Retrospective Cost Estimation on the Use of the American Thoracic Society (ATS) Guidelines for Elder Inpatients with Pneumonia of Unspecified Pathogen — a Pilot Experience in Taiwan

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ABSTRACT

Community acquired pneumonia (CAP ; pneumonia, organism unspecified) has become highly prevalent in the elderly population which is associated with substantial morbidity and mortality.

Several CAP management guidelines have been proposed, and most of the focus has been placed on American Thoracic Society (ATS) CAP guidelines in 1993. The practicality, validity and influence of the guidelines on elderly patients have not been evaluated systemically in Taiwan.

Cost-containment handling has been an important goal for hospital administrators and practitioners as well as for health insurance organizations. We have performed a retrospective estimation by assessing the cost under certain aspects linked with the therapeutic intervention of ATS guidelines. This estimation compares the outcomes (such as the

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patients' length of stay, drug expense, antibiotics expense, number of antibiotics used, total expense, and the daily cost incurred during the hospitalization) of 64 elder inpatients receiving the diagnosis of pneumonia of unknown pathogen (Coded 486 in ICD-9-CM) from one medical center in Taiwan during 1996, whose anti-microbial therapy was either consistent or inconsistent with this very set of guidelines.

The results showed, patients whose therapeutic management was consistent with the ATS guidelines had a shorter length of stay (LOS) (13.5 days v.s. 24.1 days, p=.002), cheaper total drug cost (US$823.8 v.s. US$1,901.3, p<.0001), less antibiotics cost (US$363.10 v.s. US$875.96, p<.005), and fewer number of parenteral antibiotics (1.19 v.s. 2.56, p=.0001). Notwithstanding, their total hospital expense, and daily cost did not appear to be more favorable (p>.05; NS).

Results suggest that therapeutic intervention of ATS guidelines for treating elder inpatients with pneumonia of unspecified pathogen brings about lower health care expenditure only under certain aspects. In addition to providing the basis for further investigation, this study can also partially offer an important empirical trial for the guidelines as a reasonable and feasible basis in our intervention/treatment for elderly CAP. Moreover, our research findings may become an enlightening reference for clinical practice as well as the reimbursement scheme of National Health Insurance Program in Taiwan.

Key words: cost, elder, pneumonia, ATS guideline(s), antibiotics, Taiwan

Introduction

Pneumonia is usually a representative infectious disease of lung. Medical expenditure for elderly patients is strikingly increasing for recent years and this certainly results in a socioeconomic burden at present and future as well. Both community acquired pneumonia (CAP; pneumonia, organism unspecified) and nosocomial pneumonia are major problems for elderly patients both in aspects of morbidity and mortality in representative pulmonary diseases as well as infectious diseases (Andrews et al., 1987; Bartlett et al., 1998; Cantrell & Norman, 1999).

Currently, pneumonia is increasingly common among older patients and those with co-morbid condition (Cantrell & Norman, 1999; Manchester Royal Infirmary, 1994). Millions of people suffer from CAP regardless of the time or place (Andrews et al., 1987; Bartlett et al., 1998), whether it is under the setting of institution, community or home. There are many predisposing factors including age (esp. age extremes). In

general, around one-sixth of these infections occur in patients over 65 (Cantrell & Norman, 1999; Manchester Royal Infirmary, 1994). CAP has become highly prevalent in the elderly population which is associated with substantial morbidity and mortality.

In general, anti-microbial agents (or antibiotics), are used to manage or treat this infectious condition. Significant proportion of antibiotics have been ascribed to CAP, usually coded as 486 (pneumonia of unknown pathogen) under ICD-9-CM system. In recent years, the hospitalization rate of pneumonia in the elderly has increased significantly, reaching a rate of 11.6 per 1,000 in those over age 75 (Bently & Mylotte, 1991). The prevalence of pneumonia and the associated case fatality rate are also higher as expected in the elderly as compared to the younger populations. Series of the crude mortality rate of pneumonia reported for the elderly showed 16%, 26% and 33% respectively, however, the relative mortality rate was around 20% in general, while attributable mortality rate has been estimated up to 23% (Marrie, 1990). Some other large scale studies showed mortality rates of pneumonia ranging from 2% to 22% in patients of all age strata (Jokinen et al., 1993), ranging from 7% to 24% in adult patients (Fine et al., 1990), and 16% to 33% in the elder patients (Venkateesan et al., 1990; Zweig & Post, 1990).

As for the care intervention on general pneumonia or CAP, cost-effective handling has been an important goal for hospital/facility/clinic administrators and practitioners as well as for health insurance organization. Some efforts have been made to reduce health care cost with the same clinical outcomes, or without sacrificing the health care quality. Practically, medications account for a large proportion of health care expenditures on care practices in many countries, also reasonable in Taiwan. Adaptation of the drug prescription and use is a major approach to cost-effective effort to validate the efficacy and to control the care expenditure. On the other hand, drug prescriptions, on the whole, are apparently easier to approach and more manageable in the health care practice (Bartlett et al., 1998; Wally & Davey, 1995). Anti-microbial agents, among the most commonly prescribed medication, playing a critical role in the treatment and management of infection, are thus the center of this focus.

Streptococcus pneumoniae, Mycoplasm pneumoniae, Chlamydia pneumoniae & Legionella species are usually regarded as the most popular etiologic species of CAP in the elderly, and Enterobacteriaceae are also commonly cultured in older individuals. However, Haemophilus influenzae is an increasing important cause of CAP in the elderly (Bartlett et al., 1998; Cantrell & Norman, 1999; Bently & Mylotte, 1991).

