

# Antibiotic Resistance Patterns of Uropathogens in Long Term Care Facilities

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## Abstract

**Background:** Residence at a Long term care facility (LTCF) and older age are both recognized as significant risk factors for harboring multidrug resistant Gram-negative bacteria (MDRGNB)

**Aim:** The objective of this descriptive study is to detect the commonest multidrug resistant bacteria and its antibiotic sensitivity in urine of elderly residents at LTCF with urinary tract infection (UTI).

**Methods:** Eighty one LTCF elderly residents with UTI. Culture and sensitivity was done for urine samples documenting multidrug resistant organisms with antibiotic susceptibility to a range of different antibiotic groups. Demographic data was collected and comorbidities were established. All samples were processed as per standard techniques and bacteria identified by standard biochemical tests. IBM SPSS statistics (version 24, IBM corp., USA, 2016) was used for data analysis.

**Results:** The age ranges from 60 to 90 years with mean 69.86 +/- 9.68 years Males are 74.1% while females are 25.9 %. The predominant resistant detected organism in these samples was Proteus (58.0%) then E coli (19.8 %), Klebsiella (18.5 %) then Pseudomonas (3.7 %). Proteus is found to be highly statistically significant sensitive to Cefepime (CPM), Ciprofloxacin (CP), and Imipenam (IMP) and to be highly statistically significant resistant to Colistin (CT), Gentamycin (GM), Tobramycin (Tobra.), Nitrofurantoin (FD), and Trimethoprim/Sulfamethoxazole (TS). E Coli is found to be highly statistically significant sensitive to Colistin (CT), Trimethoprim/Sulfamethoxazole (TS), Gentamycin (GM), Tobramycin(Tobra.) and Nitrofurantoin (FD) and resistant to Cefepime (CPM) .Further studies are recommended on larger numbers of elderly patients to confirm or not confirm significant findings in this study, try to explain these findings, and make use of it in clinical practice.

**Conclusion:** Proteus is the commonest multi resistant uropathogen in those under 70 years while psuedomonas is the most prevalent one in elderly between71-90 years of age

**Keywords:** Antibiotic susceptibility, multi drug resistant bacteria, urine, UTI, long term care facility, elderly

## Background

Multidrug-resistant organisms (MDROs) are serious challenges on clinical treatment, infection control and public health <sup>1,2</sup>. The complexity and recurrent features of MDROs pose a threat to affected patients worldwide and frequently lead to poorer outcomes such as longer hospital stays, increased mortality, and higher hospitalization cost <sup>3</sup>. Residence at a LTCF and older age are both recognized as significant risk factors for harboring MDRGNB <sup>4</sup>.

Residents of LTCFs for the elderly had more than double the rate of E. coli and Klebsiella UTI and more than four times the rate of E. coli and Klebsiella UTI caused by antibiotic-resistant bacteria compared with those living in the community <sup>5</sup>. The availability of antimicrobial agents that target uropathogens has become increasingly limited due to increasing rates of antibiotic resistance, especially in LTCF, as reported in

local antibiogram data in Calgary and Edmonton <sup>6,7</sup>.

The objective of this study is to detect the commonest multidrug resistant bacteria and its antibiotic sensitivity in urine of elderly residents with urinary tract infection (UTI) at long term care facility.

## Methods

A descriptive study included 81 long term care facility elderly residents having UTI with multi drug resistant organisms detected in their urine.

Urine collection was by clean-catch or catheterization. A clean-catch, midstream specimen, the urethral opening is washed with a mild, nonfoaming disinfectant

The first 5 mL of urine is not captured; the next 5 to 10 mL is collected in a sterile container.

When obtaining a clean-catch, midstream urine is

difficult; a specimen was obtained by a new sterile urinary catheter under aseptic condition.

Analysis and culture were done within 2 h of specimen collection.

When urine analysis showed pus cells more than 5 WBCs / hpf (white blood cells per high power field) with positive nitrate and leukocyte esterase in urine, those urine samples proceeded to culture and sensitivity to a range of different antibiotic groups. Samples with resistance to 2 or more antibiotic groups were included in the study.

All samples were processed as per standard techniques and bacteria identified by standard biochemical tests.

Demographic data collected and comorbidities established for included cases. Duration of Stay (DOS) stands for the time period in weeks elapsed between admission and start of Isolation for urine resistant infection. DOS Zero stands for 1<sup>st</sup> 48 hours of admission to LTCF while DOS 1 stands for the rest of 1<sup>st</sup> week of admission starting after 48hours of admission (i.e from day 3 till end of day 7).

