Results

RESULTS

Specimens from two hundered patients with nosocomial infections were collected during the period from May 2000 to April 2001 from different departments of Benha University Hospital.

156 (78%) gram negative bacilli and 44 (22%) gram positive cocci were recovered from collected specimens.

The frequency of pathogens causing different types of nosocomial infection is illustrated in table (1).

Table (1): Collective table shows the frequency of pathogens causing different types of nosocomial infections (Total No. = 200).

Type of infection	No. of % Total = 200	Order of frequency of pathogens	No.	%
Urinary tract infection	79	E. coli	24	32.4%
	(39.5%)	Proteus group	24	32.4%
		Enterobacter group	11	14.9%
		Coagulase –ve staph.	11	13.9%
		Eneterococcus faecalis	3	3.8%
		Klebsiella group	2	2.7%
		Staph. aureus	2	2.7%
		Citrobacter freundii	1	1.35%
		Pseudomonas aeruginosa	1	1.35%
Wound infection	62	Pseudomonas group	19	33.3%
	(31%)	Enterobacter group	10	17.5%
		Staph. aureus	10	16.1%
		Proteus group	4	7%
		E. coli	3	5.3%
		Coagulase –ve staph	3	4.8%
		Klebsiella group	2	3.5%
		Alcaligens xylosoxidans	2	3.5%

		Enterococcus faecalis	2	3.5%
		Streptococci	1	1.75%
		Provedentia Rettegerii	1	1.75%
		Morganella morganii	1	1.75%
		Serratia	1	1.75%
		Acinitobacter baumanii	1	1.75%
		Aeromonas hydrophila	1	1.75%
		Burkholderia cepacia	1	1.75%
Blood stream infection	33 (16.5%)	Klebsiella group	7	21.2%
		Staph aureus	5	15.2%
		E. coli	4	12.2%
		Serratia	3	9.1%
		Enterobacter group	3	9.1%
		Coagulase –ve staph	3	9.1%
		Acinitobacter baumanii	3	9.1%
		Proteus group	2	6%
		Streptococci	2	6%
		Stenotrophomonas maltophilia	1	3%
Respiratory tract infection	26 (13%)	Klebsiella group	8	30.8%
		Pseudomonas group	6	23.05%
		Serratia	4	15.4%
		Stenotrophomonas maltophilia	3	11.5%
		Enterobacter group	1	3.85%
		Morganella morganii	1	3.85%
		Acinitobacter baumanii	1	3.85%
		Staph aureus	1	3.85%
		Strpetococci	1	3.85%

The order of frequency of gram –ve bacilli causing nosocomial infections is illustrated in table (2).

Table (2): Frequency of gram negative bacilli in different samples.

Organisms	Number	%	Type of sample			
			Urine	Pus	Sputum	Blood
Proteus group	33	21.2%	24	6	1	2
E. coli	31	19.9%	24	3	-	4
Pseudomonads	26	16.7%	1	19	6	-
Enterobacter group	25	16%	11	10	1	3
Klebsiella group	19	12.2%	2	2	8	7
Serratia group	8	5.1%	-	1	4	3
Acinitobacter group	5	3.2%	-	1	1	3
Stenotrophomonas maltophilia	4	2.6%	-	-	3	1
Alcaligenes xylosoxidans	2	1.3%	-	2	-	-
Citrobacter freundii	1	0.6%	1	-	-	-
Aeromonas hydrophila	1	0.6%	-	1	-	-
Burkholderia cepacia	1	0.6%	-	1	-	-
Total	156		63	46	24	23

Proteus group was the most common gram negative pathogen isolated in the study.

The order of frequency of gram positive cocci causing nosocomial infections is illustrated in table (3)

Table (3): Frequency of gram positive cocci in different samples.

Organisms	Number	%	Type of sample			
			Urine	Pus	Blood	Sputum
Staph. aureus	18	40.9%	2	10	5	1
Coagulase –ve staph	17	38.6%	11	3	3	-
Enterococcus faecalis	5	11.4%	3	2	-	-
Strept.pneumonae	4	9.1%	-	1	2	1
Total	44		16	16	10	2

Staph. aureus was the commonest gram positive pathogen isolated in the study.

The predominant types of nosocomial infections caused by gram positive cocci were the urinary tract and wound infections (16 cases for each – 36.4%).

Blood stream and respiratory tract infections come in the subsequent order of frequency [10 cases (22.7%) and 2 cases (4.5%) respectively).

Coagulase negative staph was the most common pathogen causing urinary tract infection (11 out of 16 cases) (68.75%), while Staph aureus was the most common one in both wound (10 out of 16 cases – 62.5%) and blood stream infections (5 out of 10 cases – 50%).

In respiratory tract infections Staph aureus and Streptococci were equal causes (one case for each).

Regarding the gram negative bacilli, 63 (40.4%) were isolated from urinary tract infection, 46 (29.5%) from wound infection, 24(15.4%) from respiratory tract infection and 23 (14.7%) from blood stream infections. These results illustrated in table (4).

