

# A 2011-2012 Survey of Doctors' Perceptions of Korean Guidelines and Empirical Treatment of Community-Acquired Pneumonia

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**Background:** The causative pathogens of and prevalence of antibiotic resistance in community-acquired pneumonia (CAP) varies across countries. We evaluated the patterns of antibiotic prescriptions for adult CAP patients, and physician satisfaction with the form and content of the 2009 Korean CAP treatment guidelines.

**Materials and Methods:** We designed an online survey for clinical physicians who treat CAP (infectious disease specialists, pulmonologists, and other physicians). We e-mailed the online survey to physicians and gathered results from December 2011 to January 2012, and then analyzed their responses.

**Results:** A total of 157 physicians responded to our survey: 61 (38.9%) infectious disease specialists, 33 (21.0%) pulmonologists, and 63 (40.1%) other physicians. Two-thirds (96/157, 61.2%) had positions in tertiary and secondary hospitals; the others (61, 38.8%) worked in primary clinics (hospitals and private clinics). One hundred and eight (68.8%) were aware of the Korean CAP clinical guidelines; of these, 98 (62.4%) applied the guidelines to their practice. Among physicians using them, 86.7% (85/98) reported the guidelines to be most useful for empirical selection of antibiotics, and 75.2% (118/157) said the guidelines were useful and satisfactory. Sixty-eight (43.3%) respondents indicated that they had not used aminoglycosides as an initial empirical CAP treatment, while 51 (32.5%) had combined aminoglycosides with other antibiotics to treat patients with CAP. Seventy-three (46.5%) physicians often combined macrolides with  $\beta$ -lactam antibiotics for empirical treatment of CAP, and 21 (13.4%) reported using macrolide monotherapy (which is not recommended in the 2009 Korean CAP treatment guidelines) for CAP patients. The most commonly used  $\beta$ -lactams were third-generation cephalosporins (72, 45.9%) and ampicillin/sulbactam or amoxicillin/clavulanate (28, 17.8%).

**Conclusions:** Some physicians remain unaware of the 2009 Korean treatment guidelines for CAP and do not use them in clinical practice. In addition, aminoglycoside combination therapy is frequently and inappropriately used in practice. In some cases, CAP is treated with macrolide monotherapy. Thus, the Korean CAP clinical guidelines must be more aggressively and continuously publicized.

**Key Words:** Pneumonia, Guidelines, Antibiotics

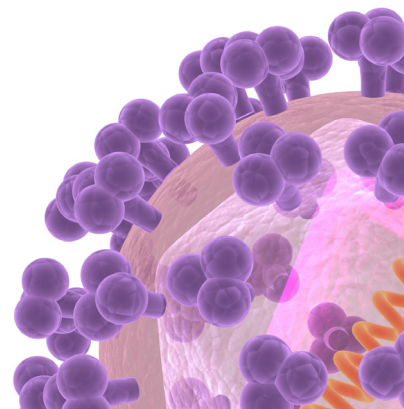
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## Introduction

Community-acquired pneumonia (CAP) is a common infectious disease. Despite advances in diagnostic and treatment methods, CAP infections can still lead to death. Less than 1–5% of deaths among ambulatory patients are reportedly caused by CAP, but an average of 12% of CAP patients require hospitalization, especially the elderly or patients with underlying diseases [1]. According to the statistical yearbook released by the National Bureau of Statistics, a CAP mortality rate in Korea was 9.4 people per 100,000 in 2007, ranking first among causes of death from infections in Korea [2]. Because it may be difficult to identify CAP pathogens, the choice of antibiotic treatment is usually empirical [3]. Pathogen distribution and antibiotic resistance differ between countries, so it may be not appropriate to use the foreign guidelines for CAP ther-

apy in Korea.

Despite availability of appropriate antibiotic therapy for CAP, mortality rates are still high; the causative pathogens and antibiotic resistance vary across countries. Thus, at the end of 2009, the Joint Committee of the Korean Society for Chemotherapy, the Korean Society of Infectious Diseases, and the Korean Academy of Tuberculosis and Respiratory Diseases published the Korean treatment guidelines for CAP [4]. These guidelines are based on CAP treatment guidelines that had been established on the basis of research data obtained from the Infectious Diseases Society of America (IDSA)/American Thoracic Society (ATS) [5] over the last 10 years, as well as data on causative pathogens of and antibiotic resistance in domestic CAP.

