IDSA 2010
212

Ceftaroline Activity Tested Against Common Organisms Causing Skin and Skin Structure Infections in USA Medical Centers in 2009

H.S. SADER, G.J. MOET, D.J. FARRELL, R.N. JONES

JMI Laboratories, North Liberty, Iowa, USA

Helio S. Sader, MD, PhD
JMI Laboratories
North Liberty, IA, USA
www.jmilabs.com
ph. 319.665.3370
fax 319.665.3371
helio-sader@jmilabs.com

Abstract

Background: Ceftaroline (CPT) is the active metabolite of CPT fosamil, an N-phosphonoamino water-soluble cephalosporin. CPT exhibits broad-spectrum activity against resistant (R) Gram-positive organisms, including methicillin-resistant *Staphylococcus aureus* (MRSA) and *Streptococcus pneumoniae*, and is in development for treatment of complicated skin and skin structure infections (cSSSI). We tested CPT and comparator agents against SSSI pathogens.

Methods: Unique (1 per patient) clinically significant isolates were consecutively collected from over 50 USA medical centers in 2009. Strains were tested for susceptibility (S) by CLSI broth microdilution against CPT and comparators currently available for treatment of SSSI.

Results: 50.4% of *S. aureus* isolates were MRSA. CPT was very active against oxacillin-S *S. aureus* (MSSA; MIC_{90}, 0.25 µg/mL) and MRSA (MIC_{90}, 1 µg/mL). Against MSSA, CPT was 16-, eight- and four-fold more active than ceftriaxone (CRO), linezolid (LZD) and vancomycin (VAN), respectively. The highest CPT MIC among MSSA was only 1 µg/mL; and 91.0% and 99.6% of strains were inhibited at ≤0.25 and ≤0.5 µg/mL, respectively. Among MRSA, 98.9% and 100.0% of strains were inhibited at 1 and 2 µg/mL of CPT, respectively. MRSA showed high R rates to levofloxacin (LEV; 58.0%) and clindamycin (30.3% [8.8% inducible R]). Against β-haemolytic streptococci (βHS), CPT was 64- and 32-fold more active than LZD and VAN, respectively, and all strains were inhibited at CPT concentration of ≤0.06 µg/mL. Viridans group streptococci (VGS) were very S to CPT, while 81.3% and 90.6% of strains were penicillin- and CRO-S, respectively. 95.7% of *Enterococcus faecalis* were inhibited by CPT at ≤4 µg/mL. CPT exhibited good activity against wild-type Enterobacteriaceae (MIC_{50}, 0.12 – 0.5 µg/mL), but limited activity against CRO-R and/or ESBL-producing strains.

Organism (no.)	Ceftaroline			Ceftriaxone			Levofloxacin			Clindamycin		
	MIC_{50}	MIC_{90}	% at ≤2	MIC_{50}	MIC_{90}	% Susc.	MIC_{50}	MIC_{90}	% Susc.	MIC_{50}	MIC_{90}	% Susc.
SA (561)	0.5	1	100.0	8	>32	49.6	≤0.5	>4	64.2	≤0.25	>2	87.0
MRSA (283)	0.5	1	100.0	32	>32	0.0	4	>4	41.0	≤0.25	>2	70.0
MSSA (278)	0.25	0.25	100.0	4	4	100.0	≤0.5	4	87.8	≤0.25	≤0.25	83.8
βHS (314)	≤0.008	0.03	100.0	≤0.25	≤0.25	100.0	1	1	98.1	≤0.25	>2	82.8
EC (157)	0.12	4	89.8	≤0.25	0.5	91.7	≤0.5	>4	66.9	-	-	-
KSP (88)	0.12	>32	77.3	≤0.25	>32	77.3	≤0.5	>4	80.7	-	-	-
PM (69)	0.12	0.5	95.7	≤0.25	≤0.25	98.6	≤0.5	>4	81.2	-	-	-
EF (47)	2	4	80.9	>32	>32	-	1	>4	74.5	-	-	-
CoNS (46)	0.25	0.5	100.0	4	32	80.4	≤0.5	>4	65.2	≤0.25	>2	73.9
ESP (39)	0.5	>32	79.5	0.5	32	74.4	≤0.5	≤0.5	97.4	-	-	-
VGS (32)	0.03	0.06	100.0	0.5	1	90.6	1	2	90.6	≤0.25	>2	78.1

