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Research Article

Effect of an infection control educational programme on anaesthetists' attitude and anaesthetic field bacterial contamination

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KEYWORD

Anaesthetic work place bacterial contamination and infection control in anaesthetic practice

Abstract *Objectives:* To evaluate the impact of an infection control educational programme in anaesthetic practice on the clinical performance of the personnel working in anaesthetic field and anaesthetic work place bacterial contamination.
Methods: This study was conducting on 35 personnel involved in 500 operations over two and half months. Their compliance towards handling of anaesthetic equipments, wearing of protective tools and hand hygiene was evaluated using a 13 items check list pre and post delivering of an educational infection control programme (intervention). Of 500 operations 300 were randomly selected for evaluation of bacterial contamination. Two swabs were taken from anaesthetic place before induction of general anaesthesia (T0) and 30 min intraoperative (T1) pre and post intervention. Another swab was taking from anaesthetists' hands 15 min after induction of anaesthesia (T2).
Results: The intervention programme influenced positively the attitude of junior anaesthetists and nurses regarding the proper use of protective tools, anaesthetic equipments and hand hygiene. Senior anaesthestists' compliance with hand hygiene, frequency use of gloves and anaesthetic filter

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did not change after intervention. But their attitude towards handling of laryngoscope, anaesthetic face mask and catheter for suction improved after intervention. The adherence of housekeepers to hand hygiene, frequency of gloves use and anaesthetic equipments' disinfection improved significantly after intervention. Ninety-two (63%) swabs were positive for bacteria at T0 before intervention. They reduced to 9 (6.3%) positive swabs after intervention. The number of positive swabs at T1 was 121 (82.9%) before intervention, reduced to 68 (47.2%) after intervention. One hundred and eight (74%) swabs from hands of anaesthetists were positive for bacteria before intervention. They lowered significantly to 55 (38.2%) after intervention. Bacterial cross infection between anaesthetic machine and anaesthetists' hands existed pre and post intervention. In conclusion, infection control programme enhanced personnel clinical compliance and reduced bacterial contamination in anaesthetic place.

1. Introduction

Healthcare-associated infections (HCAI) produce negative impact on both health care providers and patients. They increase the incidence of work absenteeism, consumption of health care resources, and patients' morbidity and mortality [1]. National infection control guidelines in hospital practice published by Egyptian Ministry of Health and Population have been renewed periodically to reduce contamination and cross infection in different medical aspects [2]. Accordingly, in Egypt, most personnel working in operative theatre including anaesthetists follow these national standard precautions. The national policy focuses on, wearing of protective tools (theatre footwear, theatre suit and gown, head cap, face mask), frequent hand hygiene, and minimising traffic in and out the operative theatre [3]. It provides a great attention for personnel who are scrubbed in operative theatre for various aseptic procedures and provides them with clear information to keep operative field sterile. It also concerns with use of aseptic technique and full barrier precautions for invasive anaesthetic procedures like neuroaxial block and arterial and central venous line insertion. Unfortunate, no specific training or guidelines have been directed towards handling of anaesthetic equipments, proper use of protective tools during general anaesthetic technique. The lack of these specific instructions is considered as an important risk factor for developing HCAI [4,5].

Lately, international specific infection control policy was published in infection control in anaesthetic field [6]. Hence, all anaesthetists should to educate themselves and collaborate with other infection control team to prevent the transmission of micro-organisms. The current study aimed to evaluate the impact of educational programme concerning with infection control in anaesthetic practice on the clinical performance of personnel working in anaesthetic field and bacterial contamination, in anaesthetic work place, at Medical Research Institute Hospital, Alexandria University, Egypt.

2. Methods

Based on previous study [7], there were certain assumptions in the design of the present study. The first was anaesthesia machines tabletop, one way valves, vaporisers dials, air bags, flow metres and monitors keys were the main work surface that were touched by anaesthesia providers' hands and may be contaminated during anaesthesia. So these sites were considered in the present study as anaesthetic work place and chosen for bacterial swabs. The second assumed that, aseptic techniques in anaesthetic practice were strictly applied during regional and neuroaxial blocks, while it was not the trend during general anaesthesia. Therefore, only general anaesthesia procedures were included in the present research.

