and strains the limited healthcare infrastructure and services of the area [34]. A significant portion of injuries during such events is directly linked to overcrowding [34]. Compounding these issues is a severe healthcare workforce shortage. Iraq has only 10 healthcare workers per 10,000 people, which is considerably lower than the WHO recommendation of 25 per 10,000 [35]. Community-based healthcare facilities, often the primary points of contact for patients, experience a large shortage of trained human resources and medical supplies [36]. This combination of inadequate infrastructure, insufficient resources, and untrained staff creates an environment where resistant pathogens can easily spread.

Conflict and healthcare system damage

Years of conflict in Iraq have severely weakened the healthcare system and contributed directly to the rise of AMR. Decades of wars and conflict in Iraq have led to a catastrophic rise in antibiotic resistance. The spread of resistance is tied to damaged hospitals, shortages of medications, resource limitations, environmental contamination, inadequate sanitation and immigration of refugees [37-39]. Between 2000 and 2020, major conflicts and the COVID-19 pandemic caused serious setbacks in healthcare service ***coverage***, with Iraq facing the COVID-19 pandemic before its health service coverage had even recovered to pre-conflict levels [40]. This indicates that conflict is not just a historical event but an ongoing, complex factor driving AMR, creating a perfect storm for resistance to flourish. The conflicts have also caused a significant displacement of medical workers. Nearly half of Iraq's healthcare workers have left the country since 2014, largely due to violence and unsafe working conditions [41]. This exodus of skilled personnel severely weakens the capacity of the remaining healthcare system. Field hospitals, often improvised and under-resourced during prolonged conflicts, struggled to adhere to infection control measures and manage battle-related injuries using evidence-based approaches. Reviews of deployed medical treatment facilities in Iraq and Afghanistan further indicated that standard IPC practices were not being implemented consistently [42]. Furthermore, poor sanitation and environmental pollution in post-conflict settings further worsen infections and increase antibiotic use. The impacts of conflict drive pathways of exposure to toxic remnants of war and environmental contaminants in settings of forced displacement and broken infrastructure [43]. This environmental degradation, including negative effects on water and sanitation, contributes to toxic waste production [43]. Cholera outbreaks, often seen during and after conflicts, are linked to unsafe water, poor sanitation, and crowded living conditions [44]. This complex interplay of destruction, human resource depletion, disrupted services, and new environmental pressures means that addressing AMR in Iraq must be part of a wider recovery effort focused on rebuilding healthcare systems and addressing environmental risks.

Weak surveillance and reporting systems

One major barrier to fighting AMR in Iraq is the lack of a unified national system to track resistant infections. Iraq does not yet have a nationwide platform to collect and analyze data on antibiotic resistance. This issue is not unique to Iraq, but is common in Low- and Middle-Income Countries (LMICs), where surveillance systems often tend to be weaker due to limited resources and infrastructure [45]. As a result, much of the existing information on AMR comes from limited studies by small research teams with restricted funding [46]. This fragmentation results in a lack of standardization in the methodological ***approach*** to AMR research across the Middle East [47]. Countries affected by conflict, such as Iraq, tend to have fewer monitoring centers and weaker reporting networks than non-conflict countries [48]. In such zones, AMR surveillance can become an unaffordable luxury due to challenges like disrupted communication, interrupted internet access, and the lack of physical connectivity between laboratories and hospitals

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[48]. The absence of robust, standardized national surveillance means Iraq lacks the real-time, comprehensive data necessary to understand the true scope of its AMR problem, identify emerging threats, and effectively measure the impact of interventions. This data deficit hinders evidence-based policy-making and efficient resource allocation, effectively blinding public health authorities to the evolving crisis. The reliance on fragmented, unstandardized data also makes regional and global comparisons difficult, isolating Iraq from broader collaborative efforts and making it difficult for Iraq to engage in global efforts such as the WHO's global AMR and use surveillance system (GLASS) program [49].

Policy recommendations to combat AMR in Iraq

Addressing AMR in Iraq requires a multifaceted strategy that addresses the root causes. We propose the following evidence-based, actionable policy measures:

Strengthen health system infrastructure and capacity

This includes strengthening lab testing capabilities and expanding surveillance in areas affected by conflict, which is crucial for understanding how serious GLASS-priority pathogens are among vulnerable civilian populations [50]. Capacity-building initiatives are broad, including developing laboratory infrastructure, strengthening host-country disease surveillance programs, transferring technical expertise, and training personnel.

Iraq faces a critical human resource deficit, with only 10 healthcare workers per 10,000 people, a figure significantly lower than the WHO recommendation of 25 per 10,000 [43]. Addressing this requires prioritizing investments in primary healthcare infrastructure and increasing the number of healthcare workers to move towards universal health coverage. A vital strategy is to encourage skilled medical professionals who emigrated due to conflict to return and train new ones, thereby rebuilding the depleted workforce. Strengthening the healthcare system is essential for any long-term solution to the AMR problem.

Enforce antibiotic prescription regulations

Enforcing prescription-only rules for antibiotics is essential to reduce misuse in Iraq. Other LMICs have used effective strategies to prohibit over the counter sales of systemic antibiotics, including pharmacies retaining prescriptions for antibiotics, government inspections, engaging pharmacists in the design of interventions, media campaigns for the general public, and educational activities for healthcare workers [51]. Regular inspections and the application of penalties to pharmacies found dispensing antibiotics without valid prescriptions are important deterrents. Simultaneously, implementing public awareness campaigns that highlight the substantial risks of antibiotic misuse is essential to shift public behavior. This approach aims to bridge the significant gap between policy commitment and actual implementation. While Iraq has national action plans and coordinating committees, the current reality of widespread empirical prescribing and low guideline adherence demonstrates that policy formulation alone is insufficient. Long-term progress will require strong political support, real-world enforcement, and better public understanding of the risks of antibiotic misuse.

