UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ

FACULTAD DE CIENCIAS QUÍMICAS

Laboratorio de Microbiología

Enterobacter aerogenes

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Grupo: 11:00 – 12:00

INTRODUCCIÓN

La enterobacter aerogenes también conocida como Aerobacter aerogenes, es un miembro de la familia del enterobacteriaceae. Es un bacilo GRAM negativo.

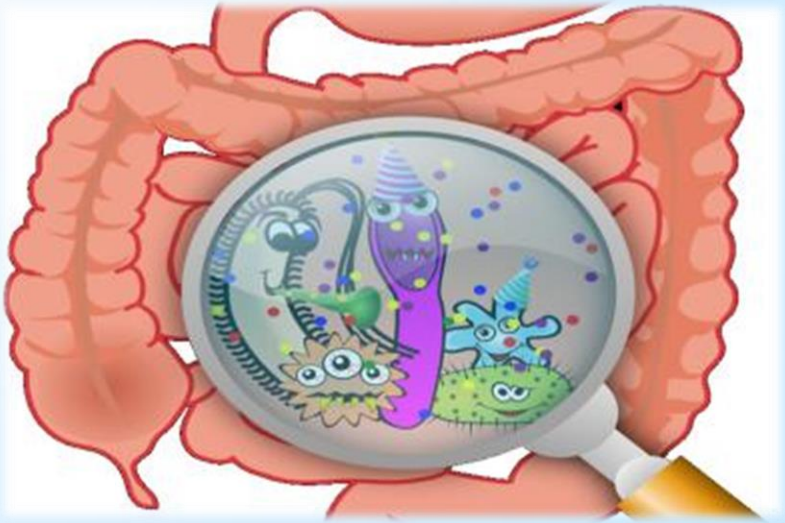
Como anaerobio facultativo, prefiere los ambientes con poco o nada de oxígeno, tales como las heces, las plantas de desecho y el suelo.

Es un patógeno oportunista nosocomial, es decir, que causa patología después de que su huésped ha estado ya debilitado, y comúnmente reside en los hospitales.

Sus factores de riesgo incluyen las estadías de dos semanas o más en el hospital, la cirugía invasiva, y el uso de antibióticos

PATOLOGÍA

Provoca un amplio rango de patologías.
Entra ellas incluyen bacteremia, osteomielitis, y artritis séptica, así como infecciones del tracto urinario, gastrointestinales, del tracto respiratorio y la piel.



METODOLOGÍA

- Siembra de m.o en medio solido en una caja de petrí, formando estrías
- Determinar las caracteristicas mas importantes del m.o (Numero de colonias, color, forma, olor) y la tincion de GRAM
- Pruebas bioquimicas para obtener los datos especificos sobre el metabolism del m.o (genero y especie) utilizando los medios: SIM, TSI, KLIA, Urea, Citrato

TRATAMIENTO

Algunos tratamientos efectivos son:

- Beta-lactámicos
- Fluoroquinolonas
- Amino glucósidos
- TMP-SMX

Todas las bacterias son resistentes a uno o más de estos tratamientos potenciales, así que el organismo debe ser sometido a pruebas de sensibilidad antes de empezar un tratamiento.

CASO CLINICO

Se realizó un estudio que evaluó retrospectivamente la eficacia del tratamiento con cefepime contra un carbapenem, en combinación con amikacina o ciprofloxacino, para los pacientes gravemente enfermos infectados con ESBL (B-lactamasas de espectro extendido medidas por plasmídos) producidas por Enterobacter aerogenes que fueron ingresados en una unidad de cuidados intensivos.

Fueron investigados 43 pacientes: 21 tratados con cefepime; 23 con carbapenem.

La duración promedio de la exposición a antibióticos fue de 8.5 días de cefapime contra 11.4 días de carbapenem.

La mejoría clínica se observo en el 62% de los pacientes que recibieron cefepime frente al 70% de los que recibieron carbapenem.

La producción de ESBL se detecto mediante la prueba de sinergia de doble disco con agar Muller-Hinton y discos de amoxicilina/acido clavulánico y cefepime.

Mediante una electroforesis en gel de campo se revelaron tres clones distintos, pero un clon predominante que alberga el gen bla TEM-24 se asocia con la mayoría de los episodios de infección.

Se concluyo que la cefepima es un agente alternativo para el tratamiento de infecciones graves causadas por TEM-24 en las ESBL producidas por E. aerogenes.