Table (4): Different types of nosocomial infections caused by gram negative bacilli.

Type of infection	No & % (Total=156)	Order of frequency of pathogens		
			No.	%
Urinary tract infections	63 40.4%	E. coli	24	38%
		Proteus group	24	38%
		Enterobacter group	11	17.6%
		Klebsiella group	2	3.2%
		Citrobacter freundii	1	1.6%
		Pseudomonas aeruginosa	1	1.6%
Wound infections	46 29.5%	Pseudomonas group	19	41.3%
		Enterobacter group	10	21.7%
		Proteus group	4	8.7%
		E. coli	3	6.5%
		Klebsiella group	2	4.3%
		Alcaligens group	2	4.3%
		Provedencia Rettgeri	1	2.2%
		Morganella morganii	1	2.2%
		Serratia	1	2.2%
		Acinitobacter baumanii	1	2.2%
		Aeromonas hydrophila	1	2.2%
		Burkholderia cepacia	1	2.2%
Respiratory tract infections	24 15.4%	Klebsiella group	8	33.3%
		Pseudomonas group	6	25%
		Serratia	4	16.6%
		Stenotrophomonas maltophilia	3	12.5%
		Enterobacter group	1	4.2%
		Morganella morganii	1	4.2%
		Acinitobacter baumanii	1	4.2%
Blood stream infections	23 14.7%	Klebsiella group	7	30.4%
		E. coli	4	17.4%
		Serratia	3	13%
		Enterobacter group	3	13%
		Acinitobacter baumanii	3	13%
		Proteus group	2	.8%
		Stenotrophomonas maltophilia	1	4.4%

E. coli and Proteus groups were equal causes for nosocomial urinary tract infection (38% for each).

In wound infection, pseudomonas was the commonest pathogen isolated (41.3%), while in respiratory tract and blood stream infections, Klebsiella group was the most frequent pathogen (33.3% and 30.4% respectively).

One hundered (out of one hundred fifty six) of gram negative isolates were identified by Sensititre gram negative autoidentification plate and the results of Sensititre plate versus that of conventional system identification is illustrated in table (5).

Table (5): Results of Sensititre AP80 plate identification versus that of conventional system identification .

Isolate	Total	Correct genus	Correct species	Incorrect ID	No identification
Enterobacteriacae:					
E. coli	20	20(100%)	20(100%)	-	-
Proteus mirabilis	10	10(100%)	9(90%)	1(10%)	-
Proteus vulgaris	8	8(100%)	8(100%)	-	-
Morgnella morganii	2	2(100%)	2(100%)	-	-
Provedencia rettegerii	1	1(100%)	1(100%)	-	-
Klebsiella pneumonae	10	10(100%)	9(90%)	1(10%)	-
* Klebsiella Oxytoca	2	2(100%)	2(100%)	-	-
Enterobacter cloacae	7	6(85.7%)	5(71.4%)	2(28.6%)	-
Enterobacter aerogenes	8	7(87.5%)	6(75%)	2(25%)	-
Enterobacter agglomerans	1	1(100%)	1(100%)	-	-
Citrobacter freundii	1	1(100%)	1(100%)	-	-
Serratia marcescens	6	6(100%)	5(83.3%)	1(16.7%)	-
Non Enterobacteriasae					
Pseudomonas aeruginosa	10	9(90%)	8(86%)	1(10%)	1(10%)
*Pseudomonas fluorescence	4	4(100%)	4(100%)	-	-
*Stenotrophomonas maltophilia	3	3(100%)	3(100%)	-	-
Burkholderia Cepacia	1	-	-	-	1 (100%)
Acinitobacter baumanii	3	3(100%)	2(66.7%)	1(33.3%)	-
Aeromonas hydrophila	1	-	-	1(100%)	-
*Alcaligens xylosoxidans	2	2(100%)	2(100%)	-	-
Total	100	95(95%)	88(88%)	10(10%)	2(2%)

Key:

- ***Correct genus:*** The unknown isolate was identified correctly to the genus level.
- ***Correct species:*** The unknown isolate was identified correctly to the genus and species levels.
- ***Incorrect ID:*** Incorrect genus or species identification
- ***No identification:*** The isolate was failed to be identified.

The agreement between the two methods for identification of members of enterobacteriacae was 97.4% at the genus level and 93.4% at species level.

However the agreement between the two methods for non enterobacteriacae group was 91.7% at both the genus and species levels.

The agreement in isolates labeled with * (Klebsiella oxytoca, Pseudomonas fluorescence, Stenotrophomonas maltophilia and Alcaligens xylosoxidans) was between the Sensititre AP 80 plate identification results and that of BBL identification system only, due to shortage testing of routine tube method ***(Sonnenwirth, 1980)*** to identify the isolates.

