Ministry of Health and Environment
Public Health Directorate
Antimicrobial Resistance control Section

Antimicrobial Resistance Surveillance

Annual Report 2020

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Antimicrobial Resistance Annual Report 2020

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Acronyms and Abbreviations

MOH	Ministry of Health
NCC	National Coordination Center
AMR	Antimicrobial Resistance
GLASS	Global Antimicrobial Resistance and Use Surveillance System
WHO	World Health Organization
CLSI	Clinical and Laboratory Standards Institutes
AST	Antimicrobial susceptibility test
WHONET	Database software for the management and analysis of microbiology laboratory data developed by World Health Organization

1. Introduction

1.1 Background:

Antimicrobial resistance (AMR) is defined as antimicrobial resistant to medicines in pathogens such as bacteria, viruses, fungi and parasites. It's the normal evolutionary process of these microorganisms which is accelerated by the selective pressure exerted by widespread use and misuse of antimicrobials.

It is a growing public health problem of significant concern in the world due to the rapid spread of pathogens that cause common infections and are resistant to multiple or all antimicrobials.

The national coordinating center (NCC) for antimicrobial resistance in public health directorate was established at 2017 consisting of a healthcare specialist, pharmacist, and statistician. They collaborate on preparation and announcement of the national action plan of AMR at 2019 which designed in a five years cycle followed by revision and further development according to the situation and lessons learned and best practice identified during these periods.

The national AMR surveillance system addresses resistant bacteria in clinical specimens of patients with common infections and against which usual antimicrobials were ineffective.

AMR program provided a standardized approach according to Global Antimicrobial Surveillance and Use System (GLASS) for the collection and analysis of AMR data by the surveillance sites in the country. The approach based on laboratory data collection and submission on WHONET software, which include epidemiological and clinical information. It provides standards and tools for routine surveillance based on microbiological and clinical information on eight priority pathogens detected in four specimens types that listed by World Health Organization (WHO). The antimicrobial-pathogen combinations rely on Clinical and Laboratory Standards Institutes 2020 (CLSI) to avoid misinterpretation of resistance.

During the period (1st January-31th December 2020), 29 surveillance sites were enrolling in national AMR surveillance system with full equipments

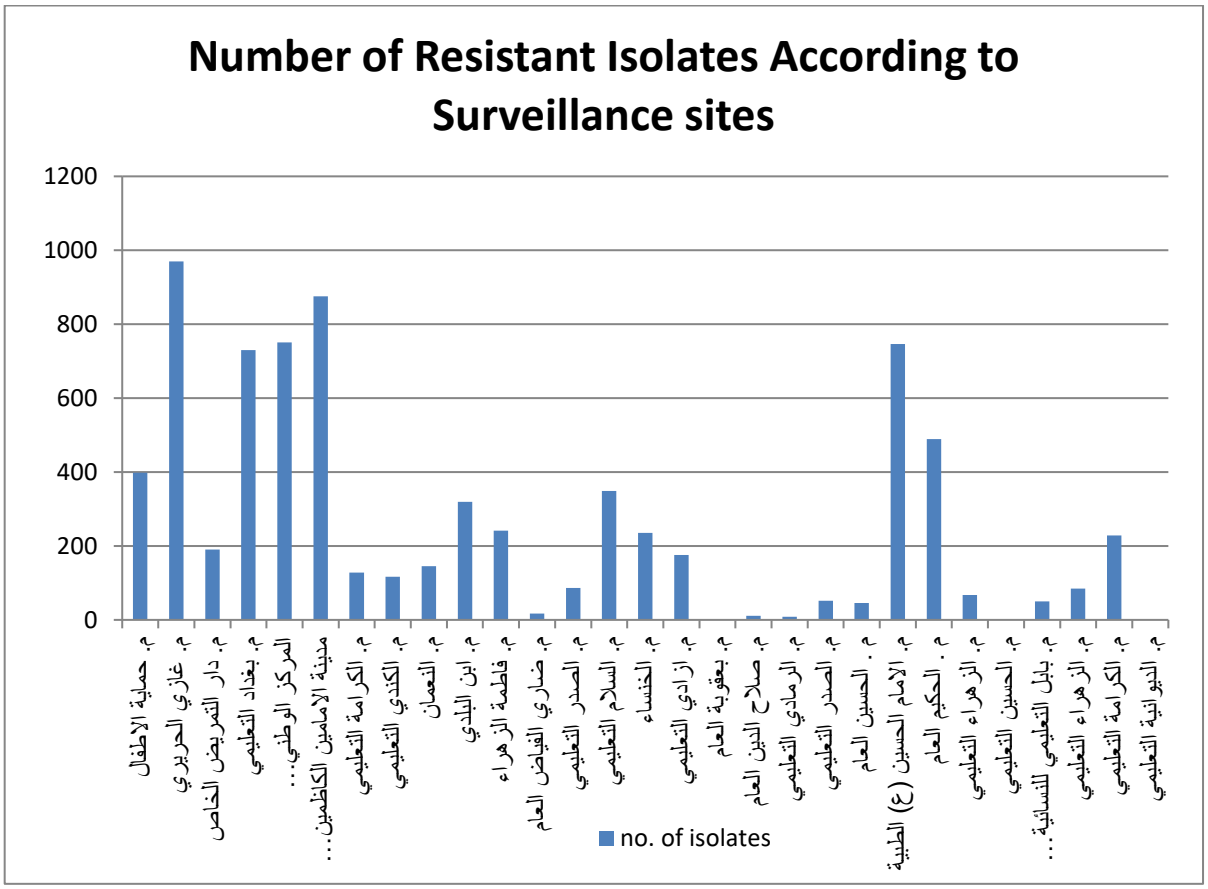
and trained personnel using WHONET software for collection of data on resistant bacteria then sending these data monthly to the national coordinating center for aggregation and analysis.

1.2 Objectives of the report:

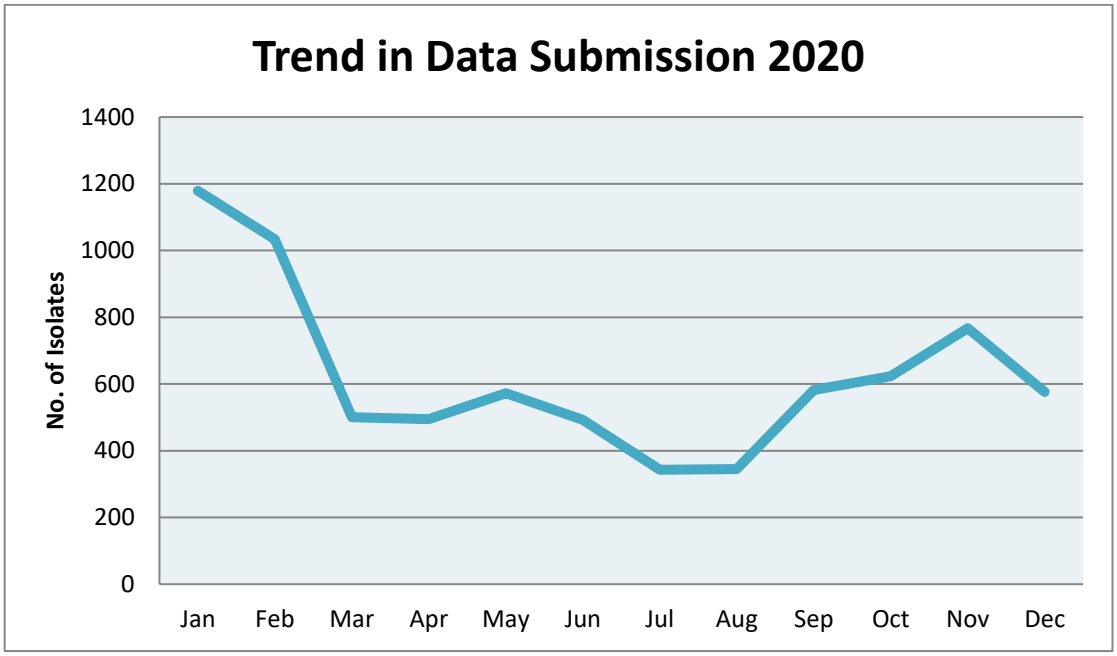
- Estimate the extent and burden of emerging AMR nationally.
- Monitor AMR trends of pathogenic bacteria that cause common infections in humans to take actions by policy makers.
- Summarize results of annual aggregated data after validation and analysis.
- Summarize national AMR surveillance activities.
- Enhancing the participation of national healthcare professionals and physicians to support the system.

