



**PEDIATRIC INFECTIOUS  
DISEASE SOCIETY OF THE  
PHILIPPINES**

# PIDSP JOURNAL

**Vol.13 No.2  
July-Dec 2012**

## Invited Review

### **Dengue: A Growing Global Health Threat**

*Usa Thisyakorn M.D., Chule Thisyakorn, M.D. Department of Pediatrics,  
Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand .....2*

## Original Articles

### **A Case Control Study of the Demographic Characteristics, Risk Factors, Clinical Findings, Treatment and Outcome among Children 18 Years and Below Who are Confirmed to have Influenza A H1N1/09 Virus**

*Romina D. Gerolaga, M.D., Robert Dennis Garcia, M.D.  
Makati Medical Center .....13*

### **The Clinical Outcome and Antibiotic Sensitivity Pattern of Enterobacter Spp. Culture Positive Neonates Admitted at Cebu Doctors' University Hospital – Neonatal Intensive Care Unit (2005-2008)**

*Lalaine Amor H. Maderal, M.D.\*, Barbra Charina V. Cavan, M.D.\*  
Cebu Doctors' University Hospital.....22*

### **Haemophilus Influenzae Type B Conjugate Vaccine (HiBCV) and Heptavalent Pneumococcal Conjugate Vaccine (PCV7) Immunization Status Of Patients 5 Years and Below Hospitalized For Pneumonia**

*Lou Ver Leigh A. Manzon, M.D., Robert Dennis J. Garcia, M.D., Sally  
Victoria B. King, M.D Department of Pediatrics, Makati Medical Center ....30*

## Interim Advice

### **Post Disaster Interim Advice on the Prevention of Leptospirosis in Children .....37**

### **Outbreak of Serratia Marcescens in the Newborn Care Unit in a Local Tertiary Hospital**

*Sandra Joyce Pena, MD, Xenia Cathrine Fabay, MD  
Baguio General Hospital and Medical Center.....39*

### **The Use of Meropenem among Neonates: A One-Year Retrospective Study in the Nursery of a Local Tertiary Hospital**

*Ferdinand P. Gangangan, MD, Xenia Cathrine Fabay, MD  
Baguio General Hospital and Medical Center.....47*

## PIDSP Newsletter

**PIDSP AT THE APAME CONGRESS 2012 .....54**

**PIDSP Joins the PPS Total Family Healthcare Expo .....56**

**Vol.13 No.2  
July-Dec 2012**

## BRIEF REPORT

# OUTBREAK OF *SERRATIA MARCESCENS* IN THE NEWBORN CARE UNIT IN A LOCAL TERTIARY HOSPITAL

**AUTHORS:** Sandra Joyce Pena, MD,\* Xenia Cathrine Fabay, MD\*

\*Baguio General Hospital and Medical Center

## KEYWORDS:

Outbreak, *Serratia marcescens*, neonatal infections, neonatal sepsis

## CORRESPONDENCE:

Sandra Joyce Pena, MD

Email: sjmd74@yahoo.com

## ABSTRACT

**Objectives:** This study was performed to investigate the *Serratia marcescens* outbreak in the Newborn Care Unit of a tertiary hospital.

**Methods:** This is a retrospective, descriptive study. Charts of all neonates with *S. marcescens* growth in their blood culture were retrieved from the Records Section of the Baguio General Hospital and Medical Center (BHGMC) from July 2002 to July 2003. During the outbreak period, the following interventions were performed: 1) orientation and re-orientation of the entire health care team, especially, the staff of the unit on infection control and prevention; 2) aerobic culture of possibly contaminated hands of concerned staff and equipment of both the delivery room and the intensive care unit; 3) closing of the pediatric newborn care unit for general cleaning and disinfection.