We investigated physicians' awareness and practical application of and satisfaction with the Korean guidelines. We also

**Table 1.** Demographics of survey participants

Question		Frequency (%)
Sex	Male	119 (75.8)
	Female	38 (24.2)
	Total	157 (100)
Specialty	Pulmonology	33 (21.0)
	Infectious disease	61 (38.9)
	Internal medicine except pulmonology or infectious disease	62 (39.5)
	Family medicine	1 (0.6)
	Total	57 (100)
Workplace	Tertiary hospital	64 (40.8)
	Secondary hospital	32 (20.4)
	Hospital	6 (3.8)
	Private clinic	55 (35.0)
	Total	157 (100)
Average number (monthly) of CAP outpatients this year	None	8 (5.1)
	1–2 patients	51 (32.5)
	3–4 patients	40 (25.5)
	5–6 patients	19 (12.1)
	7–8 patients	12 (7.6)
	More than 9 patients	27 (17.2)
	Total	157 (100)
Average number of CAP inpatients this year	None	46 (29.3)
	1–2 patients	35 (22.3)
	3–4 patients	27 (17.2)
	5–6 patients	13 (8.3)
	7–8 patients	5 (3.2)
	More than 9 patients	31 (19.7)
	Total	157 (100)

evaluated patterns of empirical antibiotic use for CAP treatment.

## Materials and Methods

### 1. Study population and period

An Internet survey was conducted for 2 weeks in December 2011 to January 2012.

Respondents included doctors from tertiary and secondary hospitals, hospitals, and private clinics.

### 2. Survey content

The survey included physician age, sex, and specialty (respiratory disease, infectious disease, internal medicine, family medicine, or general medicine) of physician. The survey focused on awareness of the CAP treatment guidelines published at the end of 2009, with questions to determine if the respondent knew the guidelines and how the guidelines were applied in clinical practice, as well as to identify the most useful guideline sections and reasons that survey respondents did not use the guidelines. The survey collected doctor opinions on CAP treatment patterns and factors leading to the decision to hospitalize CAP patients. Satisfaction with the guidelines' format and contents and reasons for dissatisfaction were also investigated. To determine treatment patterns, the factors influencing selection of empirical antibiotics for CAP treatment, the combination with aminoglycosides, the empirical use of macrolides, and the preferred  $\beta$ -lactam drugs were investigated.

### 3. Statistical analysis

The data were analyzed using SPSS Version 18.0 (SPSS Korea Data Solution Inc., Seoul, Korea). A frequency analysis and a multiple response analysis were performed on all participant responses. Chi-square tests were conducted and odds ratios calculated between respondent specializations and workplaces. All *P*-values were 2-tailed and *P* < 0.05 was considered statistically significant.

## Results

### 1. General respondent characteristics

The total response rate was 157/1,388 (11.3%); 61/149 (40.9%) were infectious disease specialists, 33/72 (45.8%) were pulmonologists, and 63/1,167 (5.4%) were other physicians. Among the 157 physicians, sixty-one (38.9%) were infectious disease specialists, 33 (21.0%) were pulmonologists, and 62 (39.5%) were internists (non-major in respiratory diseases or infectious diseases). One-hundred nineteen (75.8%) were men and 38 (24.2%), women; their mean (SD) age was 45.2 (9.5) years. Sixty-four doctors worked in tertiary hospitals (40.8%) and 32 (20.4%) in secondary hospitals. The respondents' demographic characteristics are summarized in Table 1.

### 2. Compliance and satisfaction with the Korean CAP treatment guidelines

To the question, "Did you know that the Korean CAP clinical guidelines were released in 2009?" 108 (68.8%) answered "I know" and 43 (27.4%) "I did not know" (Table 2). To "Do you

**Table 2.** Awareness of the Korean guidelines for community-acquired pneumonia

Question		Frequency (%)
Did you know that the Korean CAP clinical guidelines were released in 2009?	Yes, I know	108 (68.8)
	No, I did not know	43 (27.4)
	No response	6 (3.8)
	Total	157 (100)
How did you learn about the CAP clinical guidelines? (multiple choices)	Online article	79 (38.9)
	Offline article	22 (10.8)
	Conference, symposium	55 (27.1)
	Internet classes	3 (1.5)
	Others (Society of Infectious Diseases homepage, during practice as an attending resident, education programs)	4 (2.0)
	This survey	40 (19.7)
	Total	203 (100)

CAP, community-acquired pneumonia.