2. Summary of The Reported Data:

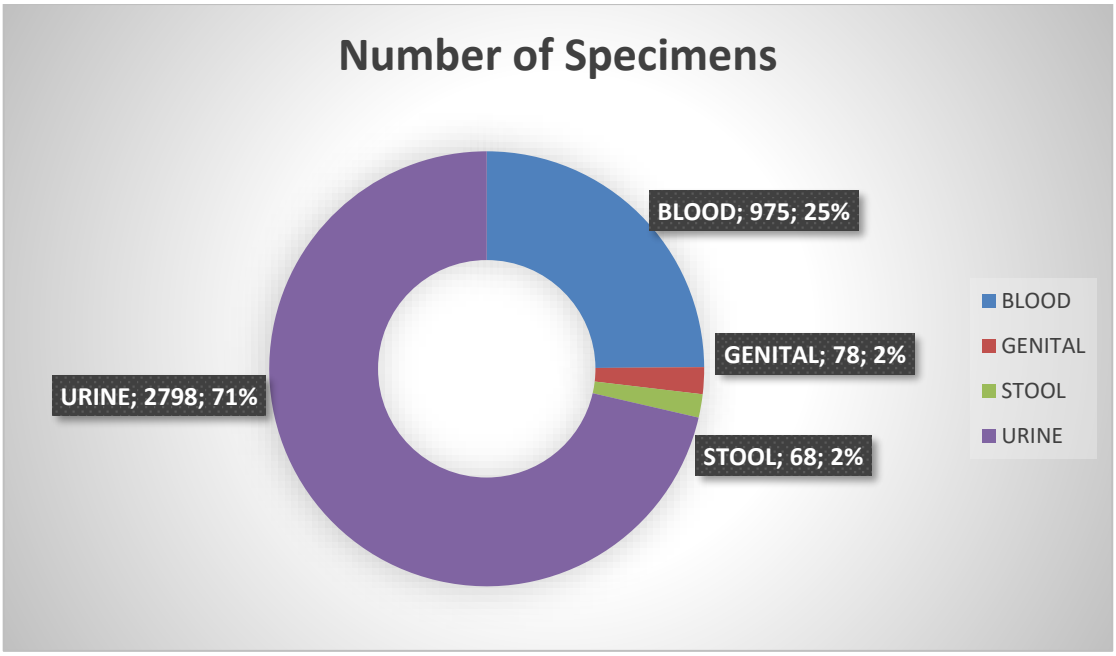
During the year 2020, 29 surveillance sites were enrolled in the national AMR surveillance system. They reported their data monthly by using WHONET software, which is windows based database software developed for the management and analysis of the microbiological laboratory data with a special focus on the analysis of antimicrobial susceptibility test results. The capacity in the laboratories of hospitals still in progress to conduct national surveillance system in all over the country.



Data aggregated from surveillance sites throughout the year 2020 showing major decline during COVID-19 pandemic as most of the hospitals turn into isolation centers for corona virus infected patients.



In total, 2798 urine, 975 bloods, 68 stool and 78 genital swabs (cervical and urethral) specimens collected for pathogen isolation with further antimicrobial susceptibility testing.



The total number of isolates that aggregated from surveillance sites was 7509, of which 3461 high priority resistant isolates according to GLASS that include eight resistant pathogens isolated from four different specimens.

Table 1: High priority pathogens according to GLASS-AMR system.

	Symbol	Pathogen	Total
1.	Eco	*Escherichia coli*	1889
2.	Aba	*Acinetobacter baumannii*	331
3.	Kpn	*Klebsiella Pneumonia*	496
4.	Sau	*Staphylococcus aurous*	687
5.	Spn	*Streptococcus pneumonia*	45
6.	Sal	*Salmonella spp.*	7
7.	Shi	*Shigella spp.*	1
8.	Ngo	*Neisseria gonorrhea*	5
		Total	3461

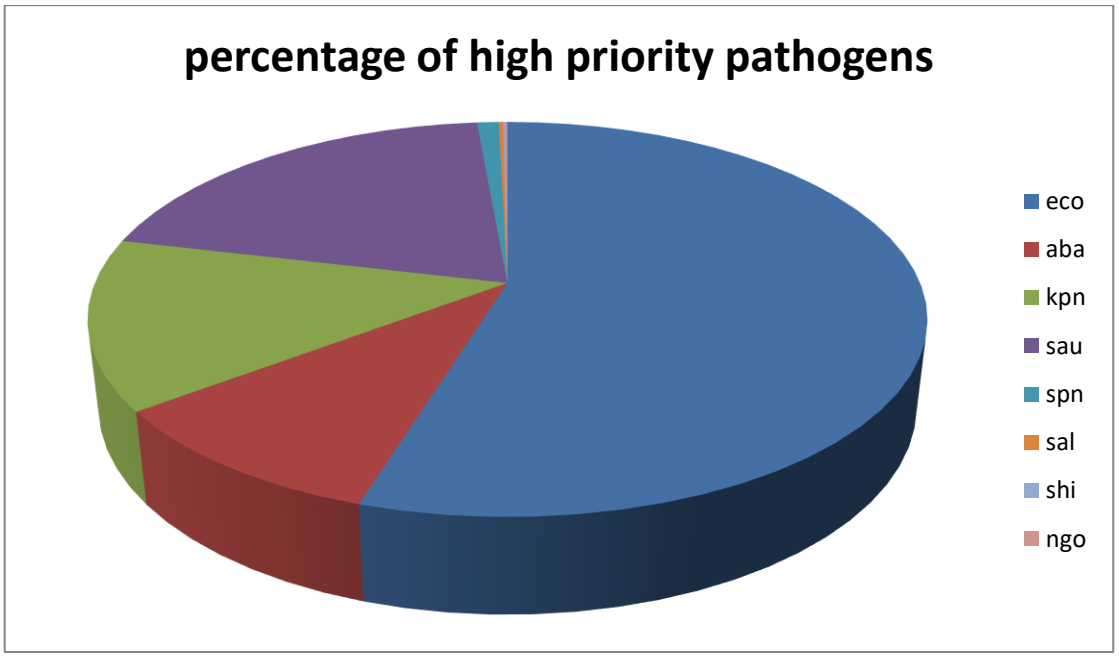


Table 2:Number of resistant pathogens according to age groups of patient.

pathogen	Age Group (years)			
	<1 - 14	15-64	>65	UNK
Eco	466	972	246	206
Aba	117	132	43	39
Kpn	134	231	68	63
Spn	4	26	6	9
Sal	3	3	0	1
Sau	147	418	42	80
Shi	0	1	0	1
ngo	0	3	0	2
Total	871	1786	810	401

The common resistant bacteria isolated on four different clinical specimens, for blood (*Escherichia coli, Acinetobacter baumannii, Klebsiella pneumonia, Staphylococcus aurous, streptococcus pneumonia, Salmonella* spp.), urine (*Escherichia coli, Klebsiella pneumonia*), stool (*Salmonella* spp. And *shigella* spp.), Genital swab (*Niesserria gonorrhea*).