**Statistical Analysis**

IBM SPSS statistics (version 24, IBM corp., USA, 2016) was used for data analysis. Data were expressed as Mean ± SD for quantitative parametric measures in addition to both number and percentage for categorized data. Chi – square test was used to study the association between each 2 variables or comparison between 2 independent groups as regards the categorized data. The probability of error at 0.05 was considered significant, while at 0.01 and 0.001 are highly significant.

**Results**

A sample of 81 elderly long term care facility (LTCF) residents having UTI with multi drug resistant uropathogens were recruited. 55.6 % of residents are in the age group 60-70 y while 44.4% of residents are in the age group 71-90 y. Males account for 74.1% of the participants, while females are 25.9 %.

The predominant resistant detected organism in this sample is Proteus (58.0%) then E coli (19.8 %), Klebsiella (18.5 %) and Pseudomonas (3.7 %).

MRSA infection was not documented in any of the studied samples

76.6% of Proteus infections are in the younger age group (60-70 years). 38.3% of Proteus infections are in patients with renal impairment.

Age is highly statistically significant correlated to different detected resistant organisms with Proteus mainly present in the younger age group while other detected resistant organisms are mainly in the older age group (p=0.000). Gender does not affect the pattern of resistant organisms UTI (p=0.387).

**Table (1): Correlation between age and detected resistant organisms in urine of long term care facility elderly.**

Age		Organism				Total
		E coli	Proteus	klebsiella	Pseudomonas	
60-70	n	6	36	3	0	45
	%	13.3%	80%	6.6%	0.0%	55.6%
71-90	n	10	11	12	3	36
	%	27.7%	30.5%	33.3%	8.3%	44.4%
Pearson Chi-Square			Value	P		
			21.969a	.000		

**Table (2): Correlation between sex and detected resistant organisms in urine of long term care facility elderly**

Sex		Organism				Total
		E coli	Proteus	klebsiella	Pseudomonas	
Male	n	13	35	9	3	60
	%	21.6%	58.3%	15%	5%	74.1%
Female	n	3	12	6	0	21
	%	14.2%	57.14%	28.5%	0.0%	25.9%
Pearson Chi-Square			Value	P		
			3.030a	.387		

There is highly statistically significant correlation between diagnoses (comorbidity) and resistant organisms with Proteus found mainly in patients with renal impairment while pseudomonas in patients with dementia (p value = 0.000).

**Meronom, Cefuroxime, Amikin, and Colistin** are effective against the 3 resistant strains to variable extents.

**Piperacillin, Ciprofloxacin, and piperacillin/tazobactam** are effective only for Proteus related infections.

**Gentamycin and Tobramycin** are effective only against E coli. [Figure 1]

The resistant uropathogens spectrum for each antibiotic are demonstrated in **figure 2**

None of Klebsiella or E coli infections are resistant to Meronom. Proteus is the only resistant pathogen to clindamycin, Ceftriaxone, piperacillin, and erythromycin.

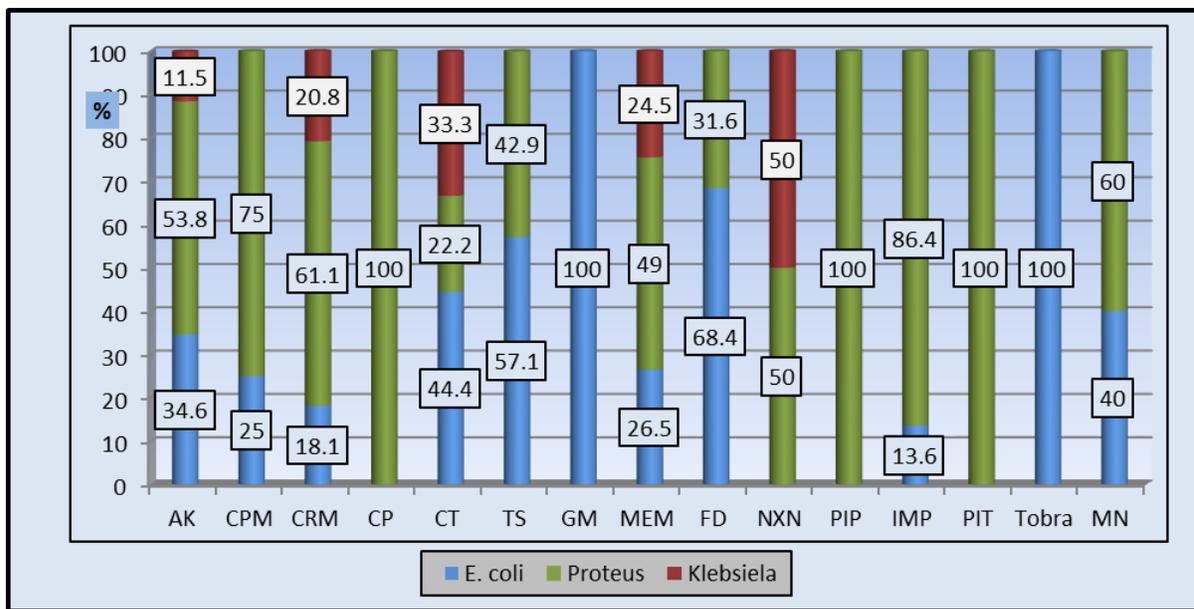
DOS is highly statistically significant related to sex with 45% of males having DOS 110-250 weeks while 61.9% of females having DOS 1-8 weeks (p=0.001).