Disagreement between the two methods at the genus level occurred with Enterobacter cloacae and Enterobacter aerogenes (by conventional identification system) which misidentified as Citrobacter freundii and Serratia fonticola respectively by Sensititre AP 80 plate identification method.

Disagreement in non enterobacteriacae group occurred with Aeromonas hydrophila (by conventional system) which misidentified as Vibrio alginolyticus (by Sensititre identification system) and also with one Pseudomonas aeruginosa isolate (by conventional ID system) which failed to be identified by Sensititre system.

Percent of agreement probability between results of Sensititre AP 80 plate identification and that of conventional system identification is illustrated in table (6).

Table (6): Results of Sensititre AP80 plate by percent of probability.

Organism	No. of isolates	No testing correctly		No. of discrepancies	
		Agr. High probability	Agr. Low probability	Incorrect	V.R. biotype
Enterobacteriacae:					
E. coli	20	17(85%)	3(15%)	-	-
Proteus mirabilis	10	8(80%)	1(10%)	1(10%)	-
Proteus vulgaris	8	8(100%)	-	-	-
Morganella morganii	2	2(100%)	-	-	-
Provedencia Rettegerii	1	1(100%)	-	-	-
Klebsiella pneumonae	10	9(90%)	-	1(10%)	-
Klebsiella oxytoca	2	2(100%)	-	-	-
Enterobacter cloacae	7	4(57.1%)	1(14.3%)	2(28.6%)	-
Enterobacter aerogenes	8	6(75%)	-	2(25%)	-
Enterobacter agglomerans	1	1(100%)	-	-	-
Citrobacter freundii	1	1(100%)	-	-	-
Serratia marcescens	6	5(83.3%)	-	1(16.7%)	-
Non enteriobacteriacae:					
Pseudomonas aeruginosa	10	7(70%)	1(10%)	2(20%)	-
Pseudomonas fluorescence	4	4(100%)	-	-	-
Stenotrophomonas maltophilia	3	3(100%)	-	-	-
Burkholderia cepacia	1	-	-	1(100%)	-
Acinitobacter baumonii	3	2(66.7%)	-	1(33.3%)	-
Aeromonas hydrophila	1	-	-	1(100%)	-
Alcaligens- xylosoxidans	2	1(50%)	1(50%)	-	-

* Agreement High probability: Mean the unknown isolates was identified at a species (or combined species) level with a probability of >85% and the identification agreed with the reference identification.
* Agreement Low probability: The unknown isolates was not identified at species level with a probability of >85% but the correct species appeared as one of the top three possible identifications at a low probability and was confirmed with the additional tests recommended by the system.
* Incorrect: did not meat any of the criteria given above.
* V.R. biotype: very rare biotype: was used if the results for the unknown showed too many deviations from the expected results.

As regard the results of Microscan one hundered (out of one hundered fifty six) of gram negative isolates were identified by Microscan Walkaway conventional negative panels and the results of Microscan panels versus that of conventional system identification is illustrated in table (7).

Table (7): Results microscan conventional negative panels identification versus that of conventional system identification.

Isolates	Total	Correct genus	Correct species	Incorrect ID	No identification
Enterobacteriacae:					
E. coli	20	20(100%)	20(100%)	-	-
Proteus mirabilis	10	10(100%)	10(100%)	-	-
Proteus vulgaris	8	8(100%)	7(87.5%)	1(12.5%)	-
Morganella morganii	2	2(100%)	2(100%)	-	-
Provedentia rettegerii	1	1(100%)	1(100%)	-	-
Klebsiella pneumonae	10	9(90%)	8(80%)	2(20%)	-
* Klebsiella Oxytoca	2	2(100%)	1(50%)	1(50%)	-
Enterobacter cloacae	7	6(85.7%)	6(85.7%)	1(14.3%)	-
Enterobacter aerogenes	8	8(100%)	8(100%)	-	-
Enterobacter agglomerans	1	1(100%)	1(100%)	-	-
Citrobacter freundii	1	1(100%)	1(100%)	-	-
Serratia marcescens	6	6(100%)	6(100%)	-	-
Non Enterobacteriasae					
Pseudomonas aeruginosa	10	10(100%)	9(90%)	1(10%)	-
* Pseudomonas fluorescence	4	3(75%)	2(50%)	2(50%)	-
* Stenotrophomonas maltophilia	3	3(100%)	3(100%)	-	-
• Burkholderia Cepacia	1	1(100%)	1(100%)	-	-
Acinitobacter baumanii	3	3(100%)	3(100%)	-	-
Aeromonas hydrophila	1	1(100%)	1(100%)	-	-
*Alcaligenes xylosoxidans	2	2(100%)	2(100%)	-	-
Total	100(100%)	97(97%)	92(92%)	8(8%)	-

Key:

- ***Correct genus:*** the unknown isolate was identified correctly to the genus level.
- ***Correct species:*** The unknown isolate was identified correctly to the genus and species leves.
- ***Incorrect ID:*** Incorrect genus or species identification.
- ***No identification:*** The isolate was failed to be identified.