Agente microbiano	Siglas	Diámetro (mm)	
Ampicillin	AM 10	11 mm	Resistente
Amikacin	AN 30	20 mm	Susceptible
Nalidixic acid	NA 30	----------	No resistente
Nitrofurantoin	FM 100	23 mm	Susceptible

Table 2A-1. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints (nearest whole mm)				Interpretive Categories and MIC Breakpoints (µg/mL)				Comments
			S	SDD	I	R	S	SDD	I	R	
PENICILLINS											
A	Ampicillin	10 µg	≥17	–	14–16	≤13	≤8	–	16	≥32	**(4)** Results of ampicillin testing can be used to predict results for amoxicillin. See **general** comment (2).
O	Piperacillin	100 µg	≥21	–	18–20	≤17	≤16	–	32–64	≥128	
O	Mecillinam	10 µg	≥15	–	12–14	≤11	≤8	–	16	≥32	**(5)** For testing and reporting of *E. coli* urinary tract isolates only.
β-LACTAM/β-LACTAMASE INHIBITOR COMBINATIONS											
B	Amoxicillin-clavulanate	20/10 µg	≥18	–	14–17	≤13	≤8/4	–	16/8	≥32/16	
B	Ampicillin-sulbactam	10/10 µg	≥15	–	12–14	≤11	≤8/4	–	16/8	≥32/16	
B	Ceftolozane-tazobactam	–	–	–	–	–	≤2/4	–	4/4	≥8/4	**(6) Breakpoints are based on a dosage regimen of 1.5 g every 8 h.**
B	Piperacillin-tazobactam	100/10 µg	≥21	–	18–20	≤17	≤16/4	–	32/4–64/4	≥128/4	
O	Ticarcillin-clavulanate	75/10 µg	≥20	–	15–19	≤14	≤16/2	–	32/2–64/2	≥128/2	
CEPHEMS (PARENTERAL) (Including cephalosporins I, II, III, and IV. Please refer to Glossary I.) **(7) WARNING:** For *Salmonella* spp. and *Shigella* spp., first- and second-generation cephalosporins and cephamycins may appear active *in vitro,* but are not effective clinically and should not be reported as susceptible. **(8)** Following evaluation of PK-PD properties, limited clinical data, and MIC distributions, revised **breakpoints** for cephalosporins (cefazolin, cefotaxime, ceftazidime, ceftizoxime, and ceftriaxone) and aztreonam were first published in January 2010 (M100-S20) and are listed in this table. Cefuroxime (parenteral) was also evaluated; however, no change in **breakpoints** was necessary for the dosage indicated below. When using the current **breakpoints**, routine ESBL testing is no longer necessary before reporting results (ie, it is no longer necessary to edit results for cephalosporins, aztreonam, or penicillins from susceptible to resistant). However, ESBL testing may still be useful for epidemiological or infection control purposes. For laboratories that have not implemented the current **breakpoints**, ESBL testing should be performed as described in Table 3A. Note that **breakpoints** for drugs with limited availability in many countries (eg, moxalactam, cefonicid, cefamandole, and cefoperazone) were not evaluated. If considering use of these drugs for *E. coli, Klebsiella,* or *Proteus* spp., ESBL testing should be performed (see Table 3A). If isolates test ESBL positive, the results for moxalactam, cefonicid, cefamandole, and cefoperazone should be reported as resistant. **(9)** *Enterobacter, Citrobacter,* and *Serratia* may develop resistance during prolonged therapy with third-generation cephalosporins as a result of derepression of AmpC β-lactamase. Therefore, isolates that are initially susceptible may become resistant within 3 to 4 days after initiation of therapy. Testing of repeat isolates may be warranted.										
A	Cefazolin	30 µg	≥23	–	20–22	≤19	≤2	–	4	≥8	**(10) Breakpoints** when cefazolin is used for therapy of infections other than uncomplicated UTIs due to *E. coli, K. pneumoniae,* and *P. mirabilis*. **Breakpoints** are based on a dosage regimen of 2 g every 8 h. See comment (8).

