計畫名稱: 院內感染退伍軍人症之前瞻性研究

Nosocomial Legionella Pneumonia

---- A Prospective Study

計畫編號: DOH 85 - TD - 008

執行期間: 84 年 7 月 1 日至 85 年 6 月 30 日

計畫主持人: 張上淳

協同主持人: 李麗娜

潘子明

執行單位: 臺大醫院內科部

中華民國八十五年八月三十一日
一. Abstract ................................................................. P.2
二. Introduction ........................................................... P.4
三. Materials and Methods ............................................. P.5
四. Results ........................................................................ P.9
五. Discussion ............................................................... P.13
六. Conclusion and Suggestion .......................................... P.18
七. 中文摘要 ............................................................... P.20
八. References .............................................................. P.22
九. Tables ......................................................................... P.26
Abstract

Legionellosis has been recognized as an important pathogen for nosocomial pneumonia and there are reservoirs for pathogenic strains in hospitals. During the period from July of 1995 to March of 1996, we have carried out a prospective study of nosocomial legionellosis at National Taiwan University Hospital. The research program consisted of both periodic environmental surveillance and active surveillance of nosocomial pneumonia for legionella.

During the period from August of 1995 to January of 1996, we do monthly surveillance culture for the condensed water in the cooling towers of the central air-conditioner to detect the existence of legionella; the same laboratory study was performed for the tap water of the medical wards during the period from August of 1995 to March of 1996. We cannot find any legionella in the potable water, regardless of cold water or hot water; however, legionella were constantly found in the cooling towers.

From July 1st of 1995 to March 31st of 1996, laboratory tests for legionella, including culture of sputum and serological tests, were checked for all patients in the medical wards when they acquired nosocomial pneumonia. During this period, 134 patients of nosocomial pneumonia were detected; among them, 42 cases were diagnosed as legionnaires’ disease – 16 cases were definitely diagnosed and the other 26 cases were probably diagnosed. There were no specific findings available for differential diagnosis from other pathogens in the aspects of symptoms, physical signs, routine laboratory tests, or radiographic pictures. Analytically, elderly and patients with liver cirrhosis carried more risk for acquiring legionella infections; once infected, The prognosis of those patients with underlying malignaices other than hematological or pulmonary malignancies and those who developed complications of respiratory failure and shock was worse and the mortelity was higher. Specific antilegionella agents did not influence the outcome.
except borderline effect on those patients complicated with septic shock.

In summary, the existance of legionella in the environment was confirmed in Taiwan; significant morbidity and mortality due to such infections in the hospital was noted also. The followings are recommended:

1. Periodic surveillance and disinfection for the cooling towers is necessary.
2. Setup of laboratory tests for legionellosis in hospitals is recommended.
3. Antilegionella agents should be included in the empirical regimens for treating patients of nosocomial pneumonia, especially for those who carry more risk or poor prognosis for such infections.
4. Environmental surveillance should be carried out in individual hospital to define the appropriate strategy of infection control for such infections.
Introduction

Legionella has been recognized as an important pathogen for nosocomial pneumonia since its discovery in 1976\textsuperscript{1-15}. Those who have specific risk factors -- impaired airway function or profound immunocompromised status may get infections of such microorganism via route of either inhalation or aspiration\textsuperscript{16,17}, the outcome were worse for these high risk patients than others.\textsuperscript{13,5,6,7,9,17,18} Legionella is ubiquitous in aquatic environment\textsuperscript{19,20}, however, only the following reservoirs were documented to be major source of infections – cooling towers of air-conditioners\textsuperscript{8,10,17}, potable water systems including hot water tanks, plumbing system or even shower heads\textsuperscript{16,19-22}. Various disinfecting procedures were tried to remove it from the reservoirs, but no ideal method can eradicate it permanently and effectively\textsuperscript{23}.

