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Effectiveness Of Ventilation Systems In Operating Rooms During Surgical Procedures: A Short Review

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Abstract—
The Postoperative infection rate (PIR) generally depends on factors such as the type of surgery, the cleanliness of equipment, medical procedures, and the level of microorganisms in the immediate and surrounding environments. Another major factor to consider is the quality of the air in the operating room (OR). The aim of this paper is review different ventilation systems in order to evaluate the of infection control (IC). This review consists of a literature review and observations in OR. The objective is to assist design engineers in developing more efficient ventilation systems, and to help stakeholders in choosing the "best" system for the particular type of surgery they need to perform. The practical result will be that security aspects of IC will be strengthened, which should lead to lower PIR.

Key words: *Indoor air quality, infection control, operating room, ventilation system*

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I. INTRODUCTION

Contamination in the operating room is considered a risk factor for invasive surgical procedures because of the possibility of airborne bacteria from the operating room, surgical staff, medical equipment, and the patient themselves can spread the disease or wound infection. Surgical site infection is a public health problem that has a major impact on the health care system and is a heavy financial burden. Ventilation system is widely used in operating room to present surgical Sites. Infection as well as other measures such as regular cleaning and disinfection of surgically operated body parts and disinfection by washing hands and applying topical disinfectants. Below is an overview of research and development in the field of surgical ventilation for airborne infections, the rationale for technical standards, and methods for monitoring the operation of installed ventilation systems. The primary Aim of this review is to assess the Effectiveness of the ventilation systems in minimizing surgical site infections due to airborne contaminants.

II. AIM

First To assess the effectiveness of ventilator systems in minimizing postoperative wound infections from air-borne contaminants.

This type of ventilation systems are used in all word, and are recommended for environments which require ultra- clean Air, including ORs Class I. The class involve the orthopaedic, transplant, and other specialised surgeries, isolation rooms, areas of people with burns and laboratories. To have Class I characteristics these ventilation systems are combined with the use of the high-efficiency particulate air filters (HEPA), and a low and uniform velocity. This system, if used alone, can divide the ORs in two zones. There are two types of LAF system, the horizontal and the vertical. The horizontal LAF was developed to overcome the problems associated with vertical airflow. However, the horizontal supply air in ORs Usually is disrupted by the surgical team. The vertical LAF is more effective in OR than the horizontal, because the clean air is supplied directly over the operating table, and also more effective in accordance with Some studies, for example, by (Lidwell, 1982, Friberg, 1998, McCarthy et al, 2000, and Technology Assessment Team, 2001). In accordance with critical review and studies made By (Friberg, 1998), the ultra clean air system ensures the potential of protection for the patient. The LAF may divide The OR in one zone or in two zones, in accordance with the design of the diffuser. For example, a full ceiling diffuser defines only a zone. Alternatively, examples other cases with diffuser smaller divide the OR in two zones. (Mermarzadeh and Manning, 2002) made a comparative study of OR ventilation systems. They evaluated the LAF, unidirectional, conventional and no aspirating and displacement diffuser types in order of contaminant deposition on an OR and back table. These ventilation systems presented some different parameters, for example, The volume flow rate for each ventilation system. This study objectives to evaluate various parameters, for example, the effects of ventilation flow rate, diffuser type and location, supply temperature and exhaust location. The methodology used was numerical simulation. This research

considered important analyses in terms of infection control. It showed results that identified the LAF ventilation systemic note peculiarities. For example, the head margin in this template measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire proceedings, and not as an independent document. Please don't revise any of the current designations. As the best performance in OR with some care. Another advantage of the LAF was that it results in better ventilation effectiveness. (Buchanan and Dunn-Rankin, 1998) simulated two ventilation systems: cross-Flow and "impinging-flow". The cross-flow presented airflow moved horizontally overt he operating table, and the particles were lifted toward the ceiling by strong air currents and then carried to the outlet and removed.

In this case the heating source had a little effect in the airflow. The impinging flow was opposed by rising natural convection currents caused by the heating loads that prevented the inlet air from properly ventilating the surgical site and its distribution in the room. Cross-flow was more efficient in the contaminant removal than impinging flow. The results showed that surgical team, patient and lights had great effect on the airflow due heat loads, which had a significant influence in the transport of air contaminants. Other papers also reported these effects in LAF, unidirectional and plenum ventilation systems, mainly which present vertical air supply. (Scherrer, 2003, Friberg, 1998, Mukhaiber and Turner, 2004, and Dharan and Pittet, 2002). (Wanner et al., 1980), evaluated ORs equipped with a LAF "modern" ("Greenhouse") and with a so called "germ-stop wall". The second system consisted of glass wall with an opening to move in the patient, and which divided the OR in two zones. The first zone is cleaner than zone 2, which attend, respectively, the surgical team and another anaesthesiologist and other support staff. The second system reported great results on control of bacteria levels. The LAF also had significant impact on postoperative infection rate, when combined with other ventilation systems, for example, the helmet aspirator system. However, a disadvantage of the body exhaust gowns is the reduced working conditions – freedom of movement, weight, etc. These results were reported in (Friberg et al., 2001, and Lidwell et al., 1987) cited in (Friberg, 1998) and (Technology Assessment Team, 2001). Otherwise, some studies reported a reduction, not significant, to the count of aerobic airborne and sedimenting bacteria-carrying particles in the OR using a mobile LAF screen in addition to conventional (mixing) ventilation system. These same levels were achieved with a LAF with HEPA filters. (Friberg et al., 2003, Napolitano, 2004 and Pasquarella et al. 2003). This subject needs to be investigated in details, because some studies presented different comments for a same type of ventilation system for the same types of surgeries.

III. DISCUSSION:

Air is the main carrier of heat, moisture, contaminants and airborne particles In the operating room. The supply air distribution and associated airflow path determine air velocity, temperature, and concentrations of pollutants, and the path of airborne particles at different locations in the room. Such distributions, in turn, determine thermal comfort, air quality, and the ability to transmit airborne particles. Ideally, in the operating room, the supply air should pass through the sterile area and exit through the ventilation mesh "once" without recirculating or mixing with the supply air stream. It is believed that a high rate of air change can create a cleaner environment in the operating room. However, recent studies indicate that increasing ACH does not necessarily result in a cleaner environment, but significantly increases operating costs.

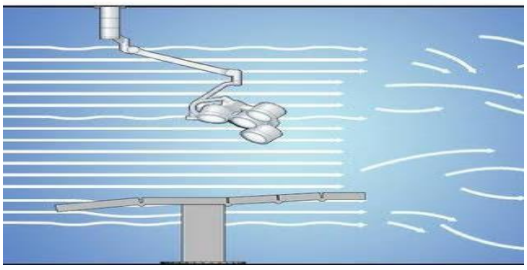

Fig1 Demonstration of vertical LAF ventilation

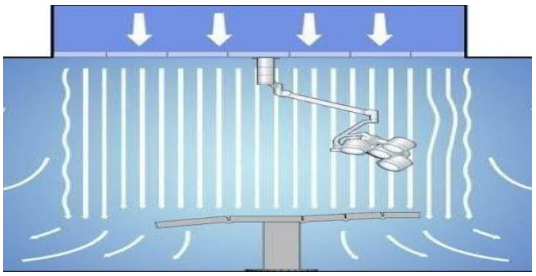

Fig2 Demonstration of vertical LAF (downward)

IV. CONCLUSION :

This review is being carried out in order to Get a clearer picture of how Different ventilation systems have been used in different situations, and how successful Their use has been in terms of dealing with the security aspects of infection control.

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