**Table 3.** Compliance with the Korean guidelines for community-acquired pneumonia

Question		Frequency (%)
Do you use the 2009 Korean CAP treatment guidelines in practice?	Yes	98 (62.4)
	No	53 (33.8)
	No response	6 (3.8)
	Total	157 (100)
If you answered "Yes," which section do you find most useful?	Diagnostic method of identifying causative pathogens	2 (2.0)
	Admission decision (severity assessment)	1 (1.0)
	Initial empirical antibiotic treatment	85 (86.7)
	Antibiotic treatment based on causative organism	6 (6.1)
	Change to oral antibiotics and treatment cessation	2 (2.0)
	No response	2 (2.0)
	Total	98 (100)
If you answered "No," what is the main reason for not referring to the guidelines?	Not different from textbooks	3 (5.7)
	Similar to foreign guidelines	9 (17.0)
	Not as reliable because of insufficient domestic references	2 (3.8)
	Does not consider clinical practice situations	5 (9.4)
	Not concise enough	1 (1.9)
	Did not know it existed but willing to refer to it in the future	7 (13.2)
	Did not know it existed and have no intention to use it in the future	3 (5.7)
	No response	22 (41.5)
Total	53 (100)	
If you answered "No," which reference do you use other than the Korean guidelines?	IDSA and ATS treatment guidelines (2007)	19 (61.3)
	European guidelines	1 (3.2)
	Others (insurance benefit standard, 1)	4 (12.9)
	Do not refer to foreign guidelines	7 (22.6)
	Total	31 (100)

CAP, community-acquired pneumonia; IDSA, Infectious Diseases Society of America; ATS, American Thoracic Society.

use the 2009 Korean CAP treatment guidelines in practice?," 98 (62.4%) said "Yes" and 53 (33.8%) said "No" (Table 3). Among those who answered "Yes," to "Which section is most useful?," the most common answer was "Initial empirical antibiotic treatment" (85/98, 86.7%) (Table 3). To "Are the contents of the guidelines satisfactory?," 66 (42.0%) answered "Yes," 48 (30.6%) answered "Not good but not bad," and 4 (2.5%) answered "Not satisfied" (Table 4). Among the respondents who said "No" to "Why are you dissatisfied? (multiple choices)?" 5/14 (35.7%) answered that they "do not agree with the empirical antibiotic treatment choice." Compliance and satisfaction with the CAP guidelines are summarized in Tables 2, 3, and 4.

### 3. Status of and opinions on CAP treatment patterns

To the question "What influences your choice of empirical antibiotics for CAP patients?" (multiple choices), 92/357

(25.8%) answered "Korean CAP clinical guidelines for adults," 74 (20.7%) answered "IDSA/ATS guidelines," 66 (18.5%) answered "Health insurance review standards for CAP," and 61 (17.1%) answered "Antibiotic-related complications and handiness" (Table 5). To the question "Do you use aminoglycosides for empirical treatment of CAP?," 68/157 (43.3%) answered "No," 23 (14.6%) answered "Yes, when gram-negative bacilli, including *Pseudomonas*, is likely to cause pneumonia," and 16 (10.2%) answered "Yes, when severe infection is likely" (Table 5). To "Do you use macrolides for empirical treatment of CAP?," 73/157 (46.5%) answered "Yes, concomitantly in combination with  $\beta$ -lactams (penicillins and cephalosporins)," 15 (9.6%) answered "Yes, macrolides only for mild pneumonia," 10 (6.4%) answered "Yes, concomitantly in combination with other antibiotics for severe CAP," and 6 (3.8%) answered "Yes, I prefer the Macrolide monotherapy" (Table 6).

**Table 4.** Satisfaction with Korean guidelines for community-acquired pneumonia

Question		Frequency (%)
Are you satisfied with the format of the guidelines?	No	3 (1.9)
	They are not good but not bad	54 (34.4)
	Satisfied	59 (37.6)
	Very satisfied	6 (3.8)
	No response	35 (22.3)
	Total	157 (100.0)
If you are dissatisfied with the format of the guidelines, why? (multiple choices)	The reference is too long	5 (35.7)
	Too short	2 (14.3)
	There are too many tables	3 (21.4)
	Not enough tables	1 (7.1)
	Other	3 (21.4)
	Total	14 (100)
Are you satisfied with the contents of the guidelines?	No	4 (2.5)
	They are not good but not bad	48 (30.6)
	Yes	66 (42.0)
	Very satisfied	4 (2.5)
	No response	35 (22.3)
	Total	157 (100)
If you are dissatisfied with the contents of the guidelines, why? (multiple choices)	Do not agree with the diagnosis method	1 (7.1)
	Do not agree with the admission indication (severity assessment)	3 (21.4)
	Do not agree with the oral antibiotic change, discharge timing, and follow-up guidelines	3 (21.4)
	Do not agree with the causative pathogen (atypical pneumonia, causative pathogen distribution and antibiotic resistance included)	1 (7.1)
	Do not agree with the empirical antibiotic choice	5 (35.7)
	Others	1 (7.1)
	Total	14 (100.0)