Abbreviations: SA = *S. aureus*; EC = *E. coli*; KSP = *Klebsiella* spp.; PM = *P. mirabilis*; EF = *E. faecalis*, ESP = *Enterobacter spp.*

Conclusion: CPT demonstrated broad-spectrum activity against the most common SSSI pathogens isolated in the USA. This favorable antimicrobial profile suggests that CPT may be a promising option for the treatment of cSSSI, including those caused by MRSA.

Introduction

Ceftaroline is the active metabolite of the prodrug ceftaroline fosamil, an N-phosphonoamino water-soluble cephalosporin. Ceftaroline exhibits broad-spectrum activity against resistant Gram-positive organisms, including methicillin-resistant *Staphylococcus aureus* (MRSA) and *Streptococcus pneumoniae*, and common Gram-negative pathogens. Ceftaroline fosamil is currently under review for the treatment of complicated skin and skin structure infections (cSSSIs) and community-acquired bacterial pneumonia (CABP).

S. aureus and *Streptococcus pyogenes* are considered the most important pathogens associated with cSSSI. Ceftaroline has demonstrated excellent in vitro activity against both of these species, as well as against coagulase-negative staphylococci (CoNS), *Enterococcus faecalis*, and viridans group streptococci, which are occasional causes of cSSSI. Ceftaroline also demonstrates in vitro activity against commonly isolated Enterobacteriaceae species, excluding those that produce extended-spectrum β-lactamases (ESBLs), derepressed AmpC enzymes, or carbapenemases.

This study evaluated the spectrum of antimicrobial activity of ceftaroline and several comparator agents against clinical isolates recovered from cSSSI collected in medical institutions throughout the United States (USA).

Methods

Clinically significant, consecutively collected, nonduplicate isolates from patients hospitalized with cSSSI in 50 USA medical centers in 2009 were utilized for this study. A total of 1353 isolates were collected. The most prevalent pathogens were: *S. aureus* (n = 561; 50.4% MRSA), β-haemolytic streptococci (n = 314), *Escherichia coli* (n = 157), *Klebsiella* spp. (n = 88), *Proteus mirabilis* (n = 69), *E. faecalis* (n = 47), CoNS (n = 46), *Enterobacter* spp. (n = 94), and viridans group streptococci (n = 32).

Broth microdilution methods conducted according to the CLSI were performed to determine antimicrobial susceptibility of ceftaroline and 20 comparators. Validated MIC panels were manufactured by TREK Diagnostics (Cleveland, Ohio, USA). *S. aureus, E. faecalis*, and Gram-negative strains were tested in cation-adjusted Mueller-Hinton broth (MHB). *Streptococcus* spp. was tested in MHB supplemented with 3-5% lysed horse blood (M07-A8, 2009).

Concurrent quality control (QC) testing was performed to determine proper test conditions and procedures. QC strains included: *S. aureus* ATCC 29213, *E. faecalis* ATCC 29212, *E. coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, and *S. pneumoniae* ATCC 49619. Susceptibility percentages and validation of QC results were based on the CLSI guidelines (M100-S20-U) and susceptibility breakpoints were used to determine susceptibility/resistance rates. No interpretive criteria for ceftaroline susceptibility have been established.

