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FINAL REPORT

PROJECT RG/2002/M/03

of

NATIONAL SCIENCE FOUNDATION

Study of hospital acquired infections in patients admitted to the intensive care unit at the Teaching Hospital, Karapitiya, Galle.

FACULTY OF MEDICINE

GALLE

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Section 2 - Executive summary of the project

INTRODUCTION

Hospital acquired infections (HAI) or nosocomial infections have become increasingly complex over the past 20 years. More than 2 million people acquire a HAI each year. The frequent use of invasive devices in the intensive care units (ICU's), especially central venous catheters and mechanical ventilators is associated with a further risk of nosocomial infections. Increasing use of broad spectrum antimicrobials to treat these infections has led to major problems with multiply antibiotic resistant bacteria in special care units. Ventilator Associated Pneumonia (VAP), Catheter related Urinary Tract Infections (UTI) with sepsis, Primary blood stream infections (BSI) and skin sepsis, account for more than 70% of all nosocomial infections.

JUSTIFICATION

Nosocomial infections with multiply resistant Gram-negative and Gram-positive bacteria are increasing in intensive care units. At present most ICU's, lack effective and appropriate antibiotic guidelines to treat such infections either empirically or definitively, since insufficient local data are available on colonizing and pathogenic bacteria in ICU's and criteria to distinguish colonization and infection are not well established. The result is an excessive and inappropriate use of broad spectrum antibiotics which is both economically unacceptable in this country and also results in the acquisition and spread of multi resistant bacteria not only in the ICU's but in general wards as well.

Effective treatment of these infections, prevention of cross infections by good infection control practices and formulation of antibiotic guidelines for the ICU require surveillance of the colonizing flora and pathogens in any particular ICU together with the antibiotic resistance patterns of the isolated bacteria.

GENERAL OBJECTIVES

1/ To study the dynamics of colonization in the pathogenesis of nosocomial ICU infections
2/ To formulate guidelines for the appropriate use of antibiotics in the empirical treatment of nosocomial ICU infections
3/ To formulate criteria that could definitively identify colonizing bacteria from pathogens.
4/ To provide reliable information to clinicians that would enable them to use antibiotics appropriately to treat infections definitively.

MATERIALS AND METHODS-

Study setting and design-

A prospective cohort study of patients admitted to intensive therapy unit (ITU) at the Teaching Hospital, Karapitiya and who were there for more than 72 hours

Microbiological methods-

All patients were be screened for bacterial colonization by collecting urine specimens from catheterized patients, throat swabs or endotracheal aspirates from ventilated patients and surface swabs of all vascular access sites within 24 hours of admission. Thereafter the same sites were sampled 3 days later.

To isolate bacteria causing nosocomial infections, appropriate specimens of tracheal aspirates, urine, blood and swabs from infected surfaces were taken, whenever there was clinical, radiological and or laboratory indication of an infection.

All specimens were taken to the laboratory within 1 hour of collection or stored at 4°C (except blood) until transported. Patient data was collected in a standard questionnaire.

The samples were processed according to standard laboratory procedures and all isolates were identified and stored. The isolates were identified using morphological and biochemical characteristics and tested for antibiotic susceptibility using the NCCLS method against a predetermined list of antibiotics. Those isolates that could not be speciated using

biochemical characteristics were identified using API commercial kits. Reports of isolates potentially causing infections were submitted to the ICU.

Statistical analysis-

Data was analysed using the EPI INFO data processing package to determine the prevalence of different isolates, the patterns of resistance and other parameters.

RESULTS:

There were a total number of 456 admissions to the ITU for one year. Males constituted 55% and females 45%. A diagnosis was documented in 324 of these cases.

Clinical entities for which ITU admission was sought are as follows:

Road traffic accidents	Poiso ning	Cancer oesophagus	Pregnancy induced hypertension	Guillain-Barre synd.	PPH	Snake bite	Dengue	Misc ellan eous
31(9.6%)	**23** (7%)	**18** (5.5%)	**15** (4.6%)	**13** (4%)	**12** (3.7%)	**6** (1.9%)	**6** (1.9%)	

Of the total admissions, 69% were sent back to the respective wards after successful ICU management. Deaths in the unit accounted for 30.87%.

301 patients had a short duration of stay in the ITU (<3 days). The majority of them were admitted for postoperative care. 155 patients stayed more than 3 days in the ITU with an average duration of 6.46 days. Among these patients, 101 ( ) were sent back to the ward and there were 54 deaths (31%). Bed occupancy was 134%.

