

# BACTERIAL PATHOGENS (NON-MYCOBACTERIUM) FROM SPUTUM CULTURE AND ANTIMICROBIAL SUSCEPTIBILITY

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**Abstract.** Sputum culture of patients at Siriraj Hospital, Bangkok was 49.84% positive for bacterial pathogens in 1994 and 40.95% in 1995. The average incidence of gram-negative rods was 3.11 fold more than the combination of gram-positive cocci and gram-negative cocci. The most common gram-negative rod was *Pseudomonas aeruginosa*, followed by either *Klebsiella pneumoniae* or *Acinetobacter anitratus* depending on year. The most common coccus was *Staphylococcus aureus*. From both years, the number of *Haemophilus influenzae*, *Streptococcus pneumoniae*, *Burkholderia pseudomallei* and *Nocardia* spp isolated were 122, 93 13 and 11 strains respectively. For antimicrobial susceptibility, *P. aeruginosa* was sensitive to ceftazidime, imipenem, gentamicin, amikacin, netilmicin, ciprofloxacin (range 56-89%). *S. aureus* (MSSA) was sensitive to common used drugs. *S. aureus* (MRSA) was sensitive to co-trimoxazole, fosfomicin, vancomycin (range 57-100%) and resistant to most drugs.

## INTRODUCTION

Respiratory tract infections are a major cause of morbidity and mortality (Woodhead *et al*, 1987; Fink *et al*, 1994). Despite improvements in antimicrobial chemotherapy and supportive care, bacterial pneumonia, whether nosocomial or community acquired, remains an infection with substantial burden on the health service. Nosocomial pneumonia accounts for about 15% of all hospital-acquired infections (Haley *et al*, 1985) and is the most common nosocomial infection among patients in intensive care units (Craig and Connelly, 1984). We describe here the incidence of common bacterial pathogens (non-*Mycobacterium*) isolated from sputa of patients at Siriraj Hospital during a 2-year period (1994-1995) and their antimicrobial susceptibility.

## MATERIALS AND METHODS

Sputa from patients who had symptoms of lower respiratory tract infections during January 1994 December 1995 were collected and sent to Bacteriology Laboratory. Each sputum was gram-stained and only sputum showing less than 25 squamous epithelial cells per low-power field was acceptable for culture.

For cultivation, sputum was spread on 5% blood

agar with staphylococcal streak technic. Culture was incubated for 24 to 48 hours at 37°C in 5% CO<sub>2</sub> incubator and identified by standard microbiological technic. Some cases of community-acquired pneumonia were processed by both conventional and molecular methods (DNA probe, Accuprobe system; Gen-probe Inc). The antimicrobial susceptibility was performed by Kirby-Bauer disk diffusion method (Murray *et al*, 1995).

## RESULTS

Table 1 shows that sputum culture was 49.84% (3,309/6,639) positive for bacterial pathogens in 1994 and 40.95% (3,211/7,840) in 1995. The average incidence of gram-negative rods was 3.11 fold more than the combination of gram-positive cocci and gram-negative cocci or 76% of all infections. Table 2 shows the incidence of common gram-positive and gram-negative cocci isolated during the study period. For both years, *Staphylococcus aureus* ranked first, followed by *Streptococcus pneumoniae*. Table 3 shows the incidence of bacteria in the family Enterobacteriaceae isolated. *Klebsiella pneumoniae* ranked first, followed by *Enterobacter* spp. Table 4 shows the isolation of bacteria in the group of nonfermentative gram-negative rods and others. For both years, *Pseudomonas aeruginosa* ranked first, followed by

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Table 1  
Number of patients and percentage of positive culture.

	1994	1995	Total
No. of patients	6,639	7,840	14,479
No. of patients with positive culture	3,309	3,211	6,520
Percentage	49.84	40.95	45.03

Table 2  
Isolation of cocci from sputum culture  
(number of strains).

Organism	1994	1995
<i>Staphylococcus aureus</i>	797	829
<i>Streptococcus pneumoniae</i>	41	52
Group A streptococci	10	4
Group B streptococci	9	12
Group C streptococci	3	12
Group G streptococci	8	4
<i>Moraxella catarrhalis</i>	18	26

Table 3  
Isolation of Enterobacteriaceae from sputum  
culture (number of strains).

Organism	1994	1995
<i>Klebsiella pneumoniae</i>	389	294
<i>Enterobacter</i> spp	75	110
<i>Escherichia coli</i>	67	55
<i>Proteus</i> spp	81	32
<i>Citrobacter</i> spp	25	3
<i>Providencia</i> spp	3	3
<i>Salmonella typhi</i>	1	2
<i>Salmonella</i> group D	1	2

*Acinetobacter anitratus*. The total number of *Haemophilus influenzae*, *Nocardia* spp and *Burkholderia pseudomallei* isolated were 122, 11 and 13 strains respectively. Table 5 shows the summary of the five most common organisms (both cocci and rods) isolated from sputum cultures. *P. aeruginosa* ranked first, followed by *S. aureus*, *K. pneumoniae*, *A. anitratus* and other nonfermentative

Table 4  
Isolation of *Pseudomonas*, NF\*, *Haemophilus influenzae* and others from sputum culture  
(number of strains).