The agreement between the two methods for identification of members of enterobacteriacae was 97.4% at the genus level and 96% at the species level.

However, the agreement between the two methods for non enterobacteriacae group was 95.8% at the genus level and 91.7% at the species level.

The agreement in isolates labeled with * (Klebsiella oxytoca, Pseudomonas fluorescence, Stenotrophomonas maltophilia and Alcaligenes xylosoxidans) was between Microscan conventional gram negative panel identification results and that of BBL identification system only, due to shortage of routine tube method ***(Sonnenwirth, 1980)*** to identify the isolates.

Disagreement between the two methods at the genus level occurred with two isolates in the enterobacteriacae group, Klebsiella pneumonae and Enterobacter cloacae (by conventional ID system) which misidentified as Enterobacter aerogenes and Klebsiella oxytoca (respectively) by Microscan conventional negative panel identification system and with one Pseudomonas fluorescence isolate (by conventional system) which was incorrectly identified as Flavimonas orzihabitans (by Microscan conventional negative panel).

Conventional identification (BBL and routine tube method) and Sensititre gram negative plate identification systems failed to identify Burkholderia cepacia which was initially identified by Microscan conventional gram negative panel as very rare biotype and after performing additional offline tests according to manfacturer's instructions the identification revealed as Burkholderia cepacia.

Percent of agreement probability between results of Microscan conventional negative panels and that of conventional system identifications is illustrated in table (8).

Table (8): Results of Microscan conventional negative panels by percent of probability.

Organism	No. of isolates	No testing correctly		No. of discrepancies	
		Agr. High probability	Agr. Low probability	Incorrect	V.R. biotype
Enterobacteriacae:					
E. coli	20	20(100%)	-	-	-
Proteus mirabilis	10	10(100%)	-	-	-
Proteus vulgaris	8	7(87.5%)	-	1(12.5%)	-
Morganella morganii	2	2(100%)	-	-	-
Provedentia rettegerii	1	1(100%)	-	-	-
Klebsiella pneumonae	10	8(80%)	-	2(20%)	-
Klebsiella oxytoca	2	1(50%)	-	1(50%)	-
Enterobacter cloacae	7	6(85.7%)	-	1(14.3%)	-
Enterobacter aerogenes	8	8(100%)	-	-	-
Enterobacter agglomerans	1	1(100%)	-	-	-
Citrobacter freundii	1	-	1(100%)	-	-
Serratia marcescens	6	5(83.3%)	1(16.7%)	-	-
Non Enterobacteriasae					
Pseudomonas aeruginosa	10	7(70%)	2(20%)	1(10%)	-
Pseudomonas fluorescence	4	1(25%)	1(25%)	2(50%)	-
Stenotrophomonas maltophilia	3	3(100%)	-	-	-
Burkholderia cepacia	1	-	-	-	1(100%)
Acinitobacter baumanii	3	3(100%)	-	-	-
Aeromonas hydrophila	1	1(100%)	-	-	-
Alcaligenes xylosoxidans	2	2(100%)	-	-	-

* Agreement High probability: Mean the unknown species was identified at a species (or combined species) level with a probability of ≥ 85% and the identification agreed with the reference identification.
* Agreement Low probability: the unknown isolates wasn't identified at a species level with a probability of ≥ 85% but the correct species appeared as one of the top three possible identifications at a low probability and was confirmed with the additional tests recommended by the system.
* Incorrect: did not meet any of the criteria given above.
* Very rare biotype: was used if the results for the unknown showed too many deviations from the expected results.

Table (9): Results of gram negative bacilli identification by Microscan Walkaway 40 and Sensititre systems versus that of conventional system identification.

Isolates	Total	Microscan		Sensititre	
		Correct genus	Correct species	Correct genus	Correct species
Enterobacteriacae:					
E. coli	20	20(100%)	20(100%)	20(100%)	20(100%)
Proteus mirabilis	10	10(100%)	10(100%)	10(100%)	9(90%)
Proteus vulgaris	8	8(100%)	7(87.5%)	8(100%)	8(100%)
Morganella morganii	2	2(100%)	2(100%)	2(100%)	2(100%)
Provedentia rettegerii	1	1(100%)	1(100%)	1(100%)	1(100%)
Klebsiella pneumonae	10	9(90%)	8(80%)	10(100%)	9(90%)
* Klebsiella oxytoca	2	2(100%)	1(50%)	2(100%)	2(100%)
Enterobacter cloacae	7	6(85.7%)	6(85.7%)	6(85.7%)	5(71.4%)
Enterobacter aerogenes	8	8(100%)	8(100%)	7(87.5%)	6(75%)
Enterobacter agglomerans	1	1(100%)	1(100%)	1(100%)	1(100%)
Citrobacter freundii	1	1(100%)	1(100%)	1(100%)	1(100%)
Serratia marcescens	6	6(100%)	6(100%)	6(100%)	5(83.3%)
Non Enterobacteriasae					
Pseudomonas aeruginosa	10	10(100%)	9(90%)	9(90%)	8(86%)
* Pseudomonas fluorescence	4	3(75%)	2(50%)	4(100%)	4(100%)
* Stenotrophomonas maltophilia	3	3(100%)	3(100%)	3(100%)	3(100%)
• Burkholderia cepacia	1	1(100%)	1(100%)	-	-
Acinitobacter baumanii	3	3(100%)	3(100%)	3(100%)	2(66.7%)
Aeromonas hydrophila	1	1(100%)	1(100%)	-	-
*Alcaligenes xylosoxidans	2	2(100%)	2(100%)	2(100%)	2(100%)
Total	100(100%)	97(97%)	92(92%)	95(95%)	88(88%)