Table 2A-1. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints (nearest whole mm)				Interpretive Categories and MIC Breakpoints (µg/mL)				Comments
			S	SDD	I	R	S	SDD	I	R	
MONOBACTAMS											
C	Aztreonam	30 µg	≥21	–	18–20	≤17	≤4	–	8	≥16	**(25) Breakpoints** are based on a dosage regimen of 1 g every 8 h. See comment (8).
CARBAPENEMS											
(26) Following evaluation of PK-PD properties, limited clinical data, and MIC distributions that include recently described carbapenemase-producing strains, revised **breakpoints** for carbapenems were first published in June 2010 (M100-S20-U) and are listed below. Because of limited treatment options for infections caused by organisms with carbapenem MICs or zone diameters in the intermediate range, clinicians may wish to design carbapenem dosage regimens that use maximum recommended doses and possibly prolonged intravenous infusion regimens, as has been reported in the literature.[1-4] Consultation with an infectious diseases practitioner is recommended for isolates for which the carbapenem MICs or zone diameter results from disk diffusion testing are in the intermediate or resistant ranges. Laboratories using *Enterobacteriaceae* MIC **breakpoints** for carbapenems described in M100-S20 (January 2010) should perform the MHT, the Carba NP test, **mCIM,** and/or a molecular assay when isolates of *Enterobacteriaceae* are suspicious for carbapenemase production based on imipenem or meropenem MICs of 2–4 µg/mL or ertapenem MIC of 2 µg/mL (refer to Tables 3B, 3C, **and 3D**). After implementation of the current **breakpoints**, **these additional tests do** not need to be performed other than for epidemiological or infection control purposes (refer to Table 3B). The following information is provided as background on carbapenemases in *Enterobacteriaceae* that are largely responsible for MICs and zone diameters in the intermediate and resistant ranges, and thus the rationale for setting revised carbapenem breakpoints: • The clinical effectiveness of carbapenem treatment of infections produced by isolates for which the carbapenem MIC or disk diffusion test results are within the intermediate range is uncertain due to lack of controlled clinical studies. Imipenem MICs for *Proteus* spp., *Providencia* spp., and *Morganella morganii* tend to be higher (eg, MICs in the intermediate or resistant range) than meropenem or doripenem MICs. These isolates may have elevated imipenem MICs by mechanisms other than production of carbapenemases.										
B	Doripenem	10 µg	≥23	–	20–22	≤19	≤1	–	2	≥4	**(27) Breakpoints** are based on a dosage regimen of 500 mg every 8 h.
B	Ertapenem	10 µg	≥22	–	19–21	≤18	≤0.5	–	1	≥2	**(28) Breakpoints** are based on a dosage regimen of 1 g every 24 h.
B	Imipenem	10 µg	≥23	–	20–22	≤19	≤1	–	2	≥4	**(29) Breakpoints** are based on a dosage regimen of 500 mg every 6 h or 1 g every 8 h.
B	Meropenem	10 µg	≥23	–	20–22	≤19	≤1	–	2	≥4	**(30) Breakpoints** are based on a dosage regimen of 1 g every 8 h.
AMINOGLYCOSIDES											
(31) WARNING: For *Salmonella* spp. and *Shigella* spp., aminoglycosides may appear active *in vitro* but are not effective clinically and should not be reported as susceptible.											
A	Gentamicin	10 µg	≥15	–	13–14	≤12	≤4	–	8	≥16	
A	Tobramycin	10 µg	≥15	–	13–14	≤12	≤4	–	8	≥16	
B	Amikacin	30 µg	≥17	–	15–16	≤14	≤16	–	32	≥64	
O	Kanamycin	30 µg	≥18	–	14–17	≤13	≤16	–	32	≥64	