2.1. Sampling and sample size

Sample size: using STATA version 10.0, assuming positive swab in 75% and a 50% reduction to 37.5%, an alpha level of 0.05 and power of 90%; a minimum sample size needed was calculated to be 40 swabs before and 40 swabs after intervention [8].

Also based on previous research on increased compliance to infection control guidelines, assuming a rise of compliance score from 50% to 75%, an alpha level of 0.05 and power of 90%; a minimum sample size needed was calculated to be 85 observations before and 85 after intervention [9]. Both were covered by the sample of this study.

2.2. Study design

After the study had been approved by the Institutional Ethics Committee and the health care providers (HCPs) gave their agreements to participate, the current work was conducted on 35 personnel delivering 500 general anaesthetic procedures for general surgeries over two and half months. Their compliance towards handling of anaesthetic equipments, wearing of protective tools and hand hygiene was evaluated using a 13 items check list pre and post delivering of infection control programme (intervention). The anaesthetic place bacterial contamination was measured for 300 general anaesthetic procedures out of 500 at pre and post intervention time (the first and the second operative cases per day were only involved). Two swabs were taken from anaesthetic work place before induction of general anaesthesia (T0) and 30 min intraoperative (T1). Another swab was taken from anaesthetists' hands 15 min after induction of anaesthesia (T2) (Table 1).

2.3. Type and blinding of the study

The current study was conducted pre and post intervention. All data were collected by person who was blinded to the study design.

Table 1 The study flow chart.

Method used in the study	Pre intervention December 1–31st 2010	Intervention (educational program) January 1st–14th 2011	Post intervention January 15th–February 14th 2011
1. Check list measured personnel' adherence to infection control	250 operations (Aj, As, N, H)		250 operations (Aj, As, N, H)
2. Swabs			
• From anaesthetic work place before induction of anaesthesia	150 operations (4 swabs discarded)	• Infection control theoretical knowledge	150 operations (6 swabs discarded)
• From anaesthetic work place 30 min intra-operative	150 operations (4 swabs discarded)	• video	150 operations (6 swabs discarded)
• From hands of anaesthetists	150 operations (4 swabs discarded)	• Practice in operation theatre	150 operations (6 swabs discarded)

Aj = anaesthetists juniors, As = anaesthetists seniors, N = nurses H = housekeepers.

2.4. Inclusion and exclusion criteria

A total of 35 HCPs (20 anaesthetists, 10 anaesthetic nurses, and 5 housekeepers) who were involved in general anaesthetic procedures for 500 surgical operations over two and half month was included in the study. Their clinical compliance with infection control guidelines in anaesthetic practice was evaluated. This study did not involve surgeons or scrubbed nurses. Of 500 surgical procedures 300 were included in the study to evaluate anaesthetic work area bacterial contamination. Regional and neuroaxial anaesthesia were excluded from the study.

2.5. Procedure

After careful reading of infection control policy in operative theatre and in anaesthetic practice published by Egyptian Ministry of Health and Population and the Association of Anaesthetists of Great Britain and Ireland, respectively, the authors of the present study cooperated with Institutional Infection Control Committee for preparation of infection control guidelines in anaesthetic practice. These guidelines were sent sequentially on line to anaesthetists in three parts each followed by a simple quiz. If they answered the first quiz successfully (80% of questions were answered correctly) they were able to read the second part and so on. The first section of safety guideline was concerning with protective tools to prevent infection transmission between patient and anaesthetists and between patients themselves. It gave a spot light on the methods used to keep anaesthetic field clean. The second part cared about the safe use and disposal of sharps and the third was about safe handling of anaesthetic equipments and methods of decontamination. Appendix A After that, personnel working in anaesthetic field were invited to watch a video about the current and the right attitude towards handling of anaesthetic equipments, hand hygiene and disinfection of anaesthetic surfaces in 2 days. Then the target personnel participated in a week of comprehensive clinical practice in infection control to keep anaesthetic field clean.

All personnel included in the present study were closely observed unobtrusively by two experts in infection control who were blinded with design of the study. A 13 items check list based on infection control guidelines in anaesthetic practice was fulfilled for every operation pre and post education (intervention). The check list measured performance of HCPs in each operation and included the proper use of protective tools, hand wash, safe use and disposable of sharps, proper use of laryngoscope, anaesthetic face mask, and catheters for suction. Frequency of cleaning of surfaces and monitors were also involved in the check list (Appendix B).

