

Bibliografia

1. Cassini A, Höglberg LD, Plachouras D, et al; Burden of AMR Collaborative Group. Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis. *Lancet Infect Dis.* 2019;19(1): 56-66.
2. Janda JM, Abbott SL. The changing face of the family Enterobacteriaceae (Order: "Enterobacterales"): new members, taxonomic issues, geographic expansion, and new diseases and disease syndromes. *Clin Microbiol Rev.* 2021; 34(2):e00174-20.
3. Kaper JB, Nataro JP, Mobley HL. Pathogenic Escherichia coli. *Nat Rev Microbiol.* 2004;2(2):123-40.
4. Hu J, Torres AG. Enteropathogenic Escherichia coli: foe or innocent bystander? *Clin Microbiol Infect.* 2015;21(8): 729-34.
5. Russo TA, Marr CM. Hypervirulent Klebsiella pneumoniae. *Clin Microbiol Rev.* 2019;32(3):e00001-19.
6. Catalán-Nájera JC, Garza-Ramos U, Barrios-Camacho H. Hypervirulence and hypermucoviscosity: Two different but complementary Klebsiella spp. phenotypes? *Virulence.* 2017;8(7):1111-23.
7. Xie M, Dong N, Chen K, et al. A hybrid plasmid formed by recombination of a virulence plasmid and a resistance plasmid in Klebsiella pneumoniae. *J Glob Antimicrob Resist.* 2020;23: 466-70.
8. Lam MMC, Wyres KL, Wick RR, et al. Convergence of virulence and MDR in a single plasmid vector in MDR Klebsiella pneumoniae ST15. *J Antimicrob Chemother.* 2019;74(5):1218-22.
9. EUCAST Intrinsic Resistance & Unusual Phenotypes v 3.2. Available at: http://www.eucast.org/expert_rules_and_intrinsic_resistance/.
10. Shaikh S, Fatima J, Shakil S et al. Antibiotic resistance and extended spectrum beta-lactamases: types, epidemiology and treatment. *Saudi J Biol Sci.* 2015;22(1):90-101.
11. Soughakoff W, Goussard S, Courvalin P. TEM-3 β-lactamases which hydrolyzes broad-spectrum cephalosporins is derived from TEM-2 penicillinas by two amino acid substitutions. *FEMS Microbiol Lett.* 1988;56(3):343-8.
12. Naas T, Oueslati S, Bonnín RA, et al. Beta-lactamase database (BLDB) – structure and function. *J Enzyme Inhib Med Chem.* 2017;32(1):917-9.
13. Tooke CL, Hinchliffe P, Bragginton EC, et al. β-lactamases and β-lactamase inhibitors in the 21st Century. *J Mol Biol.* 2019;431(18):3472-500.
14. Bush K. Game changers: new β-lactamase inhibitor combinations targeting antibiotic resistance in Gram-negative bacteria. *ACS Infect Dis.* 2018;4(2):84-7.
15. IHaider G, Clancy CJ, Chen L, et al. Identifying spectra of activity and therapeutic niches for ceftazidime-avibactam and imipenem-relebactam against carbapenem-resistant Enterobacteriaceae. *Antimicrob Agents Chemother.* 2017;61(9):e00642-17.
16. Compain F, Arthur M. Impaired inhibition by avibactam and resistance to the ceftazidime-avibactam combination due to the D179Y substitution in the KPC-2 β-lactamase. *Antimicrob Agents Chemother.* 2017;61(7):e00451-17.
17. Shields RK, Chen L, Cheng S, et al. Emergence of ceftazidime-avibactam resistance due to plasmid-borne blaKPC-3 mutations during treatment of carbapenem-resistant Klebsiella pneumoniae infections. *Antimicrob Agents Chemother.* 2017;61(3):e02097-16.
18. Humphries RM, Hemarajata P. Resistance to ceftazidime-avibactam in Klebsiella pneumoniae due to porin mutations and the increased expression of KPC-3. *Antimicrob Agents Chemother.* 2017;61(6):e00537-17.
19. Evans BA, Amyes SG. OXA β-lactamases. *Clin Microbiol Res.* 2014;27(2): 241-63.
20. Yoon EJ, Jeong SH. Class D β-lactamases. *J Antimicrob Chemother.* 2021;76(4):836-64.
21. Ryan K, Karve S, Peeters P, et al. The impact of initial antibiotic treatment failure: real-world insights in healthcare-asso-

- ciated or nosocomial pneumonia. *J Infect.* 2018;77(1):9-17.
22. Peeters P, Ryan K, Karve S, et al. The impact of initial antibiotic treatment failure: real-world insights in patients with complicated, health care-associated intra-abdominal infection. *Infect Drug Resist.* 2019;12:329-43.
23. Shiber S, Yahav D, Avni T, et al. β -Lactam/ β -lactamase inhibitors versus carbapenems for the treatment of sepsis: systematic review and meta-analysis of randomized controlled trials. *J Antimicrob Chemother.* 2015;70(1):41-7.
24. Vardakas KZ, Tansarli GS, Rafailidis PI, Falagas ME. Carbapenems versus alternative antibiotics for the treatment of bacteraemia due to Enterobacteriaceae producing extended-spectrum β -lactamases: a systematic review and meta-analysis. *J Antimicrob Chemother.* 2012;67(12):2793-803.
25. Harris PN, Yin M, Jureen R, et al. Comparable outcomes for β -lactam/ β -lactamase inhibitor combinations and carbapenems in definitive treatment of bloodstream infections caused by cefotaxime-resistant *Escherichia coli* or *Klebsiella pneumoniae*. *Antimicrob Resist Infect Control.* 2015;4:14.
26. Gutiérrez-Gutiérrez B, Pérez-Galera S, Salamanca E, et al. A multinational, preregistered cohort study of β -lactam/ β -lactamase inhibitor combinations for treatment of bloodstream infections due to extended-spectrum- β -lactamase-producing Enterobacteriaceae. *Antimicrob Agents Chemother.* 2016;60(7):4159-69.
27. Ng TM, Khong WX, Harris PN, et al. Empiric piperacillin-tazobactam versus carbapenems in the treatment of bacteraemia due to extended-spectrum beta-lactamase-producing Enterobacteriaceae. *PLoS One.* 2016;11(4):e0153696.
28. Gudiol C, Royo-Cebrecos C, Abdala E, et al. Efficacy of β -lactam/ β -lactamase inhibitor combinations for the treatment of bloodstream infection due to extended-spectrum- β -lactamase-producing Enterobacteriaceae in hematological patients with neutropenia. *Antimicrob Agents Chemother.* 2017;61(8):e00164-17.
29. Delgado-Valverde M, Torres E, Valiente-Mendez A, et al; REIPI/GEIH-SEIMC BACTERAEMIA-MIC Group. Impact of the MIC of piperacillin/tazobactam on the outcome for patients with bacteraemia due to Enterobacteriaceae: the Bacteraemia-MIC project. *J Antimicrob Chemother.* 2016;71(2):521-30.
30. EUCAST Piperacillin-tazobactam Breakpoints for Enterobacterales. General Consultation 10 July-18 September 2020. Available at: https://www.eucast.org/publications_and_documents/consultations/.
31. Kalaria SN, Gopalakrishnan M, Heil EL. A population pharmacokinetics and pharmacodynamic approach to optimize tazobactam activity in critically ill patients. *Antimicrob Agents Chemother.* 2020;64(3):e02093-19.
32. Pea F. Intracellular pharmacokinetics of antibacterials and their clinical implications. *Clin Pharmacokinet.* 2018;57(2):177-89.
