Original Research Article

Emerging antibiotic resistance: a modern-day horseman of the apocalypse

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ABSTRACT

Background: Antimicrobial resistance (AMR) has emerged as a global public health crisis, posing a significant threat to the effectiveness of antimicrobial agents. Mexico, faces a daunting challenge in tackling the rising prevalence of AMR. The misuse and overuse of antimicrobial drugs, inadequate infection control practices, and a lack of awareness among healthcare providers and the general public have all contributed to the rapid spread of resistant pathogens in the country. We aimed to determine the prevalence of antimicrobial resistance in patients hospitalized from January 2018 to December 2019

Methods: In this study, we analyzed blood, urine, wound, expectoration, and secretion cultures from January 2018 to December 2019 to assess antimicrobial resistance in our unit. We collected patient data, evaluated isolates using EUCAST and CLSI breakpoint tables, and excluded intrinsically resistant antibiotics. A circus plot graph was created to compare resistance profiles between the two years. SPSS version 25 and R Studio software were used for statistical analysis and visualization.

Results: AMR increased across diverse organisms (2018-2019), notable rises in *A. xylosoxidans* (cefuroxime, ciprofloxacin), *A. baumannii* (piperacillin/tazobactam, ceftazidime), *E. coli* (ampicillin/sulbactam), *K. pneumoniae* (ceftazidime), *P. aeruginosa* (cefuroxime) were observed. Enterococcus faecalis displayed lowest resistance to nitrofurantoin/tobramycin, but highest to fosfomycin. *Escherichia coli* showed significant resistance to aztreonam, ampicillin/sulbactam, trimethoprim/sulfamethoxazole. *Pseudomonas aeruginosa* exhibited concerning levels of resistance to ceftriaxone, ampicillin/sulbactam, ceftazidime.

Conclusions: AMR in our unit raise concerns for empiric therapy and infection control. Emerging resistance in key pathogens demands enhanced surveillance, rapid response, and robust infection control strategies, including meticulous hygiene, disinfection, antimicrobial stewardship, and resistance monitoring. Continuous optimization is crucial to combat this escalating public health threat in Mexico.

Keywords: Antimicrobial resistance, Cultures, Hospitalized, Misuse, Prevalence

INTRODUCTION

AMR is a phenomenon whereby bacteria acquire the ability to withstand exposure to antibiotics that would typically kill them. This resistance can be acquired through genetic mutations or horizontal gene transfer from other bacteria. Overutilization and improper use of antibiotics in both human and veterinary medicine can contribute to the development of antibiotic resistance. The proliferation of antibiotic-resistant bacteria can lead to infections that are challenging or impossible to treat, resulting in increased morbidity and mortality rates.

Consequently, AMR has emerged as a major public health issue, and significant efforts are being made to promote the judicious use of antibiotics, discover novel antibiotics, and explore alternative therapies for bacterial infections.[1]

Healthcare settings are a major reservoir for antibiotic-resistant bacteria in Mexico. A study conducted in a tertiary care hospital in Mexico City found high rates of resistance among commonly isolated pathogens, including *Escherichia coli* and *Klebsiella pneumoniae*. The study found that resistance to third-generation cephalosporins and carbapenems was particularly high, with rates exceeding 50% for some antibiotics. The study highlights the urgent need for effective infection control measures and antimicrobial stewardship programs in healthcare settings in Mexico.[2]

Nowadays the antimicrobial resistance has been scaling worldwide, especially in Mexico, we face to superbugs and multidrug-resistant bacteria because of the antibiotics overuse. The emergence of multiple antimicrobial-resistant pathogens presents a significant challenge in the effective management and control of infectious diseases, thereby necessitating the development of novel antimicrobial agents.[3]

Multidrug-resistant organisms (MDROs) are a growing concern in Mexico. A study conducted in a university hospital in central Mexico reported a high prevalence of MDROs among hospitalized patients, with rates exceeding 70% for some bacteria. The study found that MDROs were more prevalent in patients with longer hospital stays and previous exposure to antibiotics. The emergence of MDROs in Mexico highlights the need for effective infection control measures and antimicrobial stewardship programs to prevent the spread of resistant bacteria.[4]

AMR is not limited to healthcare settings in Mexico; it is also a problem in the community. A study conducted in a rural community in Mexico reported high rates of AMR among Streptococcus pneumoniae isolates, with 96% of isolates being resistant to at least one antibiotic. The study also found that antibiotic use was common in the community, with nearly 80% of households reporting antibiotic use in the previous year. The findings highlight the need for improved access to healthcare and education on appropriate antibiotic use in the community.[5]

