Egyptian Journal of Medical Microbiology Volume 25 / No. 2 / April 2016 67-75

ORIGINAL ARTICLE

# An Audit on Infection Control Measures in El-Ibrashi's Center of Gastrointestinal Endoscopy-Internal Medicine Department- Cairo University Hospital, Egypt

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## ABSTRACT

***Key words:***

***Audit – Infection Control - Endoscopy***

***Background:*** *The beneficial role of gastro-intestinal endoscopy for the prevention, diagnosis, and treatment of many digestive diseases and cancer is well established. Like many sophisticated medical devices, the endoscope is a complex, reusable instrument that requires reprocessing before being used on subsequent patients.* ***Objective:*** *to audit the adherence of El-Ibrashi's Center to comply with national infection control guidelines and assessment of efficacy of endoscopes disinfection in it.* ***Methodology:*** *The current study was carried out in El - Ibrashi's Center. It included first: Auditing on adherence of El - Ibrashi's Center to infection control measures and practices in relation to infection control standards in endoscopy units and assessment of efficacy of endoscopes disinfection through a survey study.* ***Results:*** *in this study we found that a total of 9.6% of accessory channels samples were contaminated after disinfection. Pseudomonas aeruginosa and coagulase negative staphylococci (CONS) were the most frequently microorganisms isolated from endoscope accessory channel samples The results of water samples used for endoscopic cleaning showed that 33.3% of water samples taken from connected water bottles were contaminated and Pseudomonas aeruginosa was the most frequent contaminant and inefficient reprocessing mainly due to use of tap water for final rinsing without alcohol rinse or forced air drying and defective storage.* ***Conclusion:*** *This study revealed that the compliances were not good in the unit, the compliance with the quality control measures there was a defect in monitoring the effective concentration of the used disinfectant daily, absence of filters for final rinse water in automatic reprocessors and microbiological surveillance tests were not done routinely at regular intervals as recommended by different guidelines. Finally there were some defects in the design of procedure and reprocessing rooms.*

## INTRODUCTION

Endoscopic procedures have become an essential tool in the diagnosis and treatment of gastrointestinal diseases, and every patient has the right to be examined and treated without risk of transmission of infectious agent or complications that my result from inadequate reprocessing of endoscopes and endoscopic accessories.[1] Decontamination of endoscopes should be undertaken at the beginning and at the end of each list, and also between patients by trained staff in dedicated rooms. Through manual cleaning with enzymatic detergent including brushing of all accessible endoscope channels must be undertaken before manual or automatic endoscope disinfection. All disinfectants should be used at the correct temperature, contact time and concentration in accordance with manufacture instructions[2].

Non compliance with infection control guidelines could result in transmission of infection at endoscopy units, not only to the patients but also to the health care workers. Exogenous microorganisms that are introduced into the patient by the endoscope, are usually due to procedural errors in decontamination, cleaning, disinfection and or sterilization the endoscope transmitted infection may be caused by microbes that are transferred from patient to patient or from environment to patient,health care workers are also at potential risk.[3]

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Potential occupational hazards include: risk of infection with blood born viruses transmitted via sharps, such as spiked biopsy forceps and needles, or may be due to mucous membranes exposure to splash of blood or aspirate due to non compliance with proper use of personal protective equipment.[4]

In El -Ibrashi's Center Gastroentrology, Hepatology and GI endoscopy (Internal Medicine Department-Cairo University Hospital) infection risk assessment was not carried out before. Such assessment will help to direct quality improvement projects to provide safer patient care, as well as, will help to eliminate occupational hazards in endoscopy units, so our aims in this work are to audit the adherence of El - Ibrashi's Center to comply with national infection control guidelinesand to assessment of efficacy of endoscopes disinfection in it.