To “What  $\beta$ -lactam drugs do you select for empirical treatment of CAP?,” 72/157 (45.9%) responded “Third-generation cephalosporins,” 28 (17.8%) responded “Ampicillin/sulbactam or amoxicillin/clavulanate,” 6 (3.8%) responded “Not at all,” another 6 (3.8%) responded “Second-generation cephalosporins,” and 4 (2.5%) responded “First-generation cephalosporin” (Table 6). The status of and opinions on the treatment of CAP are summarized in Table 5 and Table 6.

#### 4. Opinions on the determination of the need to hospitalize CAP patients

To “Do you use objective criteria to determine the need for hospital admission of CAP patients?,” 81/157 (51.6%) replied “I use clinical judgment rather than objective standards,” 25

(15.9%) replied “I use CURB-65,” and 9 replied (5.7%) “I use the Pneumonia Severity Index” (Table 7). These results are summarized in Table 7.

#### 5. Responses to the CAP treatment guidelines according to specialty

To the question “Did you know that the Korean CAP guidelines were released in 2009?,” 85/90 (94.4%) of the pulmonologists and infectious disease specialists answered “I know” and 5 (5.6%) answered “I do not know”; among other physicians, 23/61 (37.7%) answered “I know” and 38 (62.3%) “I do not know.” The awareness of the CAP treatment guidelines among pulmonologists and infectious disease specialists was higher than in other physicians (odds ratio [OR]: 28.1, 95% confi-

**Table 5.** Status of and opinions on the treatment of community-acquired pneumonia (I)

Question	Frequency (%)	
What influences your choice of empirical antibiotics for CAP patients? (multiple choices)	Do not refer to any guidelines	5 (1.4)
	Korean CAP clinical guidelines for adults	92 (25.8)
	IDSA/ATS guidelines	74 (20.7)
	Textbook recommendation	43 (12.0)
	Antibiotic-related complication and handiness	61 (17.1)
	Health insurance review standards for CAP	66 (18.5)
	Cost	16 (4.5)
	Total	357 (100.0)
Do you use aminoglycosides for empirical treatment of CAP? (for inpatients or outpatients)	Never	68 (43.3)
	When infection with GNB, including <i>Pseudomonas</i> infection, is likely	23 (14.6)
	When GNB, including <i>Pseudomonas</i> , is cultured in the sputum or blood	9 (5.7)
	Empirically combined when severe infection is likely	16 (10.2)
	For almost all cases, since it is known to have some benefits from experience	3 (1.9)
	No response	38 (24.2)
	Total	157 (100.0)

CAP, community-acquired pneumonia; IDSA, Infectious Diseases Society of America; ATS, American Thoracic Society; GNB, gram-negative bacilli.

**Table 6.** Status of and opinions on the treatment of community-acquired pneumonia (II)

Question	Frequency (%)	
Do you use macrolides for empirical treatment of CAP? (for inpatients or outpatients)	Not at all	6 (3.8)
	Macrolides only	6 (3.8)
	Macrolides only for mild pneumonia	15 (9.6)
	Combined with $\beta$ -lactams (penicillins and cephalosporins)	73 (46.5)
	$\beta$ -lactams (penicillins and cephalosporins) (not combined with macrolides)	7 (4.5)
	Combined empirically if severe CAP is likely	10 (6.4)
	Others (combined with $\beta$ -lactams, 1; when mycoplasma pneumonia is likely, 1)	2 (1.3)
	No response	38 (24.2)
Total	157 (100.0)	
How do you select $\beta$ -lactam drugs in the empirical treatment of CAP? (Intravenous or oral)	Not at all	6 (3.8)
	First-generation cephalosporin	4 (2.5)
	Second-generation cephalosporin	6 (3.8)
	Third-generation cephalosporin	72 (45.9)
	Third-generation cephalosporin which have effect on <i>Pseudomonas</i>	2 (1.3)
	Ampicillin or amoxicillin	1 (0.6)
	Ampicillin/sulbactam or amoxicillin/clavulanate	28 (17.8)
	<i>Pseudomonas</i> effective penicillins (e.g., piperacillin/tazobactam, etc.)	0 (0)
	Carbapenem (imipenem, meropenem, etc.)	0 (0)
	No response	38 (24.2)
Total	157 (100.0)	

CAP, community-acquired pneumonia.