In Taiwan, the existence of legionella in various aquatic environment has been proved (unpublished data); however, we still lacked data about the role of legionella in nosocomial pneumonia. As the advance of health care, the size of risky population for acquiring legionnaires’ disease increased progressively. It is urgent now to define the significance of legionella in Taiwan and the following questions should be answered: the first, the significance of legionella in nosocomial infections; the second, the major environmental reservoirs; the third, the risk group for acquiring legionellosis and those who carry poor prognosis; the fourth, the necessity and strategy for infection control of legionellosis, including surveillance strategy and disinfection procedures.
Materials and Methods

During the period from July 1995 to March 1996, a prospective research of nosocomial legionellosis was carried out at National Taiwan University Hospital (NTUH). The program covered two parts: periodic environmental surveillance and identification of nosocomial pneumonia due to legionella.

Periodic environmental surveillance of legionella

As previous reports, human acquired legionella infections via two major reservoirs: cooling towers of air-conditioners and potable water system. Monthly periodic surveillance culture of the above environmental reservoirs were carried out during the period from August, 1995 to March, 1996.

There are five cooling towers for central air-conditioner at NTUH: one of them are separate and the other four are connected with a common outlet. Two hundred ml of condensed water were collected from each cooling towers and the common outlet every month, regardless that the cooling towers was running or not. The collected water sample was submitted for bacteriological culture of legionella.

Surveillance of potable water system, which was represented by water collected from the faucets of tap water, hot drinking water and from the shower heads, was carried out in the medical wards of NTUH during the period from August, 1995 to March 1996. When sampling the specimens, we used a sterile swab to scrub the inner surface then collected 200ml of water from each outlet after flushing the water for 10-15 seconds. After stirring the swab in each collected water, the water was submitted for legionella culture. When sampling the tap water, we collected cool water in the period from
August of 1995 to December of 1996 and collected hot water in the rest period of study.

**Surveillance for nosocomial legionellosis**

All the patients admitted to the medical wards of NTUH during the period from July 1, 1995 to March 31, 1996 were enrolled into study when he or she acquired nosocomial pneumonia. Nosocomial pneumonia was defined as following: (1) the patient should stay in hospital for more than 48 hours before onset of pneumonia; (2) no evidence of respiratory tract infection developed while he was admitted; (3) occurrence of new meaningful change on chest radiography associated with any one criteria in the followings: (a) fever or chillness; (b) any symptoms of respiratory infection, such as cough, sore throat, chest pain or shortness of breath; (c) any extrapulmonary symptoms, such as headache, mentality or consciousness change, myalgia or arthralgia, abdominal discomfort or diarrhea. Date of onset was defined as the earliest date of occurring any of the above symptoms, either in clinical picture or chest radiographic change. However, those who developed another episode of respiratory tract infection within two weeks before or after the studied episode were excluded due to that the potential incubation period of legionella infection is 2 to 10 days, and this factor will interfere with the interpretation of serological test.

Those who acquiring nosocomial pneumonia were checked for the followings in addition to routine laboratory examination: (1) culture of the airway secretion for legionella; (2) serological test with indirect fluorescence antibody (IFA test; Zeus Scientific, USA) assay for legionella; the serology test was checked at the onset date of pneumonia and followed up every two weeks till 2 months after the onset.

All the medical data and clinical course of treatment were followed up prospectively. We provided the laboratory data to the clinician but left the judgement of
therapy to themselves.

We defined cases of legionellosis according to the criteria of Centers for Disease Control and Prevention (CDC, USA)\textsuperscript{24}. Definite diagnosis: either (1) positive culture result of legionella or (2) more than four-fold increase in IFA titer as paired sera checkup with the final IFA titer greater than 1:128x; probable diagnosis: (1) any serum IFA titer is more than 1:256x without more than four-fold elevation in paried sera IFA titer follow-up.