Results

- Ceftaroline exhibited potent activity against methicillin-susceptible *S. aureus* (MSSA) isolates (MIC_{50} and MIC_{90}, 0.25 µg/mL) and MRSA isolates (MIC_{50}, 0.5 µg/mL and MIC_{90},1 µg/mL). Against MSSA and MRSA, the highest MIC results observed were 1 and 2 µg/mL, respectively (Tables 1 and 2)
- Ceftaroline was 16-fold more active than ceftriaxone against MSSA based on MIC_{50} values. All tested agents were active against >95% of MSSA, except erythromycin (MIC_{90}, >2 µg/mL; 60.1% S) and levofloxacin (MIC_{50}, 4 µg/mL; 87.8% S; Table 2)
- The most active agents against MRSA were: ceftaroline (MIC_{90}, 1 µg/mL; 100% inhibited at ≤2 µg/mL), linezolid (MIC_{90}, 2 µg/mL; 100% susceptible [S]), vancomycin (MIC_{90}, 1 µg/mL; 100% S), daptomycin (MIC_{90}, 0.5 µg/mL; 100% S), and tigecycline (MIC_{90}, 0.25 µg/mL; 100% S). In contrast, the highest resistance (R) rate to MRSA was observed with erythromycin (86.6% R), followed by levofloxacin (58.0% R) and clindamycin (21.2% R; Table 2)
- Against β-haemolytic streptococci, ceftaroline demonstrated very potent activity (MIC_{50}, ≤0.008 µg/mL and MIC_{90}, 0.03 µg/mL) comparable to that of penicillin (MIC_{50}, ≤0.015 µg/mL and MIC_{90}, 0.06 µg/mL). Decreased susceptibility was observed only with erythromycin (MIC_{90}, >2 µg/mL; 64.6% S) and clindamycin (MIC_{90}, >2 µg/mL; 82.8% S by CLSI criteria; Table 2)
- Ceftaroline and ceftriaxone exhibited similar in vitro activities against *E. coli*, *Klebsiella* spp., *P. mirabilis,* and *Enterobacter* spp. (Table 2). Isolates susceptible to ceftriaxone generally had low ceftaroline MIC values (data not shown)
- Ceftaroline exhibited good in vitro activity against *E. faecalis,* although MIC values were elevated compared with those against other Gram-positive species tested (MIC_{50}, 2 µg/mL and MIC_{90}, 4 µg/mL; 80.9% inhibited at ≤2 µg/mL; Tables 1 and 2). All *E. faecalis* strains tested were susceptible to ampicillin (MIC_{90}, 2 µg/mL), vancomycin (MIC_{90}, 2 µg/mL), linezolid (MIC_{90}, 2 µg/mL), and tigecycline (MIC_{90}, 0.25 µg/mL; Table 2)
- Ceftaroline activity against CoNS (MIC_{50}, 0.25 µg/mL and MIC_{90}, 0.5 µg/mL) was similar to that observed against *S. aureus*. The highest ceftaroline MIC value was 1 µg/mL among CoNS (Tables 1 and 2)
- Viridans group streptococci, including strains resistant to penicillin and ceftriaxone, were very susceptible to ceftaroline (MIC_{90}, 0.06 µg/mL; Tables 1 and 2).

Table 1. Frequency of Occurrence of Ceftaroline MIC Values for Bacterial Strains Collected from cSSSI in the USA