## METHODOLOGY

The present study was carried out in El - Ibrashi's Center of Gastroentrology, Hepatology and Gastero-intestinal endoscpy, internal medicine department at Cairo university hospital to comply with national infection control guidelines, and included also assessment of efficacy of endoscopes disinfection in El - Ibrashi's Center.Three types of endoscopes were involved which were: endoscopes used in gastrodudenoscopy, endoscopes used in colonoscopy and endoscopes used in Endoscopic retrograde cholangiopancreatography ERCP and it was accepted after approval of the Cairo University Institutional Review Board (IRB) and it was consistent with the principles of the declaration of Helsinki and research meets ethical guidelines.

**A-The survey was conducted monthly for 2 years using a check list which included:**

I- Unit auditing as regards:
1-Procedure room design and structure.
2-Reprocessing room design and structure.
3-The care of the environment.
4-Staff safety measures.
5-Quality control and monitoring.

II- procedure auditing as regards:
1-Endoscopy reprocessing procedure.
2-Barrier equipments during Procedures.
3-Endoscopy storage.

**2- Microbiological cultures were done:**

Samples were collected from each in use endoscope twicely:

I- Immediately after disinfection.
II-16 hours after disinfection.

Each time samples were taken from:

1- The endoscopes in use [gastroscopes (28 times), colonoscopes (28 times) and duodenoscopes used in ERCP (27 times)], from:
- The accessory channels of the endoscope: suction and biopsy channels (a total of 83 samples).
- The outer surfaces (a total of 83 samples) and the openings of channels (a total of 83 samples).

2- The washer disinfector, (during automated reprocessing), (a total of 83 samples).

3- 83 Samples of Water: water used in reprocessing procedure (water source) (a total of 56 samples) and that used during the endoscopy procedures (from connected water bottle)(a total of 27 samples).

4- Environmental surfaces including examination table, endoscopy stack and endoscopist's desk (a total of 83 samples).

Samples were cultured by routine bacterial culture media in semi-quantitative techniques, mycobacteria, and Candida were also included.

Cultures of samples from GI endoscopes were obtained by flushing 50 ml sterile distilled water via the biopsy channel under aseptic conditions. The flushed fluid was collected in a sterile container and plated onto blood agar, MacConkey agar plates and Lowenstein–Jensen medium. **5** Swabs were taken from outer surface of the endoscope, opening of accessory channels, the residual water from the automated endoscope reprocessors (AERs) after reprocessing and from environmental surfaces. Cultures of swabs of residual water from (AERs).Immediately after completion of a high-level disinfection cycle, residual water from the inner surfaces of the AERs was collected using swabs under aseptic conditions. [5]

**3-Laboratory Procedure**

The collected samples were centrifuged down to 1mLand cultured on blood agar and MacConkey's media and incubated at 30-37 °C for 48 hours, while Lowenstein-Jensen media is incubated at 30° C for 2-3 weeks.

**4-Identification of isolated organisms**

After adequate incubation, bacteriological identification of the isolated organisms was done according to **Peterson etal** [7] and based on:

1- Microscopic examination of gram and *Ziehl–Neelsen* stained films

2- Culture

Identification of isolated organisms were done by colonial morphology, microscopic examination of isolated organisms and rapid bench tests used to identify the species e.g.

a- Coagulase test.
b- Catalase test.
c- Oxidase test.
d- Sugar fermentation tests using peptone sugar media (glucose, lactose, maltose, mannose and sucrose).
e- Tests for indole production on peptone water medium.
f- Methyl red test.
g- Citrate utilization test.
h- Urease production test.
i- Triple sugar iron agar medium (TSI) inoculation.
j- Detection of cytochrome oxidase enzyme using oxidase strips.

**Statistical methods**:

Data were statistically described in terms of frequencies (number of cases) and relative frequencies (percentages). For comparing categorical data, Chi square ($\chi^2$) test was performed. Exact test was used instead when the expected frequency is less than 5. A probability value (P value) less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs Microsoft Excel 2003 (Microsoft Corporation, NY, USA) and SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 16 for Microsoft Windows.