\textit{Bacteriological Study}

\textit{Environmental specimens} All the collected water were centrifuged at 6000rpm for 30min and 1ml of pellet was used for culture. We used 0.2N KCl-HCl buffer to treat 100ul of pellet for 3min. Both of the non-acid treated and acid treated pellets were inoculated onto L-cysteine supplement buffered charcoal yeast extract agar (BCYE agar; Mast Diagnostics Ltd, UK) and selective medium of BCYE agar supplemented with polymyxin B, vancomycin, and amphotericin B (MWY agar; Mast Diagnostics Ltd, UK). The agars were incubated in cabinets with 5\% CO\textsubscript{2} at 37\°C.

\textit{Clinical specimens} All the clinical specimens were inoculated onto both BCYE agar and selective medium of BCYE agar supplemented with polymyxin B, cycloheximide and vancomycin (PAV agar; Mast Diagnostics Ltd, UK) either before or after acid pretreatment as mentioned above. The agars were incubated at the same condition as environmental specimens. After several days of incubation and daily examination, all colonies with similar morphology of legionella were picked up and were reinoculated onto BCYE agar and 5\% sheep blood agar. The colonies growing on BCYE agar but not on blood agar were choosed for confirmatory test- direct fluorescence antibody test (DAF
test; Zeus Scientific, USA). Those colonies with positive reaction to DFA test were confirmed as *Legionella pneumophila* and were stored at -70 ºC for further study.

**Statistical Analysis**

All the data were calculated by personal computer. The statistical significance was calculated with either Fisher’s exact test or Pearson test to evaluate the P value by chi-square test.
Results

Environmental surveillance During the whole study period, legionella was constantly cultured out from the cooling towers, regardless of running or not. Due to no quantitative culture, we cannot define the severity of contamination. However, we cannot find any evidence of legionella contamination in the potable water system, either in the hot water or in the cool water. All the legionella strains in cooling towers were *Legionella pneumophila*, serogroup I. No disinfecting procedures against legionella was carried out in this period.

Active surveillance of nosocomial legionellosis The medical wards under study including wards of cardiovascular disease, pulmonary disorders, gastroenterology, immunology and rheumatology, nephrology, hematology, infectious disease, cerebral vascular disease, oncology and three intensive care units (one is coronary care unit and the other two are medical care units). During the study period, totally one hundred and thirty four cases were enrolled into study; most of the patients were elderly. The demographic data were shown in Table 1. Among them, 42 cases were identified as patients of nosocomial legionellosis: 16 cases were definite diagnosis and the other 26 cases are probable diagnosis (Table 2). Among those of definite diagnosis, 4 patients were confirmed by positive result of culture.

Among those with legionellosis, both definitely and probably diagnostic, the underlying disorders were as follows: long term bed ridden status (57.1%), hypertension (52.4%), daily life dependency (50%), smoker (45.2%), diabetes mellitus (35.7%), consciousness disturbance (35.7%), chronic pulmonary disease (31.0%), cerebral vascular disease (31.0%), chronic renal insufficiency (28.6%), congestive heart failure (26.2%), alcoholism (23.8%), underlying malignancy other than hematological or pulmonary
neoplasm (19.0%), hematological malignancy (14.3%), cirrhosis of liver (11.9%),
coronary artery disease (11.9%), pulmonary tuberculosis (11.9%; among them, 40% were
active pulmonary tuberculosis), neutropenic state (11.9%), recent attack of seizure (4.8%),
lung cancer (4.8%; all were non-small cell lung cancer), underlying malignancies with
lung metastasis (4.8%) and autoimmune disease (2.4%). Other physical or medical factors
included nasogastric tube insertion (57.1%), indwelling intravascular catheter (50.0%),
endotracheal tube intubation or tracheostomy (38.1%), nebulizer usage (38.1%),
ventilator usage (31.0%), use of hypoglycemic agents or insulin (31.0%), diuretics (23.8%)
and steroid (11.9%). All 42 patients except one had multiple underlying disorders and
none were without any underlying diseases. Six patients (14.3%) had and used
fluoroquinolones or macrolides when occurrence of legionellosis.

