The Bacteriostatic and Bactericidal Effect of Commonly Used Disinfectants in Mukalla City- Hadhramout Hospitals against Nosocomial Pathogens The Bacteriostatic and Bactericidal Effect of Commonly Used Disinfectants in Mukalla City- Hadhramout Hospitals against Nosocomial Pathogens

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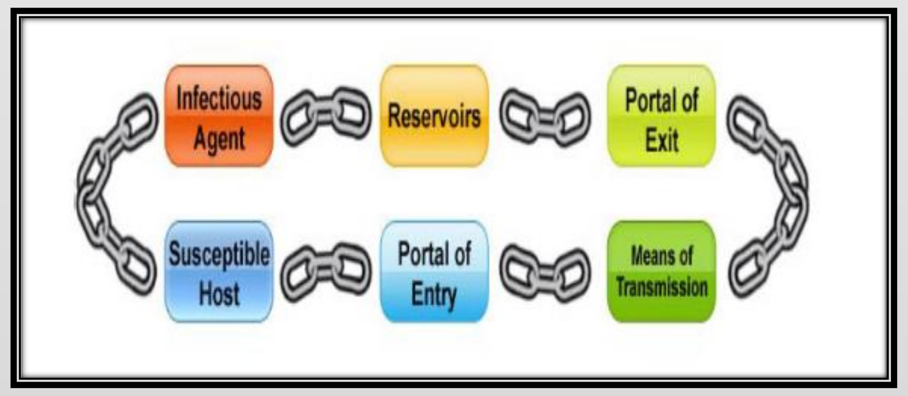
Introduction

- Medical service centers (including hospitals) are considered the safe environment to receive treatment and health care.
- However, hospitals may be a cause of an additional infections known as health care-associated infections (HAIs).
- HAIs are a global problem (1.7 million infections annually and an estimated mortality rate of 99,000 deaths)(Rutala and Weber, 2013).
- Infection rates in developed countries reach 5%-10% compared to developing countries (e.g Yemen) which have an infection rate of 65.4% (Al-Shami and Al-Haimi, 2018).
- Common hospital infections: urinary tract infection, respiratory infection, septicemia and surgical wound infection.
- Bacteria are the most prominent cause of HAIs in addition to other factors.
- To combat the spread of infection and get rid of its causes → Strategies and methods of infection control were developed.
- Chemical compounds (disinfectants) are one of the commonly used ways to break the chain of infection.



Methodology

- **Study design:** Comparative analytical study
- **Sampling:** Bacteria were isolated from Superficial and deep wound swabs, urine, and blood samples received to the microbiology department in several laboratories and hospitals
- **Duration of the study:** 6 months (1/2/2021- 31/7/2022).
- **Exclusion criteria:** Bacteria not classified by the CDC as a cause of HAI

In this comparative analytical study, bacterial species of *S. aureus, E. coli, P. aeruginosa, K. pneumoniae,* and *P. mirabilis* causing HAI according to CDC classification were isolated and tested for antibacterial activity of bleach, surgical spirit, and savlon.

Specimen collection → cultivation → diagnosis

Serial dilution of the disinfectants

By using the tube dilution method, a two-fold serial dilution of each disinfectant was prepared according to the instructions of the Clinical and Laboratory Standards Institute (CLSI, 2015) .

The undiluted disinfectant concentration at tube No. 1 was considered as 100%. Serial disinfectant dilution was calculated according to the formula:

$$V1 \times C1 = V2 \times C2$$

Table (1) Serial dilutions and the corresponding concentrations of each disinfectant