**Results:** Of the 132 cases reported to have grown *S. marcescens* in their blood cultures, 63 (48%) charts were available for review: 63% were term; 51% male; 81% were appropriate for gestational age; and 30% had birth weights of 2500 to 2999 grams and delivered via normal spontaneous delivery. The most common reasons for admission were: respiratory distress syndrome (5%), multiple congenital anomalies (5%), congenital heart disease (5%), urinary tract infection (5%), severe asphyxia (3%), and pneumonia (3%). The clinical manifestations seen during the first 4 days of life were respiratory distress (51%), poor suck (25%), bleeding (22%), jaundice (6%), sclerema (5%), and vomiting (5%). Blood transfusion (46%), such as fresh frozen plasma and packed red blood cells, was the prevalent invasive procedure done, followed by endotracheal intubation (41%), and umbilical catheterization (38%). Eighteen out of 63 cases died with a case fatality rate of 29%; 28% died of septic shock. *S. marcescens* showed 100% sensitivity to Piperacillin-Tazobactam, Cefepime, Imipenem, and Meropenem. Environmental cultures showed isolation of *S. marcescens* from the suction machines used in the aseptic and septic areas of the neonatal intensive care unit. Furthermore, this study showed that the following factors contributed to the occurrence of an outbreak: paucity of manpower, lack of equipment and area assigned for the pediatric newborn care unit.

**Conclusion:** This investigation showed that the *S. marcescens* outbreak in the pediatric newborn care unit has been associated with environmental contamination and breakdown in infection control measures such as overcrowding, understaffing, and other major disruptions of routine nursery care, particularly hand hygiene.

## INTRODUCTION

The newborn infant is uniquely susceptible to infection whether it is due to bacterial, viral, or other pathogens.<sup>1</sup> Infection is a significant cause of mortality and long-term morbidity in neonates. The two principal sources of newborn infection are the mother and the nursery environment.

*Serratia marcescens* is a gram negative bacterium classified under the family Enterobacteriaceae. During the 1950's, this was considered as a harmless saprophyte; it was only in the 1960's that *S. marcescens* was recognized as an opportunistic human pathogen.<sup>2,3,4</sup> Disease in the neonatal intensive care unit is associated with respiratory illness, with signs of apnea, hypotension, and respiratory distress. *Serratia* sepsis is characterized by shock, pneumonia, and hemorrhage, which is associated with poorer prognosis.

In the year 2001, the Baguio General Hospital and Medical Center (BGHMC) surveillance of antimicrobial resistance patterns revealed that *Serratia* was not included in the 10 most common isolates. According to the Antimicrobial Resistance Surveillance of BGHMC submitted to the Research Institute of Tropical Medicine, there were only two isolates of *S. marcescens* in the year 2000 and eight isolates in 2001. However, in the year 2002, there was an observed increase of 137 cases. *Serratia* was among the top 3 most common isolates in BGHMC in 2003. In addition, *S. marcescens* sepsis ranked as the leading cause of morbidity and mortality in the Newborn Care Unit of BGHMC. The persistence of *S. marcescens* infection among the neonates confirmed the presence of an outbreak.

This aim of this study was to investigate the *S. marcescens* outbreak in the Newborn Care Unit of BGHMC. It included determining the clinical profile of patients with *S. marcescens* growth in their blood culture, the possible causes that lead to the unusual increase and persistence in the number of cases and institute control measures to eradicate the

outbreak. An evaluation of the control measures was also undertaken.

## MATERIALS AND METHODS

This is a two-phase research study. The first phase was a retrospective, descriptive study wherein medical records of all neonates with *S. marcescens* growth in their blood cultures were retrieved from the Records Section of BGHMC from the period of July 1, 2002 to July 31, 2003. The second phase is the implementation and evaluation of the recommended control measures to address the outbreak.

A case was defined as any infant admitted to the newborn care unit from July 1, 2002 to July 31, 2003 and diagnosed to have an infection with *S. marcescens*. The following data were collected and analyzed: age; sex; gestational age; birth weight; location and duration of stay in the NICU; date of onset of signs and symptoms; blood culture and sensitivity; underlying diseases; co-morbid illness; invasive procedures; and antimicrobial therapy.