Table 3:Number of resistant pathogens according to specimen types.

	Blood	Urine	Stool	Genital swab	Total
Eco	108	1360	-	-	1468
Aba	121	-	-	-	121
Kpn	69	225	-	-	294
Sau	147	-	-	-	147
Spn	2	-	-	-	2
Sal	3	-	3	-	6
shi	-	-	1	-	1
Ngo	-	-	-	1	1
Total	450	1585	4	1	2040

Table 4:Number of resistant pathogens according to specimen types and gender of the patients.

Pathogen	Blood		Urine		Stool		Genital swab	
	F	M	F	M	F	M	F	M
Eco	56	52	947	413	-	-	-	-
Aba	43	78	-	-	-	-	-	-
Kpn	38	31	125	100	-	-	-	-
Sau	59	88	-	-	-	-	-	-
Spn	1	1	-	-	-	-	-	-
Sal	2	1	-	-	1	2	-	-
Shi	-	-	-	-	1	0	-	-
Ngo	-	-	-	-	-	-	0	1
Total	199	251	172	513	2	2	0	1

* F: female
* M: male

Table 5:Number of resistant pathogens according to infection origin.

Pathogen	Infection origin		
	CO	HO	UNK
Eco	1127	66	280
Aba	48	32	41
Kpn	175	34	85
Sau	88	26	34
Spn	1	-	1
Sal	2	1	1
Shi	1	-	-
Ngo	2	-	-
Total	1443	159	442

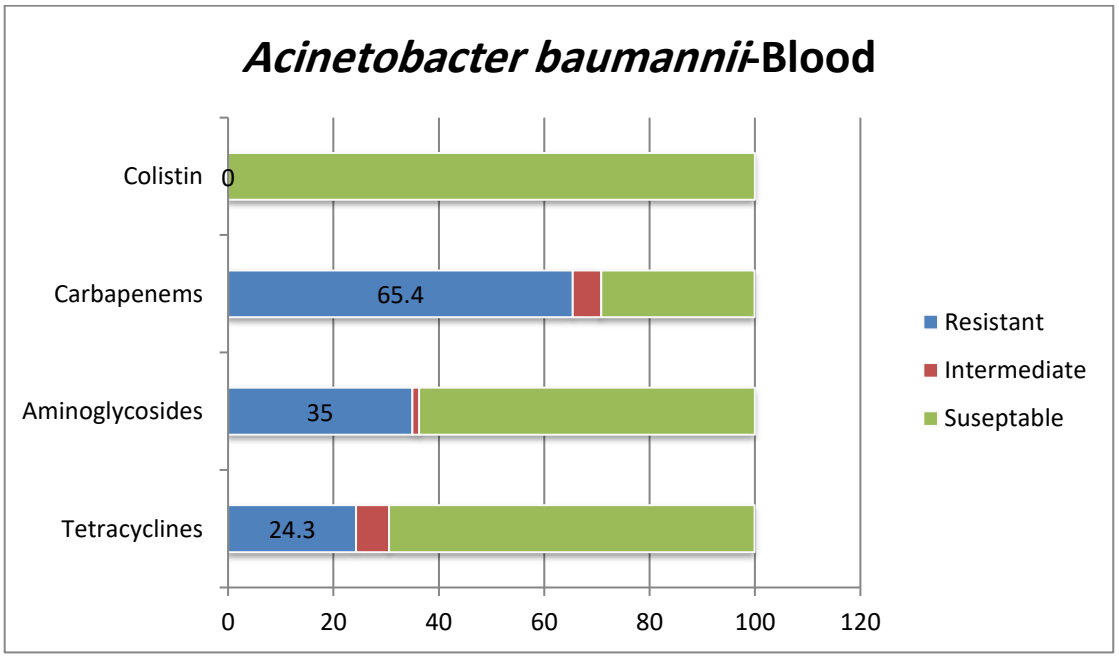
* CO: community origin
* HO: hospital origin
* UNK: unknown origin

3. Classification of Antimicrobial Resistance According to Specimen Type and antimicrobial susceptibility test:

3.1. Bloodstream Infections:

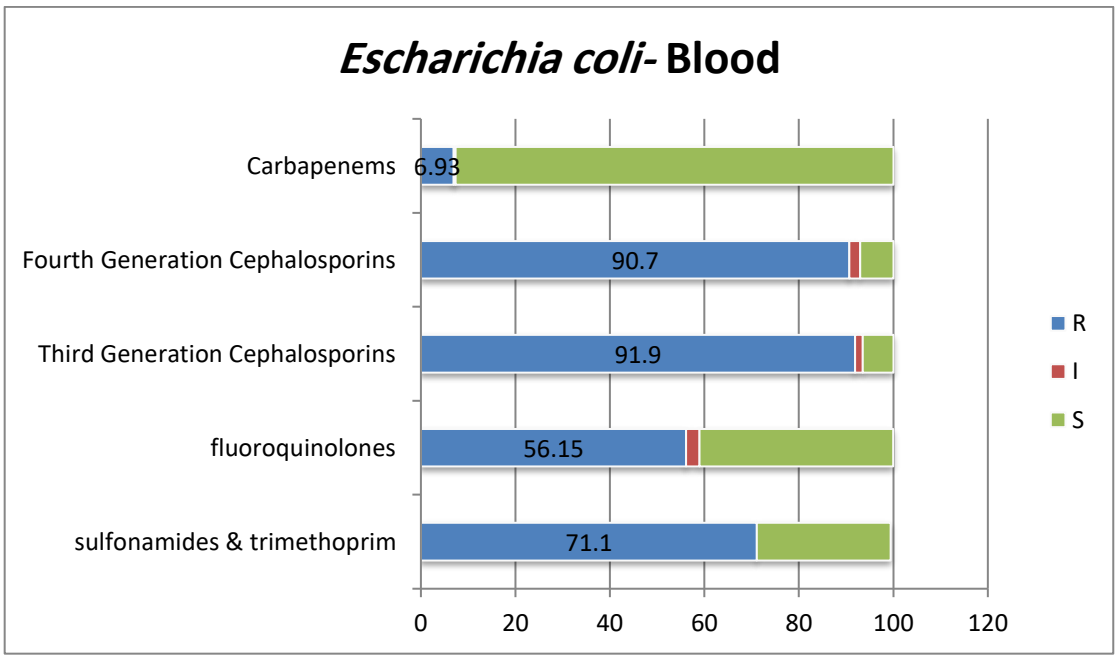
3.1.1 AST results of *Acinetobacter baumannii* in blood specimens