To the best of our knowledge, and due to practicality, pathogen-specific anti-microbial therapy is the most ideal way to intervene in infectious diseases (Andrews et al., 1987; Bartlett et al., 1998). Unfortunately, this is not usual the case for most pneumonia whose microbial agent is often difficult to identify. Approximately half of the cases of CAP cannot be identified in the hospital / clinic setting, despite the fact that many breakthroughs have been made in sophisticated laboratory procedures (Singel et al., 1996; Bates et al., 1992; Fang et al., 1990), thus early and definite identification of pathogen cannot actually be achieved and cannot seriously be relied upon to determine quick therapeutic responses, and hence the cost-effective handling.

Controlling the costs of health care delivery in case of CAP of elder patients has been a major concern of health care managers, physicians, and insurance organizations (Manchester Royal Infirmary, 1994; Venkateesan et al., 1990; Marrie, Durant, & Tates, 1989; Fine, Smith, & Singer, 1990; Fine et al., 1997).

Conventional cost-effectiveness studies have usually emphasize several aspects: (1) single antibiotic cost analysis (Paladino & Fell, 1994); (2) evaluating the efficacy of oral versus intravenous antibiotic therapy (Walley & Davey, 1995; Cunha, 1996); and even (3) screening procedures in hospital admission (Fine, Smith, & Singer, 1990; Farr, 1997). Although some studies on the health care for the elderly today have shown improvement in medication efficacy, however, study on the associated cost-effectiveness have still been limited (Farr, 1997). Current challenge stems from the identification of the most cost-effective among clinically effective approaches for treating elders suffering from pneumonia, and subsequent validation of the practicality and usefulness of therapeutic guidelines accordingly.

So far, there have been several available management guidelines detailing empirical anti-microbial therapy for CAP. Amongst them, American Thoracic Society (ATS) guidelines, introduced in 1993, have been most widely adopted and discussed (American Thoracic Society, 1993; American Thoracic Society, 1996; Gleason et al., 1997). Therapeutic intervention of CAP was categorized by ATS into four classes according to its severity. Outpatient treatment is considered sufficient for patients in class I and II; while hospitalization is recommended for patients in classes III and IV. Antibiotics suggested for treating class-I patients, who are outpatients without co-morbidity and being 60 years of aged or younger (class I) include: macrolide and tetracycline. For class II outpatients, who are over 60 or have co-morbidity second-generation cephalosporin, trimethoprim-sulfamethoxazole, a beta-

lactam / beta lactamase inhibitor with or without erythromycin or other macrolide are suggested for the treatment. Therapies for hospitalized patients include: second- or third-generation cephalosporin, beta-lactam / beta lactamase inhibitor or macrolide (Bartlett et al., 1998; American Thoracic Society, 1996). Recently, Gleason et al. have compared medical outcomes and anti-microbial costs between outpatients receiving such therapy. (Bartlett et al., 1998; Gleason et al., 1997). Their finding suggested that the use of erythromycin for Class-I outpatients, as recommended by the ATS guidelines resulted in lower anti-microbial costs. Nevertheless, they also found that Class II outpatients, receiving therapy consistent with ATS-guidelines, had ten-fold higher anti-microbial costs.

The practicality, validity and influence of the guidelines on elderly patients have not been evaluated systemically in Taiwan. There is no doubt that cost-containment handling has been an important goal for hospital administrators and practitioners as well as for health insurance organizations. Besides, several factors such as some demographical variables and health status including coexisting illness / conditions, rather, physical conditions, laboratory findings...etc. may affect the evaluation of efficacy of CAP handling (Fine et al., 1990; Venkateesan et al., 1990; Zweig, Lawhorne, & Post, 1990). So, it is very important to bear in mind the potential confounders during the handling on CAP.

Using our handy available data, we performed a pilot retrospective estimation by assessing the costs under certain aspects associated with ATS guidelines. We aimed to review and try to investigate outcomes and cost consumption of elder inpatients with CAP. Subsequently, we compare the possible outcomes and the costs between elder CAP inpatients receiving ant-microbial therapy consistent with this very set of guidelines and those receiving no such therapy. The ultimate goal of this study was to make contribution to clarification of the cost-effectiveness of ATS guidelines for treating elder CAP inpatients.

Material and Method

The research design of this retrospective study was to compare costs for treating CAP between therapeutic interventions following and those not following ATS guidelines. Data for this study were from usual inpatient claim data for a university-affiliated medical center in Taiwan. Among all these data, we picked and reviewed records with complete information on clinical courses of major diagnosis for the whole year of 1996. The process for reviewing these medical records was well discussed and carried out by attending specialist physicians with authorization.

Initially, all patients whose diagnosis was coded 486 by the ICD-9-CM system (i. e., CAP patients) were enrolled automatically. By this procedure, we identified a total of 123 CAP patients aged 65 or over. The sample size was later on further reduced by excluding from the 123 patients with at least one of the following conditions and thus not appropriate to be a subject for the present study. The conditions for exclusion are (1) staying in a hospital across two calendar years, such as 1995 to 1996 or 1996 to 1997, and thus having an incomplete clinical course for the year of 1996; (2) having missing information in medical records; (3) having pneumonia as the secondary diagnosis rather than the major one; (4) having an intravenous route of antibiotics administration during hospitalization; and (5) dying from another underlying cause during the episode of illness. These five conditions excluded 6, 4, 17, 21, and 11 patients, respectively. After this selection procedure for study subjects, a total of 64 elder CAP patients were picked and recruited for the study.