During this period, 330 specimens of urine were collected from 195 catheterized patients admitted to the 06 bed ITU. Bacteriuria and candiduria were seen in 20.5% and 8.5% respectively. Quantitative cultures showed that ( ) 73.9% of specimens had "significant" bacteriuria (>10^5CFU/ml). Klebsiella species (27.5%) and Escherichia coli (20.6 %) were the main bacterial species isolated. Ninety patients catheterized in ITU and whose stay in ITU was 3 days or more were analysed for evidence of nosocomial UTI. Twenty patients (22.2 %) developed bacteriuria and of them 15 (16.6 %) developed significant bacteriuria. Five patients (5.5 %) had evidence of developing clinical sepsis and were treated for UTI. In those who developed significant bacteriuria (15) only (2 %) had evidence of increased pus cells (> 10 /hpf). (13 %) did not show increased numbers of pus cells in direct microscopy. Catheter changes done on 5th to 7th day in 16 patients with bacteriuria showed a significant reduction of colony counts in 13 patients.

During the study period, 146 specimens of blood for culture were collected from 97 patients admitted to the 6 bed ITU. From 27 patients blood was cultured more than once.

Bacterial isolates were recovered from 40 specimens of blood of which 11 were considered to be contaminants. This was due to the incompatibility between the isolate and the clinical condition of the patient. Six of the significant isolates were recovered after 72 hrs incubation. Among 97 patients, 28 patients (28.9%) developed a BSI. Of these, seven were considered to be primary BSI because of isolation of the same organism from the IV cannula tip and blood culture. The predominant organisms causing a primary BSI were Coagulase negative *Staphylococcus* (85.71%). Secondary BSI were caused by *Aceinetobacter* (18.18%), *Klebsiella* (18.18%), *Pseudomonas* (13.64%) and *Staphylococcus aureus* (13.64%) were the most commonly isolated organisms in this study.

During period of 14 months 324 tracheal aspirate specimens were collected form 165 mechanically ventilated patients admitted to the 6 bed ITU of the teaching hospital. Out of 165 patients 119 patients stayed ≥ 3 days. Among 165 patients 6.7% (11 patients) developed VAP. Out of that 11 one had developed early-onset nosocomial VAP. Gram negative bacilli cause 57.9% of nosocomial VAP. However, *Staphylococcus aureus* was the second most frequent bacterial etiological agent

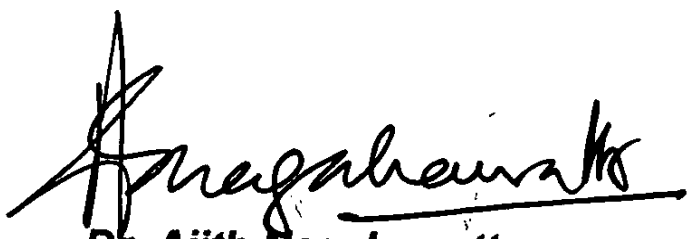
Section 7

– Signatures

i) Grantees Signature

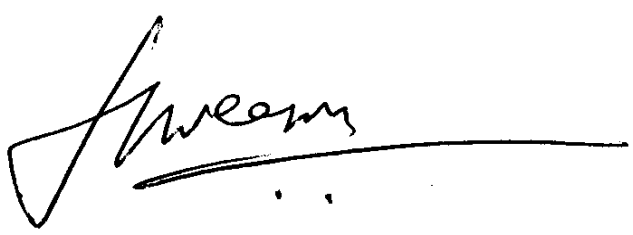
Dr. Nelun de Silva, *19th September 2008*

ii)Comments of the Head of the Department/Signature:



Dr. Ajith Nagahawatta,
Head,
Department of Microbiology,
Faculty of Medicine, Galle

iii) Head of the Institution signature:



Prof. Tilak Weerasuriya
Dean, Faculty of Medicine, Galle.
University of Ruhuna

CONTENTS

Section 1 -Information regarding Project/Project Personnel

Contract No: **RG 2002/M/03**

Title of project: Study of Hospital acquired infections in patients admitted to the intensive care unit at the Teaching hospital, Karapitiya, Galle.

