Factors Affecting the Outcome of Adult Patients with Methicillin-resistant *Staphylococcus aureus* and Non-Methicillin resistant *Staphylococcus aureus* pneumonia: A Retrospective, Cross-sectional Cohort Study

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Abstract

Introduction: Pneumonia continues to be a leading cause of morbidity and mortality worldwide. Locally, pneumonia is the 3rd cause of death (2016). Currently, one of the concerns is the rise of resistant microorganisms particularly MRSA. Knowledge regarding MRSA pneumonia is mostly from international data.

This study aims to determine the factors that may affect the outcome of MRSA and non-MRSA pneumonia as well as describe the susceptibility patterns of its etiologic agents.

Methods: This is a retrospective, cross-sectional cohort study. The setting is a tertiary government hospital. The target subjects are patients 18 y/o and above, with bacteriologically-confirmed pneumonia, and were admitted in 2017.

Results: The results revealed a high rate of MRSA pneumonia (88.2%), most are community-acquired (90%), and factors associated with mortality were: male, Type 2 DM, smoking history, radiographic findings of congestion, and atheromatous/tortuous aorta. For hospital length of stay, no significant difference was noted. For Non-MRSA pneumonia factors associated with mortality were: erythrocytosis, kidney and liver disease, cancer, previous cerebrovascular disease, previous admission (ARMMC), number of comorbidities, findings of altered sensorium, chest retractions, DBP ≤ 60 mmHg, radiographic findings of pulmonary congestion, and classification of CAP-MR. Morbidity factors included: anemia, trauma, multiple comorbidities, radiographic findings of bilateral infiltrates, unilateral/bilateral consolidation, unilateral/bilateral minimal pleural effusion, subcutaneous emphysema, congestion, and infection with multiple bacteria.

The first antibiogram for the institution revealed a poor susceptibility pattern for the usually used empiric treatment.

Conclusion: This study reveals a high rate of MRSA pneumonia, with several factors associated with its mortality. In terms of morbidity, no significant difference was noted from the variables measured. For Non-MRSA pneumonia which is seen in the majority of the subjects, several factors associated with mortality were noted and unlike MRSA pneumonia the morbidity is affected by the presence of anemia, trauma, multiple comorbidities, etc.

The antibiogram showed a poor susceptibility to the usually used empiric treatment.

Keywords: MRSA pneumonia, empiric treatment, clinical outcomes

Introduction

Pneumonia continues to be one of the leading causes of morbidity and mortality worldwide, particularly in developing countries. It afflicts at least 450 million people globally (7% of the population), producing 4 million deaths annually.[1] In the Philippines, pneumonia is the 3rd most common cause of death comprising 57,809 cases (9.9%) in 2016 after ischemic heart disease and neoplasm.[2] The significant burden of pneumonia both

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globally and locally despite numerous published studies and guidelines as well as advances in medical technology, warrants updating knowledge regarding its constantly evolving risk factors, clinical manifestations, new emerging microorganism, and its susceptibility pattern.

In the treatment of pneumonia, the differences in patient characteristics, causative microorganisms, and health care systems across different countries should be considered in the management as well as in formulating plans to reduce the risk of infection and its disease burden. In Western countries, the most commonly isolated organism for Community-Acquired Pneumonia (CAP) is the gram-positive *Streptococcus pneumoniae*, followed by gram-negative organisms. Otherwise, for nosocomial pneumonia, the leading isolates are Methicillin-resistant *Staphylococcus aureus* (MRSA) and *P. aeruginosa*, with the addition of multi-drug resistant (MDR) organisms in cases of Ventilator-associated pneumonia (VAP).[3]

One of the current concerns in terms of the bacterial pathogen is the increase in the rate of infection caused by MRSA which can be acquired both in the community or hospital setting. The history of MRSA started way back in 1961 when it was first described. Resistance to the usual treatment for *Staphylococcus aureus* is secondary to a mutation of the penicillin-binding protein which is a chromosome-encoded protein.[4] It is usually spread by direct contact with infected people or objects carrying the bacteria making it highly contagious.[5]

One of the most common types of MRSA infection is pneumonia. However, knowledge regarding MRSA pneumonia is mostly from international data, which primarily determine its risk factor. One example is a case-control retrospective study by Wooten D., et. al., which showed that prior use of antibiotics within three months was the most significant risk factor for both community-acquired MRSA (CA-MRSA) and hospital-acquired MRSA (HA-MRSA) pneumonia.[6] Additional risk factors noted in this study are tobacco use which was also significant in other studies, liver disease which is mostly related to HA-MRSA, COPD, HIV, and illicit intravenous drug use.

With regards to outcome, this same study found no difference in risk of for ICU admission or mortality at 30 days among MRSA and Methicillin-sensitive Staphylococcus aureus (MSSA).[6] Other than studies concerning risk factors, the next most studied about MRSA pneumonia is its epidemiology and outcome. A study made by Tadros, M. et. al., showed that compared to other countries the country of origin of the study (Canada) has a lower rate of nosocomial MRSA pneumonia while the 30-day all-cause mortality is at 28.0% which is within the range (16% to 37%) of mortality rates identified in other researches.[7]

Unfortunately, local data regarding characteristics of patients with MRSA pneumonia and factors that affect its outcome have not been extensively studied. Most published studies focused on the skin and soft tissue infections caused by MRSA since this is the most common site of this bacterium being a normal inhabitant of the skin.[8,9] Moreover, for the institution of origin of this study which is also experiencing a high burden of pneumonia as evidenced by its persistent inclusion in the top causes of mortality annually, information regarding factors that influence the outcome of the patients and identifying the hospital microbiome can help in formulating strategies in managing such cases; and thus, can potentially decrease its mortality rate.

This study, therefore, intends to determine the incidence of MRSA and Non-MRSA in our institution. We hope to identify demographic factors, initial presenting clinical manifestations, comorbidities, lifestyle factors, radiographic findings, and pneumonia classification with its etiology (MRSA, Non-MRSA) that may affect and predict the clinical outcomes of these patients. Lastly, is to generate a hospital antibiogram, a first for our institution.

The limitation of this study is it did not include or assess the effect of management of pneumonia on its outcome.

Methodology

Study Design. This is a retrospective, cross-sectional, hospital-based study using hospital electronic records (*Hospital Information System 8*), printed medical records, chest radiographs (UniWeb), and bacteriologic results. All respiratory specimen results for 2017 were collected from the hospital's microbiology laboratory. Hospital electronic records printed medical records and chest radiograph results were also reviewed.

Study Subjects and Setting. The setting of this study is the Amang Rodriguez Memorial Medical Center (ARMMC). It is a tertiary government-owned and operated training hospital in Marikina City, Metro Manila, Philippines. ARMMC is a 300-bed capacity hospital recently approved to increase its capacity to 500 beds (Republic Act 11287, April 12, 2019) and is the only government tertiary healthcare institution in Marikina City, catering to patients mostly from Marikina City and the province of Rizal. It also serves as a referral hospital for Rizal Provincial Hospital System (RPHS) and Antipolo City Hospital System (ACHS).

Medical records of patients from the adult service (both charity and private), aged 18 y/o and above, diagnosed and bacteriologically-confirmed pneumonia, admitted in ARMMC to the various Departments (Internal Medicine-majority, Surgery, Obstetrics and Gynecology, Ear Nose Throat-Head and Neck Surgery, Ophthalmology) in all levels of care (Intensive care unit, regular wards) in 2017. The study population are classified according to sex, age group and source of infection as Community- acquired Pneumonia (CAP) or Nosocomial pneumonia (HAP, VAP) and bacterium isolated which is divided into MRSA and non-MRSA.

Study population were divided by age group: 18-24 y/o, 25-44 y/o, 45-54 y/o, 55-64 y/o, 65-74 y/o, 75-84 y/o, and > 85 y/o.[10]

For the group of CAP, they were further classified using the Philippine guidelines for CAP as follows:[11]

- CAP moderate risk (CAP-MR): unstable vital signs, respiratory rate ≥30/min, pulse rate ≥125/min, systolic blood pressure <90 mmHg, diastolic blood pressure ≤ 60 mmHg, temperature ≥ 40°C or ≤ 36°C, altered mental state of acute onset, suspected aspiration, and unstable/decompensated comorbid condition (uncontrolled diabetes mellitus, active malignancies, neurological disease in evolution, congestive heart failure class II-IV, unstable coronary artery disease, renal failure on dialysis, uncompensated chronic obstructive pulmonary disease (COPD), and decompensated liver disease)
- CAP High Risk (CAP-HR): any of the clinical features of the moderate-risk CAP category, plus any of the following: severe sepsis or septic shock, or the need for mechanical ventilation

The group of nosocomial pneumonia was classified using the definition given by the Infectious Disease Society of America (IDSA) and the American Thoracic Society (ATS) as:

- Hospital-acquired pneumonia (HAP): pneumonia not incubating at the time of hospital admission and occurring 48 hours or more after admission[12,13]
- Ventilator-associated Pneumonia (VAP): defined as pneumonia occurring > 48 hours after endotracheal intubation[12,13]

Patients excluded from the study are those aged < 18 y/o and with pneumonia diagnosed clinically, radiologically, or both without bacteriologic confirmation.

Intervention/Measurements. The initial step in data collection was done by getting all respiratory specimen results with positive bacterial growth for the year 2017 from the hospital's microbiology laboratory. This was then followed by electronic health records (Hospital Information System 8) and medical records review. Demographic data, comorbidities, and initial presenting clinical manifestations, as well as the outcome which is divided into mortality and morbidity (based on the length of hospital stay) of the study population, were recorded. Chest radiograph results were retrieved from *Uniweb*™ a modular web-based software being used by the hospital.

Detection of pneumonia radiologically. Chest radiographs were taken upon admission in the majority of the study population. The interpretation of the results was performed initially by a Radiology resident and was then confirmed by the assigned radiologist duly licensed by the Philippine College of Radiology. The reading of chest radiograph is based on the recommendation from Fundamentals of Diagnostic Radiology, 5th edition by William E. Brant and Clyde A. Helms.

Detection of Bacteria

Culture. Sputum specimen were directly inoculated using the multiple interrupted method to three bacterial culture media which are blood agar plate, McConkey agar and chocolate agar plate. It will then be incubated at 35°C for 18 to 24 hours with the blood agar plate and chocolate agar plate placed inside a candle jar. For the endotracheal aspirate and tracheal aspirate, the specimen were placed on Tryptic soy broth (TSB), where it will then be incubated at 35°C for 18-24 hours. If the specimen is clear, it will again be incubated for an additional 72 hours, after which a clear specimen will then be reported as negative growth while those found to be turbid will be subjected to inoculation using the same method and agar used in sputum with addition of *Bacillus pumilus* (MSH). Specimen with positive bacterial

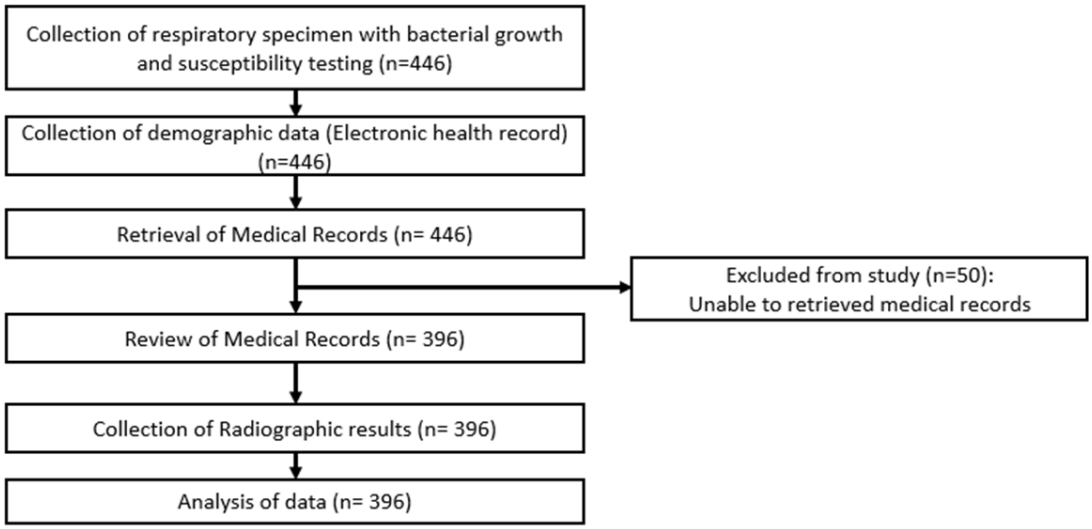

Figure 1. Data Collection Flowchart

growth will be subjected to biochemical testing for the identification of specific bacteria.

Sensitivity. Respiratory specimens with identified bacterial growth were subjected to sensitivity testing. Bacterial colonies of at least 3 to 5 are subcultured to TSB and incubated for 2 to 5 hours to produce a bacterial suspension. The subculture turbidity is standardized by comparing with the 0.5 McFarland turbidity standard behind a black background. The disk diffusion method was used for susceptibility testing. The subcultures were inoculated in a Mueller Hinton Agar using the overlap method. The antibiotic discs to be tested were then placed on the agar. The antibiotic/s tested per organism followed the hospital's laboratory protocol. The agar were then incubated for 16-18 hours at 35-37°C. After this, the zones of inhibition were measured and interpreted using the standard protocol used by the hospital laboratory.

Identification of Methicillin-resistant Staphylococcus aureus (MRSA). The oxacillin disk diffusion method was used to identify MRSA with a zone of inhibition of < 21mm as a cut-off value. This method was used because not all specimen with a growth of *S. aureus* was tested using cefoxitin; only 23 out of 30 isolates were tested. The oxacillin disk diffusion method was less favored than cefoxitin since the former frequently produces hazy zones which may be misinterpreted as evidence of susceptibility (false susceptibility).[14] Nevertheless, comparison studies between the different methods used in detecting MRSA like those made by Sahai et. al. and Shariati et. al. show that oxacillin disk diffusion has 93.4% sensitivity with 100% specificity and 95% sensitivity and 93% specificity, respectively.[15,16]

Statistical Analysis

Sample population. The population of this study was derived from the study of Azmi et. al. which showed a result of 14,245 and 5,615 cases of CAP and HAP respectively for every 100, 000 discharges.[17] The sample size computation was determined using the OpenEpi application, a sample size of at least 375 patients with pneumonia is needed for 95% accuracy.

Data were encoded and tallied in *SPSS® ver 10* for Windows. Descriptive statistics were generated for all variables. For nominal data frequencies and percentages were computed. For numerical data, mean ± SD were generated. Analysis of the different variables was done using the following test statistics:

1. t-test – used to compare two groups with numerical data
2. Mann Whitney U test - a non-parametric equivalent of the t-test
3. ANOVA – used to compare more two groups with numerical data
4. Kruskal Wallis test - a non-parametric equivalent of the ANOVA
5. Chi-square test – used to compare/associate nominal (categorical) data
6. Fisher Exact test - a modification of chi-square used for 2x2 table when there are expected frequencies <5.
7. Logistic Regression – a multivariate analysis test used in predicting a dichotomous outcome variable

Results

Pneumonia. A total of 446 respiratory specimens with positive bacterial growth and susceptibility testing were collected from the hospital's laboratory unit. Complete demographic data of these 446 subjects were collected from the electronic health record (Hospital Information System 8). The list was then given to the medical records unit for retrieval of medical records. However, 50 medical records cannot be located. The total subjects was reduced to 396. For the radiographic result, it was retrieved by accessing Uniweb™ a modular web-based software used by the hospital (*Figure 1*).

Study population demographics. A total of 396 subjects were included in this study. Most of the subjects were males (232, 58.6%), with the most common age range at 55-64 y/o(95, 24%). The biggest number resides in Marikina City (126, 31.8%), followed by Antipolo City (87, 21.7%) and San Mateo, Rizal (55, 13.9%) (*Table I*).

Bacterial Etiology. Bacteria isolated from the study population are mostly Non-MRSA at 94.0% (473/503), the majority of which is *K. pneumoniae* 16.9% (85/503) followed by *A. anitratus* 16.5% (83/503) and *E. aerogenes* 15.1% (76/503). The total *S. aureus* isolated is at 6.8% (34/503), mostly are MRSA at 88.2% (30/34) (*Table II*). The three most common bacterial etiology for the two major classifications of pneumonia were the same. For CAP these were *K. pneumoniae* (18.8%), *A. anitratus* (15.8%), *E. aerogenes* (15.2%), while for nosocomial pneumonia the leading cause was *A. anitratus* (18.5%), next was *E. aerogenes* (14.8%) and *K. pneumoniae* (11.9%). MRSA was included in the top ten etiology for both CAP and nosocomial pneumonia, ranking 6th (5.7%) and 5th (6.7%), respectively (*Table III*).

