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بسم اللّه الرحمن الرحيم

مركز الشبكات وتكنولوجيا المعلومات

قسم التوثيق الإلكتروني

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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

Utilization of electronic air filtration in improving air quality in operating rooms and reducing rates of surgical site infections (SSIs) in Pediatric Surgery department, Ain Shams University

Thesis

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Isis Magdy Mossad Shehata

List of Contents

Title	Page No.

List of Tables

Table No.	Title	Page No.

List of Tables (Cont...)

List of Tables (Cont...)

Table No.	Title	Page No.

List of Figures

List of Abbreviations

Abb.	Full term
AIA	*American Institute of Architects*
ASHRAE	*American Society of Heating, Refrigeration, and Air conditioning Engineers*
HAI	*Healthcare Associated Infection*
HEPA	*High Efficiency Particulate Air filter*
HVAC	*Heating, Ventilation and Air Conditioning*
IAQ	*Indoor Air Quality*
ISO	*International Organization for Standardization.*
OR	*Operating Room*
SSIs	*Surgical Site Infections*
FGD	*Focus Group Discussion*

INTRODUCTION

CDC defines Health care Associated Infections (HAI) as a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s). There must be no evidence that the infection was present or incubating at the time of admission to the acute care setting. HAIs may be caused by infectious agents from endogenous or exogenous sources. Endogenous sources are body sites, such as the skin, nose, mouth, gastrointestinal (GI) tract, or vagina that are normally inhabited by microorganisms. Exogenous sources are those external to the patient, such as patient care personnel, visitors, patient care equipment, medical devices, or the health care environment ***(CDC, 2016)***.

These healthcare-associated infections (HAIs) include central line-associated bloodstream infections, catheter-associated urinary tract infections, and ventilator-associated pneumonia. Infections may also occur at surgery sites, known as surgical site infections. A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. Surgical site infections can sometimes be superficial infections involving the skin only. Other surgical site infections are more serious and can involve tissues under the skin, organs, or implanted material ***(CDC, 2016).***

Surgical-site infection is the leading complication of surgery. Microbiological contamination of air in the operating room is generally considered to be an important risk factor for surgical site infections in clean surgery ***(Landrin et al., 2005).***

Evidence from a meta-analysis study carried out by ***Allegranzi et al. (2011)*** in a research funded by WHO in Europe showed that Surgical-site infection was the leading infection in hospitals (pooled cumulative incidence 5·6 per 100 surgical procedures), strikingly higher than the proportions recorded in developed countries. ***Al Bagoury et al. (2010)*** calculated the incidence rate of in-hospital SSI in Ain Shams University Surgery Hospital and it was to be 8.5%.

An estimated 40 to 60 percent of SSIs are considered preventable based on current medical practice and technology. The Center for Healthcare Design (CHD) estimates that more than 30 % of SSIs are caused by airborne pathogens, this can occur in spite of proven infection control prevention practices, suggesting that airborne-related contamination control offers one area that could play a larger role in preventing SSIs ***(Schreiber, 2014).***

The air borne route of infection requires infectious agents that are either droplet nuclei or particulate matter (dust) which act as a harbor for micro-organisms. The dirt particles measuring 5 microns and less can stay airborne indefinitely and travel hundreds of feet from its source by natural air currents or ventilation systems then settle down in an open wound ***(Mills, 2003).***

Air ventilation systems at hospitals needs special precautions during design and maintenance stage to prevent infections from spreading. 50% of all illnesses are either caused by, or aggravated by, polluted indoor air ***(Ramaswamy et al., 2010).***

The air quality requirements in health-care settings vary from department to department and often even from room to room. Some areas will require high-efficiency filtration of airborne microorganisms to protect patients, staff and visitors (e.g. in operation suites, ICUs, TB isolation rooms), whereas other areas require the filtration of gaseous contaminants, chemicals and odors to provide a safer and more pleasant working environment (e.g., in laboratories, autopsy rooms, dental surgeries, pharmacies) ***(CDC, 2003).***

Ventilation systems in the Operating rooms and ICU are known as (HVAC) system "heating, ventilation, and air conditioning"; (HVAC) system functions to prevent the spread of airborne infectious pathogens. However, general wear and tear over time may compromise the HVAC system's effectiveness to maintain good indoor air quality. Economic issues may hinder the completion of necessary renovations of the HVAC system to increase its effectiveness ***(Ontario Health Technology Assessment Series, 2005)***. This arouses the urge and the need for air cleaners (filters) to help keep indoor air quality clean and minimize the occurrence of healthcare associated infections.

Mechanical air cleaners are also called filters and are generally some form of physical device installed in the air flow system for the HVAC device. The air flows through the filter and particles are removed because they are smaller than air particles ***(The Clean Air Act, 2012).***

In-room air cleaners, one or more types of air cleaning technologies are used. High-efficiency particulate air (HEPA) filters and ultraviolet germicidal irradiation (UVGI) are the two most commonly used. Less commonly, ion emission has also been used ***(Ontario Health Technology Assessment Series, 2005)***.

Mechanical (fiber) filters are rated as HEPA filtration devices, removing up to 99.9% of contaminants 0.3 microns or larger. While, an electronic air cleaner uses a different process, actively removing particles by ionizing the suspended particles in the air passing through the machine and pulling the particles out of it. The difference is that such a process works on smaller or nano particles. So, an electronic air cleaner removes the stuff that a mechanical filter never could. There are also air purification systems that combine both technologies to create a fully-featured air cleaning system ***(The Clean Air Act, 2012).***

Spagnolo et al., 2013 mentioned that Intraoperative contamination was a major threat to the success of total joint replacements, and revealed that the rate of SSI fell dramatically from 7 to 0.5% when unidirectional airflow regimes with a high number of hourly air exchanges were adopted and surgical staff wore special suits that covered the whole body. Another retrospective study carried out by ***Gruenberg et al. (2004)*** had compared infection rates between adult patients after posterior spinal instrumentation procedures performed in a conventional versus an ultraclean air operating room. Results of the study showed that the use of ultraclean air technology reduced the SSI rate significantly**.**

Therefore the use of an in-room air cleaner to reduce the concentration of airborne pathogens and prevent the spread of airborne infectious diseases has been proposed as an alternative to renovating a HVAC system ***(Ontario Health Technology Assessment Series, 2005)***.

Measurement of air quality periodically and regular microbiological testing are some of routine monitoring strategies for infection control. Monitor controls, indoor conditions, and pressure devices, regular filter are the recommended maintenance strategy for infection control in a healthcare unit ***(Ramaswamy et al., 2010).*** So through air sampling, it is possible to evaluate microbial contamination in environments at high risk of infection; air sampling is also used to periodically monitor ventilation system efficiency to ensure optimal indoor air quality ***(Napoli et al., 2012 & Tang et al., 2009).***