Table 2A-1. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints (nearest whole mm)				Interpretive Categories and MIC Breakpoints (µg/mL)				Comments
			S	SDD	I	R	S	SDD	I	R	
AMINOGLYCOSIDES (Continued)											
O	Netilmicin	30 µg	≥15	–	13–14	≤12	≤8	–	16	≥32	
O	Streptomycin	10 µg	≥15	–	12–14	≤11	–	–	–	–	**(32)** There are no MIC interpretive standards.
MACROLIDES											
Inv.	Azithromycin	15 µg	≥13	–	–	≤12	≤16	–	–	≥32	**(33)** *Salmonella* Typhi only: **breakpoints** are based on MIC distribution data **and limited clinical data. For *Shigella flexneri* and *Shigella sonnei* see Table 2A-2.**
TETRACYCLINES **(34)** Organisms that are susceptible to tetracycline are also considered susceptible to doxycycline and minocycline. However, some organisms that are intermediate or resistant to tetracycline may be susceptible to doxycycline, minocycline, or both.											
C	Tetracycline	30 µg	≥15	–	12–14	≤11	≤4	–	8	≥16	
O	Doxycycline	30 µg	≥14	–	11–13	≤10	≤4	–	8	≥16	
O	Minocycline	30 µg	≥16	–	13–15	≤12	≤4	–	8	≥16	
QUINOLONES AND FLUOROQUINOLONES for *Enterobacteriaceae* except *Salmonella* spp. (Please refer to Glossary I.)											
B	Ciprofloxacin	5 µg	≥21	–	16–20	≤15	≤1	–	2	≥4	
B	Levofloxacin	5 µg	≥17		14–16	≤13	≤2	–	4	≥8	
O	Cinoxacin	100 µg	≥19	–	15–18	≤14	≤16	–	32	≥64	See comment (24).
O	Enoxacin	10 µg	≥18	–	15–17	≤14	≤2	–	4	≥8	**See comment (24).**
O	Gatifloxacin	5 µg	≥18	–	15–17	≤14	≤2	–	4	≥8	**See comment (24).**
O	Gemifloxacin	5 µg	≥20	–	16–19	≤15	≤0.25	–	0.5	≥1	**(35) FDA-approved for *Klebsiella pneumoniae*.**
O	Grepafloxacin	5 µg	≥18	–	15–17	≤14	≤1	–	2	≥4	
O	Lomefloxacin	10 µg	≥22	–	19–21	≤18	≤2	–	4	≥8	
O	Nalidixic acid	30 µg	≥19	–	14–18	≤13	≤16	–	–	≥32	**See comment (24).**
O	Norfloxacin	10 µg	≥17	–	13–16	≤12	≤4	–	8	≥16	**See comment (24).**
O	Ofloxacin	5 µg	≥16	–	13–15	≤12	≤2	–	4	≥8	
Inv.	Fleroxacin	5 µg	≥19	–	16–18	≤15	≤2	–	4	≥8	
QUINOLONES AND FLUOROQUINOLONES for *Salmonella* spp. (Please refer to Glossary I.) **(36)** For testing and reporting of *Salmonella* spp. (including *S.* Typhi and *S.* Paratyphi A–C). Routine susceptibility testing is not indicated for nontyphoidal *Salmonella* spp. isolated from intestinal sources. **(37) The preferred test for assessing fluoroquinolone susceptibility or resistance in *Salmonella* spp. is a ciprofloxacin MIC test. A levofloxacin or ofloxacin MIC test can be performed if either agent, respectively, is the fluoroquinolone of choice in a specific facility. If a ciprofloxacin, levofloxacin, or ofloxacin MIC or ciprofloxacin disk diffusion test cannot be done, pefloxacin disk diffusion may be used as surrogate test to predict ciprofloxacin susceptibility.** **(38) No single test detects resistance resulting from all possible fluoroquinolone resistance mechanisms that have been identified in *Salmonella* spp.**											

Table 2A-1. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints (nearest whole mm)				Interpretive Categories and MIC Breakpoints (µg/mL)				Comments
			S	SDD	I	R	S	SDD	I	R	
NITROFURANS											
U	Nitrofurantoin	300 µg	≥17	–	15–16	≤14	≤32	–	64	≥128	

Abbreviations: ATCC, American Type Culture Collection; CAMHB, cation-adjusted Mueller-Hinton broth; ESBL, extended-spectrum β-lactamase; I, intermediate; **mCIM, modified carbapenem inactivation method;** MHA, Mueller-Hinton agar; MHT, modified Hodge test; MIC, minimal inhibitory concentration; PK-PD, pharmacokinetic-pharmacodynamic; QC, quality control; R, resistant; S, susceptible; SDD, susceptible-dose dependent; UTI, urinary tract infection.

CONCLUSIONES

Es muy importante de investigar ya que representa un gran problema en el ámbito clínico debido a su preferencia por pacientes inmunodeprimidos y neonatales, ya que con frecuencia se presentan en hospitales y se contagia a través de procedimientos quirúrgicos, catéteres, entre otros, además de ser una de las mayores causas de septicemia y de infecciones del tracto urinario y gastrointestinal.