All swabs collected in the present study were sterile moistened (normal saline) swabs that taken after rolling several times over the selected parts and transferred immediately to the Microbiology laboratory for culture onto blood, and MacConkey agar plates. The culture plates were incubated for 24 h at 35–37 °C. Identification of specific microbes was done by gross examination and by the use of Gram staining and biochemically if needed.

2.6. Statistical analysis

Data were analysed considering operations before and after education as independent samples, because matching by HCP could not be applied in our sampling technique. The results were represented as number and %. Chi square test and *z* test of proportion were used to compare HCPs performance and bacterial contamination before and after intervention.

3. Results

The present study showed that, 20 anaesthetists (100%) answered the quizzes successfully. Twenty-eight HCPs (80%) attended 2 days visual aids meeting and participating in training programme. The compliance of HCPs was excellent (100%) with guidelines involving wearing of gown, foot wear and safe use and disposable of sharps at pre and post intervention period. The intervention programme influenced positively the adherence of junior staff and nursing staff to gloves wears, changes and dispose before touching equipment at post intervention time. It enhanced the compliance of junior staff and nursing staff with hand hygiene and the proper use of anaesthetic face mask and catheter for suction at post intervention period. It enhanced junior anaesthetists attitude towards proper use of laryngoscope and frequent use of anaesthetic filters (Table 2).

Senior anaesthestists were good adherent to hand hygiene (80%) at pre intervention time. But their compliance with hand hygiene did not change after intervention. Similarly, their compliance with proper use of gloves and anaesthetic filter did not alter at post intervention period. The intervention

Table 2 HCPs' performance during anaesthetic procedures for general surgical operations before and after intervention.

Guideline items	Operations conforming to guidelines							
	Aj		As		N		H	
	No.	%	No.	%	No.	%	No.	%
Pre intervention (250 operations)								
Suit/gown wear	250	100	250	100	250	100	250	100
Foot wear	250	100	250	100	250	100	250	100
Face mask wear	190	76	130	52	230	92	250	100
Hand hygiene	150	60	200	80	200	80	100	40
Gloves wear	90	36	40	16	10	4	250	100
Gloves change	0	0	40	16	0	0	100	40
Safe use and disposable of sharps	250	100	250	100	250	100	250	100
Proper use of laryngoscope	0	0	40	16	–		–	–
Proper use of anaesthetic face mask	0	0	40	16	0	0	–	
Keeping catheter for suction in its sheath	0	0	40	16	0	0	–	–
Anaesthetic filter use	100	40	50	20	–	–	–	–
Disinfection of anaesthetic table at the start and the end of day	–	–	–	–	–	–	–	–
Disinfection of anaesthetic table between cases	–	–	–	–	–	–	–	–
Post intervention (250 operations)								
Suit/gown wear	250	100	250	250	100	100	250	100
Foot wear	250	100	250	250	100	100	250	100
Face mask wear	200	80	150	250	100	60	250	100
Hand hygiene	230*	92	200	230*	92	80	190*	76
Gloves wear	150*	60	50	130*	52	20	250	100
Gloves change	150*	60	50	100*	40	20	180*	72
Safe use and disposable of sharps	250	100	250	250	100	100	250	100
Proper use of laryngoscope	200*	80	60*	–	–	24	–	–
Proper use of anaesthetic face mask	200*	80	60*	200*	80	24	–	–
Keeping Catheter for suction in its sheath	240*	96	65*	200*	80	26	–	–
Anaesthetic filter use	200*	80	50	–	–	20	–	–
Disinfection of anaesthetic table at the start and the end of day and between cases	–	–	–	–	–	–	250*	100
Disinfection of anaesthetic table between cases	–	–	–	–	–	–	250*	100

HCPs = health care providers
Aj = anaesthetists juniors, As = anaesthetists seniors, N = nurses H = housekeepers.
* $P \leqslant 0.05$: difference in performance pre and post intervention was considered statistically significant.

programme had a positive impact on senior anaesthetists' attitude towards handling of laryngoscope, anaesthetic face mask and catheter for suction (Table 2).

The adherence of housekeepers to hand hygiene, gloves change and disposed was significantly improved at post intervention period. The housekeepers' attitude towards disinfection of anaesthetic table and equipments at the start of the day, between cases and at the end of the day dramatically improved at post intervention period (Table 2).

