Resistencia a los antimicrobianos y presentación de datos acumulados sobre susceptibilidad

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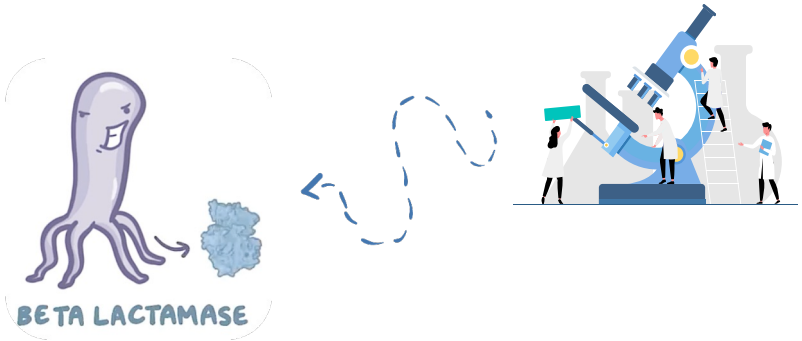


Hoja de ruta

Resistencia a los antimicrobianos

Estudio de susceptibilidad y PROA

Datos locales

Resistencia a los antimicrobianos

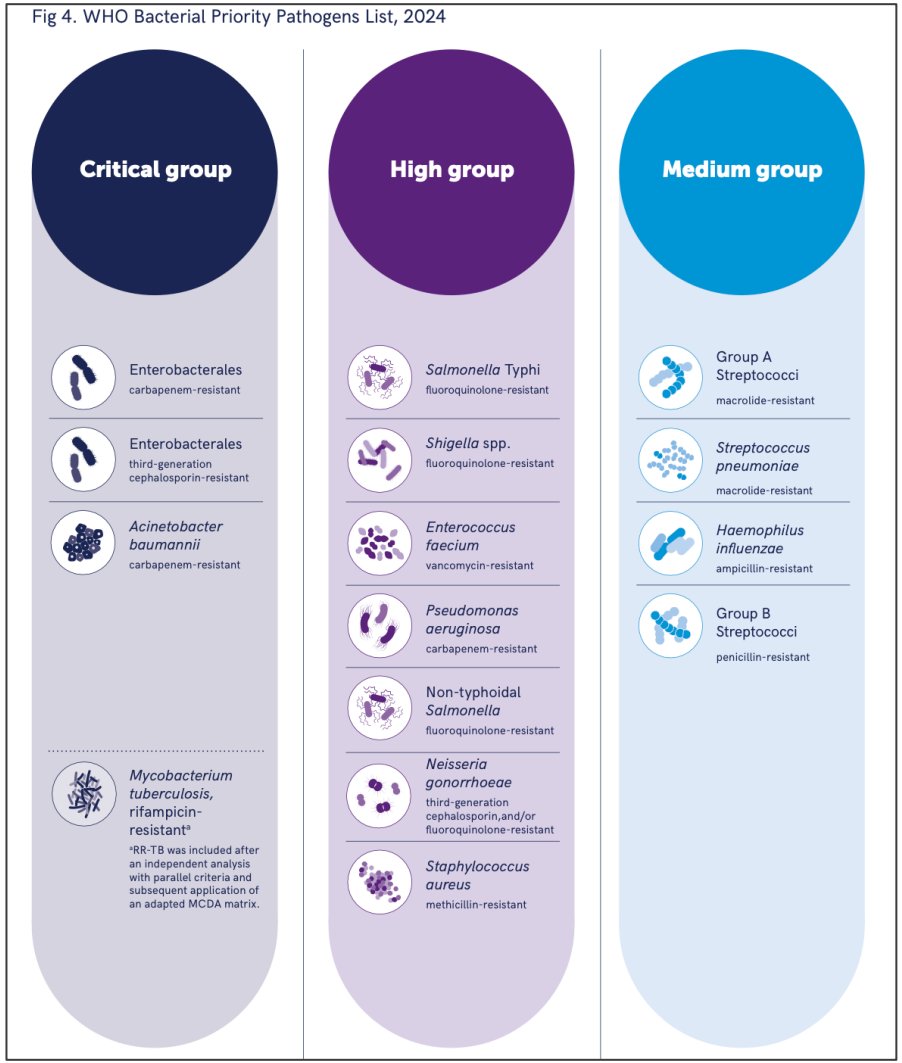
Generalidades

Introducción

- ✓ En la actualidad, la resistencia a los antimicrobianos (AMR) constituye una las principales amenazas a la salud pública
- ✓ Estudios han estimado que la mortalidad anual asociada a la AMR para el año 2050 podría alcanzar los 10 millones de personas
- ✓ El uso indiscriminado de antimicrobianos ha favorecido la selección de cepas resistentes, y con ello la potencial diseminación de mecanismos de AMR, fundamentalmente mediante elementos genéticos móbiles (MGE)
- ✓ Una **correcta interpretación de AST, junto a la detección precoz de marcadores de resistencia** son fundamentales para la toma de decisiones en el ámbito clínico y epidemiológico

Rol del laboratorio de microbiología

Wagenlehner FME, Dittmar F. Re: Global Burden of Bacterial Antimicrobial Resistance in 2019: A Systematic Analysis. Eur Urol. 2022 Dec;82(6):658.



Criterios:

- ✓ Mortalidad
- ✓ Incidencia
- ✓ Impacto en salud pública
- ✓ Tendencia en la resistencia a antimicrobianos
- ✓ Transmisibilidad
- ✓ Prevenible en contexto de atención de salud y comunidad
- ✓ Moléculas candidatas activas

WHO Bacterial Priority Pathogens List, 2024: bacterial pathogens of public health importance to guide research, development and strategies to prevent and control antimicrobial resistance. Geneva: World Health Organization; 2024.

Bases genéticas de la resistencia a los antimicrobianos (AMR)

- ✓ La AMR es el resultado de la interacción de microorganismos con el ambiente
- ✓ La mayoría de los compuestos antimicrobianos son moléculas producidas naturalmente frente a las que bacterias co-residentes han desarrollado **mecanismos que favorecen su sobrevivencia**.