Organism (no. tested)	No. of strains (cumulative %) inhibited at ceftaroline MIC (µg/mL)											
	≤0.008	0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16
S. aureus (561)												
MSSA (278)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	26 (9.4)	227 (91.0)	24 (99.6)	1 (100.0)	-	-	-	-
MRSA (283)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	9 (3.2)	144 (54.1)	127 (98.9)	3 (100.0)	-	-	-
β-haemolytic streptococci (314)	162 (51.6)	89 (79.9)	61 (99.4)	2 (100.0)	-	-	-	-	-	-	-	-
E. coli (157)	0 (0.0)	0 (0.0)	11 (7.0)	47 (36.9)	46 (66.2)	21 (79.6)	6 (83.4)	7 (87.9)	3 (89.8)	1 (90.5)	1 (91.1)	4 (93.0)
Klebsiella spp. (88)	0 (0.0)	1 (1.1)	1 (2.3)	13 (17.1)	31 (52.3)	12 (65.9)	7 (73.9)	3 (77.3)	0 (77.3)	0 (77.3)	3 (80.7)	1 (81.8)
P. mirabilis (69)	0 (0.0)	0 (0.0)	1 (1.5)	21 (31.9)	28 (72.5)	9 (85.5)	5 (92.8)	2 (95.7)	0 (95.7)	1 (97.1)	0 (97.1)	0 (97.1)
E. faecalis (47)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	18 (38.3)	20 (80.9)	7 (95.7)	2 (100.0)	-
CoNS (46)	0 (0.0)	2 (4.4)	0 (4.4)	6 (17.4)	9 (37.0)	22 (84.8)	6 (97.8)	1 (100.0)	-	-	-	-
Enterobacter spp. (39)	0 (0.0)	0 (0.0)	2 (5.1)	2 (10.3)	1 (12.8)	13 (46.2)	10 (71.8)	1 (74.4)	2 (79.5)	0 (79.5)	0 (79.5)	1 (82.1)
Viridans group streptococci (32)	6 (18.8)	8 (43.8)	12 (81.3)	3 (90.6)	2 (96.9)	0 (96.9)	1 (100.0)	-	-	-	-	-

CoNS = coagulase-negative staphylococci; cSSSI = complicated skin and skin structure infection; MRSA = methicillin-resistant *S. aureus*; MSSA = methicillin-susceptible *S. aureus*.

Table 2. Antimicrobial Activity of Ceftaroline and Comparator Agents Tested Against Gram-positive cSSSI Bacterial Isolates (USA, 2009)