33. Harris PNA, Tambyah PA, Lye DC, et al; MERINO Trial Investigators and the Australasian Society for Infectious Disease Clinical Research Network (ASID-CRN). Effect of piperacillin-tazobactam vs meropenem on 30-day mortality for patients with *E coli* or *Klebsiella pneumoniae* bloodstream infection and ceftriaxone resistance: a randomized clinical trial. *JAMA.* 2018;320(10):984-94.
34. Paterson DL, Henderson A, Harris PNA. Current evidence for therapy of ceftriaxone-resistant Gram-negative bacteremia. *Curr Opin Infect Dis.* 2020;33(1):78-85.
35. Solomkin J, Hershberger E, Miller B, et al. Ceftolozane/tazobactam plus metronidazole for complicated intra-abdominal infections in an era of multidrug resistance: results from a randomized, double-blind, phase 3 trial (ASPECT-cIAI). *Clin Infect Dis.* 2015;60(10):1462-71.
36. Wagenlehner FM, Umeh O, Steenberg J, et al. Ceftolozane-tazobactam compared with levofloxacin in the treatment of complicated urinary-tract infections, including pyelonephritis: a randomised, double-blind, phase 3 trial (ASPECT-cUTI). *Lancet.* 2015;385(9981):1949-56.
37. Huntington JA, Sakoulas G, Umeh O, et al. Efficacy of ceftolozane/tazobactam versus levofloxacin in the treatment of complicated urinary tract infections (cUTIs) caused by levofloxacin-resistant pathogens: results from the ASPECT-cUTI

- trial. *J Antimicrob Chemother.* 2016;71(7):2014-21.
38. Popejoy MW, Paterson DL, Cloutier D, et al. Efficacy of ceftolozane/tazobactam against urinary tract and intra-abdominal infections caused by ESBL-producing *Escherichia coli* and *Klebsiella pneumoniae*: a pooled analysis of phase 3 clinical trials. *J Antimicrob Chemother.* 2017;72(1):268-72.
39. Hirsch EB, Brigmam HV, Zucchi PC, et al; CEFTABUSE Study Group. Ceftolozane-tazobactam and ceftazidime-avibactam activity against β -lactam-resistant *Pseudomonas aeruginosa* and extended-spectrum β -lactamase-producing Enterobacteriales clinical isolates from U.S. medical centres. *J Glob Antimicrob Resist.* 2020;22:689-94.
40. Bassetti M, Vena A, Giacobbe DR et al. Ceftolozane/tazobactam for treatment of severe ESBL-producing Enterobacteriales infections: a multicenter nationwide clinical experience (CEFTABUSE II Study). *Open Forum Infect Dis.* 2020;7(5):ofaa139.
41. Kollef MH, Nováček M, Kivistik Ü, et al. Ceftolozane-tazobactam versus meropenem for treatment of nosocomial pneumonia (ASPECT-NP): a randomised, controlled, double-blind, phase 3, non-inferiority trial. *Lancet Infect Dis.* 2019;19(12):1299-311.
42. Isler B, Harris P, Stewart AG, Paterson DL. An update on ceftazidime and its future role in combination with novel β -lactamase inhibitors for MDR Enterobacteriales and *Pseudomonas aeruginosa*. *J Antimicrob Chemother.* 2021;76(3):550-60.
43. Paterson DL. "Collateral damage" from cephalosporin or quinolone antibiotic therapy. *Clin Infect Dis.* 2004;38 Suppl 4:S341-5.
44. Lasko MJ, Abdelraouf K, Nicolau DP. In Vivo activity of WCK 4282 (high-dose ceftazidime/tazobactam) against serine- β -lactamase-producing Enterobacteriales and *Pseudomonas aeruginosa* in the neutropenic murine lung infection model. *Antimicrob Agents Chemother.* 2021;65(4):e02193-20.
45. Rodríguez-Baño J, Gutiérrez-Gutiérrez B, Machuca I, Pascual A. Treatment of infections caused by extended-spectrum-Beta-lactamase-, AmpC-, and carbapenemase-producing Enterobacteriaceae. *Clin Microbiol Rev.* 2018;31(2):e00079-17.
46. Bassetti M, Russo A, Carmelutti A, Wilcox M. Emerging drugs for treating methicillin-resistant *Staphylococcus aureus*. *Expert Opin Emerg Drugs.* 2019;24(3):191-204.
47. Connors KP, Housman ST, Pope JS, et al. Phase I, open-label, safety and pharmacokinetic study to assess bronchopulmonary disposition of intravenous eravacycline in healthy men and women. *Antimicrob Agents Chemother.* 2014;58(4):2113-8.
48. Meini S, Tascini C, Cei M, et al. AmpC β -lactamase-producing Enterobacteriales: what a clinician should know. *Infection.* 2019;47(3):363-75.
49. Tamma PD, Doi Y, Bonomo RA, et al; Antibacterial Resistance Leadership Group. A primer on AmpC β -Lactamases: necessary knowledge for an increasingly multidrug-resistant world. *Clin Infect Dis.* 2019;69(8):1446-55.
50. Jacoby GA. AmpC beta-lactamases. *Clin Microbiol Rev.* 2009;22(1):161-82, Table of Contents.
51. Lee NY, Lee CC, Li CW, et al. Cefepime therapy for monomicrobial *Enterobacter cloacae* bacteremia: unfavorable outcomes in patients infected by cefepime-susceptible dose-dependent isolates. *Antimicrob Agents Chemother.* 2015;59(12):7558-63.
52. Harris PNA, Wei JY, Shen AW et al. Carbapenems versus alternative antibiotics for the treatment of bloodstream infections caused by *Enterobacter*, *Citrobacter* or *Serratia* spp: a systematic review with meta-analysis. *J Antimicrob Chemother.* 2016;71(2):296-306.
53. Tan SH, Ng TM, Chew KL, et al. Outcomes of treating AmpC-producing Enterobacteriales bacteraemia with carbapenems vs. non-carbapenems. *Int J Antimicrob Agents.* 2020;55(2):105860.
54. Isler B, Ezure Y, Romero JLG, et al. Is ceftazidime/avibactam an option for serious infections due to extended-spectrum-

- β -lactamase- and AmpC-producing Enterobacteriales? A systematic review and meta-analysis. *Antimicrob Agents Chemother.* 2020;65(1):e01052-20.
55. Compain F, Debray A, Adadj P, et al. Ceftazidime-avibactam resistance mediated by the N346Y substitution in various AmpC β -lactamases. *Antimicrob Agents Chemother.* 2020;64(6):e02311-19.
56. Lahiri SD, Giacobbe RA, Johnstone MR, Alm RA. Activity of avibactam against *Enterobacter cloacae* producing an extended-spectrum class C β -lactamase enzyme. *J Antimicrob Chemother.* 2014;69(11):2942-6.
57. Shields RK, Iovleva A, Kline EG, et al. Clinical evolution of AmpC-mediated ceftazidime-avibactam and cefiderocol resistance in *Enterobacter cloacae* complex following exposure to ceferipime. *Clin Infect Dis.* 2020;71(10):2713-6.
58. Soman R, Bakthavatchalam YD, Nadarajan A, et al. Is it time to move away from polymyxins? Evidence and alternatives. *Eur J Clin Microbiol Infect Dis.* 2021;40(3):461-75.
59. Shields RK, Nguyen MH, Chen L, et al. Ceftazidime-avibactam is superior to other treatment regimens against carbapenem-resistant *Klebsiella pneumoniae* bacteremia. *Antimicrob Agents Chemother.* 2017;61(8):e00883-17.
60. Tumbarello M, Trecarichi EM, Corona A, et al. Efficacy of ceftazidime-avibactam salvage therapy in patients with infections caused by *Klebsiella pneumoniae* carbapenemase-producing *K. pneumoniae*. *Clin Infect Dis.* 2019;68(3):355-64.