Urinary tract infection (UTI) is the most prevalent type of nosocomial infection, comprising over 40% of all such infections.[6]

Ventilator-associated pneumonia (VAP) is a form of lung infection that arises 48 hours or more after intubation in mechanically ventilated patients. It is a significant healthcare issue, being the second most prevalent hospital-acquired infection. Nosocomial pneumonia commonly arises in patients who require endotracheal intubation and mechanical ventilation.[7]

Arterial and central venous catheters are routinely utilized for hemodynamic monitoring and intravenous therapies in critically ill patients. However, bloodstream infections due to these catheters are prevalent in intensive care units (ICUs) and are linked to considerable morbidity and mortality.[8]

The emergence of antimicrobial resistance can render first-line antimicrobial agents ineffective, requiring the use of second-line agents. These agents may have reduced bactericidal activity and unfavorable pharmacokinetic/pharmacodynamic properties, resulting in adverse patient outcomes.[9]

Antibiograms remain an important tool in the era of multidrug-resistant organisms. The emergence of these organisms has made it increasingly difficult to select appropriate antibiotic therapy, and antibiograms can help guide treatment decisions. In addition, antibiograms can help identify emerging resistance patterns and inform infection control practices.[10]

One of the challenges in developing effective antibiograms is the lack of standardized methods for collecting and reporting data. This can make it difficult to compare data across different institutions and regions. However, efforts to improve data reporting can help address this challenge. For example, the Clinical and Laboratory Standards Institute (CLSI) has developed guidelines for the collection, analysis, and reporting of antimicrobial susceptibility testing data. Adherence to these guidelines can help improve the quality and comparability of data across different settings.[11]

METHODS

We conducted a comprehensive search for all blood, urine, wound, expectoration, and secretion cultures of patients in our unit prior to the COVID-19 pandemic, specifically from January 2018 to December 2019 in the Hospital de Especialidades "Dr. Antonio Fraga Mouret" La Raza National Medical Center. We included only blood, urine, wound, expectoration, and secretion cultures with antibiograms performed on patients in the unit between January 2018 and December 2019. Cultures had to have complete patient information: name, social security number, age, sex, collection date, collection site, underlying pathology, type of isolated agent, name of the isolated agent, sensitivity, resistance, and MIC. Cultures without a patient name, reported as contamination, with inadequate collection or sample, without the necessary reagents, or with reports of antibiotics with intrinsic resistance of microbial agents were excluded. The purpose of this study was to evaluate the antimicrobial resistance profile of isolated agents in our unit and identify any changes in resistance patterns during this time period. We collected physical records of cultures

and excluded those of patients without a name, reported as contamination, improper sample collection, inadequate sample, or without reagent. We collected important patient data such as name, social security number, age, sex, date of collection, site of sample collection, underlying pathology for which the patient was hospitalized, type of isolated agent, name of isolated agent, sensitivity, resistance, and MIC. We evaluated isolates as susceptible using EUCAST (v9.0) and CLSI (M100-ED29: 2019) breakpoint tables for each antibiotic reported in the antibiogram of each patient included in the analysis. We recorded the total number of isolated agents, type of culture, and number of microorganisms with AMR for each year. A total of 2148 samples were included in 2018 and 2455 in 2019, with 6795 and 7875 antibiotic resistance findings observed for each year, respectively. When performing the statistical analysis, antibiotics that had intrinsic resistance by microbial agents were initially excluded. Once sorted, we created a circus plot graph to illustrate the main agents found, as well as the number and percentage of them, comparing both years to determine an increase or decrease in the antimicrobial resistance profile in our unit. Statistical analysis was performed using SPSS version 25, while the circus plot graph was created using R Studio software.