Acinetobacter baumannii- Blood							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Tetracyclines	Tigecycline	TGC	Disk, MIC	27	11.1	0	88.8
	Tetracycline	TCY	Disk, MIC	8	37.5	12.5	50
Aminoglycosides	Gentamicin	GEN_ ND10	Disk	2	0	0	100
	Amikacin	AMK	Disk, MIC	40	70	2.5	27.5
Carbapenems	Imipenem	IPM	Disk, MIC	92	64.1	6.5	29.3
	Meropenem	MEM	Disk, MIC	69	66.7	4.3	29
Polymyxins	Colistin	COL	Disk, MIC	26	0	0	100



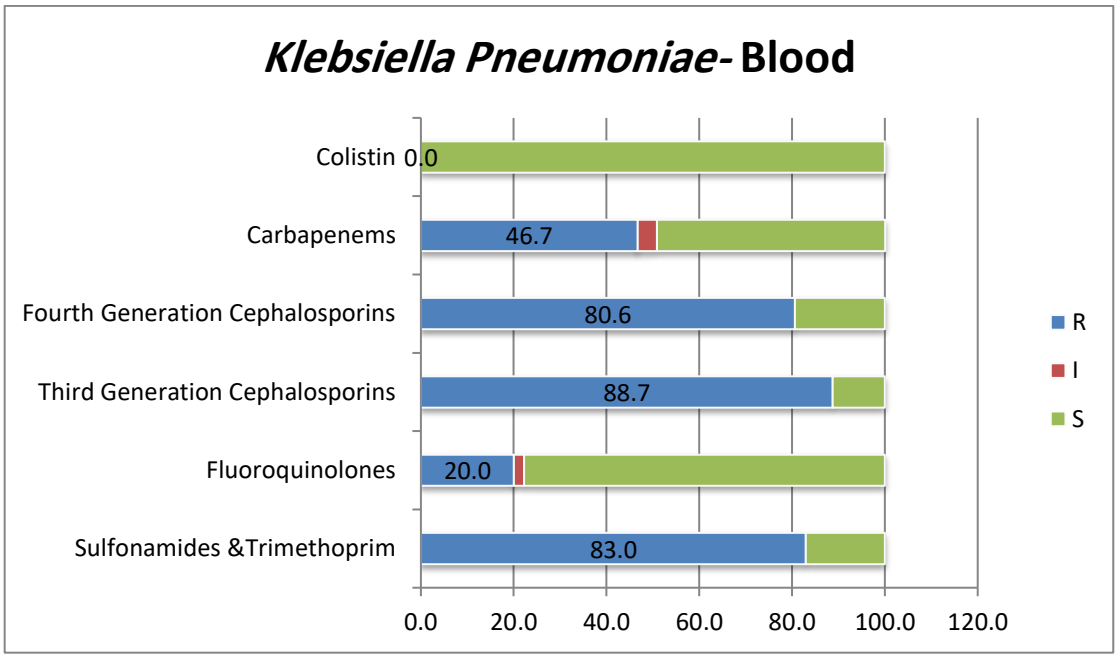
3.1.2. AST results of *Escherichia coli* in blood specimens:

Escherichia coli-Blood							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Sulfonamides and trimethoprim	Co-trimoxazole	SXT	Disk, MIC	60	71.7	0.0	28.3
Fluoroquinolones	Ciprofloxacin	CIP	Disk, MIC	71	53.5	2.8	43.7
	Levofloxacin	LVX	Disk, MIC	34	58.8	2.9	38.2
Third-generation cephalosporins	Ceftriaxone	CRO	Disk, MIC	42	90.5	2.4	7.1
	Cefotaxime	CTX_ND30	Disk	41	90.2	0.0	9.8
	Ceftazidime	CAZ_ND30	Disk	40	95	2.5	2.5
Fourth-generation cephalosporins	Cefepime	FEP	Disk, MIC	43	90.7	2.3	7.0
Carbapenems	Imipenem	IPM	Disk, MIC	85	9.4	1.2	89.4
	Meropenem	MEM	Disk, MIC	70	11.4	0.0	88.6
	Ertapenem	ETP_ND10	Disk	1	0.0	0.0	100.0



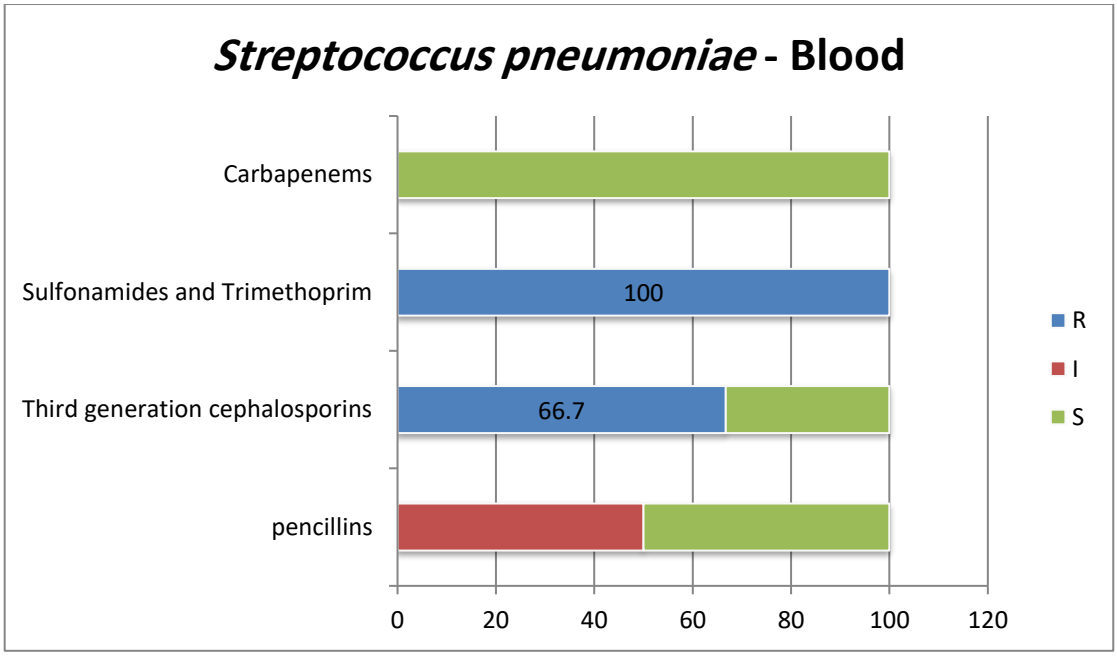
3.1.3. AST results of *Klebsiella pneumoniae* in blood specimens:

Klebsiella pneumoniae - Blood							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Sulfonamides and trimethoprim	Co-trimoxazole	SXT	Disk, MIC	44	65.9	0.0	34.1
	Trimethoprim	TMP	MIC	1	100.0	0.0	0.0
Fluoroquinolones	Ciprofloxacin	CIP	Disk, MIC	54	38.9	3.7	57.4
	Levofloxacin	LVX	Disk, MIC	33	21.2	3.0	75.8
	Norfloxacin	NOR	Disk	1	0.0	0.0	100.0
Third-generation cephalosporins	Ceftriaxone	CRO	Disk, MIC	30	76.7	0.0	23.3
	Cefotaxime	CTX_ND30	Disk	12	100.0	0.0	0.0
	Ceftazidime	CAZ_ND30	Disk	19	89.5	0.0	10.5
Fourth-generation cephalosporins	Cefepime	FEP	Disk, MIC	36	80.6	0.0	19.4
Carbapenems	Imipenem	IPM	Disk, MIC	49	46.9	0.0	53.1
	Meropenem	MEM	Disk, MIC	32	53.1	12.5	34.4
	Ertapenem	ETP_ND10	Disk	5	40.0	0.0	60.0
Polymyxins	Colistin	COL	MIC	1	0.0	0.0	100.0


