Antibiotic Susceptibility Testing by Broth Microdilution: Invasive *Streptococcus pneumoniae* Isolates
Minneapolis- St. Paul and Seven County Metropolitan Area: 1997-2002

Drug class:	*penicillins/carbapenems*						*second generation cephalosporin*		*third generation cephalosporin*		*lincosamide*		*macrolide*		*tetracycline*		*folic acid antagonist-sulfonamide*		*quinolone*	
	Penicillin		**Amoxicillin**		**Meropenem**		**Cefuroxime**		**Cefotaxime[1]**		**Clindamycin**		**Erythromycin**		**Tetracyline**		**Trimeth-Sulfameth.**		**Levofloxacin**	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
2002																				
Susceptible	230	**80.7%**	266	**93.3%**	248	**87.0%**	242	**84.9%**	248	**87.0%**	273	**95.8%**	233	**81.8%**	265	**93.0%**	202	**70.9%**	283	**99.3%**
Intermediate	21	**7.4%**	5	**1.8%**	17	**6.0%**	1	**0.4%**	30	**10.5%**	0	**0.0%**	0	**0.0%**	1	**0.4%**	16	**5.6%**	0	**0.0%**
Resistant	34	**11.9%**	14	**4.9%**	20	**7.0%**	42	**14.7%**	7	**2.5%**	12	**4.2%**	52	**18.2%**	19	**6.7%**	67	**23.5%**	2	**0.7%**
Total	285		285		285		285		285		285		285		285		285		285	
2001																				
Susceptible	235	**77.3%**	285	**93.8%**	256	**84.2%**	250	**82.2%**	254	**83.6%**	294	**96.7%**	244	**80.3%**	275	**90.5%**	216	**71.1%**	303	**99.7%**
Intermediate	21	**6.9%**	3	**1.0%**	28	**9.2%**	1	**0.3%**	34	**11.2%**	0	**0.0%**	2	**0.7%**	1	**0.3%**	19	**6.3%**	0	**0.0%**
Resistant	48	**15.8%**	16	**5.3%**	20	**6.6%**	53	**17.4%**	16	**5.3%**	10	**3.3%**	58	**19.1%**	28	**9.2%**	69	**22.7%**	1	**0.3%**
Total	304		304		304		304		304		304		304		304		304		304	
2000																				
Susceptible	301	**73.4%**	367	**89.5%**	327	**79.8%**	315	**76.8%**	341	**83.2%**	397	**96.8%**	306	**74.6%**	376	**91.7%**	273	**66.6%**	408	**99.5%**
Intermediate	41	**10.0%**	12	**2.9%**	41	**10.0%**	9	**2.2%**	41	**10.0%**	0	**0.0%**	0	**0.0%**	0	**0.0%**	22	**5.4%**	0	**0.0%**
Resistant	68	**16.6%**	31	**7.6%**	42	**10.2%**	86	**21.0%**	28	**6.8%**	13	**3.2%**	104	**25.4%**	34	**8.3%**	115	**28.0%**	2	**0.5%**
Total	410		410		410		410		410		410		410		410		410		410	
1999																				
Susceptible	423	**75.8%**	516	**92.5%**	461	**82.6%**	453	**81.2%**	465	**83.3%**	545	**97.7%**	434	**77.8%**	509	**91.2%**	371	**66.5%**	558	**100.0%**
Intermediate	43	**7.7%**	5	**0.9%**	34	**6.1%**	4	**0.7%**	71	**12.7%**	0	**0.0%**	0	**0.0%**	0	**0.0%**	37	**6.6%**	0	**0.0%**
Resistant	92	**16.5%**	37	**6.6%**	63	**11.3%**	101	**18.1%**	22	**3.9%**	13	**2.3%**	124	**22.2%**	49	**8.8%**	150	**26.9%**	0	**0.0%**
Total	558		558		558		558		558		558		558		558		558		558	
1998																				
Susceptible	374	**79.7%**	449	**95.7%**	405	**86.4%**	400	**85.7%**	407	**86.8%**	457	**97.4%**	392	**83.6%**	428	**91.3%**	337	**71.9%**	466	**99.8%**
Intermediate	34	**7.2%**	2	**0.4%**	23	**4.9%**	4	**0.9%**	42	**9.0%**	0	**0.0%**	0	**0.0%**	1	**0.2%**	30	**6.4%**	0	**0.0%**
Resistant	61	**13.0%**	18	**3.8%**	41	**8.7%**	63	**13.5%**	20	**4.3%**	12	**2.6%**	77	**16.4%**	40	**8.5%**	102	**21.7%**	1	**0.2%**
Total	469		469		469		467		469		469		469		469		469		467	
1997																			**Ofloxacin**	
Susceptible	340	**78.2%**	416	**95.6%**	375	**86.2%**	-	-	375	**86.2%**	425	**97.7%**	380	**87.4%**	403	**92.6%**	302	**69.4%**	420	**96.6%**
Intermediate	42	**9.7%**	11	**2.5%**	30	**6.9%**	-	-	33	**7.6%**	2	**0.5%**	1	**0.2%**	0	**0.0%**	25	**5.7%**	13	**3.0%**
Resistant	53	**12.2%**	8	**1.8%**	30	**6.9%**	-	-	27	**6.2%**	8	**1.8%**	54	**12.4%**	32	**7.4%**	108	**24.8%**	2	**0.5%**
Total	435		435		435		-	-	435		435		435		435		435		435	

