Microbial contamination in the operating theatres in Iraq

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ABSTRACT

Contamination of the operating theatre is a major cause of nosocomial infection. This report aimed to show the types of microorganisms and their percentages cultivated from operating theatres of 16 health directorates of 14 Iraqi governorates (3 health directorates in Baghdad and 1 in each other 13 governorates) that was reported to the Pollution Control Section at Ministry of Health in Iraq from first of January to the end of June 2018. The data of all health directorates have included cultivation taken from governmental and private hospitals. Duhok, Erbil, Sulaymaniyah, and Nineveh were not involved in this report due to unavailability of their data during the above period. *Escherichia coli, Pseudomonas aeruginosa* and *Staphylococcus aureus* are the commonest microorganisms reported by sixteen Iraqi health directorates during the first 6 months of 2018. Only few health directorates have recorded fungal contaminations, and none have reported anaerobic microorganisms.

Key words: **nosocomial infection**, operating theatres, *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus*

Iraqi New Medical Journal January 2019;5(9)

Operating theatres are one of the most complicated and risky work environments. Microbial contamination in the operating theatres increases the risk factors for developing surgical-site infections (SSI).[1] It is considered that protecting patient safety in operating rooms prevents surgical site infections, decreases complications, increases the quality of the operation and contributes to quality healthcare service by decreasing cost.[2]

Multiple reservoirs have been reported as being responsible for contamination of the operating theatres, including unfiltered air, ventilation systems and antiseptic solutions. A range of microenvironmental conditions exist even within purified water systems.[3,4]

Our report aimed to show the types and percentages of microorganisms cultivated from operating theatres of private and governmental hospitals of Iraqi Health Directorates that were notified to the Pollution Control Section at Ministry of Health in Iraq in a monthly basis from first of January to the end of June 2018.

The report has included data from 16 out of 20 Iraqi Health Directorates; Duhok, Erbil, Sulaymaniyah, and Nineveh were excluded from this report due to unavailability of their data during the above period. It is noteworthy that the calculations of some months was made on data of 15 or 14 health directorates due to missing of data of a health directorate for a month or two.

Each health directorate notifies the Pollution Control Section at Ministry of Health of the types of microorganisms cultivated in a monthly basis. We calculated the monthly percentage of each notified microorganism as follows:

Percentage of reported "X" microorganism in "Y" month = number of health directorates reporting "X" microorganism in "Y" Month / the total number of health directorates submitting their data in "Y" Month multiplied by 100.

All reports were analysed using the Statistical Package for the Social Sciences (SPSS) pro-

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Table 1: Percentages of most common bacteria contaminate operating theatres of 16 health directorates in 14 Iraqi governorates from January to June 2018.

	E. coli (%)	*Ps. aeruginosa* (%)	*S. aureus* (%)	*Coagulase -Ve Staph* (%)	*Enterobacter* (%)	*Klebsiella* (%)	*B. subtilis* (%)	No. of health directorates sending the data
January	12 (80)	9 (60)	9 (60)	8 (53.3)	7 (46.6)	6 (40.0)	4 (26.6)	15*
February	13 (86.6)	10 (66.6)	10 (66.6)	7 (46.6)	9 (60.0)	6 (40.0)	4 (26.6)	15*
March	12 (75.0)	12 (75.0)	10 (62.5)	6 (37.5)	7 (43.7)	6 (37.5)	5 (31.2)	16
April	12 (85.7)	10 (71.4)	11 (78.5)	6 (42.8)	8 (57.1)	7 (50.0)	5 (35.7)	14 ǂ
May	13 (86.6)	12 (80)	11 (73.3)	5 (33.3)	6 (40.0)	8 (53.3)	5 (33.3)	15§
June	12 (85.7)	11 (78.5)	11 (78.5)	6 (42.8)	7 (50.0)	9 (64.2)	4 (28.5)	14**

*: All excluding Babil, ǂ: all except Anbar and Basrah, §: all except Basrah, **: all except Qadisiyah and Anbar

gram version 24 Explore. The Chi-square-χ^2 test was used for comparison between percentages regarding the effect of seasons on the results.