For analysis purposes, these 64 subjects were categorized into two groups according to whether their treatment was consistent with the ATS guidelines or not. All patients in the study sample received mandatory medication, which included antibiotics, prescribed by their attending physicians. Nevertheless, patients in the "consistent" group and those in the "inconsistent" group acquired some different antibiotics. Specifically, antibiotics administered to the "consistent" group included macrolide, tetracycline, 2^{nd} or 3^{rd}-generation cephalosporin, trimethoprim-sulfamethoxazole, beta-lactam / beta lactamase inhibitor, and so forth. In contrast, patients in the "inconsistent" group received other parenteral antibiotics, such as penicillin, 1^{st}-generation cephalosporin, lincosamide, aminoglycoside, etc. In some sporadical cases with second or third opinions from physicians or with proposition from experts in infectious diseases, patients in the "inconsistent" group obtained 4^{th}-generation cephalosporin, monobactam, or carbapenem. A patient receiving both categories of antibiotics during their hospital stay were regarded as a subject in the "inconsistent" group.

The database for this study contained information on patients' basic demographics, and the major final diagnosis, management procedures and charges for patients. Each medical record was scrutinized by second opinions from a senior attending physician and a well-experienced pharmacist for clarification of a patient's major and secondary diagnoses, physical conditions, co-morbid conditions, medication regimens and use of antibiotics, and laboratory findings for the patient. For examining comparability with respect to disease severity between the two groups, necessary clinical indicators were

Table 1 Sex and age distribution between the ATS consistent and inconsistent groups**

		Consistent Gr (N=44)		Inconsistent Gr (N=20)	
Sex		N	%	N	%
	Male	28	63.64	14	70.0
	Female	16	36.36	6	30.0
Age					
	65-70 years	11	25.0	4	20.0
	70-75 years	8	18.18	4	20.0
	75-80 years	9	20.46	7	35.0
	80+ years	16	36.36	5	25.0
	Average age*	77.66±7.83		76.55±7.64	

*: mean ± 2S.D.

**: No statistical difference was observed between the ethnicity & age distribution of consistent and inconsistent groups based on χ^2 or *t* tests.

constructed according to the ATS guidelines, and the statuses of these indicators for a patient were judged by information shown in corresponding medical records. For the purposes of evaluating the cost-effectiveness of ATS guidelines, outcomes measures that included a patient's length of stay, numbers of antibiotics used, drug expenses, and total expenses were estimated for each single patient, and the average outcomes were compared between the two groups.

Statistical analyses were conducted by the SPSS software. Differences in various outcome measures between the two groups were assessed by corresponding statistical methods, including the student's *t*-test and Mann-Whitney χ^2 test. Outcome measures investigated included coexisting illness and its related condition, physical status, laboratory findings, length of stay (LOS), hospital expenses and use of antibiotics. The threshold level of statistical significance was set at the *p*-value of 0.05.

Result

Among the 64 subjects, 44 (68.75%) were in the "consistent" group, and 20 (31.25%) were in the other group. As shown in Table 1, the gender distributions of the two groups were quite close to each other, with the "consistent" group having a slightly higher proportion for males. The average ages of the two groups had no substantial difference according to the *t*-test. Results regarding comorbidity and severity indicators are reported in detail in Table 2. In both groups chronic obstructive airway disease (38.6% v.s.

Table 2 Percentage of coexisting illness and condition between the ATS consistent and inconsistent groups*

	Consistent Gr (N=44)%	Inconsistent Gr (N=20)%
a. Chronic obstructive airway disease**	38.6	35.0
b. Diabetes mellitus	25.0	10.0
c. Congestive heart failure	15.9	15.0
d. Chronic renal failure	6.8	10.0
e. Chronic liver disease	4.6	0
f. Previous hospitalization within 1 yr of the onset of pneumonia	27.3	30.0
g. Suspicion of aspiration	2.3	5.0
h. Altered mental status	2.3	5.0
i. Postsplenectomy state	0	0
j. Chronic alcohol abuse or malnutrition	0	0

*: No statistical difference was observed between the percentages of consistent and inconsistent groups based on χ^2 tests.

**: Including chronic obstructive pneumonia disease, tuberculosis, bronchiectasis, lung cancer, bronchial pulmonary dysplasia, asthma, laryngomalacia, pulmonary fibrosis and pneumopyothorax .

35.0%) was the most common co-morbidity, followed by diabetes mellitus (25.0% v.s. 10.0%), congestive heart failure (15.9% v.s. 15.0%), chronic renal failure (6.8% v.s. 10.0%), and chronic liver disease (4.6% v.s. 0%). No difference in these morbid conditions was detected between the two groups by corresponding χ^2 test. As for disease severity, which was assessed by the number of admissions in the past year, both groups also had similar results (27.3% v.s. 30.0%). Moreover, no difference with statistical significance was revealed by various statistic tests regarding other indicators for disease severity, which included suspicion of aspiration, alteration of mental status, postsplenectomy state, chronic alcohol abuse and malnutrition.