Principal investigator: ***Dr. Nelun de Silva***

Co investigators: ***Dr. WASA de Silva***

Institutes where research was carried out: Department of Microbiology, Faculty of Medicine, Galle and TH Karapitiya

Date of award: 15.01.2002, funds released in January 2003

Date of completion of project: December 2003

Total allocation of funds: Rs. 150,360.00

Total spent: Rs. 150,360.00

Number of research students employed: One

Postgraduate degree completed with dates: Not completed

Number of Technical Assistants and/or labourers employed and period of service: One labourer

Publications/communications arising from the project during the reporting period:

1. An outbreak of methicillin resistant Staphylococcus aureus in an intensive care unit of a teaching hospital . *Nelun de Silva*, Inurika Ratnaweera, Shalini Perera. Journal of the Galle Medical Association Sept. 2002: 26-28
2. Bacteriuria and candiduria in catheterised patients in a general intensive care unit. Inurika Ratnaweera, *Nelun de Silva*, Asoka de Silva, Harindi Abeykoon. Proceedings of the Annual Academic sessions of the Sri Lanka College of Microbiologists. June 2002: OP5
3. An audit of admissions to the intensive care unit of a teaching hospital. Inurika Ratnaweera, *Nelun de Silva* ; Journal of the Galle Medical Association Sept. 2002: 02
4. Ventilator associated pneumonia in and intensive care unit of a teaching hospital. *Nelun de Silva, I. Ratnaweera*, Proceedings of the Annual Academic sessions of the Sri Lanka College of Microbiologists. June 2003: OP23
5. Blood Stream Infections in a general intensive care unit
Inurika Ratnaweera[1], *Nelun de Silva*[2] Journal of the Galle Medical Association Sept. 2003: OP 21
6. Nosocomial infections in the intensive care setting: Guidelines for establishing a microbiological diagnosis and antibiotic therapy. *Nelun de Silva*, Journal of the Galle Medical Association Sept. 2003

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in front page.

Section 3 - Report in detail

Publications/communications arising from the project during the reporting period:

1. Bacteriuria and candiduria in catheterised patients in a general intensive care unit. Inurika Ratnaweera, *Nelun de Silva*, Asoka de Silva, Harindi Abeykoon. Proceedings of the Annual Academic sessions of the Sri Lanka College of Microbiologists. June 2002: OP5.

Bacteriuria and candiduria in catheterised patients in a general intensive care unit.

Introduction

Catheterisation is an important risk factor for developing urinary tract infections (UTI). About 80% of nosocomial UTI's are associated with urinary catheters.

Objectives

To determine the relevance of bacteriuria and candiduria to sepsis in catheterized patients.

Methodology

All patients admitted to the intensive therapy unit (ITU) of a teaching hospital and catheterized were screened for bacterial colonization at 24 and 72 hours after admission. Subsequent specimens were taken when there was evidence of clinical sepsis.

Results

During a period of 10 months, 330 specimens were collected from 195 catheterized patients admitted to the 06 bed ITU. Bacteriuria and candiduria were seen in 20.5% and 8.5% respectively.

Quantitative cultures showed that ( ) 73.9% of specimens had "significant" bacteriuria (>10^5CFU/ml). Klebsiella species (27.5%) and Escherichia coli (20.6 %) were the main bacterial species isolated.

90 patients catheterized in ITU and whose stay in ITU was 3 days or more were analysed for evidence of nosocomial UTI. 20 patients (22.2 %) developed bacteriuria and of them 15 (16.6 %) developed significant bacteriuria. Five patients (5.5 %) had evidence of developing clinical sepsis and were treated for UTI.

In those who developed significant bacteriuria (15) only (2 %) had evidence of increased pus cells (> 10 /hpf). (13 %) did not show increased numbers of pus cells in direct microscopy.

Catheter changes done on 5th to 7th day in 16 patients with bacteriuria showed a significant reduction of colony counts in 13 patients.

Conclusions

Patients catheterized for a longer duration, need not always develop bacteriuria or candiduria. The presence of pus cells does not correlate with significant bacteriuria or subsequent UTI. With proper management only a small proportion develop UTI and needs antibacterial therapy.

Acknowledgements:

The technical assistance of Mr. GNJ Dharmasiri is acknowledged.