Classification of Pneumonia. For the classification of pneumonia, a greater number of subjects are diagnosed with CAP (292, 73.7%), most of which are CAP-MR (217, 54.8%), followed by CAP-HR (75, 18.9%). Nosocomial pneumonia was noted in 104 (26.3%) subjects (*Table IV*). The distribution of subjects based on bacterial etiology as MRSA and Non-MRSA and according to the classification of pneumonia shows that 30 patients had MRSA with 21 (90%) as CAP, while 9 (10%) as nosocomial. The majority of patients had CAP Non-MRSA at 271 (74%) and 95 (26%) as nosocomial non-MRSA (*Table V*).

In terms of mortality outcome, the distribution of subjects with MRSA and non-MRSA according to pneumonia classification shows that of the 130 patients who died, 10 were MRSA and 120 were non-MRSA, both are mostly community-acquired (*Table VI*).

MRSA Pneumonia

Association of the different factors and pneumonia classification with mortality among subjects with MRSA pneumonia. The association of the different factors with

Table I: Demographics of Study population (n=396)

Demographics	n (%)
Gender	
Male	232 (58.6%)
Female	164 (41.4%)
Age (in years)	
18-24 y/o	15 (3.8%)
25-44 y/o	72 (18.2%)
45-54 y/o	73 (18.4%)
55-64 y/o	95 (24%)
65-74 y/o	80 (20.2%)
75-84 y/o	49 (12.4%)
85+ y/o	12 (3%)
Location	
Rizal	
Antipolo City	87 (21.7%)
Angono	3 (0.8%)
Baras	5 (1.3%)
Binangonan	5 (1.3%)
Cainta	10 (2.5%)
Cardona	1 (0.3%)
Morong	1 (0.3%)
Rodriguez	35 (8.8%)
San Mateo	55 (13.9%)
Tanay	5 (1.3%)
Taytay	17 (4.3%)
Teresa	1 (0.3%)
Metro Manila	
Marikina City	126 (31.8%)
Caloocan City	2 (0.5%)
Pasig City	24 (6.1%)
Quezon City	7 (1.8%)
Taguig City	4 (1.0%)
Others	
Batangas	1 (0.3%)
Camarines Sur	1 (0.3%)
Cavite	2 (0.5%)
Laguna	1 (0.3%)
Pangasinan	1 (0.3%)

Table II: Bacterial Etiology (n=503)

Bacterial etiology	n (%)
	n=503
MRSA	30 (6.0%)
Non-MRSA (including MSSA)	473 (94.0%)
Staphylococcus aureus	34 (6.8%)
MRSA	30 (88.2%)
MSSA	4 (11.8%)
Non-MRSA	
K. pneumoniae	85 (16.9%)
A. anitratus	83 (16.5%)
E. aerogenes	76 (15.1%)
P. aeruginosa	47 (9.3%)
E. coli	28 (5.6%)
E. cloacae	23 (4.6%)
ESBL K. pneumoniae	17 (3.4%)
A. iwoffli	16 (3.2%)
AMPC P. aeruginosa	14 (2.8%)
ESBL E. aerogenes	9 (1.8%)
Others:	
AMPC Alkaligenes specie	9 (1.8%)
Alkaligenes specie	8 (1.6%)
K. ozonae	8 (1.6%)
ESBL E. coli	6 (1.2%)
ESBL E. cloacae	5 (1.0%)
P. mirabilis	5 (1.0%)
AMPC A. anitratus	4 (0.8%)
Citrobacter specie	3 (0.6%)
Coagulase-negative Staphylococcus aureus (CONS)	2 (0.4%)
E. agglomerans	2 (0.4%)
E. hafnia alvei	2 (0.4%)
Enterococcus specie	2 (0.4%)
H. influenza	2 (0.4%)
Alkaligenes faecalis	1 (0.2%)
AMPC K. pneumoniae	1 (0.2%)
AMPC E. aerogenes	1 (0.2%)
C. freundii	1 (0.2%)
ESBL P. aeruginosa	1 (0.2%)
ESBL P. mirabilis	1 (0.2%)
K. oxytoca	1 (0.2%)
M. morganii	1 (0.2%)
P. stuartii	1 (0.2%)
P. vulgaris	1 (0.2%)
S. dysgalactiae	1 (0.2%)
S. pyogenes	1 (0.2%)
Streptococcus specie	1 (0.2%)

mortality among subjects with MRSA pneumonia showed that sex, diabetes mellitus (DM), smoking, pulmonary congestion, and atheromatous aorta/tortuous aorta (AA/TA) were significantly associated with mortality. A significantly higher proportion of mortality was noted among male subjects (*p=0.02*), DM at 70% (*p=0.05*), smokers with 5 (55.6%) compared to 2 (11.8%) smokers who survived (*p=0.02*). In terms of radiographic results, a higher proportion of subjects who died had congestion with 6 (60%) compared to 3 (15%) with the same findings who survived (*p=0.03*), while for AA/TA 5 (50.0%) died compared to only 2 (10%) who survived (*p=0.03*) (*See Appendix for Table VII*).

For the association of the pneumonia classification with mortality among subjects with MRSA pneumonia, there was no significant association noted (*Table VIII*).

Predictors of Mortality among subjects with MRSA Pneumonia. Six variables were found to be significant predictors of mortality among subjects with MRSA pneumonia. These included sex, DM, number of comorbidities, smoker, congestion, and AA/TA. The risk of male subjects for mortality was 11 times higher than females (OR=11.0; 95% CI=1.2 – 103.9; *p=0.03*), while the risk of subjects with DM for mortality was five times higher than those without DM (OR=5.4; 95% CI=1.1 – 28.5; *p=0.04*). On the other hand, for every increase in the number of comorbidities two times higher risk for mortality was noted (OR=2.3; 95% CI=1.2 – 4.3; *p=0.01*). For lifestyle factors such as smoking, mortality was nine times higher than for non-smokers (OR=9.4; 95% CI=1.3 – 67.6; *p=0.02*). Radiographic result of pulmonary congestion increases the risk to nine times higher than those without this finding (OR=8.5; 95% CI=1.5 – 49.5; *p=0.01*), while the presence of AA/TA has also a similar risk (OR=9.0; 95% CI=1.3 – 61.1; *p=0.02*) (*Table IX*).

Table III: Top 10 Bacterial Etiology based on Pneumonia Classification (n=503)

Community-acquired (n=368)		Nosocomial (n=135)	
	n (%)		n (%)
1. K. pneumoniae	69 (18.8%)58	1. A. anitratus	25 (18.5%)
2. A. anitratus	(15.8%)	2. E. aerogenes	20 (14.8%)
3. E. aerogenes	56 (15.2%)	3. K. pneumoniae	16 (11.9%)
4. P. aeruginosa	36 (9.8%)	4. P. aeruginosa	11 (8.1%)
5. E.coli	24 (6.5%)	5. MRSA	9 (6.7%)
6. MRSA	21 (5.7%)	6. ESBL E. aerogenes	8 (5.9%)
7. E. cloacae	18 (4.9%)	7. ESBL K. pneumoniae	6 (4.4%)
8. A. iwoffli	13 (3.5%)	8. AMPC P. aeruginosa	5 (3.7%)
9. ESBL K. pneumoniae	11 (3.0%)	E. cloacae	
10. AMPC P. aeruginosa	9 (2.4%)	9. Alkaligenes specie	4 (3.0%)
Others:		AMPC Alkaligenes specie	
K. ozonae	6 (1.6%)	E. coli	
AMPC Alkaligenes specie	5 (1.4%)	10. A. iwoffli	3 (2.2%)
ESBL E. coli	5 (1.4%)	ESBL cloacae	
P. mirabilis	5 (1.4%)	Others:	
Alkaligenes specie	4 (1.1%)	K. ozonae	2 (1.5%)
AMPC A. anitratus	3 (0.8%)	MSSA	2 (1.5%)
Citrobacter specie	2 (0.5%)	Alkaligenes faecalis	1 (0.7%)
CONS	2 (0.5%)	AMPC A. anitratus	1 (0.7%)
E. agglomerans	2 (0.5%)	Citrobacter specie	1 (0.7%)
ESBL E. cloacae	2 (0.5%)	E. hafnia alvei	1 (0.7%)
H. influenza	2 (0.5%)	Enterococcus specie	1 (0.7%)
MSSA	2 (0.5%)	ESBL E. coli	1 (0.7%)
AMPC K. pneumoniae	1 (0.3%)	ESBL P. aeruginosa	1 (0.7%)
AMPC E. aerogenes	1 (0.3%)	M. morganii	1 (0.7%)
C. freundii	1 (0.3%)		
E. hafnia alvei	1 (0.3%)		
Enterococcus specie	1 (0.3%)		
ESBL E. aerogenes	1 (0.3%)		
ESBL P. mirabilis	1 (0.3%)		
K. oxytoca	1 (0.3%)		
P. stuartii	1 (0.3%)		
S. dysgalactiae	1 (0.3%)		
S. pyogenes	1 (0.3%)		
Streptococcus specie	1 (0.3%)		
P. vulgaris	1 (0.3%)		

Comparison of hospital stay (morbidity) according to the different factors among subjects with MRSA pneumonia who were alive. *Table X* (*see Appendix*) shows the comparison of hospital stay according to different factors among subjects with MRSA pneumonia who were alive. There were no significant differences noted in the hospital stay of subjects according to demographic characteristics, comorbidities, initial presenting clinical manifestations, vital signs, radiographic results, and presence of multiple organisms isolated.

Table IV. Classification of Pneumonia of Study population (n=396)

Classification of Pneumonia		n (%)
Community-Acquired		292 (73.7%)
CAP-MR		217(54.8%)
CAP-HR		75 (18.9%)
Nosocomial		104 (26.3%)
Pneumonia		78 (19.7%)
HAP		26 (6.6%)
VAP		

**CAP HR, Community-Acquired Pneumonia-High Risk; CAP MR, Community-Acquired Pneumonia-Moderate Risk; HAP, Hospital-Acquired Pneumonia; VAP, Ventilator-Associated Pneumonia*

Non-MRSA Pneumonia

Association of the different factors and pneumonia classification with mortality among subjects with non-MRSA pneumonia. The results showed that erythrocytosis, kidney disease, liver disease, previous CVD, cancer, previous admission in ARMMC, number of comorbidities, altered sensorium, retraction, diastolic

Table V. Classification of Pneumonia and Bacterial Etiology (MRSA or Non-MRSA) of Study population

Pneumonia Classification	MRSA (n=30)	Non MRSA (n=366)	Total (n=396)
Community Acquired	21 (90.0%)	271 (74.0%)	292 (73.7%)
Nosocomial	9 (10.0%)	95 (26.0%)	104 (26.3%)

**MRSA, Methicillin-Resistant Staphylococcus Aureus; Non-MRSA, Non Methicillin-Resistant Staphylococcus aureus*

Table VI. Classification of Pneumonia and Bacterial Etiology (MRSA or Non-MRSA) of Study population in relation to Mortality

	Died (n=130)	Alive (n=266)	Total (n=396)
Community Acquired			
MRSA	**7 (5.4%)**	14 (5.3%)	21
Non-MRSA	**82 (63.1%)**	189 (71.1%)	271
Nosocomial			
MRSA	3 (2.3%)	6 (2.3%)	9
Non-MRSA	38 (29.2%)	57 (21.4%)	95

**MRSA, Methicillin-Resistant Staphylococcus aureus; Non-MRSA, non Methicillin-Resistant Staphylococcus aureus*

blood pressure ≤ 60 mmHg, and pulmonary congestion were significantly associated with mortality among patients with non-MRSA pneumonia. A significantly higher proportion of mortality was noted among patients with erythrocytosis (*p=0.001*), kidney disease (*p<0.0001*), liver disease (*p=0.01*), previous CVD (*p=0.03*), cancer (*p=0.02*), previous admission to ARMMC (*p=0.01*), altered sensorium (*p=0.0003*), chest retractions (*p=0.003*), DBP of ≤ 60 mmHg (*p=0.04*), and pulmonary congestion (*p=0.003*). For the number of comorbidities, the proportion of patients who died significantly increases with an increasing number of comorbidities (*p=0.01*) (See Appendix for *Table XI*).

There was a statistically significant association as well between the pneumonia classification and mortality among subjects with non-MRSA pneumonia (*p < 0.0001*). The highest proportion of mortality was noted among patients with CAP MR (*Table XII*).

Predictors of Mortality among subjects with non-MRSA pneumonia. Eight variables were found to be significant predictors of mortality among subjects with non-MRSA pneumonia. These included clinical findings of altered sensorium, retraction, a concomitant condition such as kidney disease, liver disease, cancer, extensive PTB, previous admission to ARMMC, and classification as CAP.

For subjects who initially presented with altered sensorium the risk for mortality was twice those without it (OR=2.4; 95% CI=1.1 – 5.3; *p=0.02*). Those with chest retractions were noted to have a three times higher risk for mortality (OR=2.6; 95% CI=1.1 – 6.8; *p=0.04*). In terms of comorbidities, those with kidney disease had a three times higher risk for mortality compared to those without kidney disease (OR=2.8; 95% CI=1.3 – 5.9; *p=0.006*), a similar risk was also noted for those with liver disease (OR=2.6; 95% CI=1.0 – 7.1; *p=0.05*) and cancer (OR=3.1; 95% CI=1.1 – 8.6; *p=0.02*). The highest risk for mortality was noted among subjects with extensive PTB with a six times higher risk for mortality compared to those without it (OR=6.2; 95% CI=1.4 – 27.2; *p=0.01*). Patients with a previous admission to ARMMCshowed a four times higher risk (OR=4.3; 95% CI=1.3 – 14.6; *p=0.01*). The same risk was also seen for those classified as CAP (OR=4.1; 95% CI=1.8 – 9.3; *p=0.001*). (*Table XIII*).

Table VIII. Association of the Pneumonia Classification and with Mortality among subjects with MRSA Pneumonia (n=30)

Pneumonia Classification	Died (n=10)	Alive (n=20)	Total (n=30)	*p-value**
Community acquired	7 (70.0%)	14 (70.0%)	21	1.00 ‡
Nosocomial	3 (30.0%)	6 (30.0%)	9	
CAP HR	4 (40.0%)	3 (15.0%)	7	0.44 †
CAP MR	3 (30.0%)	11 (55.0%)	14	
HAP	2 (20.0%)	4 (20.0%)	6	
VAP	1 (10.0%)	2 (10.0%)	3	

p>0.05- Not significant; p ≤0.05-Significant
† Chi-square test; ‡Fisher Exact test
**CAP HR, Community-Acquired Pneumonia-High Risk; CAP MR, Community-Acquired Pneumonia-Moderate Risk; HAP, Hospital-Acquired Pneumonia; VAP, Ventilator-Associated Pneumonia*

Table IX. Predictors of Mortality among subjects with MRSA Pneumonia (n=30) by Multivariate Analysis

Variable	OR	95% CI	p value
Sex (male)	11.0	1.2 – 103.9	0.03
DM	5.4	1.1 – 28.5	0.04
Number of comorbidities	2.3	1.2 – 4.3	0.01
Smoker	9.4	1.3 – 67.6	0.02
Congestion	8.5	1.5 – 49.5	0.01
AA/TA	9.0	1.3 – 61.1	0.02

Logistic Regression Analysis
**DM, Diabetes Mellitus; AA/TA, Atheromatous aorta/Tortuous aorta*

Comparison of length of hospital stay (morbidity) according to the different factors among subjects with non-MRSA pneumonia who are alive. Table XIV (see Appendix) shows the comparison of length of hospital stay according to the different factors among subjects with non-MRSA pneumonia who are alive. There was a significant difference in the hospital stay of patients with and without anemia (22.4 days vs 14.9 days *p < 0.001*). Similarly, there was a significant difference in the hospital stay of patients with and without trauma (32.0 days vs 18.2 days *p=0.006*). A significant difference was also seen according to the number of comorbidities (*p=0.009*). In contrast to this, patients with asthma were seen to have a shorter duration of hospital stay compared to those without asthma (11.7 days vs 19.5 days). In terms of initial presenting clinical manifestation, those who presented with chest pain and hypotension (DBP ≤ 60 mmHg) were noted with a much shorter duration of hospitalization compared to those without, (12.7 vs 19.6 days and 14.5 vs 19.9 days, respectively). For the radiographic findings, a significantly longer duration of hospital stay was noted among those with bilateral infiltrates (*p=0.007*), bilateral consolidation (*p=0.02*), unilateral consolidation (*p=0.01*), bilateral minimal pleural effusion (*p=0.04*), unilateral minimal pleural effusion (*p=0.03*), subcutaneous emphysema (*p=0.03*) and pulmonary congestion (*p=0.05*). Moreover, patients with multiple organisms (bacteria) were also found to

Table XII. Association of the Pneumonia Classification and with Mortality among subjects with Non-MRSA pneumonia (n=366)

Pneumonia Classification	Died (n=120)	Alive (n=246)	Total (n=366)	*p-value**
Community acquired	82 (68.3%)	189 (76.8%)	271	0.08 †
Nosocomial	38 (31.7%)	57 (23.2%)	95	
CAP HR	40 (33.3%)	28 (11.4%)	68	<0.0001 †
CAP MR	42 (35.0%)	161 (65.4%)	203	
HAP	27 (22.5%)	45 (18.3%)	72	
VAP	11 (9.2%)	12 (4.9%)	23	

p>0.05- Not significant; p ≤0.05-Significant
† Chi-square test
**CAP HR, Community-Acquired Pneumonia-High Risk; CAP MR, Community-Acquired Pneumonia-Moderate Risk; HAP, Hospital-Acquired Pneumonia; VAP, Ventilator-Associated Pneumonia*

Table XIII. Predictors of Mortality among subjects with Non-MRSA Pneumonia (n=366) by Multivariate Analysis

Variable	OR	95% CI	P value
Kidney Disease	2.8	1.3 – 5.9	*0.006*
Liver Disease	2.6	1.0 – 7.1	*0.05*
Cancer	3.1	1.1 – 8.6	*0.02*
Previous Admission (ARMMC)	4.3	1.3 – 14.6	*0.01*
Altered Sensorium	2.4	1.1 – 5.3	*0.02*
Retraction	2.6	1.1 – 6.8	*0.04*
Extensive PTB	6.2	1.4 – 27.2	*0.01*
Pneumonia Classification (community acquired)	4.1	1.8 – 9.3	*0.001*

Logistic Regression Analysis
**ARMMC, Amang Rodriguez Memorial Medical Center; PTB, Pulmonary Tuberculosis*

have a longer duration of hospital stay than those with a single organism (*p=0.0003*).

