RESULTS

RESULTS

The results of this study are presented in the following tables and figures.

Microorganisms isolated from studied groups:

Frequency and percentage of microorganisms isolated from air taken from twenty location in ICU are illustrated in table (1):

Table (1): Frequency and percent of microorganisms isolated from air

Organism	Number	Percentage
S. aureus	18	32.7%
Coagulase negative staph	15	27.3%
Gram negative bacilli	12	21.8%
Candida	10	18.2%
Total no. of organisms	55	100%

The comparison between colony counts taken from twenty locations in ICU which were obtained by strips and exposure plates, is illustrated in table (2), Fig. (1, 2).

Table (2): comparison between colony counts obtained by strips and exposure plates.

Location	Strips (CFU)	Exposure plates (CFU)
L1	190	180
L2	236	145
L3	635	600
L4	850	400
L5	680	240
L6	238	200
L7	374	260
L8	340	160
L9	306	360
L10	374	400
L11	442	400
L12	516	420
L13	221	301
L14	621	350
L15	200	160
L16	410	390
L17	372	400
L18	522	371
L19	235	198
L20	400	280

L = Location   CFU = colony forming unit

Colony count obtained by strips was higher in (80%) of samples to that obtained by exposure plates.

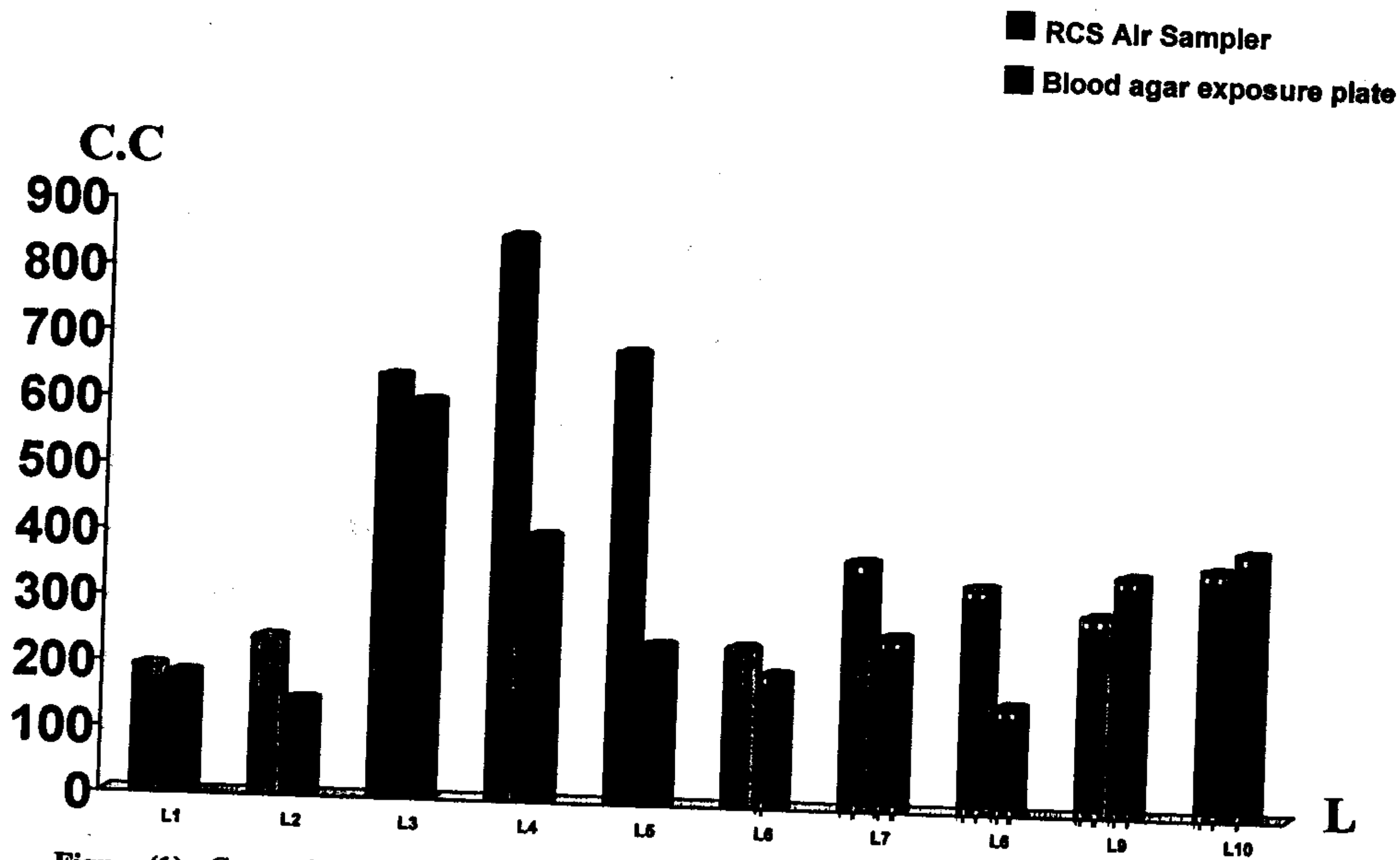


Figure (1): Comparison between C.C. obtained by RCS air sampler and blood agar exposure plate
(L= Location) C.C. : Colony count

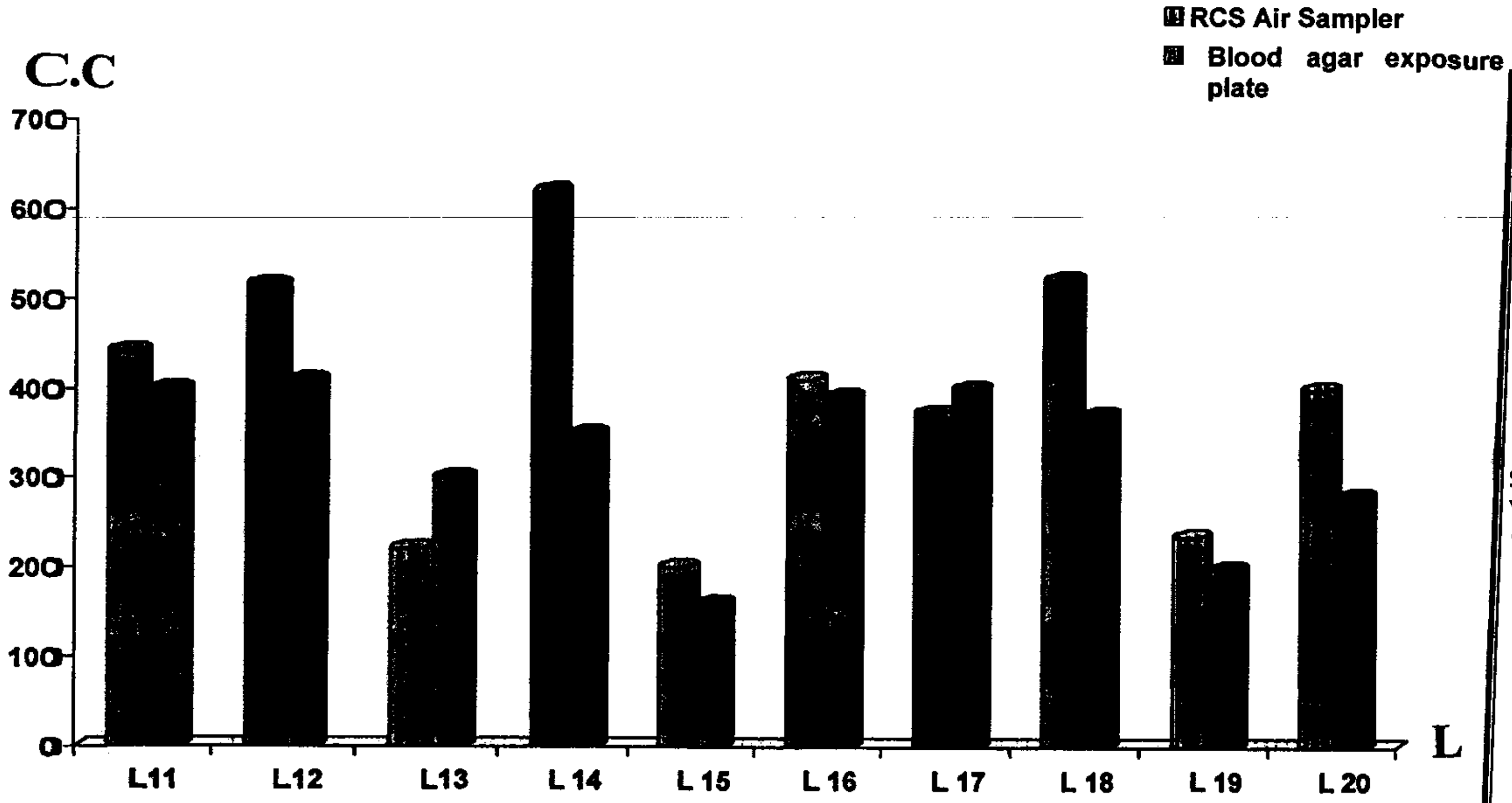
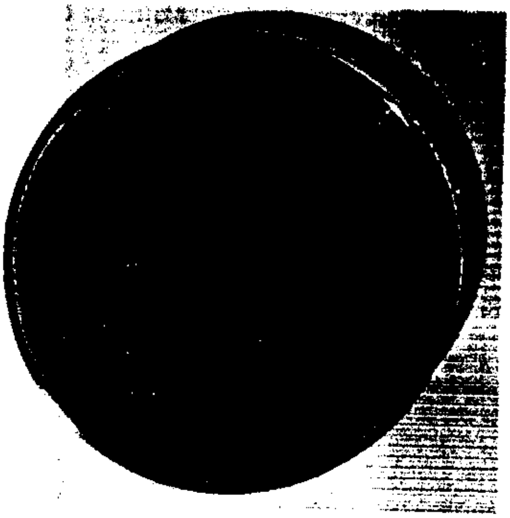