**Table 7.** Use of admission criteria for community-acquired pneumonia

Question		Frequency (%)
Do you use objective criteria to determine the need for hospital admission of CAP patients?	Pneumonia Severity Index	9 (5.7)
	CURB-65	25 (15.9)
	CRB-65	2 (1.3)
	Clinical judgment rather than objective standards	81 (51.6)
	Did not know of objective standards until now, and willing to refer to them in the future	2 (1.3)
	No response	38 (24.2)
	Total	157 (100.0)

CAP, community-acquired pneumonia; CURB-65, Confusion, Urea > 7 mmol/L, Respiratory rate > 30/min, low Blood pressure(diastolic blood pressure (DBP) < 60 mmHg or systolic blood pressure (SBP) < 90 mmHg and age ≥ 65 years; CRB-65, does not include urea.

**Table 8.** Responses to the CAP treatment guidelines according to specialty (I)

Question		Pulmonologists and infectious disease specialists	Other physicians	OR (95% CI)	P-value
		Frequency (%)			
Did you know that the Korean CAP clinical guidelines were released in 2009?	Yes, I know	85/90 (94.4)	23/61 (37.7)	28.1 (9.9 to 79.5)	< 0.001
	No, I did not know	5/90 (5.6)	38/61 (62.3)		
Do you use the 2009 Korean CAP treatment guidelines in practice?	Yes	67/90 (74.4)	31/61 (50.8)	2.8 (1.4 to 5.6)	0.003
	No	23/90 (25.6)	30/61 (49.2)		
Do you use macrolides for empirical treatment of CAP? (for inpatients or outpatients)	Not at all	1/76 (1.3)	5/43 (11.6)	-	-
	Macrolides only	2/76 (2.6)	4/43 (9.3)		
	Macrolides only for mild pneumonia	4/76 (5.3)	11/43 (25.6)		
	Combined with β-lactams (penicillins and cephalosporins)	59/76 (77.6)	14/43 (32.6)		
	β-lactams (penicillins and cephalosporins) (not combined with macrolides)	2/76 (2.6)	5/43 (11.6)		
	Combined empirically if severe CAP is likely	7/76 (9.2)	3/43 (7.0)		
	Others	1/76 (1.3) (combined with β-lactams)	1/43 (2.3) (when mycoplasma pneumonia is likely)		

CAP, community-acquired pneumonia; OR, odds ratio; CI, confidence interval.

dence interval [CI]: 9.9 to 79.5,  $P$ -value < 0.001). To “Do you use the 2009 Korean CAP treatment guidelines in practice?” 67/90 (74.4%) pulmonologists and infectious disease specialists answered “Yes” and 23 (25.6%) answered “No”; among other physicians, 31/61 (50.8%) answered “Yes” and 30 (49.2%) “No.” The frequency CAP treatment guideline use in clinical practice was also higher among pulmonologists and infectious disease specialists than among other physicians (OR: 2.8, 95% CI: 1.4 to 5.6,  $P$ -value = 0.003). Six of 76 (7.9%)

pulmonologists and infectious disease specialists, and 15 of 43 (34.9%) other physicians reported using macrolide monotherapy for CAP treatment. To “What β-lactam drugs do you use to empirically treat CAP?” “Third-generation cephalosporins” was the most common answer (58/76, 76.3%) in pulmonologists and infectious disease specialists; “Ampicillin/sulbactam or amoxicillin/clavulanate” was the most common answer (16/43, 37.2%) in the other physicians. To “Do you use objective criteria to determine the need for hospital admis-