Aspects of statistical analysis of acquired data

I. Incidence of contamination of different parts of used endoscopes, washer disinfector, source of water (used in reprocessing), water of connected water bottle (used during the endoscopy procedure) and environmental surfaces.
II. Incidence of contamination of different parts of used endoscopes according to type of endoscope.
III. Incidence of contamination of different parts of used endoscopes according to mode of disinfection.
IV. Incidence of contamination of different parts of used endoscopes according to timing of disinfection.

## RESULTS

Table 1 showed that 9.6% of samples taken from accessory channels were contaminated. CONS* (Coagulase Negative Staphylococci) and Pseudomonas were the most frequent contaminants of accessory channel and less frequent contaminants were acinetobacter, coryneform bacilli and klebsiella.

**Table 1**: The Incidence rate of isolated organisms in samples taken from accessory channels.

| | ***Frequency*** | ***Percent*** |
|---|---|---|
| Acinetobacter | 1 | 1.2 |
| Anthracoids | 1 | 1.2 |
| CONS* | 2 | 2.4 |
| Coryneform bacilli | 1 | 1.2 |
| Klebseilla | 1 | 1.2 |
| Pseudomonas | 2 | 2.4 |
| Total Growth | **8** | **9.6** |
| NG | **75** | **90.4** |
| Total | **83** | **100.0** |

Table 2 showed that 7.2% of samples taken from accessory channels opening were contaminated. CONS were the most frequent contaminants of the accessory channels opening while MRSA were the less frequent contaminant of the openings.

**Table 2:** The Incidence rate of isolated organisms from the opening of channels

| | ***Frequency*** | ***Percent*** |
|---|---|---|
| CONS | 5 | 6.0 |
| MRSA | 1 | 1.2 |
| **Total Growth** | **6** | **7.2** |
| **No Growth** | **77** | **92.8** |
| **Total** | **83** | **100.0** |

Table 3 showed that 4.8% of all samples taken from endoscopes outer surfaces were contaminated and showed also that CONS were the most frequent contaminants of the endoscopes outer surface, pseudomonas and anthracoids were less frequent contaminants of the endoscopes outer surface.

**Table 3:** The Incidence rate in isolated organisms from outer surface of used endoscopes.

| | ***Frequency*** | ***Percent*** |
|---|---|---|
| Anthracoid | 1 | 1.2 |
| CONS | 2 | 2.4 |
| Pseudomonas | 1 | 1.2 |
| **Total Growth** | **4** | **4.8** |
| **No Growth** | **79** | **95.2** |
| **Total** | **83** | **100.0** |

Table 4 showed significant increase in the contamination of water used during procedures compared to that used in reprocessing.

**Table 4:** Comparison between water used in disinfection and water used during the procedure.

| | | | ***source of water*** | | ***Total*** | ***P value*** |
|---|---|---|---|---|---|---|
| | | | **G** | **NG** | | |
| | Disinfection | Count | 4 | 52 | 56 | 0.004 |
| | | % within mode | 7.1% | 92.9% | 100.0% | |
| | Procedure | Count | 9 | 18 | 27 | |
| | | % within mode | 33.3% | 66.7% | 100.0% | |
| Total | | Count | 13 | 70 | 83 | |
| | | % within water | 15.7% | 84.3% | 100.0% | |

Table 5 showed that pseudomonas was the most frequent contaminant of water used during the procedures, acinetobacter and anthracoids were less frequent contaminants and CONS was the most frequent contaminant of water used in reprocessing.

**Table 5:** Type of isolated organisms in samples taken from water used in reprocessing and water used during the procedures.

| | ***Frequency*** | | ***Percent*** |
|---|---|---|---|
| **Acinetobacter** | 2 | Water of procedure | 2 |
| **Anthracoids** | 2 | Water of procedure | 2.4 |
| **CONS** | 3 | **1** in Water of procedure<br>**2** in water of reprocessing | 3.6 |
| **Klebseilla** | 1 | Water of reprocessing | 1.2 |
| **Pseudomonas** | 5 | **4**In water of procedure<br>**1** in water of reprocessing | 6 |
| **NG** | 70 | | 84.3 |
| **Total** | 83 | | 100.0 |

Table (6) showed that acinetobacter was the most frequent contaminant of environmental surfaces; anthracoids, MRSA and pseudomonas were less frequent contaminants of the environmental surfaces.

