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Chapter 1

Introductory Chapter: Overview of Disinfection

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1. Introduction

1.1. Importance of disinfection

Disinfection is the method to destroy most microbial forms, especially vegetative pathogens rather than bacterial spores, by using physical and chemical procedures such as UV radiation, boiling, vapor. Each surgical process and medical applications need sterile procedures to avoid infection of tissue by surgical and medical equipment that are contaminated. During these processes, surgical and medical equipment can be contaminated by pathogens via contaminated surgical gloves. This leads to entrance of bacteria adhered on surgical and medical equipment or devices to sterile tissues of patient as a result of infection. Not only contaminated surgical and medical equipment are risk factors for infection but also contaminated common areas used by community such as toilets, public transport vehicles and door handles and contaminated air causing transmission of pathogens from person to person and contaminated kitchen equipment causing cross contamination between equipment and foods are risk factors for health-threatening infections. Inadequate disinfections of these equipment and air are risk factors for transmission of pathogens to patients. Hepatitis B, hepatitis C, Rota virus, *Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli* O157:H7, *Salmonella typhimurium, Shigella dysenteriae, Vibrio cholera*, and *Helicobacter pylori* are the most common examples of pathogens transmitted. Failure to apply disinfection applications has been leading to various outbreaks [1].

2. Guidelines for disinfection applications

There are many guidelines for choosing and using proper disinfection and sterilization methods by effective disinfectants in distinct areas, and application of disinfection and sterilization methods in many countries, such as Centers for Disease Control and Prevention (CDC), and the Society for Healthcare Epidemiology of America (SHEA). Guideline for Disinfection and Sterilization in Healthcare Facilities that searched and used articles published in American Journal of Infection Control, Infection Control and Hospital Epidemiology, and Journal of Hospital Infection that are the three common journals for controlling infection was written by Rutala and Weber (2008 and updated in February 15, 2017) and published by CDC [1].

3. Disinfectants

Contaminated biotic surfaces such as skin, contaminated abiotic surfaces such as medical devices, and kitchen equipment exposed to cross contamination must be disinfected to prevent pathogens. Alcohols, chlorine and chlorine compounds, quaternary ammonium compounds, phenolics, iodophors, formaldehyde, glutaraldehyde, *ortho*-phthalaldehyde, hydrogen peroxide, peracetic acid are examples of disinfectants used. Microbicide metals, ultraviolet radiation (UV), pasteurization were also used for disinfection of surfaces, as miscellaneous inactivating agents [1].

4. Efficacy of disinfection

Bactericidal effects of disinfectants vary against each microorganism. According to efficacy of disinfectant, appropriate disinfectant must be used against each microorganism. For example, a few types of disinfectants are not suitable for cold, due to inefficacy of disinfectant at lower temperatures of environment. This problem can be overcome by selecting appropriate disinfectant of which effect is high in cold conditions [2, 3].

Temperature and pH of the disinfection process, amount of microorganism, physical factors such as surface type, chemical factors such as chemical composition of surface or disinfectant, antibacterial resistance of microorganism, biofilm production of microorganism, dose of disinfection, and duration of exposure to disinfection are the factors affecting efficacy of disinfectant against pathogens [1].

Susceptibilities of biofilm-embedded bacteria (sessile cells) and spores to disinfectants are lesser than planktonic and vegetative cells. It is hard to destroy bacterial biofilms, bacterial spores, and resistant microorganisms that can stay alive. Bacterial spores and resistant microorganisms can resist disinfectants. Studies showed that the effect of some disinfectants such as chlorhexidine, propamidine, and quaternary ammonium compound cetrimide against methicillin-sensitive *Staphylococcus aureus* (MSSA) was greater than that of methicillin-resistant *Staphylococcus aureus* (MRSA) which is a life-threatening pathogen [4]. Researchers found that the susceptibility of gentamicin-resistant *Staphylococcus aureus* (*S. aureus*) isolates against propamidine, quaternary ammonium compounds, and ethidium bromide was lesser than gentamicin-susceptible *S. aureus* isolates [5]. Tennent et al. demonstrated that the susceptibility of staphylococci carrying *qac*A gene that encodes cytoplasmic membrane-associated protein which is a member of an efflux system was reduced against some disinfectants such as quaternary ammonium compounds [6].

In contrary to these studies, some other studies demonstrated that susceptibility of common antibiotic-resistant nosocomial isolates such as *Enterococcus, Pseudomonas aeruginosa, Klebsiella pneumoniae, E. coli*, *S. aureus*, and *Staphylococcus epidermidis* against disinfectants was the same as antibiotic-sensitive ones [7–10]. Other studies concluded that vancomycin-resistant *Enterococcus* (VRE) was eliminated by disinfectants [11].

Although biofilm-embedded bacteria are 10- to 1000-fold more resistant than planktonic ones [12], disinfectants such as chlorine and monochloramines eliminate biofilm-embedded bacteria [13–15].

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