Antibiogram. Our study came up with the first antibiotic susceptibility pattern (antibiogram) for pneumonia in ARMMC. The general rule followed in interpreting this antibiogram for each drug uses a cut-off value of ≥ 20% resistance rate which is to be avoided for use as empiric therapy. It is recommended that a much lower threshold of 5-10% is used for patients who are critically ill.[18]

For pneumonia caused by non-MRSA bacteria; gentamicin (6 out of 10 most common isolates), meropenem (6 out of 10), and levofloxacin (4 out of 10) are the antibiotics with > 80% susceptibility among the most number of isolates. This is followed by amikacin, cefotetan, doripenem, and ertapenem (3 out of 10). For pneumonia caused by MRSA; gentamicin, cefotetan, and ceftriaxone all had 100% susceptibility. However, these drugs are only tested on a very limited number of isolates (3, 2, and 1 respectively). Most MRSA isolates are tested with the following drugs with acceptable susceptibility of > 80%; linezolid (95%, 20 isolates), levofloxacin (89%, 18), ofloxacin (86%, 7), cephalexin (83%, 6), and chloramphenicol (81%, 27) (*Table XV*).

Discussion

Pneumonia. In this study, we determined the demographics, comorbidities, initial presenting clinical manifestations, radiographic and bacteriologic results as well as pneumonia classification that are associated and predictors of clinical outcomes of MRSA and non-MRSA pneumonia. The results revealed that most of the subjects are males at 58.6% with the majority at the age range of 55-64 years old. The sex-based difference was explained in a study showing that females have more resistance to pneumonia because of estrogen which enhances the ability of the alveolar macrophages to kill bacteria by increasing the number of proteins produced from a gene called *NOS3,* thus making males more at risk in acquiring and developing severe pulmonary infections than their female counterparts.[19]

In terms of location, most patients reside in Marikina City which is where ARMMC is located. This is followed by Antipolo City and San Mateo, Rizal which are approximately 5.1 and 5.9 km away, respectively from ARMMC.

The bacterial isolates from this study are mainly non-MRSA (94%), which are mostly gram-negative organisms such as *K. pneumoniae*, *A. anitratus,* and *E. aerogenes*. These three bacteria were also the most common etiology for both CAP and nosocomial pneumonia, with the difference only in terms of chronology. The only gram-positive organism in the ten most common etiology for both pneumonia classification is *Staphylococcus. aureus* at 6.8% (34/503), 88.2% of which are MRSA with the majority as community-acquired (21 out of 30 isolates). This result is similar to that seen in a systematic review study regarding bacterial etiology of CAP in Asia done by Peto, L., et. al., which also showed *K. pneumonia* as the gram-negative bacilli most commonly identified in an admitted patient, and is primarily seen in Southeast Asia and India compared to East Asia. This study also reveals a pattern of predominantly gram-negative bacilli etiology in Asia compared to the western part of the globe in which this organism is mainly seen in cases of HAP.[20]

Similarly, MRSA which is also previously identified mostly in nosocomial infection has been increasingly observed

in the community. This is confirmed by the ANSORP study, which primarily determined the spread of MRSA between the community and hospitals in several countries in Asia. In this study, the Philippines has a rate of community-acquired MRSA at 30.1% (3rd highest in Asia), while the rate of hospital-acquired MRSA in the Philippines is low (2nd to the lowest) at 38.1%.[21] However, the reason behind this finding was not cited and can be a topic for another research. Another significance of identifying the rate of MRSA isolates in an institution specifically in a hospital unit is its impact on deciding whether to include an empiric treatment in patients who develop HAP/VAP.

A percentage of MRSA from the total *S. aureus* isolates of > 20% and >10-20% in a hospital where HAP and VAP patients, respectively, are being treated, or the rate is unknown, warrants empiric treatment for MRSA, as recommended by IDSA and ATS.[12] Based on the result of this study which showed 88.2% of *S. aureus* are MRSA, a re-evaluation regarding the institution's protocol of empiric treatment of nosocomial pneumonia should be considered.

For the pneumonia classification, the majority are community-acquired at 73.7%, which are mostly CAP-MR followed by CAP-HR. On the other hand, nosocomial pneumonia is at 26.3%. As mentioned previously, most are caused by non-MRSA in both CAP and HAP/VAP. On the other hand, the majority of MRSA pneumonia is seen in CAP (90%) compared to nosocomial acquired (10%). Nosocomial infection or healthcare-associated infection approximately affects 15% of all admitted patients according to WHO, and occurs both in developed and developing countries, accounting for 7% and 10%, respectively.[22,23] One of the frequently prevalent types is VAP.[23] Locally, one study done in a public hospital revealed that pneumonia was the most predominant hospital-acquired infection.[24]

Navoa-Ng, et. al., showed a significant increase in the length of hospital stay in the ICU of VAP patients from 3.4 to 12.7 days with extra mortality of 4.8%.[25] The importance of documenting nosocomial infection which can help in planning to decrease its occurrence should be emphasized since it causes a significant burden both clinically and economically. It is also a public health issue because of its relation to the rise of antimicrobial resistance. In terms of mortality outcome, the majority who died of MRSA and non-MRSA pneumonia are community-acquired since this classification has the most number of subjects.

Clinical Outcome of MRSA Pneumonia. In our study, factors that have a significant association with mortality among MRSA pneumonia are male sex, DM, smokers, and radiographic findings of pulmonary congestion and atheromatous aorta/tortuous aorta. These are also the predictors of mortality with the addition of an increasing number of concomitant comorbidities. As previously mentioned, males are at greater risk of severe pneumonia as compared to females because of the effect of estrogen.[18] Based on the result of this study males are at 11 times higher risk of mortality compared to their female counterparts.

DM was the only one with a significant association with mortality increasing the risk up to five times. Diabetic individuals are predisposed to greater frequency and more severe infections. The reasons behind this include incompletely defined defects in cell-mediated immunity and function of phagocytes and enhanced colonization and growth of a variety of organisms due to hyperglycemia, as well as diminished vascularization.[9]

The lifestyle factor in this study that increases the risk of dying from MRSA pneumonia nine times is smoking. A study analyzing the effects of cigarette smoking on *Staphylococcus* found that its extracts can induce a general stress response to MRSA, resulting in higher resistance to killing by the macrophages as well as the antimicrobial peptide (AMPs) and partial resistance to killing by oxygen radicals. This also reduces lysis resulting in increased virulence in vivo.[26]

For the radiographic findings, both pulmonary congestion and AA/TA can increase the risk of mortality by nine times. The increase in mortality in the presence of these findings could be because pulmonary congestion or edema can be a result of bacteremia (interstitial edema) or airspace infections (alveolar edema).[27] The mechanism behind this was further explained in a study regarding the immunopathogenesis of *Staphylococcus* in pulmonary infection, which states the effects of Panton-valentine leukocidin (PVL), a toxin produced by a virulent strain (USA300) of MRSA which has specificity to human and rabbit neutrophils. Rabbit models from this study showed necrotizing pneumonia is due to the effects of PVL on lung pathologies such as necrosis, pulmonary edema, and other outcomes seen in necrotizing pneumonia in humans.[28]

This suggests that pulmonary congestion can be one of the manifestations of severe MRSA infection. Moreover, its presence can further cause a decline in pulmonary function which may have also contributed to the increase in mortality seen in this study. For the finding of AA/TA, no similar studies showed the same results. The possible reason is its relation to ischemia that can eventually lead to hypoxia which may be aggravated in the setting of pulmonary disease such as pneumonia.

On the other hand, the presence of multiple comorbidities was also found to be significant with every increase in number corresponding to a twice higher risk of mortality. This result is expected since the more concomitant condition that is present the more complex the management would be.

In terms of pneumonia classification, no significant association with mortality was noted in this study. This is in contrast to one study which compares community-acquired to healthcare-associated MRSA pneumonia that showed higher 28-day mortality for those with MRSA Healthcare-associated pneumonia (HCAP).[29] This was attributed in the study to the probable severe underlying diseases. The non-significance in terms of classification of

pneumonia in our study could be due to the practice of the institution under study in which empiric treatment of MRSA is usually not instituted, hence there could be a decreased rate of MDR MRSA pneumonia, making hospital-acquired as susceptible as CAP to the usual treatment for MRSA.

For the morbidity of MRSA pneumonia subjects which is based on the length of hospital stay, there were no significant differences noted for all the factors measured. This could be due to the high susceptibility of the bacteria to the conventional treatment as previously mentioned.

Clinical Outcome of Non-MRSA Pneumonia. The following are factors noted in this study with significant association to mortality in non-MRSA pneumonia subjects; erythrocytosis, kidney and liver disease, cancer, previous CVD, previous admission (ARMMC), number of concomitant comorbidities, clinical findings of altered sensorium, retraction and a DBP ≤ 60 mmHg, radiographic finding of congestion, and lastly a classification of CAP-MR.

In the presence of erythrocytosis, especially if excessive the increase in blood viscosity can cause marked pulmonary hypertension resulting in alteration of pulmonary function.[30] This could be the contributing factor to the mortality of our subjects. Likewise, comorbidities such as kidney and liver disease as well as cancer have a significant association with mortality and increase its risk to three times higher. All of these conditions are known to decrease immune function. In kidney disease, the increase in risk for acquiring as well as in the severity of pneumonia is due to uremia-related impairment in the phagocytic function of monocytes, neutrophils, T lymphocytes, and B lymphocytes, and with an accompanying increase in cytokines.[31]

In terms of liver disease, several studies have found that preexisting chronic liver disease is an independent risk factor for the increase in incidence as well as mortality in pneumonia.[32]. It causes significant immunodeficiency and systemic inflammation resulting in a higher risk of contracting infectious diseases. One example of a defect is the deficiency in innate immunity leading to impairment of bacterial clearance in the lungs.[33]

On the other hand, for cancer, the disease itself and its treatment cause aberration in the innate and adaptive response to bacteria in the lungs. It can cause depletion of leukocytes, dysregulated inflammatory reaction, disruption in the mucosa, etc., which are all contributory to increase susceptibility and severity of pneumonia. Furthermore, conditions like concomitant functional and anatomical abnormalities as well as multiple encounters of cancer patients with health care increase their chances of nosocomial infections and exposure to multidrug-resistant pathogens contributing to its strong association with mortality in pneumonia.[34]

The history of previous cerebrovascular disease (CVD) is also significantly associated with mortality. A similar result is seen in a study done on a multicenter retrospective cohort with an ischemic stroke which showed that pneumonia after stroke was linked with mortality at 30 days and 1 year, prolonged length of hospital stay, and dependency at discharge.[35] A study by Chen, et al determined that in terms of aspiration pneumonia the most significant risk factor is stroke and post-stroke states.[36] The mechanism is thought to be due to the development of dysphagia that can be seen in at least half of stroke patients. Dysphagia reduces involuntary coughing when a foreign object suddenly enters the airway resulting in aspiration.[37]

Subjects who had pneumonia and were admitted within the preceding three months were previously defined as having healthcare-associated pneumonia (HCAP). However, this was removed in the recent 2016 IDSA and ATS guidelines for HAP and VAP.[13] In our study, subjects who can previously be categorized as HCAP have a significant association with mortality for non-MRSA pneumonia with a risk of four times higher. This result is also seen in another study showing the persistence of a significant mortality difference in HCAP compared to CAP patients after controlling for comorbidities, the severity of pneumonia, and infection with MDR.[38] The authors suggested that the difference is correlated with the category of pneumonia rather than simply due to the increased prevalence of comorbidities or the presence of a more severe illness. They also attributed the increase in mortality to the use of inappropriate initial antibiotics for patients categorized as HCAP.

In our study, patients who were previously admitted to ARMMC were managed initially as HCAP using a broader spectrum empiric antibiotic. The possibility that these patients were also given antibiotics during their previous admission cannot be ascertained fully. The possibility that they may have eventually developed antibiotic resistance due to previous antibiotic exposure cannot be excluded. Again, this is another topic for re-evaluation in the institution's protocol in managing pneumonia patients. In terms of the number of concomitant comorbidities, similar to MRSA pneumonia, there is also a significant increase in mortality for every increase in the number of comorbidities present. This is similar to a study that showed that the presence of any comorbidity is associated with mortality within 30 days in cases of CAP.[39]

The initial presenting clinical findings with significant association with mortality in non-MRSA pneumonia are altered sensorium, retraction, and DBP of ≤ 60 mmHg, where the risk was noted to be two times and three times higher for altered sensorium and retraction, respectively. The same study also showed an association of altered sensorium to a higher mortality rate in CAP.[39] A local study also had the same result where it was observed that those patients who died of pneumonia presented drowsiness on admission.[40] Meanwhile, the presence of retraction which is one of the variables in terms of work of breathing serves as a strong indicator of severe disease, hence are expected to have a poorer prognosis.[44] The last clinical finding with association to mortality is a DBP of ≤ 60 mmHg. Pneumonia

complicated by hypotension and eventually developing septic shock has also been shown to present a poor prognosis, with high overall mortality reaching up to 51%.[42]

The highest risk for mortality in this study is seen in those with extensive PTB at six times higher compared to those without. A study describing the outcome of dual PTB and non-mycobacterial respiratory infection also observed more in-hospital morbidity and mortality rates in the group with dual pulmonary infection. They attributed the outcome to several variables such as lower serum albumin, older age, more extensive infiltration and consolidation on chest radiographs, and delay in the anti-tuberculosis treatment.[43]

Non-MRSA pneumonia is significantly associated with mortality in contrast to subjects with MRSA pneumonia. It was noted to increase the risk for mortality to as high as four times. A higher proportion of mortality was seen in subjects diagnosed with CAP-MR. This can be due to a much higher number of subjects classified as CAP.

In terms of longer length of hospital stay, the following factors were significantly associated with prolonged duration of hospital stay: subjects who are anemic, trauma cases, presence of multiple comorbidities, those with radiographic findings of bilateral infiltrates, unilateral or bilateral pulmonary consolidation, unilateral or bilateral minimal pleural effusion, subcutaneous emphysema, and pulmonary congestion, as well as infection with multiple bacteria.

Anemia in pneumonia is usually secondary to complications of an inflammatory process. The molecule mainly responsible is hepcidin, an iron-regulatory hormone that increases in production during inflammation. This molecule depletes iron depot and suppresses erythropoiesis resulting in anemia of inflammation, in turn, anemia especially in severe form enhances hypercapnia and slowed red blood cells maturation in the bone marrow which then promotes ischemic syndrome.[44] Numerous studies have been published regarding the relation of anemia to pneumonia specifically that of CAP. An example of such is a study by Shallan et. al., which showed that not only does iron deficiency anemia causes significant rates of mortality and morbidity in CAP patients, but it also serves as a risk factor in acquiring such infection. The reason behind the increased risk is significant impairment of oxidative metabolism, cellular immune mechanisms, and cellular energetics.[45] In our study, the cut-off values used in defining anemia are lifted from WHO (non-pregnant < 120 g/L, pregnant < 110 g/L, and male < 130 g/L), which were also the same values used by the Food and Nutrition Research Institute-Department of Science and Technology (FNRI-DOST) in its national nutrition survey.[46,47]

This study revealed prolonged hospitalization in anemic subjects that may be attributed to the previously mentioned reasons. Another contributory factor is the limited supply of blood products which is especially true for anemia requiring transfusions. According to WHO for the year 2015, the median blood donation rate in lower-middle-income countries is 8.1 donations per 1000 people compared to high-income countries at 32.6 donations per 1000 people.[48]

Additionally, blood products are expensive. Locally, for a unit of packed red blood cells the minimum cost is PhP 1,100.[49] This, in turn, makes government hospitals more vulnerable to the effect of this scarcity in blood supply. In cases of trauma, being the only tertiary hospital in Marikina City and nearby province (Rizal) capable of advanced surgical procedures, ARMMC receives a great number of such cases, most of which sustained trauma secondary to a motor vehicle accident. A prolonged hospital stay is expected since most require surgical procedures along with the additional challenge of securing blood for transfusion.