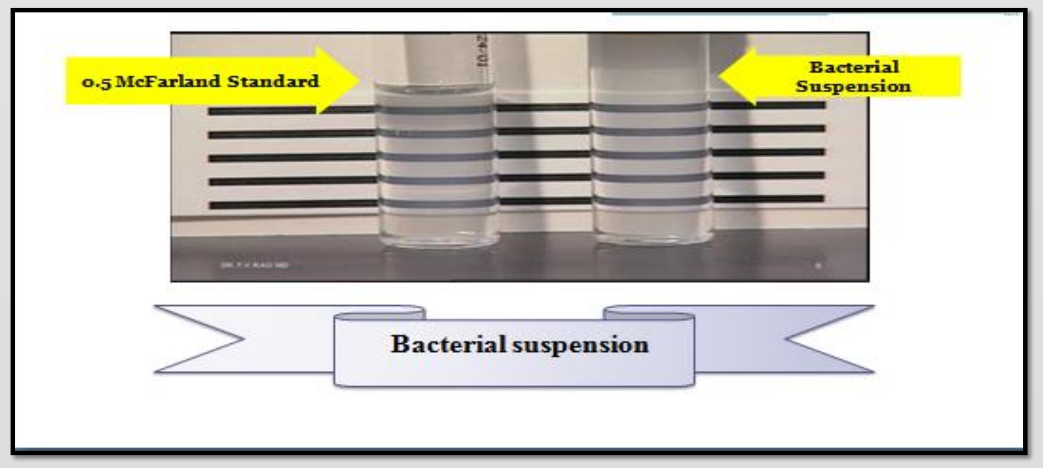
Tube No.	Dilution	Concentration %	Bleach (mg/L)	Surgical spirit (mg/L)	Savlon (mg/L) Chlorohexidine/cetrimide
1	Neat	100	5250	70000	500/5000
2	1:2	50	2625	35000	250/2500
3	1:4	25	1313	17500	125/1250
4	1:8	12.5	656	8750	63/625
5	1:16	6.25	328	4375	31/313
6	1:32	3.125	164	2188	16/156
7	1:64	1.56	82	1094	8/78
8	1:128	0.78	41	547	4/39
9	1:256	0.39	20	273	2/20

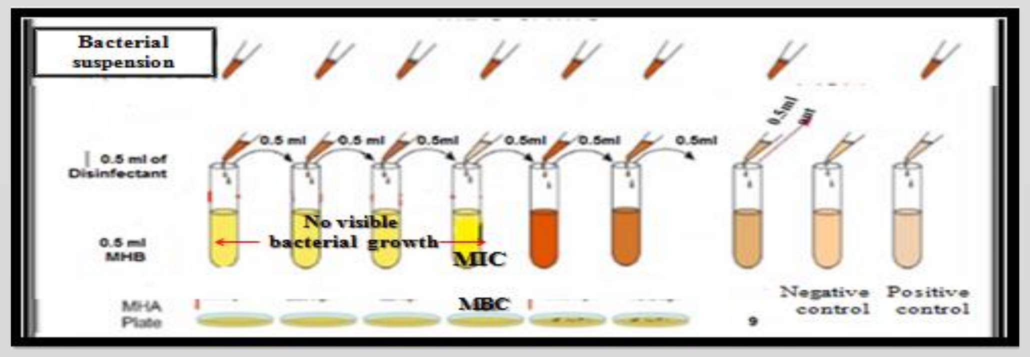
Preparation of bacterial suspension

The bacterial suspension was prepared according to the instructions of the Clinical and Laboratory Standards Institute (CLSI, 2015) .

The McFarland standard of 0.5 was used as a reference to compare the bacterial suspension turbidity in order to adjust the approximate cell density of 1-2 X10^8 colony-forming units (C.F.U) per milliliter.

Finally 0.5 ml of the bacterial suspension was added to all tubes of diluted disinfectants within 15 minutes of preparation sealed with tin and incubated at 37°C under aerobic conditions for 24 h.



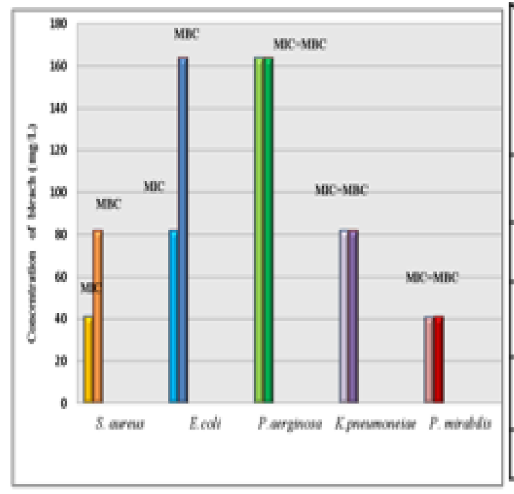


Determination of MIC
- The lowest conc. of the disinfectant inhibited bacterial growth.
- Observing the turbidity formed in the tubes. The lowest conc. of the disinfectant did not show visible turbidity to the naked eye compared to the negative control.