Klebsiella Pneumoniae- Blood
Colistin
Carbapenems
Fourth Generation Cephalosporins
Third Generation Cephalosporins
Fluoroquinolones
Sulfonamides &Trimethoprim
0.0
46.7
80.6
88.7
20.0
83.0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
R
I
S

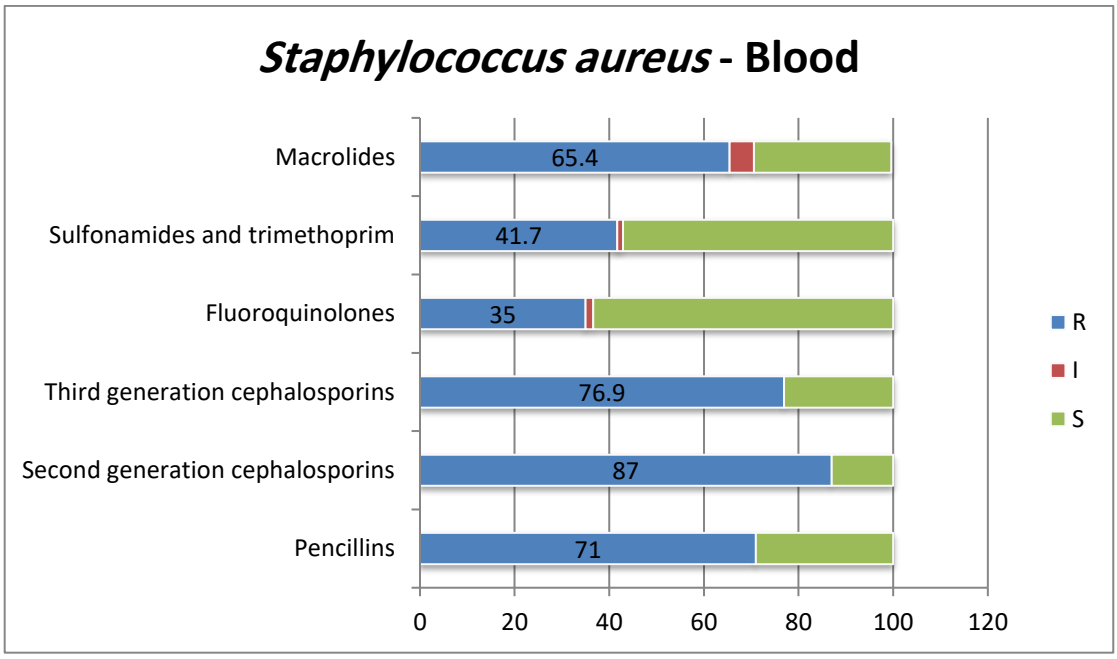
3.1.4. AST results of *Streptococcus pneumoniae* in blood specimens:

Streptococcus pneumoniae- Blood							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
penicillins	Amoxicillin/Clavulanic acid	AMC	Disk	2	0.0	50	50
Third-generation cephalosporins	Ceftriaxone	CRO	Disk	2	50	0.0	50
	Cefotaxime	CTX_ND30	Disk	2	50	0.0	50
	Cefixime	CFM	Disk	1	100	0.0	0.0
Sulfonamides and trimethoprim	Co-trimoxazole	SXT	Disk	1	100	0.0	0.0
Carbapenems	Meropenem	MEM	Disk	1	0.0	0.0	100
	Imipenem	IPM	Disk	1	0.0	0.0	100



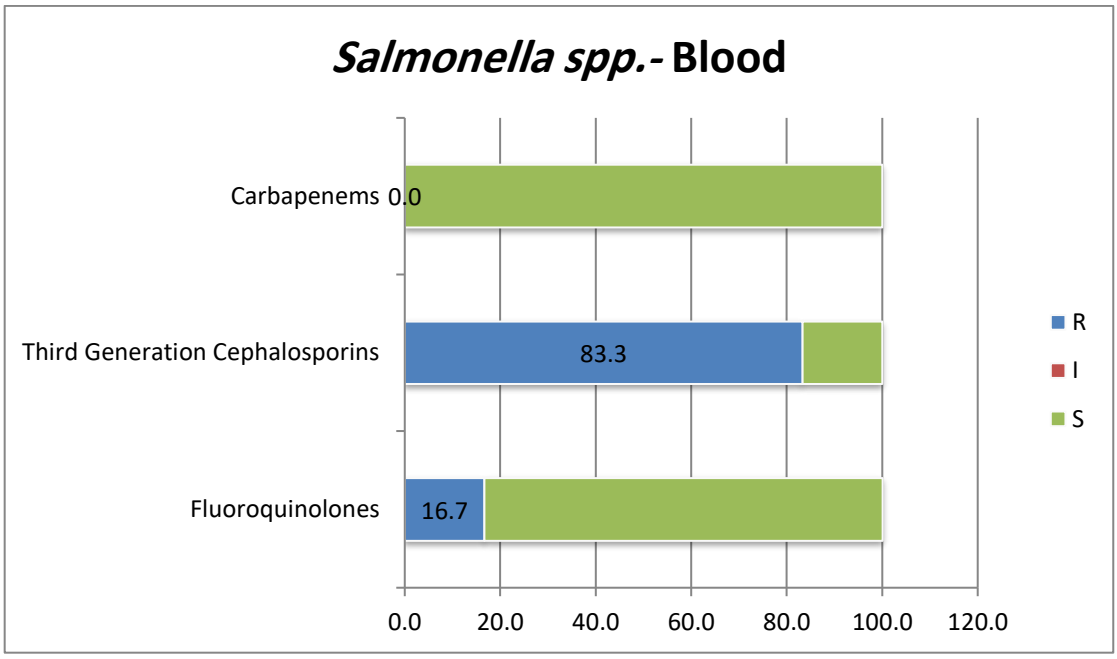
3.1.5. AST results of *Staphylococcus aureus* in blood specimens:

Staphylococcus aureus - Blood							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
penicillins	Penicillin G	PEN	Disk, MIC	32	87.5	0.0	12.5
	Piperacillin	PIP_ND100	Disk	11	54.5	0.0	45.5
Second-generation cephalosporins	Cefoxitin		Disk, MIC	23	87.0	0.0	13.0
Third-generation cephalosporins	Ceftriaxone	CRO	Disk, MIC	27	70.4	0.0	29.6
	Cefotaxime	CTX_ND30	Disk	18	83.3	0.0	16.7
Fluoroquinolones	Ciprofloxacin	CIP	Disk, MIC	60	40.0	0.0	60.0
	Levofloxacin	LVX	Disk, MIC	63	30.2	3.2	66.7
Sulfonamides and trimethoprim	Co-trimoxazole	SXT	Disk, MIC	84	41.7	1.2	57.1
Macrolides	Erythromycin	ERY_ND15	Disk	44	72.7	4.5	22.7
	Azithromycin	AZM	Disk, MIC	17	58.8	5.9	35.3