After institution of control measures, continuous surveillance for presence of *S. marcescens* was continued from August 2003 to August 2004.

## RESULTS

A total of 132 cases were reported to have grown *S. marcescens* in their blood culture, however, 63 (48%) medical records were available for review (Figure 1). Table 1 shows the demographic characteristics of the study population with *Serratia* infection.

The babies were admitted for respiratory distress syndrome, multiple congenital anomalies, congenital heart disease, urinary tract infection, severe asphyxia, and pneumonia (Table 2).

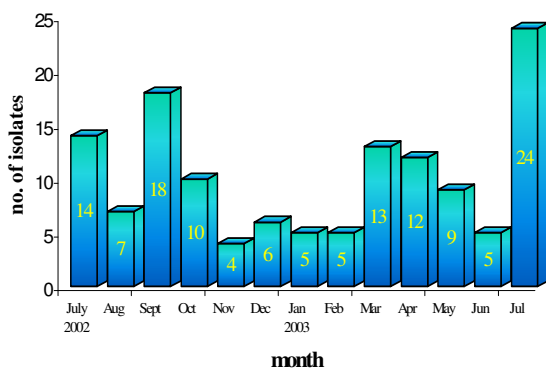
Twenty patients (26%) had no identifiable risk factors, 14 (18%) had premature rupture of membranes, and 13 (17%) had pre-eclampsia/eclampsia as the maternal risk factor (Table 3). The most common clinical manifestation seen during the first four days of life were

respiratory distress, poor suck, and bleeding (Table 4).

**Table 1.** Demographic characteristics of Neonates with Confirmed *Serratia* Infection

	N	%
Age		
Term	40	63
Preterm	23	37
Sex		
Male	32	51
Female	31	49
Weight		
Approp for Gestational Age	51	81
Small for Gestational Age	12	19
Birth weight (gms)		
<1000	2	3
1000-1499	6	10
1500-1999	16	25
2000-2499	7	11
2500-2999	19	30
3000-3800	7	11
Mode of delivery		
Normal spont vaginal	38	60
LS Caesarian section	19	30
Outborn	5	8
Breach	1	2

**Figure 1.** *S. marcescens* Isolates in PNCU-BGHMC July 2002-July 2003



Twenty-four patients (38%) stayed in the NICU for less than seven days; 24 patients (38%) stayed for seven to fourteen days; and only 15 patients (24%) stayed for more than fourteen days (Table 4).

**Table 2.** Underlying Illnesses of Patients Admitted to the NCU-BGHMC, July 2002-July 2003 (n= 63).

Co-Morbid Illnesses	N	(%)
Necrotizing Enterocolitis	1	2
Severe Asphyxia – Hypoxic-Ischemic Encephalopathy	2	3
Respiratory Distress Syndrome	3	5
Meconium Aspiration Syndrome	2	2
Multiple Congenital Anomalies	3	5
Congenital Heart Disease Probably Patent Ductus Arteriosus	3	5
Urinary Tract Infection	3	5
Pneumonia	2	3
Folliculitis	1	2
Partial Intestinal Obstruction	1	2
Omphalocele	1	2
Congenital Hydrocephalus	1	2
Acute Renal Failure	1	2

**Table 3.** Maternal Risk Factors Associated with the Study Population, July 2002 to July 2003.

Maternal Factors	No.	(%)
None	20	26
Pre-eclampsia/ Eclampsia	13	17
Placenta Previa	1	1.3
Thick meconium staining	6	8
PROM	14	18
Oligohydramnios	7	9
UTI	7	9
Unwanted pregnancy	2	2.6
Maternal fever	2	2.6
Varicella	1	1.3
Pneumonia	1	1.3
Asthma	1	1.3
Hyperthyroidism	1	1.3

Blood transfusion (27%), such as fresh frozen plasma and packed red blood cells, was the most common invasive procedure done on the cases, followed by endotracheal intubation, (25%), and umbilical catheterization (23%).