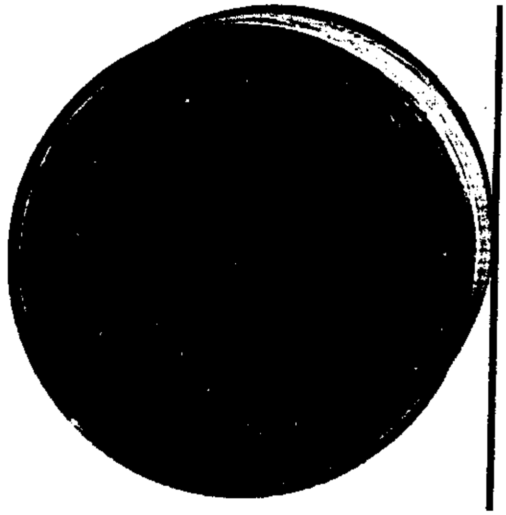
Figure (2). Comparison between C.C. obtained by RCS air sampler and blood agar exposure plate

(L=Location) C.C. : Colony count

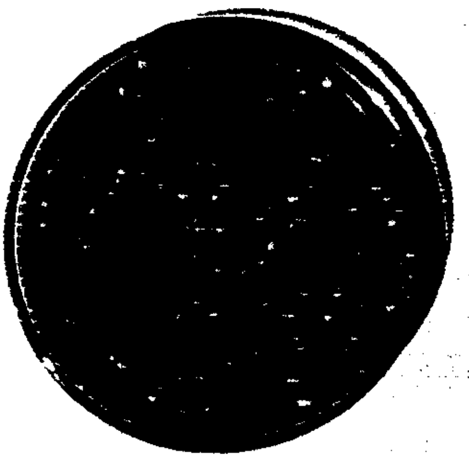
A



B



C



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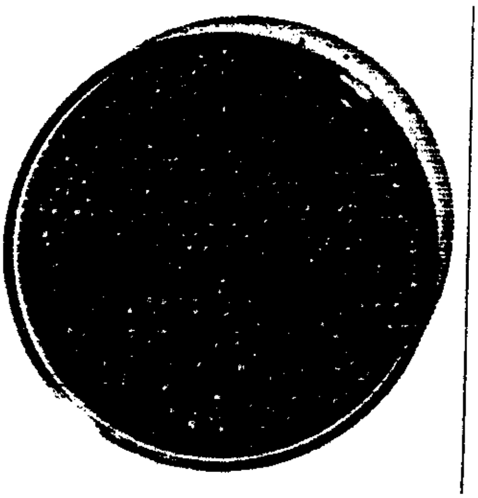

Fig. (3): Air samples taken from different location in the ICU by exposure plates

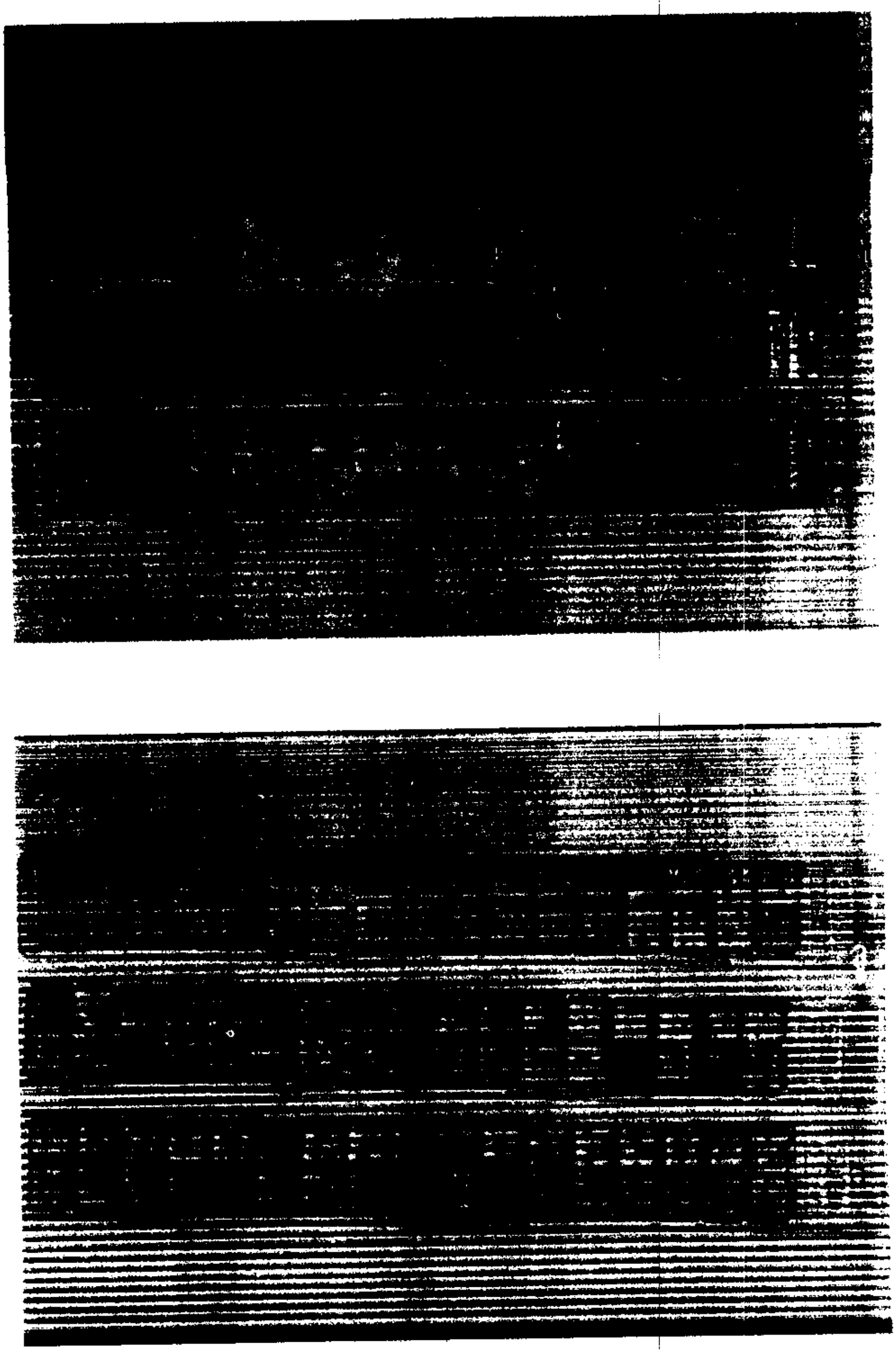

Fig. (4): Air samples taken from dlfferent location in the ICU by standard RCS alr sampler

Frequency and percentage of microorganisms isolated from environmental swabs (Laryngoscopes ventillators, air condition grills and beds) are illustrated in table (3).

Table (3): Frequency and percent of microorganisms isolated from environmental swabs.

Organism	Number	Percentage
S. aureus	22	44 %
Coagulase negative staph	10	20 %
Gram negative bacilli	18	36 %
Total no. of organisms	50	100%

Microorganisms isolated from workers samples

a) Hand samples

Frequency and percentage of bacteria in fifty samples taken from workers hands are shown in Table (4), Fig (5).

S. epidermidis was the commonest isolate (40%) followed by S. aureus (24%), S. saprophyticus (20%) and S. haemolyticus (16%).

Table (4): Frequency and percent of bacteria in hand swabs from workers

Organism	Frequency	
	No.	%
S. epidermidis	20	(40%)
S. aureus	12	(24%)
S. saprophyticus	10	(20%)
S. haemolyticus	8	(16%)
Total no. of organisms	50	(100%)

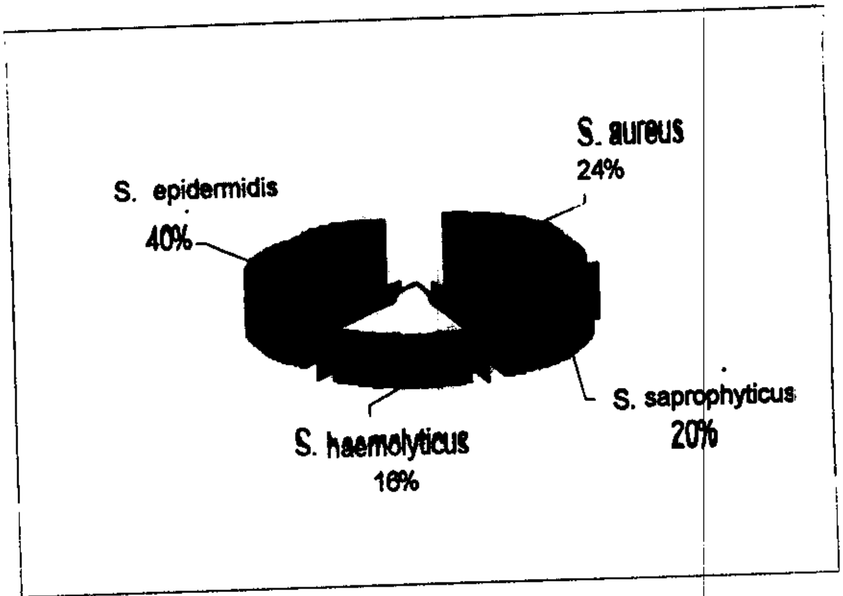

Figure (5): Percent of bacteria in hand swabs from workers.

b) Nasal samples

The frequency of organisms in fifty samples taken from workers nose are illustrated in Table (5), Fig. (6). S. aureus was 50% and also S. epidermidis was 50%.