RESULTS

Our analysis of antimicrobial resistance trends among various microorganisms between 2018 and 2019 revealed concerning increases in resistance across a wide spectrum of agents (Table 1). Most notably, *Achromobacter xylosoxidans* exhibited emerging resistance to cefuroxime (0.15%) and ciprofloxacin (0.13%), while *Acinetobacter baumannii* displayed concerning increases in resistance to piperacillin/tazobactam (1.18%) and ceftazidime (1.09%). Additional noteworthy resistances included *Aeromonas salmonicida* with cefuroxime (0.13%), *Citrobacter freundii* with tigecycline and aztreonam (0.22%), *Enterococcus faecalis* with ciprofloxacin (2.13%), *Escherichia coli* with ampicillin/sulbactam (8.05%), *Klebsiella pneumoniae* with ceftazidime (2.07%), *Morganella morganii* with trimethoprim/sulfamethoxazole (0.48%), *Proteus vulgaris* with trimethoprim/sulfamethoxazole (0.57%), *Pseudomonas aeruginosa* with cefuroxime (1.88%), *Salmonella enterica* with cefazolin/cefalotina (0.33%), *Serratia marcescens* with ampicillin/sulbactam (0.64%), *Sphingomonas paucimobilis* with cefazolin/cefalotina (0.22%), and *Staphylococcus aureus* with benzylpenicillin (8.61%). Notably, *Streptococcus agalactiae* demonstrated a low emergence of resistance to trimethoprim/sulfamethoxazole (0.27%) (Figure 1). Conversely, 2019 exhibited the highest resistance in *Acinetobacter baumannii* against ampicillin/sulbactam (2.43%) and piperacillin/tazobactam (2.92%). Likewise, *Citrobacter freundii* demonstrated notable resistance to cefepime (2.55%) and ciprofloxacin (2.55%). Notably, *Enterococcus faecalis* displayed the lowest resistance to nitrofurantoin (0.44%) and tobramycin (2.67%) amidst its highest resistance to fosfomycin (0.37%). In 2018, *Escherichia coli* exhibited the most significant resistance to aztreonam (30.5%), followed by ampicillin/sulbactam (20.1%) and trimethoprim/sulfamethoxazole (20.1%). Similarly, *Pseudomonas aeruginosa* displayed concerning resistance to ceftriaxone (5.0%), ampicillin/sulbactam (2.9%), and ceftazidime (3.7%). Finally, *Enterococcus faecalis* once again exhibited its highest resistance to fosfomycin (1.5%) in 2018 (Figure 2).

Table 1: Characterization of antibiotic resistance patterns: number, percentages, and trends across microorganisms (2018-2019).

Microorganism	Antibiotic	No. of samples with resistance in 2018	% of resistance in 2018	No. of samples with resistance in 2019	% of resistance in 2019	Increase in number of samples with resistance between 2018 and 2019	Increase in % of resistance between 2018 and 2019
Achromobacter xylosoxidans	Ciprofloxacin	1	0.05279831	3	0.186567164	2	0.133768854
	Tobramycin	2	0.105596621	2	0.124378109	0	0.018781488
	Cefuroxime	3	0.158394931	5	0.310945274	2	0.152550343
	Gentamicin	3	0.158394931	3	0.186567164	0	0.028172233
	Cefotaxime	3	0.158394931	3	0.186567164	0	0.028172233
	Ceftazidime	3	0.158394931	3	0.186567164	0	0.028172233
Acinetobacter baumannii	Amikacin	2	0.105596621	4	0.248756219	2	0.143159598
	Cefuroxime	6	0.316789863	6	0.373134328	0	0.056344465
	Gentamicin	22	1.16156283	31	1.927860697	9	0.766297867
	Ampicillin/sulbactam	27	1.425554382	39	2.425373134	12	0.999818752
	Ciprofloxacin	29	1.531151003	41	2.549751244	12	1.018600241
	Ceftazidime	30	1.583949314	43	2.674129353	13	1.090180039
	Meropenem	30	1.583949314	39	2.425373134	9	0.84142382
	Piperacillin/tazobactam	33	1.742344245	47	2.922885572	14	1.180541327
	Tobramycin	38	2.006335797	43	2.674129353	5	0.667793556
	Cefepime	38	2.006335797	41	2.549751244	3	0.543415447
	Cefotaxime	41	2.164730729	43	2.674129353	2	0.509398624
Aeromonas	Cefuroxime	1	0.05279831	3	0.186567164	2	0.133768854