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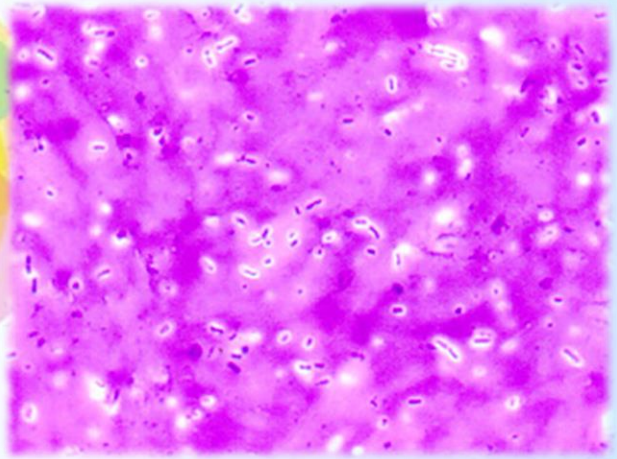
Labratory of microbiology

Enterobacter aerogenes

Teacher: Juana Tovar Oviedo



Cecilia Araceli Vázquez Almendarez

INTRODUCTION

The enterobacter aerogenes also known as Aerobacter aerogenes, is a member of the enterobacteriaceae family.
It´s a GRAM negative bacillus

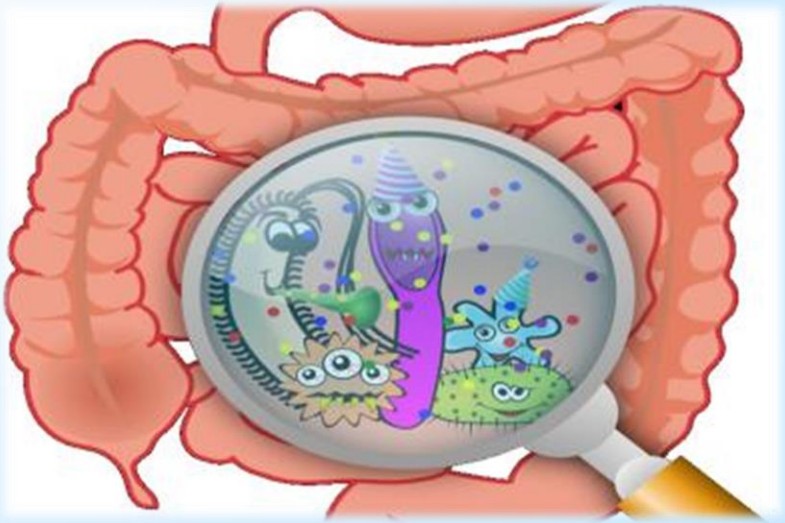
As an anaerobic facultative, it prefers environments with little or no oxygen, such as feces, waste plants and soil.

It is a nosocomial opportunistic pathogen, that is, causes pathology after its guest has already been weakened, and commonly resides in hospitals.

Your risk factors include stays of two weeks or more in the hospital, invasive surgery, and use of antibiotics

PATHOLOGY

It causes a wide range of pathologies.
They include bacteremia, osteomyelitis, and septic arthritis, as well as infections of the urinary tract, gastrointestinal, respiratory tract, and skin.



METODOLOGÍA

Sow m.o in solid medium, in petri dish, forming striae

Determine the most important characteristics of the m.o (Number of colonies, color, shape, odor) and GRAM staining

Biochemical tests to obtain specific data of the m.o (determined genus and species) Using the means of: SIM, TSI, Klia, Urea, Citrate

TREATMENT

Some effective treatments are :

- Beta-lactámicos
- Fluoroquinolonas
- Amino glucósidos
- TMP-SMX

All bacteria are resistant to one or more of these potential treatments, so the body must be tested for sensitivity before starting a treatment.

CLINICAL CASE

A retrospective evaluation of the efficacy of cefepime against carbapenem in combination with amikacin or ciprofloxacin was performed for severely diseased patients with ESBL (extended-spectrum B-lactamases measured by plasmids) produced by Enterobacter aerogenes who were admitted In an intensive care unit.

We investigated 43 patients: 21 treated with cefepime; 23 with carbapenem.

The mean duration of exposure to antibiotics was 8.5 days of cefapime versus 11.4 days of carbapenem.

Clinical improvement was observed in 62% of patients receiving cefepime versus 70% of those receiving carbapenem.

ESBL production was detected by double-disc synergy testing with Muller-Hinton agar and amoxicillin / clavulanic acid and cefepime discs.