Table (5): Frequency and percent of bacteria in nasal swabs from workers.

Organism	Frequency	
	No.	%
S. epidermidis	25	(50%)
S. aureus	25	(50%)
Total no. of organisms	50	(100%)

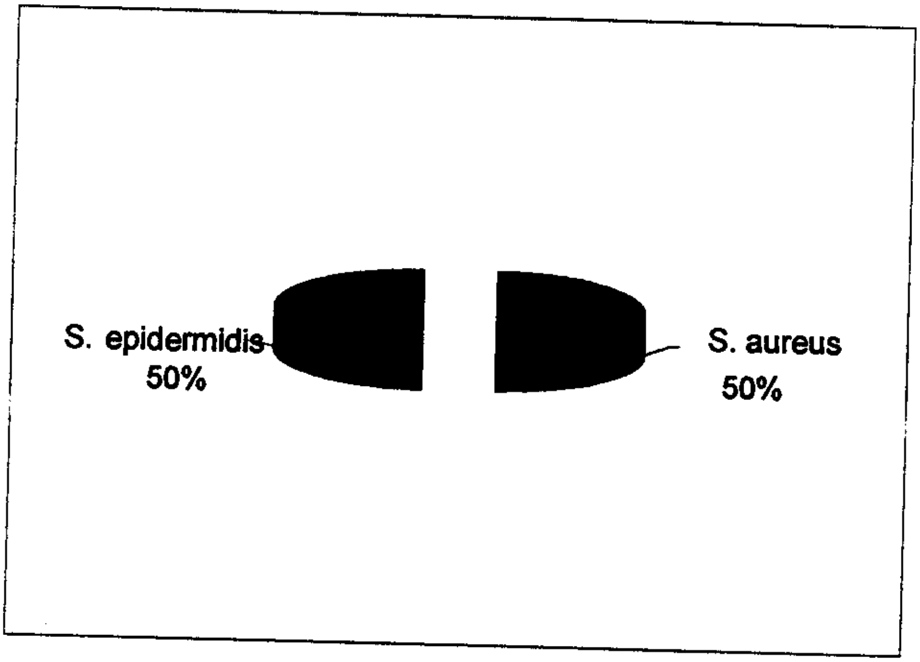

Fig. (6): Percent of bacteria in nasal swabs from workers

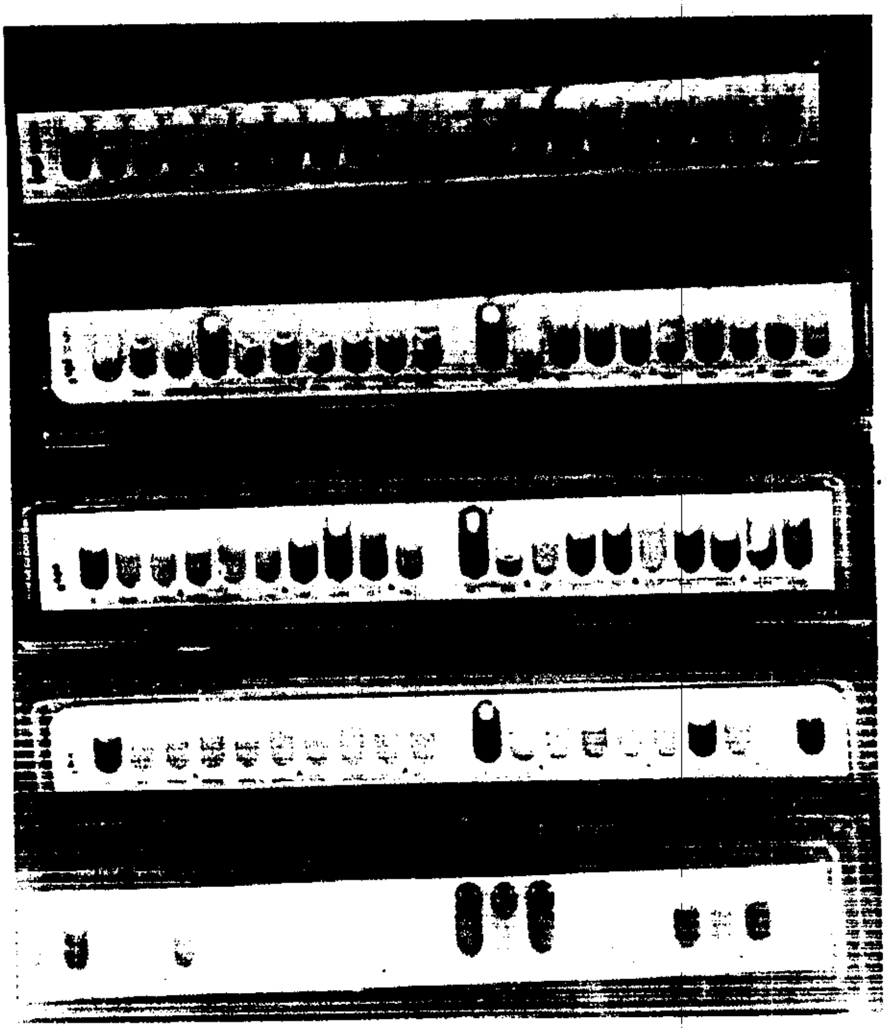

Fig. (7): API reaction profile of different isolated staphylococci

Microorganisms Isolated from patients samples

a) Nasal samples

Frequency of bacteria in fifty nasal samples taken from patients are illustrated in Table (6) Fig. (8), the most common isolate was S. aureus (40%). Gram-positive cocci represented (66%) of isolates while gram-negative bacilli represented (34%).

Table (6): Frequency and percent of bacteria in nasal swabs from patients.

Organism	Frequency	
	No.	%
S. aureus	20	(40%)
Aeromonas hydrophila	3	(6%)
Citrobacter freundii	4	(8%)
E coli	5	(10%)
S. saprophyticus	5	(10%)
P. mirabilis	1	(2%)
S. epidermidis	7	(14%)
Pseud. aeruginosa	2	(4%)
Enterobacter cloacae	3	(6%)
Total no. of organisms	50	(100%)

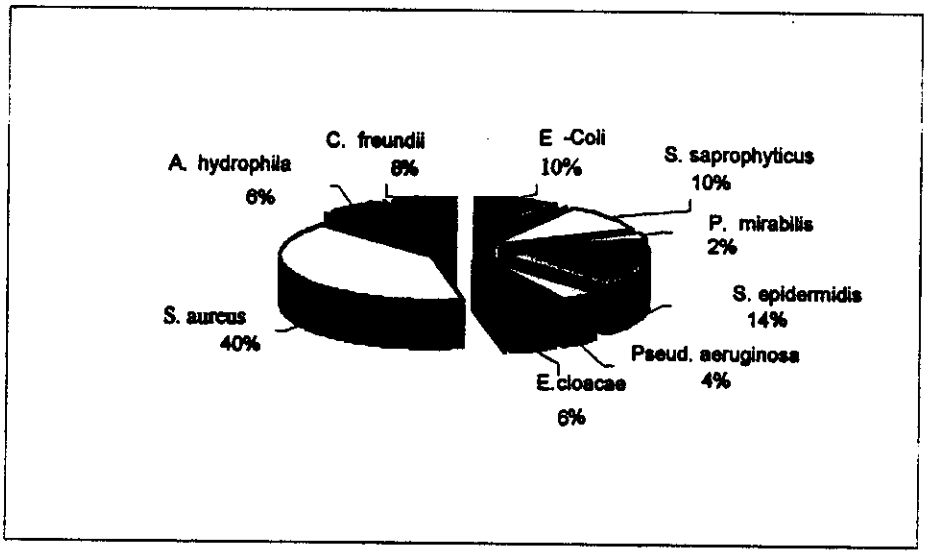

Fig. (8) : Percent of bacteria in nasal swabs from patients

b) Rectal samples

The frequency and percent of bacteria in fifty rectal samples taken from patients are illustrated in Table (7), Fig. (9).

The most common isolate was E. coli (38%) of the all isolated organisms.

Table (7): Frequency and percent of bacteria in rectal swabs from patients.

Organism	Frequency	
	No.	%
Citrobacter koseri	5	(10%)
A. hydrophili	4	(8%)
C. freundii	4	(8%)
E. coli	19	(38%)
K. ornithinolyticus	4	(8%)
P. mirabillis	5	(10%)
K. oxytoca	5	(10%)
Serratia marcescens	4	(8%)
Total no. of organisms	50	(100%)

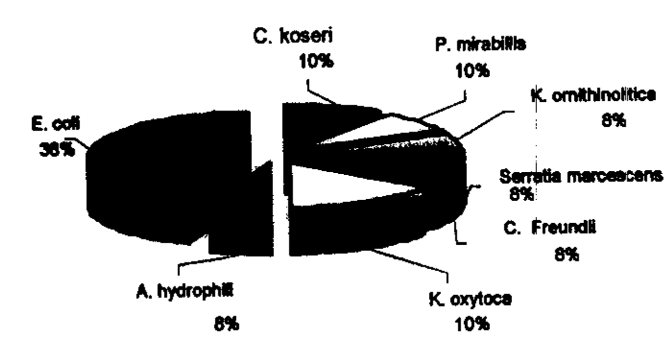

Fig. (9): Percent of bacteria in rectal swabs from patients.