Determination of MBC
- The lowest conc. of an antibacterial agent that revealed no visible bacterial growth.
- A 50 µl from the clear tubes were cultivated on MHA plates and incubated at 37°C for 24 hrs. The lowest conc. of disinfectant that showed no visible bacterial growth.

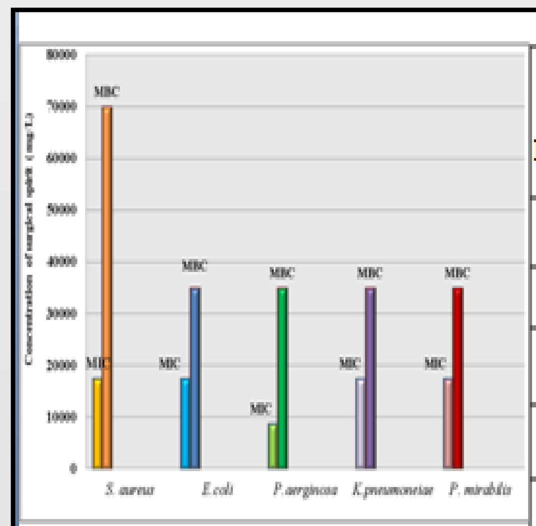
Determination of MBC/MIC ratio
- Evaluation the antibacterial activity of disinfectants.
- MBC/MIC ≤ 2 → bactericidal
  MBC/MIC ≥4 → bacteriostatic

Results



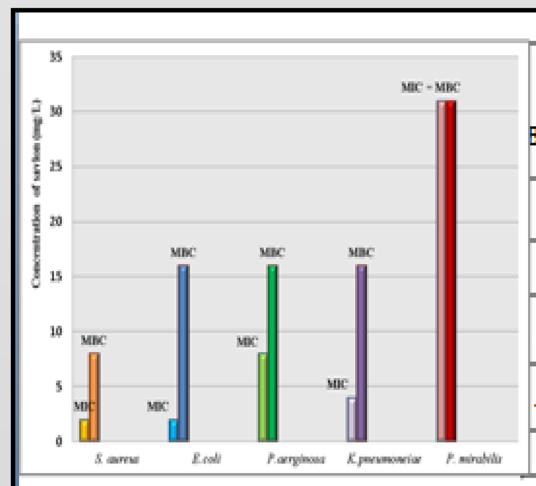
Bacteria \ Disinfectant	Bleach MIC (mg/L)	Bleach MBC (mg/L)	MBC/MIC ratio
S. aureus	41	82	2
E. coli	82	164	2
P.aeruginosa	164	164	1
K. pneumonia	82	82	1
P.mirabilis	41	41	1

Effect of bleach on bacteria



Bacteria \ Disinfectant	Surgical spirit MIC(mg/L)	Surgical spirit MBC(mg/L)	MBC/ MIC ratio
S. aureus	17500	70000	4
E. coli	17500	35000	2
P. aeruginosa	8750	35000	4
K. pneumonia	17500	35000	2
P. mirabilis	17500	35000	2

Effect of surgical spirit on bacteria



Bacteria \ Disinfectant	Savlon MIC(mg/L)	Savlon MBC(mg/L)	MBC/ MIC ratio
S. aureus	2/20	8/78	4
E. coli	2/20	16/156	8
P. aeruginosa	8/78	16/156	2
K. pneumonia	4/39	16/156	4
P. mirabilis	31/313	31/313	1

Effect of savlon on bacteria

Conclusions

1. Disinfectants are important for controlling the spread of disease but may reveal various efficacies and diverse ranges of activity against different bacterial strains.
2. Equal concentrations of disinfectants in the same application situation and same conditions may have different effects on different types of bacteria.
3. The choice of disinfectants in healthcare settings should depend upon the type of bacterial colonization.
4. Savlon showed the best bacteriostatic efficiency, bleach was the best effective in killing the tested bacteria, while the surgical spirit had low efficiency against the tested bacteria.
5. A great deal remains to be learned about the mode of action of antiseptics and disinfectants.

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