**Table 6:** Type of isolated organisms in samples taken from environmental surfaces.

| | ***Frequency*** | ***Percent*** |
|---|---|---|
| Acinetobacter | 4 | 4.8 |
| Anthracoids | 2 | 2.4 |
| MRSA | 1 | 1.2 |
| Pseudomonas | 1 | 1.2 |
| NG | 75 | 90.4 |
| Total | 83 | 100.0 |

**II- Incidence of contamination of different parts of used endoscopes according to type of endoscope.**

Table(7) showed that in comparing between gastroscope, colonoscope and endoscopes used in ERCP accessory channels regarding the frequency of contamination after disinfection, revealed higher rate of contamination of gastroscope compared to both those used in ERCP and colonoscopy with (p-value 0.023).

**Table 7:** Comparison between the endoscopes under study as regard the frequency of accessory channel contamination after disinfection.

| | | | ***accessory channel*** | | ***Total*** | ***P value*** |
|---|---|---|---|---|---|---|
| | | | **G** | **NG** | | |
| Endoscope | Colonoscope | Count | 2 | 26 | 28 | |
| | | % within endoscope | 7.1% | 92.9% | 100.0% | 0.024 |
| | ERCP | Count | 0 | 27 | 27 | |
| | | % within endoscope | .0% | 100.0% | 100.0% | |
| | UPPER | Count | 6 | 22 | 28 | |
| | | % within endoscope | 21.4% | 78.6% | 100.0% | |
| Total | | Count | 8 | 75 | 83 | |
| | | % within endoscope | 9.6% | 90.4% | 100.0% | |

**III- Incidence of contamination of different parts of used endoscopes according to mode of disinfection.**

Table(8) showed significant increase in the contamination rate of accessory channels following manual disinfection in comparison to automatic disinfection and the most frequent contaminants were pseudomonas and CONS.

**Table 8:** Contamination rate and frequency of accessory channel contamination according to the mode of disinfection and type of contaminating microorganism.

| | | | **Accessory channel** | | | | | | | | **Total** | **P value** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Pseudomonas** | **Klebseilla** | **CONS** | **Acintobacter** | **Anthracoids** | **Corynefrombacilli** | **Total Growth** | **NG** | | |
| Mode | Automatic | Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56 | 56 | 0.000 |
| | | % within mode | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100.0% | 100.0% | |
| | Manual | Count | 2 | 1 | 2 | 1 | 1 | 1 | 8 | 19 | 27 | |
| | | % within mode | 7.4% | 3.7% | 7.4% | 3.7% | 3.7% | 3.7% | 29.6% | 70.4% | 100.0% | |
| Total | | Count | 2 | 1 | 2 | 1 | 1 | 1 | 8 | 75 | 83 | |
| | | % within mode | 2.4% | 1.2% | 2.4% | 1.2% | 1.2% | 1.2% | 9.6% | 90.4% | 100.0% | |

Table (9) showed insignificant change in the contamination rate of accessory channels opening in relation to the mode of disinfection.

**Table 9:** Frequency of accessory channel opening contamination according to the mode of disinfection and type of contaminating microorganism.

| *Mode* | | | ***opening of channel*** | | | | ***Total*** | ***P value*** |
|---|---|---|---|---|---|---|---|---|
| | | | **CONS** | **MRSA** | **Growth** | **NG** | | |
| | Automatic | Count | 4 | 1 | 5 | 51 | 56 | 1 |
| | | % within mode | 7.1% | 1.8% | 8.9% | 91.1% | 100.0% | |
| | Manual | Count | 1 | 0 | 1 | 26 | 27 | |
| | | % within mode | 3.7% | .0% | 3.7% | 96.3% | 100.0% | |
| Total | | Count | 5 | 1 | 6 | 77 | 83 | |
| | | % within mode | 6.0% | 1.2% | 7.2% | 92.8% | 100.0% | |

This (10) table showed insignificant change in the contamination rate of endoscopes outer surface in relation to the mode of disinfection and the most frequent contaminant is CONS.