Organism	1994	1995
<i>Pseudomonas aeruginosa</i>	1,215	1,010
<i>Acinetobacter anitratus</i>	238	330
NF*	174	206
<i>Haemophilus influenzae</i>	49	73
<i>Nocardia</i> spp	11	0
<i>Burkholderia pseudomallei</i>	4	9

\* Nonfermentative gram-negative rods

gram-negative rods. Table 6 shows the percentages of antimicrobial susceptibility for some important bacteria. *P. aeruginosa* was sensitive to ceftazidime, imipenem, gentamicin, amikacin, netilmicin, ciprofloxacin (range 56-89%) and resistant to ceftriaxone, ofloxacin, and co-trimoxazole. *A. anitratus* and *K. pneumoniae* were more sensitive to the antimicrobial agents tested than *P. aeruginosa*. *H. influenzae* was 67% sensitive to ampicillin and 100% sensitive to amoxicillin/sulbactam, cefotaxime, ceftriaxone, ofloxacin and ciprofloxacin. *S. aureus* (MSSA) was sensitive to common used drugs. *S. aureus* (MRSA) was sensitive to co-trimoxazole, fosfomycin, vancomycin (range 57-100%) and resistant to most drugs.

DISCUSSION

In several reviews, mortality due to nosocomial pneumonia has been estimated to be 30% to 70%

Table 5

Summary of the five most common organisms and number of strains isolated from sputum culture.

Rank	1994		1995	
	Organism	No. of strains	Organism	No. of strains
1	<i>P. aeruginosa</i>	1,215	<i>P. aeruginosa</i>	1,010
2	<i>S. aureus</i>	797	<i>S. aureus</i>	829
3	<i>K. pneumoniae</i>	389	<i>A. anitratus</i>	330
4	<i>A. anitratus</i>	238	<i>K. pneumoniae</i>	294
5	NF	174	NF	206

Table 6

Percentages of antimicrobial susceptibility.

Drug	<i>P. aeruginosa</i>	<i>A. anitratus</i>	<i>K. pneumoniae</i>	<i>H. influenzae</i>	<i>B. pseudomallei</i>	MSSA	MRSA	<i>S. pneumoniae</i>
Penicillin G	ND	ND	ND	ND	ND	7	0	75
Ampicillin	0	5	0	67	50	10	0	94
Amoxicillin/Clavulanate	0	6	53	100	100	88	8	100
Ampicillin/Sulbactam	0	75	49	100	100	81	5	100
Cefazolin	0	0	46	ND	0	100	9	100
Cefaclor	0	0	41	73	0	53	0	80
Cefuroxime	33	0	45	98	100	97	7	100
Cefotaxime	3	14	55	100	100	95	14	100
Ceftriaxone	24	14	61	100	100	100	7	100
Ceftazidime	62	28	48	ND	100	88	3	100
Imipenem	82	95	99	ND	100	100	37	100
Gentamicin	56	24	53	97	20	51	3	27
Amikacin	64	25	60	ND	90	51	18	8
Netilmicin	89	89	42	ND	0	86	7	67
Ofloxacin	53	25	82	100	90	98	5	92
Ciprofloxacin	64	20	85	100	100	96	5	86
Fosfomycin	ND	ND	ND	ND	ND	ND	71	ND
Co-trimoxazole	4	19	51	66	80	86	57	67

ND= Not done

(Craven *et al*, 1986; Celis *et al*, 1988; Fagon *et al*, 1989; Leu *et al*, 1989). Several cases of community-acquired pneumonia usually necessitate hospitalization and have been associated with a mortality rate as high as 21%, even among patients without obvious preexisting immune deficit (Pachon *et al*, 1990; Torres *et al*, 1991). In the present study,

the data on common bacterial pathogens isolated from sputum culture and their antimicrobial susceptibility were analyzed. A better understanding of the pathogens responsible for lower respiratory tract infections and pneumonia should lead to a more logical approach to the treatment.

In this study more *H. influenzae* strains were isolated in comparison to *S. pneumoniae* which are different from other studies (Johnson *et al*, 1995; Macfarlane *et al*, 1993; Venkatesan, 1995). Antimicrobial resistance of *P. aeruginosa*, *A. anitratus* and MRSA is well established and becoming a major issue in the management of hospital infections. Resistance mechanisms are primarily related to the production of various enzymes that activate antimicrobial agents (Baquero *et al*, 1991; Fink *et al*, 1994; Forsgren and Walder 1994; Hosker *et al*, 1994; Jett *et al*, 1995; Powell *et al*, 1991; Powell *et al*, 1992). More recently the emergence of penicillin-resistant *S. pneumoniae* (PRSP) further aggravates the magnitude of the resistance problem. In this study, there is 25% of PRSP. The main resistance mechanism in *S. pneumoniae* is alteration in the penicillin binding proteins.

It is interesting to study the incidence of common bacterial pathogens isolated from sputum culture and their antimicrobial susceptibility each year. Although several types of bacteria were isolated, there were some common trends. This may provide guidelines for physicians concerning treatment.

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