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Short Communication

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Role of Textiles in Management of Infectious Diseases

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Textiles for infectious disease management, including antimicrobial, antiviral, and barrier fabrics, are crucial for reducing cross-contamination in healthcare and public settings. These materials use agents like silver nanoparticles, chitosan, and hydrogen peroxide to combat pathogens (e.g., bacteria, viruses) and improve biosafety. Key technologies include electrospun fibers, smart fabrics, and specialized, disposable non-woven textiles.

Textiles are a critical frontier in managing infectious diseases, serving as both potential "fomites" (surfaces that transmit pathogens) and advanced tools for infection prevention. Research and product development focus on high-performance materials like Advances in Healthcare and Protective Textiles that utilize antimicrobial and antiviral technologies to reduce hospital-acquired infections (HAIs).

Key Aspects of Infection-Control Textiles

Antimicrobial Agents

Functionalized fabrics utilize silver nanoparticles (sol-gel), quaternary ammonium compounds, natural agents (chitosan, tea tree oil), and metal-organic frameworks for pathogen elimination.

Smart Fabrics (SF)

These modern textiles feature pathogen detection, repellency, and antimicrobial properties. They reduce pathogen adhesion by up to 99.79% (fecal) and 99.88% (urine) in healthcare applications.

Barrier Materials

Non-woven composite fabrics (e.g., polypropylene) act as crucial barriers against blood-borne pathogens, while maintaining air and moisture permeability for medical gowns and masks.

Hospital Laundry Management

Proper management includes washing at temperatures for 25 minutes or using antimicrobial chemicals to disinfect linens and reduce Healthcare-Associated Infections (HAIs).

Future Trends

Development focuses on sustainable, biodegradable antimicrobial agents and advanced nanofiber technologies to combat pathogen survival on textiles. These materials are vital in limiting the role of textiles as fomites (disease vectors) and enhancing the safety of healthcare professionals and patients.

Types of Textiles & Applications

Textiles used for infection management are generally categorized by their use-case and material composition

Protective Apparel (PPE)

Includes Antimicrobial Protective Clothing, surgical gowns, lab coats, and masks. These are often made from non-woven materials like Anti-Microbial PP Spunbond Fabric, which provides superior barrier properties compared to woven fabrics.

Hospital Linens & Bedding

Items such as bed sheets, pillowcases, and curtains can act as reservoirs for pathogens like MRSA. Emerging smart textiles incorporate "Repel + Kill" functions to prevent biofilm formation from bodily fluids.

Wound Dressings

Advanced multi-layer dressings use antimicrobial agents (e.g., silver nanoparticles) and specialized fiber shapes (like 4-deep-grooved fibers) to manage moisture and prevent secondary infections.

Surface Disinfectants

Disposable options like PDI Sani-Cloth Plus Germicidal Wipes are used to clean non-porous surfaces in dental and medical offices.

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Key Antimicrobial Agents & Technologies

Agent Type	Mechanism of Action	Examples
Metal-Based	Disrupts cell membranes and DNA replication.	Silver (Ag), Copper (Cu), Zinc Oxide (ZnO)
Organic Compounds	Cationic charge disrupts bacterial walls.	Quaternary Ammonium Compounds (QACs), Chitosan
Natural Extracts	Plant-derived inhibitors.	Neem seed/leaf extract, Tea tree oil
Smart Functions	Detection and real-time monitoring.	pH-sensitive dyes (e.g., Bromothymol Blue) for colorimetric detection of biofilms

Management & Decontamination

Effective management is as vital as the textile's composition:

Laundering

Industrial laundering at high temperatures (or) with bleach is recommended by the CDC for adequate decontamination of reusable linens.

Disposable vs Reusable

While disposables (single-use non-wovens) offer a "virgin-clean" image and high initial barrier, reusables (woven polyester) can be more cost-effective over 50+ cycles and are more sustainable if proper sterilization is maintained.

Active Surveillance

Modern systems are beginning to integrate Machine Learning with smart fabrics to automatically detect contamination based on textile color shifts, reducing human error in busy clinical settings.