**Table 10:** Frequency of endoscopes outer surface contamination according to the mode of disinfection and type of contaminating microorganism.

| *Mode* | | ***outer surface*** | | | | ***Total*** | ***P value*** |
|---|---|---|---|---|---|---|---|
| | | **CONS** | **Pseudomonas** | **thracoid** | **NG** | | |
| Automatic | Count | 1 | 0 | 0 | 55 | 56 | 0.099 |
| | %within mode | 1.8% | .0% | .0% | 98.2% | 100.0% | |
| Manual | Count | 1 | 1 | 1 | 24 | 27 | |
| | %within mode | 3.7% | 3.7% | 3.7% | 88.9% | 100.0% | |
| Total | Count | 2 | 1 | 1 | 79 | 27 | |
| | %within mode | 2.4% | 1.2% | 1.2% | 95.2% | 100.0% | |

**IV- Incidence of contamination of different parts of used endoscopes according to timing of disinfection.**

Table(11) showed increase in the rate of contamination of accessory channels 16 hours after disinfection with statistically significant changes by using chi-square test.

**Table 11:** Frequency of contamination of accessory channels in relation to the timing of disinfection.

| *Timing* | | *Accessory channel* | | *Total* | *P value* |
|---|---|---|---|---|---|
| | | **G** | **NG** | | |
| 16 hr | Count | 6 | 27 | 33 | 0.05 |
| | % within timing | 18.2% | 81.8% | 100.0% | |
| I hr | Count | 2 | 48 | 50 | |
| | % within timing | 4.0% | 96.0% | 100.0% | |
| Total | Count | 8 | 75 | 83 | |
| | % within timing | 9.6% | 90.4% | 100.0% | |

## DISCUSSION

Flexible endoscopes belong to semi-critical devices which come in contact with mucus membranes or non intact skin during endoscopic procedures with not only an external surface, but also internal channels (e.g., suction/biopsy, air/water and elevator channels) and accessories that are exposed to body fluids and other contaminants. Such endoscopes should be sterilized or receive an intensive disinfection procedure**.**8 Endoscopic procedures most often result in endogenous infections (i.e., infections resulting from the patient's own microbial flora).[9]

Endogenous infections are associated with endoscopy but cannot be prevented by well controlled disinfection procedures. Exogenous endoscopy related infections are very low but should be considered.[10] This should be prevented by strict endoscope disinfection procedures11 **.**Various classes of infectious agents have different patterns of resistance to germicides, the recognition of which is important for developing strategies for endoscope and accessory reprocessing. The most resistant organisms are bacterial spores (*Bacillus* and *Clostridium*) followed by, in descending order, mycobacteria and nonlipid viruses (e.g., poliovirus, hepatitis A virus), vegetative fungi and bacteria, and finally lipid containing viruses such as HBV and HIV that are highly sensitive to germicides. Hepatitis C virus (HCV) is also a lipid-containing virus and is likely to be similarly sensitive. Processes that eliminate high numbers of bacterial spores will likely eliminate all other microbial life as well.[12]

The involved pathogens include bacteria, viruses, and protozoa. Bacteria associated with outbreaks related to endoscope include *Pseudomonas aeruginosa, Salmonella spp., Helicobacter pylori, Serratia marcescens, Enterobacter cloacae, Klebsiella spp., Mycobacterium fortuitum, Clostridium difficile*, and Flavobacterium spp. Viruses include hepatitis B virus and hepatitis C virus. Parasites include *Strongyloides stercoralis* and *Trichosporon spp*.[13]