Antimicrobial agent	MIC_{50}	MIC_{90}	Range	CLSI[a] %S / %R	EUCAST[a] %S / %R
Staphylococcus aureus (561)					
Ceftaroline[b]	0.5	1	0.12 – 2	- / -	- / -
Oxacillin	>2	>2	≤0.25 – >2	49.6 / 50.4	49.6 / 50.4
Ceftriaxone	8	>32	1 – >32	49.6 / 50.4	49.6 / 50.4
Erythromycin	>2	>2	≤0.25 – >2	36.2 / 63.3	36.4 / 63.3
Clindamycin	≤0.25	>2	≤0.25 – >2	87.0 / 12.3	86.4 / 13.0
Levofloxacin	≤0.5	>4	≤0.5 – >4	64.2 / 34.4	64.2 / 34.4
Linezolid	2	2	≤0.06 – 4	100.0 / 0.0	100.0 / 0.0
Vancomycin	1	1	0.25 – 2	100.0 / 0.0	100.0 / 0.0
Daptomycin	0.5	0.5	≤0.06 – 1	100.0 / -	100.0 / 0.0
Tigecycline[c]	0.12	0.25	≤0.03 – 0.5	100.0 / -	100.0 / 0.0
MSSA (278)					
Ceftaroline[b]	0.25	0.25	0.12 – 1	- / -	- / -
Ceftriaxone	4	4	1 – 8	100.0 / 0.0	100.0 / 0.0
Erythromycin	0.5	>2	≤0.25 – >2	60.1 / 39.6	60.1 / 39.6
Clindamycin	≤0.25	≤0.25	≤0.25 – >2	96.0 / 3.2	94.9 / 4.0
Levofloxacin	≤0.5	4	≤0.5 – >4	87.8 / 10.4	87.8 / 10.4
Linezolid	2	2	≤0.06 – 2	100.0 / 0.0	100.0 / 0.0
Vancomycin	1	1	0.25 – 2	100.0 / 0.0	100.0 / 0.0
Daptomycin	0.25	0.5	≤0.06 – 1	100.0 / -	100.0 / 0.0
Tigecycline[c]	0.12	0.25	0.06 – 0.5	100.0 / -	100.0 / 0.0
MRSA (283)					
Ceftaroline[b]	0.5	1	0.25 – 2	- / -	- / -
Ceftriaxone	32	>32	4 – >32	0.0 / 100.0	0.0 / 100.0
Erythromycin	>2	>2	≤0.25 – >2	12.7 / 86.6	13.1 / 86.6
Clindamycin	≤0.25	>2	≤0.25 – >2	78.1 / 21.2	78.1 / 21.9
Levofloxacin	4	>4	≤0.5 – >4	41.0 / 58.0	41.0 / 58.0
Linezolid	2	2	0.5 – 4	100.0 / 0.0	100.0 / 0.0
Vancomycin	1	1	0.25 – 2	100.0 / 0.0	100.0 / 0.0
Daptomycin	0.5	0.5	≤0.06 – 1	100.0 / -	100.0 / 0.0
Tigecycline[c]	0.12	0.25	≤0.03 – 0.5	100.0 / -	100.0 / 0.0
β-haemolytic streptococci (314)					
Ceftaroline[b]	≤0.008	0.03	≤0.008 – 0.06	- / -	- / -
Penicillin	≤0.015	0.06	≤0.015 – 0.12	100.0 / -	100.0 / 0.0
Ceftriaxone	≤0.25	≤0.25	≤0.25 – 0.5	100.0 / -	100.0 / 0.0
Erythromycin	≤0.25	>2	≤0.25 – >2	64.6 / 34.7	64.6 / 34.7
Clindamycin	≤0.25	>2	≤0.25 – >2	82.8 / 16.9	83.1 / 16.9
Levofloxacin	1	1	≤0.5 – >4	98.1 / 1.6	93.9 / 1.9
Linezolid	1	1	0.12 – 1	100.0 / -	100.0 / 0.0
Vancomycin	0.5	0.5	0.25 – 1	100.0 / -	100.0 / 0.0
Daptomycin	≤0.06	0.25	≤0.06 – 0.5	100.0 / -	100.0 / 0.0
Tigecycline[c]	≤0.03	0.06	≤0.03 – 0.12	100.0 / -	100.0 / 0.0
Escherichia coli (157)					
Ceftaroline[b]	0.12	4	0.03 – >32	- / -	- / -
Ceftriaxone	≤0.25	0.5	≤0.25 – >32	91.7 / 8.3	91.7 / 8.3
Cefepime	≤0.12	0.5	≤0.12 – >16	95.5 / 2.5	93.6 / 5.1
Ceftazidime	0.25	1	0.06 – >32	92.4 / 7.0	91.1 / 7.6
Imipenem	0.25	0.25	≤0.12 – 2	99.4 / 0.0	100.0 / 0.0
Ertapenem	≤0.06	≤0.06	≤0.06 – 2	98.1 / 1.3	98.7 / 0.6
Piperacillin/tazobactam	2	16	≤0.5 – >64	93.0 / 3.8	89.8 / 7.0
Levofloxacin	≤0.5	>4	≤0.5 – >4	66.9 / 32.5	66.9 / 33.1
Tigecycline[c]	0.12	0.25	≤0.03 – 1	100.0 / 0.0	100.0 / 0.0