In terms of the number of comorbidities, similar to mortality outcome, this is also a significant contributor to a prolonged hospital stay. This is an expected result since this also equates to multiple treatments needed and can as well affect the response to pneumonia treatment.

For the radiographic results associated with a prolonged hospital stay, bilateral infiltrates, unilateral/bilateral consolidation, and unilateral/bilateral minimal pleural effusion were all significant. These findings point to multiple lobe involvement being associated with more severe pneumonia. This is in line with several scoring systems and guidelines such as the Pneumonia Severity Index (PSI) and Philippine guidelines for CAP.[11,50] A similar result is seen in a study for CAP patients, in which an excess length of 4.4 days was noted in subjects with multi-lobar involvement.[51]

Additional results with association to prolonged hospital stay are subcutaneous emphysema and pulmonary congestion. Subcutaneous emphysema usually occurs in the setting of chest injury or is associated with pneumomediastinum and pneumothorax caused by a pathological alteration in the respiratory tract. Spontaneous subcutaneous emphysema is rarely seen in the absence of these two entities.[52] One theory regarding its occurrence is a possible preexisting weakness of either the alveolar or bronchial wall in which a condition that causes excessive coughing can result in increased intrapulmonary pressure resulting to rupture of the weakened point permitting escape of air into the tissue.[52] On the other hand, pulmonary congestion can be from cardiac or non-cardiac conditions and even adverse drug effects.[53].The presence of these two findings warrants additional treatment and hence could be the reason for the prolonged hospital stay.

In terms of the number of organisms isolated, subjects infected with multiple bacterial isolates showed prolonged hospitalization. This suggests more severe pneumonia for those affected. Several studies also showed a similar prognosis that implies more severe pneumonia is seen in patients with polymicrobial etiology. Polymicrobial pneumonia was defined as pneumonia caused by more than one pathogen.[54] A study that collected epidemiologic data from different

parts of the world showed that in Spain a study of 3523 CAP patients found that 14% of cases were polymicrobial and *S. pneumoniae* was the most common pathogen (65%). The most frequent combination they noted was two bacteria in 32% of the cases. On the other hand, the same study showed that in Japan a study of 1032 CAP patients found that polymicrobial infection is seen in 18% of severe CAP and 12.5% in the group of non-survivors, they concluded that polymicrobial infection is a risk factor for severe CAP.[55]

For asthmatic subjects in this study, the results revealed that they had a much shorter length of hospital stay compared to non-asthmatics. All asthmatic subjects (28) in this study are classified as CAP, most of whom are in the age range of 55-64 y/o (8/28), followed by 25-44 y/o (6/28). However, most of these subjects have multiple comorbidities. Despite that 21 out of 28 subjects were still discharged alive (seven mortality). The relatively younger age of these asthmatics might be a factor that contributed to its favorable outcome. Terraneo S, et. al., also showed a significantly shorter hospital stay (2 days) for asthmatic CAP patients, which they attributed to younger age and less concomitant co-morbidities of these patients.[56]

In terms of clinical manifestation, those who initially presented with chest pain and hypotension (DBP ≤60 mmHg) had a significantly shorter hospital stay. The possible reason behind this is because these manifestations indicate a severe condition hence these subjects are the ones usually prioritized to be admitted to ICU. Thus, they are the ones who have more access to advanced critical care, equipment, and medical resources which may have contributed to its favorable outcome.

Antibiogram. As a recommendation of IDSA, all hospitals should regularly generate and disseminate an antibiogram, and ideally, it should be specific to their intensive care population.[13] Thus, one of the objectives of this study is to make a hospital antibiogram for the top ten most common bacterial isolates, this is the first for the institution of origin of this study. The antibiogram revealed a poor susceptibility pattern for the antibiotics usually used as an empiric treatment by the institution. These antibiotics are ceftriaxone for CAP pneumonia and piperacillin + tazobactam for nosocomial pneumonia, both of which have < 80% susceptibility to the most common bacterial isolated in the institution. This data can help in the institution's formulation of cost-effective empiric treatment for pneumonia in the adult patient.

Conclusion

In this study, the rate of MRSA and non-MRSA were documented. It reveals an increased rate of MRSA pneumonia, with several factors associated with its mortality; male sex, DM, smokers, and radiographic findings of pulmonary congestion and atheromatous aorta/tortuous aorta. In terms of morbidity which is based on the length of hospital stay, there were no significant differences noted in the hospital stay of the subjects according to demographic characteristics, comorbidities, initial presenting clinical manifestations, vital signs, radiographic results, and presence of multiple organisms isolated.

On the other hand, non-MRSA pneumonia was seen in the majority of the subjects. Factors associated with its mortality are erythrocytosis, kidney and liver disease, cancer, previous CVD, previous admission (ARMMC), number of concomitant comorbidities, clinical findings of altered sensorium, retraction, and DBP ≤ 60 mmHg, radiographic findings of congestion, and lastly a classification of CAP-MR. In terms of morbidity, factors that increased the length of stay are anemia, trauma, presence of multiple comorbidities, radiographic findings of bilateral infiltrates, unilateral/bilateral consolidation, unilateral/bilateral minimal pleural effusion, subcutaneous emphysema and congestion, and infection with multiple bacteria.

This study also generated a hospital antibiogram which showed a poor susceptibility pattern for the antibiotics usually used as an empiric treatment in ARMMC. Hence, going forward, this antibiogram can be used to formulate a cost-effective empiric treatment for pneumonia in the adult patient

The limitation of this study is it did not include or assess the effect of management of pneumonia on its outcome. This can be another topic for research.

Conflict of Interest

The authors declare no conflict of interest. No funding was received for conduct of this study

References

1. Ruuskanen O, Lahti E, Jennings L, Murdoch D. [2011]. Viral pneumonia, [Internet]. The Lancet, 377(9773):1264-1275, 2011 April. Available: https://doi.org/10.1016/S0140-6736(10)61459-6, (Accessed Date: 2019, September 15)
2. Bersales L, Philippine Statistics Authority. [2018 February]. Death in the Philippines, 2016, [Internet]. Philippine Statistics Authority. Available from: https://psa.gov.ph/content/deaths-philippines-2016 (Accessed Date: 2019, September 15)
3. Sattar SBA, Sharma S. Bacterial Pneumonia. [Updated 2019 Dec 12]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK513321 (Accessed Date: 2019, September 15)
4. Siddiqui AH, Koirala J. Methicillin Resistant Staphylococcus Aureus (MRSA) [Updated 2018 Oct 27]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan. Available from:https://www.ncbi.nlm.nih.gov/books/NBK482221/#article-25074.s12 (Accessed Date: 2019, September 15)
5. Centers for Disease Control and Prevention. [2019, June 26]. Methicillin-resistant Staphylococcus aureus (MRSA), [Internet]. Centers for Disease Control and Prevention. Available from: https://www.cdc.gov/mrsa/community/index.html (Accessed Date: 2019, September 15)
6. Wooten D, Winston L; Risk factors for methicillin-resistant Staphylococcus aureus in patients with community-onset and hospital-onset pneumonia. Respiratory Medicine, 107(8):1266-12270, 2013 August 1
7. Tadros M, Williams V, Coleman BL, McGeer AJ, Haider S, Lee C, Iacovides H, Rubinstein E, John M, Johnston L, McNeil S, Katz K, Laffin N, Suh KN, Powis J, Smith S, Taylor G, Watt C, Simor AE. Epidemiology and outcome of pneumonia caused by

methicillin-resistant Staphylococcus aureus (MRSA) in Canadian hospitals. *PLoS One*. 2013 Sep 17;8(9): e75171. doi: 10.1371/journal.pone.0075171. PMID: 24069391; PMCID: PMC3775759 (Accessed Date: 2019, September 16)

8. Chen C, Huang Y; New epidemiology of Staphylococcus aureus infection in Asia. Clinical Microbiology and Infection, 20(7): 605 – 623, 2014 July
9. Juayang A, de los Reyes G, de la Rama A, Gallega C. Antibiotic Resistance Profiling of Staphylococcus aureus Isolated from Clinical Specimens in a Tertiary Hospital from 2010 to 2012," Interdisciplinary Perspectives on Infectious Diseases, vol. 2014, Article ID 898457, 4 pages, 2014. https://doi.org/10.1155/2014/898457 (Accessed Date: 2019, September 16)
10. Jameson J, Kasper D, Longo D, Fauci A, Hauser S, Loscalzo J. Harrison's Principles of Internal Medicine 20th Edition. New York; Mc Graw Hill Education, 2018. Chapter 463 The Biology of Aging, P3413
11. Chua M, De Los Reyes MR, Coronel R, Galvez B, Genuino A, Ceralvo RJ, Limpoco A, Mangahas C, Obusan LJ, Siasoco MB, Solante R, Villa ML, Lansang MA, Saniel M. [Updated 2016]. Diagnosis, Empiric Management and Prevention of Community-Acquired Pneumonia in Immunocompetent Adults 2016 Update, [Internet]. Philippine Society For Microbiology And Infectious Diseases, Philippine College of Chest Physicians, Philippine Academy of Family Physicians, Philippine College of Radiology. Available: http://philchest.org/v3/wp-content/uploads/2013/05/CAP-Guidelines.pdf (Accessed Date: 2019, September 16)
12. American Thoracic Society (ATS) and Infectious Diseases Society of America (IDSA). Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. American Journal of Respiratory Critical Care Medicine. 171: 388–416, 2005 (Accessed Date: 2019, September 16)
13. Kalil A, Metersky M, Klompas M, Muscedere J, Sweeney D, Palmer L, Napolitano L, O'Grady N, Barlett J, Carratala J, Solh A, Ewig S, Fey P, File Jr. T, Restrepo M, Roberts J, Waterer G, Cruse P, Knight S, Brozek J. [2016]. Management of Adults with Hospital-acquired and Ventilator-associated Pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society, [Internet]. Infectious Diseases Society of America (IDSA) and American Thoracic Society (ATS). Available: https://www.thoracic.org/statements/resources/tb-opi/hap-vap-guidelines-2016.pdf (Accessed Date: 2019, September 16)
14. Broekema NM, Van TT, Monson TA, Marshall SA, Warshauer DM. Comparison of cefoxitin and oxacillin disk diffusion methods for detection of mecA-mediated resistance in Staphylococcus aureus in a large-scale study. *J Clin Microbiol*. 2009 Jan;47(1):217-9. doi: 10.1128/JCM.01506-08. Epub 2008 Nov 19. PMID: 19020073; PMCID: PMC2620872 (Accessed Date: 2019, October 1)
15. Sahai S, Chauhan S. [2014]. Comparative evaluation of Oxacillin and Cefoxitin disk diffusion method in detection of Methicillin-resistant Staphylococcus aureus (MRSA) isolates from a tertiary care hospital in North India, [Internet]. International Journal of Scientific Study, 2(6): 125-128, 2014 September. Available: https://www.ijss-sn.com/uploads/2/0/1/5/20153321/ijss_sept_2014.pdf (Accessed Date: 2019, October 1)
16. Shariati L, Validi M, Tabatabaiefar MA, Karimi A, Nafisi MR. [2010]. Comparison of Real-time PCR with disk diffusion, agar screen and E-test methods for detection of Methicillin-resistant Staphylococcus aureus, [Internet]. Current Microbiology, 61(6): 520-4, 2010 December. Available: https://www.ncbi.nlm.nih.gov/pubmed/20405128 (Accessed Date: 2019, October 1)
17. Azmi S, Aljunid SM, Maimaiti N, Ali A, Nur AM, De Rosas-Valera M, Encluna J, Mohamed R, Wibowo B, Komaryani K, Roberts C. [2016]. Assessing the burden of pneumonia using administrative data from Malaysia, Indonesia, and the Philippines, [Internet]. International Journal of Infectious Diseases, 49: 87-93, 2016 August. Available: https://www.ijidonline.com/article/S1201-9712(16)31064-5/fulltext (Accessed Date: 2019, October 1)
18. Gauthier T, Justo JA. [2018]. Five important things to know about hospital antibiogram, [Internet]. IDStewardship. Available: https://www.idstewardship.com/five-important-things-know-hospital-antibiograms/ (Accessed Date: 2019, November 30)
19. Yang Z, Huang YC, Koziel H, de Crom R, Ruetten H, Wohlfart P, Thomsen RW, Kahlert JA, Sørensen HT, Jozefowski S, Colby A, Kobzik L. [2014] Female resistance to pneumonia identifies lung macrophage nitric oxide synthase-3 as a therapeutic target, [Internet]. Elife, 3: e03711, 2014 October. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4215537/ (Accessed Date: 2019, November 30)
20. Peto L, Nadjm B, Horby P, Ngan TTD, van Doorn R, Van Kinh N, Wertheim H. [2014]. The bacterial aetiology of adult community –acquired pneumonia in asia: a systematic review, [Internet]. Transactions of The Royal Society of Tropical Medicine and Hygiene, 108(6): 326-337, 2014 June. Available: https://academic.oup.com/trstmh/article/108/6/326/2765176 (Accessed Date: 2019, November 30)
21. Song JH, Hsueh PR, Chung DR, Ko KS, Kang CI, Peck KR, Yeom JS, Kim SW, Chang HH, Kim YS, Jung SI, Son JS, So TM, Lalitha M, Yang Y, Huang SG, Wang H, Lu Q, Carlos C, Perera J, Chiu CH, Liu JW, Chongthaleong A, Thamlikitkul V, Van PH, Lee H, Thomas MK, Mathai D, Ngoc TV. [2011]. Spread of methicillin-resistant Staphylococcus aureus between the community and the hospitals in Asian countries: an ANSORP study, [Internet]. Journal of Antimicrobial Chemotherapy, 66(5): 1061-1069, 2011 May. Available: https://academic.oup.com/jac/article/66/5/1061/780716 (Accessed Date: 2019, November 30)
22. World Health Organization (WHO). [2016]. The burden of health care-associated infection worldwide, [Internet]. World Health Organization (WHO). Available: https://www.who.int/gpsc/country_work/burden_hcai/en/ (Accessed Date: 2019, November 30)
23. Khan HA, Baig FK, Mehboob R. [2017]. Nosocomial infections: Epidemiology, prevention, control and surveillance, [Internet]. Asian Pacific Journal of Tropical Biomedicine, 7(5): 478-482, 2017 May. Available: https://www.sciencedirect.com/science/article/pii/S2221169116309509 (Accessed Date: 2019, November 30)
24. Vergeire-Dalmacion G, Itable J, Baja E. [2016]. Hospital-acquired infection in public hospital buildings: Is the type of ventilation increasing the risk?, [Internet]. The Journal of Infection in Developing Countries, 10: 1236-1242, 2016 November. Available: https://jidc.org/index.php/journal/article/view/27886037 (Accessed Date: 2019, December 6)
25. Ng JA, Rosenthal V. [2007]. Healthcare-associated infection rates, extra length of stay and mortality in a hospital of the Philippines. Findings of the INICC, [Internet]. American Journal of Infection Control, 35(5): E55-E56, 2007 June. Available: https://www.researchgate.net/publication/257050269_Healthcare-Associated_Infection_Rates_Extra_Length_of_Stay_and_Mortality_in_a_Hospital_of_the_Philippines_Findings_of_the_INICC (Accessed Date: 2019, December 6)
26. McEachern E, Hwang J, Sladewski K, NIcatia S, Dewitz C, Mathew D, Nizet V, Crotty Alexander L. [2015]. Analysis of the Effects of Cigarette Smoke on Staphylococcal Virulence Phenotypes, [Internet]. Infection and Immunity, 83(6): 2443-2452, 2015 May. Available: https://iai.asm.org/content/83/6/2443.long (Accessed Date: 2019, December 6)
27. Moskowitz S, Wiener-Kronish J. [2010]. Mechanism of bacterial virulence in pulmonary infections, [Internet]. Current Opinion in