3.1.6. AST results of *Salmonella spp*. in blood specimens:

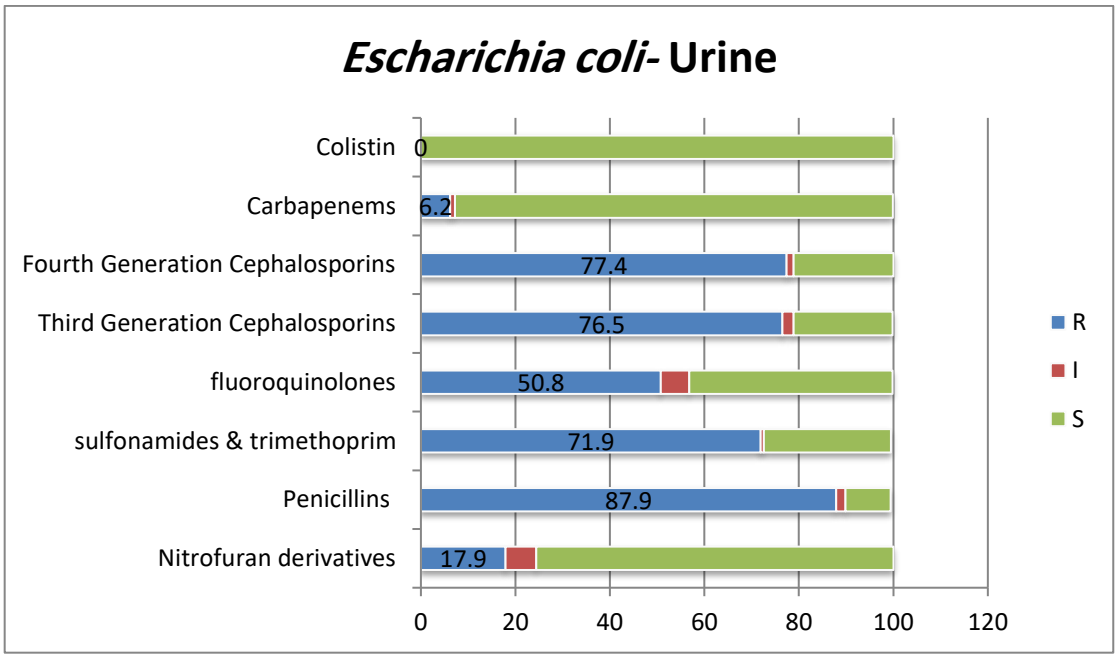
Salmonella spp.- Blood							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Fluoroquinolones	Ciprofloxacin	PEN	Disk, MIC	3	33.3	0.0	66.7
	Levofloxacin	LVX	Disk, MIC	1	0.0	0.0	100.0
Third-generation cephalosporins	Ceftriaxone	CRO	Disk	3	100	0.0	0.0
carbapenems	Cefotaxime	CTX_ND30	Disk	1	100	0.0	0.0
	Ceftazidime	CAZ	Disk	2	50	0.0	50
	Meropenem	MEM	Disk, MIC	1	0.0	0.0	100.0
	Imipenem	IPM	Disk, MIC	3	0.0	0.0	100.0


Salmonella spp.- Blood
Carbapenems
Third Generation Cephalosporins
Fluoroquinolones
0.0
83.3
16.7
0.0
20.0
40.0
60.0
80.0
100.0
120.0
R
I
S

3.2. Urinary Tract Infections:

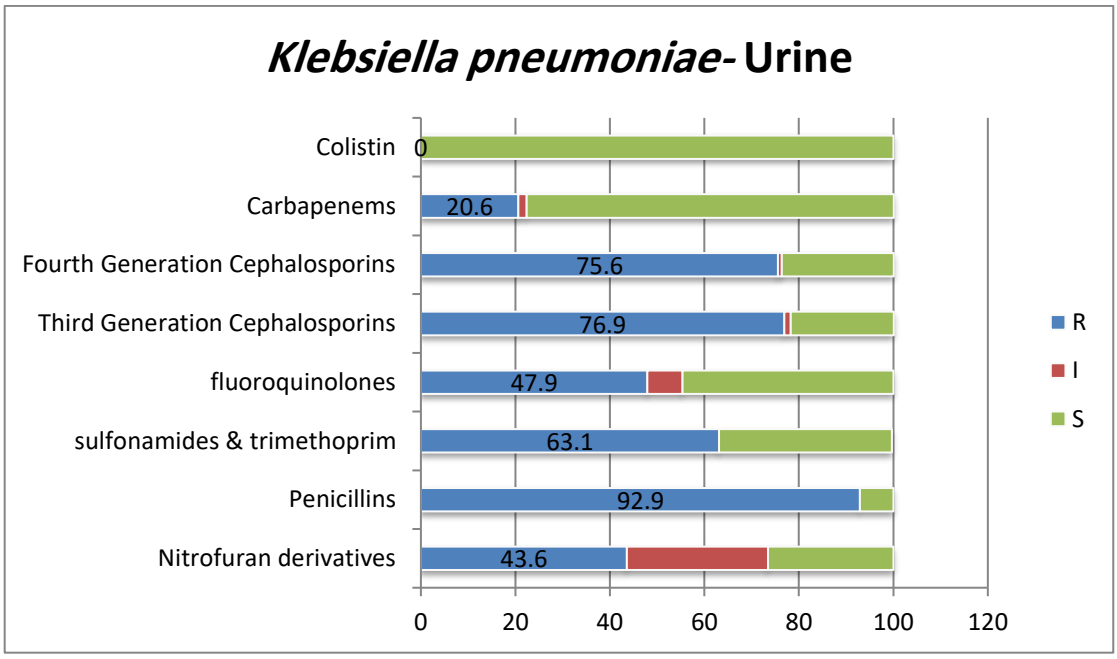
3.2.1 AST results of *Escherichia coli* in Urine specimens:

Escherichia coli- Urine							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Nitrofuran derivatives	Nitrofurantoin	NIT	Disk, MIC	804	17.9	6.5	75.6
Penicillins	Ampicillin	AMP	Disk, MIC	341	93.3	1.2	4.1
	Pipracillin	PIP_ND100	Disk	250	82.4	2.8	14.8
Sulfonamides and trimethoprim	Co-trimoxazole	SXT	Disk, MIC	903	70.2	0.4	28.9
	Trimethoprim	TMP	Disk, MIC	230	73.5	0.9	24.8
Fluoroquinolones	Ciprofloxacin	CIP	Disk, MIC	1007	58.0	1.4	40.3
	Levofloxacin	LVX	Disk, MIC	646	54.3	2.9	42.3
	Norfloxacin	NOR	Disk, MIC	127	36.2	1.6	62.2
	Ofloxacin	OFX	Disk, MIC	11	54.5	18.2	27.3
Third-generation cephalosporins	Ceftriaxone	CRO	Disk, MIC	713	78.3	0.8	20.8
	Cefotaxime	CTX_ND30	Disk	463	74.9	2.2	22.7
	Ceftazidime	CAZ_ND30	Disk	388	76.3	4.1	19.3
Fourth-generation cephalosporins	Cefepime	FEP	Disk, MIC	788	77.4	1.5	21.1
Carbapenems	Imipenem	IPM	Disk, MIC	966	9.2	2.2	88.5
	Meropenem	MEM	Disk, MIC	723	9.5	1.0	89.5
	Ertapenem	ETP_ND10	Disk	30	0.0	0.0	100.0
Polymyxins	Colistin	COL	Disk, MIC	8	0.0	0.0	100.0