Antimicrobial agent	MIC_{50}	MIC_{90}	Range	CLSI[a] %S / %R	EUCAST[a] %S / %R
Klebsiella spp. (88)					
Ceftaroline[b]	0.12	>32	0.015 – >32	- / -	- / -
Ceftriaxone	≤0.25	>32	≤0.25 – >32	77.3 / 21.6	77.3 / 21.6
Cefepime	≤0.12	16	≤0.12 – >16	88.6 / 9.1	81.8 / 13.6
Ceftazidime	0.25	>32	0.03 – >32	77.3 / 22.7	76.1 / 22.7
Imipenem	0.25	8	≤0.12 – >8	89.8 / 10.2	89.8 / 6.8
Ertapenem	≤0.06	>8	≤0.06 – >8	89.8 / 10.2	89.8 / 10.2
Piperacillin/tazobactam	4	>64	≤0.5 – >64	81.8 / 13.6	76.1 / 18.2
Levofloxacin	≤0.5	>4	≤0.5 – >4	80.7 / 18.2	77.3 / 19.3
Tigecycline[c]	0.25	1	0.12 – 4	96.6 / 0.0	93.2 / 3.4
Enterobacter spp. (39)					
Ceftaroline[b]	0.5	>32	0.03 – >32	- / -	- / -
Ceftriaxone	0.5	32	≤0.25 – >32	74.4 / 25.6	74.4 / 25.6
Cefepime	≤0.12	2	≤0.12 – 16	97.4 / 0.0	89.7 / 2.6
Ceftazidime	0.25	>32	0.06 – >32	79.5 / 20.5	76.9 / 20.5
Imipenem	0.5	1	≤0.12 – 2	94.9 / 0.0	100.0 / 0.0
Ertapenem	≤0.06	0.5	≤0.06 – 4	87.2 / 7.7	92.3 / 2.6
Piperacillin/tazobactam	4	64	1 – >64	82.1 / 7.7	76.9 / 17.9
Levofloxacin	≤0.5	≤0.5	≤0.5 – >4	97.4 / 2.6	97.4 / 2.6
Tigecycline[c]	0.5	0.5	0.25 – 4	97.4 / 0.0	97.4 / 2.6
Proteus mirabilis (69)					
Ceftaroline[b]	0.12	0.5	0.03 – >32	- / -	- / -
Ceftriaxone	≤0.25	≤0.25	≤0.25 – 4	98.6 / 1.4	98.6 / 1.4
Cefepime	≤0.12	≤0.12	≤0.12 – 1	100.0 / 0.0	100.0 / 0.0
Ceftazidime	0.06	0.06	0.03 – 8	98.6 / 0.0	98.6 / 1.4
Imipenem	2	2	0.25 – 8	49.3 / 8.7	91.3 / 0.0
Ertapenem	≤0.06	≤0.06	≤0.06	100.0 / 0.0	100.0 / 0.0
Piperacillin/tazobactam	≤0.5	1	≤0.5 – 4	100.0 / 0.0	100.0 / 0.0
Levofloxacin	≤0.5	>4	≤0.5 – >4	81.2 / 17.4	75.4 / 18.8
Tigecycline[c]	2	4	0.25 – >4	87.0 / 1.4	49.3 / 13.0
CoNS (46)					
Ceftaroline[b]	0.25	0.5	0.015 – 1	- / -	- / -
Oxacillin	1	>2	≤0.25 – >2	30.4 / 69.6	30.4 / 69.6
Ceftriaxone	4	32	≤0.25 – >32	30.4 / 69.6	30.4 / 69.6
Erythromycin	>2	>2	≤0.25 – >2	43.5 / 56.5	43.5 / 56.5
Clindamycin	≤0.25	>2	≤0.25 – >2	73.9 / 26.1	73.9 / 26.1
Levofloxacin	≤0.5	>4	≤0.5 – >4	65.2 / 30.4	65.2 / 30.4
Linezolid	1	2	0.5 – 2	100.0 / 0.0	100.0 / 0.0
Vancomycin	1	2	≤0.12 – 4	100.0 / 0.0	97.8 / 2.2
Daptomycin	0.25	0.5	0.12 – 1	100.0 / -	100.0 / 0.0
Tigecycline[c]	0.12	0.25	≤0.03 – 0.5	- / -	100.0 / 0.0
Enterococcus faecalis (47)					
Ceftaroline[b]	2	4	1 – 8	- / -	- / -
Ampicillin	≤1	2	≤1 – 2	100.0 / 0.0	100.0 / 0.0
Ceftriaxone	>32	>32	32 – >32	- / -	- / -
Levofloxacin	1	>4	≤0.5 – >4	74.5 / 25.5	- / -
Linezolid	2	2	0.5 – 2	100.0 / 0.0	100.0 / 0.0
Vancomycin	1	2	1 – 2	100.0 / 0.0	100.0 / 0.0
Daptomycin	1	2	0.5 – 8	97.9 / -	- / -
Tigecycline[c]	0.12	0.25	≤0.03 – 0.25	100.0 / -	100.0 / 0.0
Viridans group streptococci (32)					
Ceftaroline[b]	0.03	0.06	≤0.008 – 0.5	- / -	- / -
Penicillin	0.06	0.5	≤0.015 – 2	81.3 / 0.0	81.3 / 0.0
Levofloxacin	1	2	≤0.5 – >4	90.6 / 9.4	- / -
Linezolid	1	1	0.12 – 1	100.0 / -	- / -
Vancomycin	0.5	1	0.25 – 1	100.0 / -	100.0 / 0.0
Daptomycin	0.5	1	≤0.06 – 1	100.0 / -	- / -
Tigecycline[c]	≤0.03	0.12	≤0.03 – 0.25	100.0 / -	- / -

