Journal of Iranian Medical Council, Volume 10, Issue no. 1
http://dx.doi.org/10.18502/jimc.v10i1.23289

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The Antibiotic Overuse Trap: Safeguarding Children's Future against Superbugs

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Received: 10 Sept 2025
Accepted: 2 Feb 2026

Citation to this article
Abdollahi R. The Antibiotic Overuse Trap: Safeguarding Children's Future against Superbugs. *J Iran Med Counc*. 2027;10(1):312-4.

Dear Editor,

In a world where medical miracles once seemed invincible, the rise of antibiotic-resistant superbugs poses a dire threat, particularly to the youngest and most vulnerable among us. Imagine a child suffering from a routine ear infection that spirals into a life-threatening ordeal since standard antibiotics fail. This scenario is no longer hypothetical; in 2022 alone, over three million children worldwide succumbed to infections linked to antimicrobial resistance (AMR). Driven by decades of antibiotic overuse and misuse, superbugs bacteria that have evolved to withstand multiple drugs are trapping humanity in a cycle of escalating danger (1).

Antibiotics, hailed as one of the 20th century's greatest discoveries, revolutionized medicine by targeting bacterial infections with precision. However, their overuse has accelerated natural evolutionary processes in bacteria. When antibiotics are prescribed unnecessarily for viral illnesses like the common cold or used prophylactically in agriculture, surviving bacteria with resistance genes multiply and spread. This selective pressure fosters superbugs such as Methicillin-Resistant *Staphylococcus aureus* (MRSA) and Carbapenem Resistant Enterobacteriaceae (CRE). The World Health Organization identifies misuse and overuse in humans, animals, and plants as the primary drivers of drug-resistant pathogens. In agriculture, antibiotics are routinely administered to livestock for growth promotion, creating reservoirs of resistance that transfer to human populations through food chains and environmental contamination (2).

Children are particularly susceptible to this trap for several reasons. Their developing immune systems make them prone to frequent infections, leading to higher rates of antibiotic prescriptions. In pediatric care, over prescription is rampant: studies show that up to 50% of antibiotics given to children are unnecessary, often for conditions like upper respiratory tract infections that are viral in origin. This exposure not only risks immediate side effects like allergic reactions and gut microbiome disruption but also contributes to community-wide resistance. Moreover, children's smaller body mass means that resistant infections can progress rapidly, turning treatable

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ailments into emergencies requiring hospitalization or invasive procedures (3).

The statistics paint a grim picture. Globally, AMR has claimed at least one million lives annually since 1990, with projections estimating 39 million direct deaths from superbugs by 2050 if trends continue unchecked. For children, the burden is staggering. While AMR deaths among those under five have declined by 50% from 1990 to 2021 due to improved sanitation and vaccination efforts, the absolute numbers remain alarming. In 2022, AMR-related infections were associated with over three million child fatalities, predominantly in low- and middle-income countries where diagnostic tools are scarce, leading to both overuse and under-treatment. Paradoxically, in these regions, lack of access to antibiotics exacerbates the spread of superbugs, as untreated infections allow resistant strains to proliferate unchecked. A 2024 study forecasts that from 2025 to 2050, AMR could be linked to a cumulative 169 million deaths worldwide, with varying impacts by age group underscoring the urgent need for targeted interventions in pediatric populations (4).

The causes of this overuse are multifaceted. In human medicine, pressures on healthcare providers such as patient demands, time constraints, and diagnostic uncertainty fuel inappropriate prescribing. In veterinary and agricultural sectors, economic incentives prioritize productivity over prudence, with antimicrobials used en masse in animal farming. Environmental factors compound the issue: antibiotic residues in wastewater from pharmaceutical manufacturing and farming pollute ecosystems, promoting resistance in soil and water bacteria. Socioeconomic disparities amplify these problems; in poorer countries, over-the-counter antibiotic sales without prescriptions are common, while counterfeit drugs dilute efficacy and hasten resistance (5).

The consequences extend beyond mortality. Resistant infections lead to prolonged hospital stays, higher healthcare costs, and increased use of last-resort antibiotics, which are often more toxic and expensive. For children, this means disrupted development, potential long-term health issues like chronic kidney damage from alternative treatments, and a higher risk of secondary infections. Economically, the global burden of AMR is projected to cost trillions in lost productivity by 2050. Superbugs also erode trust in healthcare systems, as parents witness once-curable diseases becoming intractable (6).

To escape this trap and protect children's futures, a multipronged approach is essential. Antibiotic stewardship programs (ASPs) are at the forefront, promoting judicious use through guidelines, education, and surveillance. In pediatric settings, ASPs have reduced unnecessary prescriptions by up to 30% without compromising outcomes, emphasizing rapid diagnostics to distinguish bacterial from viral infections. Public education campaigns can empower parents to avoid demanding antibiotics for non-bacterial illnesses, while healthcare training must stress evidence-based prescribing (3). Innovation offers hope: research into novel antibiotics, bacteriophage therapy, and vaccines targeting resistant pathogens is accelerating. For instance, vaccines against pneumococcus and *Haemophilus influenzae* have already curbed resistance by preventing infections altogether. Regulatory reforms are crucial banning non-therapeutic antibiotic use in agriculture, as the European Union has done, could significantly slow resistance spread. International collaboration, such as through the WHO's Global Action Plan on AMR, should address access inequities, ensuring antibiotics reach those in need without fostering overuse (7).

Moreover, preventive measures such as improved hygiene, sanitation, and infection control in schools and daycare centers can reduce infection rates among children. Digital tools, including AI-driven prescribing aids, promise to personalize treatments and minimize errors. However, challenges remain: pharmaceutical companies face slim profit margins for new antibiotics due to stewardship limiting their use, necessitating incentives like extended patents or subsidies (2).

Conclusion

The antibiotic overuse trap is a man-made crisis with superbugs as its harbingers, endangering children's health on a massive scale. With over three million child deaths tied to AMR in 2022 and forecasts of escalating tolls, inaction is untenable. By embracing stewardship, innovation, and global equity, this cycle can be dismantled. Safeguarding the next generation demands collective resolve from policymakers

enforcing bans on agricultural misuse to parents advocating for prudent care. Only through such vigilance can antibiotics be preserved as a lifeline, ensuring a future where superbugs are contained, not conquerors.

Conflict of Interest

There are no conflicts of interest among the authors of this article.

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