Table 3 presents results related to physical conditions and laboratory findings. The two groups had no difference with statistical significance in most outcome measures. These indicators included a respiratory rate of over 30 breaths per minute (36.4% v.s. 35.0%), body temperature (37.34°C v.s. 37.60°C), a fever over 101°F (i.e., 38.3°C) (15.9% v.s. 20.0%), the average speed of heart beating (86.0 beats/min v.s. 88.2 beats/

Table 3 Physical condition and laboratory findings between the ATS consistent and inconsistent groups (% or specified)*

	Consistent Gr (N=44)	Inconsistent Gr (N=20)
Physical conditions		
a. Respiratory rate in excess of 30 breaths/min.	36.4%(16/44)	35.0%(7/20)
b. Body temperature	37.34°C	37.60°C
c. Temperature > 38.3°C (101°F)	15.9%(7/44))	20%(4/20)
d. Average heart beat	86.0 beats/min.	88.2 beats/min.
e. Average respiratory rate	23.7 times/min.	23.0 times/min.
f. Extrapulmonary site of disease+	2.3	0
b. Confusion and/or decreased level of consciousness	6.8	0
Laboratory findings		
a. WBC count < 4×10^9/L or > 30×10^9/L or absolute neutrophil count below 1×10^9/L	2.3	15.0
b. Average WBC count	11,500.8	12,072.5
c. Need for mechanical ventilation	4.6	5.0
d. Abnormal renal function#	47.7	55.0
e. Lobe involvement (0/1/2)	5.1/71.8/23.1	5.6/61.1/33.3
f. Presence of a pleural effusion	29.6	40.0
g. Hematocrit of 30% or Hemoglobin < 9 g/dl	6.8	20.0
h. Sepsis or metabolic acidosis	4.6	0

*: No statistical difference was observed between the percentages or means of consistent and inconsistent groups based on χ^2 tests or t tests except line a & g of lab findings.

+: Including acute otitis media and urinary tract infection.

#: Serum creatinine > 1.2 mg/dl or blood urea nitrogen determination > 20 mg/dl (or > 7 mmol/L)

min), the average respiratory rate (23.7 times/min v.s. 23.0 times/min), disease in an extrapulmonary site(2.3% v.s. 0%), confusion and/or decreased level of consciousness (6.8% v.s. 0%), the average WBC count (11,500.8 v.s. 12,072.5), need for mechanical ventilation (4.6% v.s 5.0%), abnormal renal function (47.7% v.s. 55.0%), lung lobe involvement(0/1/2) (5.1/71.8/23.1 v.s. 5.6/61.1/33.3), presence of pleural effusion (29.6% v.s. 40.0%), and sepsis or metabolic acidosis (4.6% v.s. 0.0%). Difference was detected for only two outcome measures, which were presence of a WBC count smaller than 4×10^9/L or larger than 30×10^9/L or presence of an absolute neutrophil count below

Table 4 Length of stay (LOS), hospital expenses * and the use of antibiotics in the ATS consistent and inconsistent groups

	Consistent Gr (N=44)	Inconsistent Gr (N=20)	Statistical Significance+
LOS (days)	13.5 ± 13.7	24.1 ± 24.2	+p = .002
Drug costs / day	58.7 ± 32.3	66.4 ± 37.9	p = .3802
Total drug cost	823.8 ± 219.5	1901.3 ± 813.2	+p = .0000
Hospital expense / day	163.3 ± 66.3	177.7 ± 85.9	p = .1601
Total hospital expense	2,584.3 ±2,309.6	5,327.2 ±3,219.6	p = .0955
# of parenteral antibiotics	1.19 ± 0.46	2.56 ± 1.19	+p = .0001
Antibiotic cost	363.10 ± 208.88	875.96 ± 594.72	+p = .0037

* Mean ± 2S.D. in US$ (1 US$ = 28 NT$, in 1996);

+ Significant probability of difference shown was based on *t*-test for the distribution between consistent and inconsistent group.

1×10^9/L (2.3% v.s 15.0%), and presence of Hematocrit of 30% or of Hemoglobin smaller than 9 g/dl (6.8% v.s. 20.0%).

According to information shown in Tables 2 and 3, these two groups were relatively comparable to each other in terms of health status, co-morbid conditions, and disease severity, as well as other physical related conditions. Table 4 demonstrates results pertaining to cost analyses. This study measured monetary costs in 1996 current dollar, and also adopted the average exchange rate of US dollar with respect to NT dollar of the year of 1996. Results in Table 4 indicate that the "consistent" group had significantly shorter length of stay (LOS) (13.5 days v.s 24.1 days, p=.002), smaller total drug outlay (US$ 823.8 or NT$ 23,066.4 v.s. US$ 1,901.3 or NT$ 53,236.4, p<.0001), less expenses for antibiotics (US$363.10 or NT$101,66.80 v.s. US$875.96 or NT$24,526.88, p<.005), a smaller number of parenteral antibiotics used (1.19 v.s. 2.56, p=.0001). Notwithstanding, the "consistent" group did not have better results for the daily outlay of drug and the daily total expense of hospitalization.

Discussion

This is only a rough study design trying to determine the status of practice, management, administration and even the reimbursement basis related to some representative clinical guidelines. That is even more impressive for those trying to propose a genuinely valuable principle or rule for health care practicing to be applied in most important domains. In stead of formal cost analysis, we

just conduct it by cost estimation through some key expenditure domains, mostly because of some limitations about the precise duty center allocation and the diversiform samples individually in clinical setting.

