

## **Clinical evaluation of nursing management of laminar flow operating room in controlling hospital infection.**

**Yanqing Feng, Xijie Geng, Fang Zhou, Yuxian Fu\***

Operation Room, First Affiliated Hospital, Sun Yat-sen University, 58, Zhongshan Er Road, Yuexiu District, Guangzhou City, Guangdong Province, PR China

### **Abstract**

**Objective:** To study the nursing management measures about controlling hospital-acquired infection in laminar flow operating rooms.

**Method:** 261 cases of nursing materials in operating rooms with quality strengthening management and nursing management in LFOR of the hospital from May 2015 to May 2016 are taken as the observation group, and 261 cases of nursing materials before May 2015 with routine management are taken as the control group. The intra-operation colony count in the air, the colony count in hands of medical staffs, and the nosocomial infection incidence are analysed and compared, and the nursing satisfaction is investigated at the same time.

**Result:** After the quality strengthening management and nursing management, the intra-operation colony count in the air of LFOR is  $(104.5 \pm 20.3)$  cfu/m<sup>3</sup> and the colony count in hands is  $(1.2 \pm 0.2)$  cfu/m<sup>3</sup>. The infection rate of patients in the observation group is 0.70%, which is significantly lower than that of the control group. The difference is with statistical significance ( $p < 0.05$ ). After quality strengthening management and nursing management, the nursing satisfaction rate for LFOR by patients and the general satisfaction rate are 83.6% and 94.5% respectively, which are clearly superior to the control group which is 63.2% and 75.3%. The difference is with statistical significance ( $p < 0.05$ ).

**Conclusion:** The nursing management mode mentioned by the study includes strengthening the personnel and material in and out management, setting special ways for people and goods, controlling the number of visitors and learners, reducing the frequency of opening and closing the operation door, avoid too much walk indoor, dispose pollutants timely, and conduct colony observation regularly. The hospital-acquired infection incidence can be controlled effectively with such nursing management mode.

**Keywords:** LFOR, Hospital-acquired infection, Management mode, Nursing.

*Accepted on March 27, 2017*

### **Introduction**

Operating rooms are where patients receive operations and first aid, but operations are invasive and can damage normal tissue. If the operation environment is not qualified, hospital-acquired infection may occur [1]. Hospital-acquired infection is a key index to evaluate the level and management quality of medical agencies, so it is of great importance to prevent and control hospital-acquired infection in operating rooms [2,3]. In LFOR, microorganism pollution can be controlled through the air cleaning technology, so it is suitable for executing various operations [4]. Meanwhile, appropriate temperature and humidity can be provided for operations in LFOR, so as to create a clean and fresh operation environment with qualified colony quantity and to lower the hospital-acquired infection rate [5]. Effects of LFOR after carrying out quality strengthening management and nursing management are explored in this research.

### **Materials and Methods**

251 cases of nursing materials with quality strengthening management and nursing management in LFOR of Yichang Yiling Hospital from February 2012 to February 2013 are taken as the observation group, and 109 cases with routine management and nursing before February 2012 are taken as the control group. In the observation group, there are 134 male cases and 121 female cases aging from 22 to 79. Their average age is  $(55.4 \pm 29.6)$ ; the number of first aid operation is 62, that of delayed operation are 98, and that of selective operation is 91. In the control group, there are 62 male cases and 47 female cases aging from 22 to 80. Their average age is  $(54.3 \pm 27.5)$ ; the number of first aid operation is 20, that of delayed operation are 39, and that of selective operation is 50. In terms of gender, age, operation types and basic disease types, the difference of the two groups of patients shows no statistical significance ( $p > 0.05$ ).

### ***Strengthening and controlling LFOR hospital-acquired infection measures***

Functions and flows of each section should be made clear [6]

1) Layout of LFOR is rational with rigorous differentiation of the polluted zone, relatively sterile zone, and sterile zone. Meanwhile, clean corridors and polluted corridors should be set for patients, workers and pollutants to be in and out. 2) Personal and material control in LFOR. The move of people and materials in LFOR can significantly affect the indoor air quality. In and out of patients, operators and operation tools should be controlled rigorously with the implementation of clean-dirt division, thus reducing the probability of cross infection. 3) Patients for operation should wear isolation hats, disinfected clothes and picked up by exchange cars.