The clinical features were non-specific and the most common symptom was fever
(97.6%), cough (85.7%) and sputum production (83.3%). Among those with sputum
production, most cases (74.2%) produced purulent sputum. Other presentations included
shortness of breath (76.2%), chills (21.4%) hemoptysis (21.4%), and sore throat (4.76%);
overall, 33 cases (78.6%) presented with any of the following extrapulmonary symptoms:
diarrhea (57.1%), mentality impairment (40.5%), abdominal discomfort (9.5%), nausea
or vomiting (7.1%), headache (2.4%), seizure (2.4%), myalgia or arthralgia (2.4%) and
dizziness or general malaise (2.4%). As shown in Table 3, Table 4 and Table 5, there
were no specific features of nosocomial legionellosis in the aspects of physical findings,
laboratory tests and radiographic pictures. In the clinical course, 10 case (23.8%) and 20
cases (47.6%) developed the complications of shock and respiratory failure, respectively;
18 cases (42.9%) of nosocomial legionellosis were dead and the rate was higher than the
overall case fatality rate of nosocomial pneumonia (50/134=37.3%); however, only seven
mortal cases (16.7%) were directly attributed to legionella infection itself.
As shown in Table 6, those who had underlying condition of liver cirrhosis and elderly (age ≥ 61 year-old) had more chance for acquiring legionella infection. Conversely, those who had underlying chronic pulmonary disease, used steroid for long period, or received chemotherapy seemed to have lower risk for acquiring legionellaires' disease.

When considering the prognostic factors as shown in Table 7. Those who had underlying malignancies other than lung cancer or hematological malignancies will developed the worst outcome -- more chance for septic shock, respiratory failure and even mortality. Those patients presenting with chest pain or tachypnea were more likely to develop septic shock in clinical course. When septic shock occurred, the clinical course were always complicated with hypoxemia, jaundice and renal failure (Table 8). The occurrence of chest pain, extrapulmonary symptoms, tachypnea or hypotension episode (regardless of septic shock or not), renal failure or coagulopathy were expected to have more chance for development of respiratory failure. Those who presented with chills, chest pain, septic shock, hypoxemia, persistent abnormal liver function or renal failure will carry more mortality risk.

If we evaluated the interaction of each complication, we may found that renal failure, respiratory failure, septic shock, comatose status and even mortality may increase risk among each other themselves; ie, those who developed renal failure may carry more possibility for respiratory failure, septic shock and mortality, and vice versa(Table 9).

Twenty-five patients (69.4%) had other microorganism found in their airway secretions. We did not define the role of these additional microorganisms and these was no influence in the outcome for such patients (Table 10). As shown in Table 11, most patients (34/42 = 81.0%) received inappropriate antimicrobial therapy; even among those received specific antimicrobial agents, most cases were delayed in the initiation of
the therapy. However, the inadequate treatment did not influence the outcome significantly and only borderline effect on septic shock was noted.
Discussion

Legionella has been proved to be ubiquitous in the environment for a long time; however, there were, at present, only two transmission routes documented to cause human respiratory tract infections\textsuperscript{16,17,25} -- either aspiration of contaminated potable waters or inhalation of aerosols, which is contaminated by the contaminated cooling towers. Both routes of transmission have been reported to result in endemic or epidemic outbreaks in hospitals. In our survey, we found that the cooling towers of air-conditioners, either operational or not, were constantly contaminated by legionella, which were all proved to be \textit{Legionella pneumophila}, serogroup 1. Conversely, no legionella were isolated in the potable water, either from faucets of tap water, drinking water or from shower heads. Although both cool water and warm water were checked, there was still no evidence for the existence of legionella in potable water. Although it may not be excluded completely for the existence of legionella in potable water system, such as hot water tanks or inner surface of plumb, human have no access to acquire legionella infections via such route due to no such microorganism in the outflow waters. In conclusion, in the teaching hospital, the major transmission route of legionellosis is inhalation of contaminated aerosol and the major reservoirs of clinical strains is the cooling towers.