61. Onorato L, Di Caprio G, Signoriello S, Coppola N. Efficacy of ceftazidime/avibactam in monotherapy or combination therapy against carbapenem-resistant Gram-negative bacteria: a meta-analysis. *Int J Antimicrob Agents.* 2019;54(6):735-40.
62. Karaikos I, Daikos GL, Gkoufa A, et al; Hellenic Ceftazidime/Avibactam Registry Study Group. Ceftazidime/avibactam in the era of carbapenemase-producing *Klebsiella pneumoniae*: experience from a national registry study. *J Antimicrob Chemother.* 2021;76(3):775-783.
63. Haidar G, Clancy CJ, Chen L, et al. Identifying spectra of activity and therapeutic niches for ceftazidime-avibactam and imipenem-relebactam against carbapenem-resistant *Enterobacteriaceae*. *Antimicrob Agents Chemother.* 2017;61(9):e00642-17.
64. Bianco G, Boattini M, Iannaccone M, et al. Bloodstream infection by two subpopulations of *Klebsiella pneumoniae* ST1685 carrying KPC-33 or KPC-14 following ceftazidime/avibactam treatment: considerations regarding acquired heteroresistance and choice of carbapenemase detection assay. *J Antimicrob Chemother.* 2020;75(10):3075-6.
65. Louise A, Maynard M, Duncanson B, et al. Determination of the dynamically linked indices of fosfomycin for *Pseudomonas aeruginosa* in the hollow fiber infection model. *Antimicrob Agents Chemother.* 2018;62(6):e02627-17.
66. Shields RK, Nguyen MH, Hao B, et al. Colistin does not potentiate ceftazidime-avibactam killing of carbapenem-resistant *Enterobacteriaceae* in vitro or suppress emergence of ceftazidime-avibactam resistance. *Antimicrob Agents Chemother.* 2018;62(8):e01018-18.
67. Lomovskaya O, Sun D, Rubio-Aparicio D, et al. Vaborbactam: spectrum of β -lactamase inhibition and impact of resistance mechanisms on activity in *Enterobacteriaceae*. *Antimicrob Agents Chemother.* 2017;61(11):e01443-17.
68. Pogue JM, Bonomo RA, Kaye KS. Ceftazidime/avibactam, meropenem/vaborbactam or both? Clinical and formulary considerations. *Clin Infect Dis.* 2019;68(3):519-24.
69. Noval M, Banoub M, Claeys KC, Heil E. The Battle Is On: new beta-lactams for the treatment of multidrug-resistant Gram-negative organisms. *Curr Infect Dis Rep.* 2020;22(1):1.
70. Dulyayangkul P, Wan Nur Ismah WAK, Douglas EJA, Avison MB. Mutation of *kvrA* causes OmpK35 and OmpK36 porin downregulation and reduced meropenem-vaborbactam susceptibility in KPC-producing *Klebsiella pneumoniae*. *Antimicrob Agents Chemother.* 2020;64(7):e02208-19.
71. Dulyayangkul P, Douglas EJA, Lastovka F, Avison MB. Resistance to ceftazidime/avibactam plus meropenem/ vaborbactam when both are used together is achieved in four steps in metallo- β -lactamase-negative *Klebsiella pneumoniae*. *Antimicrob Agents Chemother.* 2020;64(10):e00409-20.

72. Karlowsky JA, Lob SH, Kazmierczak KM, et al. In vitro activity of imipenem/relebactam against Gram-negative ESKAPE pathogens isolated in 17 European countries: 2015 SMART surveillance programme. *J Antimicrob Chemother.* 2018;73(7):1872-9.
73. Karaikos I, Galani I, Souli M, Giannarellou H. Novel β -lactam- β -lactamase inhibitor combinations: expectations for the treatment of carbapenem-resistant Gram-negative pathogens. *Expert Opin Drug Metab Toxicol.* 2019;15(2):133-49.
74. Noinaj N, Guillier M, Barnard TJ, Buchanan SK. TonB-dependent transporters: regulation, structure, and function. *Annu Rev Microbiol.* 2010;64:43-60.
75. Kazmierczak KM, Tsuji M, Wise MG, et al. In vitro activity of cefiderocol, a siderophore cephalosporin, against a recent collection of clinically relevant carbapenem-non-susceptible Gram-negative bacilli, including serine carbapenemase- and metallo- β -lactamase-producing isolates (SIDERO-WT-2014 Study). *Int J Antimicrob Agents.* 2019;53(2):177-84.
76. Delgado-Valverde M, Conejo MDC, Serrano L, et al. Activity of cefiderocol against high-risk clones of multidrug-resistant Enterobacteriales, Acinetobacter baumannii, Pseudomonas aeruginosa and Stenotrophomonas maltophilia. *J Antimicrob Chemother.* 2020;75(7):1840-9.
77. Mushtaq A, Sadouki Z, Vickers A, et al. In vitro activity of cefiderocol, a siderophore cephalosporin, against multidrug-resistant Gram-negative bacteria. *Antimicrob Agents Chemother.* 2020;64(12):e01582-20.
78. Lin CS, Tsai YH, Chang CJ, et al. An iron detection system determines bacterial swarming initiation and biofilm formation. *Sci Rep.* 2016;6:36747.
79. Wu Y, Outten FW. IscR controls iron-dependent biofilm formation in *Escherichia coli* by regulating type I fimbria expression. *J Bacteriol.* 2009;191(4):1248-57.
80. Pybus CA, Felder-Scott C, Obuekwe V, Greenberg DE. Cefiderocol retains antibiofilm activity in multidrug-resistant Gram-negative pathogens. *Antimicrob Agents Chemother.* 2021;65(2):e01194-20.
81. Wunderink RG, Matsunaga Y, Ariyasu M, et al. Cefiderocol versus high-dose, extended-infusion meropenem for the treatment of Gram-negative nosocomial pneumonia (APEKS-NP): a randomised, double-blind, phase 3, non-inferiority trial. *Lancet Infect Dis.* 2021;21(2):213-25.
82. Wu JY, Srinivas P, Pogue JM. Cefiderocol: a novel agent for the management of multidrug-resistant Gram-negative organisms. *Infect Dis Ther.* 2020;9(1):17-40.
83. Gatti M, Pea F. Pharmacokinetic/pharmacodynamic target attainment in critically ill renal patients on antimicrobial usage: focus on novel beta-lactams and beta lactams/beta-lactamase inhibitors. *Expert Rev Clin Pharmacol.* 2021;14(5):583-99.
84. Kawaguchi N, Katsube T, Echols R, Wajima T. Population pharmacokinetic and pharmacokinetic/ pharmacodynamic analyses of cefiderocol, a parenteral siderophore cephalosporin, in patients with pneumonia, bloodstream infection/ sepsis, or complicated urinary tract infection. *Antimicrob Agents Chemother.* 2021;65(3):e01437-20.
85. Georges B, Conil JM, Seguin T, et al. Population pharmacokinetics of ceftazidime in intensive care unit patients: influence of glomerular filtration rate, mechanical ventilation, and reason for admission. *Antimicrob Agents Chemother.* 2009;53(10):4483-9.
86. Katsube T, Kawaguchi N, Echols R, et al. Cefiderocol population pharmacokinetics and probability of target attainment in plasma and epithelial lining fluid in patients with pneumonia, blood-stream infection/sepsis, or complicated urinary tract infections. *Open Forum Infectious Diseases.* Volume 7, Issue Supplement_1, October 2020, Page S665.
87. Yuan Q, He L, Ke H. A potential substrate binding conformation of β -lactams and insight into the broad spectrum of NDM-1 activity. *Antimicrob Agents Chemother.* 2012;56(10):5157-63.