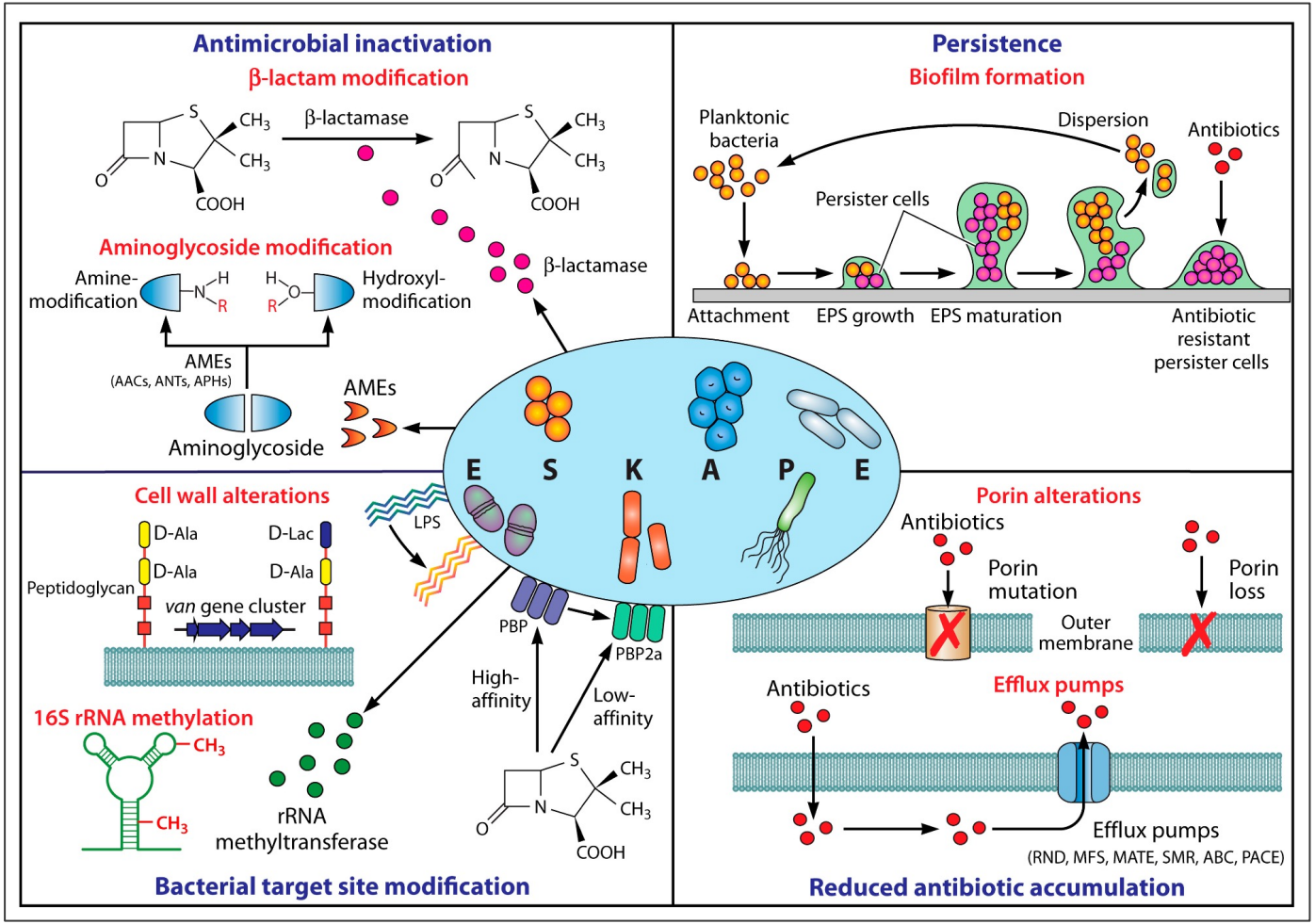
Base genética de la AMR

- Resistencia intrínseca
- Resistencia adquirida
  - ✓ Mutación de genes cromosomales
  - ✓ Adquisición de determinantes de resistencia externos (HGT)

Expresión de resistencia en una población bacteriana inicialmente susceptible a un ATB

Munita JM, Arias CA. 2016. Mechanisms of antibiotic resistance. Microbiol Spectrum 4(2):VMBF-0016-2015

- ✓ *Enterococcus faecium*
- ✓ *Staphylococcus aureus*
- ✓ *Klebsiella pneumoniae*
- ✓ *Acinetobacter baumannii*
- ✓ *Pseudomonas aeruginosa*
- ✓ *Enterobacter* spp.



De Oliveira DMP, Forde BM, Kidd TJ, Harris PNA, Schembri MA, Beatson SA, Paterson DL, Walker MJ. 2020. Antimicrobial resistance in ESKAPE pathogens. Clin Microbiol Rev 33:e00181-19

Clasificación de b-lactamasas en *Enterobacterales*
Clasificación de Ambler o estructural)