Escharichia coli- Urine
Colistin
Carbapenems
Fourth Generation Cephalosporins
Third Generation Cephalosporins
fluoroquinolones
sulfonamides & trimethoprim
Penicillins
Nitrofuran derivatives
0
6.2
77.4
76.5
50.8
71.9
87.9
17.9
0
20
40
60
80
100
120
R
I
S

3.2.2 AST results of *Klebsiella pneumoniae* in Urine specimens:

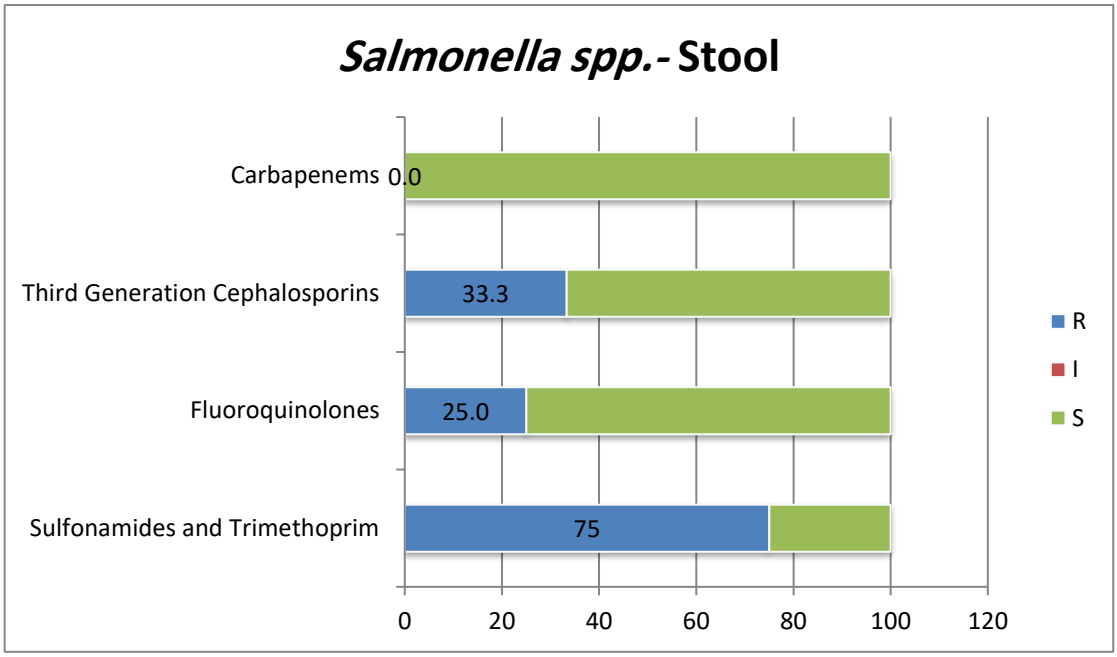
Klebsiella pneumoniae- Urine							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Nitrofuran derivatives	Nitrofurantoin	NIT	Disk, MIC	117	43.6	29.9	26.5
Penicillins	Ampicillin	AMP	Disk, MIC	71	97.2	0.0	2.8
	Piperacillin	PIP_ND100	Disk	35	88.6	0.0	11.4
Sulfonamides and trimethoprim	Co-trimoxazole	SXT	Disk, MIC	151	64.9	0.0	34.4
	Trimethoprim	TMP	Disk, MIC	31	61.3	0.0	38.7
Fluoroquinolones	Ciprofloxacin	CIP	Disk, MIC	170	42.9	4.1	52.9
	Levofloxacin	LVX	Disk, MIC	109	32.1	0.9	67.0
	Norfloxacin	NOR	Disk	9	66.7	0.0	33.3
	Ofloxacin	OFX	Disk	4	50.0	25.0	25.0
Third-generation cephalosporins	Ceftriaxone	CRO	Disk, MIC	125	69.6	0.0	30.4
	Cefotaxime	CTX_ND30	Disk	59	79.7	0.0	20.3
	Ceftazidime	CAZ_ND30	Disk	48	81.3	4.2	14.6
Fourth-generation cephalosporins	Cefepime	FEP	Disk, MIC	131	75.6	0.8	23.7
Carbapenems	Imipenem	IPM	Disk, MIC	175	28.0	3.4	68.6
	Meropenem	MEM	Disk, MIC	104	33.7	1.9	64.4
	Ertapenem	ETP_ND10	Disk	10	0.0	0.0	100.0
Polymyxins	Colistin	COL	Disk, MIC	2	0.0	0.0	100.0



3.3. Gastro-Enteric Infections:

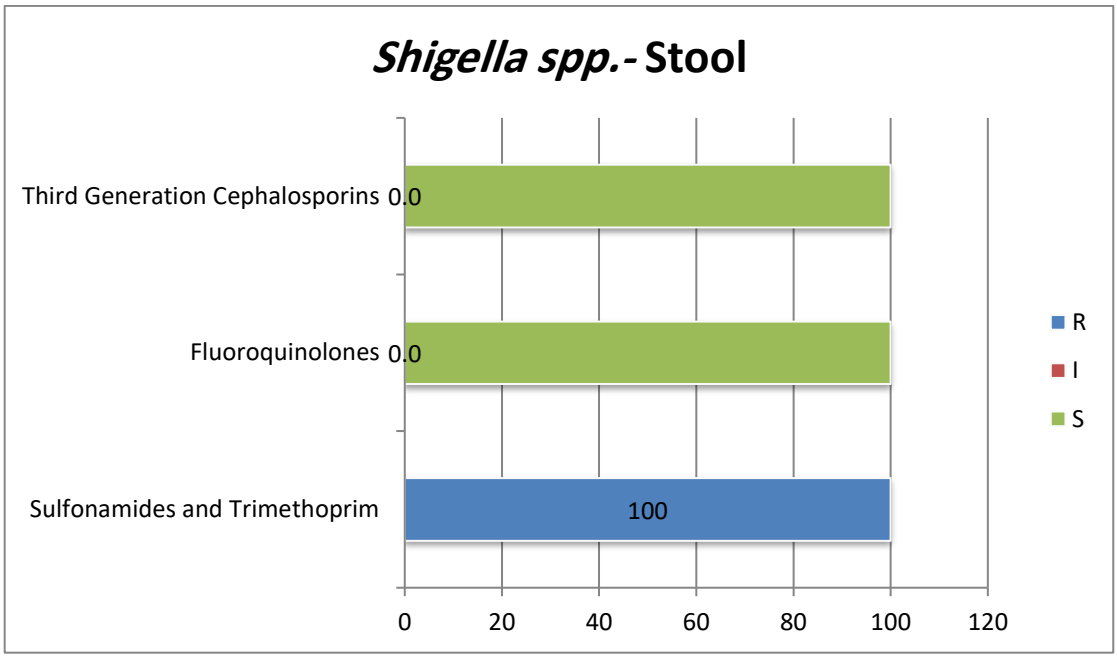
3.3.1 AST results of *Salmonella spp*. in Stool specimens:

Salmonella spp.- Stool							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Sulfonamides and trimethoprim	Co-trimoxazole	SXT	Disk, MIC	2	50.0	0.0	50.0
	Trimethoprim	TMP	MIC	1	100.0	0.0	0.0
Fluoroquinolones	Ciprofloxacin	PEN	Disk, MIC	2	50.0	0.0	50.0
	Levofloxacin	LVX	MIC	1	0.0	0.0	100.0
Third-generation cephalosporins	Ceftriaxone	CRO	Disk	3	33.3	0.0	66.7
carbapenems	Imipenem	IPM	Disk, MIC	2	0.0	0.0	100.0