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Microrganism	Antibiotic	No. of samples with resistance in 2018	% of resistance in 2018	No. of samples with resistance in 2019	% of resistance in 2019	Increase in number of samples with resistance between 2018 and 2019	Increase in % of resistance between 2018 and 2019
salmonicida	Amikacin	1	0.05279831	1	0.062189055	0	0.009390745
	Nitrofurantoin	3	0.158394931	3	0.186567164	0	0.028172233
	Trimethoprim/ sulfamethoxazole	3	0.158394931	3	0.186567164	0	0.028172233
	Ceftazidime	3	0.158394931	3	0.186567164	0	0.028172233
Citrobacter freundii	Cefepime	1	0.05279831	1	0.062189055	0	0.009390745
	Amikacin	1	0.05279831	1	0.062189055	0	0.009390745
	Tobramycin	1	0.05279831	1	0.062189055	0	0.009390745
	Ceftriaxone	2	0.105596621	4	0.248756219	2	0.143159598
	Gentamicin	3	0.158394931	4	0.248756219	1	0.090361288
	Norfloxacin	3	0.158394931	3	0.186567164	0	0.028172233
	Nitrofurantoin	6	0.316789863	7	0.435323383	1	0.11853352
	Ciprofloxacin	8	0.422386484	8	0.497512438	0	0.075125954
	Cefuroxime	9	0.475184794	11	0.684079602	2	0.208894808
	Trimethoprim/ sulfamethoxazole	9	0.475184794	10	0.621890547	1	0.146705753
	Tigecycline	11	0.580781415	13	0.808457711	2	0.227676296
	Aztreonam	11	0.580781415	13	0.808457711	2	0.227676296
Enterococcus faecalis	Fosfomycin	6	0.316789863	19	1.18159204	13	0.864802177
	Norfloxacin	11	0.580781415	18	1.119402985	7	0.53862157
	Ceftriaxone	12	0.633579725	16	0.995024876	4	0.361445151
	Cefepime	12	0.633579725	14	0.870646766	2	0.237067041
	Cefuroxime	27	1.425554382	30	1.865671642	3	0.44011726
	Nitrofurantoin	28	1.478352693	37	2.300995025	9	0.822642332
	Trimethoprim/ sulfamethoxazole	32	1.689545935	34	2.114427861	2	0.424881926
	Aztreonam	33	1.742344245	35	2.176616915	2	0.43427267
	Tobramycin	33	1.742344245	35	2.176616915	2	0.43427267
	Ciprofloxacin	148	7.814149947	160	9.950248756	12	2.136098809
Escherichia coli	Amikacin	18	0.950369588	22	1.368159204	4	0.417789616
	Meropenem	19	1.003167899	23	1.430348259	4	0.42718036
	Ertapenem	102	5.385427666	112	6.965174129	10	1.579746463
	Nitrofurantoin	148	7.814149947	159	9.888059701	11	2.073909754
	Piperacillin/tazobactam	154	8.13093981	177	11.00746269	23	2.87652288
	Fosfomycin	167	8.817317846	206	12.81094527	39	3.993627424
	Gentamicin	201	10.6124604	268	16.66666667	67	6.05420627
	Trimethoprim/ sulfamethoxazole	380	20.06335797	428	26.61691542	48	6.55355745
	Ampicillin/sulbactam	381	20.11615628	453	28.17164179	72	8.05548551
	Aztreonam	578	30.51742344	607	37.74875622	29	7.23133278
Klebsiella pneumoniae	Piperacillin/tazobactam	4	0.211193242	17	1.05721393	13	0.846020688
	Meropenem	6	0.316789863	8	0.497512438	2	0.180722575
	Tigecycline	8	0.422386484	9	0.559701493	1	0.137315009
	Amikacin	10	0.527983105	12	0.746268657	2	0.218285552
	Fosfomycin	33	1.742344245	49	3.047263682	16	1.304919437
	Ertapenem	39	2.059134108	40	2.487562189	1	0.428428081
	Nitrofurantoin	48	2.534318902	57	3.544776119	9	1.010457217
	Ciprofloxacin	56	2.956705385	70	4.353233831	14	1.396528446
	Gentamicin	56	2.956705385	69	4.291044776	13	1.334339391
	Norfloxacin	56	2.956705385	61	3.793532338	5	0.836826953
	Tobramycin	77	4.065469905	93	5.78358209	16	1.718112185
	Cefazolin/cefalotina	87	4.59345301	103	6.405472637	16	1.812019627
	Ceftazidime	89	4.69904963	109	6.778606965	20	2.079557335
	Cefepime	91	4.804646251	98	6.094527363	7	1.289881112
	Cefuroxime	94	4.963041183	112	6.965174129	18	2.002132946
	Ampicillin/sulbactam	94	4.963041183	105	6.529850746	11	1.566809563
	Trimethoprim/ sulfamethoxazole	94	4.963041183	103	6.405472637	9	1.442431454
	Aztreonam	95	5.015839493	101	6.281094527	6	1.265255034
	Ceftriaxone	98	5.174234424	102	6.343283582	4	1.169049158
	Cefotaxime	105	5.543822598	111	6.902985075	6	1.359162477
Morganella morganii	Ampicillin/sulbactam	14	0.739176346	16	0.995024876	2	0.25584853
	Aztreonam	6	0.316789863	8	0.497512438	2	0.180722575
	Cefotaxime	12	0.633579725	13	0.808457711	1	0.174877986

Continued.