Personal training and management [7] 1) Strengthening personal training, organize nursing staffs and doctors in operating rooms to participate the LFOR environment and health management knowledge training, realize the effect of LFOR in hospital-acquired infection control, implement in strict accordance with rules and regulations, and control the LFOR hospital-acquired infection rate. 2) Strengthening personal management. Special slippers and sterilized clothes should be applied when entering to operation rooms, masks and hats should be worn at the same time. Hair should be fully wrapped by the hat, and mouth and nose should be covered by the mask. Isolation shoes of operators and nursing staffs should be cleaned, sterilized and disinfected every day. Non-operators shall not enter LFOR. The number of visitors or learners entering to LFOR should be controlled strictly and arranged according to specific operation situation. 5 persons should be at most for each room. Visitors and learners can walk in designated zones, and it is not allowed to go around freely. 3) Hand washing for surgeries. Thorough hand washing for surgeries can effectively remove resident flora on hands, and bacteria monitoring for the hand disinfection should be conducted regularly. 4) Aseptic technique should be conducted rigorously, and incision infection should be avoided. Strict aseptic operation is the premise for the success of LFOR operation, which provides requirements for LFOR nurses in enhancing professional knowledge. During the operation, methods to prevent pollution are: (1) The kidney basin should be used when passing knives, needles and other sharp instruments, thus avoiding the occurrence of accidents like stabbing workers; (2) Instruments and dressings used for skin and visceral organ cutting as well as hollow organ and solid organ cutting should be separated; (3) Workers should wear two-layer gloves and pay attention to personal vocational protection, avoid blood pollution, and avoid contaminating the operational cut by the bacteria on hands. In case of glove damage during operation, they should be replaced as soon as possible. As the operation proceeds, the number of bacteria in gloves is increasing, so gloves should be replaced timely for operators working for over 2 h; (4) Asepsis sheets contaminated by body fluid should be replaced timely.

### ***Goods management, disinfection and sterilization [8]***

1) Execute rules and regulations about disinfection and sterilization rigorously. Operation instruments should be cleaned and sterilized in the central supply room. High-pressure steam sterilization is preferred. Low-temperature plasma sterilization should be conducted for thermal sensitive and humidity sensitive goods, 2% glutaraldehyde soaking for over 10 h should be adopted for operation tools like laparoscopes and microinstruments. Indicator card check should be used for disinfectant along with regular replacement. Sterilization indicator cards can be replaced by the sterilization package, thus ensuring the application during validity. 2) Disposable medical supplies. Before use, the name, specification, trademark, validity and the package seal should be checked carefully. Cabinets should be dry and clean, and operation articles should be installed before entering to LFOR. 3) Cleaning and sterilization of endoscopes as well as their maintenance should be mastered by LFOR medical staffs. After use, they can be flushed by flowing water first with high-pressure water guns, and then be brushed with soft fur. Components of instruments should be dismantled and cleaned and then placed into the multi-enzyme detergent for ultrasonic cleaning for 10 min. After washed with flowing water, their surface should be dry with the removal of water by high-pressure guns. They cannot be used unless sterilized and disinfected with endoscopic sterilizers. 4) Operation wastes should be classified and disposed in a harmless way in accordance with "Regulations of Management of Medical Wastes".

### ***Purification system management [9,10]***

1) A comfortable environment should be available with the indoor temperature being 22-25°C and humidity being 40%-60%. 30 minutes to 1 h before operation, the purification air conditioning should be turned on and it should be off 30 min after completion of operations. 2) LFOR should be used correctly. The operation bed should be placed below the laminar flow smallpox. Operations are all done here, and the sterilization package should not be opened at the return air inlet. 3) Positive pressure should be maintained in operating rooms. During the operation, the electronic door should be closed, otherwise, the pressure difference will be disturbed. The door opening and close frequency should be reduced. People and materials in and out should be in strict control. Conventional instruments and medicines should be well-prepared in LFOR with positioned management by specially assigned persons. Frequent door opening for material fetch should be avoided, otherwise, the cleanness degree will be lowered. 4) The sense of responsibility by LFOR workers should be strengthened, disinfection and isolation systems and measures should be taken strictly, and contaminants should be removed timely, thus preventing bacterial transmission, ensuring the cleanness quality of the operating room, and decreasing the hospital-acquired infection. Humidity cleaning should be adopted for LFOR, and it should be done when the air conditioning purification system is on. Weaving materials