One hundred and forty-six and one hundred and forty-four operations were involved for bacterial contamination at pre and post intervention period, respectively. Ninety-two (63%) cultured swabs were positive for bacteria at T0 at pre intervention time. Seventy-four of them were non-pathogenic and

Table 3 Bacterial swabs from anaesthetic work place and anaesthetists' hands in 290 operations pre- and post-intervention.

Swabs	Pre-intervention		Post-intervention		Test of significance
	No. (146)	%	No. (144)	%	
Anaesthetic work place before induction of general anaesthesia					
Sterile	54	37.0	135	93.8	$X^2 = 102.9$
Organisms	92	63.0	9	6.3	$P = 0.0001$
Anaesthetic work place after induction of general anaesthesia					
Sterile	25	17.1	76	52.8	$X^2 = 40.6$
Organisms	121	82.9	68	47.2	$P = 0.0001$
Hands of anaesthetists					
Sterile	38	26.0	89	61.8	$X^2 = 37.7$
Organisms	108	74.0	55	38.2	$P = 0.0001$

* $P \leqslant 0.05$: was considered statistically significant pre and post intervention.

46.7% were pathogenic. The positive swabs lowered significantly to 9 (6.3%) at post intervention time, all of them were non-pathogenic (100%). The number of positive swabs increased during anaesthetic procedure at pre and post intervention time. They were 121 (82.9%) positive swabs at pre intervention and lowered significantly to 68 (47.2%) at post intervention time. Of the 121 positive swab at T1, 91 swabs (75.2%) was non-pathogenic and 68 swabs (56.2%) were pathogenic. Of the 68 positive swabs, 37 swabs (54.4%) were non-pathogenic and 42 (61.8%) were pathogenic. One hundred and eight (74%) cultured swabs from hands of anaesthetists were positive for bacteria at pre intervention period. Of these, 73 swabs (67.6%) were non-pathogenic and 58 swabs (53.7) were pathogenic. The positive swabs decreased significantly to be 55 (38.2%) at post intervention period. Sixty-seven percent of them were non-pathogenic and 52.7% were pathogenic. (Tables 3 and 4). The previous data indicated that, the intervention programme reduced significantly the incidence of bacterial contamination at anaesthetic work place and in anaesthetists' hands.

Bacterial cross infection between anaesthetists' hands and anaesthetic machine was noticed at pre and post-intervention time. Three pathogenic organisms; *Staphylococcus aureus*, *Enterococcus species* and *Alpha hemolytic Streptococcus* were not found on anaesthetic work place before induction of anaesthesia and identically found in anaesthetists' hands and anaesthetic area 30 min after induction of anaesthesia at pre and post intervention period. While *coagulase negative Staph* and *Bacillus not anthrus* were detected at anaesthetic work area before induction of anaesthesia and cultured from hand of anaesthetists and work place after induction of anaesthesia at pre and post intervention periods.

4. Discussion

Recently, intraoperative bacterial contamination of both anaesthetic work place and hands of anaesthetists was demonstrated and associated with an increase in health care cost and patient morbidity and mortality [10]. Exhaustive efforts were directed to minimise healthcare-associated infections wherever possible. The first step to reduce intraoperative contamination was increased awareness with potential sources of bacterial contamination inside operative theatre and delivering measures to control it in every day practice [11].

In the current study, the impact of an educational programme in infection control in anaesthetic practice on the clinical performance of HCPs and bacterial contamination of anaesthetic work place was investigated. The results showed that, a number of pathogenic and non-pathogenic bacteria were isolated from anaesthetic work place before induction of anaesthesia at pre and post intervention time. But bacterial contamination was significantly less at post intervention time with complete eradication of pathogenic organisms. Unfortunate, there is no standardised definition for pathogenic and non-pathogenic micro-organisms. International classification schemes defined pathogenicity as the ability of an organism to enter the body and cause disease. This ability depends not only on the virulence of organism but also on the defense systems. During surgery, both innate and humoral immunity are compromised and non-harmful organisms could provide seri-

Table 4 Distribution of pathogenic and non-pathogenic micro organisms of positive swabs at pre and post intervention periods.