Implement national antimicrobial stewardship programs

Iraq urgently needs national guidelines that reflect its local antibiotic resistance trends, given the current low availability of such guidelines [30]. National guidelines have been shown to improve how antibiotics are used—making treatment more effective and reducing unnecessary prescriptions, also enhancing antibiotic selection, dose, duration, and route of administration, while also lowering costs and minimizing antimicrobial side effects [52]. The Iraqi Ministry of Health's approval of an AMR National Coordinating Committee in 2017, intending to prevent the emergence and spread of AMR among the Iraqi people, signifies a foundational step [5]. Studies from LMICs indicate that most AMR interventions report a positive effect for hospitalized patients [53].

Enhance Infection Prevention and Control (IPC)

Improving IPC practices is essential across all levels of Iraq's healthcare system. Key IPC practices, including contact control, hand hygiene, personal protective equipment, disinfection, and environmental cleaning, are critical to prevent pathogen transmission. Although most hospitals introduced IPC protocols and staff training during the COVID-19 pandemic, challenges persisted, such as insufficient PPE and inadequate adherence to patient isolation protocols [32].

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Healthcare workers require consistent training, access to appropriate PPE, and proper disinfectants to effectively implement these measures.

In addition to IPC, promoting a culture of safety and expanding vaccine access are also crucial strategies. Vaccines play a role in AMR control by preventing bacterial and viral infections, thereby reducing the use or misuse of antibiotics, and by preventing antibiotic-resistant infections [54]. By reducing the incidence of infections, vaccination programs directly decrease the demand for antibiotics, consequently alleviating the selective pressure that drives resistance. For Iraq, with its compromised healthcare infrastructure, re-establishing and strengthening vaccination programs offers a practical and affordable way to reduce infections and ease the pressure that drives AMR [5].

Public education and awareness

National efforts to improve public understanding of antibiotic use and resistance are urgently needed. Studies indicate that public awareness regarding antibiotic resistance largely remains unrecognized in Baghdad, with many participants lacking sufficient knowledge about the indications for antibiotic use and the consequences of their overuse or misuse [55]. That's why public education campaigns are necessary to explain how and when antibiotics should be used [25].

Sharing clear, reliable information through schools, media, and online platforms is essential. Partnering with respected local leaders can help spread the message and encourage behavior change. Individuals who are better informed about antibiotics are demonstrably less likely to misuse them. Engaging local stakeholders and understanding cultural nuances is important for this approach to achieve sustainable change, so that these educational efforts connect with the public and lead to lasting improvements.

Surveillance and research expansion

The WHO GLASS plan offers a structure for sharing reliable AMR and antibiotic use data worldwide [49]. Upgrading existing laboratories and establishing mechanisms to share data quickly are essential steps to enable Iraq's full participation in the WHO GLASS plans. Specifically, enhancing laboratory diagnostic capacity and improving surveillance in conflict-affected settings are required to assess the burden of GLASS priority pathogens in vulnerable non-combatant populations [50]. A reliable data system is key to designing targeted responses and tracking progress.

International support and collaboration

Addressing AMR in Iraq requires sustained international support and collaboration. Working closely with organizations such as WHO and other international bodies is essential for securing technical and financial assistance [7]. The updated Iraqi NAP explicitly relies on strong national and international collaboration to meet its vital objectives [7]. Global collaboration helps not just with funding, but also with research, data sharing, and policy implementation. Exchanging AMR data and best practices globally can provide valuable insights and accelerate progress. The interconnectedness of global health dictates that the AMR problem is not limited to conflict zones. Populations displaced by war flee to other areas or countries, thereby spreading and contributing to the global AMR problem, with far-reaching consequences for healthcare systems everywhere [43]. This underscores that AMR in Iraq is not merely a national problem but a global concern with direct international implications. Therefore, international support is not solely an act of humanitarian aid but a strategic imperative for global health security. Furthermore, investing in training Iraqi scientists abroad is crucial to enhance their skills and build local capacity for AMR research and control within the country. This shifts the narrative from charity to shared responsibility, recognizing that unaddressed AMR in one region poses a threat to all.

Conclusions

AMR in Iraq is not just a health concern—it is a systemic crisis caused by years of instability, weak regulation, and infrastructure collapse. This is evidenced by an extremely high prevalence of MDR bacteria with 3,400 deaths attributable to AMR and 12,400 deaths associated with AMR in 2019. The root causes are not singular but interconnected, involving multiple overlapping failures in the health system and beyond. Easy access to antibiotics without prescriptions, combined with poor oversight and limited diagnostics, continues to drive resistance. Weak infection control, along with a shortage of trained staff and damaged infrastructure, makes it easier for resistant bacteria to spread. Years of war have worsened the problem by damaging health services, forcing professionals to leave, and polluting the environment. Compounding everything, without a functioning national monitoring system, Iraq lacks a clear understanding of how the AMR crisis is evolving.

To effectively counter AMR in Iraq, it demands an immediate, comprehensive "One Health" strategy. This approach must break down traditional departmental divisions, integrating efforts across human, animal, and environmental health. Crucially, Iraq must implement strong national plans that rebuild healthcare services, enforce prescription laws, and promote responsible antibiotic use. Alongside these, Major investments in infection control, vaccination programs, and public awareness campaigns are essential to reduce misuse.

Ultimately, while the fight against AMR in Iraq requires consistent national commitment and political will, its success also critically depends on sustained international collaboration, technical aid, and financial support. Unchecked AMR in conflict zones like Iraq has serious consequences for global health, as resistant infections can easily spread across borders. Therefore, international assistance is not just humanitarian, it is a vital part of protecting international health and safety from a growing global threat.

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