are not applicable to use. Non-shadow lamps, instrument tables, closet surfaces, operation beds and floor should be wrapped with clean water and disinfection water before and after surgery every day. Thorough cleaning should be carried out regularly as well. The filtering net at the air inlet and air outlet of the clean zone also needs to be disinfected and cleaned regularly. 5) Cultivate bacterial for air, workers' hands, disinfection agents and asepsis articles in LFOR should be conducted regularly, which shall be consistent with the health standard.

The average colony count in the intra-operation air of LFOR, the colony count on disinfected hands of nursing workers in the operating room, and the intra-operation infection cases are analysed by observing indexes and taking methods. Ordinary nutritious agar is used for colony cultivation. Infected cases in the operating room are consistent with the standard of "Hospital-Acquired Infection Classification Diagnosis Standard" enacted by the Ministry of Health. Meanwhile, the nursing satisfaction of patients from the two groups is researched as well.

**Statistical methods**

The SPSS 17.0 software was adopted for statistical analysis. Measuring materials are represented by ( $\chi \pm s$ ) with t-test;  $\chi^2$  is used to check counting materials and  $p < 0.05$ , which means the difference is with statistical significance.

**Table 2.** Comparison of satisfaction ratio in LFOR group and control group.

Groups	N	Great satisfaction		Satisfactory		Dissatisfaction		General satisfaction	
		n	%	n	%	n	%	n	%
Control	261	182	69.7	50	19.2	29	11.1	232	88.9
LFOR	261	224	85.8	28	10.7	9	3.4	252	96.6*

\*It indicated that compared with the control group, the difference was significant.

**Discussion**

Hospital-acquired infection control belongs to "full-process control", that is, the pollution approach should be cut off during operation to avoid the contact by microorganism and bacterial with surgical wounds [11,12]. LFOR with air cleaning technology can help to prevent external microorganism from entering to the operating room, which is effective to prevent bacterial from reproducing vigorously after the bacterial balance is destroyed in the operating room [13]. The hospital-acquired inflection rate can be reduced in LFOR, but the laminar flow technique is not an all-purpose solution. Although bacterial transmission in the air can be under control, LFOR itself does not have the sterilization function, nor can it prevent contamination sources from other operating rooms. If LFOR medical workers and patients are not disinfected thoroughly, instruments are not disinfected completely, or there is regional disorderly flow in the operating room, contamination will occur. Thus, personal and material in and out management should be strengthened, various rules and regulations like

**Result**

The colony count in the of air, and infection rate of patients After quality strengthening management and nursing management, the colony count in the intra-operation air of LFOR is ( $117.5 \pm 50.9$ ) cfu/m<sup>3</sup>, the colony count in hands is ( $1.9 \pm 0.7$ ) cfu/m<sup>3</sup>, and the infection rate of patients in the observation group is 0.80%, all three factors of which are lower than that in the control group, indicating the difference is with statistical significance ( $P < 0.05$ ), as shown in Table 1.

**Table 1.** Comparison of colony count and infection rate of patients in two groups.

Groups	N	Colony count in the air (cfu/m <sup>3</sup> )	Colony count in hands (cfu/m <sup>3</sup> )	Infection Rate	
				N	Percent (%)
Control	261	286.5 ± 25.8	6.5 ± 1.6	13	4.98
LFOR	261	124.7 ± 42.2	1.7 ± 0.6*	3	1.15

\*It indicated that compared with the control group, the difference was significant.