Methods: Isolates from 1997 represent 93% of cases (435/467), 1998: 93% of cases (469/503), 1999: 96% (558/583), 2000: 94% (410/438), 2001: 90% (304/339), and 2002: 95% (285/300). MICs were determined by broth microdilution. NCCLS 2003 MIC interpretive standards for *S. pneumoniae* were used.

Also Tested: For susceptibility to **chloramphenicol**: 2-3% of isolates were resistant each year from 1999-2002; between 4-5% were resistant each year from 1996-98. All isolates were screened for resistance to **vancomycin**: all isolates were susceptible. The panel of antibiotics tested has included different screening MICs for **rifampin** in different years. Through 1999 all isolates were susceptible to rifampin (MICs $\leq$ 1 µg/mL,); in 2000 all MICs were $\leq$ 4 µg/mL (undefined susceptibility) and in 2001-2002, all were $\leq$ 2 µg/mL (intermediate or susceptible). From 1996-1999 and in 2002 all isolates were susceptible to **quinupristin/dalfopistin**; in 2000 < 1% (2/410) and in 2001 1% (2/304) were resistant.

Note: [1]In 2002 NCCLS cefotaxime and ceftriaxone breakpoints changed for nonmeningitis pneumococcal isolates. Reported above are the proportions of isolates in each susceptibility category by the meningitis breakpoints (S: $\leq$ 0.5 µg/mL, I: 1 µg/mL, R: $\geq$ 2 µg/mL). Nonmeningitis breakpoints are S: $\leq$ 1 µg/mL, I: 2 µg/mL, R: $\geq$ 4 µg/mL, so adding isolates included in the susceptible and intermediate categories above gives the number susceptible to cefotaxime by nonmeningitis breakpoints.

Penicillin Susceptibility by Age Group and Year and Multiple-Drug Resistance by Age, Year and Residence: Invasive *Streptococcus pneumoniae* Isolates, Minneapolis-St. Paul and Seven County Metropolitan Area:1997-2001 and Minnesota:2002