Critical Care, 16(1): 8-12, 2010 February. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2845290/ (Accessed Date: 2019, December 6)
28. Parker D, Prince A. [2012]. Immunopathogenesis of Staphylococcus aureus pulmonary infection, [Internet]. Seminars in Immunopathology, 34(2): 281-297, 2012 March. Available: https://link.springer.com/article/10.1007%2Fs00281-011-0291-7 (Accessed Date: 2019, December 6)
29. Leem AY, Jung WJ, Kang YA, Park SC, Kim YJ, Hwang ED, Kim EY, Jung KS, Park MS, Kim SY, Kim YS, Kim SK, Chang J, Jung JY. [2014]. Comparison of Methicillin-resistant Staphylococcus aureus community acquired and healthcare-associated pneumonia, [Internet]. Yonsei Medical Journal, 55(4): 967-974, 2014 July. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4075401/ (Accessed Date: 2019, December 6)
30. Taylor A. [2004]. Effects of excessive erythrocytosis on pulmonary vascular smooth muscle mass, [Internet]. American Journal of Respiratory and Critical Care Medicine, 169(7):829-835, 2004 April. Available: https://www.atsjournals.org/doi/full/10.1164/rccm.2401011 (Accessed Date: 2019, December 6)
31. Chou CY, Wang SM, Liang CC, Chang CT, Liu JH, Wang K, Hsiao LC, Muo CH, Huang CC, Wang RY. [2014]. Risk of pneumonia among patients with Chronic Kidney Disease in Outpatient and Inpatient: a nationwide population-based study, [Internet]. Medicine (Baltimore), 93(27): e174, 2014 December. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4602797/ (Accessed Date: 2019, December 6)
32. Htun ZM, Gul M. [2018]. Preexisting chronic liver disease is an independent risk factor for increased incidence and mortality in pneumonia (Abstract), [Internet]. Chest Journal, 154(4): 958A, 2018 October. Available: https://journal.chestnet.org/article/S0012-3692(18)32058-0/fulltext (Accessed Date: 2019, December 6)
33. Xu L, Ying S, Hu J, Wang Y, Yang M, Ge T, Huang C, Xu O, Zhu H, Chen Z, Ma W. [2018]. Pneumonia in patients with cirrhosis: risk factors associated with mortality and predictive value of prognostic models, [Internet]. Respiratory Research, 19(1): 242, 2018. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6280505/ (Accessed Date: 2019, December 6)
34. Wong J, Evans S. [2017]. Bacterial pneumonia in cancer patients: novel risk factors and current management, [Internet]. Clinic in Chest Medicine, 38(2): 263-277, 2017 June. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5424613/ (Accessed Date: 2019, December 6)
35. Finlayson O, Kapral M, Hall R, Asilani E, Seichen D, Saposnik G. [2011]. Risk factors, in patient care and outcomes of pneumonia after ischemic stroke, [Internet]. Neurology, 77(14): 1338-1345, 2011 October. Available: https://n.neurology.org/content/77/14/1338.long (Accessed Date: 2019, December 6)
36. Chen LF, Chang CY, Hsu LC, Tsai PH, Chang SJ, Chang SC, Yuan MK, Lai YC, Liu YC, Wang WS. [2013]. Bacterial pneumonia following ischemic stroke, [Internet]. Journal of the Chinese Medical Association, 76(2): 78-82, 2013 February. Available: https://www.sciencedirect.com/science/article/pii/S1726490112002821?via%3Dihub (Accessed Date: 2019, December 6)
37. Saebo. [2018]. What is the relationship between stroke and pneumonia?, [Internet]. Saebo, 2018 November. Available: https://www.saebo.com/what-is-the-relationship-between-stroke-and-pneumonia/ (Accessed Date: 2019, December 6)
38. Hsu J, Siroka A, Smith M, Holodniy M, Meduri G. [2011]. One year outcomes of community-acquired and healthcare-associated pneumonia in the Veterans affairs healthcare system, [Internet]. International Journal of Infectious Diseases, 15(6): e382-e387, 2011 June. Available: https://www.ijidonline.com/article/S1201-9712(11)00038-5/fulltext (Accessed Date: 2019, December 6)
39. Luna CM, Palma I, Niederman MS, Membriani E, Giovini V, Wiemken TL, Peyrani P, Ramirez J. [2016]. The impact of age and comorbidities on the mortality of patients of different age groups admitted with Community-acquired pneumonia, [Internet]. Annals of the American Thoracic Society, 13(9):1519-1526, 2016 September. Available: https://www.atsjournals.org/doi/full/10.1513/AnnalsATS.201512-848OC?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed (Accessed Date: 2019, December 6)
40. Lupisan S, Suzuki A, Macalalad N, Egos R, Sombrero L, Okamoto M, Dapat C, Mondoy M, Galang H, Zeta VFF, de la Pena F, Romano V, Olveda R, Oshitani H. [2019]. Etiology and epidemiology of Community- acquired pneumonia in adults requiring hospital admission: A prospective study in rural Central Philippines, [Internet]. International Journal of Infectious Diseases, 80:46-53, 2019 March. Available: https://www.sciencedirect.com/science/article/pii/S1201971218349567 (Accessed Date: 2019, December 6)
41. Wagener J. [2011]. Pneumonia, [Internet]. ScienceDirect, 2011. Available: https://www.sciencedirect.com/topics/neuroscience/pneumonia (Accessed Date: 2019, December 6)
42. Speiser J, Karvellas C, Shumilak G, Sligl W, Mirzanejad Y, Gurka D, Kumar A, Kumar A, Cooperative Antimicrobial Therapy of Septic Shock (CATSS), Database Research Group. [2018]. Predicting in-hospital mortality in pneumonia-associated septic shock patients using a classification and regression tree: a nested cohort study, [Internet]. Journal of Intensive Care, 6(1): 66, 2018 October. Available: https://jintensivecare.biomedcentral.com/articles/10.1186/s40560-018-0335-3 (Accessed Date: 2019, December 6)
43. Lin GM, Chang FY, Chou CH, Lin YP, Ku CH. [2011]. Characteristics and outcome of patients with dual pulmonary tuberculosis and non-mycobacterial respiratory infections, [Internet]. Journal of Clinical Medicine Research, 3(6): 309-318, 2011 Deceber. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3279476/ (Accessed Date: 2019, December 6)
44. Budnevsky AV, Esaulenko IE, Ovsyannikov ES, Labzhaniya NB, Voronina EV, Chernov AV. [2016]. Anemic Syndrome in Patients with Community-Acquired Pneumonia (Abstract), [Internet]. Klin Med (Mosk), 94(1): 56-60, 2016. Available: https://www.ncbi.nlm.nih.gov/pubmed/27172725 (Accessed Date: 2019, December 27)
45. Shallan I, Azeem HA, Al-Sayed M. [2015]. Iron Deficiency Anemia as a Risk and Prognostic Factor of Community Acquired Pneumonia, [Internet]. Medical Journal of Cairo University, 83(2): 179-186, 2015 December. Available: https://pdfs.semanticscholar.org/47d6/e2034cbb639b568a45ab95fefd0f0d9b20d3.pdf (Accessed Date: 2019, December 27)
46. World Health Organization (WHO). [2011]. Haemoglobin concentrations for the diagnsosis of anaemia and assessment of severity, [Internet]. Geneva, World Health Organization (WHO), 2011. Available: https://www.who.int/vmnis/indicators/haemoglobin.pdf (Accessed Date: 2019, December 27)
47. Food and Nutrition Research Institute-Department of Science and Technology (FNRI-DOST). [2013]. 2nd National Nutrition Summit: 8th National Nutrition Survey, "Juan Mission for a Well-Nourished Nation", [Internet]. Food and Nutrition Research Institute-Department of Science and Technology (FNRI-DOST), 2013. Available: http://122.53.86.125/NNS/8thNNS.pdf (Accessed Date: 2019, December 27)
48. World Health Organization (WHO). [2019]. Blood Safety and Availability, [Internet], World Health Organization, 2019 June. Available: https://www.who.int/news-room/fact-sheets/detail/blood-safety-and-availability, (Accessed Date:

2019, December 27)
49. National Voluntary Blood Services Program (NVBSP). What Fees are Associated with Blood?, [Internet], Department of Health (DOH). Available: https://www.doh.gov.ph/node/1431, (Accessed Date: 2019, December 27)
50. Ravindranath M, Raju CH. [2016]. Validity of pneumonia severity index/pneumonia outcome research trial and CURB-65 severity scoring system in community acquired pneumonia in Indian setting, [Internet]. International Journal of Advances in Medicine, 3(2): 338-344, 2016 May. Available: http://dx.doi.org/10.18203/2349-3933.ijam20161087, (Accessed Date: 2019, December 27)
51. Garau J, Baquero F, Perez-Trallero E, Perez J-L, Martin-Sanchez AM, Garcia-Rey C, Martin-Herrero JE, Dal-Re R. [2008]. Factors impacting on length of stay and mortality of community-acquired pneumonia, [Internet]. Clinical Microbiology and Infection, 14(4): 322-329, 2008 April. Available: https://doi.org/10.1111/j.1469-0691.2007.01915.x, (Accessed Date: 2019, December 27)
52. Pandey D, Jaret P, Sharma R, Sharma A, Thakur S. [2007]. Subcutaneous emphysema secondary to pulmonary cavity in absence of pneumothorax or pneumomediastinum, [Internet]. Respiratory Medicine, 101(2): 363-365, 2007 February. Available: https://doi.org/10.1016/j.rmed.2006.04.024, (Accessed Date: 2019, December 27)
53. Purvey M, Allen G. [2017]. Managing acute pulmonary oedema, [Internet]. Australian Prescriber, 40(2): 59-63, 2017 April. Available: https://doi.org/10.18773/austprescr.2017.013, (Accessed Date: 2019, December 27)
54. Cilloniz C, Ewig S, Ferrer M, Polverino E, gbarrus A, de la Bellacasa JP, Mensa J, Torres A. [2011]. Community-acquired polymicrobiak pbeumonia in the intensive care unit aetiology and prognosis, [Internet]. Critical Care, 15(5): R209, 2011. Available: https://doi.org/10.1186/cc10444, (Accessed Date: 2019, December 29)
55. Cilloniz C, Civljak R, Nicolini A, Torres A. [2016]. Polymicrobial community-acquired pneumonia: An emerging entity, [Internet]. Respirology, 21(1): 65-75, 2016 January. Available: https://doi.org/10.1111/resp.12663, (Accessed Date: 2019, December 29)
56. Terraneo S, Polverino E, Cilloniz C, Amaro R, del Carmen Vennera M, Gabarrus A, Montull B, Moreno E, Menendez R, Centanni S, Torres A. [2014]. Severity and outcomes of community acquired pneumonia in asthmatic patients, [Internet]. Respiratory Medicine, 108(11): 1713-1722, 2014 November. Available: https://doi.org/10.1016/j.rmed.2014.09.001, (Accessed Date: 2019, December 29)

ABBREVIATIONS AND SYMBOLS

A. anitratus	Acinetobacter anitratus
AA/TA	Atheromatous aorta/Tortuous
AMP	Antimicrobial peptide
AMPC	class C cephalosporinases
ANSORP	Asian Network for Surveillance of Resistant Pathogen
ARMMC	Amang Rodriguez Memorial Medical Center
ATS	American Thoracic Society
C. freundii	Citrobacter freundii
CA-MRSA	Community-Acquired Methicillin-Resistant Staphylococcus aureus
CAP	Community-Acquired Pneumonia
CAP-HR	Community-Acquired Pneumonia High Risk
CAP-MR	Community-Acquired Pneumonia Moderate Risk
CONS	Coagulase-Negative Staphylococcus aureus
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cerebrovascular disease
DBP	Diastolic Blood Pressure
DM	Diabetes Mellitus
DOB	Difficulty of Breathing
DOH	Department of Health
E. aerogenes	Enterobacter aerogenes
E. agglomerans	Enterobacter agglomerans
E. cloacae	Enterobacter cloacae
E. coli	Escherichia coli
E. hafnia alvei	Enterobacter hafnia alvei
ESBL	Extended Spectrum Beta-Lactamases
FNRI-DOST	Food and Nutrition Research Institute-Department of Science and Technology
H. influenza	Haemophilus influenza
HA-MRSA	Hospital-Acquired Methicillin-Resistant Staphylococcus aureus
HAP	Hospital-Acquired Pneumonia
HCAP	Healthcare-Associated Pneumonia
HIV	Human Immunodeficiency Virus
HTN	Hypertension
IDSA	Infectious Disease Society of America
ICU	Intensive Care Unit
K. oxytoca	Klebsiella oxytoca
K. ozaenae	Klebsiella ozaenae
K. pneumoniae	Klebsiella pneumoniae
M. morganii	Morganella morganii
MDR	Multi-Drug Resistant
MG	Myasthenia gravis
MRSA	Methicillin Resistant Staphylococcus aureus
MSH	Bacillus pumilus
MSSA	Methicillin Sensitive Staphylococcus aureus
Non-MRSA	Non Methicillin Resistant Staphylococcus aureus
NOS3	Nitric Oxide Synthase 3
NVBSP	National Voluntary Blood Services Program
P. aeruginosa	Pseudomonas aeruginosa
P. mirabilis	Proteus mirabilis
P. stuartii	Providencia stuartii
P. vulgaris	Proteus vulgaris
PR	Pulse Rate
PTB	Pulmonary Tuberculosis
PVL	Panton Valentine Leukocidin
RR	Respiratory Rate
S. aureus	Staphylococcus aureus
S. dysgalactiae	Streptococcus dysgalactiae
S. pyogenes	Streptococcus pyogenes
SBP	Systolic Blood Pressure
SD	Standard Deviation
TSB	Tryptic Soy Broth
UGIB	Upper Gastrointestinal Bleeding
VAP	Ventilator Associated Pneumonia
WHO	World Health Organization

APPENDIX

Table VII: Association of the Different Factors with Mortality among subjects with MRSA Pneumonia (n=30)

Factors	Died (n=10)	Alive (n=20)	Total (n=30)	*p-value**
Age (in years)				
18 – 24	0	1 (5.0%)	1 (3.3%)	
25 – 44	0	2 (10.0%)	2 (6.7%)	
45 – 54	4 (40.0%)	8 (40.0%)	12 (40.0%)	0.69 †
55 – 64	1 (10.0%)	3 (15.0%)	4 (13.3%)	
65 – 74	3 (30.0%)	4 (20.0%)	7 (23.3%)	
75 – 84	2 (20.0%)	1 (5.0%)	3 (10.0%)	
≥85	0	1 (5.0%)	1 (3.3%)	
Sex				
Male	**9 (90.0%)**	**9 (45.0%)**	**18 (60.0%)**	0.02 ‡
Female	**1 (10.0%)**	**11 (55.0%)**	**12 (40.0%)**	
Location				
Metro Manila				
Marikina	2 (20.0%)	3 (15.0%)	5 (16.7%)	
Pasig	1 (10.0%)	1 (5.0%)	2 (6.7%)	
Taguig	0	1 (5.0%)	1 (3.3%)	
Others				
Cavite	0	1 (5.0%)	1 (3.3%)	
Rizal				0.72 †
Angono	1 (10.0%)	0	1 (3.3%)	
Antipolo City	4 (40.0%)	5 (25.0%)	9 (30.0%)	
Baras	0	1 (5.0%)	1 (3.3%)	
Rodriguez	1 (10.0%)	2 (10.0%)	3 (10.0%)	
San Mateo	0	3 (15.0%)	3 (10.0%)	
Tanay	1 (10.0%)	1 (5.0%)	2 (6.7%)	
Taytay	0	2 (10.0%)	2 (6.7%)	
Comorbidities				
HTN	6 (60.0%)	6 (30.0%)	12 (40.0%)	0.14 ‡
DM	**7 (70.0%)**	**6 (30.0%)**	**13 (43.3%)**	**0.05 ‡**
Dyslipidemia	3 (30.0%)	6 (30.0%)	9 (30.0%)	1.00 ‡
Heart Failure	0	3 (15.0%)	3 (10.0%)	0.53 ‡
CAD	2 (20.0%)	1 (5.0%)	3 (10.0%)	0.25 ‡
Thyroid Disease	1 (10.0%)	1 (5.0%)	2 (6.7%)	1.00 ‡
Anemia	6 (60.0%)	9 (45.0%)	15 (50.0%)	0.44 †
Kidney Disease	6 (60.0%)	5 (25.0%)	11 (36.7%)	0.11 ‡
ON_HD	2 (20.0%)	1 (5.0%)	3 (10.0%)	0.25 ‡
Liver Disease	2 (20.0%)	2 (10.0%)	4 (13.3%)	0.58 ‡
UGIB	1 (10.0%)	2 (10.0%)	3 (10.0%)	1.00 ‡
COPD	3 (30.0%)	1 (5.0%)	4 (13.3%)	0.10 ‡
Asthma	0	1 (5.0%)	1 (3.3%)	1.00 ‡
Current PTB	1 (10.0%)	0	1 (3.3%)	0.33 ‡
Previous PTB	0	1 (5.0%)	1 (3.3%)	1.00 ‡
Myasthenia Gravis (MG)	0	1 (5.0%)	1 (3.3%)	1.00 ‡
Current CVD	1 (10.0%)	1 (5.0%)	2 (6.7%)	1.00 ‡
Previous CVD	2 (20.0%)	0	2 (6.7%)	0.10 ‡
Cancer	1 (10.0%)	3 (15.0%)	4 (13.3%)	1.00 ‡
Diaphragmatic Hernia	0	1 (5.0%)	1 (3.3%)	1.00 ‡
Previous Admission (ARMMC) (within 3 mons)	1 (10.0%)	2 (10.0%)	3 (10.0%)	1.00 ‡
Previous Antibiotic Use (within 3 months)	1 (10.0%)	3 (15.0%)	4 (13.3%)	1.00 ‡
Trauma	0	2 (10.0%)	2 (6.7%)	0.54 ‡
Number of Comorbidities				
1	1 (10.0%)	6 (30.0%)	7 (23.3%)	
2	0	6 (30.0%)	6 (20.0%)	
3	1 (10.0%)	3 (15.0%)	4 (13.3%)	0.06 †
4	3 (30.0%)	2 (10.0%)	5 (16.7%)	
≥5	5 (50.0%)	3 (15.0%)	8 (26.7%)	
Smoker	(n=9)	(n=17)	(n=26)	
Yes	**5 (55.6%)**	**2 (11.8%)**	**7 (26.9%)**	**0.02 ‡**
No	**4 (44.4%)**	**15 (88.2%)**	**19 (73.1%)**	