88. Jean SS, Gould IM, Lee WS, Hsueh PR; International Society of Antimicrobial Chemotherapy (ISAC). New drugs for multidrug-resistant Gram-negative organisms: time for stewardship. *Drugs.* 2019;79(7):705-14.

89. Lodise TP, Smith NM, O'Donnell N, et al. Determining the optimal dosing of a novel combination regimen of ceftazidime-avibactam with aztreonam against NDM-1-producing Enterobacteriaceae using a hollow-fibre infection model. *J Antimicrob Chemother.* 2020;75(9):2622-32.
90. Biagi M, Wu T, Lee M, et al. Searching for the optimal treatment for metallo- and serine- β -lactamase producing Enterobacteriaceae: aztreonam in combination with ceftazidime-avibactam or meropenem-vaborbactam. *Antimicrob Agents Chemother.* 2019;63(12):e01426-19.
91. Boyd SE, Livermore DM, Hooper DC, Hope WW. Metallo- β -lactamases: structure, function, epidemiology, treatment options, and the development pipeline. *Antimicrob Agents Chemother.* 2020;64(10):e00397-20.
92. Hamrick JC, Docquier JD, Uehara T, et al. VNRX-5133 (taniborbactam), a broad-spectrum inhibitor of serine- and metallo- β -lactamases, restores activity of cefepime in Enterobacteriales and *Pseudomonas aeruginosa*. *Antimicrob Agents Chemother.* 2020;64(3):e01963-19.
93. Castanheira M, Deshpande LM, Mendes RE, et al. Variations in the occurrence of resistance phenotypes and carbapenemase genes among Enterobacteriaceae isolates in 20 years of the SENTRY antimicrobial surveillance program. *Open Forum Infect Dis.* 2019;6(Suppl 1):S23-S33.
94. Sousa A, Pérez-Rodríguez MT, Soto A, et al. Effectiveness of ceftazidime/avibactam as salvage therapy for treatment of infections due to OXA-48 carbapenemase-producing Enterobacteriaceae. *J Antimicrob Chemother.* 2018;73(11):3170-5.
95. Hirvonen VHA, Spencer J, van der Kamp MW. Antimicrobial resistance conferred by OXA-48 β -lactamases: towards a detailed mechanistic understanding. *Antimicrob Agents Chemother.* 2021;65(6):e00184-21.
96. de Jonge BL, Karlowsky JA, Kazmierczak KM, et al. In vitro susceptibility to ceftazidime-avibactam of carbapenem-non-susceptible Enterobacteriaceae isolates collected during the INFORM Global Surveillance Study (2012 to 2014). *Antimicrob Agents Chemother.* 2016;60(5):3163-9.
97. Hrabák J, Chudáčková E, Papagiannitsis CC. Detection of carbapenemases in Enterobacteriaceae: a challenge for diagnostic microbiological laboratories. *Clin Microbiol Infect.* 2014;20(9):839-53.
98. Aktaş Z, Kayacan C, Onçul O. In vitro activity of avibactam (NXL104) in combination with β -lactams against Gram-negative bacteria, including OXA-48 β -lactamase-producing *Klebsiella pneumoniae*. *Int J Antimicrob Agents.* 2012;39(1):86-9.
99. Breidenstein EB, de la Fuente-Núñez C, Hancock RE. *Pseudomonas aeruginosa*: all roads lead to resistance. *Trends Microbiol.* 2011;19(8):419-26.
100. Walkty A, Lagace-Wiens P, Adam H, et al. Antimicrobial susceptibility of 2906 *Pseudomonasaeruginosa* clinical isolates obtained from patients in Canadian hospitals over a period of 8 years: Results of the Canadian Ward surveillance study (CANWARD), 2008-2015. *Diagn Microbiol Infect Dis.* 2017;87(1):60-3.
101. European Centre for Disease Prevention and Control (ECDC). 2015. Antimicrobial resistance surveillance in Europe 2015. Annual report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). Available at: <https://www.ecdc.europa.eu/en/publications-data/antimicrobial-resistance-surveillance-europe-2015>.
102. Grosjean M, Tazourt S, Bour M, et al. Reassessment of the cooperativity between efflux system MexAB-OprM and cephalosporinase AmpC in the resistance of *Pseudomonas aeruginosa* to β -lactams. *J Antimicrob Chemother.* 2021;76(2):536-9.
103. Wi YM, Greenwood-Quaintance KE, Schuetz AN, et al. Activity of ceftolozane-tazobactam against carbapenem-resistant, non-carbapenemase-producing *Pseudomonas aeruginosa* and associated resistance mechanisms. *Antimicrob Agents Chemother.* 2017;62(1):e01970-17.
104. Li XZ, Plésiat P, Nikaido H. The challenge of efflux-mediated antibiotic resistance in Gram-negative bacteria. *Clin Microbiol Rev.* 2015;28(2):337-418.

105. Juan C, Torrens G, González-Nicolau M, Oliver A. Diversity and regulation of intrinsic β -lactamases from non-fermenting and other Gram-negative opportunistic pathogens. *FEMS Microbiol Rev.* 2017;41(6):781-815.
106. Moya B, Juan C, Alberti S, et al. Benefit of having multiple ampD genes for acquiring beta-lactam resistance without losing fitness and virulence in *Pseudomonas aeruginosa*. *Antimicrob Agents Chemother.* 2008;52(10):3694-700.
107. European Committee on Antimicrobial Susceptibility Testing (EUCAST) - Breakpoint tables for interpretation of MICs and zone diameters. Version 9.0, valid from 2019-01-01. Available at: https://www.eucast.org/fileadmin/src/media/PDFs/EUCAST_files/Breakpoint_tables/v_9.0_Breakpoint_Tables.pdf.
108. Riera E, Cabot G, Mulet X, et al. *Pseudomonas aeruginosa* carbapenem resistance mechanisms in Spain: impact on the activity of imipenem, meropenem and doripenem. *J Antimicrob Chemother.* 2011;66(9):2022-7.
109. Gomis-Font MA, Cabot G, Sánchez-Diener I, et al. In vitro dynamics and mechanisms of resistance development to imipenem and imipenem/relebactam in *Pseudomonas aeruginosa*. *J Antimicrob Chemother.* 2020;75(9):2508-15.
110. Iregui A, Khan Z, Landman D, Quale J. Activity of ceftazidime against Enterobacterales, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii* endemic to Medical Centers in New York City. *Microb Drug Resist.* 2020;26(7):722-6.
111. Zerbaxa, INN-ceftazidime sulfate/tazobactam sodium. Available at: https://www.ema.europa.eu/en/documents/product-information/zerbaxa-epar-product-information_it.pdf.
112. Escolà-Vergé L, Pigrau C, Almirante B. Ceftazidime/tazobactam for the treatment of complicated intra-abdominal and urinary tract infections: current perspectives and place in therapy. *Infect Drug Resist.* 2019;12:1853-67.
113. Moya B, Zamorano L, Juan C, et al. Activity of a new cephalosporin, CXA-101 (FR264205), against beta-lactam-resistant *Pseudomonas aeruginosa* mutants selected in vitro and after antipseudomonal treatment of intensive care unit patients. *Antimicrob Agents Chemother.* 2010;54(3):1213-7.
114. Zhanell GG, Chung P, Adam H, et al. Ceftazidime/tazobactam: a novel cephalosporin/ β -lactamase inhibitor combination with activity against multidrug-resistant gram-negative bacilli. *Drugs.* 2014;74(1):31-51.
115. Cabot G, Bruchmann S, Mulet X, et al. *Pseudomonas aeruginosa* ceftazidime-tazobactam resistance development requires multiple mutations leading to overexpression and structural modification of AmpC. *Antimicrob Agents Chemother.* 2014;58(6):3091-9.