Swabs	Post-intervention		Pre-intervention		X^2, P value
	No.	%	No.	%	
Anaesthetic work place before induction of general anaesthesia					
Positive swabs	92	63.0	9	6.3	
Non-pathogenic (*coagulase negative Staph*)	68	74.0	9	100	3.1, 0.079
Pathogenic	43	46.7	0	0	7.3, 0.007*
Staphylococcus aureus	37	40.2	0	0	
Bacillus not Anthracis	13	14.1	0	0	
Hands of anaesthestists					
Positive swabs	108	74.0	55	38.2	
Non-pathogenic (*coagulase negative Staph*)	73	67.6	37	67.3	0.0, 0.967
Pathogenic	58	53.7	29	52.7	0.01, 0.905
Staphylococcus aureus	*41*	*37.9*	*14*	*25.5*	
Enterococcus species	*25*	*23.1*	*0*	*0.0*	
Alpha hemolytic Streptococcus	*23*	*21.3*	*20*	*36.4*	
Bacillus not Anthracis	*13*	*12.0*	*0*	*0.0*	
Anaesthetic work place after induction of general anaesthesia					
Positive swabs	121	82.9	68	47.2	
Non-pathogenic (*coagulase negative Staph*)	91	75.2	37	54.4	8.6, 0.003*
Pathogenic	68	56.2	42	61.8	0.55, 0.456
Staphylococcus aureus	*50*	*41.3*	*17*	*25.0*	
Bacillus not Anthracis	*24*	*19.8*	*0*	*0.0*	
Enterococcus species	*19*	*15.7*	*15*	*22.1*	
Alpha hemolytic Streptococcus	*34*	*28.1*	*18*	*26.5*	

Bacillus not Anthracis: *E. coli*, Klebsiella, Serratia, Pseudomonas, and *Acinetobacter*. Some positive swabs contained more than one type of organisms.

* $P \leqslant 0.05$ was considered statistically significant pre and post intervention.

ous illness. Therefore great attention should be directed to all positive bacterial culture in anaesthetic field [12].

The lowered bacterial contamination at post intervention period may be explained by the positive impact of intervention programme on housekeepers' clinical compliance with disinfection of anaesthetic place. Their adherence to anaesthetic machine disinfection rose to 100% at post intervention time. At the time of education and training in the present study, housekeepers were encouraged to disinfect anaesthetic work area at the start and the end of the day and in between cases instead of once (at the end of the day). They kept this maneuver as a habit to be regularly done after education. In consistence with the result of the current study, Maslyk et al. [12] demonstrated many organisms that grow on the table of anaesthetic machine mostly *coagulase negative Staphylococcus*, *Acinetobacter*, *Streptocococcus*, *S. aureus* and gram negative rods. The number of colonies increased significantly after use of machine. They recommended change protocol of cleaning to be more than once that was occurred at the end of the day.

In the present study, the number of positive swabs increased at T1 with development of new kinds of pathogenic bacteria those were not found at the anaesthetic work place before induction of anaesthesia at pre and post intervention time. These bacterial contamination were 121 (82.9%) at pre intervention time and lowered to 68 (47.2%) at post intervention time. The increased incidence of bacterial isolation after use of machine during general anaesthetic procedure may be expected because during induction of general anaesthesia and tracheal intubation there is an exposure to bacteria in mouth and oropharynx. These organisms could be transmitted to anaesthetic work place through laryngoscope blades, handles and anaesthetists' hand.

The significant reduction of bacterial contamination at post intervention time showed the positive impact of intervention programme on the adherence of HCPs to hand hygiene and safe use of equipments. Junior anaesthetists and nursing staff were more adherent to hand hygiene and gloves use (gloves wears, changes and dispose before touching equipment at post intervention time). They used laryngoscope, anaesthetic face mask and catheter for suction in proper way. Although, there was no change in senior staff behaviour to hand hygiene at post intervention time, their good hand hygiene compliance at pre intervention (80%) may counteract their resistance to change. In addition, the significant adherence of housekeepers to hand hygiene, gloves change and disposed could be another factor in reducing bacterial contamination at T1 at post intervention period.