Pneumonia is the 7th leading cause of death in Taiwan in general, with a growth rate of 27.9% in ten years (Department/Ministry of Health, the Executive Yuan, 1997). However, for those aged over 65, pneumonia is the 5th leading cause of death (Department/Ministry of Health, the Executive Yuan, 1997). Therefore, pneumonia management guideline is important, especially for the aged, and the cost-effectiveness is always taken into consideration. Fortunately, the result shows us that this guideline is suitable for advanced age, as well as younger adult counterparts (American Thoracic Society, 1993; American Thoracic Society, 1996).

Among the cases recruited, the number of male patients is greater than that of the female, but without significance. This may reflect the poorer health status of the male in general view, esp. in the older population, or somewhat reflect the hints of gender imbalance trend of the old population in Taiwan from the massive immigration of soldier and refugees during civil war of China in 1949, but it is not conclusive for the small sample size.

Out of our expectation before conduction, final sample size for use is small. Although initial population totaled 123 patients age 65+ hospitalized for pneumonia with an ICD-9-CM code 486 were recruited, only 64 patients, far less than expected, met the criteria after comprehensively reviewing the medical records. Amongst them, just following pre-study settled criteria, we had 6 patients who stayed in hospital across the calendar years from 1995 to 1996 or 1996 to 1997, and was classified as incomplete clinical courses in 1996, and it let us lose few samples; we had 4 patients missing information or with incomplete records. If the study design can be expanded in years (such as up to 5 years), the samples across the calendar years will diminished furthermore. We can dig more complete records by intensive follow-up, even outreach visiting and interviewing. However, it is not easier to get available for the limitation of manpower, time, and other resource. Here in this case, we tried to recruit 6 patients who stayed in hospital across the calendar years, and the outcome is close.

We had 17 patients with pneumonia as a secondary diagnosis rather than a major one, as usual in most elderly inpatients, frail hosts and other victims with chronic condition. It was supposed to be so anyway, because there is no better way to clearly clarify and classify the therapeutic interventions between 2 or more different health problem categories, rather, there still be a question mark on the list and priority of health problems. This

should be a barrier of those study designs related to care, intervention, management and ascertainment/classification in general.

We also had 21 patients without intravenous route of antibiotics administration during hospitalization, and it is quite difficult to link with ATS guideline in itself. 11 patients died from other underlying cause of death during the episodic illness, and it will let their clinical course incomplete for the CAP.

At the present, health problems (morbidity, condition.....) has been digitalized under the classification system for better clarification, classification, summation, health policy making, administration, supervising and monitoring...etc.. Based on this classification system of disease and related health problems, all morbid conditions can be given a specific code number in the ICD framework. In this study design, underlying case ascertainment, diseases or morbid conditions as our targets are common community acquired pneumonia (CAP), and the specific coding counterpart in the ICD-9-CM is 486 (i.e. pneumonia ; organism unspecified). Ascertainment of cases should be with inherent and concrete limitation to gain access and get the precise results for the study.

Ultimately, a total of 64 selected elder patients were recruited for the study. Besides, there still be with potential to possess coding aberration resulting in misclassification and priority/sequence bias from the practicing physicians and the coders, esp. there is still no formal education/training system and program at present in Taiwan whatever. This implies, in the current data file claims for the similar purpose, some bias potential comprises the barriers and limitation to interfere the related study design and conducting.

Even the database available contained basic information, major diagnosis, management procedures and expense of the patients, more health care information of the samples may be acquired from hospital records, but functional grading of lung or holistic care information is still insufficient. We can do more estimation & analysis to validate research design, lessen the confounding, but important care information to be collected and compiled from the conventional health information system may still be with reluctance.

For some positive results in our pilot study trial, we chose CAP (ICD-9 CM code 486) to study not only because it accounts for a major portion of pneumonic patients in general, but it also exemplifies the common dilemma that physicians face in their daily practice. This clinical study, showed 1) significant differences on the length of stay (LOS), 2) decreased total drug cost, 3) decreased antibiotic cost, and 4) decreased the number of parenteral antibiotics used, by 1.8, 2.3, 2.4 and 2.2 fold between the ATS

guidelines consistent and inconsistent groups. Hence, the results of the study helps to clarify drug of choice and the clinical decision making in respect of CAP treatment during routine practice.

Although the daily charge of drug and daily total hospital expense are similar in these two groups, the total drug cost, the number of parenterd antibiotices and the antibiotic costs are significantly lowered in the consistent group. Even though the samples size is limited, significant differences of cost-effectiveness in some aspects between both two groups (ATS Guidelines consistence or not) was noted in the study.

The basic health status on the elder patients, including physical & lab finding, co-morbidities, co-existing illness' & conditions, complications known or unknown varies amongst individuals. Results of our study from Table 2 & 3, only little significant differences were noted between these two groups, we cannot give a suitable explanation, however, at least these issue is no selection bias during sampling.

The management of elder CAP is more difficult due to the effects of multiple co-morbidities, frequent combined underlying diseases or conditions, and aging-related altering of pharmacokinetics & pharmacodynamics, responses, greater potential adverse drug reactions (ADRs) and possible drug to drug interactions (Gleason et al., 1997; Department/Ministry of Health, the Executive Yuan, 1997). The result of recent prospective studies shows significantly worse outcome (Singel et al., 1996; Bates et al., 1992; Fang et al., 1990). Majority of study subjects may possibly received anti-microbial medications before admission because they may have been referred from local hospitals or clinics. For the sake of cost reduction, first-generation antibiotic was recommended by the National Health Insurance Agency in Taiwan for the initial treatment. Now, we have assured the practical value of ATS guidelines in the management of CAP. Practice consistent with the guidelines may result in resource saving, decrease cost consumption during health care delivery which is an important aspect in health care worldwide.