3.3.2 AST results of *Shigella spp*. in Stool specimens:

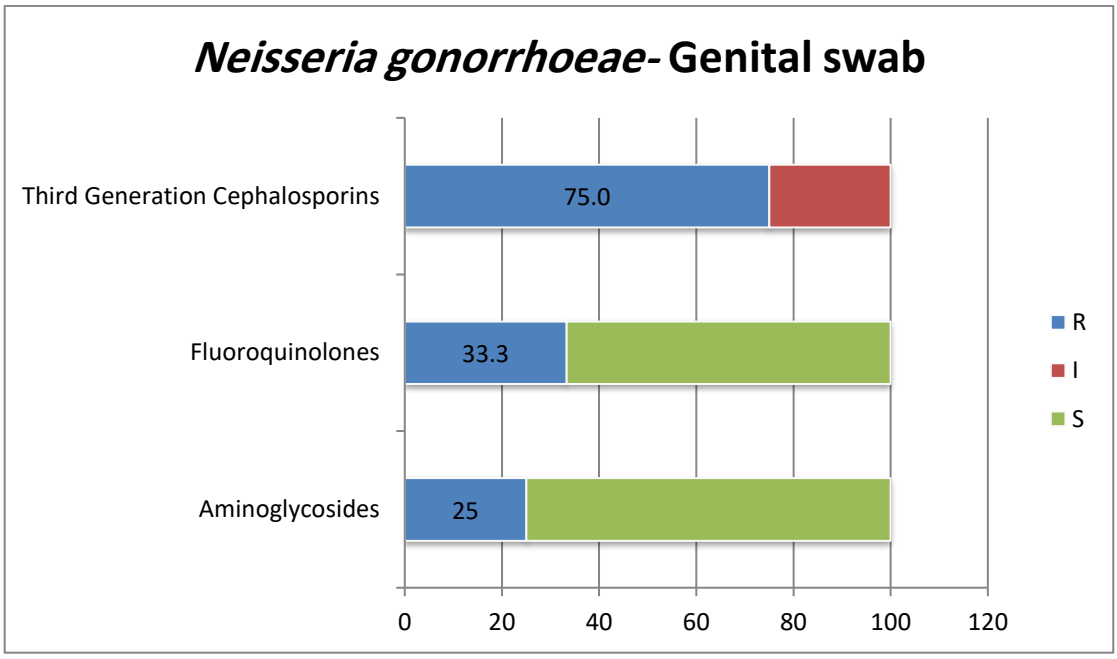
Shigella spp.- Stool							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Sulfonamides and trimethoprim	Co-trimoxazole	SXT	MIC	1	100.0	0.0	0.0
Fluoroquinolones	Ciprofloxacin	PEN	Disk, MIC	1	0.0	0.0	100.0
	Levofloxacin	LVX	MIC	1	0.0	0.0	100.0
Third-generation cephalosporins	Ceftriaxone	CRO	Disk	1	0.0	0.0	100.0



3.4. Genital Tract Infections:

3.4.1 AST results of *Neisseria gonorrhoeae* in Genital swab specimens:

Neisseria gonorrhoeae- Genital swab							
Antibiotic group	**Antibiotic name**	**Code**	**Methods**	**No.**	**R%**	**I%**	**S%**
Third-generation cephalosporins	Ceftriaxone	CRO	Disk	2	50.0	50.0	0.0
	Cefotaxime	CTX_ND30	Disk	1	100.0	0.0	0.0
Fluoroquinolones	Ciprofloxacin	CIP	Disk, MIC	3	33.3	0.0	66.7
	Levofloxacin	LVX	MIC	3	33.3	0.0	66.7
Aminoglycosides	Gentamicin	GEN_ND10	Disk	2	50.0	0.0	50.0
	Tobramycin	TOB	Disk	2	0.0	0.0	100.0


Neisseria gonorrhoeae- Genital swab
Third Generation Cephalosporins
Fluoroquinolones
Aminoglycosides
75.0
33.3
25
0
20
40
60
80
100
120
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4. **National activities to promote AMR surveillance system:**

Several activities were conducted by NCC during the year 2020, which continue to establish and improve AMR surveillance programme in all healthcare institutes and ensures that the system is functional. These activities include the following:

- Laboratory capacity of healthcare institutes for detection of AMR mapped and established.
- Continuous technical support provided to the National Reference Laboratory of public health to increase their capacity an establish laboratory quality management system according to international standards.
- Continuous technical support to the surveillance sites to ensure data accuracy and submission.
- Capacity-building workshops were conducted for training of laboratory personnel and surveillance team from all health directorates on standardized methods of antimicrobial susceptibility testing and data submission on WHONET software along with data management and analysis.

5. **Conclusions:**

The reported AMR data represent number of patients with positive culture (Show growth of bacteria) per specimen type. Each pathogen-antimicrobial combination interpreted according to CLSI (Clinical and Laboratory Standards Institutes) which include susceptible, intermediate and resistance results of antibiotic to each bacterium under surveillance.

Age distribution shows high rate of resistance in young adults (15-64 years of age) with Enterobacteriaceae and *Staphylococcus aureus*.

Gender distribution shows higher rate of infection in male patients.

Most resistant bacteria of community origin, meaning that most of patient seeking acute care complaining resistant infections.

High rate of resistance noticed in urinary tract infections with *Escherichia coli* predominance followed by bloodstream infections with *Staphylococcus aureus.*

High resistance rate among antimicrobials frequently used to treat common bacterial infections have been observed. Analysis of pathogen-antimicrobials combination according to CLSI, type of infections classified depending on specimen type so there was four types of infections (bloodstream, urinary tract, gastro-enteric and genital tract). The rate of resistance to common antibiotics used to treat bloodstream infections was for carbapenem, 65.4% in *acinetobacter baumannii* and 46.7% in *Klepsiella pneumoniae*. And resistance rate to third generation cephalosporines was 91.9% in *Escherichia coli*, 88.7% in *klebseilla pneumoniae*, 83.3% in *salmonella* spp. and 76.9% in *staphylococcus aureus*. While the resistance rate to common antibiotics in urinary tract infections with enterobacteriaceae (*Escheriacia coli* and *Klepsiella* spp.) was 90.4% for penicillins, 49.4% for floroquinolones, 67.5% for sulfonamides, 76.7% for third generation cephalosporines and 76.5% for fourth generation cephalosporines. The resistance rate of enteric infections with *Salmonella* and *Shigella* spp. for sulfonamides and trimethoprim was 87.5%. the resistance rate of genital infections with *Neisseria gonorrhea* for third generation cephalosporines was 75%.

6. Recommendations:

To promote AMR surveillance system and ensure better quality and representativeness of the data collected and results, the limitations and gaps of the system must be identified and addressed. Improvements are required to ensure more accurate assessment of the threats and drivers of AMR nationally.

Advocacy and communication are essential to engage and support healthcare institutes for further development of AMR surveillance system to meet national public health needs.

The system need for consolidation to improve the knowledge and evidence base to inform effective and sustainable control strategies to tackle the AMR threat.

Provision and encourage use of new diagnostics and rapid testing methods to cut the use of unnecessary antimicrobials.

Promote the use of new antimicrobials side by side with rational use of the old one to control resistance of bacteria.

7. References:

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