116. Fraile-Ribot PA, Zamorano L, Orellana R, et al; GEMARA-SEIMC/REIPI *Pseudomonas* Study Group. Activity of imipenem-relebactam against a large collection of *Pseudomonas aeruginosa* clinical isolates and isogenic β -lactam-resistant mutants. *Antimicrob Agents Chemother.* 2020;64(2):e02165-19.
117. Fournier D, Carrière R, Bour M, et al; GERPA Study Group. Mechanisms of resistance to ceftazidime/tazobactam in *Pseudomonas aeruginosa*: results of the GERPA multicenter study. *Antimicrob Agents Chemother.* 2021;65(2):e01117-20.
118. RECARBIO, INN-imipenem/cilastatin/relebactam. Available at: https://www.ema.europa.eu/en/documents/product-information/recarbio-epar-product-information_it.pdf.
119. Campanella T, Gallagher JC. A clinical review and critical evaluation of imipenem-relebactam: evidence to date. *Infect Drug Resist.* 2020;13:4297-308.
120. Horcajada JP, Montero M, Oliver A, et al. Epidemiology and treatment of multidrug-resistant and extensively drug-resistant *Pseudomonas aeruginosa* infections. *Clin Microbiol Rev.* 2019;32(4):e00031-19.
121. Clancy C, Potoski B, Shields R, Nguyen M. A formal antimicrobial stewardship intervention programme targeting carbapenem-resistant *Klebsiella pneumoniae* (CRKP) bacteraemia improved mortality, shortened lengths of stay, and reduced costs over a three-year period. *ECCMID 2017 – P1146.*
122. Vázquez-Ucha JC, Arca-Suárez J, Bou G, Beceiro A. New carbapenemase inhibitors: clearing the way for the β -Lactams. *Int J Mol Sci.* 2020;21(23):9308.
123. Heo YA. Imipenem/cilastatin/relebactam: a review in Gram-negative bacterial infections. *Drugs.* 2021;81(3):377-88.

124. Dimelow R, Wright JG, MacPherson M, et al. Population pharmacokinetic modelling of ceftazidime and avibactam in the plasma and epithelial lining fluid of healthy volunteers. *Drugs R D.* 2018;18(3):221-30.
125. Zavicefta, INN-ceftazidime/avibactam. Available at: https://www.ema.europa.eu/en/documents/product-information/zavicefta-epar-product-information_it.pdf.
126. van Duin D, Bonomo RA. Ceftazidime/avibactam and ceftolozane/tazobactam: second-generation β -lactam/ β -lactamase inhibitor combinations. *Clin Infect Dis.* 2016;63(2):234-41.
127. Yahav D, Giske CG, Grämatniece A, et al. New β -lactam- β -lactamase inhibitor combinations. *Clin Microbiol Rev.* 2020;34(1):e00115-20.
128. Asli A, Brouillet E, Krause KM, et al. Distinctive binding of avibactam to penicillin-binding proteins of Gram-negative and Gram-positive bacteria. *Antimicrob Agents Chemother.* 2015;60(2):752-6.
129. López-Argüello S, Montaner M, Oliver A, Moya B. Molecular basis of AmpC β -lactamase induction by avibactam in *Pseudomonas aeruginosa*: PBP occupancy, live cell binding dynamics and impact on resistant clinical isolates harboring PDC-X variants. *Int J Mol Sci.* 2021;22(6):3051.
130. ClinicalTrial.Gov. Aztreonam avibactam. Available at: <https://clinicaltrials.gov/ct2/results?cond=&term=aztreonam+avibactam&cntry=&state=&city=&dist=>.
131. Cies JJ, LaCoursiere RJ, Moore WS 2nd, Chopra A. Therapeutic drug monitoring of prolonged infusion aztreonam for multi-drug resistant *Pseudomonas aeruginosa*: a case report. *J Pediatr Pharmacol Ther.* 2017;22(6):467-70.
132. Karlowsky JA, Kazmierczak KM, de Jonge BLM, et al. In Vitro activity of Aztreonam-Avibactam against Enterobacteriaceae and *Pseudomonas aeruginosa* isolated by clinical laboratories in 40 Countries from 2012 to 2015. *Antimicrob Agents Chemother.* 2017;61(9):e00472-17.
133. Davies TA, Shang W, Bush K, Flamm RK. Affinity of doripenem and comparators to penicillin-binding proteins in *Escherichia coli* and *Pseudomonas aeruginosa*. *Antimicrob Agents Chemother.* 2008;52(4):1510-2.
134. Fetcroja, INN-cefiderocol. Available at: https://www.ema.europa.eu/en/documents/product-information/fetcroja-e-par-product-information_it.pdf.
135. Giacobbe DR, Ciacco E, Girmenia C, et al; ISGRI-SITA (Italian Study Group on Resistant Infections of the Italian Society of Anti-infective Therapy). Evaluating cefiderocol in the treatment of multidrug-resistant Gram-negative bacilli: a review of the emerging data. *Infect Drug Resist.* 2020;13:4697-711.
136. Katsuma T, Kawaguchi N, Matsunaga Y, et al. Pharmacokinetic/pharmacodynamic analyses of cefiderocol in critically ill patients. *OFID* 2020; 7(Suppl 1): S669-S670.
137. Ito A, Nishikawa T, Ota M, et al. Stability and low induction propensity of cefiderocol against chromosomal AmpC β -lactamases of *Pseudomonas aeruginosa* and *Enterobacter cloacae*. *J Antimicrob Chemother.* 2018;73(11):3049-52.
138. Ito A, Sato T, Ota M, et al. In Vitro antibacterial properties of cefiderocol, a novel siderophore cephalosporin, against Gram-negative bacteria. *Antimicrob Agents Chemother.* 2017;62(1):e01454-17.
139. Streling AP, Al Obaidi MM, Lainhart WD, et al. Evolution of cefiderocol non-susceptibility in *Pseudomonas aeruginosa* in a patient without previous exposure to the antibiotic. *Clin Infect Dis.* 2021 Jan 7:ciaa1909.
140. Patel G, Bonomo RA. Status report on carbapenemases: challenges and prospects. *Expert Rev Anti Infect Ther.* 2011;9(5):555-70.
141. Botelho J, Grosso F, Peixe L. Unravelling the genome of a *Pseudomonas aeruginosa* isolate belonging to the high-risk clone ST235 reveals an integrative conjugative element housing a blaGES-6 carbapenemase. *J Antimicrob Chemother.* 2018;73(1):77-83.
142. Recio R, Villa J, Viedma E, et al. Bacteraemia due to extensively drug-resistant *Pseudomonas aeruginosa* sequence type 235 high-risk clone: facing the perfect storm. *Int J Antimicrob Agents.* 2018;52(2):172-9.

143. Castón JJ, De la Torre Á, Ruiz-Camps I, et al. Salvage therapy with ceftolozane-tazobactam for multidrug-resistant *Pseudomonas aeruginosa* infections. *Antimicrob Agents Chemother.* 2017;61(3):e02136-16.
144. Haidar G, Philips NJ, Shields RK, et al. Ceftolozane/tazobactam for the treatment of multidrug-resistant *Pseudomonas aeruginosa* infections: clinical effectiveness and evolution of resistance. *Clin Infect Dis.* 2017;65(1):110-20.
145. Munita JM, Aitken SL, Miller WR, et al. Multicenter evaluation of ceftolozane/tazobactam for serious infections caused by carbapenem-resistant *Pseudomonas aeruginosa*. *Clin Infect Dis.* 2017;65(1):158-61.
