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From Abattoir to ICU: The Hidden Journey of Drug-Resistant Pathogens

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1. Introduction

The phrase "From Abattoir to ICU" reflects an increasingly recognized pathway in modern public health, where pathogens originating from food animals and slaughterhouse environments traverse the food chain and ultimately cause severe infections in humans. This issue has gained critical importance in the context of antimicrobial resistance (AMR), which is considered one of the greatest global health threats of the 21st century. According to the World Health Organization (WHO), AMR could cause millions of deaths annually if not effectively controlled (Salam *et al*., 2023).

Food-producing animals serve as reservoirs for a wide variety of zoonotic and opportunistic pathogens. When coupled with the misuse of antibiotics in animal husbandry, these microorganisms can acquire resistance traits and enter human populations through food, direct contact or environmental dissemination (Economou and Gousia, 2015). This continuum from abattoir contamination to life-threatening infections in intensive care units (ICUs) highlights the urgent need for integrated control strategies.

2. The abattoir: A critical control point

Abattoirs play a pivotal role in ensuring meat safety, yet they are also recognized as high-risk environments for microbial contamination. During slaughter and processing,

pathogens from the gastrointestinal tract, skin and environment can contaminate carcasses. Common pathogens associated with abattoirs include *Salmonella enterica*, *Escherichia coli* (O157:H7), *Campylobacter jejuni*, *Staphylococcus aureus* and *Acinetobacter baumannii*. Contamination occurs through improper evisceration, use of contaminated water, poor sanitation of equipment and surfaces and inadequate worker hygiene. Inadequate implementation of Hazard Analysis Critical Control Point (HACCP) systems and Sanitation Standard Operating Procedures (SSOPs) significantly increases microbial load in meat products (García-Díez *et al*., 2023 and Ovuru *et al*., 2023).

3. Antimicrobial use in food animals and emergence of resistance

The use of antimicrobials in livestock production is a major driver of AMR. Antibiotics are widely used for therapeutic purposes, disease prevention and growth promotion (in some regions). Indiscriminate use creates selective pressure that promotes the proliferation of resistant bacteria (Enshaie *et al*., 2025). Resistance mechanisms include genetic mutations, horizontal gene transfer via plasmids, transposons and integrons, and biofilm formation. These resistant bacteria can persist in animal tissues, spread to farm workers, contaminate the environment and transfer resistance genes to other bacteria. Extended-spectrum beta-lactamase (ESBL)-producing *E. coli* and carbapenem-resistant *Acinetobacter* have been reported in livestock and meat products, demonstrating their zoonotic significance (de Brito *et al*., 2022).

4. Transmission through the food chain

Once contaminated meat leaves the abattoir, several factors contribute to the survival and spread of pathogens. Inadequate cold chain maintenance during transport and storage allows bacterial multiplication. Poor hygiene in retail markets and improper storage practices facilitate cross-contamination (Zewude *et al*., 2025).

At the household level, unsafe practices such as cross-contamination between raw and cooked foods, use of contaminated utensils and insufficient cooking temperatures further increase the risk. Healthy individuals may develop mild illness whereas vulnerable populations including the elderly, immunocompromised individuals and hospitalized patients are at risk of severe infections such as septicemia, urinary tract infections, pneumonia and organ failure. The World Trade Organization emphasizes sanitary and phytosanitary (SPS) measures to reduce such risks in the food chain (Chillaud *et al.,* 1996).

5. ICU: Amplification of Drug-Resistant Infections

The entry of drug-resistant pathogens into healthcare settings, particularly intensive care units (ICUs), leads to severe and life-threatening consequences. ICUs are characterized

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by critically ill patients, extensive use of invasive devices, and high antibiotic consumption, creating ideal conditions for the spread of multidrug-resistant organisms. Common ICU-associated infections include vent ilator-associated pneumonia (VAP), bloodstream infections (BSIs) and surgical site infections (SSIs). Multidrug-resistant pathogens such as *A. baumannii*, methicillin-resistant *S. aureus* (MRSA) and resistant *Salmonella* significantly contribute to morbidity and mortality. These infections result in limited treatment options, prolonged hospital stays, increased mortality and higher healthcare costs (Strich and Palmore, 2017).

6. One Health Approach

The "abattoir to ICU" pathway underscores the interconnectedness of human, animal and environmental health, forming the foundation of the One Health concept. International organizations advocate coordinated efforts to combat AMR. In India, the National Action Plan on AMR (NAP-AMR) focuses on surveillance, infection prevention and control, rational antimicrobial use and awareness generation. Environmental contamination, including wastewater from farms and hospitals, further contributes to the dissemination of resistance genes, emphasizing the need for integrated interventions (Ranjalkar and Chandy, 2019).

7. Breaking the Chain: Preventive Strategies

Effective control of AMR requires interventions at multiple levels. At the farm level, judicious use of antibiotics, vaccination programs and improved biosecurity measures are essential. At the abattoir level, strict ante-mortem and post-mortem inspection, proper HACCP implementation, Sanitation SOP adherence and routine microbial surveillance are critical. At the consumer level, safe food handling practices, proper cooking and prevention of cross-contamination are necessary. In healthcare settings, antibiotic stewardship programs, strict infection control measures and continuous surveillance of resistant pathogens play a vital role in limiting AMR spread (Al-Khalaifah *et al*., 2025).

8. Conclusion

The journey from abattoir to ICU represents a significant and growing public health challenge. The spread of antimicrobial-resistant pathogens through the food chain illustrates the complexity of disease transmission in modern society. Addressing this issue requires a comprehensive One Health approach involving coordinated action across veterinary, medical and environmental sectors. Strengthening surveillance systems, promoting responsible antimicrobial use and improving hygiene practices at all stages of the food chain are essential to mitigate this threat. In the absence of sustained efforts, infections originating in food systems may increasingly lead to life-threatening conditions in ICUs, highlighting the urgent need for global cooperation.

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