Eighteen out of 63 cases died, with a case fatality rate of 29%. The cause of mortality of 5 cases (28%) was septic shock; 4 cases (22%) died of disseminated intravascular



coagulopathy. All the babies were admitted at the neonatal intensive care unit, intubated, and started on empiric antibiotics of Penicillin G Sodium and aminoglycoside. The remaining 9 (50%) died of other causes, like multiple congenital anomalies and respiratory failure.

**Table 4.** Presenting Signs and Symptoms of Patients Prior to the Isolation of *S. marcescens*.

Signs and symptoms	No.	(%)
Bleeding (ET, OGT) Petechiae, purpura	14	22
Respiratory Distress	32	51
Jaundice	4	6
Sclerema	3	5
Bloody stools	1	2
Vomiting	3	5
Seizures	1	2
Poor suck	16	25
Abdominal distention	2	3
Fever	2	3

**Table 5.** Duration of Stay of Patients in the NCU-BGHMC, July 2002 to July 2003.

Number of Days	No. of Patients	(%)
< 7 days	24	38%
7-14 days	24	38%
> 14 days	15	24%

**Table 6.** Susceptibility Pattern of *S. marcescens*.

ANTIBIOTIC	No. of Isolates Tested	Sens (%)	Interm (%)	Resist (%)
Piperacillin-Tazobactam	4	4(100)		
Ticarcillin	3	3 (100)		
Cefotaxime	48	39 (81)	7(14)	2 (4)
Ceftazidime	30	28 (94)		1 (3)
Cefepime	60	60 (100)		
Aztreonam	59	56 (95)	2(3)	1 (2)
Imipenem	48	48 (100)		
Meropenem	12	12 (100)		
Amikacin	57	51 (89)	4(7)	2 (3)
Gentamicin	31	27 (87)	1(6)	2 (6)
Netilmycin	18	17 (94)		
Tobramycin	1	1(100)		

Out of the cases, 34 (54%) were discharged with improved condition, 18 (29%) died, and 11 (17%) were discharged against medical advice. The remaining 14 % died of other causes.

Table 6 shows the susceptibility patterns of *S. marcescens*. Blood isolates showed 100% sensitivity to Cefepime, Imipenem, Meropenem Piperacillin-Tazobactam, Tobramycin, and Ticarcillin; 95% were sensitive to Aztreonam; 94% sensitive to Ceftazidime and Netilmycin; 89% had sensitivity to Amikacin; and 87% to Gentamicin. Eighty-one percent (81%) were sensitive to Cefotaxime. Meanwhile, 6% were resistant to Gentamicin; 4% were resistant to Cefotaxime; and 3% were resistant to Ceftazidime and Amikacin. Two percent (2%) had resistance to Aztreonam.

Fourteen (22%) of the cases who were given the initial empiric treatment (Penicillin G Sodium + Aminoglycoside) were shifted to Cefepime; 5 (8%) were shifted to Piperacillin – Tazobactam; 2 (3%) were shifted to Ceftazidime; and 1 (2%) was shifted to Cefotaxime. One out of the 14 cases (7%), who was initially shifted to Cefepime, was later shifted to Meropenem. One case was given Fluconazole because of a concomitant *Candida* infection. Another case was given Metronidazole because of the possible presence of an anaerobic infection. One patient, on the other hand, was given Intravenous immunoglobulin because the mother had varicella infection at the time of delivery.

To check for contamination, several environmental cultures were done. However, only the following records were retrieved from the laboratory. Bacteriological examination of tap water in the neonatal intensive care unit revealed no growth after 48 hours of incubation. The suction machine tubes used in the aseptic and septic areas of the neonatal intensive care unit revealed *S. marcescens*.