146. Gallagher JC, Satlin MJ, Elabor A, et al. Ceftolozane-tazobactam for the treatment of multidrug-resistant *Pseudomonas aeruginosa* infections: a multicenter study. *Open Forum Infect Dis.* 2018;5(11):ofy280.
147. Bassetti M, Castaldo N, Cattelan A, et al; CEFTABUSE Study Group. Ceftolozane/tazobactam for the treatment of serious *Pseudomonas aeruginosa* infections: a multicentre nationwide clinical experience. *Int J Antimicrob Agents.* 2019;53(4):408-15.
148. Kalil AC, Metersky ML, Klompas M, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. *Clin Infect Dis.* 2016;63(5):e61-e111.
149. Langer M, Cigada M, Mandelli M, et al. Early onset pneumonia: a multicenter study in intensive care units. *Intensive Care Med.* 1987;13(5):342-6.
150. Torres A, Niederman MS, Chastre J, et al. International ERS/ESICM/ESCMID/ALAT guidelines for the management of hospital-acquired pneumonia and ventilator-associated pneumonia: Guidelines for the management of hospital-acquired pneumonia (HAP)/ventilator-associated pneumonia (VAP) of the European Respiratory Society (ERS), European Society of Intensive Care Medicine (ESICM), European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and Asociación Latinoamericana del Tórax (ALAT). *Eur Respir J.* 2017;50(3):1700582.
151. Kollef MH, Nováček M, Kivistik Ü, et al. Ceftolozane-tazobactam versus meropenem for treatment of nosocomial pneumonia (ASPECT-NP): a randomised, controlled, double-blind, phase 3, non-inferiority trial. *Lancet Infect Dis.* 2019;19(12):1299-311.
152. Xiao AJ, Miller BW, Huntington JA, Nicolau DP. Ceftolozane/tazobactam pharmacokinetic/pharmacodynamic-derived dose justification for phase 3 studies in patients with nosocomial pneumonia. *J Clin Pharmacol.* 2016;56(1):56-66.
153. Talbot GH, Das A, Cush S, et al; Foundation for the National Institutes of Health Biomarkers Consortium HABP/VABP Project Team. Evidence-based study design for hospital-acquired bacterial pneumonia and ventilator-associated bacterial pneumonia. *J Infect Dis.* 2019;219(10):1536-44.
154. Giani T, Arena F, Pollini S, et al; *Pseudomonas aeruginosa* Working Group. Italian nationwide survey on *Pseudomonas aeruginosa* from invasive infections: activity of ceftolozane/tazobactam and comparators, and molecular epidemiology of carbapenemase producers. *J Antimicrob Chemother.* 2018;73(3):664-71.
155. Carmeli Y, Armstrong J, Laud PJ, et al. Ceftazidime-avibactam or best available therapy in patients with ceftazidime-resistant Enterobacteriaceae and *Pseudomonas aeruginosa* complicated urinary tract infections or complicated intra-abdominal infections (REPRISE): a randomised, pathogen-directed, phase 3 study. *Lancet Infect Dis.* 2016;16(6):661-73.
156. Rodríguez-Núñez O, Ripa M, Morata L, et al. Evaluation of ceftazidime/avibactam for serious infections due to multidrug-resistant and extensively drug-resistant *Pseudomonas aeruginosa*. *J Glob Antimicrob Resist.* 2018;15:136-9.
157. Torres A, Zhong N, Pachl J, et al. Ceftazidime-avibactam versus meropenem in nosocomial pneumonia, including ventilator-associated pneumonia (REPROVE): a randomised, double-blind, phase 3 non-inferiority trial. *Lancet Infect Dis.* 2018;18(3):285-95.
158. Matsumoto S, Singley CM, Hoover J, et al. Efficacy of ceferodrol against carbapenem-resistant Gram-negative bacilli in immunocompetent-rat respiratory tract infection models recreating human plasma pharmacokinetics. *Antimicrob Agents Chemother.* 2017;61(9):e00700-17.

- 159.** Hackel MA, Tsuji M, Yamano Y, et al. In vitro activity of the siderophore cephalosporin, cefiderocol, against carbapenem-nonsusceptible and multidrug-resistant isolates of Gram-negative bacilli collected worldwide in 2014 to 2016. *Antimicrob Agents Chemother*. 2018;62(2):e01968-17.
- 160.** Bassetti M, Echols R, Matsunaga Y, et al. Efficacy and safety of cefiderocol or best available therapy for the treatment of serious infections caused by carbapenem-resistant Gram-negative bacteria (CREDIBLE-CR): a randomised, open-label, multicentre, pathogen-focused, descriptive, phase 3 trial. *Lancet Infect Dis*. 2021;21(2):226-40.
- 161.** Portsmouth S, van Veenhuizen D, Echols R, et al. Cefiderocol versus imipenem-cilastatin for the treatment of complicated urinary tract infections caused by Gram-negative uropathogens: a phase 2, randomised, double-blind, non-inferiority trial. *Lancet Infect Dis*. 2018;18(12):1319-28.
- 162.** Karlowsky JA, Lob SH, Young K, et al. Activity of imipenem/relebactam against *Pseudomonas aeruginosa* with antimicrobial-resistant phenotypes from seven global regions: SMART 2015-2016. *J Glob Antimicrob Resist*. 2018;15:140-7.
- 163.** Mushtaq S, Meunier D, Vickers A, et al. Activity of imipenem/relebactam against *Pseudomonas aeruginosa* producing ESBLs and carbapenemases. *J Antimicrob Chemother*. 2021;76(2):434-42.
- 164.** Johnston BD, Thuras P, Porter SB, et al. Activity of imipenem-relebactam against carbapenem-resistant *Escherichia coli* isolates from the United States in relation to clonal background, resistance genes, coresistance, and region. *Antimicrob Agents Chemother*. 2020;64(5):e02408-19.
- 165.** Rhee EG, Rizk ML, Calder N, et al. Pharmacokinetics, safety, and tolerability of single and multiple doses of relebactam, a β -lactamase inhibitor, in combination with imipenem and cilastatin in healthy participants. *Antimicrob Agents Chemother*. 2018;62(9):e00280-18.
- 166.** Rizk ML, Rhee EG, Jumes PA, et al. Intrapulmonary pharmacokinetics of relebactam, a novel β -lactamase inhibitor, dosed in combination with imipenem-cilastatin in healthy subjects. *Antimicrob Agents Chemother*. 2018;62(3):e01411-17.
- 167.** Lucasti C, Vasile L, Sandesc D, et al. Phase 2, dose-ranging study of relebactam with imipenem-cilastatin in subjects with complicated intra-abdominal infection. *Antimicrob Agents Chemother*. 2016;60(10):6234-43.
- 168.** Sims M, Mariyanovski V, McLeroy P, et al. Prospective, randomized, double-blind, Phase 2 dose-ranging study comparing efficacy and safety of imipenem/cilastatin plus relebactam with imipenem/cilastatin alone in patients with complicated urinary tract infections. *J Antimicrob Chemother*. 2017;72(9):2616-26.
- 169.** Motsch J, Murta de Oliveira C, Stus V, et al. RESTORE-IMI 1: A Multicenter, randomized, double-blind trial comparing efficacy and safety of imipenem/relebactam vs colistin plus imipenem in patients with imipenem-nonsusceptible bacterial infections. *Clin Infect Dis*. 2020;70(9):1799-808.
- 170.** Titov I, Wunderink RG, Roquilly A, et al. A randomized, double-blind, multicenter trial comparing efficacy and safety of imipenem/cilastatin/relebactam versus piperacillin/tazobactam in adults with hospital-acquired or ventilator-associated bacterial pneumonia (RESTORE-IMI 2 Study). *Clin Infect Dis*. 2020 Aug 12:ciaa803.