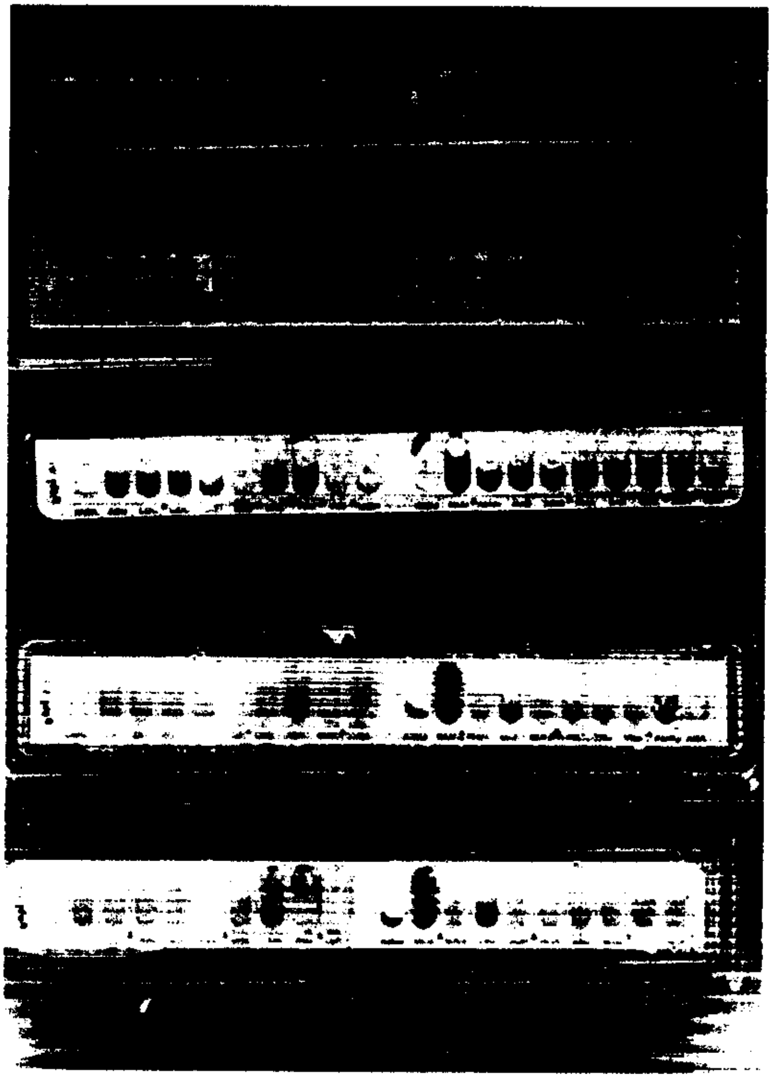

Fig. (10): API reaction profile of different isolated Enterobacteriacae

Results of antimicrobial susceptibility of different organisms isolated

Workers samples

a) Hand samples

The frequency and percent of MRSA which were detected from S. aureus isolates from workers hands are illustrated in Table (8). The percentage of MRSA was 8.3%.

Table (8): Frequency and percent of MRSA isolated from workers hands.

	Methicillin		Vancomycin		Fnsidic acid		Rifampicin	
	No.	%	No.	%	No.	%	No.	%
Sensitive	11	(91.7%)	12	(100%)	11	(91.7%)	11	(91.7%)
Resistant	1	(8.3%)	0	(0%)	1	(8.3%)	1	(8.3%)

b) Nasal samples

Antibiotic sensitivity and resistance of the two organisms isolated from workers nose towards different antibiotics are illustrated in Table (9).

Table (9): Antimicrobial susceptibility of bacteria isolated from nasal swabs of workers.

Antibiotic	Organism							
	S. aureus				S. epidermidis			
	Sensitive		Resistant		Sensitive		Resistant	
	No	%	No	%	No	%	No	%
Imipenem	20	(80%)	5	(20%)	17	(68%)	8	(32%)
Amoxycillin+ clavulinic acid	20	(80%)	5	(20%)	17	(68%)	8	(32%)
Rifampicin	23	(92%)	2	(8%)	22	(88%)	3	(12%)
Cephalexin	17	(68%)	8	(32%)	15	(60%)	10	(40%)
Gentamycin	17	(68%)	8	(32%)	22	(88%)	3	(12%)
Ceftazidime	20	(80%)	5	(20%)	22	(88%)	3	(12%)
Fusidic acid	22	(88%)	3	(12%)	25	(100%)	0	(0%)
Ampicillin + Sulbactam	15	(60%)	10	(40%)	17	(68%)	8	(32%)
Kanamycin	8	(32%)	17	(68%)	12	(48%)	13	(52%)
Cephradine	15	(60%)	10	(40%)	20	(80%)	5	(20%)
Amoxicillin	12	(48%)	13	(52%)	20	(80%)	5	(20%)
Vancomycin	25	(100%)	0	(0%)	25	(100%)	0	(0%)
Tabramycin	17	(68%)	8	(32%)	20	(80%)	5	(20%)
Penicillin	10	(40%)	15	(60%)	5	(20%)	20	(80%)
Methicillin	15	(60%)	10	(40%)	22	(88%)	3	(12%)

MRSA strains were detected in nasal samples from workers. They represented (40%) of isolated S. aureus and it is illustrated in Table (10), Fig. (11).

Table (10): Frequency and percent of MRSA isolated from nasal swabs of workers.

Response	Methicillin		Rifampicin		Vancomycin		Fusidic acid	
	No.	%	No.	%	No.	%	No.	%
Sensitive	15	(60%)	23	(92%)	25	(100%)	22	(88%)
Resistant	10	(40%)	2	(8%)	0	(0%)	3	(12%)

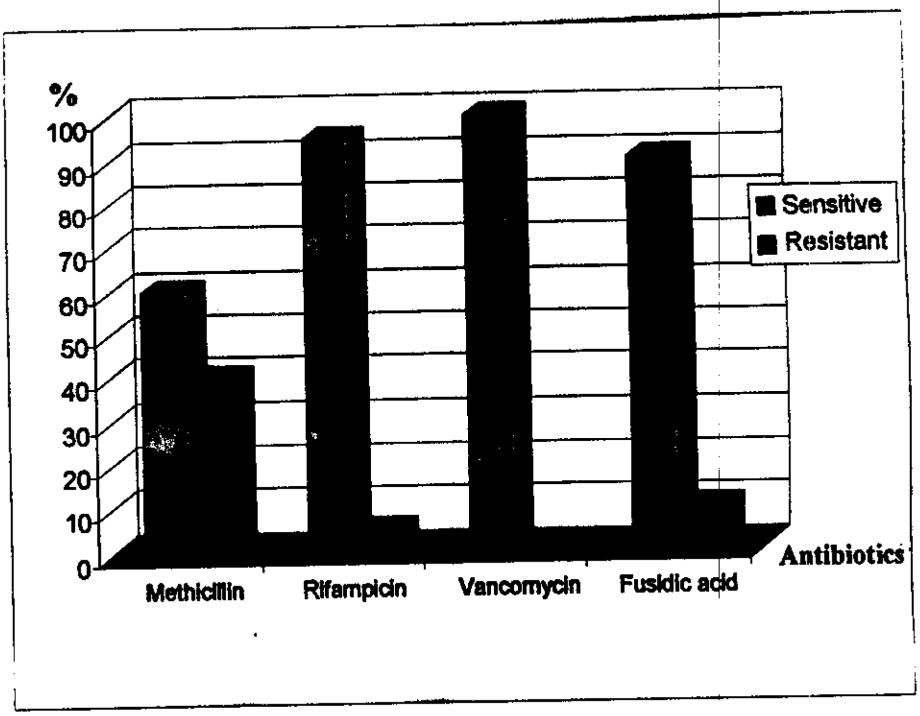

Fig. (11) : Percent of MRSA isolated in nasal samples from Workers.

Patients samples

a) Nasal samples

The results of antimicrobial susceptibility testing of gram-negative and gram positive isolates from nasal samples of patients are illustrated in Table (11).

Table (11) : Antimicrobial susceptlibility of bacteria isolated from nasal samples of patients