**Table 9.** Responses to the CAP treatment guidelines according to specialty (II)

Question		Pulmonologists and infectious disease specialists	Other physicians	OR (95% CI)	P-value
		Frequency (%)			
How do you select $\beta$ -lactam drugs in the empirical treatment of CAP? (intravenous or oral)	Not at all	1/76 (1.3)	5/43 (11.6)	-	-
	First-generation cephalosporin	1/76 (1.3)	3/43 (7.0)		
	Second-generation cephalosporin	2/76 (2.6)	4/43 (9.3)		
	Third-generation cephalosporin	58/76 (76.3)	14/43 (32.6)		
	Third-generation cephalosporin, which has an effect on <i>Pseudomonas</i>	2/76 (2.6)	0/43 (0.0)		
	Ampicillin or amoxicillin	0/76 (0.0)	1/43 (2.3)		
	Ampicillin/sulbactam or amoxicillin/clavulanate	12/76 (15.8)	16/43 (37.2)		
Do you use the objective criteria to determine the need for hospital admission of CAP patients?	Pneumonia Severity Index	7/76 (9.2)	2/43 (4.7)	-	-
	CURB-65	20/76 (26.3)	5/43 (11.6)		
	CRB-65	2/76 (2.6)	0/43 (0.0)		
	Clinical judgment rather than objective standards	47/76 (61.8)	34/43 (79.1)		
	Did not know objective standards until now, and willing to refer to them in the future	0/76 (0.0)	2/43 (4.7)		

CAP, community-acquired pneumonia; OR, odds ratio; CI, confidence interval.

CURB-65, Confusion, Urea > 7 mmol/L, Respiratory rate > 30/min, low Blood pressure (diastolic blood pressure [DBP] < 60 mmHg or systolic blood pressure [SBP] < 90 mmHg and age  $\geq$  65 years); CRB-65, does not include urea.

sion of CAP patients?," "I use clinical judgment rather than objective standards" was the most common response (47/76, 61.8%) among pulmonologists and infectious disease specialists, as well as in other physicians (34/43, 79.1%). The responses to the CAP treatment guidelines according to specialty are summarized in Table 8 and Table 9.

## 6. Responses to the CAP treatment guidelines according to workplace

To the question "Do you know that the Korean CAP clinical guidelines were released in 2009?," 90/93 (96.8%) of tertiary and secondary hospital doctors answered "I know," 3 (3.2%) answered "I do not know," while 18/58 (31.0%) of primary clinic doctors (hospitals and private clinics) answered "I know" and 40/58 (69.0%) answered "I do not know." Awareness of the CAP treatment guidelines by tertiary and secondary hospital doctors was higher than that of the primary clinic doctors (OR: 66.7, 95% CI: 18.6 to 239.3,  $P$ -value < 0.001). To "Do you use the 2009 Korean CAP treatment guidelines in practice?," the majority of tertiary and secondary hospital doctors answered "Yes" (72/93, 77.4%); only 21 (22.6%) said "No."

Among primary clinic doctors, 26/58 (44.8%) answered "Yes" and 32 (55.2%) "No." Clinical use of CAP treatment guidelines was higher among tertiary and secondary hospital doctors than among primary clinic doctors (OR: 4.2, 95% CI: 2.1 to 8.6,  $P$ -value < 0.001). To "Do you use macrolides to empirically treat CAP?," "I use macrolides only for mild pneumonia" was the most common response of primary clinic doctors (12/38, 31.6%). To "What  $\beta$ -lactam drugs do you use to empirically treat CAP?," "Third-generation cephalosporins" was the most common answer among doctors of tertiary and secondary hospital doctors (66/81, 81.5%), while "ampicillin/sulbactam or amoxicillin/clavulanate" was the most common answer among doctors of primary clinic doctors (17/38, 44.7%). To "Do you use objective criteria to determine the need for hospital admission of CAP patients?," "I use clinical judgment rather than objective standards" was the most common answer among both doctors of tertiary and secondary hospital doctors and primary clinic doctors (51/81, 63.0%; 30/38, 78.9%; respectively). The responses to the CAP treatment guidelines according to specialty are summarized in Table 10 and Table 11.