Table VII (cont'd). Association of the Different Factors with Mortality among subjects with MRSA Pneumonia (n=30)

Factors	Died (n=10)	Alive (n=20)	Total (n=30)	*p-value**
Alcohol Intake	(n=9)	(n=17)	(n=26)	
Yes	4 (44.4%)	2 (11.8%)	6 (23.1%)	0.13 ǂ
No	5 (55.6%)	15 (88.2%)	20 (76.9%)	
Drug Use	(n=4)	(n=9)	(n=13)	1.00 †
No	4	9	13	
Initial presenting clinical manifestations				
Cough	6 (60.0%)	15 (75.0%)	21 (70.0%)	0.43 ǂ
DOB	6 (60.0%)	13 (65.0%)	19 (63.3%)	1.00 ǂ
Fever	1 (10.0%)	9 (45.0%)	10 (33.3%)	0.10 ǂ
Chills	0	2 (10.0%)	2 (6.7%)	0.54 ǂ
Chest Pain	3 (30.0%)	1 (5.0%)	4 (13.3%)	0.09 ǂ
Weakness	1 (10.0%)	4 (20.0%)	5 (16.7%)	0.64 ǂ
Easy Fatigability	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Loss of Appetite	2 (20.0%)	4 (20.0%)	6 (20.0%)	1.00 †
Altered Sensorium	1 (10.0%)	3 (15.0%)	4 (13.3%)	1.00 †
Cyanosis	0	1 (5.0%)	1 (3.3%)	1.00 †
Weight Loss	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Retraction	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Wheezing	3 (30.0%)	4 (20.0%)	7 (23.3%)	0.66 ǂ
Rales/Crackles	9 (90.0%)	15 (75.0%)	24 (80.0%)	0.63 ǂ
Decreased Breath Sound	0	3 (15.0%)	3 (10.0%)	0.53 ǂ
Vital Signs	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Respiratory Rate (RR): ≥30/min	0	1 (5.0%)	1 (3.3%)	1.00 †
Pulse Rate (PR): ≥125/min	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Temperature: ≤36°C	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Systolic Blood Pressure (SBP) <90mmHg	1 (10.0%)	4 (20.0%)	5 (16.7%)	0.64 ǂ
Diastolic Blood Pressure (DBP) ≤60 mmHg	1 (10.0%)	2 (10.0%)	3 (10.0%)	1.00 †
O_2 Saturation <94%				
Radiographic Results				
Bilateral Infiltrates	8 (80.0%)	10 (50.0%)	18 (60.0%)	0.24 ǂ
Unilateral Infiltrates	0	5 (25.0%)	5 (16.7%)	0.14 ǂ
Bilateral Consolidation	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Unilateral Consolidation	1 (10.0%)	1 (5.0%)	2 (6.7%)	1.00 †
Bilateral Minimal Pleural Effusion	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Unilateral Minima Pleural Effusion	2 (20.0%)	10 (50.0%)	12 (40.0%)	0.24 ǂ
Unilateral Moderate Pleural Effusion	0	1 (5.0%)	1 (3.3%)	1.00 †
Unilateral Thickening	0	2 (10.0%)	2 (6.7%)	0.54 †
Bilateral PTB	3 (30.0%)	1 (5.0%)	4 (13.3%)	0.10 †
Unilateral PTB	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Fibrosis	1 (10.0%)	1 (5.0%)	2 (6.7%)	1.00 †
Bronchiectatic Changes	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Atelectasis	0	2 (10.0%)	2 (6.7%)	0.54 †
Bullous Changes	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Hyperaeration	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Single Mass	2 (20.0%)	2 (10.0%)	4 (13.3%)	0.58 †
Multiple Mass	0	1 (5.0%)	1 (3.3%)	1.00 †
Subcutaneous Emphysema	0	1 (5.0%)	1 (3.3%)	1.00 †
Congestion	**6 (60.0%)**	**3 (15.0%)**	**9 (30.0%)**	**0.03** †
Cardiomegaly	0	3 (15.0%)	3 (10.0%)	0.53 †
Cervical Spondylosis	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Thoracic Spondylosis	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
Rib Fracture	0	1 (5.0%)	1 (3.3%)	1.00 †
Osteodegenerative Changes	1 (10.0%)	0	1 (3.3%)	0.33 ǂ
AA/TA	**5 (50.0%)**	**2 (10.0%)**	**7 (23.3%)**	**0.03** ǂ
Multiple Organism				
Yes	5 (50.0%)	8 (40.0%)	13	0.71 ǂ
No	5 (50.0%)	12 (60.0%)	17	

p>0.05- Not significant; p ≤0.05-Significant
Data presented as frequency (%)
† Chi-square test; ǂFisher Exact test
**HTN, Hypertension; DM, Diabetes Mellitus; CAD, Coronary Artery Disease; ON_HD, On Hemodialysis; UGIB, Upper Gastrointestinal Bleeding; COPD, Chronic Obstructive Pulmonary Disease; PTB, Pulmonary Tuberculosis; CVD, Cerebrovascular Disease; ARMMC, Amang Rodriguez Memorial Medical Center; DOB, Difficulty of breathing; AA/TA, Atheromatous aorta/Tortuous aorta*

Table X.Comparison of Hospital Stay (Morbidity) According to the Different Factors among subjects with MRSA Pneumonia who were alive (n=20)

Characteristics	Total (n=20)	Hospital Stay (in days) (Mean ± SD) (Median)	*p-value**
Age (in years)			
18 – 24	1	25.0 ± 0.0 (25.0)	
25 – 44	2	14.5 ± 6.4 (14.5)	
45 – 54	8	15.6 ± 12.9 (11.0)	
55 – 64	3	15.0 ± 1.7 (14.0)	0.56 §
65 – 74	4	21.8 ± 15.6 (18.5)	
75 – 84	1	21.0 ± 0.0 (21.0)	
≥85	1	24.0 ± 0.0 (24)	
Sex			
Male	9	19.4 ± 10.3 (19.0)	0.49 ‖
Female	11	15.9 ± 11.5 (14.0)	
Location			0.26 †
Metro Manila			
Marikina	3	14.0 ± 7.0 (17.0)	
Pasig	1	21.0 ± 0.0 (21.0)	
Taguig	1	44.0 ± 0.0 (44.0)	
Others			
Cavite	1	7.00 ± 0.00 (7.0)	
Rizal			
Angono	0	---	
Antipolo City	5	13.4 ± 4.7 (13.0)	
Baras	1	14.0 ± 0.0 (14.0)	
Rodriguez	2	15.0 ± 11.3 (15.0)	
San Mateo	3	13.0 ± 6.6 (14)	
Tanay	1	25.0 ± 0.0 (25.0)	
Taytay	2	33.5 ± 13.4 (33.5)	

Parameter	Hospital Stay (in days) (Mean ± SD) (Median)		p Value
	With the Parameter	Without the Parameter	
Comorbidities			
HTN	15.2 ± 6.0 (13.5)	18.9 ± 12.2 (18.0)	0.48 ‖
DM	19.8 ± 12.5 (17.5)	16.9 ± 10.2 (15.5)	0.59 ‖
Dyslipidemia	21.0 ± 12.4 (20.0)	16.4 ± 10.1 (14.0)	0.40 ‖
Heart Failure	15.7 ± 7.6 (14.0)	18.2 ± 11.3 (17.0)	0.72 ‖
CAD	14.0 ± 0.0 (14.0)	18.0 ± 11.0 (17.0)	0.73 ‖
Thyroid Disease	19.0 ± 0.0 (19.0)	17.7 ± 10.9 (14.0)	0.91 ‖
Anemia	19.0 ± 11.4 (14.0)	16.8 ± 10.6 (17.0)	0.66 ‖
Kidney Disease	12.8 ± 5.7 (14.0)	19.5 ± 11.6 (19.0)	0.24 ‖
On HD	9.0 ± 0.0 (9.0)	18.2 ± 10.8 (17.0)	0.41 ‖
Liver Disease	17.5 ± 5.0 (17.5)	17.8 ± 11.3 (15.5)	0.97 ‖
UGIB	14.0 ± 0.0 (14.0)	18.2 ± 11.2 (18.0)	0.61 ‖
COPD	7.0 ± 0.0 (7.0)	18.4 ± 10.7 (17.0)	0.31 ‖
Asthma	7.0 ± 0.0 (7.0)	18.4 ± 10.7 (17.0)	0.31 ‖
Current PTB	---	17.8 ± 10.7 (15.5)	---
Previous PTB	7.0 ± 0.0 (7.0)	18.4 ± 10.7 (17.0)	0.31 ‖
Myasthenia Gravis (MG)	19.0 ± 0.0 (19.0)	17.7 ± 10.9 (14.0)	0.91 ‖
Current CVD	24.0 ± 0.0 (24.0)	17.5 ± 10.9 (14.0)	0.26 ‖
Previous CVD	---	21.5 ± 23.3 (21.5)	---
Cancer	15.3 ± 8.1 (19.0)	18.2 ± 11.2 (14.0)	0.67 ‖
Diaphragmatic Hernia	44.0 ± 0.0 (44.0)	16.4 ± 9.0 (14.0)	0.09 ‖
Previous Admission (ARMMC) (w/in 3 mos)	12.5 ± 9.2 (12.5)	18.2 ± 11.2 (14.0)	0.50 ‖
Previous Antibiotic Use (within 3 months)	15.3 ± 8.1 (19.0)	18.2 ± 11.2 (14.0)	0.68 ‖
Trauma	19.5 ± 7.8 (19.5)	17.6 ± 11.1 (15.5)	0.44 ‖
Number of Comorbidities	(n=20)		
1	6	14.8 ± 5.9 (15.0)	
2	6	21.8 ± 18.3 (16.0)	
3	3	18.0 ± 3.6 (19.0)	0.84 §
4	2	19.0 ± 7.1 (19.0)	
≥5	3	14.7 ± 6.0 (14.0)	
Smoker	(n=17)		
Yes	2	14.0 ± 9.9 (14.0)	0.60 ‖
No	15	18.7 ± 11.6 (17.0)	

Table X (Cont'd). Comparison of Hospital Stay (Morbidity) According to the Different Factors among subjects with MRSA Pneumonia who were alive (n=20)

Parameters	Hospital Stay (in days) (Mean ± SD) (Median)		p Value
	With the Parameter	Without the Parameter	
Alcohol Intake	(n=17)		
Yes	2	14.0 ± 9.9 (14.0)	0.60 ‖
No	15	18.7 ± 11.6 (17.0)	
Drug Use	(n=9)		
No	9	20. ± 14.0 (17.0)	---
Initial presenting clinical manifestations			
Cough	17.5 ± 9.2 (14.0)	18.8 ± 15.6 (14.0)	0.81 ‖
DOB	19.1 ± 12.1 (17.0)	15.4 ± 7.6 (14.0)	0.48 ‖
Fever	15.0 ± 7.0 (14.0)	20.1 ± 12.9 (17.0)	0.30 ‖
Chills	19.0 ± 7.1 (19.0)	17.7 ± 11.2 (15.5)	0.87 ‖
Chest Pain	9.0 ± 0.0 (9.0)	18.3 ± 10.8 (17.0)	0.41 ‖
Weakness	15.5 ± 7.3 (16.5)	18.4 ± 11.5 (15.5)	0.64 ‖
Easy Fatigability	---	17.8 ± 10.7 (15.5)	---
Loss of Appetite	22.3 ± 1.5 (22.0)	16.7 ± 11.7 (14.0)	0.06 ‖
Altered Sensorium	17.3 ± 9.1 (21.0)	17.9 ± 11.2 (14.0)	0.94 ‖
Cyanosis	7.0 ± 9.1 (7.0)	18.4 ± 10.7 (17.0)	0.31 ‖
Weight Loss	---	17.8 ± 10.7 (15.5)	---
Retraction	---	17.8 ± 10.7 (15.5)	---
Wheezing	13.3 ± 8.5 (10.5)	18.9 ± 11.1 (18.0)	0.36 ‖
Rales/Crackles	17.3 ± 9.7 (17.0)	19.4 ± 14.5 (14.0)	0.71 ‖
Decreased Breath Sound	13.7 ± 7.5 (14.0)	18.5 ± 11.2 (17.0)	0.48 ‖
Vital Signs	---		
Respiratory Rate (RR): ≥30/min		17.8 ± 10.7 (15.5)	---
Pulse Rate (PR): ≥125/min	25.0 ± 0.0 (25.0)	17.4 ± 10.9 (14.0)	0.20 ‖
Temperature: ≤ 36 °C	---	17.8 ± 10.7 (15.5)	---
SBP <90 mmHg	---	17.8 ± 10.7 (15.5)	---
DBP ≤ 60 mmHg	20.5 ± 5.1 (21.5)	17.1 ± 11.7 (14.0)	0.59 ‖
O_2 Satn < 94%	17.5 ± 5.0 (17.5)	17.8 ± 11.3 (15.5)	0.96 ‖
Radiographic Results			
Bilateral Infiltrates	16.7 ± 5.0 (18.0)	18.9 ± 14.6 (14.0)	0.76 ‖
Unilateral Infiltrates	22.4 ± 14.3 (23.0)	16.3 ± 9.4 (14.0)	0.28 ‖
Bilateral Consolidation	---	17.8 ± 10.7 (15.5)	---
Unilateral Consolidation	19.0 ± 0.0 (19.0)	17.7 ± 10.9 (14.0)	0.73 ‖
Bilateral Minimal Pleural Effusion	---	17.8 ± 10.7 (15.5)	---
Unilateral Minimal Pleural Effusion	19.8 ± 13.7 (16.5)	15.8 ± 6.7 (15.5)	0.88 ‖
Unilateral Moderate Pleural Effusion	44.0 ± 0.0 (44.0)	16.4 ± 9.0 (14.0)	0.09 ‖
Unilateral Thickening	6.5 ± 0.7 (6.5)	19.1 ± 10.6 (18.0)	0.12 ‖
Bilateral PTB	24.0 ± 0.0 (24.0)	17.5 ± 10.9 (14.0)	0.26 ‖
Unilateral PTB	---	17.8 ± 10.7 (15.5)	---
Fibrosis	7.0 ± 0.0 (7.0)	18.4 ± 10.7 (17.0)	0.22 ‖
Bronchiectatic Changes	---	17.8 ± 10.7 (15.5)	---
Atelectasis	25.0 ± 25.5 (25.0)	17.0 ± 9.1 (15.5)	0.33 ‖
Bullous Changes	---	17.8 ± 10.7 (15.5)	---
Hyperaeration	---	17.8 ± 10.7 (15.5)	---
Single Mass	21.0 ± 0.0 (21.0)	17.4 ± 11.3 (14.0)	0.31 ‖
Multiple Mass	14.0 ± 0.0 (14.0)	18.0 ± 10.9 (17.0)	0.79 ‖
Subcutaneous Emphysema	25.0 ± 0.0 (25.0)	17.4 ± 10.9 (14.0)	0.19 ‖
Congestion	22.0 ± 18.4 (14.0)	17.1 ± 9.5 (17.0)	0.48 ‖
Cardiomegaly	23.0 ± 17.8 (17.0)	16.9 ± 9.5 (14.0)	0.38 ‖
Cervical Spondylosis	---	17.8 ± 10.7 (15.5)	---
Thoracic Spondylosis	---	17.8 ± 10.7 (15.5)	---
Rib Fracture	14.0 ± 0.0 (14.0)	18.0 ± 10.9 (17.0)	0.79 ‖
Osteodegenerative Changes	---	17.8 ± 10.7 (15.5)	---
AA/TA	15.0 ± 12.0 (15.5)	18.1 ± 10.9 (15.5)	0.76 ‖
Multiple Organism	(n=20)		
Yes	8	17.7 ± 6.9 (20.0)	0.98 ‖
No	12	17.8 ± 12.9 (14.0)	

** p>0.05- Not significant; p ≤0.05-Significant*

*Data presented as Mean ± SD, (medians) were computed as needed; or as frequency (%) § ANOVA/Kruskall Wallis test; ‖T-test/Mann Whitney U test **HTN, Hypertension; DM, Diabetes Mellitus; CAD, Coronary Artery Disease; ON_HD, On Hemodialysis; UGIB, Upper Gastrointestinal Bleeding; COPD, Chronic Obstructive Pulmonary Disease; PTB, Pulmonary Tuberculosis; CVD, Cerebrovascular Disease; ARMMC, Amang Rodriguez Memorial Medical Center; DOB, Difficulty of breathing; AA/TA, Atheromatous aorta/Tortuous aorta*

Table XI: Association of the Different Factors with Mortality among subjects with Non-MRSA pneumonia (n=366)