Antibiotic	Organisms																	
	E coli		C. freundii		A. hydrophili		S. aureus		E. cloacae		Pseud. aeruginosa		S. epidermidis		P. mirabilis		s. saprophyticus	
	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
IPM	5 (100)	0	4 (100)	0	3 (100)	0	2 (10)	18 (90)	3 (100)	0	2 (100)	0	6 (85.2)	1 (14.2)	1 (100)	0	3 (60)	2 (40)
AMC	2 (40)	3 (60)	3 (75)	1 (25)	1 (33)	2 (67)	2 (10)	18 (90)	0	3 (100)	1 (50)	1 (50)	6 (85.2)	1 (14.2)	0	1 (100)	2 (40)	3 (60)
RD	1 (20)	4(80)	1 (25)	3(75)	0	3 (100)	18 (90)	2 (10)	0	3 (100)	0	2 (100)	6 (85.2)	1 (14.2)	0	1 (100)	4 (80)	1 (20)
CL	2 (40)	3 (60)	:2 (50)	2 (50)	0	3 (100)	2 (10)	18 (90)	0	3 (100)	0	2 (100)	6 (85.2)	1 (14.2)	0	1 (100)	3 (60)	2 (40)
CN	4 (80)	1 (20)	1 (25)	3 (75)	1 (33)	2 (67)	18 (90)	2 (10)	1 (33)	2 (67)	1 (50)	1 (50)	6 (85.2)	1 (14.2)	1 (100)	0	4 (80)	1 (20)
CAZ	3 (60)	2 (40)	4 (100)	0	2 (67)	1 (33)	2 (10)	18 (90)	1 (33)	2 (67)	1 (50)	1 (50)	6 (85.2)	1 (14.2)	1 (100)	0	4 (80)	1 (20)
FD	3 (60)						14 (70)	6 (30)					7 (100)	0			4 (80)	1 (20)
SAM	1 (20)	4(80)	3(75)	1 (25)	1 (33)	2 (67)	4 (20)	16 (80)	1 (33)	2 (67)	1 (50)	1 (50)	5 (72)	2 (28.4)	0	1 (100)	5 (100)	0
K	1 (20)	4(80)	1 (25)	3(75)	0	3 (100)	14 (70)	6 (30)	0	3 (100)	2 (100)	0	6 (85.2)	1 (14.2)	1 (100)	0	1 (20)	4 (80)
CE	1 (20)	4(80)	2 (50)	2 (50)	0	3 (100)	4 (20)	16 (80)	0	3 (100)	0	2 (100)	5 (72)	2 (28.4)	0	1 (100)	0	5 (100)
AML	0	5 (100)	1 (25)	3 (75)	0	3(100)	2 (10)	18 (90)	0	3 (100)	0	2(100)	4(56.8)	3(42.6)	0	1(100)	5(100)	0
VA							20 (100)	0						7 (100)	0		5 (100)	0
TOB	360	2 (40)	1(25)	3 (75)	1 (33)	2 (67)	6 (30)	14 (70)	3 (100)	0	2 (100)	0	3(42.6)	4 (56.8)	0	1 (100)	3 (60)	2 (40)
P	0	5 (100)	0	4 (100)	0	3 (100)	0	20 (100)	0	3 (100)	0	2 (100)	2 (28.4)	5(72)	0	1 (100)	0	5 (100)
MET							4 (20)	16 (80)					6 (85.2)	1 (14.2)			4 (80)	1 (20)

IPM : Imipenem; AMC : Amoxycillin+ clavulinic acid; RD : Rifampicin; CL : Cephalexin; CN : Gentamycin
CAZ : Ceftazidime; SAM : Sulbactam + Ampicillin; K : Kanamycin; CE : Cephradine; AML : Amoxicillin
TOB : Tobramycin; P : Penicillin; FD : Fusidic acid.; VA : Vancomycin; MET : Methicillin

MRSA was detected in (80%) of isolated S. aureus. The antimicrobial susceptibilty of MRSA is illustrated in Table (12), Fig. (12).

Vanconycin was the most effective antibiotic against MRSA (100%) susceptible.

Table (12): Frequency and percent of MRSA in nasal swabs from patients.

Response	Methicillin		Rifampicin		Vancomycin		Fusidinic acid	
	No	%	No	%	No	%	No	%
Sensitive N(%)	4	(20%)	18	(90%)	20	(100%)	14	(70%)
Resistant N(%)	i6	(80%)	2	(10%)	0	(0%)	6	(30%)

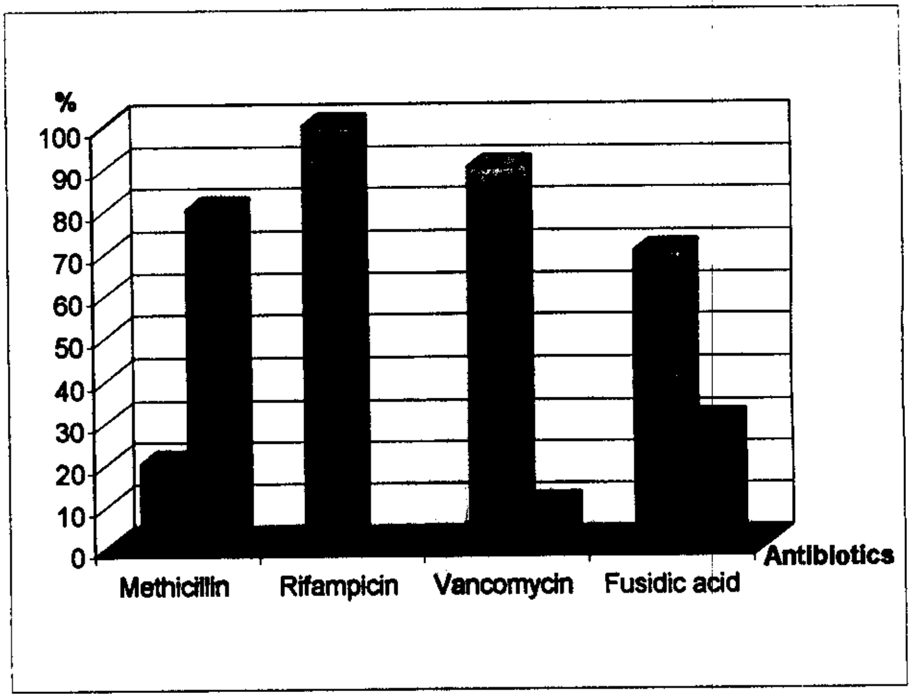

Fig. (12) : Percent of MRSA in nasal swabs from patients.

Table (13): Antimicrobial susceptibility of bacteria isolated from rectal samples of patients.

Antibiotic	Organisms															
	E coli		Aeromonas hydrophili		Citrobacter freundii		Klebsiella oxytoca		Citrobacter koseri		Proteus mirabillis		Klebsiella ornithinolytica		Serratia marcescens	
	S No.(%)	R No.(%)	S No.(%)	R No.(%)	S No.(%)	R No.(%)	S No.(%)	R No.(%)	S No.(%)	R No.(%)	S No.(%)	R No.(%)	S No.(%)	R No.(%)	S No.(%)	R No.(%)
CAZ	7(37.1)	12(62.9)	4(100)	0	4(100)	0	3(60)	2 (40)	4(80)	1 (20)	3 (60)	2 (40)	2 (50)	2 (50)	4 (100)	0
AMC	7(37.1)	12(62.9)	3(75)	1(25)	4(100)	0	2 (40)	3(60)	3(60)	2 (40)	2 (40)	3 (60)	2 (50)	2 (50)	4 (100)	0
RD	0	19 (100)	2 (50)	2 (50)	0	4 (100)	0	5 (100)	0	5 (100)	0	5 (100)	0	4 (100)	4 (100)	0
CL	6 (31.8)	13 (68.2)	2 (50)	2 (50)	0	4 (100)	0	5(100)	2(40)	3 (60)	0	5 (100)	0	4 (100)	0	4 (100)
CN	5 (26.5)	14 (73.5)	0	4 (100)	2 (50)	2 (50)	2 (40)	3 (60)	5 (100)	0	2 (40)	3 (60)	4 (100)	0	4 (100)	0
IPM	14 (73.5)	5 (26.5)	4 (100)	0	4 (100)	0	5 (100)	0	5 (100)	0	4 (80)	1 (20)	4 (100)	0	4 (100)	0
SAM	5 (26.5)	14 (73.5)	2 (50)	2 (50)	4 (100)	0	2 (40)	3 (60)	3 (60)	2 (40)	2 (40)	3 (60)	2 (50)	2 (50)	4 (100)	0
K	8 (42.4)	11 (57.6)	0	4 (100)	3 (75)	1 (25)	3 (60)	1 (40)	5 (100)	0	2 (40)	3 (60)	2 (50)	2 (50)	4 (100)	0
CE	6 (31)	13 (69)	0	4 (100)	1 (25)	3 (57)	2 (40)	3 (60)	0	5 (100)	0	5 (100)	2 (50)	2 (50)	0	4 (100)
AML	5 (26.5)	14 (73.5)	0	4 (100)	0	4 (100)	2 (40)	3 (60)	0	5 (100)	0	5 (100)	0	4 (100)	4 (100)	0
TOP	5 (26.5)	14 (73.5)	4 (100)	0	1 (25)	3 (75)	2 (40)	3 (60)	2 (40)	3 (60)	0	5(100)	0	4(100)	4 (100)	0
P	3 (15.9)	16 (84.1)	0	4(100)	0	4(100)	0	5(100)	0	5(100)	2 (40)	3 (60)	0	4(100)	0	4 (100)

IPM : Imipenem
CAZ : Ceftazidime
TOB : Tobramycin
AMC : Amoxycillin+ clavulinic acid
SAM : Sulbactam + Ampicillin
P : Penicillin
RD : Rifampicin
K : Kanamycin
S : Sensitive
CL : Cephalexin
CE : Cephradine
R : Resistant
CN : Gentamycin
AML : Amoxicillin

b) Rectal samples

Results of antibiotic susceptibility testing to the isolated microorganisms obtained from rectal samples of patients are illustrated in Table (13).

The percentage of ESBL in patient's rectal samples is illustrated in table (14).

Table (14): Detection of resistant pattern of ESBL producing gram negative bacilli according to IPM susceptibility.

Organism response	Ceftazidime	Imipenem
E.coli		
S-n(%)	7(37.1%)	14(73.5%)
R-n(%)	12(62.9%)	5(26.5%)
Aeromonas hydrophili		
S-n(%)	4(100%)	4(100%)
R-n(%)	0(0%)	0(0%)
Citobacter freundii		
S-n(%)	4(100%)	4(100%)
R-n(%)	0(0%)	0(0%)
Klebsiella oxytoca		
S-n(%)	3(60%)	5(100%)
R-n(%)	2(40%)	0(0%)
Citrobacter koseri		
S-n(%)	4(80%)	5 (100%)
R-n(%)	1(20%)	0 (0%)
Proteus mirabilis		
S-n(%)	3(60%)	4 (80%)
R-n(%)	2(40%)	1 (20%)
Klebsiella		
ornithinolyticus	2(50%)	4(100%)
S-n(%)	2(50%)	0(0%)
R-n(%)		
Serratia marcescens		
S-n(%)	4 (100%)	4 (100%)
R-n(%)	0 (0%)	0 (0%)

S= Sensitive R= Resistant.