To the best of our knowledge, and due to practicality, pathogen-specific anti-microbial therapy is the most ideal way to intervene in infectious diseases. Unfortunately, this is not usual the case for most pneumonia whose microbial agent is often difficult to identify. Approximately half of the cases of CAP cannot be identified in the hospital/clinic setting, even though breaking thru' limitation and proceeding by the sophisticated laboratory procedure (Singel et al., 1996; Bates et al., 1992; Fang et al., 1990), thus early and definite identification of pathogen cannot actually be achieved and cannot seriously be re-

lied upon to determine quick therapeutic responses, and hence the cost-effective handling. And furthermore, controlling the costs of health care delivery in case of CAP of elder patients has been indeed a major concern of health care managers, physicians, and insurance organizations (Marrie, Durant, & Tates, 1989; Fine, Smith, & Singer, 1990; Fine et al., 1997).

Conventional cost-effectiveness studies has usually emphasize several aspects : i.e. single antibiotic cost analysis; evaluating the efficacy of oral versus intravenous antibiotic therapy; and screening procedures in hospital admission. Current challenge stems from the determination of the most cost-efficient, yet clinically effective approaches in elders suffering from pneumonia, in turn to validate the practicality and usefulness of therapeutic guidelines. Sparing the single antibiotic cost analysis and screening procedures in hospital admission, our study have shown some improvement in medication efficacy, however, study on the associated cost-effectiveness have still been limited in our pilot setting.

In this retrospective study, all patients traced took the prescribed medication administered by the attending physicians (esp. antibiotics). Longer hospital stay in the patients of "inconsistent" group may reflect the refractory nature of the severity of CAP, their clinical status, such as with some co-morbidity & complication. The antibiotics administered for patients in the "inconsistent group" include penicillin, 1^{st}-generation cephalosporin, lincosamide, aminoglycoside and on rare occasions 4^{th}-generation cepha-losporin, monobactam, carbapenem, (after consultation with infection specialist); for the "consistent group" different combination regimen from the similar types of antibiotics of ATS guideline may be adopted depending on the personal preference of individual attending physician. So, attending physician executes the professional care intervention and play the key role to take a good care of the CAP elder victims, he is supposed to get the knowledge & skill of practice guideline(s).

As for the results of overall cost estimation, it revealed significantly shorter length of stay (LOS), less total drug cost, and less antibiotics cost, and fewer number of parenteral antibiotics in the group whose therapy administering is consistent with the ATS guidelines, but not for the daily charge of drug and daily total hospital expense. It is not easy to set the definite conclusion that therapeutic intervention of ATS guidelines for treating elder inpatients with pneumonia of unspecified pathogen are considerably cost-effective in all aspects with definite evidence-basis, but it also cannot discard the potential of ATS guidelines for treating elder inpatients with CAP.

On the other hands, several factors such

as some demographical variables and health status including coexisting illness, conditions, physical conditions, laboratory findings...etc. may interfere our evaluation of efficacy of CAP handling (Fine et al., 1990; Venkateesan et al., 1990; Zweig, Lawhorne, & Post, 1990). We have controlled all possible/potential confounders to the handling on our samples with CAP through randomized procedure. Yet, possibly due to less samples or inherent diversity among the elderly, a few laboratory data items can't be well-controlled still.

The purpose of our study is to perform the cost estimation just based on the consistence of the ATS guidelines for elder inpatients with CAP, and its feasibility in general practice of elder health care is acceptable, there are still with over-, trivial-, and minute-issues outside the cost are necessary but uneasy to investigate in detail, such as the subjects of drug efficacy and the drug resistance ...etc. (Swartz, 1997; Kollef, 1994; Schwartz, Bell, & Hughes, 1997; Seppälä et al., 1997; Shales et al., 1997).

The management of elder CAP is more complicated due to intermingling of complex effects of co-morbidities, in addition, aging-related altering of pharmacokinetics & pharmacodynamics, greater potential adverse drug reactions (ADRs) and possible drug to drug interactions (Cusack & Vestal, 1986; Cusack, 1989; Carbonin et al., 1991). Pneumonia may be life threatening to the elderly, thus aggressive intervention such as empirical anti-microbial therapy is necessary whether the etiologic organism has been identified or not.

On the other hand, elderly care is in itself a complex practice due to diversified clinical, sub-clinical, multi-systemic, biopsychosocial.....manifestation ranging from potentially life threatening events requiring aggressive intervention, to mild disease / condition needing only conservative care. The ATS guideline helps us categorize and treat these unique clinical conditions, and individualized care plan proposed is still essential.

To study pneumonia with unspecified pathogens is a worthwhile effort, not only because it accounts for a major portion of pneumonia patients in general, but it also exemplifies the common dilemma that physician face in their daily practice. The purpose of our study is to present empirical findings on elder inpatient care in order to meet this goal.

Pneumonia, at present, is one of the most common etiologies causing morbidity or complication in the elderly. It is reasonable to conclude that, under general clinical setting, the benefit by adopting the ATS guideline include saving health care expenses under some aspects, and even decrease the incidence of drug-resistant strain of bacteria for those antibiotics theoretically.