If we analyze all cases of legionellosis, either definitely or probably diagnostic, according to place or month of occurrence, there seemed to be no outbreak in place but three episodes of clustering in August, September of 1995 and January of 1996 were detected. We did not do quantitative culture for environmental surveillance; however, if we regarded the number of positive culture of cooling towers as severity of environmental contamination, there seemed to be some correlation between occurrence of clustering episodes and the severity of cooling tower contamination( Table 12 ). The fact of no place clustering can be realized due to widespread spreading of contaminated aerosols in the hospital
and the condition may be quite different if potable water contamination is the major transmission route. In other words, all patients admitted to the teaching hospital have the potentials for acquiring legionnaires’ disease.

Among 134 cases of nosocomial pneumonia, forty-two patients were documented to be cases of legionellosis: 16 cases were definitely diagnostic and the rest 26 cases were probably diagnostic. The frequency of legionellosis among nosocomial pneumonia was 31.3% and if we counted the definite cases only, the frequency was 11.9%. In previous report, frequency of legionellosis in nosocomial pneumonia ranged from 4.6% to 41%\(^3\)\(^{-14}\), which depended on the studied population. The population of high frequency included more cases of immunosuppression, especially those of organ transplantation\(^7\),\(^9\),\(^17\),\(^18\),\(^26\),\(^27\). In our report, although no enrollment of cases of organ transplantation, the frequency was still higher than usual. The most remarkable underlying diseases among cases of legionellosis included elderly and liver cirrhosis; however, the most frequently reported risk factors -- chronic pulmonary disorders, long-term steroid usage, smoker or renal failure did not outweigh their roles on the occurrence of the clinical diseases in our study. It had been mentioned that the risk factors for acquiring community - acquired or nosocomial legionellosis were quite different\(^28\) -- the former included all conventionally mentioned disorders (chronic obstructive pulmonary disease, smoker, steroid user) but only immunosuppression was documented in the latter. The fact was explained by method of sampling -- ie, those patients of nosocomial pneumonia, either legiollosis or not, all had underlying disorders, but the difference in virulence cannot be excluded completely.

Few study had shown the significance of liver cirrhosis in acquiring legionnaires’ disease before and it was considered that easily aspiration as occurrence of hepatic encephalopathy rather than liver cirrhosis itself to be the mechanism\(^9\). However,
in our study, inhalation of contaminated aerosols rather than aspiration was documented to be the major transmission route and none of them had disturbed consciousness while occurrence of pneumonia. We believed that immunosuppression due to impaired activity of reticuloendothelial system to be the real mechanism for legionella infection among patients of liver cirrhosis. It must be notified that the attack rate was so high (100%), i.e. all five patients of liver cirrhosis in the study acquired legionellosis, and liver cirrhosis is so prevalent in this country, more attention should be paid in this aspect.