ESBL represent (62.9%) of E. coli, (50%) of K. ornithinolitica, (40%) of both "K. oxytoca, and P. mirabilis" and (20%) of C. koseri.

As shown in Table (14) imipenem was very effective in all isolated organisms.

Laboratory trial of disinfectants

The effectiveness of different types of disinfectants towards organisms isolated from different environmental samples is illustrated in Table (15).

Table (15): Effectiveness of different types of disinfectants against different environmental samples.

Samples	Alkanol	Polyseptol	Clorox	Hydrocil	Mada-cide I	Cidex
Air	-	+	+	-	-	-
Laryngoscope	-	+	-	-	-	-
Ventilator	-	+	-	-	-	-
Air condition grill	-	+	-	-	-	-
Beds	-	-	-	-	-	-

+Growth - No growth

The potency of different disinfectants towards organisms isolated from environmental samples were as follow:

- **In air samples:** Alkanol, Hydrocil, Cidex and Mada-cide 1 were effective in the inhibition of the growth of microorganism while polyseptol was not effective.
- **In laryngoscope, Ventillator and air condition grill samples:** Alkanol, Hydrocil, clorox, Mada-cide 1 and cidex were effective in inhibition of growth of microorganisms, while polysoptol was not effective.
- **In bed samples,** all used disinfectants were effective in inhibition of growth of microorganisms.

The MIC values of different disinfectants versus Staphylococci isolated from environmental samples are illustrated in Table (16), Fig. (13).

Cidex was the most potent 1/16 followed by clorox 1/8, Madacide-1 1/4 polyseptol 1/2, and lastly hydrocil and alkanol.

Table (16): Minimal inhibitory concentration (MIC) of different types of disinfectants against Staphylococci

Disinfectant	Disinfectant concentration							MIC
	Conc. Solution	1/2	¼	1/8	1/16	1/32	1/64	
Alkanol	-	+	+	+	+	+	+	1
Polyseptol	-	-	+	+	+	+	+	1/2
Clorox	-	-	-	-	+	+	+	1/8
Hydrocil	-	+	+	+	+	+	+	1
Mada-cide 1	-	-	-	+	+	+	+	1/4
Cidex	-	-	-	-	-	+	+	1/16

+ growth - no growth

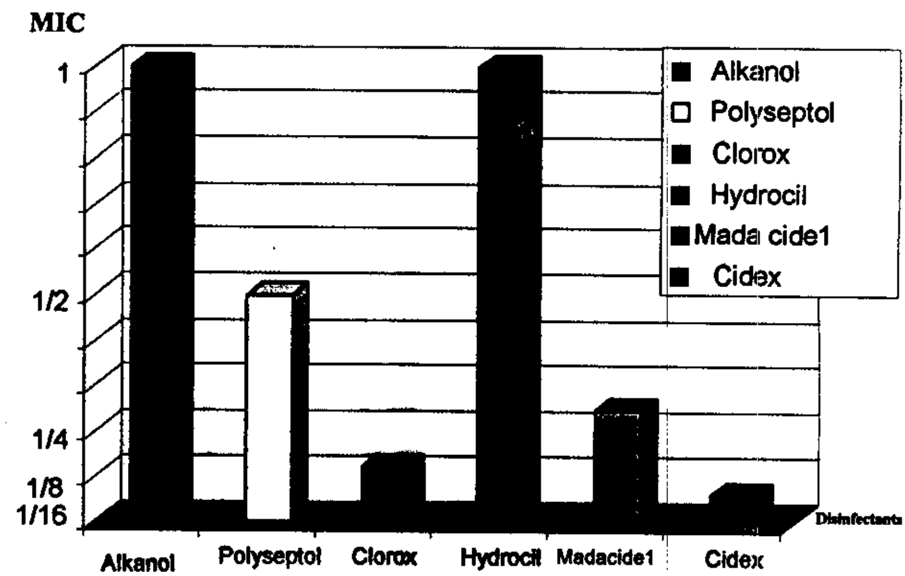

Fig.(13) : Minimal inhibitory concentration (MIC) of different types of disinfectants against Staphylococci

The MIC values of different disinfectants versus gram negative bacilli isolated from environmental samples are illustrated in table (17), Fig (14).

The most potent disinfectants working against gram negative bacilli were cidex and clorox 1/8 followed by alkanol 1/4, hydrocil and Madacide 1 1/2 and then polyseptol 1.

Table (17): Minimal inhibitory concentration (MIC) of different types of disinfectants against gram negative bacilli.

Disinfectant	Concentration of Disinfectant							MIC
	Conc. Solution	1/2	¼	1/8	1/16	1/32	1/64	
Alkanol	-	-	-	+	+	+	+	1/4
Polyseptol	-	+	+	+	+	+	+	1
Clorox	-	-	-	-	+	+	+	1/8
Hydrocil	-	-	+	+	+	+	+	1/2
Mada-cide 1	-	-	+	+	+	+	+	1/2
Cidex	-	-	-	-	+	+	+	1/8

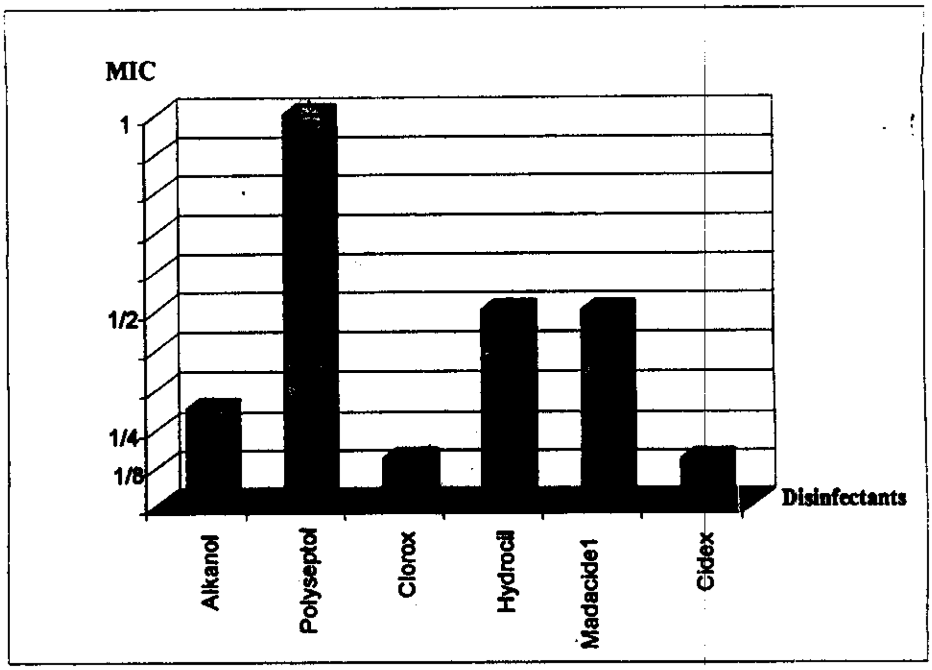

Fig. (14) : Minimal inhibitory concentration (MIC) of different types of disinfectants against Gram negative bacilli.

The MIC of different disinfectants versus candida isolates are illustrated in table (18) Fig. (15).

- The most potent disinfectants working against candida were [cidex and clorox 1/16] followed by [alkanol and hydrocil 1/8], Mada-cide 1 1/4 and lastly polyseptol 1/2.

Table (18): Minimal inhibitory Concentration (MIC) of different types of disinfectants against Candida.

Disinfectant	Concentration of Disinfectant							MIC
	Conc. Solution	1/2	1/4	1/8	1/16	1/32	1/64	
Alkanol	-	-	-	-	+	+	+	1/8
Polyseptol	-	-	+	+	+	+	+	1/2
Clorox	-	-	-	-	-	+	+	1/16
Hydrocil	-	-	-	-	+	+	+	1/8
Mada-cide 1	-	-	-	+	+	+	+	1/4
Cidex	-	-	-	-	-	+	+	1/16

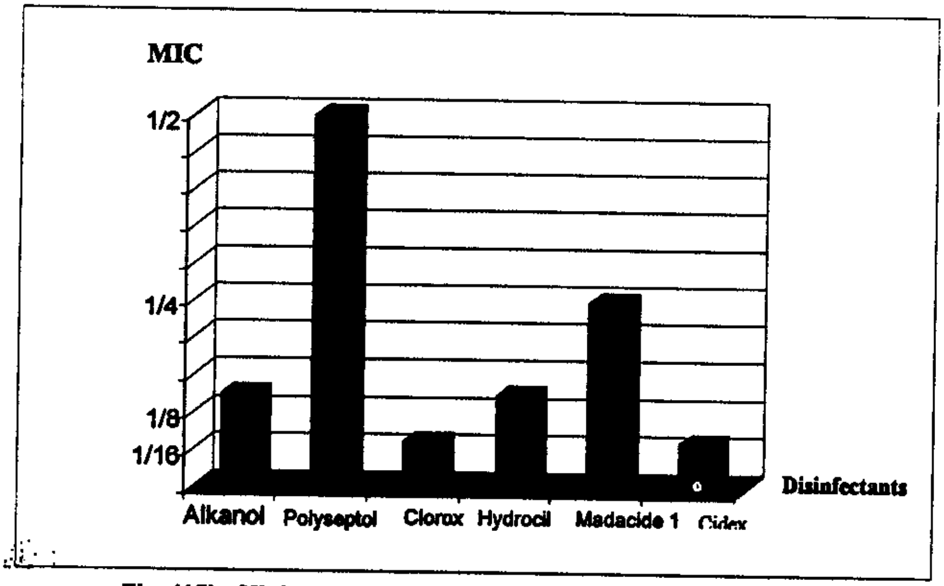

Fig. (15): Minimal Inhibitory Concentration (MIC) of different types of disinfectants against Candida.