RESULTS OF ANTIMICROBIAL SUSCEPTIBILITY TESTING

One hundered of gram negative isolates and fourty of gram positive isolates were tested for antimicrobial susceptibility by automated systems (Sensititre breakpoint susceptibility system and Microscan Walkaway gram negative breakpoint combo panels).

The results of antimicrobial susceptibility testing by disc diffusion method and by automated systems were compared. Discrepancies between the automated systems and disc diffusion method were classified as very major (the reference disc diffusion method was resistant and the automated system result was susceptible), major (the disc diffusion method was susceptible and the automated system result was resistant) or minor (an intermediate results was obtained by one method against sensitive or resistant result by the other method) discrepancies ***(Frederick et al., 1988).***

Results of antibiotic susceptibility testing by Microscan Walkaway and Sensititre systems versus that obtained by disc diffusion method for members of the family enterobacteriacae is illustrated in table (10).

Table (10): Percent of antibiotic susceptibility and resistance obtained by the 3 methods for members of the family enterobacteriacae (No = 76).

Antibiotic	D.D			Microscan			Sensititre		
	S(%)	I(%)	R(%)	S(%)	I(%)	R(%)	S(%)	I(%)	R(%)
Amikacin	64.5		35.5	60.6	3.9	35.5	59.2	5.3	35.5
Ampicillin	7.9		92.1	7.9		92.1	6.5		93.4
Cefazoline	21.1		78.9	21.1		78.9	21.1		78.9
Ceftazidime	63.2		35.5	64.5	1.3	34.2	63.2	1.3	35.5
Cefotaxime	61.8	1.3	38.2	61.8		38.2	60.5	1.3	38.2
Cefuroxime	47.4		52.6	44.8	2.6	52.6	44.8	2.6	52.6
Cefoxitin	42.1		57.9	42.1		57.9	42.1		57.9
Ciprofloxacin	69.7		30.3	69.7		30.3	69.7		30.3
Gentamycin	35.5		64.5	35.5		64.5	34.2	1.3	64.5
Imipenem	81.6		18.4	77.7	3.9	18.4	76.4	5.2	18.4
* Nitrofuranton	10		90	7.5		92.5	12.5		87.5
Ticracillin	47.4		52.6	47.4		52.6	47.4		52.6
Piperacillin	44.7		55.3	43.4	1.3	55.3	44.7		55.3
Tetracycline	21.1		78.9	18.5	2.6	78.9	23.7		76.3
Tobramycin	39.5		60.5	36.9	1.3	61.8	36.9	2.6	60.5
Trim/sulfa	25		75	23.7	1.3	75	22.4	1.3	76.3

Key: DD: Disc diffusion S: Sensitive

I: Intermediate R: Resistant

* Nitrofurantion was tested with urine samples only.

Imipenem was the most effective antibiotic against members of the family enterobacteriacae isolated in the study (81.6% susceptible by DD method).

Results of antibiotic susceptibility testing by Microscan Walkaway and Sensititre systems versus that obtained by disc diffusion method for non enterobacteriacae group is illustrated in table (11).

Table (11): Percent of antibiotic susceptibility and resistance obtained by the three methods for organisms in the non enterobacteriace group (No = 24).

Antibiotic	D.D			Microscan			Sensititre		
	S(%)	I(%)	R(%)	S(%)	I(%)	R(%)	S(%)	I(%)	R(%)
Amikacin	62.5		37.5	62.5	12.5	25	62.5	8.3	29.2
Ampicillin	4.2		95.8	4.2		95.8	4.2		95.8
Cefazoline	8.3		91.7	8.3		91.7	8.3		91.7
Ceftazidime	33.3		66.7	29.2		70.8	33.3		66.7
Cefotaxime	29.2		70.8	29.2		70.8	29.2	4.2	66.6
Cefuroxime	20.8		79.2	16.7		83.3	16.7		83.3
Cefoxitin	16.7		83.3	20.8	4.2	75	20.8		79.2
Ciprofloxacin	58.3		41.7	58.3		41.7	58.3		41.7
Gentamycin	25		75	20.8		79.2	29.2		70.8
Imipenem	62.5		37.5	58.3		41.7	54.1	4.2	41.7
Ticracillin	45.8		54.2	45.8		54.2	45.8		54.2
Piperacillin	50		50	45.8	4.2	50	54.2		45.8
Tetracycline	16.7		83.3	16.7		83.3	20.8	4.2	75
Tobramycin	33.3		66.7	33.3		66.7	37.5		62.5
Trim/sulfa	8.3		91.7	8.3		91.7	8.3		91.7

Key: DD: disc diffusion S: Sensitive

I: Intermediate R: Resistant

Amikacin and imipenem were the most effective antibiotics against members of non enterobacteriacae group isolated in the study (62.5% susceptible for each).