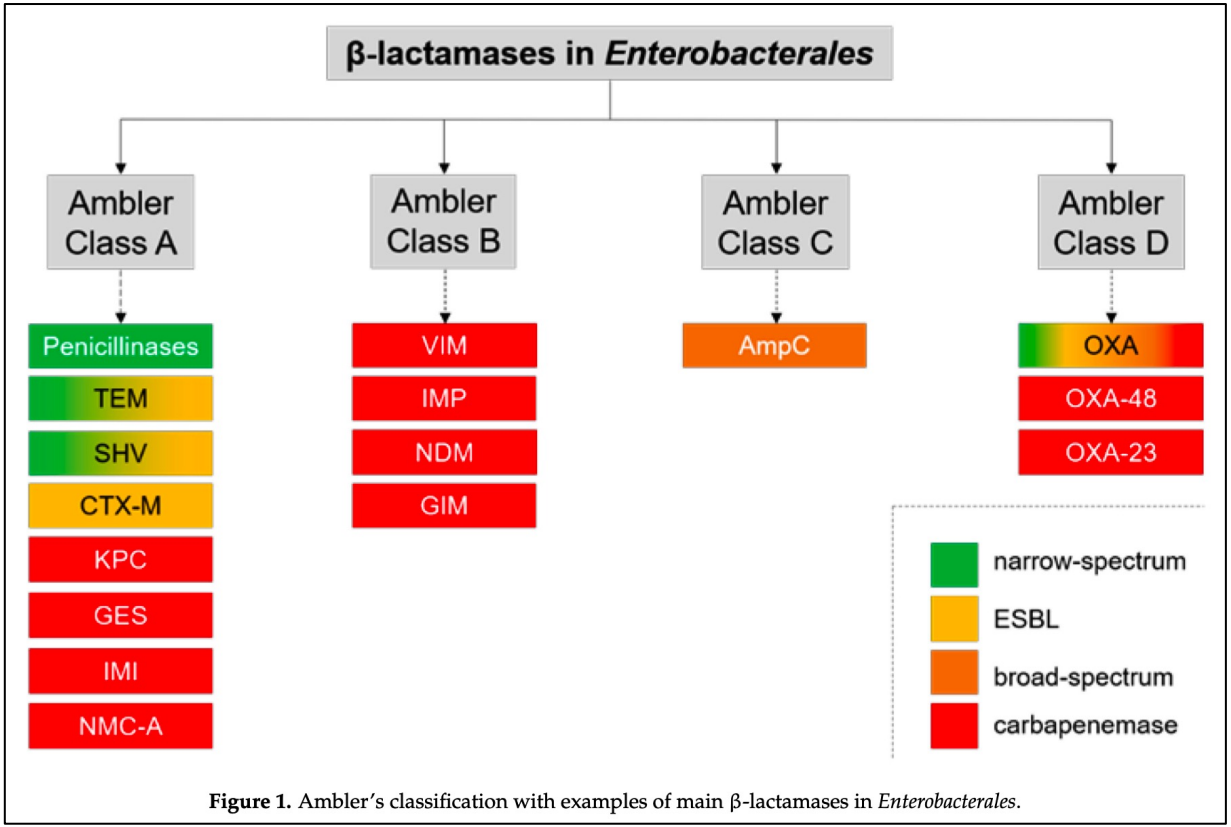


Figure 1. Ambler's classification with examples of main β-lactamases in *Enterobacterales*.

Diferencias

- ✓ Perfil de hidrólisis
- ✓ Distribución entre especies
- ✓ Epidemiología

Noster,J.;Thelen,P.; Hamprecht, A. Detection of Multidrug-Resistant *Enterobacterales*—From ESBLs to Carbapenemases. *Antibiotics* 2021, *10*, 1140

Table 1. Classification of the most relevant carbapenemases in the clinic

Ambler-Bush Class	Carbapenemase	Most frequently identified in	Key characteristics
A	KPC	*K. pneumoniae* and other *Enterobacteriaceae*	• Variable level of carbapenem hydrolysis. • Some are chromosomal (SME, NMC) others are mainly plasmidic (KPC). • Inhibition by boronic acid, avibactam and partial inhibition by clavulanic acid
	SME	*S. marcescens*	
	IMI, NMC, GES	*Enterobacteriaceae*	
B	**Metallo-β-lactamases (VIM, IMP, GIM, SPM and NDM)**	*Enterobacteriaceae (E. coli, Klebsiella, Enterobacter, Providencia, Citrobacter, Proteus mirabilis)*	• Mainly plasmidic • High hydrolytic activity against carbapenems and cephalosporins • No activity against aztreonam by definition • Inhibition with EDTA and dipicolinic acid • No inhibition with boronic acid, clavulanic acid or avibactam
D	OXA-48-family	*Klebsiella pneumoniae, E.coli* and other *Enterobacteriaceae*	• Low hydrolysis of oximino-cepaholsporins and moderate hydrolysis of carbapenems • No inhibition with EDTA, dipicolinic and boronic acid. Partial inhibition with avibactam

Table adapted from Bush[52]

RESISTENCIA A CARBAPENÉMICOS NO ES SINÓNIMO DE PRODUCCIÓN DE CARBAPENEMASAS

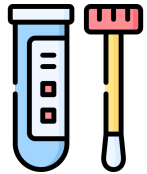
M.V. Villegas, et al. Carbapenemase-producing Enterobacteriaceae: A diagnostic, epidemiological and therapeutic challenge. Infectio 2019; 23(4): 388-398. http://dx.doi.org/10.22354/in.v23i4.808