The effect of different disinfectants against the growth of Mycobcterium tuberculosis is illustrated in Table (19).

Cidex, hydrocil, clorox and alkanol were the most effective on the inhibition of the growth of Mycobacterium tuberculosis, while polyseptol and Mada-cide 1 were not effective on the inhibition of growth of M. tuberculosis.

Table (19): The effect of different disinfectants in the inhibition of the growth of Mycobacterium tuberculosis.

Disinfectant	Response
Alkanol	-
Polyseptol	+
Clorox	-
Hydrocil	-
Mada- cide 1	+
Cidex	-

+ growth - no growth

The MICs values of different types of antiseptics towards different organisms isolated from workers hands are illustrated in Table (20), Fig. (16).

Hydrocil was the most effective against S. epidermidis (1/8) followed by alkaonl (1/4), polyseptol (1/2) and lastly Madacide-1 (1).

Alkanol and hydrocil (1/2) were the most effective antiseptics against S. aureus followed by polyseptol (1) while Mada-cide 1 was not inhibitory of the growth of S. aureus.

The most potent antispetic against S. saprophyticus was hydrocil 1/16 followed by alkanol 1/8,polyseptol 1/4 and Madacide- 1(1/2).

The most potent antispetic against S.haemolyticus was alkanol and hydrocil 1/16 followed by polyseptol 1/8 and Mada-cide 1(1/4).

Table (20): Minimal inhibitory Concentration (MIC) of different antiseptics against staphylococci isolated from workers hands.

Organism	Alkanol	Polyseptol	Hydrocil	Mada- cide 1
S. epidermidis	¼	1/2	1/8	1
S. aureus	½	1	1/2	Not affected
S. saprophyticus	1/8	1/4	1/16	1/2
S. haemolyticus	1/16	1/8	1/16	1/4

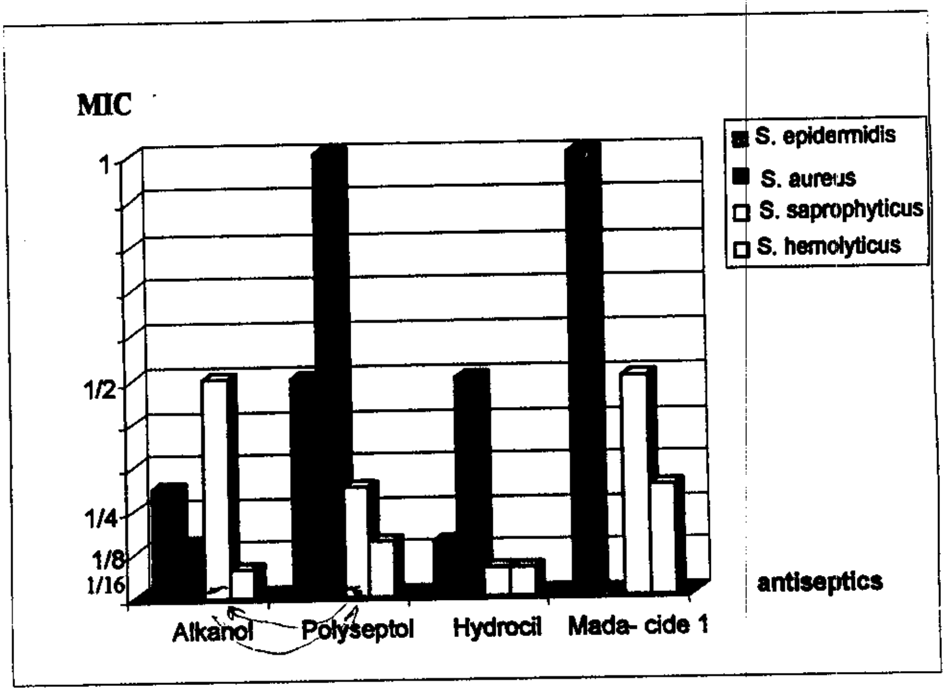

Fig. (16) : Minimal inhibitory concentration (MIC) of different antiseptics against staphylococci isolated from workers hands.

Results of bactericidal activity of different types of disinfectants using the British/European standard test method is illustrated in table (21).

Table (21): Results of bactericidal activity of different types of disinfectants using the British/European standard test method.

Microorganism	Staphylococci			MRSA			Pseudomonas			Klebsiella			Candida		
Contact time	2	5	10	2	5	10	2	5	10	2	5	10	2	5	10
Disinfectants:															
Alkanol	-ve	-ve	-ve	-ve	-ve	-ve	+ve	-ve	-ve	-ve	-ve	-ve	+ve	-ve	-ve
Polyseptol	+ve	-ve	-ve	+ve	-ve	-ve	+ve	+ve	-ve	+ve	-ve	-ve	+ve	+ve	-ve
Cidex	+ve	+ve	-ve	+ve	+ve	-ve	+ve	+ve	-ve	+ve	+ve	-ve	+ve	+ve	-vc
Clorox	-ve	-ve	-ve	-ve	-ve	-ve	+ve	-v e	-ve	-ve	-ve	-ve	+ve	+ve	-ve
Mada-cide 1	+ve	+ve	-ve	+ve	+ve	-ve	+ve	-ve	-ve	+ve	-ve	-ve	+ve	+ve	-ve
Hydrocil	-ve	-ve	-ve	-ve	-ve	-ve	+ve	+ve	-ve	+ve	+ve	+ve	+ve	+ve	+ve

+ ve = growth - ve = no growth

Alkanaol is suitable for surface disinfection but it needs a higher contact time > 2 minutes to get ride of Pseudomonas and Candida (surface).

Cidex was effective at contact time > 5 minutes versus all microorganisms tested (soaking).

Hydrocil was highly effective against gram positive bacteria at a contact time 2 minutes (air).

Results of in-use test:

The in use-dilution of the cidex disinfectant taken from containers for contaminated instruments was sufficient for 14 days in killing all the organisms added as indicated by no growth in the 2 plates after the incubation period.

In this study, however, the results obtained from air sampling, by the two methods, (exposure plates and RCS air sampler) show the evidence of contamination of air. This contamination of air is mostly referred to the increased number and movement of circulating staff within the ICU unit and this finding are in agreement with those of ***Zaza and Jarvis, (1996)***.

The colony count by strips in most cases (80%) was higher than that counted by plates, because of centrifugal force of RCS air sampler, which concentrates the air into the strip.

In this study the most common microorganisms isolated from environmental swabs (laryngoscopes, ventillators, air condition grills and beds) were S.aureus 44%, Gram negative bacilli 36% and lastly CNS was 20%.

The warm conditions in the ventilators and associated equipment, together with the moisture accumulated leads to colonization by large population of gram-negative bacteria particularly Pseudomonas aeruginosa and Klebsiella spp, which may produce fatal pneumonia in immunocompromized patients using such equipment ***(Zack et al., 2002)***.

Prevention of nosocomial pneumonia in critically-ill patients who are mechanically ventilated need care of respiratory therapy devices, which prevent cross contamination ***(Voss and Widmer, 1997)***.

Effective washing of workers hands can prevent nosocomial infections, particularly in high-risk areas of the hospital (eg. ICU). The hands of health care workers are the main vehicles of multidrug-resistant bacteria and nosocomial infections in hospital wards ***(Wenzel, 1998)***.

The study of microbial flora of the skin include resident and transient flora. The resident microorganisms, which are integral part of normal skin. They live, grow and multiply in the superficial layers. Examples are CNS and diphteriods. While transient microorganisms are not an integral part of normal skin, but gain access to them from animate or inanimate surfaces. Examples of them are S. aureus and E. coli ***(Kim et al., 2003)***.

This agreed with our sampling of workers hands where the commonest microorganisms isolated was S. epidermidis (40%) followed by S. aureus (24%), S. saprophyticus (20%) and S. haemolyticus (16%) but E.coli was not found during this study.

Systemic review evidence, appraised and used by EPIC (European Prevalence of Infection in Intensive Care) guideline developers identified several well designed studies showing that patients contact resulted in contamination of health care workers hands by pathogens. For example, 10% of all patient-nurse interactions on the ICU resulted in transmission of Klebsiella to the nurse's hands. However study of ***Pratt et al., (2001)*** showing that staff dressing wounds with MRSA have an 80% chance of carrying the organisms on their hands.

Girou et al., (2002) found that the correct choice for disinfection of the hands are alcoholic preparations especially that are rubbed in. These finding came in agreement with the finding of ***Stefanska et al. (2002)*** who found that S.aureus was resistant to QACs. ***Russo et al., (2003)*** optimized a new antiseptic formulation specifically targeted at skin, which is 5.0% chloramine-T diluted in 50% isopropyl alcohol with the efficacy against clinically important bacteria, fungi and viruses.

These finding are in agreement with our study since we found that the most effective antiseptics of the hands were alkanol and hydrocil while polyseptol and Mada-cide 1 were less effective.

On the other hand, the frequency of bacteria isolated from workers nose were S. aureus (50%) and S. epidermidis (50%), this finding was in accordance with ***Volk et al, (1991)***, who stated that S. aureus was found in the nasopherynx of 20-30% of adult at any time, and this may increase to 50-70% carriers rate in a hospital setting.

As regard patients swabs, 66% of isolated organisms from patients nose were gram-positive cocci. S. aureus was 40% of isolated gram-positive cocci and 34% were gram-negative bacilli.