#### Control Measures Instituted

Basic control measures were intensified, especially, strict hand hygiene, which was emphasized to all personnel of the newborn care unit. Body substance isolation, in the form of proper use of gloves in between patients and after hand hygiene, was reiterated. Gowns and masks were worn when secretions, blood, or

body fluids were most likely to soil or splash on clothing, skin, or face. Soiled reusable items, linen, and trash were contained to prevent leaking. Needles and sharps were placed in puncture-resistant and, rigid containers. Cleaning and disinfection of cribs were done daily. Eating in the unit was strictly prohibited. Any staff member with signs and symptoms that suggested infection was asked to go on sick leave. The suction machines in the delivery room and neonatal intensive care unit were cleaned and sterilized with 2% glutaraldehyde every shift, which was every 8 hours. The neonatal intensive care unit and the delivery room floors and walls were also cleaned with Lysol (6%) weekly. The delivery room and pediatric newborn care unit were provided with continuous water supply.

The occurrence of increasing number of *S. marcescens* infections in the NCU was not immediately detected until after a thorough investigation was done on March 2003 with the arrival of the newly-trained Infectious Diseases Consultant of this institution. Because of the paucity in manpower, lack of equipment, and difficulty in finding an appropriate location for the temporary NCU, the unit was not closed initially. Infection control practices, such as strict hand hygiene, limitation of visitors in the PNCU, decontamination of stethoscopes and pulse oximeters with 70% alcohol, food restriction in identified areas of the unit, cleaning and sterilizing of suction machines with 2% glutaraldehyde, and cleaning of the unit weekly, were reiterated and emphasized. However, only a minimal decline in the number of isolates was noted.

The Department of Pediatrics, which included the sections of Neonatology, and Infectious Disease, and the Department of Obstetrics and Gynecology, together with the Infection Control Committee headed by the newly trained infectious disease consultant of the hospital, had several meetings. Problems were identified and appropriate measures and recommendations were drafted and

implemented. The unit was finally closed for 15 days. The following infection control measures were strictly implemented:

- Orientation and re-orientation of the entire health care team (nurses, nursing attendants and medical interns and resident physicians) to avoid cross-contamination, emphasizing strict hand hygiene and contact precautions.
- Attendance in regular meetings regarding infectious control practices, including hand hygiene, sharps safety, and standard precaution.
- The use of scrub suits and proper attire among NICU personnel was strictly observed. Wearing of gloves before touching blood, body fluid secretions, excretions, contaminated items, as well as, touching mucous membranes and non-intact skin, were followed.
- The wearing of mask was done to protect the nasal and oral mucosa during procedures, which were likely to generate splashes or sprays of blood, body fluid secretions, or excretions.
- Rings, watches, and bracelets were not worn while providing patient care. Jewelries were removed before hand hygiene. Long nails and colored nail polish were strictly discouraged.
- Visitors were restricted from entering the neonatal intensive care unit.
- Food and drinks were restricted to identified areas of the unit.
- Examining equipment such as stethoscopes and pulse oximeters were restricted for the use of one patient or decontaminated with 70% alcohol in between patients when there was lack of equipment.
- Equipment assigned to a single patient such as resuscitation bags and masks or items in contact with the newborn skin and mucous membranes were replaced and sterilized on a regular basis.
- Suctions machines were cleaned and sterilized with 2% glutaraldehyde every shift.

- Provision of at least 2 to 3 nurses in the Newborn Care Unit for every 8 hour shift.
- Cleaning and disinfection of cribs were done daily.
- The neonatal intensive care unit and the delivery room floors and walls were also cleaned with phenol weekly

### C. Evaluation of Control Measures Done

Subsequently, there was a significant decline both in the number of *S. marcescens* isolates (Figure 2) and in the rate of morbidity and mortality caused by *Serratia marcescens*. From a previous morbidity rate of 2.8% and 4.17% mortality rate in the month of August 2003, this decreased to 0.17% and 3.45% morbidity and mortality rate, respectively, in September 2003. There were no noted cases of *S. marcescens* infection from October to August 2004. According to the antimicrobial resistance surveillance of BGHMC for the year 2004, there was a significant decline to 4 cases of *S. marcescens* compared to the previous year.