Estudio de susceptibilidad y PROA

Rol del laboratorio de microbiología

Flujo de trabajo en el laboratorio

Fase pre-analítica



Fase analítica

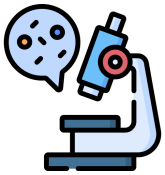
Fase post-analítica

Flujo de trabajo en el laboratorio de microbiología

Evaluación clínica e indicación de examen

Recolección y transporte de muestra

Procesamiento y siembra

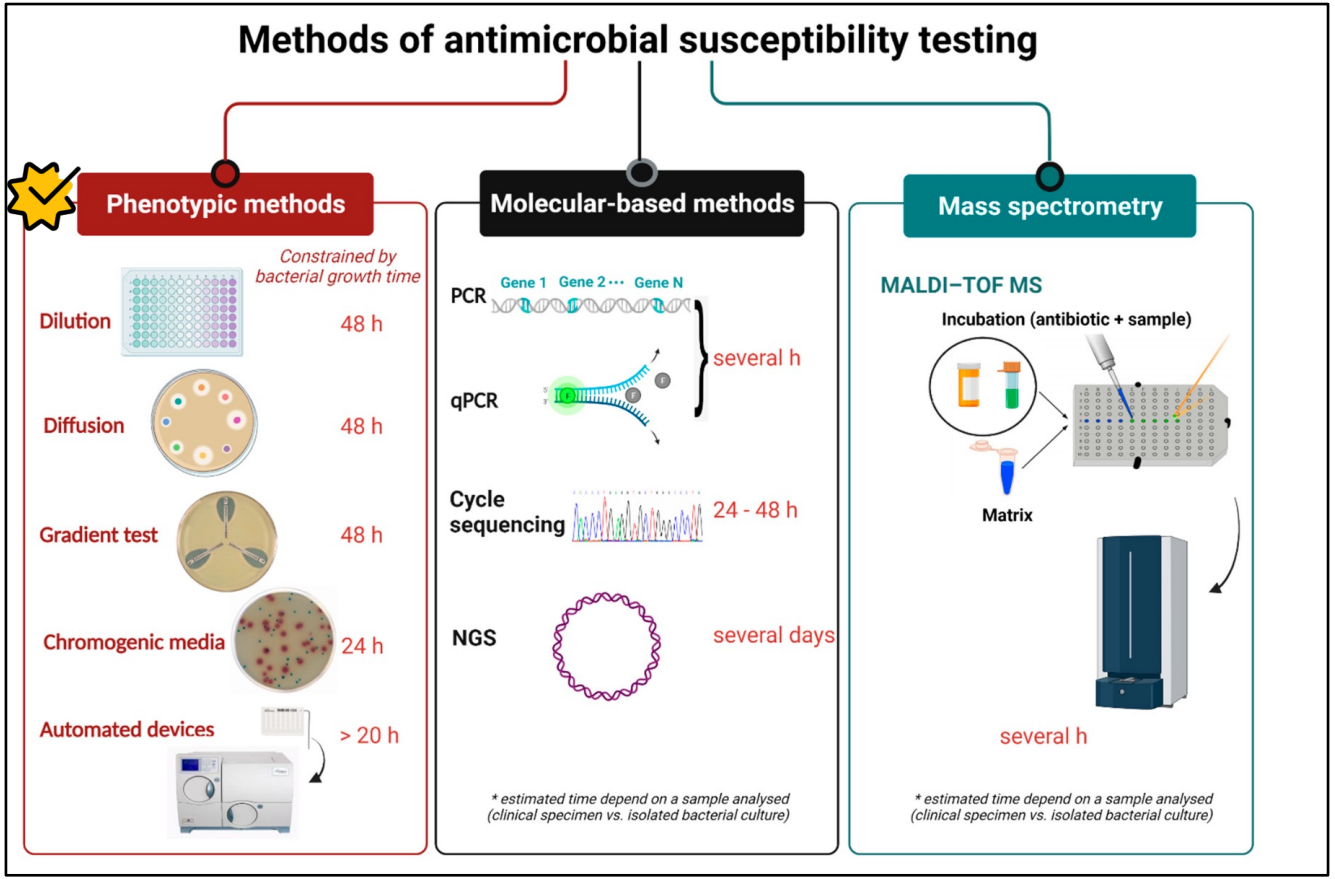


Análisis e identificación de microorganismo (cultivo)

Estudio de susceptibilidad a los antimicrobianos

Reporte selectivo o en cascada

Optimización terapia antimicrobiana



Detección de marcadores de resistencia

Estudio de Susceptibilidad a Antimicrobianos

Métodos fenotípicos

Evalúan la respuesta bacteriana frente a la presencia de un agente antimicrobiano, por lo que dependen del **crecimiento del microorganismo en un medio de cultivo**. El tiempo de incubación suele ir desde las 18 a 24 horas.

Métodos fenotípicos

- Cuantitativos
  - Dilución/microdilución en caldo y dilución en agar *GOLD - STANDARD*
  - Gradiente de concentración (E – test)

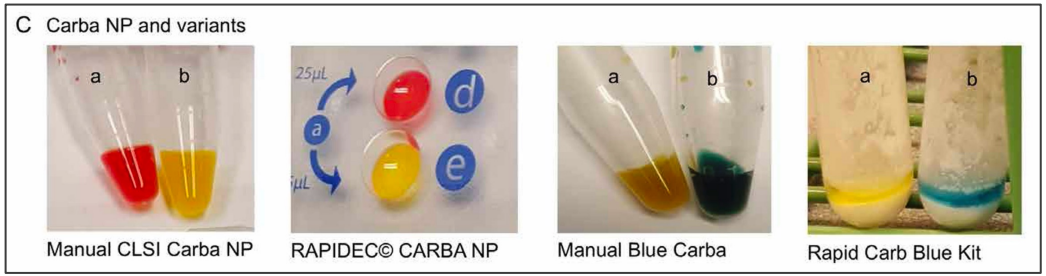
  → Determinan CIM

  Categorías de susceptibilidad por puntos de corte
- Cualitativos
  - Difusión en disco
  - Agares cromogénicos

  → No permiten determinar CIM

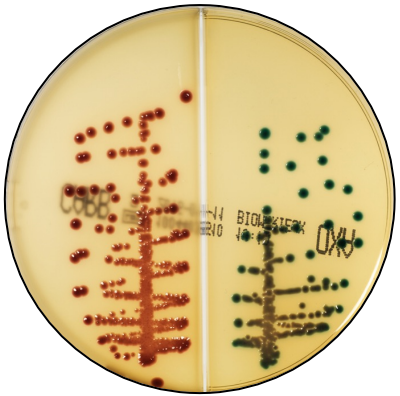
Susceptibilidad disminuida a carbapenémicos

Carbapenemasas – métodos de detección y/o identificación



Colorimetría

Inmunocromatografía



Agar cromogénico (*screening*)

Métodos genotípicos

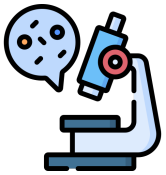
Tamma PD, Simner PJ. Phenotypic Detection of Carbapenemase-Producing Organisms from Clinical Isolates. J Clin Microbiol. 2018 Oct 25;56(11):e01140-18.

Flujo de trabajo en el laboratorio de microbiología

Evaluación clínica e indicación de examen

Recolección y transporte de muestra

Procesamiento y siembra



Análisis e identificación de microorganismo (cultivo)

Estudio de susceptibilidad a los antimicrobianos

Reporte (selectivo o en cascada)

Optimización terapia antimicrobiana

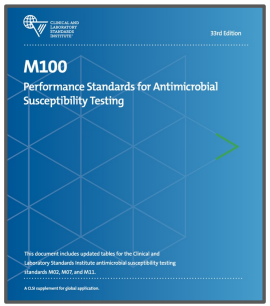


Table 1A-1. Enterobacterales (excluding *Salmonella/Shigella*)[a]

Tier 1: Antimicrobial agents that are appropriate for routine, primary testing and reporting	Tier 2: Antimicrobial agents that are appropriate for routine, primary testing but may be reported following cascade reporting rules established at each institution	Tier 3: Antimicrobial agents that are appropriate for routine, primary testing in institutions that serve patients at high risk for MDROs but should only be reported following cascade reporting rules established at each institution	Tier 4: Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors
Ampicillin			
Cefazolin	Cefuroxime		
Cefotaxime or ceftriaxone[b]	Cefepime[c]		
	Ertapenem Imipenem Meropenem	Cefiderocol	
		Ceftazidime-avibactam	
		Imipenem-relebactam	
		Meropenem-vaborbactam	
Amoxicillin-clavulanate Ampicillin-sulbactam			
Piperacillin-tazobactam			
Gentamicin	Tobramycin	Plazomicin	
	Amikacin		
Ciprofloxacin Levofloxacin			
Trimethoprim-sulfamethoxazole			
	Cefotetan Cefoxitin		
	Tetracycline[d]		
			Aztreonam
			Ceftaroline[b]
			Ceftazidime[b]
			Ceftolozane-tazobactam
Urine Only			
Cefazolin (surrogate for uncomplicated UTI)[e]			
Nitrofurantoin			
		Fosfomycin[f] (*Escherichia coli*)	

Abbreviations: MDRO, multidrug-resistant organism; UTI, urinary tract infection.