a. According to CLSI breakpoints [CLSI, 2010].
b. No breakpoint has been established by CLSI, USA-FDA, or EUCAST.
c. USA-FDA breakpoints were applied [Tygacil Package Insert; 2009].

CoNS = coagulase-negative staphylococci; cSSSI = complicated skin and skin structure infection; EUCAST = European Committee on Antimicrobial Susceptibility Testing; MRSA = methicillin-resistant *S. aureus*; MSSA = methicillin-susceptible *S. aureus*; R = resistant; S = susceptible.

Conclusions

- Ceftaroline demonstrated broad-spectrum activity against the most common cSSSI pathogens isolated in the USA
- Activity of ceftaroline against staphylococci causing cSSSI was similar to that of vancomycin, daptomycin, and linezolid. Activity against streptococci was similar to that of ceftriaxone
- The broad-spectrum activity of ceftaroline suggests that its prodrug, ceftaroline fosamil, may be a promising agent for the treatment of cSSSIs, including those caused by MRSA.

References

1. Clinical and Laboratory Standards Institute (2009). *M07-A8. Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically; approved standard: eighth edition.* Wayne, PA: CLSI.
2. Clinical and Laboratory Standards Institute (2010). *M100-S20-U. Performance standards for antimicrobial susceptibility testing: 20th informational supplement (June 2010 Update)*. Wayne, PA: CLSI.
3. Corey GR, Wilcox M, Talbot GH, Friedland HD, Baculik T, Witherell GW, Critchley I, Das AF, Thye D (2010). Integrated analysis of CANVAS 1 and 2: Phase 3, multicenter, randomized, double-blind studies to evaluate the safety and efficacy of ceftaroline versus vancomycin plus aztreonam in complicated skin and skin-structure infection. *Clin Infect Dis* 51: 641-650.
4. Ge Y, Biek D, Talbot GH, Sahm DF (2008). In vitro profiling of ceftaroline against a collection of recent bacterial clinical isolates from across the United States. *Antimicrob Agents Chemother* 52: 3398-3407.
5. Jacqueline C, Amador G, Caillon J, Le Mabecque V, Batard E, Miegeville AF, Biek D, Ge Y, Potel G, Hamel A (2010). Efficacy of the new cephalosporin ceftaroline in the treatment of experimental methicillin-resistant *Staphylococcus aureus* acute osteomyelitis. *J Antimicrob Chemother* 65: 1749-1752.
6. Nannini EC, Stryjewski ME, Corey GR (2010). Ceftaroline for complicated skin and skin-structure infections. *Expert Opin Pharmacother* 11: 1197-1206.
7. Talbot GH, Thye D, Das A, Ge Y (2007). Phase 2 study of ceftaroline versus standard therapy in the treatment of complicated skin and skin structure infections. *Antimicrob Agents Chemother* 51: 3612-3616.
8. Tygacil Package Insert (2009). Available at www.wyeth.com. Accessed August 2009.
9. Zhanel GG, Sniezek G, Schweizer F, Zelenitsky S, Lagace-Wiens PR, Rubinstein E, Gin AS, Hoban DJ, Karlowsky JA (2009). Ceftaroline: A novel broad-spectrum cephalosporin with activity against meticillin-resistant *Staphylococcus aureus*. *Drugs* 69: 809-831.

Acknowledgment

Supported by Forest Laboratories, Inc.