Hygienic Assessment of Medical Waste Management in Uzbekistan: Challenges and Solutions

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Introduction: The rapid modernization of the healthcare system in Uzbekistan has led to a significant increase in medical waste volume, especially in major cities such as Tashkent, where leading medical institutions, clinical bases, and private clinics are concentrated. This surge in medical waste volume is primarily driven by the growing use of disposable medical products, instruments, and personal hygiene items. As a result, the morphological composition of medical waste has significantly changed, raising concerns regarding its management and disposal. Inadequate handling of medical waste poses severe epidemiological and environmental risks due to high microbial contamination and the potential for spreading infectious diseases.

The most alarming issue is the emergence of epidemiologically hazardous waste, which requires an integrated approach to its disposal and the development of an efficient management system. Moreover, improper handling of medical waste can lead to environmental contamination, increasing the risk of infectious diseases and creating new sanitary-hygienic challenges. This research aims to evaluate the hygienic management of medical waste in public and private healthcare institutions in Uzbekistan and develop recommendations for optimizing waste management processes in line with international standards.

Main part: Medical waste management is a critical issue worldwide due to the hazardous nature of the waste, which may contain infectious, toxic, radioactive, or chemical substances harmful to human health and the environment. One of the primary international documents governing the management of hazardous waste, including medical waste, is the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, adopted in 1989 and enforced in 1992. According to the convention, medical waste must be managed following the principle of "Environmentally Sound Management" (ESM).

In Uzbekistan, the adoption of the sanitary regulations SanPiN 0317-15 established a unified system for classifying, collecting, storing, and disposing of medical waste in healthcare institutions. These regulations categorize medical waste into five hazard classes (A, B, C, D, and E), with particular emphasis on hazardous (Class B) and extremely hazardous (Class C) waste, which contain infectious agents and pathogenic microorganisms. Key provisions include:

1. **Classification and Segregation:** Medical waste must be strictly divided according to hazard classes using specialized containers and color-coded markings.
2. **Disinfection Requirements:** Classes B and C waste must undergo mandatory disinfection through physical (thermal, autoclaving) or chemical methods.

3. **Transport and Storage Regulation:** The transport and storage processes should be regulated to prevent uncontrolled accumulation and mixing of hazardous waste.

4. **Sanitary Control:** Monitoring compliance with sanitary regulations is conducted by state supervisory authorities.

Despite the regulatory framework, practical issues remain, including non-compliance with waste segregation requirements, limited mechanization of waste transport, and a lack of centralized disinfection facilities in certain regions. Furthermore, the research revealed significant variability in the quantity of medical waste generated across different healthcare institutions:

- **Public Hospitals:**
  - Multidisciplinary hospitals: 0.35 ± 0.21 kg/bed-day
  - Specialized hospitals (oncology, cardiology): 0.39 ± 0.12 kg/bed-day
  - Infectious disease hospitals: 1.01 ± 0.54 kg/bed-day
  - Maternity hospitals: 1.52 ± 0.31 kg/bed-day
- **Private Healthcare Facilities:**
  - Multidisciplinary clinics: 0.30 ± 0.18 kg/bed-day
  - Specialized clinics: 0.35 ± 0.10 kg/bed-day
  - Diagnostic and therapeutic centers: 0.85 ± 0.50 kg/visit

A proposed method for calculating quantitative indicators of epidemiologically hazardous medical waste considers bed turnover and patient visits. This method is recommended for developing sanitary control programs and optimizing waste management practices. Additionally, the study proposes a combined waste management system where up to 75% of medical waste is disinfected on-site, while the remaining 25% is sent to specialized centralized facilities for processing especially hazardous waste.

Results and conclusion: The study identified the need for a comprehensive and systematic approach to managing medical waste, involving both decentralized and centralized treatment methods. Practical recommendations were developed to enhance training for medical staff, focusing on proper waste handling, disinfection techniques, and compliance with sanitary standards. The introduction of educational programs is expected to minimize professional health risks and ensure the safe management of medical waste.

The results were presented at the KOR-UZB International Conference on Ecology and Environmental Protection and published in the "Uzbekistan Republic Journal of Sanitary-Epidemiological and Public Health Service" in 2024. The research was also recognized at the Techno Ways Technology Marathon for its innovative approach to medical waste management in healthcare institutions.

This study highlights the critical challenges associated with medical waste management in Uzbekistan and underscores the importance of adhering to international standards, such as the Basel Convention. Implementing a combined system of decentralized and centralized waste treatment is essential for ensuring sanitary and environmental safety. Furthermore, continuous training and capacity building for medical personnel are vital for minimizing health risks and promoting sustainable waste management practices.

The proposed model and recommendations contribute to the improvement of medical waste management strategies, thereby enhancing public health protection and environmental sustainability. Future research should focus on evaluating the long-term impacts of implemented measures and exploring advanced technologies for waste treatment and disposal.

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