Three distinct clones were revealed by field gel electrophoresis, but a predominant clone harboring the TEM-24 bla gene is associated with most episodes of infection.

It was concluded that cefepime is an alternative agent for the treatment of serious infections caused by TEM-24 in ESBL produced by E. aerogenes.

Agente microbiano	Siglas	Diámetro (mm)	
Ampicillin	AM 10	11 mm	Resistente
Amikacin	AN 30	20 mm	Susceptible
Nalidixic acid	NA 30	----------	No resistente
Nitrofurantoin	FM 100	23 mm	Susceptible

Table 2A-1. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints (nearest whole mm)				Interpretive Categories and MIC Breakpoints (µg/mL)				Comments
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PENICILLINS											
A	Ampicillin	10 µg	≥17	–	14–16	≤13	≤8	–	16	≥32	**(4)** Results of ampicillin testing can be used to predict results for amoxicillin. See **general** comment (2).
O	Piperacillin	100 µg	≥21	–	18–20	≤17	≤16	–	32–64	≥128	
O	Mecillinam	10 µg	≥15	–	12–14	≤11	≤8	–	16	≥32	**(5)** For testing and reporting of *E. coli* urinary tract isolates only.
β-LACTAM/β-LACTAMASE INHIBITOR COMBINATIONS											
B	Amoxicillin-clavulanate	20/10 µg	≥18	–	14–17	≤13	≤8/4	–	16/8	≥32/16	
B	Ampicillin-sulbactam	10/10 µg	≥15	–	12–14	≤11	≤8/4	–	16/8	≥32/16	
B	Ceftolozane-tazobactam	–	–	–	–	–	≤2/4	–	4/4	≥8/4	**(6) Breakpoints are based on a dosage regimen of 1.5 g every 8 h.**
B	Piperacillin-tazobactam	100/10 µg	≥21	–	18–20	≤17	≤16/4	–	32/4–64/4	≥128/4	
O	Ticarcillin-clavulanate	75/10 µg	≥20	–	15–19	≤14	≤16/2	–	32/2–64/2	≥128/2	
CEPHEMS (PARENTERAL) (Including cephalosporins I, II, III, and IV. Please refer to Glossary I.) **(7) WARNING:** For *Salmonella* spp. and *Shigella* spp., first- and second-generation cephalosporins and cephamycins may appear active *in vitro,* but are not effective clinically and should not be reported as susceptible. **(8)** Following evaluation of PK-PD properties, limited clinical data, and MIC distributions, revised **breakpoints** for cephalosporins (cefazolin, cefotaxime, ceftazidime, ceftizoxime, and ceftriaxone) and aztreonam were first published in January 2010 (M100-S20) and are listed in this table. Cefuroxime (parenteral) was also evaluated; however, no change in **breakpoints** was necessary for the dosage indicated below. When using the current **breakpoints**, routine ESBL testing is no longer necessary before reporting results (ie, it is no longer necessary to edit results for cephalosporins, aztreonam, or penicillins from susceptible to resistant). However, ESBL testing may still be useful for epidemiological or infection control purposes. For laboratories that have not implemented the current **breakpoints**, ESBL testing should be performed as described in Table 3A. Note that **breakpoints** for drugs with limited availability in many countries (eg, moxalactam, cefonicid, cefamandole, and cefoperazone) were not evaluated. If considering use of these drugs for *E. coli, Klebsiella,* or *Proteus* spp., ESBL testing should be performed (see Table 3A). If isolates test ESBL positive, the results for moxalactam, cefonicid, cefamandole, and cefoperazone should be reported as resistant. **(9)** *Enterobacter, Citrobacter,* and *Serratia* may develop resistance during prolonged therapy with third-generation cephalosporins as a result of derepression of AmpC β-lactamase. Therefore, isolates that are initially susceptible may become resistant within 3 to 4 days after initiation of therapy. Testing of repeat isolates may be warranted.										
A	Cefazolin	30 µg	≥23	–	20–22	≤19	≤2	–	4	≥8	**(10) Breakpoints** when cefazolin is used for therapy of infections other than uncomplicated UTIs due to *E. coli, K. pneumoniae,* and *P. mirabilis*. **Breakpoints** are based on a dosage regimen of 2 g every 8 h. See comment (8).