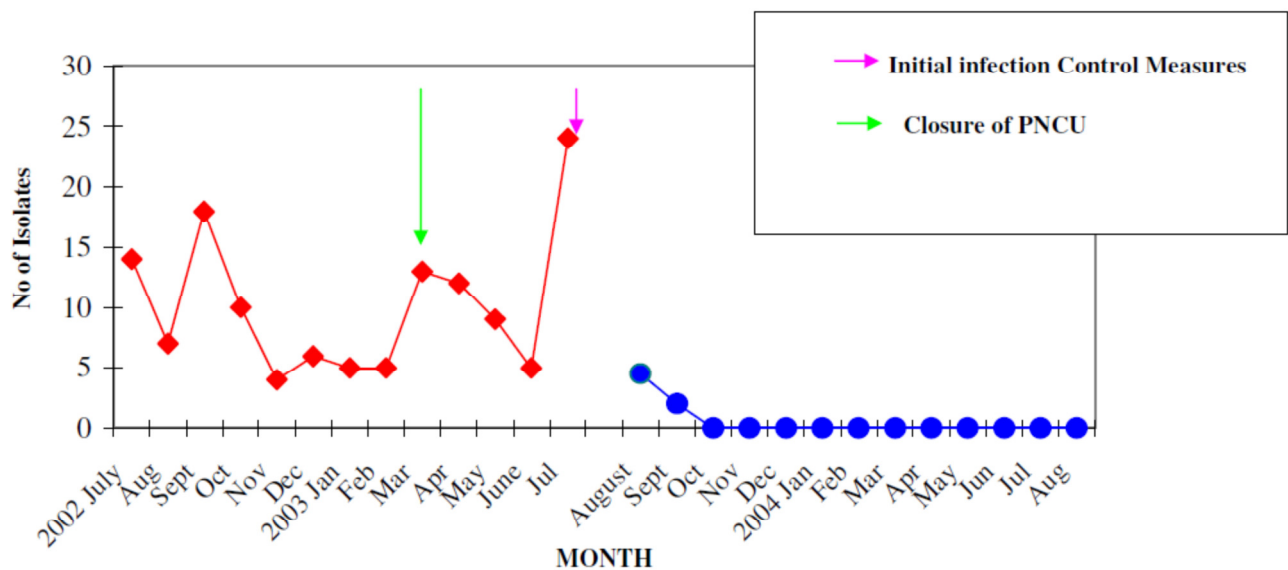
### DISCUSSION

Outbreak of *S. marcescens* infection in the neonatal intensive care unit has been associated with environmental contamination, colonization of respiratory therapy equipment, and suction machines. It is also related to breakdown in infection control techniques, such as overcrowding, understaffing, and other major disruptions of nursery routine, particularly, hand hygiene. These were the same reasons observed in the Newborn Care Unit of BGHMC, which is a tertiary government hospital. In the study done by Cimolai, et. al.<sup>5</sup> in 1997 on the *S. marcescens* outbreak in the Pediatric ICU, he identified that inadequate decontamination of materials such as ventilators, ECG equipment, dialysis shunts, and even disinfectants were responsible for such

occurrence. In another study by Howland, et. al.<sup>6</sup> in a surgical intensive care unit in July 2000, the risk factors identified were the duration of central lines, invasive procedures done, and respiratory colonization. In addition, understaffing of nurses may have played a role in this outbreak. A study done in a maternity Hospital by Berthelot, et. al.<sup>7</sup> in April 1999, showed that *S. marcescens* was isolated from a bottle of enteral feed additive in the neonatal unit and from the transducers of 2 internal tocographs in the delivery rooms. The colonization of some newborns was shown to occur few hours after delivery. According to Mayhall<sup>8</sup>, *Serratia* causes serious endemic and epidemic infections in the NICU. Outbreaks are characterized by widespread newborn gastrointestinal colonization with the infants serving as reservoirs. Contaminated intravenous fluids, delivery room equipment, breast pump, and soap have been implicated.