Choice of these sites was selected according to Bradley [14] who stated that microbiological surveillance cultures are not practical for determining the total bioburden present on an endoscope. The entire endoscope is not sampled as part of routine surveillance. Instead, sampling locations that represent the greatest challenge to cleaning and disinfection should be selected. In general, samples should be taken from locations that are exposed to the highest bioburden, are the most difficult to clean and disinfect, and represent the greatest risk to patient safety. In most cases, this will be the suction and instrument channel of flexible endoscopes. If results indicate that these locations were effectively reprocessed, this provides some assurance that the entire endoscope was effectively reprocessed. Other sampling locations, such as the air/water channel, auxiliary water channel, elevator wire channel, opening of accessory channels and endoscope outer surfaces should be periodically monitored to ensure established reprocessing guidelines are being followed.14Rinse fluid samples were taken by the anterograde method in accordance with Tunuguntla and Sullivan [15] and in disagreement with Buss et al.[16] who stated that anterograde sampling is not sensitive enough. In this study we found that a total of 9.6% of accessory channels samples were contaminated after disinfection. Various groups of bacteria were found in the surveillance cultures.

The following microorganisms were frequently found: aerobic gram-positive cocci (CONS), gram-negative nonfermenters (*Pseudomonas, Acinetobacter species*), Enterobacteriaceae (klebsiella) and others like anthracoids and coryneform bacilli. Pseudomonas aeruginosa and coagulase negative staphylococci (CONS) were the most frequently microorganisms isolated from endoscope accessory channel samples with a percent of 2.4%, for each of them, out of 9.6%. This is in accordance with previous studies which recovered most frequently Pseudomonas spp, pseudomonas aeruginosa and Staphylococcus spp from both external and internal parts of esophagogastro-

duodenoscopes and colonoscope, and reported an association of P. aeruginosa with sepsis in individuals submitted to endoscopic examinations[17].

Similarly amore recent study reported that most of the outbreaks have involved waterborne organisms and P. aeruginosa, is the most commonly reported organism due to its predilection for moist environments so it can be found in tap water and can quickly colonize any damp area, including the channel of a reprocessed endoscope, unsterilized irrigation water bottle, or endoscopic automated reprocessor**,** therefore Pseudomonas aeruginosa is a common hospital environmental pathogen.[18] According to the recent reports, *P*. aeruginosa transmission during gastrointestinal endoscopy has been attributed to improper endoscope reprocessing including inadequate high level disinfection of the endoscope channels.[19] and, most importantly, failure to adequately dry any channels of the endoscope with 70% alcohol solution and forced air 18**,** also colonization of the water supply to the endoscope and defective disinfecting machines i.e. failure in design or defects in endoscope channels and accessories are important underlying factors for pseudomonas contamination.[18] Finally microbial resistance to biocides and establishment of biofilms are other important factors related with decontamination failure.[20]

Weber and Rutala [21] reported that contamination of medical devices can be due to either "Possible scope contamination" i.e. the organisms cultured may have derived from the patient and the scope have been inadequately cleaned or "Possible process contamination" i.e. the contamination may have occurred during sample collection or sample culture in the laboratory.So our study included in addition random specimens of washer disinfector, rinse water, water of connected water bottles and from environmental surfaces including examination table, endoscopy stack and endoscopist's desk. The results of these samples showed that 33.3% of water samples taken from connected water bottles were contaminated and *pseudomonas aeruginosa* was the most frequent contaminant. This was attributed to lack of adherence of our unit to the reprocessing guidelines which stated that water bottles must be cleaned and sterilized or, at a minimum, high level disinfected at least daily, should be filled with sterile water and changed after each endoscopy session and testing of water bottles should be included in regular quality control.[22]

Regarding the contamination with coagulase negative staphylococci (CONS) our results showed that 7.2% of all samples taken from accessory channel openings, 4.8% of all samples taken from endoscopes outer surfaces and 7.1% of all samples taken from the water source were contaminated and CONS, an environmental nonpathogenic organism, was the most frequent contaminating microorganism with a percent of 2.4% out of 9.6%,6% out of 7.2%, 2.4% out of 4.8% and 3.5% out of 7.1%, from accessory channels, opening of channels, endoscope outer surface and water source respectively.