As previous report 29,30, no specific features in the aspects of clinical presentation, laboratory tests or radiographic findings could differentiate legionellosis from other nosocomial pneumonia. In this study, the rate of complication was as follows: respiratory failure 47.6% (20/42), septic shock 26.2% (11/42), renal failure 29.0% (12/42). Eighteen cases were dead and the case fatality rate was 42.9%; however, only seven cases (7/42 = 16.2%) could attributed their causes of death to legionella infection directly. Among fatal patients of nosocomial pneumonia (50 cases), 36% was related to legionellosis and 14% was directly caused by legionellosis. If we consider the definite cases only, the related and direct case fatality rate was 25% and 6.25%, respectively. The related case fatality rate in previous reports was around 5% to 40% 1-13, which depended on the study population, i.e., including all cases or the definite cases only. The previously mentioned prognostic factors included corticosteroid therapy, elderly, immunosuppression, underlying end stage renal disease and cancer (including hematological maligncies and lung cancers)3,7,9,12. In our report, only those patients with underlying malignancies excluding hematological maligncies and lung cancers carried significant risk for mortality and it also exerted the influence on the development of serious complications -- septic shock and respiratory failure (Table7). However, neither lung metastasis nor chermotherapy could show such pictures and we believe that immunosuppression caused
by malignancy itself may be the real risk factor. Those who have active daily life may also carry borderline risk for mortality when they acquire legionellosis (Table 7). From the data of risk factor analysis, we may make a conclusion that those who should not have the risk for acquiring legionellosis may carry significant risk for mortality once they developed this disease. Except for the underlying disease, development of any serious complications, such as septic shock, respiratory failure, renal failure or vegetative status, in the clinical course have resulted in greater tendency for occurring of another serious complication and had higher mortality rate (table 9). It is wise and ethical to initiate specific anti-legionella therapy as early as possible for those who carry poor prognostic factors and present ominous signs mentioned before in the clinical course as early as possible.

From the analysis of resposse of specific therapy, we can only find borderline efficacy on the development of septic shock rather than the clinical outcome (Table 11). The effect was also noted when other microorganism were isolated from the patients’ airway secretion (Table 10). Although we did not define the role of other microorganism in the patients’ airway, we thought the outcome may be influenced by such factor. Antilegionella therapy was not and routinely used in the treatment of nosocomial pneumonia in the hospital although it was believed to reduce mortality rate when it was early initiated. We suggest the inclusion of antilegionella agents as empirical therapy for nosocomial pneumonia due to the high probability of multiple bacteria infections (25/42 = 59.5%) including legionella. It is recommended to consider any patient of nosocomial pneumonia as case of legionellosis once any cases of legionnaires’ disease had been documented in the hospital.

No ideal tools have been developed for the effective diagnosis of legionellosis. In our study, culture had low sensitivity (4/42 = 9.5%) and the IFA test was time-consuming
and poor for definite diagnosis, especially when patients were dead early in the course. It is recommended to use urinary antigen and DFA test of airway secretion for early diagnosis and to preserve culture and IFA test for further epidemiological study. Although keep all of the four tests is ineconomic, it is still necessary if the occurrence of legionellosis is still possible. We recommend to keep the former two tests (urine antigen and DFA test) in routine laboratory examination and to preverve the latter two tests (culture and IFA test) in research laboratory tests of infectious disease department.

It is recommended to watch for the occurrence of outbreak if more than two cases of nosocomial legionellosis occur and further disinfecting procedures and environmental surveillance should be carried out then. Due to no existance of legionella in potable water system, and occurrence one suspicious epidemic episode in the January of 1996, further disinfecting procedures and surveillance study of cooling towers in the hospital may be justified. However, no ideal methods can eradicate legionella from cooling towers permanently, periodic surveillance and disinfection are necessary. Could we overlook the possibility of potable water contamination? Further data from other hospital in Taiwan is necessary for judgement.
Conclusion and Suggestion

In this study, we found that patients can only get legionella infection via inhalation of the contaminated aerosols from air-conditioners and the cooling towers may be the major reservoirs of clinically significant strains. The cooling towers may be contaminated permanently, regardless of seasonal variation and operational status. In nosocomial pneumonia, legionella played great role in the etiology: 31.3% of cases were related to legionellosis and 11.9% of patient were caused by legionellosis directly. Case fatality rate was relatively higher than usual (related rate: 42.9% and direct case fatality rate: 16.7%). Those who are elderly (age > 61 year-old) and cases of liver cirrhosis rather than the usual risk factors, such as COPD, smoking and immunosuppression have more chance to acquire legionella infections. Although not being the risk factor for acquiring legionellosis, underlying malignancies other than hematological malignancies or lung cancers exert greatest tendency for development of respiratory failure, septic shock and even mortality. Those who developed any serious complication, such as respiratory failure, septic shock, renal failure, and comatose status, have greater possibility for development of other serious complications; mortality rate was also higher than other patients.