There is statistically significant difference between sensitive patients and resistant patients to GM as regards DOS 75% of sensitive patients to GM have DOS zero while 44.6% of resistant to GM have DOS(1-80 weeks) p=0.026.

**Table (3): Correlation between comorbidities (diagnosis) and detected resistant organisms in urine of long term care facility elderly.**

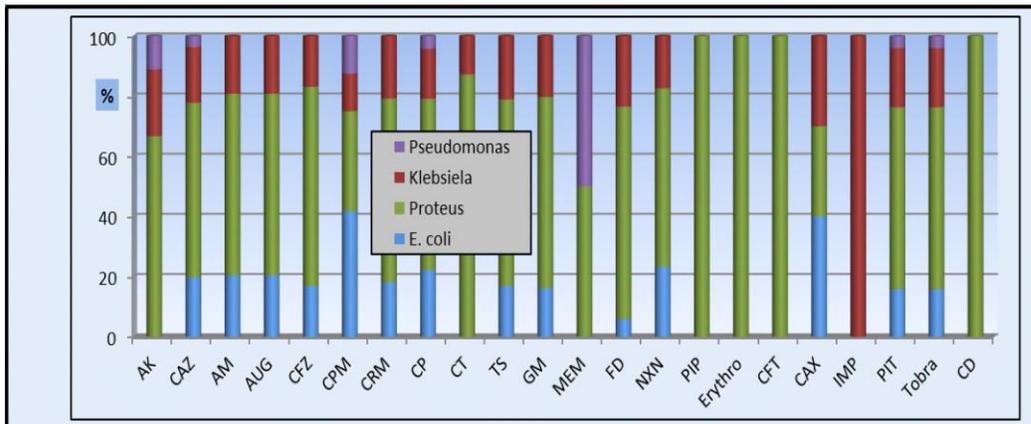
Diagnosis	N	Organism				Total
		E coli	proteus	Klebsiela	pseudomonas	
Diabetes mellitus	N	2	0	0	0	2(2.4%)
anoxic brain damage	N	0	3	0	0	3 (3.7%)
Dementia	N	0	0	0	3	3 (3.7%)
Diabetes Mellitus +bedsore+Dementia	N	0	3	4	0	7(8.6%)
Post Cardiac Arrest + Bed sore	N	0	0	3	0	3 (3.7%)
Diabetes Mellitus +CVS+Dementia	N	4	0	0	0	4(4.9%)
Hypertension	N	3	8	0	0	11(13.58%)
cerebrovascular stroke	N	0	0	2	0	2(2.4%)
RTA	N	0	12	0	0	12(14.8%)
Renal impairment	N	0	18	0	0	18(22.2%)
Pressure sore	N	0	0	3	0	3 (3.7%)
Brain tumor	N	1	0	3	0	4(4.9%)
Cancer colon	N	6	0	0	0	6(7.4%)
Post cardiac arrest	N	0	3	0	0	3 (3.7%)
<b>Total</b>	<b>N</b>	<b>16</b>	<b>47</b>	<b>15</b>	<b>3</b>	<b>81</b>
Pearson Chi-Square		Value	P			
		208.136 <sup>a</sup>	0.000			

**Figure (1): Frequency of all studied antibiotics as regards their sensitivities.**



Amikin (AK), Cefepime (CPM), Cefuroxime (CRM), Ciprofloxacin (CP), Colistin (CT), Trimethoprim/Sulfamethoxazole (TS), Gentamycin (GM), Meronam (MEM), nitrofurantoin (FD), Norfloxacin (NXN), piperacillin (PIP), Imipenam (IMP), piperacillin/tazobactam (PIT), Tobramycin (Tobra.), Minocyclin (MN)