Our study also revealed that 100% of the studied samples from washer disinfector were free of contamination.This rate was lower than the previously reported contamination rate for GI scope culture (9.6% for accessory channels, 7.2% for opening of channels and 4.8% for outer surface). This suggests that the contamination of GI scopes is not caused by AER contamination. A total of 9.6% of all samples taken from environmental surfaces including examination table, endoscopy stack and endoscopist's desk were contaminated and acinetobacter was the most frequent contaminant of environmental surfaces; anthracoids, MRSA and pseudomonas were less frequent contaminants of the environmental surfaces. ***Acinetobacter*** are widely distributed in nature, and commonly occur in soil. They can survive on moist and dry surfaces, including hospital environment.[23]

In assessing the culture status of different parts of endoscopes and type of endoscope, we found that the contamination frequency of accessory channels of gastroscopes was higher than those of duodenoscopes (ERCP) and colonoscopes with p- value 0.023 and 0.25 respectively. This was in contrast to Chiu et al.[5] who stated that the length of the endoscope is an important factor that adds to the difficulty of disinfection. Regarding the opening of accessory channels there was a higher rate of contamination in gastroscopes and colonoscopes compared to duodenoscopes but the difference was not statistically significant (p-value 0.23). Also there was no significant difference between different types of endoscopes (gastroscope, duodenoscope and colonoscope with p- value 1) as regarding the outer surface. On the other hand when we compared the incidence of contamination of accessory channels, opening of accessory channels and outer surface of each type of endoscopes separately we found no significant difference between the incidence of infection in samples of different parts in gastroscopes (p-value 0.144) or duodenoscopes (p-value 1) or colonoscopes (p-value 1).There is significant increase in the contamination rate of water used during procedures (from water bottles) compared to that used in reprocessing (tap water) and this as previously described was attributed to lack of adherence of our unit to the reprocessing guidelines which stated that water bottles must be cleaned and sterilized or, at a minimum, high level disinfected at least daily, should be filled with sterile water and changed after each endoscopy session and testing of water bottles should be included in regular quality control. [22]

As regard the disinfectant (Cidex) that is used in the unit: 1) During automated reprocessing it was stored in special container related and connected to the washer disinfector machine according to the manufacturer instructions in a separate reprocessing room and is

changed every 20 cycles, this is agreed with Bader et al.[22] who stated that cidex should be changed every 24-28 or 20 cycles of endoscope reprocessing respectively to ensure the efficacy of the disinfectant. 2) During manual reprocessing it was stored in an opened container which was partially covered and placed over a bar near the water sink of the procedure room so it was liable for contamination from air or water. Cidex was changed every 14 day during manual reprocessing, this was in agreement with Alvrado et al.[8] who stated that the chemically stabilized activated glutaraldehyde (Cidex) solutions have a shelf life (i.e., a period during which they maintain adequate glutaraldeyde concentration and action) of 14 days and cidex should be changed every 14 days.But this was not agreed with Bader et al.[22] who stated that cidex should be changed after a specific number of disinfection cycles as described above.

In addition, improper drying of channels after manual cleaning can result in dilution of cidex concentration and decrease its efficacy; this is agreed with Cowen et al.[24] who stated that dilution by rinse water and age of the chemical disinfectant solution result in gradual reduction of the effectiveness of reusable biocides (disinfectants).As regard the mode of disinfection used in El- Ibrashi unit, they used to use the manual disinfection method when the AFER is for repair or rarely during emergency with high flow of emergent cases (this occurs in EGD not in ERCP), so it would not properly disinfect the endoscopes unlike the automated endoscope washer. But during the last two years manual disinfection was markedly restricted only to emergent cases when the AFER is for repair. Finally we recommend further studies with larger sample size and in other centers to validate the importance of adherence to the national infection control guidelines in preventing the endoscopy related infections**.**

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