Microrganism	Antibiotic	No. of samples with resistance in 2018	% of resistance in 2018	No. of samples with resistance in 2019	% of resistance in 2019	Increase in number of samples with resistance between 2018 and 2019	Increase in % of resistance between 2018 and 2019
	Ceftazidime	21	1.10876452	29	1.803482587	8	0.694718067
	Ceftriaxone	4	0.211193242	6	0.373134328	2	0.161941086
	Ciprofloxacin	11	0.580781415	12	0.746268657	1	0.165487242
	Fosfomycin	20	1.055966209	26	1.616915423	6	0.560949214
	Norfloxacin	13	0.686378036	15	0.932835821	2	0.246457785
	Tigecycline	22	1.16156283	24	1.492537313	2	0.330974483
	Trimethoprim/ sulfamethoxazole	19	1.003167899	24	1.492537313	5	0.489369414
Proteus vulgaris	Ampicillin/sulbactam	16	0.844772967	17	1.05721393	1	0.212440963
	Aztreonam	12	0.633579725	14	0.870646766	2	0.237067041
	Cefepime	12	0.633579725	19	1.18159204	7	0.548012315
	Cefotaxime	19	1.003167899	21	1.305970149	2	0.30280225
	Ceftazidime	19	1.003167899	21	1.305970149	2	0.30280225
	Ceftriaxone	20	1.055966209	21	1.305970149	1	0.25000394
	Ciprofloxacin	14	0.739176346	16	0.995024876	2	0.25584853
	Ertapenem	1	0.05279831	1	0.062189055	0	0.009390745
	Fosfomycin	10	0.527983105	13	0.808457711	3	0.280474606
	Gentamicin	15	0.791974657	19	1.18159204	4	0.389617383
	Norfloxacin	2	0.105596621	2	0.124378109	0	0.018781488
	Piperacillin/tazobactam	2	0.105596621	10	0.621890547	8	0.516293926
	Tobramycin	8	0.422386484	8	0.497512438	0	0.075125954
	Trimethoprim/ sulfamethoxazole	22	1.16156283	28	1.741293532	6	0.579730702
Pseudomonas aeruginosa	Amikacin	32	1.689545935	40	2.487562189	8	0.798016254
	Ampicillin/sulbactam	55	2.903907075	59	3.669154229	4	0.765247154
	Ceftazidime	70	3.695881732	71	4.415422886	1	0.719541154
	Cefuroxime	95	5.015839493	111	6.902985075	16	1.887145582
	Ciprofloxacin	63	3.326293559	73	4.539800995	10	1.213507436
	Fosfomycin	58	3.062302006	68	4.228855721	10	1.166553715
	Gentamicin	32	1.689545935	43	2.674129353	11	0.984583418
	Meropenem	48	2.534318902	52	3.233830846	4	0.699511944
	Nitrofurantoin	93	4.910242872	94	5.845771144	1	0.935528272
	Norfloxacin	69	3.643083421	74	4.60199005	5	0.958906629
	Piperacillin/tazobactam	15	0.791974657	15	0.932835821	0	0.140861164
	Tobramycin	46	2.428722281	46	2.860696517	0	0.431974236
Salmonella enterica	Amikacin	3	0.158394931	5	0.310945274	2	0.152550343
	Ampicillin	2	0.105596621	3	0.186567164	1	0.080970543
	Cefazolin/cefalotina	3	0.158394931	8	0.497512438	5	0.339117507
	Ciprofloxacin	1	0.05279831	2	0.124378109	1	0.071579799
	Gentamicin	7	0.369588173	10	0.621890547	3	0.252302374
	Nitrofurantoin	4	0.211193242	5	0.310945274	1	0.099752032
	Tobramycin	10	0.527983105	10	0.621890547	0	0.093907442
	Trimethoprim/ sulfamethoxazole	1	0.05279831	4	0.248756219	3	0.195957909
Serratia marcescens	Amikacin	1	0.05279831	1	0.062189055	0	0.009390745
	Ampicillin/sulbactam	9	0.475184794	18	1.119402985	9	0.644218191
	Aztreonam	9	0.475184794	12	0.746268657	3	0.271083863
	Cefepime	5	0.263991552	5	0.310945274	0	0.046953722
	Ceftazidime	14	0.739176346	16	0.995024876	2	0.25584853
	Ciprofloxacin	6	0.316789863	9	0.559701493	3	0.24291163
	Gentamicin	8	0.422386484	10	0.621890547	2	0.199504063
	Meropenem	3	0.158394931	3	0.186567164	0	0.028172233
	Norfloxacin	13	0.686378036	15	0.932835821	2	0.246457785
	Tobramycin	10	0.527983105	11	0.684079602	1	0.156096497
	Trimethoprim/ sulfamethoxazole	3	0.158394931	7	0.435323383	4	0.276928452
Sphingomonas paucimobilis	Aztreonam	5	0.263991552	7	0.435323383	2	0.171331831
	Cefazolin/cefalotina	4	0.211193242	7	0.435323383	3	0.224130141
	Cefepime	1	0.05279831	1	0.062189055	0	0.009390745
	Cefotaxime	1	0.05279831	1	0.062189055	0	0.009390745
	Ceftazidime	1	0.05279831	1	0.062189055	0	0.009390745
	Cefuroxime	2	0.105596621	2	0.124378109	0	0.018781488
	Ciprofloxacin	3	0.158394931	3	0.186567164	0	0.028172233
	Nitrofurantoin	3	0.158394931	3	0.186567164	0	0.028172233