- 171.** Wenzler E, Deraedt MF, Harrington AT, Danziger LH. Synergistic activity of ceftazidime-avibactam and aztreonam against serine and metallo- β -lactamase-producing gram-negative pathogens. *Diagn Microbiol Infect Dis*. 2017;88(4):352-4.
- 172.** Lee M, Abbey T, Biagi M, Wenzler E. Activity of aztreonam in combination with ceftazidime-avibactam against serine- and metallo- β -lactamase-producing *Pseudomonas aeruginosa*. *Diagn Microbiol Infect Dis*. 2021;99(1):115227.
- 173.** Davido B, Fellous L, Lawrence C, et al. Ceftazidime-avibactam and aztreonam, an interesting strategy to overcome β -lactam resistance conferred by metallo- β -lactamases in Enterobacteriaceae and *Pseudomonas aeruginosa*. *Antimicrob Agents Chemother*. 2017;61(9):e01008-17.
- 174.** Mularoni A, Mezzatesta ML, Pilato M, et al. Combination of aztreonam, ceftazidime-avibactam and amikacin in the treatment of VIM-1 *Pseudomonas aeruginosa* ST235 osteomyelitis. *Int J Infect Dis*. 2021;108:510-2.
- 175.** Cornely OA, Cisneros JM, Torre-Cisneros J, et al; COMBACTE-CARE consortium/REJUVENATE Study Group. Pharmacoki-

- netics and safety of aztreonam/avibactam for the treatment of complicated intra-abdominal infections in hospitalized adults: results from the REJUVENATE study. *J Antimicrob Chemother.* 2020;75(3):618-27.
- 176.** Edeki T, Zhou D, van den Berg F, et al. A phase I, 3-part placebo-controlled randomised trial to evaluate the safety, tolerability and pharmacokinetics of aztreonam-avibactam in healthy subjects. 26th European Congress of Clinical Microbiology and Infectious Diseases (ECCMID), Amsterdam, The Netherlands, 2016. Poster EV0643.
- 177.** Harding CM, Hennon SW, Feldman MF. Uncovering the mechanisms of *Acinetobacter baumannii* virulence. *Nat Rev Microbiol.* 2018;16(2):91-102.
- 178.** Sarshar M, Behzadi P, Scribano D, et al. *Acinetobacter baumannii*: an ancient commensal with weapons of a pathogen. *Pathogens.* 2021;10(4):387.
- 179.** Krasauskas R, Skerniškytė J, Armalytė J, Sužiedėliūnė E. The role of *Acinetobacter baumannii* response regulator BfmR in pellicle formation and competitiveness via contact-dependent inhibition system. *BMC Microbiol.* 2019;19(1):241.
- 180.** Pakharukova N, Tuittila M, Paavilainen S, et al. Structural basis for *Acinetobacter baumannii* biofilm formation. *Proc Natl Acad Sci U S A.* 2018;115(21):5558-63.
- 181.** Cerqueira GM, Kostoulias X, Khoo C, et al. A global virulence regulator in *Acinetobacter baumannii* and its control of the phenylacetic acid catabolic pathway. *J Infect Dis.* 2014;210(1):46-55.
- 182.** O'Shea MK. *Acinetobacter* in modern warfare. *Int J Antimicrob Agents.* 2012;39(5):363-75.
- 183.** Chang HC, Chen YC, Lin MC, et al. Mortality risk factors in patients with *Acinetobacter baumannii* ventilator-associated pneumonia. *J Formos Med Assoc.* 2011;110(9):564-71.
- 184.** Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 9th Edition. Elsevier - Health Sciences Division, 2020.
- 185.** Tsai HY, Cheng A, Liu CY, et al. Bacteremia caused by *Acinetobacter junii* at a medical center in Taiwan, 2000-2010. *Eur J Clin Microbiol Infect Dis.* 2012;31(10):2737-43.
- 186.** Hujer KM, Hamza NS, Hujer AM, et al. Identification of a new allelic variant of the *Acinetobacter baumannii* cephalosporinase, ADC-7 beta-lactamase: defining a unique family of class C enzymes. *Antimicrob Agents Chemother.* 2005;49(7):2941-8.
- 187.** Ingati B, Upadhyay S, Hazarika M, et al. Distribution of carbapenem resistant *Acinetobacter baumannii* with bla ADC-30 and induction of ADC-30 in response to beta-lactam antibiotics. *Res Microbiol.* 2020;171(3-4):128-33.
- 188.** Higgins PG, Pérez-Llarena FJ, Zander E, et al. OXA-235, a novel class D beta-lactamase involved in resistance to carbapenems in *Acinetobacter baumannii*. *Antimicrob Agents Chemother.* 2013;57(5):2121-6.
- 189.** Higgins PG, Poirel L, Lehmann M, et al. OXA-143, a novel carbapenem-hydrolyzing class D beta-lactamase in *Acinetobacter baumannii*. *Antimicrob Agents Chemother.* 2009;53(12):5035-8.
- 190.** Tascini C, Menichetti F, Bozza S, et al. Evaluation of the activities of two-drug combinations of rifampicin, polymyxin B and ampicillin/sulbactam against *Acinetobacter baumannii*. *J Antimicrob Chemother.* 1998;42(2):270-1.
- 191.** Diancourt L, Passet V, Nemec A, et al. The population structure of *Acinetobacter baumannii*: expanding multiresistant clones from an ancestral susceptible genetic pool. *PLoS One.* 2010;5(4):e10034.
- 192.** König C, Both A, Rohde H, et al. Cefiderocol in critically ill patients with multi-drug resistant pathogens: real-life data on pharmacokinetics and microbiological surveillance. *Antibiotics (Basel).* 2021;10(6):649.
- 193.** Doi Y. Treatment options for carbapenem-resistant Gram-negative bacterial infections. *Clin Infect Dis.* 2019;69(Suppl 7):S565-S575.
- 194.** Candel FJ, Henriksen AS, Longshaw C, et al. In vitro activity of the novel siderophore cephalosporin, cefiderocol, in Gram-negative pathogens in Europe by site of infection. *Clin Microbiol Infect.* 2021;S1198-743X(21)00410-9.
- 195.** Yamano Y. In vitro activity of cefiderocol against a broad range of clinically important Gram-negative bacteria. *Clin In-*

- fect Dis. 2019;69(Suppl 7):S544-S551.
196. Longshaw C, Manissero D, Tsuji M, et al. *In vitro* activity of the siderophore cephalosporin, cefiderocol, against molecularly characterized, carbapenem-non-susceptible Gram-negative bacteria from Europe. JAC Antimicrob Resist. 2020;2(3):dlaa060.
197. Poirel L, Sadek M, Nordmann P. Contribution of PER-type and NDM-type β -lactamases to cefiderocol resistance in *Acinetobacter baumannii*. Antimicrob Agents Chemother. 2021;AAC0087721.
198. Trecarichi EM, Quirino A, Scaglione V et al; IMAGES Group. Successful treatment with cefiderocol for compassionate use in a critically ill patient with XDR *Acinetobacter baumannii* and KPC-producing *Klebsiella pneumoniae*: a case report. J Antimicrob Chemother. 2019;74(11):3399-401.
199. Zingg S, Nicoletti GJ, Kuster S, et al. Cefiderocol for extensively drug-resistant Gram-negative bacterial infections: real-world experience from a case series and review of the literature. Open Forum Infect Dis. 2020;7(6):ofaa185.
200. Dagher M, Ruffin F, Marshall S, et al. Case report: successful rescue therapy of extensively drug-resistant *Acinetobacter baumannii* osteomyelitis with cefiderocol. Open Forum Infect Dis. 2020;7(5):ofaa150.