Table (12): Resistance patterns of study organisms as determined by the DD method.

Antibiotic	% of resistant organisms	
	Enteriobacteriacae (n = 76)	Non Enterobacteriacae (n = 24)
Amikacin	35.5%	37.5%
Ampicillin	92.1%	95.8%
Cefazoline	78.9%	91.7%
Ceftazidime	35.5%	66.7%
Cefotoxime	38.2%	70.8%
Cefuroxime	52.6%	79.2%
Cefoxitin	57.9%	83.3%
Ciprofloxacin	30.3%	41.7%
Gentamycin	64.5%	75%
Imipenem	18.4%	37.5%
Nitrofurantoin	90%	-
Ticracillin	52.6%	54.2%
Piperacillin	55.3%	50%
Tetracycline	78.9%	83.3%
Tobramycin	60.5%	66.7%
Trim/sulfa	75%	91.7%

Key: DD: disc diffusion

Highest percent of resistance for the enterobacteriacae group occurred with ampicillin (92.1%), followed by nitrofurantoin (90%), while for non enterobacteriacea group occurred also with ampicillin (95.8%) followed by cefazoline and trimethoprim/ sulfamethoxyzole (91.7% for each).

Table (13): Percent of agreement between results of Microscan Walkaway and that obtained by disc diffusion method.

Antibiotic	No. of tests with @		Full agreement by drug %
	Enterobacteriaceae	Non Enterobacteriaceae	
Amikacin	0, 0, 3, 73	0, 0, 3, 21	94%
Ampicillin	0, 0, 0, 76	0, 0, 0, 24	100%
Cefazoline	0, 0, 0, 76	0, 0, 0, 24	100%
*Ceftazidime	1, 0, 0, 75	1, 0, 0, 23	98%
Cefotoxime	0, 0, 0, 76	0, 0, 0, 24	100%
Cefuroxime	0, 0, 2, 74	0, 1, 0, 23	97%
Cefoxitin	0, 0, 0, 76	1, 0, 1, 22	98%
Ciprofloxacin	0, 0, 0, 76	0, 0, 0, 24	100%
Gentamycin	0, 0, 0, 76	0, 1, 0, 23	99%
Imipenem	0, 0, 3, 73	0, 1, 0, 23	96%
*Nitrofurantoin	0, 1, 0, 39	Not tested	97.5%
Ticracillin	0, 0, 0, 76	0, 0, 0, 24	100%
Piperacillin	0, 0, 1, 75	0, 0, 1, 23	98%
Tetracycline	0, 0, 2, 74	0, 0, 0, 24	98%
Tobramycin	0, 1, 1, 74	0, 0, 0, 24	98%
Trim/sulfa	0, 0, 1, 75	0, 0, 0, 24	99%
Full agreement by org. %	98.6%	97.2%	

@ No indicate very major discrepancies, major discrepancies, minor discrepancies and concordant result respectively

For members of the family enterobacteriacae, hundered percent agreement was found between results of Microscan Walkaway and that of

disc diffusion method for ampicillin, cefazoline, cefotaxime, cefoxitin, ciprofloxacin, gentamycin and ticracillin.

Minor discrepancies occurred with amikacin (3), cefuroxime (2), imipenem (3), piperacillin (1), tetracycline (2), tobramycin (1) and trimethoprime, sulfamethoxyzole (1).

Two major discrepancies were detected one with nitrofurantoin and the other with tobramycin. Only one very major discrepancy was detected with ceftazidime.

For non enterobacteriacae group, hundered percent agreement was found between results of Microscan Walkaway and that of disc diffusion method for ampicillin, cefazoline, cefotaxime, ciprofloxacin, ticracillin, tetracycline, tobramycin and trimethoprim/sulfa methoxazole.

Minor discrepancies were found with amikacin (3), cefoxitin (1) and piperacillin (1), while major discrepancies were detected with cefuroxime (1), gentamycin (1) and imipenem (1).

Very major discrepancies was found with ceftazidime (1) and cefoxitin (1).

Table (14): Percent of agreement between results of Sensititre system and that obtained by disc diffusion method.