Continued.

Microrganism	Antibiotic	No. of samples with resistance in 2018	% of resistance in 2018	No. of samples with resistance in 2019	% of resistance in 2019	Increase in number of samples with resistance between 2018 and 2019	Increase in % of resistance between 2018 and 2019
	Tobramycin	7	0.369588173	7	0.435323383	0	0.06573521
Staphylococcus aureus	Ampicillin/sulbactam	198	10.45406547	222	13.80597015	24	3.35190468
	Ampicillin	479	25.29039071	508	31.5920398	29	6.30164909
	Benzylpenicillin	388	20.48574446	468	29.10447761	80	8.61873315
	Ciprofloxacin	284	14.99472017	301	18.71890547	17	3.7241853
	Gentamicin	65	3.43189018	78	4.850746269	13	1.418856089
	Trimethoprim/ sulfamethoxazole	119	6.282998944	125	7.773631841	6	1.490632897
Streptococcus agalactiae	Trimethoprim/ sulfamethoxazole	16	0.844772967	18	1.119402985	2	0.274630018
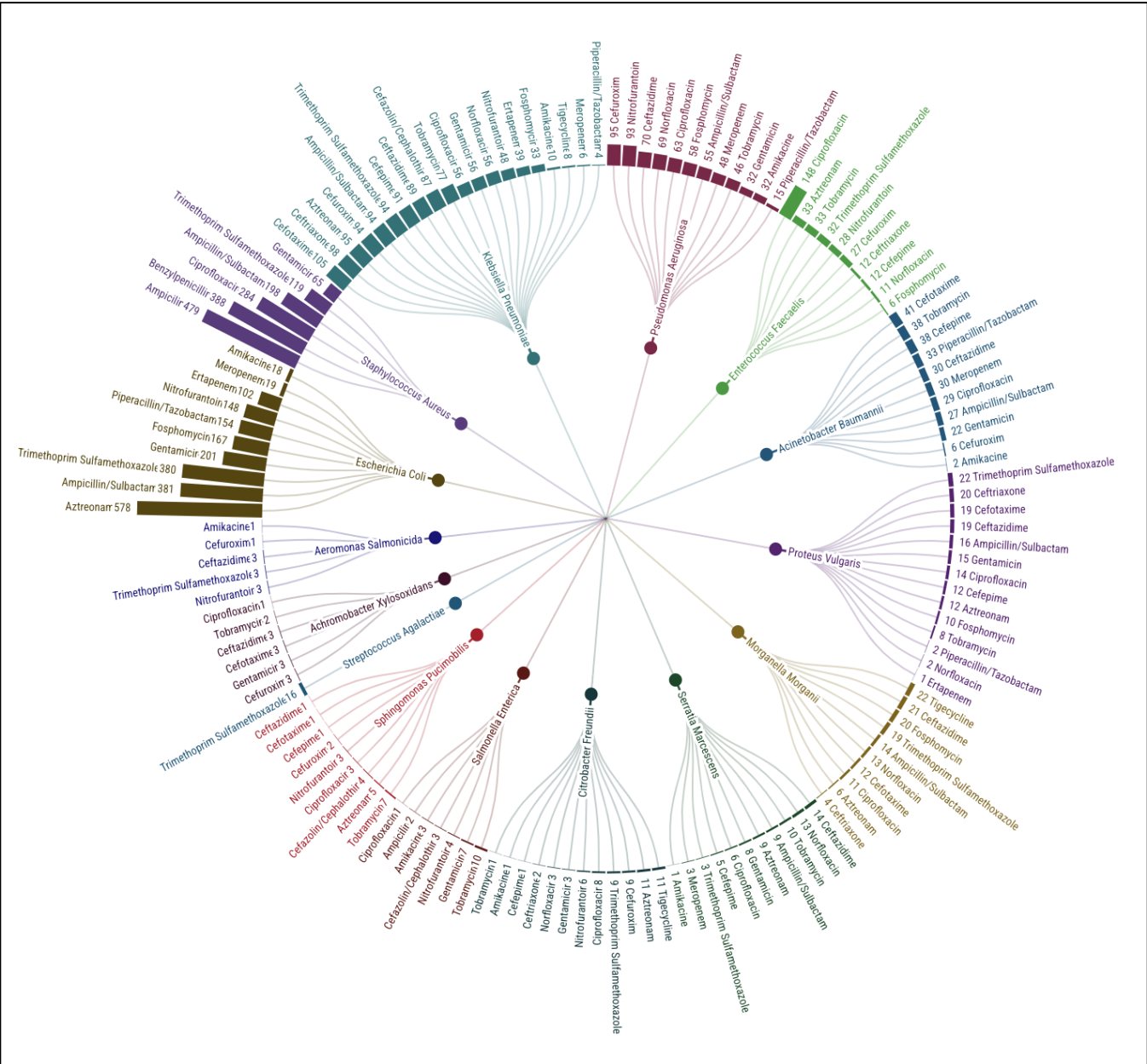
Figure 1: Radial plot which shows the main isolated agents in the cultures taken as well as the number of agents with antimicrobial resistance during the year of 2018.
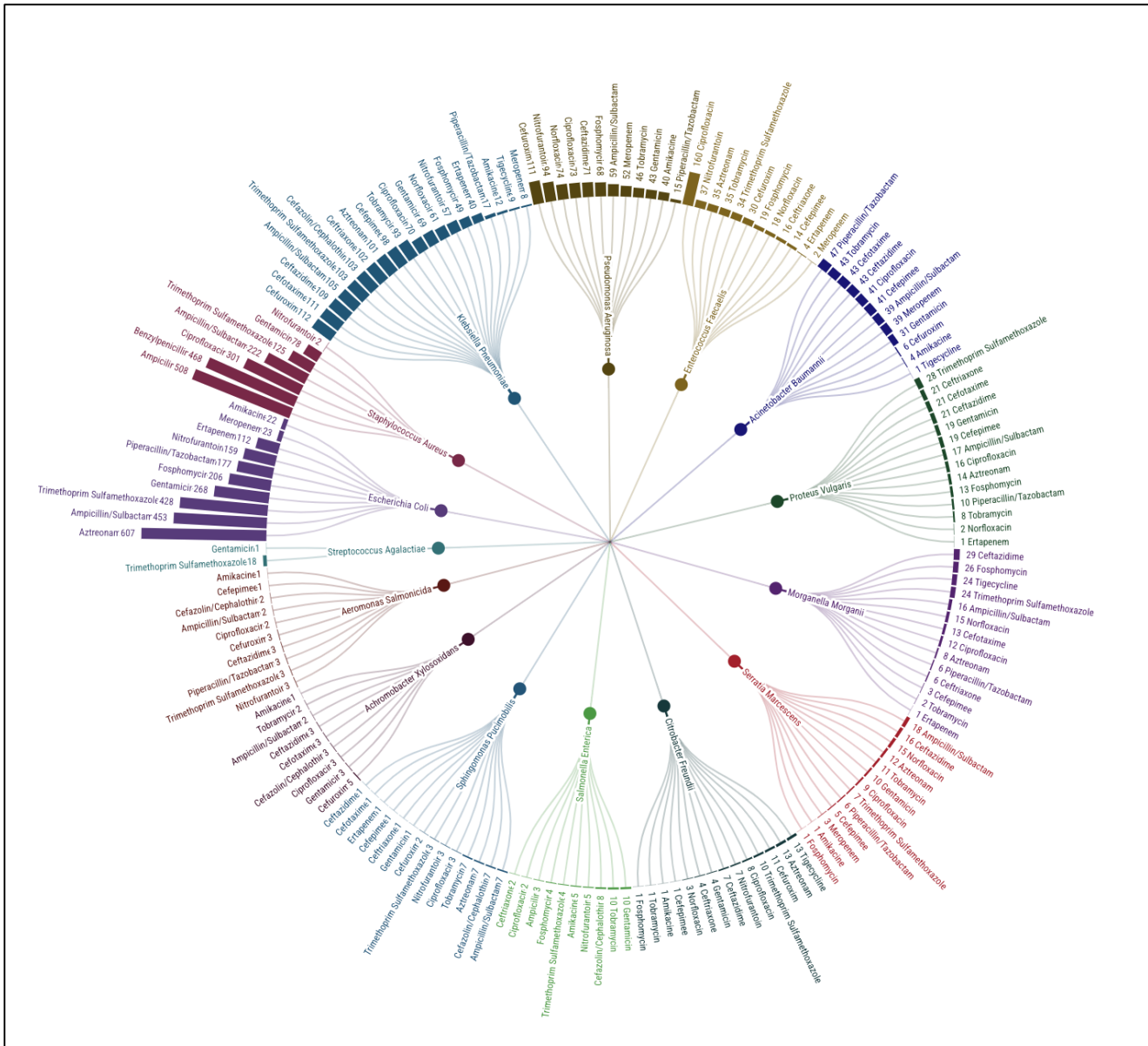
Figure 2: Radial plot graphically displaying the most prevalent isolated agents in collected cultures, related with antimicrobial resistance throughout the year 2019.