Cost-effective handling is always important and mandatory therapeutic interven-

tions to all the health problems in Taiwan, for care administrators, practitioners as well as for health insurance organization whoever, esp. for its National Health Insurance Program (NHIG) effective operating. Now, general pneumonia or CAP management is a representative case and this retrospective estimating model may be regarded as a preliminary pilot trial basis for further workup.

On the whole, our empirical results suggest that therapeutic intervention of ATS guidelines for treating elder inpatients with pneumonia of unspecified pathogen are considerably with lower cost consumption under certain aspects only. However, this study can provide an important empirical trial for the guideline as a reasonable and feasible basis in our intervention/treatment of elderly CAP. Moreover, our result may partially become an important basis of reference to clinical practice and reimbursement of National Health Insurance Program in Taiwan.

Furthermore, lots of some other guidelines for the management of health conditions in the elderly population can be proposed and wait for investigating and discussing.

Conclusion

Our study showed that therapy consistent with ATS guidelines shortened the length of stay by 11 days, and decreased the drug and total hospital expense by 57% and 51%. The results revealed lower cost consumption with ATS guideline also suggest, only under certain aspects, the feasibility of it's application in elder patients with the diagnosis of pneumonia of unknown pathogen. Our results suggest therapeutic intervention of ATS-guidelines for treating elder inpatients with pneumonia of unspecified pathogen brings about lower health care expenditure only under certain aspects. In addition to providing the basis for further investigation, this study can also partially offer an important empirical trial for the guidelines as a reasonable and feasible basis in our intervention / treatment for elderly CAP. Moreover, our research findings may become an enlightening reference for clinical practice as well as the reimbursement scheme of National Health Insurance Program in Taiwan.

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REFERENCE

American Thoracic Society(ATS)(1993). Medi-

cal section of the American lung association. Guidelines for the initial management of adults with community-acquired pneumonia: diagnosis, assessment of severity, and initial antimicrobial therapy. *Am Rev Respir Dis*, *148*, 1418-1426.

American Thoracic Society(ATS) (1996). Hospital-acquired pneumonia in adults: Diagnosis, assessment of severity, initial antimicrobial therapy, and preventive strategies: a consensus statement. American Thoracic Society. *Am J Respir Crit Caer med*, *152*, 1711.

Andrews, B. E. et al. (1987). Community acquired pneumonia in adult in British hospitals in 1982-1983: A survey of aetilogy in mortality, prognostic factors and outcome. *Q J Med*, *62*(239), 195.

Bartlett, J. G. et al. (1998). Community acquired pneumonia in adults: Guidelines for management. *Clin Infect Dis*, *26*, 811.

Bates, J. H., Campbell, G. D., Barron, A. L., Mc Cracken, G. A., Morgan, P. N., & Moses, E. B., et al. (1992). Microbial etiology of acute pneumonia in hospitalized patients. *Chest*, *101*, 1005-1012.

Bently, D., & Mylotte, J. (1991). *Epidemiology of respiratory infections in the elderly*. In Niederman MS's (ed) Respiratory infections in the Elderly. Raven Press, New York, 1-23.

Cantrell, M., & Norman, D. (1999). Pneumnia; in Chap 54, *Principle of Geriatric Medicine and Gerontology* (4th ed), edited by W. R., Hazzard, J. P., Blass, W. H. Ettinger, (Jr), Halter J. B., Ousalnder J. G., et al(ed). McGraw-Hill, 729.

Carbonin, P., Pahor, M., Bernabei, R., & Sgadari, A. (1991). Is age an independent risk factor of adverse drug reaction in hospitalized medical patients? *J Am Geriatric Soc*, *39*, 1093-1099.

Cunha, B. A. (1996). Community-acquired pneumonia: cost-effective antimicrobial therapy. *Postgrad Med*, *1*, 109-122.

Cusack, B. J. (1989). Polypharmacy and clinical pharmacology; *in Geriatric Review Syllabus: A core Curriculum in Geriatric Medicine*, 1st ed, edited by Beck, J. C., New York, American Geriatrics Society, 127-136.

Cusack, B. J., & Vestal, R. E. (1986). Clinical pharmacology: Special considerations in the elderly. *in Practice of Geriatric Medicine*, edited by E. Calkins, P. J. Davis, A. B. Ford, Philadelphia, WB Saunders Co., 115-136.

Department/Ministry of Health, the Executive Yuan (1997). *Health and Vital Statisics 1996*. Department of Health, the Executive Yuan, Taiwan.

Farr, B. M. (1997). Prognosis and decisions in pneumonia. *N Engl J Me*, *336*, 288-289.

Fang, G. K., Fine, M., Orloff, J., Arisumi, D., Yu, V. L., Kapoor, W. et al. (1990). New and emerging etiologies for community-acquired pneumonia with implication for therapy: a prospective multicenter study of 359 cases. *Medicine*, *69*, 307-316.

Fine, M. J., Orloff, J. J., & Arisumi, D. et al. (1990). Prognosis of patients hospitalized with community-acquired pneumonia. *Am J Med*, *88*(5N), 1N-8N.

Fine, M. J., Smith, D. N., & Singer, D. E. (1990). Hospitalization decision in patients with community-acquired pneumonia: a prospective cohort study. *Am J Med*, *89*, 713-721.

Fine, M. J., hough, L. J., Medsger, A. R., Li, Y. H., Ricci, E. M., & Singer, D. E. et al. (1997). The hospital admission decision for patients with community-acquired pneumonia. *Arch Intern Med*, *157*, 36-44.