**Table 10.** Responses to the CAP treatment guidelines according to workplace (I)

Question		Tertiary and secondary hospitals	Primary clinics	OR (95% CI)	P-value
		Frequency (%)			
Did you know that the Korean CAP clinical guidelines were released in 2009?	Yes	90/93 (96.8)	18/58 (31.0)	66.7 (18.6 to 239.3)	<0.001
	No	3/93 (3.2)	40/58 (69.0)		
Do you use the 2009 Korean CAP treatment guidelines in practice?	Yes	72/93 (77.4)	26/58 (44.8)	4.2 (2.1 to 8.6)	<0.001
	No	21/93 (22.6)	32/58 (55.2)		
Do you use macrolides for empirical treatment of CAP? (for inpatients and outpatients)	Not at all	0/81 (0.0)	6/38 (15.8)	-	-
	Macrolides only	2/81 (2.5)	4/38 (10.5)		
	Macrolides only for mild pneumonia	3/81 (3.7)	12/38 (31.6)		
	Combined with $\beta$ -lactams (penicillins and cephalosporins)	65/81 (80.2)	8/38 (21.1)		
	Beta-lactams (penicillins and cephalosporins) are used empirically and macrolides are not combined	3/81 (3.7)	4/38 (10.5)		
	Combined empirically if severe CAP is likely	7/81 (8.6)	3/38 (7.9)		
	Others	1/81 (1.2) (combined with $\beta$ -lactams)	1/38 (2.6) (when mycoplasma pneumonia is likely)		

CAP, community-acquired pneumonia; OR, odds ratio; CI, confidence interval.

**Table 11.** Responses to the CAP treatment guidelines according to workplace (II)

Question		Tertiary and secondary hospitals	Primary clinics	OR (95% CI)	P-value
		Frequency (%)			
How do you select $\beta$ -lactam drugs in the empirical treatment of CAP? (intravenous or oral)	Not at all	0/81 (0.0)	6/38 (15.8)	-	-
	First-generation cephalosporin	1/81 (1.2)	3/38 (7.9)		
	Second-generation cephalosporin	1/81 (1.2)	5/38 (13.2)		
	Third-generation cephalosporin	66/81 (81.5)	6/38 (15.8)		
	Third-generation cephalosporin, which has an effect on <i>Pseudomonas</i>	2/81 (2.5)	0/38 (0.0)		
	Ampicillin or amoxicillin	0/81 (0.0)	1/38 (2.6)		
	Ampicillin/sulbactam or amoxicillin/clavulanate	11/81 (13.6)	17/38 (44.7)		
Do you use objective criteria to determine the need for hospital admission of CAP patients?	Pneumonia Severity Index	7/81 (8.6)	2/38 (5.3)	-	-
	CURB-65	21/81 (25.9)	4/38 (10.5)		
	CRB-65	2/81 (2.5)	0/38 (0.0)		
	Clinical judgment rather than objective standards	51/81 (63.0)	30/38 (78.9)		
	Did not know of objective standards until now, but willing to refer to them in the future	0/81 (0.0)	2/38 (5.3)		

CAP, community-acquired pneumonia; OR, odds ratio; CI, confidence interval.

CURB-65, Confusion, Urea > 7 mmol/L, Respiratory rate > 30/min, low Blood pressure (diastolic blood pressure [DBP] < 60 mmHg or systolic blood pressure [SBP] < 90 mmHg and age  $\geq$  65 years); CRB-65, does not include urea.

## Discussion

In the United States and Korea, CAP has the sixth highest mortality rate [6]. However, the distribution and resistance patterns of CAP pathogens differ among regions and countries; therefore, antimicrobial treatment of CAP also differs. The Korean CAP treatment guidelines were released at the end of 2009. They reflect the current domestic and international status of CAP causative pathogens and resistance patterns. The Korean CAP guidelines may be accepted to varying degrees by practitioners treating CAP.

Yoon et al. [7] researched antibiotic choices for patients who were hospitalized for CAP in 2004, and showed that cephalosporin was administered to 6.0% of patients, quinolone in 3.5%,  $\beta$ -lactam/ $\beta$ -lactamase inhibitors in 2.3%, and macrolides in 2.2% of patients. Empirical antibiotics for CAP treatment may have changed since this report and after the release of the new CAP treatment guidelines. We conducted our survey not only for the entire study patients' population but also according to doctor specialization and workplace. Although the Korean CAP treatment guidelines were released a full 3 years ago, many doctors (27.4%) are still unaware of their existence. The number of other physicians and primary clinic doctors who are unaware of these guidelines was higher than that of doctors from any other specialty or workplace. In addition, fewer other physicians and primary clinic doctors use the guidelines in clinical practice. This suggests that the guidelines must be more aggressively promoted. Because online papers and official symposiums are common paths for learning about the guidelines, we should consider promoting them in more accessible and economical ways such as through the Internet or social media.

Many physicians thought that "The guidelines do not reflect the actual situation, especially on the choice of initial empirical antibiotics." This finding is not unexpected, because the choice of antibiotics is affected by various factors such as pathogen, severity of patient disease, the doctor's preferred antibiotics, and drug availability.