Estudio de Susceptibilidad Antimicrobiana (AST) en un aislado de muestra clínica → Optimización de terapia antimicrobiana

↓

Generación y almacenamiento de datos sobre AST en el tiempo → Datos acumulados de AST

↓

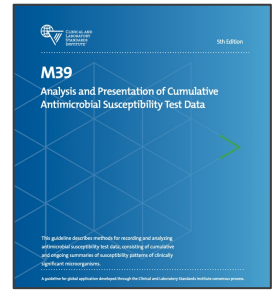
Elaboración de antibiograma

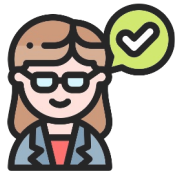
Definición actual

- Selección de tratamiento antimicrobiano empírico en paciente individual
- Desarrollo de guías locales/algoritmos de tratamiento ATB empírico (sitio de infección, servicio clínico, otros)

Simner PJ, Hindler JA, Bhowmick T, Das S, Johnson JK, Lubers BV, Redell MA, Stelling J, Erdman SM. What's New in Antibiograms? Updating CLSI M39 Guidance with Current Trends. J Clin Microbiol. 2022 Oct 19;60(10):e0221021. doi: 10.1128/jcm.02210-21.

Susceptibilidad ATB
Tipos de reporte





Perfil de susceptibilidad antimicrobiana

Resultado obtenido al analizar la susceptibilidad antimicrobiana de un **aislado simple**

Antibiograma

- ✓ **Reporte de un conjunto de perfiles de susceptibilidad (datos acumulados)**
- ✓ Periodo de tiempo (anual)
- ✓ Porcentaje de microorganismos **susceptibles**

Simner PJ, Hindler JA, Bhowmick T, Das S, Johnson JK, Lubers BV, Redell MA, Stelling J, Erdman SM. What's New in Antibiograms? Updating CLSI M39 Guidance with Current Trends. J Clin Microbiol. 2022 Oct 19;60(10):e0221021. doi: 10.1128/jcm.02210-21.

Recomendaciones básicas para la elaboración de un antibiograma

TABLE 1 Key recommendations for routine antibiogram development

Recommendation
Antibiogram reports should be analyzed and presented at least annually.
Only diagnostic (not surveillance) isolates should be included.
Only final, verified test results should be included.
Duplicates should be eliminated by including only the first isolate of a species, patient, and/or analysis period, regardless of specimen source or antimicrobial susceptibility profile.
Only species with testing data for ≥30 isolates should be included.
Only antimicrobial agents routinely tested against the population of isolates to be analyzed should be included, and the %S should be calculated from results reported as well as those that may be suppressed on patient reports for which selective or cascade reporting rules have been applied.
To decrease biases in susceptibility estimates, laboratorians should refrain from including results for supplemental antimicrobial agents selectively tested on resistant isolates only.
Laboratorians should report the %S but exclude the %I and %SDD in the %S statistic.

Simner PJ, Hindler JA, Bhowmick T, Das S, Johnson JK, Lubers BV, Redell MA, Stelling J, Erdman SM. What's New in Antibiograms? Updating CLSI M39 Guidance with Current Trends. J Clin Microbiol. 2022 Oct 19;60(10):e0221021. doi: 10.1128/jcm.02210-21.

Supplemental Table 1. Antibiogram With Antimicrobial Agents Listed Alphabetically: Gram-Negative Isolates

Memorial Medical Center
1 January – 31 December 2020 Antibiogram[a]
Percent Susceptible

Organism	Number of Strains	Amikacin	Ampicillin	Cefazolin (systemic[b])	Cefazolin (urine[c])	Cefepime	Ceftriaxone	Ceftazidime	Ciprofloxacin	Ertapenem	Gentamicin	Meropenem	Piperacillin-tazobactam	Trimethoprim-sulfamethoxazole	Tobramycin
Acinetobacter baumannii	32	60	R	R	R	33	34	42	41	R	57	60	46	48	59
Citrobacter freundii	49	100	R	R	R	81	72	67	90	98	96	99	83	67	97
Enterobacter cloacae	76	99	R	R	R	78	61	62	92	89	90	99	77	84	90
Escherichia coli	1433	99	35	68	87	92	93	90	72	99	91	99	94	73	92
Klebsiella (formerly *Enterobacter*) *aerogenes*	31	100	R	R	R	81	68	60	92	99	91	99	74	95	91
Klebsiella pneumoniae	543	99	R	72	89	93	91	87	84	99	94	95	86	81	94
Morganella morganii	44	100	R	R	R	94	85	81	89	98	100	99	96	75	100
Proteus mirabilis	88	100	87	80	92	99	99	92	79	100	90	100	70	73	93
Pseudomonas aeruginosa	397	97	R	R	R	88	R	86	75	R	80	80	85	R	83
Salmonella spp.	32	-	88	-	-	98	97	97	90	100	-	100	91	86	-
Serratia marcescens	50	100	R	R	R	95	87	80	95	99	94	99	94	91	89
Shigella spp.	33	-	64	-	-	98	98	96	90	100	-	100	91	69	-
Stenotrophomonas maltophilia	72	R	R	R	R	-	R	63	6	R	R	R	-	98	R

Abbreviation: R, intrinsic resistance.
Symbol: -, drug not tested or drug not indicated.
[a] The percent susceptible for each organism/antimicrobial agent combination was generated by including the first isolate of that organism encountered in a given patient.
[b] Cefazolin (systemic) refers to application of susceptibility breakpoint minimal inhibitory concentration (MIC) ≤ 2 µg/mL and applies to the treatment of patients with infections other than uncomplicated urinary tract infections (UTIs).
[c] Cefazolin (urine) refers to application of urinary susceptibility breakpoint MIC ≤ 16 µg/mL (using a cefazolin dosage regimen of 1 g intravenously [IV] every 12 hours) and can be used to predict susceptibility for oral cefaclor, cefdinir, cefpodoxime, cefprozil, cefuroxime, cephalexin, and loracarbef when used for therapy of uncomplicated UTIs due to *E. coli, K. pneumoniae,* and *P. mirabilis.* Cefazolin as a surrogate may overcall resistance to cefdinir, cefpodoxime, and cefuroxime. If cefazolin tests resistant, these drugs should be tested individually if needed for therapy.