Antibiotic	No. of tests with @		Full agreement by drug %
	Enterobacteriacae	Non enterobacteriacae	
Amikacin	0, 1, 3, 72	0, 0, 2, 22	94%
Ampicillin	0, 1, 0, 75	0, 0, 0, 24	99%
Cefazoline	0, 0, 0, 76	0, 0, 0, 24	100%
Ceftazidime	0, 0, 0, 76	0, 0, 0, 24	100%
Cefotoxime	0, 0, 1, 75	0, 0, 1, 23	98%
Cefuroxime	0, 0, 2, 74	0, 1, 0, 23	97%
Cefoxitin	0, 0, 0, 76	1, 0, 0, 23	99%
Ciprofloxacin	0, 0, 0, 76	0, 0, 0, 24	100%
Gentamycin	0, 0, 1, 75	1, 0, 0, 23	98%
Imipenem	0, 1, 3, 72	0, 1, 1, 22	94%
*Nitrofurantoin	2, 0, 0, 38	Not tested	95%
Ticracillin	0, 0, 0, 76	0, 0, 0, 24	100%
Piperacillin	0, 0, 0, 76	1, 0, 0, 23	99%
Tetracycline	2, 0, 0, 74	1, 0, 1, 22	96%
Tobramycin	0, 0, 2, 74	1, 0, 0, 23	97%
Trim/sulfa	0, 1, 1, 74	0, 0, 0, 24	98%
Full agreement by org. %	98.2%	96.7%	

@ No indicate very major discrepancies, major discrepancies, minor discrepancies and concordant results respectively

For members of the family enteroacteriacae, hundered percent agreement was found between the results of Sensititre system and that of

disc diffusion method for cefazoline, ceftazidime, cefoxitin, ciprofloxacin, ticracillin and piperacillin.

Minor discrepancies occurred with amikacin (3), cefotaxime (1), cefuorxime (2), gentamycin (1), imipenem (3), tobramycin (2) and trimethoprime/sulfa methoxazole (1).

Major discrepancies was found with amikacin, ampicillin, imipenem and trimethoprime/ sulfamethoxazole (one for each).

Very major discrepancies occurred with nitrofurantoin (2) and tetracycline (2).

For non enterobacteriacae group, hundered percent agreement was found between the results of Sensititre system and that of disc diffusion method for ampicillin, cefazoline, ceftazidime, ciprofloxacin, ticracillin and trimethoprim/ sulfa methoxazole.

Minor discrepancies was found with amikacin (2), cefotaxime (1), imipenem (1) and tetracycline (1), while major discrepancies was detected with cefuroxime (1) and imipenem (1).

Very major discrepancies was found with cefoxitin, gentamycin, piperacillin, tetracycline and tobramycin (one for each).

Table (15): The number of antibiotic susceptibility and resistance obtained by the 3 methods for gram positive isolates (No=40).

Antibiotic	D.D.			Microscan			Sensititre		
	S	I	R	S	I	R	S	I	R
Penicillin	7	-	33	7	1	32	7	1	32
Ampicillin	10		30	10	1	29	10	1	29
Oxacillin	14		26	12		28	13		27
Cephalothin	19		21	20		20	20		20
Erythromycin	19		21	19		21	19		21
Clindamycin	20		20	20		20	20		20
Imipenem	33		7	33		7	33		7
Vancomycin	39		1	39		1	39		1
Gentamycin	20		20	20		20	19		21
Rifampin	28		12	28		12	28		12
Chlormphenicol	26		14	25		15	25	1	14
Tetracycline	23		17	23		17	21		19
Ciprofloxacin	27		13	27		13	27		13
Trim/sulfa	15		25	13		27	14		26

* Streptococci was not tested by automated systems (special panel was not available).

S: Sensitive I: Intermediate R: Resistant

Table (16): The percent of antibiotic susceptibility and resistance obtained by the 3 methods for gram positive isolates (No = 40).

Antibiotic	D.D.			Microscan			Sensititre		
	S	I	R	S	I	R	S	I	R
Penicillin	17.5%		82.5%	17.5%	2.5%	80%	17.5%	2.5%	80%
Ampicillin	25%		75%	25%	2.5%	72.5%	25%	2.5%	72.5%
Oxacillin	35%		65%	30%		70%	32.5%		67.5%
Cephalothin	47.5%		52.5%	50%		50%	50%		50%
Erythromycin	47.5%		52.5%	47.5%		52.5%	47.5%		52.5%
Clindamycin	50%		50%	50%		50%	50%		50%
Imipenem	82.5%		17.5%	82.5%		17.5%	82.5%		17.5%
Vancomycin	97.5%		2.5%	97.5%		2.5%	97.5%		2.5%
Gentamycin	50%		50%	50%		50%	47.5%		52.5%
Rifampin	70%		30%	70%		30%	70%		30%
Chlormphenicol	65%		35%	62.5%		37.5%	62.5%	2.5%	35%
Tetracycline	57.5%		42.5%	57.5%		42.5%	52.5%		47.5%
Ciprofloxacin	67.5%		32.5%	67.5%		32.5%	67.5%		32.5%
Trim/sulfa	37.5%		62.5%	32.5%		67.5%	35%		65%

S: Sensitive I: Intermediate R: Resistant

Vancomycin was the most effective antibiotic against gram positive isolates (97.5% susceptible), followed by imipenem (82.5% susceptible).