According to Nielsen, et. al.<sup>9</sup> extrinsic and intrinsic risk factors for infection were identified. The incidence of sepsis was inversely proportional to birth weight and gestational age. Extrinsic factors include indwelling devices, intubation, umbilical or central intravenous catheters, antibiotic induced overgrowth of resistant flora, and ongoing exposure to nosocomial infections. An outbreak of *S. marcescens* in the NICU was reported by Archibald and colleagues in association with extrinsic contamination of soaked bottles. This led to the transmission to neonates by nursery personnel, resulting in colonization and infection. Thirty two cases occurred in infants with a median gestational age of 29 weeks. Twenty five percent of this developed bacteremia, which carried a 50% mortality rate.<sup>9</sup> Forty-one percent of patients, was

**Figure 2 . Effect of Infection Control Measures**



mechanically ventilated and 38% had umbilical catheterization done requiring frequent handling and suctioning, which increased the risk for acquiring infection. In a study done by Litam, et. al., it was concluded that the NICU outbreak of *Salmonella* was secondary to person-to-person spread. Intensified and strict adherence to infection control practices ultimately terminated the outbreak.<sup>10</sup> Pagcatipunan, et. al.<sup>11</sup> surmised that the *P. aeruginosa* outbreak was controlled through cohort nursing, educational measures, regular thorough cleaning of the sinks, use of disinfectants, appropriate use of antimicrobials, and hand hygiene.

**CONCLUSIONS**

The *S. marcescens* outbreak in the newborn care unit of BGHMC showed that all newborns were susceptible to *Serratia marcescens* infection. During the first 4 days of life, 51% presented with respiratory distress, 25% had poor suck, and 22% had bleeding. Case fatality rate was 29%.

This outbreak has been associated with environmental contamination, colonization of respiratory therapy equipment, and suction machines. It was also likely related to

breakdown in infection control techniques such as overcrowding, understaffing, lack of equipment and area assigned for the NCU, and other major disruptions of nursery routine particularly hand hygiene.

**REFERENCES**

- Pickering, L., et.al. Red Book 2003 Report on the Committee on Infectious Diseases, 26<sup>th</sup> ed. 2003; 273-275.
- Feigin, R., et. al. Textbook of Pediatric Infectious Disease 5<sup>th</sup> ed.; Saunders. 2004 2:1469-1471.
- Klaus, M., Fanaroff, A., Care of the High Risk Neonate. W.B. Saunders Company. 2001. 363-385.
- Avery, G., et.al. Neonatology Pathophysiology and Management of the Newborn, 5<sup>th</sup> ed. Lippincott Williams and Wilkins. 1999. 1189-1206.
- Cimolai, N., et. al. Heterogeneous *Serratia marcescens* Genotypes from a Nosocomial Pediatric Outbreak.; *Clinical Investigations In Critical Care*. 1997. 194-197.
- Howland, K., et. al. A Heterogeneous Outbreak of *Enterobacter cloacae* and *Serratia marcescens* Infections in a Surgical Intensive Care Unit. *Infection Control and Hospital Epidemiology* 2000. 21: 465-469.
- Berthelot, P., et. al. Investigation of a Nosocomial Outbreak due to *Serratia marcescens* in a Maternity Hospital. *Infection Control and Hospital Epidemiology* 1999; 20: 233-236.



8. Mayhall, C.G., Hospital Epidemiology and Infection Control 3<sup>rd</sup> ed.; Lippincott Williams and Wilkins. 2004. 1: 851-875.
9. Nielsen, K., Infections in the Neonatal Intensive Care Unit: State of the Art. American Academy of Pediatrics, 2000.
10. Litam MG, Maramba C. Outbreak Of Non-Typhoidal Salmonella In The NICU. PIDSP Journal 2002; 6 (2): 10-19.
11. Pagcatipunan, M., Lopez. A. Multi Drug Resistant *P. aeruginosa* Outbreak in the Neonatal Intensive Care Unit of Philippine General Hospital. PIDSP Journal 2003; 7 (1): 9-14.