Demographic Characteristics	Died (n=120)	Alive (n=240)	Total (n=360)	*p-value**
Age (in years)				
18 – 24	2 (1.7%)	12 (4.9%)	14	0.13 †
25 – 44	19 (15.8%)	51 (20.7%)	70	
45 – 54	15 (12.5%)	46 (18.7%)	61	
55 – 64	30 (25.0%)	61 (24.8%)	91	
65 – 74	29 (24.2%)	44 (17.9%)	73	
75 – 84	20 (16.7%)	26 (10.6%)	46	
≥85	5 (4.2%)	6 (2.4%)	11	
Sex				
Male	71 (59.2%)	143 (58.1%)	214	0.85 †
Female	49 (40.8)	103 (41.9%)	152	
Location				
Metro Manila				
Caloocan	0	2 (0.8%)	2	
Marikina	42 (35.0%)	79 (32.1%)	121	
Pasig	8 (6.7%)	14 (5.7%)	22	
Quezon City	2 (1.7%)	5 (2.0%)	7	
Taguig	0	3 (1.2%)	3	
Others				
Batangas	0	1 (0.4%)	1	
Camarines Sur	0	1 (0.4%)	1	
Cavite	0	1 (0.4%)	1	
Laguna	1 (0.8%)	0	1	
Pangasinan	1 (0.8%)	1 (0.4%)	1	
Rizal				0.70 †
Angono	1 (0.8%)	1 (0.4%)	2	
Antipolo City	22 (18.3%)	56 (22.8%)	78	
Baras	1 (0.8%)	3 (1.2%)	4	
Binangonan	2 (1.7%)	3 (1.2%)	5	
Cainta	2 (1.7%)	8 (3.3%)	10	
Cardona	0	1 (0.4%)	1	
Morong	1 (0.8%)	0	1	
Rodriguez	14 (11.7%)	18 (7.3%)	32	
San Mateo	15 (12.5%)	37 (15.0%)	52	
Tanay	1 (0.8%)	2 (0.8%)	3	
Taytay	6 (5.0%)	11 (4.5%)	17	
Teresa	1 (0.8%)	0	1	
Comorbidities				
HTN	63 (52.5%)	120 (48.8%)	183	0.50 †
DM	48 (40.0%)	92 (37.4%)	140	0.63 †
Dyslipidemia	17 (14.2%)	46 (18.7%)	63	0.28 ‡
Heart Failure	22 (18.3%)	43 (17.5%)	65	0.84 ‡
CAD	33 (27.5%)	48 (19.5%)	81	0.08 ‡
Thyroid Disease	4 (3.3%)	8 (3.3%)	12	1.00 ‡
Anemia	70 (58.3%)	128 (52.0%)	198	0.26 †
Erythrocytosis	**6 (5.0%)**	**0**	**6**	**0.001 ‡**
Kidney Disease	**81 (67.5%)**	**101 (41.1%)**	**182**	**<0.0001 †**
On HD	5 (4.2%)	11 (4.5%)	16	0.89 †
Liver Disease	**16 (13.3%)**	**15 (6.1%)**	**31**	**0.01 †**
UGIB	2 (1.7%)	12 (4.9%)	14	0.16 ‡
Hyperuricemia	9 (7.5%)	11 (4.5%)	20	0.23 †
COPD	17 (14.2%)	29 (11.8%)	46	0.52 †
Asthma	7 (5.8%)	21 (8.5%)	28	0.36 †
Current PTB	33 (27.5%)	64 (26.0%)	97	0.76 †
Previous PTB	12 (10.1%)	28 (11.4%)	40	0.71 †
Pulmonary Abscess	1 (0.8%)	2 (0.8%)	3	1.00 ‡
Psychiatric disorder	1 (0.8%)	3 (1.2%)	4	1.00 ‡
Myasthenia Gravis (MG)	0	1 (1.4%)	1	1.00 ‡
Spinal cord compression	2 (1.7%)	0	2	0.10 ‡
Seizure	2 (1.7%)	3 (1.2%)	5	0.66 ‡
Current CVD	19 (15.8%)	26 (10.6%)	45	0.15 †
Previous CVD	**16 (13.3%)**	**16 (6.5%)**	**32**	**0.03 †**
Other Infection (1st)	6 (5.0%)	9 (3.7%)	15	0.58 ‡
Other Infection (2nd)	1 (0.8%)	1 (0.4%)	2	0.55 ‡
Multiple Infection	1 (0.8%)	1 (0.4%)	2	0.55 ‡

Table XI (Cont'd). Association of the Different Factors with Mortality among subjects with Non-MRSA pneumonia (n=366)

Demographic Characteristics	Died (n=120)	Alive (n=240)	Total (n=360)	*p-value**
Comorbidities				
HIV	2 (1.7%)	2 (0.8%)	4	0.60 ǂ
Cancer	**17 (14.2%)**	**17 (6.9%)**	**34**	**0.02** †
Blood Dyscrasia	1 (0.8%)	1 (0.4%)	2	0.55 ǂ
Umbilical Hernia	1 (0.8%)	0	1	0.33 ǂ
CHRONS	0	1 (0.4%)	1	1.00 ǂ
Previous Admission (ARMMC) (within 3 months)	**11 (9.2%)**	**8 (3.3%)**	**19**	**0.01** †
Previous Admission (Other Hospital) (within 3 months)	2 (1.7%)	1 (0.4%)	3	0.26 ǂ
Previous Antibiotic Use (within 3 months)	9 (7.5%)	13 (5.3%)	22	0.40 †
Trauma	3 (2.5%)	11 (4.5%)	14	0.56 ǂ
Number of Comorbidities				
0	**0**	**8 (3.3%)**	**8**	**0.01** †
1	**9 (7.5%)**	**32 (13.0%)**	**41**	
2	**16 (13.3%)**	**54 (22.0%)**	**70**	
3	**18 (15.0%)**	**38 (15.4%)**	**56**	
4	**33 (27.5%)**	**45 (18.3%)**	**78**	
≥5	**44 (36.7%)**	**69 (28.0%)**	**113**	
Smoker	(n=106)	(n=221)	(n=327)	
Yes	25 (23.6%)	56 (25.3%)	81	0.73 †
No	81 (76.4%)	165 (74.7%)	246	
Alcohol Intake	(n=107)	(n=221)	(n=328)	
Yes	22 (21.5%)	57 (25.8%)	80	0.40 †
No	84 (78.5%)	164 (74.7%)	248	
Drug Use	(n=70)	(n=125)	(n=195)	
Yes	1 (1.4%)	1 (0.8%)	2	1.00 ǂ
No	69 (98.6%)	124 (99.2%)	193	
Initial presenting clinical manifestations				
Cough	72 (60.0%)	166 (67.5%)	238	0.16 †
DOB	74 (61.7%)	154 (62.6%)	228	0.86 †
Fever	46 (38.3%)	83 (33.7%)	129	0.39 †
Chills	3 (2.5%)	6 (2.4%)	9	1.00 ǂ
Chest Pain	9 (7.5%)	29 (11.8%)	38	0.21 †
Palpitations	1 (0.8%)	0	1	0.33 ǂ
Weakness	14 (11.7%)	33 (13.4%)	47	0.64 †
Easy Fatigability	12 (10.0%)	26 (10.6%)	38	0.87 †
Myalgia	2 (1.7%)	0	2	0.10 ǂ
Hemoptysis	6 (5.0%)	14 (5.7%)	20	0.78 †
Loss of Appetite	20 (16.7%)	33 (13.4%)	53	0.41 †
Altered Sensorium	**30 (25.0%)**	**26 (10.6%)**	**56**	**0.0003** †
Pallor	1 (0.8%)	4 (1.6%)	5	1.00 ǂ
Cyanosis	2 (1.7%)	1 (0.4%)	3	0.25 ǂ
Diaphoresis	2 (1.7%)	2 (0.8%)	4	0.60 ǂ
Nausea	1 (0.8%)	1 (0.4%)	2	0.55 ǂ
Vomiting	4 (3.3%)	10 (4.1%)	13	1.00 ǂ
Abdominal Pain	6 (5.0%)	12 (4.9%)	18	0.96 ǂ
Headache	3 (2.5%)	3 (1.2%)	6	0.40 ǂ
Dizziness	3 (2.5%)	8 (3.3%)	11	1.00 ǂ
Weight Loss	5 (4.2%)	17 (6.9%)	22	0.30 †
Retraction	**23 (19.2%)**	**21 (8.5%)**	**44**	**0.003** †
Wheezing	16 (13.3%)	50 (20.3%)	66	0.10 †
Rales/Crackles	98 (81.7%)	189 (76.8%)	287	0.29 †
Decreased Breath Sound	12 (10.0%)	33 (13.5%)	45	0.34 †
Cold/Clammy	2 (1.7%)	2 (0.8%)	4	0.60 ǂ
Vital Signs				
Respiratory Rate (RR): ≥30/min	3 (2.5%)	5 (2.0%)	8	0.72 ǂ
Pulse Rate (PR): ≥125/min	6 (5.0%)	6 (2.4%)	12	0.22 ǂ
Temperature: ≤ 36°C	6 (5.0%)	9 (3.7%)	15	0.58 ǂ
Temperature: ≥ 40°C	1 (0.8%)	1 (0.4%)	2	0.55 ǂ
SBP < 90 mmHg	12 (10.0%)	12 (4.9%)	24	0.06 †
DBP ≤ 60 mmHg	**36 (30.0%)**	**50 (20.3%)**	**86**	**0.04** †
O_2 Sat <94%	12 (10.0%)	16 (6.5%)	28	0.24 †

Table XI (Cont'd). Association of the Different Factors with Mortality among subjects with Non-MRSA pneumonia (n=366)

Demographic Characteristics	Died (n=120)	Alive (n=240)	Total (n=360)	*p-value**
Radiographic Results				
Bilateral Infiltrates	80 (66.7%)	156 (63.4%)	236	0.54 †
Unilateral Infiltrates	15 (12.5%)	50 (20.3%)	65	0.07 †
Lung Abscess	5 (4.2%)	4 (1.6%)	9	0.16 ‡
Bilateral Consolidation	4 (3.3%)	3 (1.2%)	7	0.22 ‡
Unilateral Consolidation	11 (9.2%)	23 (9.3%)	34	0.95 ‡
Bilateral Minima PE	37 (30.8%)	59 (24.0%)	96	0.16 ‡
Unilateral Minima PE	32 (26.7%)	61 (24.8%)	93	0.70 †
Unilateral Mod PE	6 (5.0%)	6 (2.4%)	12	0.22 ‡
Unilateral Massive PE	2 (1.7%)	5 (2.0%)	7	1.00 ‡
Bilateral Massive PE	0	1 (0.4%)	1	1.00 ‡
Unilateral Thickening	5 (4.2%)	13 (5.3%)	18	0.64 †
Bilateral Pleural Thickening	5 (4.2%)	14 (5.7%)	19	0.54 †
Unilateral Pleurodiaphragmatic Adhesion	5 (4.2%)	18 (7.3%)	23	0.34 †
Bilateral Pleurodiaphragmatic Adhesion	0	1 (0.4%)	1	1.00 ‡
Unilateral Pleural Plaque	1 (0.8%)	2 (0.8%)	3	1.00 ‡
Extensive PTB	7 (5.8%)	6 (2.4%)	13	0.13 ‡
Miliary TB	0	1 (0.4%)	1	1.00 ‡
Bilateral PTB	20 (16.7%)	59 (24.0%)	79	0.11 †
Unilateral PTB	7 (5.8%)	29 (11.8%)	36	0.07 †
Fibrotic Residual PTB	9 (7.5%)	11 (4.5%)	20	0.23 †
Fibrosis	2 (1.7%)	6 (2.4%)	8	1.00 ‡
Cavitary Changes	4 (3.3%)	4 (1.6%)	8	0.45 ‡
Bronchiectatic Changes	5 (4.2%)	18 (7.3%)	23	0.24 †
Emphysematous Changes	0	1 (0.4%)	1	1.00 ‡
Atelectasis	21 (17.5%)	41 (16.7%)	62	0.84 †
Bullous Changes	8 (6.7%)	22 (8.9%)	30	0.46 †
Hyperaeration	17 (14.2%)	31 (12.6%)	48	0.68 †
Single Mass	7 (5.8%)	17 (6.9%)	24	0.70 †
Multiple Mass	6 (5.0%)	6 (2.4%)	12	0.22 ‡
Unilateral Pneumothorax	1 (0.8%)	8 (3.3%)	9	0.28 ‡
Bilateral Pneumothorax	0	1 (0.4%)	1	1.00 ‡
Unilateral Tension Pneumothorax	0	2 (0.8%)	2	1.00 ‡
Unilateral Pneumohydrothorax	0	4 (1.6%)	4	0.31 ‡
Unilateral Hemothorax	0	4 (1.6%)	4	0.31 ‡
Bilateral Hemothorax	0	1 (0.4%)	1	1.00 ‡
Subcutaneous Emphysema	2 (1.7%)	5 (2.0%)	7	1.00 ‡
Pneumoperitoneum	1 (0.8%)	0	1	0.33 ‡
Congestion	**47 (39.2%)**	**59 (24.0%)**	**106**	**0.003 †**
Cardiomegaly	26 (21.7%)	51 (20.7%)	77	0.84 †
Left Ventricular Prominence	9 (7.5%)	10 (4.1%)	19	0.16 †
Chronic ILD	0	1 (0.4%)	1	1.00 ‡
Cervical Spondylosis	1 (0.8%)	0	1	0.33 ‡
Thoracic Spondylosis	9 (7.5%)	9 (3.7%)	18	0.11 †
Thoracic Dextroscoiliosis	0	1 (0.4%)	1	1.00 ‡
Rib Fracture	2 (1.7%)	8 (3.3%)	10	0.51 ‡
Tracheal Deviation	0	1 (0.4%)	1	1.00 ‡
Pulmonary Contusion	0	3 (1.2%)	3	0.55 ‡
Osteodegenerative Changes	11 (9.2%)	19 (7.7%)	30	0.64 †
AA/TA	43 (35.8%)	65 (26.4%)	108	0.06 †
Multiple Organism				
Yes	34 (28.3%)	58 (23.6%)	92	0.32 †
No	86 (71.7%)	188 (76.4%)	274	

p>0.05- Not significant; p ≤0.05-Significant
Data presented as frequency (%)
† Chi-square test; ‡Fisher Exact test
**HTN, Hypertension; DM, Diabetes Mellitus; CAD, Coronary Artery Disease; ON_HD, On Hemodialysis; UGIB, Upper Gastrointestinal Bleeding; COPD, Chronic Obstructive Pulmonary Disease; PTB, Pulmonary Tuberculosis; CVD, Cerebrovascular Disease; HIV, Human Immunodeficiency Virus; ARMMC, Amang Rodriguez Memorial Medical Center; DOB, Difficulty of breathing; ILD, Interstitial Lung Disease; AA/TA, Atheromatous aorta/Tortuous aorta*

Table XIV. Comparison of Hospital Stay (Morbidity) According to the Different Factors among subjects with Non-MRSA Pneumonia who were Alive (n=246)

Demographic Characteristics	Total (n=246)	Hospital Stay (in days) (Mean ± SD) (Median)	*p-value**
Age (in years)			0.09 §
18 – 24	12	26.3 ± 15.5 (25.0)	
25 – 44	51	18.6 ± 12.9 (16.0)	
45 – 54	46	15.9 ± 14.8 (9.0)	
55 – 64	61	22.0 ± 23.1 (18.0)	
65 – 74	44	18.9 ± 13.7 (13.5)	
75 – 84	26	14.2 ± 12.3 (9.5)	
≥85	6	14.5 ± 7.3 (11.5)	
Sex			
Male	143	19.4 ± 14.9 (13.0)	0.36 ‖
Female	103	18.3 ± 15.6 (13.0)	
Location			0.46 †
Metro Manila			
Caloocan	2	20.5 ± 10.6 (20.5)	
Marikina	79	18.6 ± 20.6 (12.0)	
Pasig	14	16.3 ± 14.9 (10.5)	
Quezon City	5	13.2 ± 6.1 (14.0)	
Taguig	3	13.3 ± 3.5 (13.0)	
Others			
Batangas	1	14.0 ± 0.0 (14.0)	
Camarines Sur	1	7.00 ± 0.0 (7.0)	
Cavite	1	7.00 ± 0.0 (7.0)	
Laguna	0	---	
Pangasinan	1	5.00 ± 0.0 (5.0)	
Rizal			
Angono	1	3.0 ± 0.0 (3.0)	
Antipolo City	56	19.1 ± 15.2 (12.0)	
Baras	3	25.0 ± 11.5 (24.0)	
Binangonan	3	33.0 ± 13.1 (39.0)	
Cainta	8	20.4 ± 23.1 (14.0)	
Cardona	1	14.0 ± 0.0 (14.0)	
Morong	0	---	
Rodriguez	18	18.4 ± 14.1 (16.0)	
San Mateo	37	21.4 ± 14.5 (18.0)	
Tanay	2	24.5 ± 0.8 (24.5)	
Taytay	11	14.5 ± 9.4 (10.0)	
Teresa	0	---	
Number of Comorbidities			
0	8	12.8 ± 7.5 (10.5)	
1	32	14.6 ± 13.0 (10.0)	0.009 §
2	54	23.1 ± 15.0 (21.5)	
3	38	14.4 ± 9.8 (11.0)	
4	45	16.9 ± 12.5 (13.0)	
≥5	69	21.7 ± 23.0 (15.0)	
Smoker			0.25 ‖
Yes	56	19.1 ± 13.8 (14.0)	
No	165	17.9 ± 17.6 (12.0)	
Alcohol Intake	(n=221)		0.70 ‖
Yes	57	16.9 ± 12.7 (12.0)	
No	164	18.7 ± 17.8 (12.0)	
Drug Use	(n=125)		0.19 ‖
Yes	1	42.0 ± 0.0 (47.0)	
No	124	20.6 ± 19.9 (13.0)	
Multiple Organism			
Yes	58	25.2 ± 23.8 (20.5)	
No	188	16.8 ± 13.1 (12.0)	