We found that *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* were the commonest microorganisms notified by the health directorates as shown in **table 1**. While **table 2** shows other less commonly cultivated microorganisms from operating theatres as reported by the health directorates.

DISCUSSION

Escherichia coli, *Pseudomonas aeruginosa* and *Staphylococcus aureus* were the most frequently reported microorganisms contaminating the operating theatres of Iraqi Health directorates the percentages were 80, 60, 60% respectively. So, our programmes of infection control should be extended to target these microorganisms. Whether these microorganisms are originated from the patients (endogenous flora) or from the staff, instruments and consumers (exogenous flora) is difficult to be determined as endogenous flora can be transformed to exogenous one.[5] Many studies[6,7] have also shown that *Staphylococcus aureus,* coagulase-negative *Staphylococcus*, *Enterococcus* species., and *Escherichia coli.*

We found that E coli is the commonest isolated bacteria, the source of contamination could be food and water supply. Another possible contaminant source is the bowels of patients, and genitourinary systems particularly in the delivery theatres.[8]

Pseudomonas aeruginosa is an opportunistic pathogen that has multiple determinants of the virulence such as biofilm formation, enzymes, diffusible pigments, and it is usually resistant to commonly used antibiotics and disinfectants. These features make it a major life threatening agent for many outbreaks in operating thea-

Table 2: Percentages of less common bacteria and fungi contaminate operating theaters of 16 health directorates in 14 Iraqi governorates from January to June 2018.

	Aeromonas hydrophila (%)	Acinetobacter (%)	Burkholderia (%)	Citrobacter (%)	Haemophilus (%)	Micrococcus (%)	Moraxella (%)	Ochrobactrum (%)	Pantoea (%)	Pasteurella (%)	Proteus (%)	Serratia (%)	Sphingomonas (%)	Streptococcus (%)	Fungi (%)	No. of health directorates sending the data
January	0 (0.0)	2 (13.3)	0 (0.0)	1 (6.6)	0 (0.0)	0 (0.0)	1 (6.6)	1 (6.6)	1 (6.6)	1 (6.6)	1 (6.6)	1 (6.6)	0 (0.0)	1 (6.6)	2 (13.3)	15*
February	0 (0.0)	2 (13.3)	0 (0.0)	1 (6.6)	0 (0.0)	1 (6.6)	0 (0.0)	0 (0.0)	1 (6.6)	0 (0.0)	3 (20.0)	1 (6.6)	0 (0.0)	2 (13.3)	3 (20.0)	15*
March	1 (6.25)	3 (18.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.2)	0 (0.0)	3 (18.7)	1 (6.2)	1 (6.2)	3 (18.7)	1 (6.2)	16
April	0 (0.0)	3 (21.4)	1 (7.1)	0 (0.0)	1 (7.1)	1 (7.1)	0 (0.0)	1 (7.1)	1 (7.1)	0 (0.0)	2 (14.2)	0 (0.0)	0 (0.0)	5 (35.7)	1 (7.1)	14 ǂ
May	0 (0.0)	3 (20.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (26.6)	2 (13.3)	0 (0.0)	3 (20.0)	3 (20.0)	15§
June	0 (0.0)	3 (21.4)	0 (0.0)	1 (7.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (7.1)	0 (0.0)	0 (0.0)	2 (14.2)	0 (0.0)	0 (0.0)	1 (7.1)	1 (7.1)	14**

*: All excluding Babil, ǂ: all except Anbar and Basrah, §: all except Basrah, **: all except Qadisiyah and Anbar

tres.[9] It has also been reported that keeping antiseptics in reusable containers that have been used many times could contaminate antiseptics with *Pseudomonas aeruginosa.*[10] Although most of the hospitals included in our report claimed that they follow the standards recommended to eradicate microbial contamination; however, *Pseudomonas aeruginosa* is still reported by many health directorates. More efforts are still needed to educate staff working in the operating theatres about how to store antiseptics and how to use them properly.