**Figure (2) : Frequency of all studied antibiotics as regards their resistance**



Amikin (AK), Ceftazidime (CAZ), Ampicillin (AM), Augmentin (AUG), (CFZ) Cefazolin, Cefepime (CPM), Cefuroxime (CRM), Ciprofloxacin (CP), Colistin (CT), Trimethoprim/Sulfamethoxazole (TS), Gentamycin (GM), Meronam (MEM), Nitrofurantoin (FD), Norfloxacin (NXN), peperacillin (PIP), Erythromycin (Erythro.), Ceftriaxone (CFT), Cefotaxime (CAX), Imipenam (IMP), Tazocin (PIT), Tobramycin (Tobra.), Clindamycin (CD)

## Discussion

For many worldwide regions, our knowledge regarding the scope of the resistance problem is imprecise and unreliable. Surveillance of resistance is an integral part of combating resistance<sup>8</sup>.

This study tried to describe the most prevalent resistant bacteria in urine of elderly patients resident at LTCF with UTI and to find which antibiotics still are those organisms sensitive to and which are resistant to.

The predominant resistant detected organism in this sample was Proteus (58.0%) then E coli (19.8 %), Klebsiella (18.5 %) and Pseudomonas (3.7 %).

On the other hand Joseph M. Mylotte et.al, 2001 detected E Coli as the most detected organism in urine of LTCF residents under the study, but Enterococci as the most common resistant organisms in their urine then S. aureus (MRSA) then E coli and Pseudomonas aeruginosa then lastly, Klebsiella pneumoniae and proteus were isolated.<sup>9</sup>

According to Azad L. 2016,<sup>10</sup> E Coli was the commonest isolated organism in urine 10, but current study found Proteus to be the most predominant resistant organism and this cannot be explained by higher percentage of males in the sample as no statistically significant relation between sex and different detected organisms.

Differences between current study and previous studies findings can be explained by differences in samples.

In current study, younger age group (60 – 70 years) is highly statistical significant sensitive to CPM and IMP and highly statistical significant resistant to GM, TS, and Tobramycin this findings may be explained by Proteus which is found to be significantly present in younger age group under the study and is highly statistical significant sensitive to CPM and IMP and highly statistical significant resistant to GM, CT, TS, and Tobramycin.

According to current study, there is statistically significant difference between sensitive organisms and resistant organisms to GM as regards DOS 75% of sensitive organisms to GM have DOS zero while 44.6% of resistant organisms to GM have DOS(1-80 weeks) p=0.026. This means newly admitted cases are mostly sensitive to GM then resistance was acquired by admission to LTCF.

There is statistically significant difference between organism sensitivity to CP and DOS as 100% of sensitive organisms to CP have DOS 1-8weeks, while 100% of intermediately sensitive organisms to CP have DOS(100-250 weeks) p=0.037. This can show decreasing sensitivity as DOS increase .

Current study is showing statistical significant relation between comorbidity of Cancer colon and sensitivity to

FD, MEM, and CT but patients with comorbidities of Diabetes Mellitus + Bed sore + Dementia are statistical significant sensitive to MEM whereas Dementia is statistical significant resistant to MEM. These statistical significant relations may be explained by Statistically significant relation between cancer colon and E Coli which is significantly sensitive to FD, MEM, and CT also Statistically significant relation between comorbidities of Diabetes Mellitus+ Bed sores +Dementia and Proteus which is Statistically significantly sensitive to MEM. On the other hand, Statistical significant relation between Dementia and Pseudomonas which is Statistical significant resistant to MEM.

### Recommendations:

Further studies are recommended on larger numbers of elderly patients to confirm or not to confirm significant findings in this study, try to explain these findings and make use of it in clinical practice.

According to current study's significant results, maybe we can recommend that LTCF patients with UTI with suspected resistant bacteria we can predict that:

- It can be mostly Proteus especially in younger patients (60-70 years old) and having comorbidities of DM +Dementia + Pressure ulcer. Certain antibiotics are recommended for this Proteus such as CPM, CP, and IMP and avoid other antibiotics as CT, GM, and Tobramycin.
- It can be Pseudomonas especially if patients aged from 71-90 years and have comorbidity of Dementia. MEM is recommended to be avoided in those patients.
- CT, TS, GM, Tobramycin and FD are recommended for resistant E Coli while CPM to be avoided for it.
- IMP recommended to be avoided for resistant Klebsiella and MEM to be avoided for Pseudomonas.

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