Although the response of specific antilegionella therapy was unremarkable except borderline effect on the prevention for septic shock, it may be interfered with the effect of other potential pathogens.

The followings are recommended according to the study results:

1. laboratory tests to detect legionellosis are necessary in hospitals; routine tests should include the effective test for early diagnosis: urinary antigen and DFA test of airway secretions; culture and IFA test may be preserved in research laboratory for further epidemiological studies.
2. Surveillance and environmental disinfection for cooling towers should be carried out periodically. Disinfection for potable water system are ineconomic and not recommended now; however, surveillance culture should be done, while occurrence of outbreak in spite of disinfection of cooling towers.

3. Adding specific anti-legionella therapy into empirical therapeutic regimens for nosocomial pneumonia is recommended; especially as the patients are elderly, cases of liver cirrhosis or malignancies.

4. Adding anti-legionella regimens may be worthy if patients with nosocomial pneumonia develop complication of respiratory failure, septic shock or renal failure; however, the efficacy may be limited at that time.

5. The strategy for infection control of legionella depends on the ecology of each hospital; initiation of environmental study is recommended.
自 1995 年七月至 1996 年三月，於一所醫學中心，我們完成了為期九個月的退伍軍人症的前瞻性研究。此研究計畫包含了定期之環境篩檢及臨床病例之監測兩部分。


自 1995 年七月一日至 1996 年三月三十一日止，所有內科住院病人一旦發生院內感染肺炎之現象，皆予以進行退伍軍人菌之實驗室檢查：項目包括退伍軍人菌之痰液培養及血清抗體檢查。於此研究期間，共有 134 位病人發生院內感染肺炎，其中 42 位病人之退伍軍人菌檢驗為陽性反應；這些病人中，16 位為確定病例，其他 26 位則為可能病例。共有 18 位病人死亡 (18/42 = 42.9%)，其中有 7 位病患為退伍軍人造成之直接死亡病例 (7/42 = 16.7%)。這些退伍軍人症患者之臨床表徵並不具有任何特異性足資供做鑑別診斷。統計學上，老年人(年紀大於 60 歲)及肝硬化之患者較其他人易罹患退伍軍人菌之感染。一旦發生感染，血液性癌症及肺癌以外的癌症患者及出現呼吸衰竭、休克等併發症之患者其致死率則較其他病人為高；對於退伍軍人菌患者給予特殊之藥物治療似乎無法改變其結果，其中合併其他微生物之
感染可能是重要的影響因素。

總結而言，退伍軍人菌已存在於台灣的環境中，而且也造成相當程度的致病率。

因此以下各點是值得考慮的：

1. 定期對冷卻水塔進行環境篩檢及去除污染的工作。

2. 各醫院中應設置退伍軍人菌之實驗室檢驗方法。

3. 對於院內感染肺炎之經驗性治療中，應包含退伍軍人症之抗菌藥物，特別針對某些高危險群的病人，更應如此。

4. 各醫院應對自己的環境進行篩檢，以供制定恰當的感染管制政策及措施。
References


five nosocomial acquired cases and revies of the literature. Medicine 1980; 59: 188-205.


27: 247-56.


Table 12. Relationship of environmental contamination and occurrence of clinical disease

<table>
<thead>
<tr>
<th>Case No. of</th>
<th>1995</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>No. 2</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>No. 3</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>No. 4</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>No. 5</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Common outlet</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

Case No. of Legionellosis
- definite: 7, 5, 4, 0, 4, 12
- probable: 4, 1, 0, 0, 1, 4
- probable: 3, 4, 4, 0, 3, 8

ND: not done