This finding was near to the finding of ***Volk et al., (1991)*** who found that S. aureus was found in the nosopharyngeal at 50-70% carrier rate in a hospital setting.

In this work, the most common isolate of rectal swabs from patients was E-coli.

Contribution to the seriousness of nosocomial infections, especially in ICUs, is the increasing incidence of infections caused by antibiotic-resistant pathogens, so surveillance of antibiotic resistance is important in ICU ***(Hanberger et al., 1999)***.

Nosocomial infections, especially those caused by antibiotic resistant pathogens, represent an important source of morbidity and mortality for the patient hospitalized in an ICU. Important antibiotic-resistant nosocomial pathogens include Methicillin Resistant S. aureus (MRSA), vancomycin-resistant enterococci (VRE), gram-negative bacilli (especially, Klebsiella and Enterobacter) producing extended-spectrum β-lactamases (ESBL), multiple drug-resistant Mycobacterium tuberculosis, and fluconazole-resistant Candida sp. The key to control of antibiotic-resistant pathogens in the ICU is vigorous adherence to infection control guidelines and prevention of antibiotic misuse. Antibiotic restriction policies clearly result in reduced drug costs. Evidence suggested that reducing use of certain antibiotics may lead to a decreased prevalence of antibiotic-resistant pathogens: vancomycin, VRE; gentamicin, gentamicin-resistant gram-negative bacilli; and ceftazidime, gram-negative bacilli producing extended-spectrum β-lactamases. Limited data suggest that measures to control antibiotic use do not adversely affect and may actually improve patient outcomes (eg, decreased length of stay, risk of subsequent infection) ***(Jarvis, 1996)***.

The development and use of antibiotics for the chemotherapy of bacterial infections was one of the most remarkable accomplishments in medicine of the 20^{th}. However, antibiotic-resistant bacteria were found in clinical isolates soon after the introduction of the earliest antimicrobial agents into the market. Resistances to antimicrobial agents are serious among immunocompromised host. The most important of these organism are MRSA, VRE, ESBL. These resistance have made anti microbial therapy of many infections extremely difficult or virtually impossible in some instances ***(Yamagnchi and Ohno, 2001)***.

Surveillance of bacterial resistance is a key element in understanding the problem. The large number of existing networks for resistance surveillance need to be coordinated and the results made available. To help doctors choose appropriate antibiotics and to detect local epidemics of resistant bacteria surveillance at local level is necessary. Good quality local data provide a basic for national and international surveillance ***(Brossette et al., 1998)***.

MRSA spread rapidly within hospital and can cause substantial morobidity and mortality ***(Marchese et al, 2000)***. We must know well the main mode of transmission of MRSA to control it. Hands of heath care-workers which may be contaminated by contact with colonized or infected patient, colonized or infected body sites of personnel themselves, or devices or environmental surfaces contaminated with body fluids containing MRSA ***(Ayliffe, 1996)***.

In this study the percentage of MRSA from workers hands was 8.3% of isolated S. aureus, and 40% of workers nose.

However, a study done by ***Al-Hendy et al. (1997)*** in Benha University Hospital found that (62.5%) of S.aureus isolated from nasal samples was MRSA.

In patients group, 80% of S. aureus isolated from nasal samples was MRSA, However. our results were not in agreement with that of ***Lucet et al. (2003)***, they found that percentage for MRSA carriage in nasal swab from ICU patients was 20%, but they also mentioned that, there are many factors which increase this percentage, as age older than 60 years, prolonged hospital stay in transferred patients and surgery. This may explain our results, because most of patients present in ICU were referred from other wards.

In this study, 100% of MRSA were sensitive to vancomycin and this finding was in agreement with ***Duckworth, (1993)***. They found that all MRSA were vancomycin sensitive.

This finding was also in agreement with the results of ***Rasha (2000)*** who reported that vancomycin was the most effective antibiotic against gram-positive isolates particularly S.aureus.

In this work imipenem was the most effective antibiotic for gram-negative bacilli isolated from rectal swabs of patients.

These results were consistant with the data of ***Rasha (2000)*** who reported that imipenem proved to have a broad spectrum and a high activity against gram-negative bacilli.

Since, large number of gram-negative isolates from rectal swab in our study were suspected or confirmed ESBL producers, 62.9% of E-coli, 50% of K.ornithinolyticus, 40% of both "K.oxytoca, and Proteus mirabilis" and 20% of Citrobacter koseri. Imipenem was very effective in all ESBL-producing gram negative bacilli.

These results are also in agreement with that of ***Bell et al. (2002)*** they found that the best coverage against ESBL producing isolates was obtained with imipenem.

Sterilization and disinfection of patient care items are an important aspect of infection control. Every health care establishment should have a disinfection policy depending on the services provided, types of items used and facilities available ***(Ayliffe et al., 1990)***. Disinfection describes a process by which pathogenic organism with the exception of bacterial spores are killed, in order to prevent their transmission and is achieved by action on their structure or metabolism ***(Russel et al., 1982)***.

Disinfection policy is one step in infection control program in hospital, which is very important especially in ICU, because patients in ICU are more susceptible to nosocomial infections and they are exposed to great hazards of contamination and cross infection than others in ordinary wards. This is due to they receive much more nursing attention and various forms of instrumentation *(Spatenkova et al., 2002)*.

The disinfection policy in the ICU should provide information on all types of disinfectants and on their procedure for their use which depend on the degree of risk of infection involved in the use of the item, whether critical, semi-critical or noncritical *(Rutala, 1987)*.

In this study various chemical disinfectants and antiseptics were tested for their activity against different microorganisms isolated from ICU. The chemical disinfectants and antiseptics which were tested included: alkanol, polyseptol, cidex, clorox, hydrocil, and mada cide-1 and their activity were evaluated by using microtitration and tuble neutralization methods.

In our study, the effectiveness of the various disinfectants and antiseptics versus inhibition of growth of environmental isolates was assayed.

In air samples, hydrocil, Mada-cide 1, alkanol, and cidex were effective in the inhibition of the growth of microorganisms isolated from air, while polyseptol was not effective.

In this study, swabs were taken from laryngoscope, ventillators and air condition, the cidex, clorox, hydrocil, alkanol and Mada-cide 1 were effective in inhibition of growth of microorganisms, while polyseptol was not effective.

In bed swabs, all used disinfectants were effective in the inhibition of growth of microorganisms.

The number of antiseptics and disinfectants tests described in the world, show that, there is a lack of agreement among workers in different countries on standarization of the component of the testing method. The performance of different testing procedures yields a diversity of results for the same disinfectant. Disagreement is still on the testing method themselves, varying results will be obtained ***(Favero and Bond 1991)***.

In addition we did laboratory testing of different disinfectants and antiseptics versus Staphylococci, gram-negative bacilli, Candida and Mycobactrium tuberculosis by using microtitration and tube neutralization tests.

In Staphylocci, cidex was the most potent (1/16), followed by clorox (1/8), Mada-cide 1 (1/4), ployseptol (1/2)and lastly hydrocil and alkanol (1). While, the most potent disinfectant working against gram-negative bacilli were cidex and clorox (1/8), followed by alkanol (1/4), Mada-cide-1 (1/2), hydrocil (1/2) and then polyseptol (1). The most potent disinfectants working against candida were cidex and clorox (1/16) followed by alkanol and hydrocil (1/8), Mada-cide 1 (1/4) and lastly polyseptol (1/2).

The results are in agreement with that of ***McDonnell and Russell (1998),*** they found that most effective disinfectants were cidex and clorox against gram-positive cocci, gram-negative bacilli and Candida.

In our study the effect of different disinfectants against the growth of Mycobacterium tuberculosis, was studied, cidex, hydrocil, clorox and alkanol were the most effective in the inhibition of growth of M.tuberculosis, while polyseptol and mada cide-1 were not effective in the inhibition of growth of M.tuberculosis.

The resistance of Mycobacterium tuberculosis to disinfectants has been considered intermediate between those of other vegetative bacteria and spores. This is attributed in part to their unusually higher cell wall lipid content and resultant hydrophobicity ***(Russel et al., 1986)***.

The results of disinfectants effect in Mycobacterium tuberculosis in our study are also in agreement with that of ***Best et al. (1990).*** They found that QACs and iodophor were completely ineffective, chlorohexdine and cidex have good effective.

Patients with critical illness requiring aggressive medical intervention because they are at risk of acquiring serious nosocomial infection that may lead to increases in medical expenditures, morbidity, and mortality. Infection control of this population entails continuos surveillance for HAI with investigation of outbreaks. Policies for effective antibiotic utilization, disinfection of medical devices and hospital environment, and patient isolation may limit nosocomial infection in this population ***(Dieckhaus and Cooper, 1998)***.

In this study, data collection concerning types of microorganisms isolated from personnel, patients, & different sites in the ICU, and their antimicrobial & anti-septic resistance patterns were only a preliminary step in building-up an integrated strategy to control infection in Benha university hospital ICU, and to give model to other hospitals & infection control teams to get benefit from it. Another aim was reached in this work, is that a bridge between laboratory and ICU workers was built up for the purpose of patient's benefit. Simple guidelines about changing behaviour of the ICU personnel and their awareness about the potential danger imposed on their patients, and on themselves were among our goals, & further studies are needed to follow-up and assess the clinical outcome of these behavioural and conceptual changes.

Also strict measures about anti-septic and disinfectants use were suggested including appropriate choices and methods and timing of their use, antimicrobial regimens were revised meticulously with clinicians. Rotational policy of use of main antibiotic families was advised. 1st line & 2nd line concept was established, to save newer and effective drug, for those cases with multiple drug resistance.