DISCUSSION

This study was conducted to provide valuable insights into the antimicrobial resistance profile of isolated agents in our unit, which can help us better understand antimicrobial resistance (AMR) and develop effective strategies to combat it. We conducted a meticulous retrospective analysis of culture data from a single hospital unit prior to the COVID-19 pandemic. Our findings of increasing resistance rates across many bacterial species and antibiotics from 2018 to 2019 parallel alarming global trends.

The observed emerging resistance in key pathogens like *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Escherichia coli* is especially worrisome given their prominence in serious nosocomial infections. The rise in resistance could rapidly undermine standard empirical antibiotic therapy protocols. For example, the increasing prevalence of 3rd generation cephalosporin-resistant *E. coli* threatens first-line therapy for Gram-negative bacteremia.[12]

Recently the INVIFAR group analyzed the evolution of antimicrobial resistance in Mexico from 2009 to 2018, based on data collected from 108 hospitals. The study found a significant increase in antimicrobial resistance, particularly in hospitals with high morbidity and pressure. The article remarks the significance of adopting measures to prevent and manage resistance, ensuring prescription of antimicrobial drugs and educating healthcare professionals and patients on the responsible use of these medications.[13]

However, our study setting was a single hospital unit, limiting generalizability the results. Overall, these data underscore the need for robust infection control strategies like hand hygiene, environmental disinfection, and antimicrobial stewardship. A concerted global effort is required to curb needless antibiotic use and implement evidence-based prevention measures. Without swift action, modern medicine faces the grim possibility of entering a "post-antibiotic era", making routine infections deadly once again.[14]

CONCLUSION

In a pre-pandemic retrospective analysis of antimicrobial resistance patterns within our unit, we identified worrying trends with significant implications for empirical therapy and infection control. Notably, emerging resistance amongst key pathogens, including *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and third-generation cephalosporin-resistant *Escherichia coli*, necessitates enhanced surveillance and rapid response measures. These findings resonate with global concerns and underscore the urgency for robust infection control strategies. Implementation of evidence-based interventions, including meticulous hand hygiene compliance, thorough environmental disinfection, rigorous antimicrobial stewardship programs, and comprehensive resistance surveillance, is crucial to curtailing unnecessary antibiotic use and impeding bacterial transmission. Continuous optimization of both infection control practices and antimicrobial prescribing through dedicated stewardship programs will be paramount in preserving antibiotic efficacy and combating this escalating public health threat.

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