201. Falcone M, Tiseo G, Nicastro M, et al. Cefiderocol as rescue therapy for *Acinetobacter baumannii* and other carbapenem-resistant Gram-negative infections in Intensive Care Unit patients. Clin Infect Dis. 2021;72(11):2021-4.
202. Bavaro DF, Belati A, Diella L, et al. Cefiderocol-based combination therapy for "difficult-to-treat" Gram-negative severe infections: real-life case series and future perspectives. Antibiotics (Basel). 2021;10(6):652.
203. Oliva A, Ceccarelli G, De Angelis M, et al. Cefiderocol for compassionate use in the treatment of complicated infections caused by extensively and pan-resistant *Acinetobacter baumannii*. J Glob Antimicrob Resist. 2020;23:292-6.
204. Penwell WF, Shapiro AB, Giacobbe RA, et al. Molecular mechanisms of sulbactam antibacterial activity and resistance determinants in *Acinetobacter baumannii*. Antimicrob Agents Chemother. 2015;59(3):1680-9.
205. Mohd Sazly Lim S, Heffernan AJ, Roberts JA, Sime FB. Semi-mechanistic PK/PD modelling of fosfomycin and sulbactam combination against carbapenem-resistant *Acinetobacter baumannii*. Antimicrob Agents Chemother. 2021;65(5):e02472-20.
206. Yang Y, Xu Q, Li T, et al. OXA-23 is a prevalent mechanism contributing to sulbactam resistance in diverse *Acinetobacter baumannii* clinical strains. Antimicrob Agents Chemother. 2018;63(1):e01676-18.
207. Pasteran F, Cedano J, Baez M, et al. A new twist: the combination of sulbactam/avibactam enhances sulbactam activity against Carbapenem-Resistant *Acinetobacter baumannii* (CRAB) isolates. Antibiotics (Basel). 2021;10(5):577.
208. Geisinger E, Mortman NJ, Dai Y, et al. Antibiotic susceptibility signatures identify potential antimicrobial targets in the *Acinetobacter baumannii* cell envelope. Nat Commun. 2020;11(1):4522.
209. Abdul-Mutakabbir JC, Nguyen L, Maassen PT, et al. In vitro antibacterial activity of cefiderocol against multidrug-resistant *Acinetobacter baumannii*. Antimicrob Agents Chemother. 2021;65(9):e0264620.
210. Drawz SM, Bonomo RA. Three decades of beta-lactamase inhibitors. Clin Microbiol Rev. 2010;23(1):160-201.
211. Bullitta J, Shan J, Moya B, et al. First comprehensive penicillin-binding protein (PBP) occupancy patterns of beta-lactams in *Acinetobacter baumannii* (AB). P1531, ECCMID 2018.
212. Yamano Y, Takemura M, Anan N, et al. 1626. Synergistic Effect of Cefiderocol with Other Antibiotics Against PER-Producing *Acinetobacter baumannii* Isolates from the Multinational SIDERO-WT Studies. Open Forum Infectious Diseases, Volume 7, Issue Supplement_1, October 2020, Page S805.
213. Jung SY, Lee SH, Lee SY, et al. Antimicrobials for the treatment of drug-resistant *Acinetobacter baumannii* pneumonia in critically ill patients: a systematic review and Bayesian network meta-analysis. Crit Care. 2017;21(1):319.
214. Liu J, Shu Y, Zhu F, et al. Comparative efficacy and safety of combination therapy with high-dose sulbactam or colistin with additional antibacterial agents for multiple drug-resistant and extensively drug-resistant *Acinetobacter baumannii*

- infections: a systematic review and network meta-analysis. *J Glob Antimicrob Resist.* 2021;24:136-47.
- 215.** Busey K, Ferreira J, Aldridge P, et al. Treatment efficacy of ampicillin/sulbactam in comparison to alternative beta-lactams for severe *Acinetobacter baumannii* infections. *Infect Dis (Lond).* 2016;48(10):775-7.
- 216.** Karaikos I, Galani L, Baziaka F, Giannarellou H. Intraventricular and intrathecal colistin as the last therapeutic resort for the treatment of multidrug-resistant and extensively drug-resistant *Acinetobacter baumannii* ventriculitis and meningitis: a literature review. *Int J Antimicrob Agents.* 2013;41(6):499-508.
- 217.** Chusri S, Sakarunchai I, Kositpantawong N, et al. Outcomes of adjunctive therapy with intrathecal or intraventricular administration of colistin for post-neurosurgical meningitis and ventriculitis due to carbapenem-resistant *Acinetobacter baumannii*. *Int J Antimicrob Agents.* 2018;51(4):646-50.
- 218.** Zheng JY, Huang SS, Huang SH, Ye JJ. Colistin for pneumonia involving multidrug-resistant *Acinetobacter calcoaceticus-Acinetobacter baumannii* complex. *J Microbiol Immunol Infect.* 2020;53(6):854-65.
- 219.** Dalfino L, Puntillo F, Mosca A, et al. High-dose, extended-interval colistin administration in critically ill patients: is this the right dosing strategy? A preliminary study. *Clin Infect Dis.* 2012;54(12):1720-6.
- 220.** Durante-Mangoni E, Signoriello G, Andini R, et al. Colistin and rifampicin compared with colistin alone for the treatment of serious infections due to extensively drug-resistant *Acinetobacter baumannii*: a multicenter, randomized clinical trial. *Clin Infect Dis.* 2013;57(3):349-58.
- 221.** Paul M, Daikos GL, Durante-Mangoni E, et al. Colistin alone versus colistin plus meropenem for treatment of severe infections caused by carbapenem-resistant Gram-negative bacteria: an open-label, randomised controlled trial. *Lancet Infect Dis.* 2018;18(4):391-400.
- 222.** Russo A, Bassetti M, Ceccarelli G, et al; ISGRI-SITA (Italian Study Group on Resistant Infections of the Società Italiana Terapia Antinfettiva). Bloodstream infections caused by carbapenem-resistant *Acinetobacter baumannii*: Clinical features, therapy and outcome from a multicenter study. *J Infect.* 2019;79(2):130-8.
- 223.** Shao Hua SY, Jie H, Linlin H. Pharmacokinetics and drug concentration monitoring of high dose tigecycline in patients with septic shock. *J China Pharmaceut Univers.* 2017;48:721-6.
- 224.** Yang T, Mei H, Wang J, Cai Y. Therapeutic drug monitoring of tigecycline in 67 infected patients and a population pharmacokinetics/microbiological evaluation of *A. baumannii* study. *Front Microbiol.* 2021;12:678165.
- 225.** Beganovic M, Daffinee KE, Luther MK, LaPlante KL. Minocycline alone and in combination with polymyxin b, meropenem, and sulbactam against carbapenem-susceptible and -resistant *Acinetobacter baumannii* in an in vitro pharmacodynamic model. *Antimicrob Agents Chemother.* 2021;65(3):e01680-20.
- 226.** Sumyk M, Himpich S, Foong WE, et al. Binding of tetracyclines to *Acinetobacter baumannii* TetR involves two arginines as specificity determinants. *Front Microbiol.* 2021;12:711158.
- 227.** Seifert H, Müller C, Stefanik D, et al. In vitro activity of sulbactam/durlobactam against global isolates of carbapenem-resistant *Acinetobacter baumannii*. *J Antimicrob Chemother.* 2020;75(9):2616-21.
- 228.** Moussa SH, Shapiro AB, McLeod SM, Miller AA. Resistance to sulbactam-durlobactam in clinical isolates of *Acinetobacter baumannii* is rare and maps to PBP3. Presented at: Acinetobacter 2019, Frankfurt, September 2019.