The use of  $\beta$ -lactam alone, combined  $\beta$ -lactam and macrolide, or respiratory quinolones, are recommended as empirical antibiotics for patients who do not require hospitalization. Because of their high resistance rates, tetracycline and macrolide monotherapy are not recommended treatments [4]. A secondary retrospective study was performed using the Community-acquired Pneumonia Organization CASE database (CAPO database) that was registered in Phase III clinical trials around the world. The study found that, on the basis of mor-

talidity and clinical outcomes, antibiotics that were effective for atypical pneumonia showed better results [8]. The most common response to survey questions on the content of the guidelines was dissatisfaction with the selection of initial empirical antibiotic therapy.

These responses indicate that a randomized controlled clinical trial comparing  $\beta$ -lactam monotherapy with combination therapy ( $\beta$ -lactams plus macrolides or  $\beta$ -lactams plus quinolone) is needed. Aminoglycosides are easily administered intramuscularly to outpatients, and anaphylaxis is rare. Some physicians still use a combination of aminoglycosides and other antibiotics as CAP therapy [9]. However, empirical aminoglycoside combination therapy should be limited to CAP cases with suspected *Pseudomonas* infections, and is not recommended under typical circumstances [10]. However, aminoglycoside combination therapy was often mentioned in our survey. The use of aminoglycosides as an option in treatment of pneumonia has insufficient evidence on the effectiveness and adverse events such as nephrotoxicity or ototoxicity [11, 12]. Better education and consensus on the minimization of aminoglycosides use for CAP treatment are needed for antimicrobial stewardship, patient safety, and reduction of medical costs.

This survey showed that pulmonologists, other physicians, and primary clinic doctors use macrolide therapy alone only for mild cases. Macrolide monotherapy is currently recommended for mild outpatient CAP patients by the IDSA/ATS CAP guidelines. We believe that these recommendations likely affect the high number of responses indicating monotherapy use for CAP treatment. Reported macrolide resistance rates to *Streptococcus pneumoniae* have reached 62.0-87.6% [4, 13-19] and resistance rates to *Mycoplasma pneumoniae* were similarly high; therefore, macrolide monotherapy is not recommended in the Korean CAP guidelines [20]. We need more data on the clinical significance of *in vitro* macrolide resistance to *Mycoplasma*. However, physicians should know the reasons that macrolide monotherapy is omitted from the empirical therapy recommendations in the Korean CAP guidelines.

Third-generation cephalosporins or ampicillin/sulbactam, and amoxicillin/clavulanate such as  $\beta$ -lactams, usually have been used for treatment of patients hospitalized with CAP [21-25]. According to our survey, very similar trends were observed in our study, yet first- or second-generation cephalosporins were often used. However, empirical antibiotic treatment of CAP with first- or second-generation cephalosporins is considered inappropriate, because pneumococcal

antibiotic resistance to cefuroxime, a typical second-generation cephalosporin [17], is 61.3%. *Haemophilus influenzae* resistance to cefuroxime and cefaclor has been reported to be 9.2% and 41.0%, respectively [26]. A large number of doctors decided to hospitalize patients on the basis of clinical judgment rather than objective criteria. This is owing to the difficulty of uniformly applying CURB-65 (Confusion, Urea > 7 mmol/L, Respiratory rate > 30/min, low Blood pressure (diastolic blood pressure [DBP] < 60 mmHg or systolic blood pressure [SBP] < 90 mmHg and age ≥ 65 years) and the Pneumonia Severity Index (PSI), severity scoring systems that are traditionally used to determine if hospitalization is required. In many circumstances, the patient's condition, underlying diseases, and socioeconomic conditions should be considered to determine the need for hospitalization. The physician's experience and clinical judgment are also important for making this decision. CURB-65 and CRB-65 (CRB-65 does not include urea) scores are simpler and easier to use than PSI as a CAP severity assessment tool [27], and doctors should consider its use in clinical practice to determine the need for hospitalization. The higher mortality rate of hospitalized patients compared to outpatients among low-risk patients suggests the importance of clinical judgment in addition to objective criteria [28].

As a conclusion, a large number of doctors still don't know that the Korean CAP treatment guidelines exist even though they were released at the end of 2009. Therefore, the guidelines must be more aggressively promoted in medical society and hospitals. For some clinicians who still inappropriately use aminoglycoside as a combination therapy and macrolide monotherapy, inappropriately, we should make a strong and consistent effort to educate them and make changes in clinical practice.

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