This result was in consistence with the study done by Pittet et al. [13] that investigated the implementing of hospital-wide programme on promoting hand hygiene and reduced hospital acquired infection rate between 1994 and 1997. They concluded that frequency of hand disinfection increased after education, hand hygiene improved significantly among nurses and nursing assistants, but remained poor among doctors. The overall nosocomial infection and Methicillin-resistant *S. aureus* (MRSA) transmission rates decreased significantly. Mathai et al. [14] evaluated the efficacy of a multimodal intervention strategy in improving hand hygiene compliance in a tertiary level intensive care unit. They documented the intervention improved over all hand hygiene compliance from 25.95%, pre intervention to 57.36% post intervention among various health care categories. The highest change in hand hygiene was observed in paramedical category 10.71–55.45%, followed by nursing and junior staff 21.48–61.59% and 21.62–60.71%, respectively. They also reported that although ICU consultants developed more hand hygiene compliance but they were the most difficult to reach. They explained this finding by that the consultants felt that they knew all about hand hygiene and did not need to attend the educational session.

The overall reduction of bacterial contamination at post intervention time in the present study did not focus only on the adherence to hand hygiene but it was also related to proper use of anaesthetic equipments and protective tools. In consistence with this result, the study done by the University of Chicago [15] documented the effectiveness of education and the change of performance of HCPs on catheter associated urinary tract infection in ICU. Safdar et al. [16] confirmed the effectiveness of the implementing protective tools like new gowns and gloves in terminating MRSA outbreak in burn unit. New and update guidelines in infection control stressed on that, HCPs should change their practice in handling anaesthetic equipments and not focus only on hand hygiene to reduce preventable infection [17].

In the current study, 74% cultured swabs from hands of anaesthetists were positive for bacteria at pre intervention period. This incidence lowered to 38.2% at post intervention time. The compliance with hand hygiene among junior staff was 60% at pre intervention time and increased to 92% at post intervention period. The difference was statistically significant. This finding reflected the positive impact of intervention programme on hand hygiene.

In consistence to the current result, Koff et al. [18] reported that anaesthetists hand contamination could be reduced by improving of hand hygiene. Two studies done by Rosenthal et al. [19,20] showed that delivering education increased hand wash compliance and consequently, it was associated with a significant reduction in catheter associated urinary tract infection rate from 21.3 to 12.39 per 1000 catheter/days and central catheter infection rates by 33% during the first 6 months after education and increasing hand hygiene compliance. Fitzpatrick et al. [21] investigated the effect of providing educational programme to improve knowledge of HCPs regarding HCAI and hand hygiene and they demonstrated that, the programme decreased significantly infection at post intervention time in comparison with pre intervention time.

Bacterial cross infection between anaesthetists' hands and anaesthetic machine was detected by the presence of identical organisms at pre and post intervention time. This finding showed that, anaesthetic work area, anaesthetists' hands and improper use of anaesthetic equipment could be a source of bacterial contamination and transmission of infection in anaesthetic field. The cross infection between anaesthetists hand and anaesthetic machine after education could be explained by that, senior staff showed some resistance to change their attitude towards proper use of gloves. There were some difficulties for them to change their habits after long time of anaesthetic practice.

In agreement with the present finding, previous studies [22,23] confirmed that hand of anaesthestists could be a considerable source of cross infection in operative theatre. The Association of Anaesthetists of Great Britain and Ireland [6] reported that the surfaces of anaesthetic machines and monitoring, especially those area touched by hand of anaesthetists were considered as a considerable source of HCAI. Loftus

et al. [10] reported that nearly 50% of intraoperative bacterial transmission to i.v. stopcock device was a contamination of hand of anaesthesia providers. Baillie et al. [24], reported that cross infection may occur between anaesthetic machine, hand of anaesthestists and patients. They recommended cleaning of anaesthetic machine and equipments between cases.

In conclusion, infection control programme used in the present study enhanced personnel clinical compliance with infection control policy and reduced bacterial contamination in anaesthetic place. The encouraged results recommended the renewal of infection control guidelines in anaesthetic practice, and providing periodical clinical training on handling and disinfection of anaesthetic equipments.