Staphylococcus aureus was the third commonest microorganism isolated and reported by health directorates. *Staphylococcus aureus* is a normal skin flora of the patients and the staff working in the theatres. Droplet and nuclei contaminated with *Staphylococcus* can infect not only the wounds but also the ground, shelves, and lamps of the operating rooms. Dust is an important factor in aerosolization of the microorganisms settled on the ground.[11,12] Unnecessary mobility of the staff during the operation can create air stream around the open wound; therefore, continuous maintenance of laminar airflow-ventilated operating rooms offers high-quality air during surgery and the guidelines for environmental infection control in health-care facilities should be always implemented.[13,14]

Regarding the seasonal factor there was no clear pattern in the percentages of microbial types in different studied months (p-value > 0.05).

Many other microorganisms were reported sporadically (see **table 2**). Alarmingly, none of the health directorates have reported a contamination with anaerobic microorganisms such as for example *Clostridium difficile* which is very dangerous once it contaminates an operating theatre.[15] Whether its nonexistence in the notified data is a reflection of good infection control at operating theatres or inability to cultivate anaerobic microorganisms is something that needs to be verified and studied in order to consolidate the good practices and overcome any weaknesses. The other point which deserves mentioning is that the notification is sometimes nonspecific for example health directorates notified fungi in general or *Staphylococcus aureus* not a specific strain; such poor specification cannot help to define the problem accurately and to put a plan for action and education.

It is also noteworthy that most of the rarely diagnosed bacteria were recorded from Baghdad-Karkh and Karbala health directorates. This may reflect that these directorates may follow strictly the standards of how to take the swabs and how to cultivate them. Many health directorates are in need to promote their contamination recording system, improving the yield of cultivation by taking sufficient number of the swabs from suitable sites and using appropriate culture media and protocols, and conducting education programmes for the involved staff.

Challenges and difficulties that many Iraqi health directorates have suffered during the last few years specifically limited financial and human resources or provision of the operating theatres with personnels of insufficient knowledge and experience have jeopardised the safety of operating theatres by increasing the contamination by different microbial. All these conditions agree with a study done by Henry et al in 2012.[16] In addition, improper use of the surgical attire or scrubs (sanitary clothing worn by surgeons, nurses, physicians and other workers) can lead to contamination of the theatres. The use of gloves and impervious surgical gowns in the operating room reduces the prevalence of surgical site infection.[17]

Most of the infections can be prevented with readily available, relatively inexpensive strategies. This can be achieved through:

- Maintaining asepsis in the operating room and providing sterility at the maximum level.
- Reduction of pre and post-operative length of hospitalization.[18]
- Reduction of the length of procedures through adequate training of the staff on proper surgical techniques.
- Using the sensitivity culture media to check the presence of resistant bacterial strains.
- Periodic checks and intense follow up surveillance for health institutions especially those record no microbial contamination in their operating theatres.
- Following the rules of sterilization in sterile areas by all personnel.
- Make a CAP study for the operation room personnel to know their level of knowledge

about the microbial contamination; effects and control.

In conclusion microbial contamination of the operating theatres is still high in many Iraqi hospitals. *Escherichia coli, Pseudomonas aeruginosa* and *Staphylococcus aureus* are the commonest isolated microorganisms.

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Abbreviation list: Statistical Package for the Social Sciences (**SPSS**), Surgical-site infections (**SSI**)

Conflict of interest: Authors have nothing to declare.

Funding: Self fundig.

Acknowledgement: The authors would like to thank Specialist Dentist Manal Hadi with Specialist Chemist Linh Shamil at the The National Centre for Training and Human Development/ Ministry of Health.