Table (17): Number of discrepancies for antibiotic by method compared to results obtained by DD method for gram positive isolates (No = 40).

Antibiotic	Number of discrepancies					
	Microscan			Sensititre		
	Minor	Major	V. major	Minor	Major	V. major
Penicillin	1	-	-	1	-	-
Ampicillin	1	-	-	1	-	-
Oxacillin	-	2	-	-	1	-
Cephalothin	-	-	1	-	-	1
Erythromycin	-	-	-	-	-	-
Clindamycin	-	-	-	-	-	-
Imipenem	-	-	-	-	-	-
Vancomycin	-	-	-	-	-	-
Gentamycin	-	-	-	-	1	-
Rifampin	-	-	-	-	-	-
Chlormphenicol	-	1	-	1	-	-
Tetracycline	-	-	-	-	2	-
Ciprofloxacin	-	-	-	-	-	-
Trim/sulfa	-	2	-	-	1	-
Full agreement	98.7%			98.5%		

There was full agreement between the antibiotic susceptibility testing results of Microscan Walkaway and that of disc diffusion methods for erythromycin, clindamycin, imipenem, vancomycin, gentamycin, rifampin, tetracycline and ciprofloxacin.

Minor discrepancies was found with penicillin (1) and ampicillin (1), while major discrepancies was detected with oxacillin (2), chlormphenicol (1) and trim/sulfa (2).

Very major discrepancies occurred only with cephalothin (1). Full agreement was found between the results of Sensititre system and antibiotic susceptibility testing by disc diffusion method for erythromycin, clindamcyin, imipenem, vancomycin, rifampin and ciprofloxacin.

Minor discrepancies was found with penicillin (1), ampicillin (1) and chlormphenicol (1), major discrepancies was detected with oxacillin (1), gentamycin (1), tetracycline (2) and trim/sulfa methoazole (1).

There was one very major discrepancy found with cephalothin.

Table (18): Results of antibiotic susceptibility testing by Microscan Walkaway versus that of D.D method (No = 40).

Antibiotic	No of tests with @		Full agreement by drug
	Staphylococci	Enterococci	
Penicillin	0,0,0,35	0,0,1,4	97.5%
Ampicillin	0,0,0,35	0,0,1,14	97.5%
Oxacillin	0,2,0,33	0,0,0,5	95%
Cephalothin	1,0,0,34	0,0,0,5	97.5%
Erythromycin	0,0,0,35	0,0,0,5	100%
Clindamycin	0,0,0,35	0,0,0,5	100%
Imipenem	0,0,0,35	0,0,0,5	100%
Vancomycin	0,0,0,35	0,0,0,5	100%
Gentamycin	0,0,0,35	0,0,0,5	100%
Rifampin	0,0,0,35	0,0,0,5	100%
Chlormphenicol	0,1,0,34	0,0,0,5	97.5%
Tetracycline	0,0,0,35	0,0,0,5	100%
Ciprofloxacin	0,0,0,35	0,0,0,5	100%
Trim/sulfa	0,2,0,33	0,0,0,5	95%
Full agreement by org %	98.8%	97.1%	

@ No indicate very major, major, minor discrepancies and concordant result respectively.

Table (19): Results of antibiotic susceptibility testing by Sensititre breakpoint system versus that of DD method (No = 40).

Antibiotic	No of tests with @		Full agreement by drug
	Staphylococci	Enterococci	
Penicillin	0, 0, 0, 35	0, 0, 1, 4	97.5%
Ampicillin	0, 0, 0, 35	0, 0, 1, 4	97.5%
Oxacillin	0, 1, 0, 34	0, 0, 0, 5	97.5%
Cephalothin	1, 0, 0, 34	0, 0, 0, 5	97.5%
Erythromycin	0, 0, 0, 35	0, 0, 0, 5	100%
Clindamycin	0, 0, 0, 35	0, 0, 0, 5	100%
Imipenem	0, 0, 0, 35	0, 0, 0, 5	100%
Vancomycin	0, 0, 0, 35	0, 0, 0, 5	100%
Gentamycin	0, 1, 0, 34	0, 0, 0, 5	97.5%
Rifampin	0, 0, 0, 35	0, 0, 0, 5	100%
Chlormphenicol	0, 0, 1, 34	0, 0, 0, 5	97.5%
Tetracycline	0, 2, 0, 33	0, 0, 0, 5	95%
Ciprofloxacin	0, 0, 0, 35	0, 0, 0, 5	100%
Trim/sulfa	0, 1, 0, 34	0, 0, 0, 5	97.5%
Full agreement by org %	98.6%	97.1%	

@ No indicate very major, major, minor discrepancies and concordant result respectively.