Appendix A. Safety guidelines of the computer-based infection control theoretical knowledge delivered to anaesthetists [2,6]

Section 1. Protective tools to prevent infection transmission:

1. *Theatre suits and gowns:* should be available for all operative theatre personnel. Sterile gowns should be worn when invasive procedures are undertaken. Contaminated clothing should be immediately changed and safely discarded into an appropriate container
2. *Facemasks* should be handled from its ties
3. *Footwear*: special footwear should be worn in the operating department and cleaned if contaminated or after every use
4. *Hand hygiene: anaesthetists* must be familiar with proper hand hygiene and take it as a habit in their clinical work
5. *Gloves*: must be worn as single-use items; they should be changed between different procedures on the same patient. Gloves must be disposed of as clinical waste and hands should be washed or decontaminated following the removal of gloves. Non-sterile examination gloves should be put on immediately before contact of mucous membrane or non-intact skin – for example introduce of oral airways, naso-gastric tubes or oral suction – and removed as soon as the activity is completed, and before touch anaesthetic machine keys, air bag, or other objects such as pen and clinical notes. Sterile gloves must be worn for invasive procedures; for example; an introduction of urinary catheter or central venous line
6. *Movement within the theatre: general* traffic in and out of the operating theatre should be kept to a minimum to reduce airborne contamination. Doors should be kept closed to ensure the efficiency of the ventilation system
7. *Order of patients: infected* cases should be identified before surgery and scheduled last on an operating list. Where this is not possible, an operating theatre should require a minimum of 15 min before proceeding to the next case

Section 2. Safe use and disposal of sharp objects:

1. Sharps must not be transferred between personnel and handling should be kept to a minimum
2. Needles must not be bent or broken prior to use or disposal
3. Needles and syringes must not be disassembled by hand prior to disposal
4. Needles should not be re-capped or re-sheathed
5. Used sharps must be discarded into an approved sharps container at the point of use
6. The sharps container should be sealed and disposed of safely when about two-thirds full or in use for more than 4 weeks, whichever is sooner
7. Blunt aspirating needles should be used for drawing up drugs
8. Syringes, infusion tubing are single use items for each patients

Section 3. Handling of anaesthetic equipments and methods of decontamination:

1. Laryngoscopes: Anaesthetists should wear gloves during intubation and put used laryngoscope in a special container to prevent contamination
2. Re-usable laryngoscope blades should be sterilized between patients. Proper cleaning of laryngoscope blades is of great importance before decontamination/sterilization, particularly of residue around light sources or articulated sections. Laryngoscope handles also become contaminated with micro-organisms and blood during use, and they should be washed/disinfected and, if suitable, sterilized after every use
3. Keeping catheter for suction in its cover for reuse in same patient
4. Anaesthetic equipment may become contaminated by hand of the staff so they should not be touched by used gloves
5. Anaesthetic face masks are frequently contaminated by secretions from patients and have been implicated in causing cross infection. These items should be kept in special container during surgery and be sterilized between patients
6. Oral airways, nasal airways and tracheal tubes should be of single-use type since they readily become contaminated with transmissible organisms. Supraglottic airways designed for repeated use should be sterilized no more often than the manufacturer recommends
7. Supraglottic airway used for tonsillectomy or adenoidectomy should not be used again
8. Appropriate filter should be placed for anaesthetic breathing circuit (between the patient and the breathing circuit) and a new filter should be used for each patient
9. Anaesthetic circuits are routinely changed on a daily basis. If visibly contaminated or used for highly infectious cases, e.g. tuberculosis, the circuits should be changed between patients and safely discarded
10. All equipment that touches intact skin, or does not ordinarily touch the patient at all, is cleaned with a detergent at the end of the day or whenever visibly contaminated. This includes non-invasive blood pressure cuffs and tubing, pulse oximeter probes and cables, stethoscopes, electrocardiographic cables, blood warmers

Appendix B. Check list evaluated HCPs performance during general anaesthetic procedures

Suit/gown wear	Yes	No
Foot wear		
Face mask wear		
Hand hygiene: proper hand wash before patient contact, before and after invasive procedure and after induction of anaesthesia)		
Gloves wear: gloves used whenever potential for hand contact with blood/body fluids		
Gloves change: gloves removed and disposed immediately after use and before touching equipments to avoid contaminating the environment		
Safe use and disposable of sharps		
Proper use of laryngoscope (take off blade immediately from handle and keeping in special container, blade sterilization between cases and handle disinfection)		
Proper use of anaesthetic face mask (changes between cases and keeping in container)		
Keeping catheter for suction in its sheath		
Use anaesthetic filter		
Disinfection of anaesthetic table at the start and the end of day		
Disinfection of anaesthetic table between cases		

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