	Penicillin Susceptibility												*Resistant to One or More Drug Classes*[1]		
	0-4 years		5-17 years		18-39 years		40-64 years		65 years and older		Total			All Ages	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent		No.	Percent
2002: Greater MN													***2002: Greater MN***		
Susceptible	21	**84.0%**	11	**91.7%**	11	**78.6%**	59	**80.8%**	93	**78.8%**	195	**80.6%**	**1 Drug Class**	24	**9.9%**
Intermediate	0	**0.0%**	1	**8.3%**	0	**0.0%**	5	**6.8%**	11	**9.3%**	17	**7.0%**	**2-3 Drug Classes**	23	**9.5%**
Resistant	4	**16.0%**	0	**0.0%**	3	**21.4%**	9	**12.3%**	14	**11.9%**	30	**12.4%**	**4-6 Drug Classes**	16	**6.6%**
Total	25		12		14		73		118		242		**Total**	242	
2002: 7 County Metro.													***2002: 7 County Metro.***		
Susceptible	31	**75.6%**	11	**78.6%**	28	**84.8%**	84	**84.0%**	76	**78.4%**	230	**80.7%**	**1 Drug Class**	34	**11.9%**
Intermediate	5	**12.2%**	0	**0.0%**	2	**6.1%**	3	**3.0%**	11	**11.3%**	21	**7.4%**	**2-3 Drug Classes**	34	**11.9%**
Resistant	5	**12.2%**	3	**21.4%**	3	**9.1%**	13	**13.0%**	10	**10.3%**	34	**11.9%**	**4-6 Drug Classes**	17	**6.0%**
Total	41		14		33		100		97		285		**Total**	285	
2001													***2001***		
Susceptible	51	**71.8%**	18	**85.7%**	26	**78.8%**	69	**87.3%**	71	**71.0%**	235	**77.3%**	**1 Drug Class**	32	**10.5%**
Intermediate	8	**11.3%**	1	**4.8%**	0	**0.0%**	3	**3.8%**	9	**9.0%**	21	**6.9%**	**2-3 Drug Classes**	36	**11.8%**
Resistant	12	**16.9%**	2	**9.5%**	7	**21.2%**	7	**8.9%**	20	**20.0%**	48	**15.8%**	**4-6 Drug Classes**	23	**7.6%**
Total	71		21		33		79		100		304		**Total**	304	
2000													***2000***		
Susceptible	87	**65.4%**	15	**83.3%**	30	**71.4%**	79	**83.2%**	90	**73.8%**	301	**73.4%**	**1 Drug Class**	47	**11.5%**
Intermediate	13	**9.8%**	1	**5.6%**	5	**11.9%**	8	**8.4%**	14	**11.5%**	41	**10.0%**	**2-3 Drug Classes**	71	**17.3%**
Resistant	33	**24.8%**	2	**11.1%**	7	**16.7%**	8	**8.4%**	18	**14.8%**	68	**16.6%**	**4-6 Drug Classes**	26	**6.3%**
Total	133		18		42		95		122		410		**Total**	410	
1999													***1999***		
Susceptible	134	**67.0%**	20	**87.0%**	60	**84.5%**	100	**80.0%**	109	**78.4%**	423	**75.8%**	**1 Drug Class**	56	**10.0%**
Intermediate	19	**9.5%**	0	**0.0%**	5	**7.0%**	5	**4.0%**	14	**10.1%**	43	**7.7%**	**2-3 Drug Classes**	85	**15.2%**
Resistant	47	**23.5%**	3	**13.0%**	6	**8.5%**	20	**16.0%**	16	**11.5%**	92	**16.5%**	**4-6 Drug Classes**	39	**7.0%**
Total	200		23		71		125		139		558		**Total**	558	
1998													***1998***		
Susceptible	140	**71.1%**	25	**96.2%**	44	**89.8%**	73	**93.6%**	92	**77.3%**	374	**79.7%**	**1 Drug Class**	52	**11.1%**
Intermediate	22	**11.2%**	0	**0.0%**	0	**0.0%**	1	**1.3%**	11	**9.2%**	34	**7.2%**	**2-3 Drug Classes**	46	**9.8%**
Resistant	35	**17.8%**	1	**3.8%**	5	**10.2%**	4	**5.1%**	16	**13.4%**	61	**13.0%**	**4-6 Drug Classes**	32	**6.8%**
Total	197		26		49		78		119		469		**Total**	469	
1997													***1997***		
Susceptible	127	**75.1%**	17	**81.0%**	38	**74.5%**	65	**84.4%**	93	**79.5%**	340	**78.2%**	**1 Drug Class**	58	**13.3%**
Intermediate	18	**10.7%**	2	**9.5%**	6	**11.8%**	7	**9.1%**	9	**7.7%**	42	**9.7%**	**2-3 Drug Classes**	41	**9.4%**
Resistant	24	**14.2%**	2	**9.5%**	7	**13.7%**	5	**6.5%**	15	**12.8%**	53	**12.2%**	**4-6 Drug Classes**	26	**6.0%**
Total	169		21		51		77		117		435		**Total**	435	

Notes: [1]To assess multiple-drug susceptibility, the following beta-lactam/cephalosporin agents were considered one drug class: penicillin, amoxicillin, meropenem, cefuroxime, and cefotaxime, and the following fluoroquinolones were considered one drug class: levofloxacin and ofloxacin. Five additional antibiotics each representing a single drug class were assessed: clindamycin (lincosamide), erythromycin (macrolide), tetracycline (tetracycline), trimethoprim-sulfamethoxazole (folic acid antagonist-sulfonamide), and chloramphenicol (phenicol). In total, seven drug classes were assessed.

In Greater Minnesota in 2002, isolates represented 81% of cases (242/298), and in the 7-County Twin Cities Metropolitan Area 95% of cases (285/300).