Gleason, P. P., Kapoor, W. N., Stone, R. A., Lave, J. R., Obrosky, D. S., & Schulz, R. et al(1997). Medical outcomes and antimicrobial costs with the use of the American Thoracic Society guidelines for outpatients with community-acquired pneumonia. *JAMA*, *278*, 32-39.

Jokinen, C., Heiskanen, L. & Juvonen, H., et al. (1993). Incidence of community-acquired pneumonia in the population of four municipalities in eastern Finland. *Am J Epidemiol*, *137*, 977-988.

Kollef, M. H. (1994). Antibiotic use and antibiotic resistance in the intensive care unit: are we curing or creating disease? *Heart Lung*, *23*, 363-367.

Manchester Royal Infirmary (1994). Pneumonia in the Elderly. *J of Antimicrobial Chemotherapy*, *34*, suppl. A, 85-92.

Marrie, T. J., Durant, H., & Tates, L. (1989). Community-acquired pneumonia requiring hospitalization: a 5 year prospective study. *Rev Infect Dis*, *11*, 586-599.

Marrie, T. J. (1990). Epidemiology of community acquired pneumonia in the elderly. *Semin Respir Infec*, *5*, 269-275.

Paladino, J. A., & Fell, R. E. (1994). Pharmacoeconomic analysis of Cefmenoxime dual individualization in the treatment of nosocomial pneumonia. *Ann Pharmacother*, *28*, 384-389.

Schwartz, B., Bell, D. M., & Hughes, J. M. (1997). Preventing the emergence of antimicrobial resistance: a cell for action by clinicians, public health officials, and patients. *JAMA*, *278*, 944-945.

Seppälä, H., Klaukka, T., Vuopio-Varkila, J., Muotiala, A., Helenius, H., & Larger, K. et al. (1997). The effect of changes in the consumption of macrolide antibiotics on erythromycin resistance in group A streptococci in Finland. *N Engl J Med*, *337*, 441-446.

Shales, D. M., Gerding, D. N., John, Jr. J. F., Craig, W. A., Bornstein, D. L. & Duncan,

R. A., et al. (1997). Society for Healthcare Epidemiology of America and Infectious Disease Society of America, Joint Committee on the Prevention of Antimicrobial Resistance: Guidelines for the prevention of antimicrobial resistance in hospitals. *Infect Control Hosp Epidemiol*, *18*, 275-291.

Singe, R. E., Halpern, N. A., Almenoff, P. L., Lee A., & Greene J. G. (1996). A prospective randomized study of inpatient IV antibiotics for community-acquired pneumonia the optimal duration of therapy. *Chest*, *110*, 965-971.

Swartz, M. N. (1997). Use of antimicrobial agents and drug resistance. *N Engl J Med*, *337*, 491-492.

Venkateesan, P., Gladman, J., & Macfarlane, J. T. et al. (1990). A hospital study of community-acquired pneumonia in the elderly. *Thorax*, *45*, 254-258.

Walley, T., & Davey, P. (1995). Pharmacoeconomics: a challenge for clinical pharmacologists. *Br J Clin Pharmacol*, *40*, 199-202.

Zweig, S., Lawhorne, L., & Post, R. (1990). Factors predicting mortality in rural elderly hospitalized for pneumonia. *J Fam Pract*, *30*, 153-159.

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依照美國胸腔學會(ATS)治療準則處理老年非特定病原肺炎之回溯性成本估計 —台灣之初步經驗

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摘 要

在老人族群中肺炎 (CAP；非特定病原之社區感染性肺炎) 已成爲高度盛行之疾病，而且和罹病率與死亡率顯著相關。到目前爲止，已有一些處理非特定病原之社區感染性肺炎的準則被提出，其中以美國胸腔學會（ATS）在 1993 年所提者較受重視。這套準則對於台灣老年病人之實用性、有效性以及相關之影響目前爲止尚未有系統化之評估。

成本控制一向爲醫院管理者、醫療業務執行者、以及健康保險機構的重要目標。我們針對與 ATS 準則相關之治療介入的某些層面進行了一個回溯性成本估計研究。本研究以 64 個在 1996 年因爲非特定病原之肺炎而於台灣某醫學中心住院的老年病人（ICD-9-CM 之編碼爲 486）爲對象，依照其照護是否符合 ATS 之準則爲基礎比較其相關醫療照顧結果，例如住院日數、藥物費用、抗生素費用、抗生素之使用數目、全部住院費用以及單日住院之費用等。

研究結果顯示其照護符合 ATS 準則處置的老年肺炎病患有較少的住院日數（LOS；13.5 天相對於 24.1 天， p=.002），較低之全部藥物費用（US$823.8 相對於 US$1,901.3 ，p<.0001），較低之抗生素費用（US$363.10 相對於 US$875.96 ，p< .005），並利用較少的抗生素針劑（1.19 相對於 2.56 ， p=.0001）。然而，他們在全部住院費用及單日住院費用上卻沒有顯出較好的結果(p>.05; NS)。 本研究結果顯示以 ATS 準則治療非特定病原之老年肺炎病人只在某些方面促成較低之健康照護成本。這個研究不僅對未來更進一步的研究提供了基礎，也在某程度上試驗了以此準則治療非特定病原之社區感染性肺炎老年病患的合理性和可行性。此外，我們的研究發現也可成爲臨床應用以及健保給付機制的啓發性參考。

關鍵字：成本、老人、肺炎、 ATS 之準則、抗生素、台灣

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