Table E4. Antibiogram for Gram-Positive Blood Isolates From Inpatients

Organism	Number of Strains	%S										
		Ampicillin	Clindamycin	Daptomycin	Erythromycin	Linezolid	Oxacillin	Penicillin	Trimethoprim-sulfamethoxazole	Vancomycin	Gentamicin Synergy	Streptomycin Synergy
S. aureus	107	5	71	99	60	99	57	5	97	100	-	-
Enterococcus faecalis[a]	54	100	R	99	16	100	-	100	R	96	54	62
Enterococcus faecium[b]	128	8	R	98[c]	4	97	-	8	R	23	61	60

Abbreviations: %S, percent susceptible; R, intrinsic resistance.
Symbol: -, drug not tested or drug not indicated.
[a] 19% high-level resistance to both gentamicin synergy and streptomycin synergy.
[b] 25% high-level resistance to both gentamicin synergy and streptomycin synergy.
[c] Percent susceptible-dose dependent.

Tipos de reporte de datos acumulados de susceptibilidad antimicrobiana

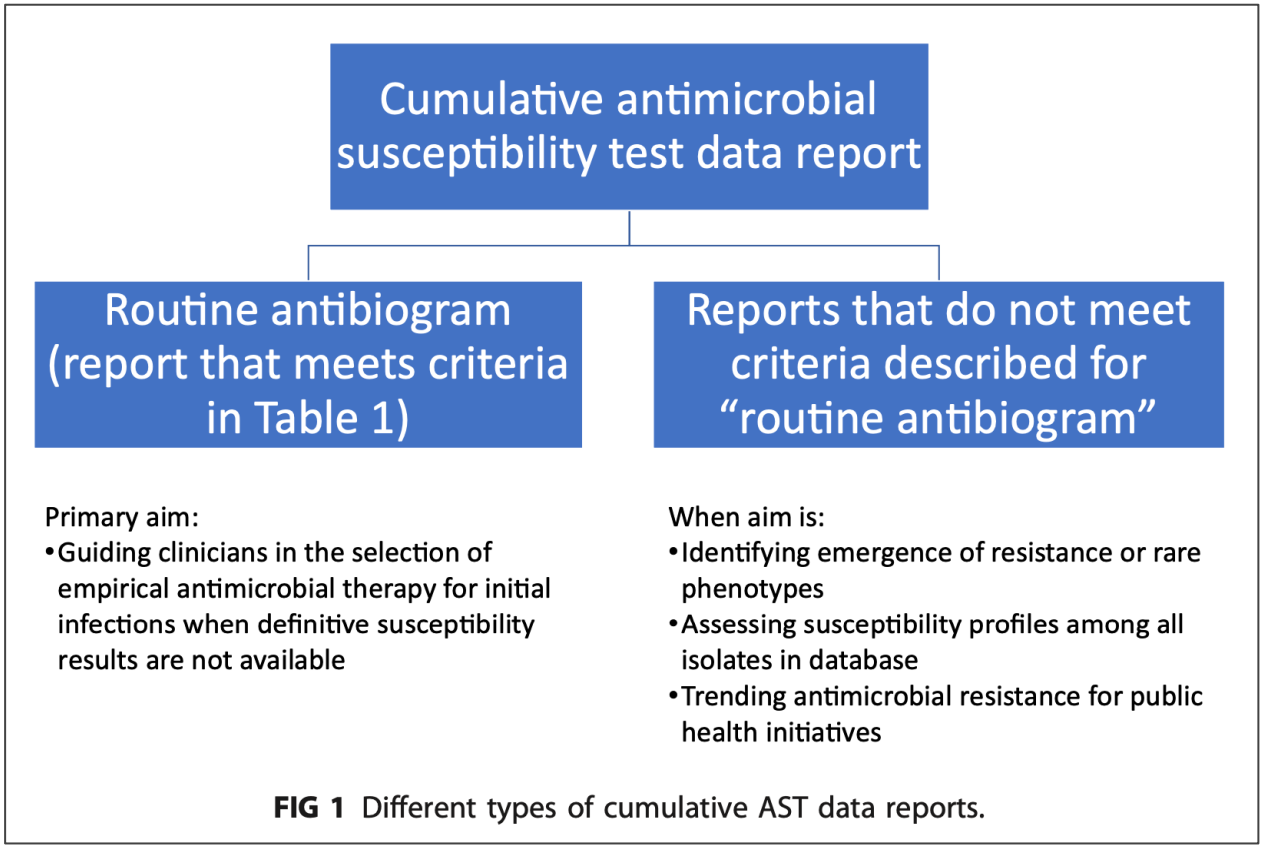


FIG 1 Different types of cumulative AST data reports.

Simner PJ, Hindler JA, Bhowmick T, Das S, Johnson JK, Lubers BV, Redell MA, Stelling J, Erdman SM. What's New in Antibiograms? Updating CLSI M39 Guidance with Current Trends. J Clin Microbiol. 2022 Oct 19;60(10):e0221021. doi: 10.1128/jcm.02210-21.

Table 26. Enhancing Antibiogram Data With Results From Molecular Detection of Resistance Markers for *K. pneumoniae* From Positive Blood Cultures

Organism	Number of Strains	%S									
		Amikacin	Aztreonam	Ampicillin	Cefepime	Ceftriaxone	Ciprofloxacin	Ertapenem	Gentamicin	Meropenem	Piperacillin-tazobactam
K. pneumoniae, all blood isolates	207	93	72	R	77	72	78	97	81	99	85
K. pneumoniae, negative for bla_{CTX-M} and carbapenemase genes	151	98	95	R	99	94	94	99	94	99	95
K. pneumoniae, positive for bla_{CTX-M}	35	96	0	R	33	0	36	96	46	100	50
K. pneumoniae, positive for bla_{KPC}	11[a]	78	0	R	25	0	17	0	17	0	0
K. pneumoniae, positive for bla_{NDM}	10[a,b]	0	70	R	0	0	10	0	0	0	0

Abbreviations: %S, percent susceptible; R, intrinsic resistance.
[a] Calculated from fewer than the standard recommendation of 30 isolates.
[b] Data collected over three years.