Table 2A-1. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints (nearest whole mm)				Interpretive Categories and MIC Breakpoints (µg/mL)				Comments
			S	SDD	I	R	S	SDD	I	R	
MONOBACTAMS											
C	Aztreonam	30 µg	≥21	–	18–20	≤17	≤4	–	8	≥16	**(25) Breakpoints** are based on a dosage regimen of 1 g every 8 h. See comment (8).
CARBAPENEMS											
(26) Following evaluation of PK-PD properties, limited clinical data, and MIC distributions that include recently described carbapenemase-producing strains, revised **breakpoints** for carbapenems were first published in June 2010 (M100-S20-U) and are listed below. Because of limited treatment options for infections caused by organisms with carbapenem MICs or zone diameters in the intermediate range, clinicians may wish to design carbapenem dosage regimens that use maximum recommended doses and possibly prolonged intravenous infusion regimens, as has been reported in the literature.[1-4] Consultation with an infectious diseases practitioner is recommended for isolates for which the carbapenem MICs or zone diameter results from disk diffusion testing are in the intermediate or resistant ranges. Laboratories using *Enterobacteriaceae* MIC **breakpoints** for carbapenems described in M100-S20 (January 2010) should perform the MHT, the Carba NP test, **mCIM,** and/or a molecular assay when isolates of *Enterobacteriaceae* are suspicious for carbapenemase production based on imipenem or meropenem MICs of 2–4 µg/mL or ertapenem MIC of 2 µg/mL (refer to Tables 3B, 3C, **and 3D**). After implementation of the current **breakpoints**, **these additional tests do** not need to be performed other than for epidemiological or infection control purposes (refer to Table 3B). The following information is provided as background on carbapenemases in *Enterobacteriaceae* that are largely responsible for MICs and zone diameters in the intermediate and resistant ranges, and thus the rationale for setting revised carbapenem breakpoints: • The clinical effectiveness of carbapenem treatment of infections produced by isolates for which the carbapenem MIC or disk diffusion test results are within the intermediate range is uncertain due to lack of controlled clinical studies. Imipenem MICs for *Proteus* spp., *Providencia* spp., and *Morganella morganii* tend to be higher (eg, MICs in the intermediate or resistant range) than meropenem or doripenem MICs. These isolates may have elevated imipenem MICs by mechanisms other than production of carbapenemases.										
B	Doripenem	10 µg	≥23	–	20–22	≤19	≤1	–	2	≥4	**(27) Breakpoints** are based on a dosage regimen of 500 mg every 8 h.
B	Ertapenem	10 µg	≥22	–	19–21	≤18	≤0.5	–	1	≥2	**(28) Breakpoints** are based on a dosage regimen of 1 g every 24 h.
B	Imipenem	10 µg	≥23	–	20–22	≤19	≤1	–	2	≥4	**(29) Breakpoints** are based on a dosage regimen of 500 mg every 6 h or 1 g every 8 h.
B	Meropenem	10 µg	≥23	–	20–22	≤19	≤1	–	2	≥4	**(30) Breakpoints** are based on a dosage regimen of 1 g every 8 h.
AMINOGLYCOSIDES											
(31) WARNING: For *Salmonella* spp. and *Shigella* spp., aminoglycosides may appear active *in vitro* but are not effective clinically and should not be reported as susceptible.											
A	Gentamicin	10 µg	≥15	–	13–14	≤12	≤4	–	8	≥16	
A	Tobramycin	10 µg	≥15	–	13–14	≤12	≤4	–	8	≥16	
B	Amikacin	30 µg	≥17	–	15–16	≤14	≤16	–	32	≥64	
O	Kanamycin	30 µg	≥18	–	14–17	≤13	≤16	–	32	≥64	