Table XIV (Cont'd). Comparison of Hospital Stay (Morbidity) According to the Different Factors among subjects with Non-MRSA Pneumonia who were Alive (n=246)

Parameter	Hospital Stay (in days) (Mean ± SD) (Median)		p Value
	With Parameter	Without Parameter	
Comorbidities			
HTN	19.5 ± 19.1 (14.0)	18.1 ± 13.9 (13.0)	0.82 ‖
DM	17.5 ± 14.2 (12.0)	19.6 ± 17.9 (14.5)	0.35 ‖
Dyslipidemia	14.9 ± 8.4 (12.0)	19.7 ± 17.9 (14.0)	0.37 ‖
Heart Failure	17.5 ± 11.6 (12.0)	19.1 ± 17.5 (14.0)	0.89 ‖
CAD	19.7 ± 24.9 (12.0)	18.6 ± 13.9 (14.0)	0.48 ‖
Thyroid Disease	13.0 ± 7.2 (14.5)	19.0 ± 16.8 (13.0)	0.34 ‖
Anemia	**22.4 ± 19.7 (16.0)**	**14.9 ± 11.2 (11.0)**	**<0.001** ‖
Erythrocytosis	---	---	---
Kidney Disease	18.6 ± 14.1 (14.0)	18.9 ± 18.1 (13.0)	0.69 ‖
On HD	24.4 ± 20.2 (21.0)	18.6 ± 16.4 (13.0)	0.33 ‖
Liver Disease	18.3 ± 13.6 (13.0)	18.6 ± 16.8 (13.0)	0.92 ‖
UGIB	24.6 ± 16.2 (20.5)	18.5 ± 16.6 (13.0)	0.22 ‖
Hyperuricemia	26.6 ± 20.1 (19.0)	18.5 ± 16.4 (13.0)	0.11 ‖
COPD	22.2 ± 29.6 (12.0)	18.4 ± 14.0 (14.0)	0.80 ‖
Asthma	**11.7 ± 7.0 (9.0)**	**19.5 ± 17.0 (14.0)**	**0.01** ‖
Current PTB	19.1 ± 14.4 (14.5)	18.7 ± 17.4 (13.0)	0.80 ‖
Previous PTB	21.9 ± 29.6 (15.0)	18.4 ± 14.2 (13.0)	0.75 ‖
Pulmonary Abscess	22.5 ± 14.8 (22.5)	18.8 ± 16.6 (13.0)	0.75 ‖
Psychiatric disorder	27.0 ± 12.1 (20.0)	18.7 ± 16.6 (13.0)	0.39 ‖
Myasthenia Gravis (MG)	26.0 ± 0.0 (26.0)	18.8 ± 16.6 (13.0)	0.36 ‖
Seizure	15.7 ± 7.0 (15.0)	18.9 ± 16.6 (13.0)	0.74 ‖
Current CVD	26.4 ± 31.8 (20.0)	17.9 ± 13.6 (13.0)	0.19 ‖
Previous CVD	15.6 ± 9.9 (14.5)	19.0 ± 17.0 (13.0)	0.65 ‖
Other Infection (1st)	18.1 ± 9.7 (15.0)	18.8 ± 16.8 (13.0)	0.90 ‖
Cancer	26.1 ± 17.4 (23.0)	18.3 ± 16.4 (13.0)	0.07 ‖
Diaphragmatic Hernia	---	18.8 ± 16.6 (13.0)	---
Previous Admission (ARMMC) (within 3 months)	15.0 ± 8.5 (13.0)	18.9 ± 16.9 (13.0)	0.89 ‖
Previous Antibiotic Use (within 3 months)	24.0 ± 0.0 (24.0)	18.8 ± 16.7 (13.0)	0.41 ‖
Trauma	**32.0 ± 15.7 (29.0)**	**18.2 ± 16.4 (13.0)**	**0.006** ‖
Initial presenting clinical manifestations			
Cough	16.9 ± 11.8 (13.0)	22.8 ± 23.2 (15.0)	0.26 ‖
DOB	17.2 ± 12.0 (12.0)	21.6 ± 22.0 (15.0)	0.40 ‖
Fever	17.6 ± 13.9 (14.0)	19.4 ± 17.8 (13.0)	0.41 ‖
Chills	12.7 ± 7.3 (12.0)	18.9 ± 16.7 (13.0)	0.34 ‖
Chest Pain	**12.7 ± 9.9 (9.0)**	**19.6 ± 17.1 (14.0)**	**0.007** ‖
Weakness	15.3 ± 8.6 (12.0)	19.4 ± 17.5 (14.0)	0.44 ‖
Easy Fatigability	14.3 ± 9.7 (10.5)	19.3 ± 17.2 (14.0)	0.14 ‖
Loss of Appetite	17.5 ± 12.0 (15.0)	19.0 ± 17.2 (13.0)	0.84 ‖
Altered Sensorium	26.2 ± 32.2 (17.5)	18.0 ± 13.5 (13.0)	0.32 ‖
Cyanosis	7.0 ± 0.0 (7.0)	18.8 ± 16.6 (13.0)	0.26 ‖
Diaphoresis	6.5 ± 0.7 (6.5)	18.9 ± 16.6 (13.5)	0.07 ‖
Nausea	5.0 ± 0.0 (5.0)	18.9 ± 16.6 (13.0)	0.12 ‖
Vomiting	16.1 ± 10.4 (13.5)	18.9 ± 16.8 (13.0)	0.60 ‖
Abdominal Pain	17.8 ± 17.6 (8.5)	18.9 ± 16.6 (13.0)	0.83 ‖
Headache	7.0 ± 1.0 (7.0)	18.9 ± 16.6 (14.0)	0.07 ‖
Dizziness	11.0 ± 7.5 (8.5)	19.1 ± 16.7 (14.0)	0.08 ‖
Weight Loss	17.6 ± 12.6 (13.0)	18.9 ± 16.6 (13.0)	0.76 ‖
Retraction	18.9 ± 17.1 (13.0)	17.9 ± 9.3 (18.0)	0.50 ‖
Wheezing	18.8 ± 14.3 (13.5)	18.9 ± 23.7 (12.0)	0.48 ‖
Rales/Crackles	18.5 ± 17.0 (13.0)	20.0 ± 15.1 (16.0)	0.53 ‖
Decreased Breath Sound	19.9 ± 17.4 (12.0)	18.7 ± 16.5 (14.0)	0.61 ‖
Vital Signs			
Respiratory Rate (RR): ≥30/min	18.4 ± 13.1 (17.0)	18.8 ± 16.7 (13.0)	0.95 ‖
Pulse Rate (PR): ≥125/min	20.3 ± 13.5 (18.5)	18.8 ± 16.7 (13.0)	0.82 ‖
Temperature: ≤36 °C	13.3 ± 8.6 (12.0)	19.0 ± 16.8 (14.0)	0.35 ‖
SBP < 90 mmHg	12.5 ± 8.0 (10.5)	19.1 ± 16.9 (14.0)	0.17 ‖
DBP ≤ 60 mmHg	**14.5 ± 9.4 (12.0)**	**19.9 ± 17.8 (14.0)**	**0.04** ‖
O_2 Sant < 94%	14.4 ± 7.3 (12.0)	19.1 ± 17.0 (13.0)	0.50 ‖

Table XIV (Cont'd). Comparison of Hospital Stay (Morbidity) According to the Different Factors among subjects with Non-MRSA Pneumonia who were Alive (n=246)

Parameter	Hospital Stay (in days) (Mean ± SD) (Median)		p Value
	With Parameter	Without Parameter	
Radiograph Results			
Bilateral Infiltrates	**20.5 ± 17.8 (16.0)**	**15.9 ± 13.8(11.5)**	**0.007** ‖
Unilateral Infiltrates	16.0 ± 13.6 (12.0)	19.5 ± 17.2 (14.0)	0.15 ‖
Bilateral Consolidation	**33.0 ± 21.1 (21.0)**	**18.6 ± 16.4 (13.0)**	**0.02** ‖
Unilateral Consolidation	**27.3 ± 19.3 (26.0)**	**17.9 ± 16.1 (13.0)**	**0.01** ‖
Bilateral Minimal Pleural Effusion	**23.1 ± 23.8 (14.0)**	**17.5 ± 13.4 (13.0)**	**0.04** ‖
Unilateral Minimal Pleural Effusion	**20.6 ± 13.1 (18.0)**	**18.2 ± 17.6 (12.0)**	**0.03** ‖
Bilateral Moderate Pleural Effusion	---	18.8 ± 16.6 (13.0)	---
Unilateral Moderate Pleural Effusion	17.2 ± 8.6 (17.0)	18.9 ± 16.8 (13.0)	0.89 ‖
Bilateral Thickening	7.0 ± 0.0 (7.0)	18.9 ± 16.6 (13.0)	0.26 ‖
Unilateral Thickening	19.8 ± 20.7 (12.0)	18.8 ± 16.6 (13.0)	0.24 ‖
Bilateral PTB	20.7 ± 22.7 (15.0)	18.2 ± 14.1 (13.0)	0.39 ‖
Unilateral PTB	16.2 ± 13.0 (12.0)	19.1 ± 17.0 (14.0)	0.36 ‖
Fibrosis	18.5 ± 18.0 (11.5)	18.8 ± 16.6 (13.5)	0.71 ‖
Bronchiectatic Changes	20.9 ± 14.0 (17.5)	18.7 ± 16.8 (13.0)	0.58 ‖
Atelectasis	24.8 ± 27.3 (17.0)	17.6 ± 13.3 (13.0)	0.07 ‖
Bullous Changes	17.0 ± 11.1 (14.0)	18.9 ± 17.0 (13.0)	0.83 ‖
Hyperaeration	16.8 ± 11.9 (12.0)	19.1 ± 17.2 (14.0)	0.71 ‖
Single Mass	23.7 ± 16.5 (12.0)	18.5 ± 16.5 (13.0)	0.21 ‖
Multiple Mass	19.5 ± 13.1 (15.5)	18.8 ± 16.7 (13.0)	0.92 ‖
Subcutaneous Emphysema	**34.4 ± 11.9 (34.0)**	**18.5 ± 16.5 (13.0)**	**0.03** ‖
Congestion	**22.9 ± 23.6 (18.0)**	**17.5 ± 13.5 (12.0)**	**0.05** ‖
Cardiomegaly	17.4 ± 15.3 (12.0)	19.2 ± 16.9 (14.0)	0.48 ‖
Cervical Spondylosis	---	18.8 ± 16.6 (13.0)	---
Thoracic Spondylosis	19.9 ± 11.3 (15.0)	18.7 ± 16.7 (13.0)	0.84 ‖
Rib Fracture	27.2 ± 14.4 (29.0)	18.5 ± 16.6 (13.0)	0.14 ‖
Osteodegenerative Changes	16.4 ± 10.2 (12.0)	19.0 ± 17.0 (14.0)	0.98 ‖
AA/TA	17.4 ± 14.3 (13.0)	19.3 ± 17.3 (13.0)	0.43 ‖

p>0.05- Not significant; p ≤0.05-Significant
Data presented as Mean ± SD, (medians) were computed as needed; or as frequency (%)
§ ANOVA/Kruskall Wallis test; ‖T-test/Mann Whitney U test
**HTN, Hypertension; DM, Diabetes Mellitus; CAD, Coronary Artery Disease; ON_HD, On Hemodialysis; UGIB, Upper Gastrointestinal Bleeding; COPD, Chronic Obstructive Pulmonary Disease; PTB, Pulmonary Tuberculosis; CVD, Cerebrovascular Disease; ARMMC, Amang Rodriguez Memorial Medical Center; DOB, Difficulty of breathing; AA/TA, Atheromatous aorta/Tortuous aorta*

Table XV. Antibiogram

Antibiotic Susceptibility Patterns of Top Ten Commonly Isolated Bacteria for Pneumonia for the year 2017 in ARMMC Numbers below represent **percent of susceptible isolates** (no. of isolates tested)	*Klebsiella pneumoniae*	*Acinetobacter anitratus*	*Enterobacter aerogenes*	*Pseudomonas aeruginosa*	*Escherichia coli*	*MRSA*	*Enterobacter cloacae*	*ESBL Klebsiella pneumoniae*	*Acinetobacter iwoffii*	*AMPC Pseudomonas aeruginosa*
Tobramycin	**64** (47)	**60** (42)	**65** (51)	**89** (28)	**92** (13)		**56** (9)		**50** (6)	**100** (7)
Tetracycline	**57** (23)	**45** (11)	**65** (23)		**40** (5)	**80** (5)	**67** (6)		**50** (2)	
Ticarcillin-Calvulanic acid							**25** (12)		**40** (10)	
Piperacillin-Tazobactam	**40** (53)	**44** (55)	**44** (52)	**62** (29)	**40** (15)		**44** (16)		**70** (10)	**90** (10)
Rifampin						**74** (23)				
Ofloxacin						**86** (7)				
Minocycline									**100** (1)	
Meropenem	**91** (70)	**54** (59)	**86** (58)	**77** (39)	**83** (24)		**81** (16)	**86** (14)	**75** (12)	**92** (12)
Levofloxacin	**73** (37)	**71** (41)	**80** (44)	**84** (25)	**71** (14)	**89** (18)	**100** (8)	**38** (8)	**80** (10)	**100** (7)
Linezolid						**95** (20)				
Imipenem	**90** (61)	**56** (54)	**76** (50)	**79** (29)	**80** (20)		**79** (14)	**73** (15)	**58** (12)	**92** (12)
Gentamicin	**72** (22)	**86** (21)	**94** (17)	**91** (12)		**100** (3)	**100** (4)	**50** (2)	**100** (1)	**100** (1)
Ertapenem	**81** (21)		**67** (21)				**86** (7)		**100** (1)	
Erythromycin						**43** (28)				
Doripenem	**100** (2)	**53** (19)	**67** (6)	**82** (11)				**100** (2)	**50** (2)	**86** (7)
Cotrimoxazole	**74** (27)	**38** (24)	**38** (29)		**50** (8)	**60** (10)			**67** (6)	
Clindamycin						**58** (26)				
Chloramphenicol	**57** (47)	**60** (43)	**65** (37)	**83** (24)	**56** (16)	**71** (17)	**73** (11)		**67** (9)	**100** (10)
Cephalexin	**77** (16)		**63** (30)		**78** (9)	**81** (27)	**67** (6)		**100** (1)	
Cefuroxime	**69** (16)	**62** (13)	**63** (8)	**83** (12)		**83** (6)				
Ceftriaxone					**32** (25)					
Ceftazidime	**66** (58)		**63** (56)		**53** (19)	**100** (1)	**53** (15)		**30** (10)	
Cefoxitin	**55** (77)	**44** (72)	**54** (65)	**69** (42)	**50** (20)		**63** (19)		**47** (15)	**79** (14)
Cefpodoxime	**86** (64)		**57** (58)		**64** (25)	**33** (24)	**35** (17)	**58** (12)		
Cefotetan	**62** (50)		**43** (47)		**53** (15)		**18** (11)		**50** (2)	
Cefotaxime	**100** (5)		**86** (7)			**100** (2)		**75** (4)		**100** (2)
Cefepime	**51** (78)		**49** (69)		**63** (24)		**44** (18)		**50** (14)	
Cefazolin	**45** (77)	**41** (69)	**45** (71)	**54** (41)	**44** (25)		**52** (21)		**56** (9)	**80** (10)
Cefazolin	**33** (78)		**31** (67)	**17** (6)	**23** (26)					
Aztreonam	**67** (78)		**67** (69)	**64** (44)	**59** (22)		**67** (18)		**25** (4)	**85** (13)
Ampicillin-Sulbactam	**51** (59)	**44** (55)	**46** (57)		**32** (19)		**56** (16)	**100** (1)	**44** (9)	
Amoxicillin-Clavulanic acid	**23** (79)		**17** (64)		**19** (22)					
Amikacin	**83** (75)	**70** (70)	**73** (62)	**85** (39)	**74** (19)		**81** (16)	**62** (13)	**69** (13)	**92** (13)