Table 24. Common Antimicrobial Resistance Genes and Predicted Phenotype Based on Presence and/or Absence of the Gene

Resistance Gene	Organisms	Phenotype Predicted and Accuracy of Prediction[a]			
		Presence	Approximate Accuracy	Absence	Approximate Accuracy
mecA	*S. aureus*	MRSA	98% to 100%	MSSA	98% to 100%
vanA/vanB	*E. faecalis* or *E. faecium*	VRE	95% to 100%	VSE	95% to 100%
bla_{CTX-M}	Enterobacterales *P. aeruginosa* *A. baumannii* *S. maltophilia*	ESBL producing gram-negative organism: resistance to penicillins, narrow- and expanded-spectrum cephalosporins	95% to 100%	N/A. The lack of detection does not predict susceptibility because many other mechanisms can lead to resistance.	50% to 95%
bla_{KPC}, bla_{NDM}, bla_{OXA-48}, bla_{VIM}, bla_{IMP}	Enterobacterales *P. aeruginosa* *A. baumannii*	Carbapenemase-producing gram-negative organism: resistance to penicillins, narrow- and expanded-spectrum cephalosporins, and carbapenems	95% to 100%	N/A. The lack of detection does not predict susceptibility because many other mechanisms can lead to resistance.	10% to 98%

Abbreviations: ESBL, extended-spectrum β-lactamase; MRSA, methicillin (oxacillin)-resistant *S. aureus;* MSSA, methicillin (oxacillin)-susceptible *S. aureus;* N/A, not applicable; VRE, vancomycin-resistant enterococci; VSE, vancomycin-susceptible enterococci.

[a] The accuracy of prediction will vary based on the local epidemiology, and the values provided are estimates based on the presence or absence of the gene.

Susceptibilidad acumulada a los ATB

Datos locales, año 2023

Pacientes adultos
Hemocultivos

		Antimicrobianos										
Bacterias Gram positiva	**N° aislados**	Cloxacilina	Ampicilina	Vancomicina	Cotrimoxazol	Eritromicina	Clindamicina	Tetraciclina	Daptomicina	Linezolid	Gentamicina (HLAR)	Rifampicina
Staphylococcus epidermidis	21	38		100	56	19	56	94	100	100		94
Staphylococcus aureus	14	54		100	100	62	62	92	100	100		100
Enterococcus faecium	12		0	0					**SDD**	100	25	

		Antimicrobianos											Betalactamasas			
Bacterias Gram negativa	**N° aislados**	Amikacina	Ampicilina/Sulbactam	Ceftazidima	Piperacilina/Tazobactam	Cefepime	Ciprofloxacino	Ertapenem	Meropenem	Imipenem	Ceftazidima/Avibactam	Ceftolozano/Tazobactam	Aztreonam	**BLEE**	**KPC (n)**	**NDM (n)**	**VIM (n)**
Escherichia coli	36	100	42		92	75	44	100	100	100	100	97	69	25%	0	0	0
Klebsiella pneumoniae	27	70	26		33	37	37	54	59	59	85	48	30	41%	5	4	0
Pseudomonas aeruginosa	10	90		80	60	80	80		60	50	90	90	*		0	0	1
															5	**4**	**1**

Pacientes adultos
Urocultivos

		Antimicrobianos								
Bacterias Gram positiva	**N° aislados**	Ampicilina	Ciprofloxacino	Vancomicina	Daptomicina	Linezolid	Gentamicina (HLAR)	Penicilina	Nitrofurantoina	Clindamicina	Eritromicina
Enterococcus faecalis	49	94	84	100	100	100	82		98		
Enterococcus faceium	6	0	ND	ND	**SDD**	100	17				
Streptococcus agalactiae	16							100		80	67

		Antimicrobianos												Betalactamasas			
Bacterias Gram negativa	**N° aislados**	Amikacina	Ampicilina/Sulbactam	Ceftazidima	Cefazolina	Cefepime	Ciprofloxacino	Ertapenem	Meropenem	Ceftriaxona	Ceftazidima/Avibactam*	Fosfomicina	Cotrimoxazol	Nitrofurantoina	**BLEE**	**KPC (N)**	**NDM (N)**	**VIM (N)**
Escherichia coli	467	98	54		23	87	56	99	100	86	100	99	66	96	13%	1		
Klebsiella pneumoniae	61	92	44		5	48	51	73	84	51	83		60	18	44%	4	1	
Pseudomonas aeruginosa	24	96		79		74	79		74		0							
Proteus mirabilis	22	95	82		23	91	73	100	100	91	0		76					
																5	**1**	**0**

Pacientes adultos
Secreciones

		Antimicrobianos										
Bacterias Gram positiva	**N° aislados**	Cloxacilina	Ampicilina	Vancomicina	Cotrimoxazol	Eritromicina	Clindamicina	Tetraciclina	Daptomicina	Linezolid	Gentamicina (HLAR)	Rifampicina
Staphylococcus aureus	39	77		100	97	44	59	95	100	100		100
Enterococcus faecium	10		0	10					**SDD**	100	20	
Enterococcus faecalis	5		100	100					100	100	71	

		Antimicrobianos											Betalactamasas			
Bacterias Gram negativa	**N° aislados**	Amikacina	Ampicilina/Sulbactam	Ceftazidima	Piperacilina/Tazobactam	Cefepime	Ciprofloxacino	Ertapenem	Meropenem	Imipenem	Ceftazidima/Avibactam	Ceftolozano/Tazobactam	Aztreonam	**BLEE**	**KPC (N)**	**NDM (N)**	**VIM (N)**
Pseudomonas aeruginosa	33	84		62	47	62	66		53	56	72	84			1		4
Klebsiella pneumoniae	25	88	44		52	56	56	65	76	72	96	60	52	24%	4	1	
Escherichia coli	10	100	25		83	25	17	100	100	100	100	100	25	**75%**			
***Enterobacter cloacae* complex**	12	100			72	91	91	72	91	91	91	83	77		1	1	
															6	**2**	**4**

Pacientes pediátricos
Hemocultivos

		Antimicrobianos									
Bacterias Gram positiva	**N° aislados**	Cloxacilina	Vancomicina	Cotrimoxazol	Eritromicina	Clindamicina	Tetraciclina	Daptomicina	Linezolid	Rifampicina	Rifampicina
Staphylococcus aureus	16	81	100	100	69	75	100	100	100	100	100
Staphylococcus epidermidis	20	12	100	69	38	56	94	100	100	100	100

		Antimicrobianos										
Bacterias Gram negativa	**N° aislados**	Amikacina	Ceftazidima	Piperacilina/Tazobactam	Cefepime	Ciprofloxacino	Ertapenem	Meropenem	Imipenem	Ceftazidima/Avibactam	Ceftolozano/Tazobactam	Aztreonam	**Betalactamasas** **BLEE**
Escherichia coli	13	100	85	85	85	85	100	100	100	92	92	80	15%
Klebsiella pneumoniae	4	100	80	60	80	80	100	100	100	100	100	85	20%
Pseudomonas aeruginosa	2	100	100	100	100	100		100	100	100	100		