Table 2A-1. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints (nearest whole mm)				Interpretive Categories and MIC Breakpoints (µg/mL)				Comments
			S	SDD	I	R	S	SDD	I	R	
AMINOGLYCOSIDES (Continued)											
O	Netilmicin	30 µg	≥15	–	13–14	≤12	≤8	–	16	≥32	
O	Streptomycin	10 µg	≥15	–	12–14	≤11	–	–	–	–	**(32)** There are no MIC interpretive standards.
MACROLIDES											
Inv.	Azithromycin	15 µg	≥13	–	–	≤12	≤16	–	–	≥32	**(33)** *Salmonella* Typhi only: **breakpoints** are based on MIC distribution data **and limited clinical data. For *Shigella flexneri* and *Shigella sonnei* see Table 2A-2.**
TETRACYCLINES **(34)** Organisms that are susceptible to tetracycline are also considered susceptible to doxycycline and minocycline. However, some organisms that are intermediate or resistant to tetracycline may be susceptible to doxycycline, minocycline, or both.											
C	Tetracycline	30 µg	≥15	–	12–14	≤11	≤4	–	8	≥16	
O	Doxycycline	30 µg	≥14	–	11–13	≤10	≤4	–	8	≥16	
O	Minocycline	30 µg	≥16	–	13–15	≤12	≤4	–	8	≥16	
QUINOLONES AND FLUOROQUINOLONES for *Enterobacteriaceae* except *Salmonella* spp. (Please refer to Glossary I.)											
B	Ciprofloxacin	5 µg	≥21	–	16–20	≤15	≤1	–	2	≥4	
B	Levofloxacin	5 µg	≥17		14–16	≤13	≤2	–	4	≥8	
O	Cinoxacin	100 µg	≥19	–	15–18	≤14	≤16	–	32	≥64	See comment (24).
O	Enoxacin	10 µg	≥18	–	15–17	≤14	≤2	–	4	≥8	**See comment (24).**
O	Gatifloxacin	5 µg	≥18	–	15–17	≤14	≤2	–	4	≥8	**See comment (24).**
O	Gemifloxacin	5 µg	≥20	–	16–19	≤15	≤0.25	–	0.5	≥1	**(35) FDA-approved for *Klebsiella pneumoniae*.**
O	Grepafloxacin	5 µg	≥18	–	15–17	≤14	≤1	–	2	≥4	
O	Lomefloxacin	10 µg	≥22	–	19–21	≤18	≤2	–	4	≥8	
O	Nalidixic acid	30 µg	≥19	–	14–18	≤13	≤16	–	–	≥32	**See comment (24).**
O	Norfloxacin	10 µg	≥17	–	13–16	≤12	≤4	–	8	≥16	**See comment (24).**
O	Ofloxacin	5 µg	≥16	–	13–15	≤12	≤2	–	4	≥8	
Inv.	Fleroxacin	5 µg	≥19	–	16–18	≤15	≤2	–	4	≥8	
QUINOLONES AND FLUOROQUINOLONES for *Salmonella* spp. (Please refer to Glossary I.) **(36)** For testing and reporting of *Salmonella* spp. (including *S.* Typhi and *S.* Paratyphi A–C). Routine susceptibility testing is not indicated for nontyphoidal *Salmonella* spp. isolated from intestinal sources. **(37) The preferred test for assessing fluoroquinolone susceptibility or resistance in *Salmonella* spp. is a ciprofloxacin MIC test. A levofloxacin or ofloxacin MIC test can be performed if either agent, respectively, is the fluoroquinolone of choice in a specific facility. If a ciprofloxacin, levofloxacin, or ofloxacin MIC or ciprofloxacin disk diffusion test cannot be done, pefloxacin disk diffusion may be used as surrogate test to predict ciprofloxacin susceptibility.** **(38) No single test detects resistance resulting from all possible fluoroquinolone resistance mechanisms that have been identified in *Salmonella* spp.**											

Table 2A-1. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints (nearest whole mm)				Interpretive Categories and MIC Breakpoints (µg/mL)				Comments
			S	SDD	I	R	S	SDD	I	R	
NITROFURANS											
U	Nitrofurantoin	300 µg	≥17	–	15–16	≤14	≤32	–	64	≥128	

Abbreviations: ATCC, American Type Culture Collection; CAMHB, cation-adjusted Mueller-Hinton broth; ESBL, extended-spectrum β-lactamase; I, intermediate; **mCIM, modified carbapenem inactivation method;** MHA, Mueller-Hinton agar; MHT, modified Hodge test; MIC, minimal inhibitory concentration; PK-PD, pharmacokinetic-pharmacodynamic; QC, quality control; R, resistant; S, susceptible; SDD, susceptible-dose dependent; UTI, urinary tract infection.

CONCLUSIONS

It is very important to investigate since it represents a great problem in the clinical field due to its preference for immunosuppressed and neonatal patients, since they frequently present in hospitals and are spread through surgical procedures, catheters, among others, besides being a Of the major causes of septicemia and of urinary and gastrointestinal tract infections.

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