Nursing satisfaction After quality strengthening management and nursing management, the very satisfaction rate and general satisfaction rate for LFOR nursing by patients are 86.9% and 96.8% respectively, which are clearly superior to 66.1% and 87.2% of the control group, so the difference is significant ( $P < 0.05$ ), as shown in Table 2.

asepsis operation should be executed rigorously, people and material ways should be set, the number of visitors and learners should be controlled, the frequency of opening and closing the operation door should be lowered, indoor move should be reduced, contaminants should be disposed timely, and bacterial cultivation should be conducted regularly [14]. If the above measures are taken, the infection incidence rate can be reduced. After quality strengthening management and nursing management, the colony count in the intra-operation air of LFOR is ( $117.5 \pm 50.9$ ) cfu/m<sup>3</sup>, the colony count on hands is ( $1.9 \pm 0.7$ ) cfu/m<sup>3</sup>, and the infection rate of patients in the observation group is 0.80%. The very satisfaction rate and general satisfaction rate for LFOR nursing by patients are 86.9% and 96.8% respectively, which are clearly superior to that of the control group ( $P < 0.05$ ).

All in all, specific to various threatening factors likely to cause hospital-acquired infection in LFOR, LFOR infection prevention and nursing management measures are concluded with full preparation. In addition, by stressing asepsis

operation, cleaning and disinfecting operating rooms and operation instruments regularly, and improving the air quality in operating rooms, the hospital-acquired infection incidence in LFOR can be reduced significantly.

## References

1. Borella P, Bargellini A, Marchegiano P. Hospital-acquired Legionella infections: an update on the procedures for controlling environmental contamination. *Annali Di Igiene Medicina Preventiva E Di Comunita* 2016; 28: 98.
2. Nanwa N, Kwong JC, Krahn M. The economic burden of hospital-acquired *Clostridium difficile* Infection: a population-based matched cohort study. *Infect Cont Hosp Epidemiol* 2016; 37:1068.
3. Phu VD, Wertheim HFL, Larsson M. Burden of hospital acquired infections and antimicrobial use in Vietnamese adult intensive care units. *Plos One* 2016; 11: 0147544.
4. Herron MA, Guerra L, Smith KC. Sliding hinges and related methods and devices suitable for apparatus for automated evaluation of microorganism growth in test samples. *Erteilung Patent* 2016.
5. Cheng DH, Liu PZ, Hong MA. Daily monitoring of air in the clean laminar flow operation room. *J Nurs* 2006.
6. Shen Y, Qian XM. Hospital infection in laminar air flow operating-room: current situation and nursing measure. *Chin J Nosocomiol* 2010.
7. Whyte W, Shaw BH, Barnes R. An experimental laminar-flow operating-room. *Lancet* 1971; 2: 905-906.
8. Tan J, Yin S, Li DU. Air purification and disinfection methods and precautions in the operating room. *China Health Stand Manag* 2016.
9. Diab-Elschahawi M, Berger J, Blacky A. Impact of different-sized laminar air flow versus no laminar air flow on bacterial counts in the operating room during orthopedic surgery. *Am J Infect Cont* 2011; 39: 25-29.
10. Liu R, Ying-Hong WU, Xin YB. Air circumstance in laminar flow operating room in Beijing: a cross-section investigation of 18 hospitals. *Chin J Nosocomiol* 2008; 18: 973-975.
11. Beardsley JR, Williamson JC, Johnson JW. Using local microbiologic data to develop institution-specific guidelines for the treatment of hospital-acquired pneumonia. *Chest* 2006; 130: 787-793.
12. Komatsu M. Backup support from the independent laboratory to the hospital for infection control of antimicrobial agent-resistant bacteria. *Rinsho Byori Jap J Clin Pathol* 2012; 60: 960.
13. Friberg B, Friberg S, Burman LG. Inconsistent correlation between aerobic bacterial surface and air counts in operating rooms with ultra-clean laminar air flows: proposal of a new bacteriological standard for surface contamination. *J Hosp Infect* 1999; 42: 287-293.
14. Botzenhart K, Hoppenkamps G. Wound contamination in conventionally air-conditioned operating rooms as compared to laminar-flow-operating-rooms (authors transl). *Zentralbl Bakteriolog B* 1978; 167: 29-37.

## \*Correspondence to

Yuxian Fu  
 Operation Room  
 First Affiliated Hospital  
 Sun Yat-sen University  
 PR China