Pacientes pediátricos
Urocultivos

		Antimicrobianos										
Bacterias Gram positivas	**N° aislados**	Cloxacilina	Ampicilina	Vancomicina	Cotrimoxazol	Ciprofloxacino	Clindamicina	Nitrofurantoína	Daptomicina	Linezolid	Rifampicina	Gentamicina (HLAR)
Enterococcus faecalis	16		100	100		94		100	100	100		88
Staphylococcus saprophyticus	4	ND		100	100	100	75	100	100	100	100	

		Antimicrobianos												
Bacterias Gram negativas	**N° aislados**	Amikacina	Ampicilina/sulbactam	Ceftazidima	Cefazolina	Ceftriaxona	Cefepime	Ertapenem	Meropenem	Ciprofloxacino	Nitrofurantoína	Gentamicina	Cotrimoxazol	**Betalactamasas**
														BLEE / **Carbapenemasas**
Escherichia coli	325	100	47		26	93	93	100	100	70	95	84	62	8% /
Proteus mirabilis	42	100	90		29	98	98	98	100	90		95	76	/
Klebsiella pneumoniae	12	100	67		25	92	92	92	92	92		100	100	/ NDM (1) y OXA-48 (1)
Pseudomonas aeruginosa	6	100		83			83		83	83		100		/

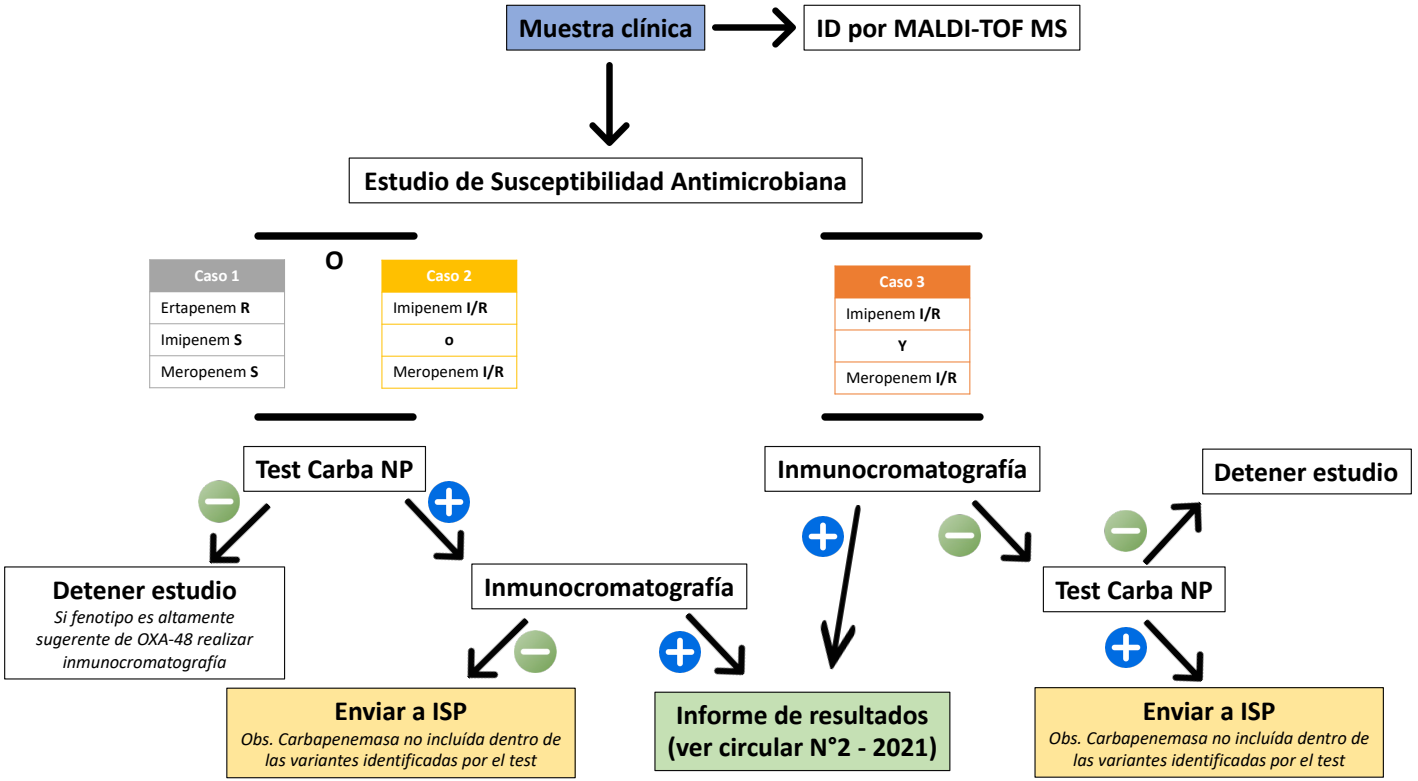
Pacientes pediátricos

Secreciones

		Antimicrobianos										
Bacterias Gram positiva	**N° aislados**	Cloxacilina	Penicilina	Vancomicina	Cotrimoxazol	Eritromicina	Clindamicina	Tetraciclina	Daptomicina	Linezolid	Rifampicina	Levofloxacino
Staphylococcus aureus	33	73		100	100	52	58	100	100	100	100	
Streptococcus pneumoniae	6		80	100	ND	67	67	ND				100

		Antimicrobianos											Betalactamasas	
Bacterias Gram negativa	**N° aislados**	Amikacina	Ampicilina/Sulbactam	Ceftazidima	Piperacilina/Tazobactam	Cefepime	Ciprofloxacino	Ertapenem	Meropenem	Imipenem	Ceftazidima/Avibactam	Ceftolozano/Tazobactam	Aztreonam	**BLEE**	**Carbapenemasas**
Pseudomonas aeruginosa	12	77		92	69	92	77		77	77	92	92			
Klebsiella pneumoniae	5	80	40		40	40	40	75	80	80	80	40	40	40%	NDM (1)
Serratia marcescens	4	75				100	75	100	100	100	100	100	100		
***Enterobacter cloacae* complex**	6	100			100	100	100	100	100	100	100	100	100		

Algoritmo de estudio de bacilos Gram negativo con susceptibilidad disminuida a carbapenémicos



Resistencia a los antimicrobianos y presentación de datos acumulados sobre susceptibilidad

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