2. An outbreak of methicillin resistant Staphylococcus aureus in an intensive care unit of a teaching hospital . *Nelun de Silva*, Inurika Ratnaweera, Shalini Perera. Journal of the Galle Medical Association Sept. 2002: 26-28

An outbreak of methicillin resistant *Staphylococcus aureus* in an intensive care unit of a teaching hospital

Abstract:

An increased prevalence of methicillin resistant *Staphylococcus aureus* (MRSA) was detected in the intensive therapy unit (ITU) of the Teaching Hospital, Karapitiya during a period of two months. All six patients undergoing treatment in the ITU became colonized with MRSA at various sites. Subsequently two of them developed ventilator associated pulmonary infection and was successfully treated with vancomycin. Adherence to strict infection control practices by the staff and the use of appropriate antibiotics to treat the colonized and infected patients were able to contain this episode without closure of the unit.

Introduction:

When methicillin was introduced as the first β-lactamase stable penicillin active against staphylococci, very few *Staphylococcus aureus* were MRSA. Forty years later, in many countries more than 50% of staphylococci are MRSA, and are resistant to many other antibiotics as well (1).

Infections caused by MRSA, can be community acquired, hospital acquired or acquired in intensive care units (ICU) (2). Community acquired infection is an infection occurring in the community, but manifest on admission to the hospital. A hospital acquired infection is present on admission to the ICU in a patient from another ward or hospital. ICU acquired infections develop in the ICU and are detected 48 hours after admission to the ICU.

Over the past two decades MRSA has emerged as a major hospital acquired pathogen worldwide. Numerous hospitals have begun active screening for MRSA, since infections caused by these strains are likely to be more severe and require longer hospitalization, with increased costs. (3)

S. aureus can be recovered from various sites in a significantly greater percentage of people in the hospital setting. This carrier state can serve as a reservoir for infection of hospitalized patients. From these sites the organisms can invade the bloodstream and cause severe life threatening infections. MRSA prevalence rates range from about 20-40% in local hospitals (4,5).

Materials and methods:

Patients admitted to the intensive therapy unit (ITU) of a teaching hospital were screened for bacterial colonization at 24 hours and 72 hours after admission. Specimens of endotracheal aspirates (ET), throat swabs, urine and surface swabs were collected and processed according to standard microbiological procedures. Subsequent specimens were taken from relevant sites, whenever there was evidence of developing clinical sepsis. Antibiotic susceptibility tests were performed on all isolates.

Results:

During a period of two months, ten isolates of MRSA were cultured form various sites in the six patients undergoing treatment in the ITU. Table 01 shows the colonizing and infecting bacteria in all six patients during this period.

The antibiogram of the MRSA strains is shown in table 02. Isolates 1 and 2 were susceptible to ciprofloxacin, erythromycin and gentamicin. The subsequent isolates (3 to 10) were resistant to these antibiotics.

Discussion

The first isolate of MRSA was detected in a patient admitted to the ITU with Tetanus, with a history of leprosy. He had been admitted to the hospital for varying periods in the past for treatment of his disability. He became colonized with MRSA on the 7th day in the ITU, indicating that this was an ITU acquired infection. Subsequently, MRSA were isolated from various sites in all the other patients. However, none of the patients showed evidence of MRSA colonization in specimens taken at 24 to 48 hours after admission to the ITU. Therefore the presence of MRSA in these patients was documented as being ITU acquired. The staff was alerted and strict infection control practices were enforced. Two patients developed ventilator associated pulmonary infection with MRSA and were treated with vancomycin. The patients who were colonized by MRSA were treated with other anti staphylococcal antibiotics to which the strains were sensitive.

The antibiogram of the isolates showed that there were two strain types. One strain (isolates 1 and 2) was susceptible to ciprofloxacin, erythromycin and gentamicin. The other strain (isolates 3 to 10) were resistant to these antibiotics.

A Wright's respirometer had been used in all these patients to assess lung functions. Instructions regarding disinfection of this instrument were not available. However, it could not be determined if this instrument was responsible for transmission. Swabs taken from this instrument showed no evidence of bacterial growth. Instructions were given to wipe the instrument with alcohol after each patient contact and to use this instrument minimally.

The spread of MRSA could have occurred through medical equipment (e.g. respirometer) or via the hands of staff through contact with patients. The staff were advised to wash their hands after each patient contact. Bowls of alcohol and detergent were kept by the side of all patients for staff to immerse their hands after patient contact. Subsequent specimens taken after treatment from those infected or colonized did not show evidence of MRSA. Sporadic cases of MRSA isolations continue to occur in the ITU, but have not spread further due to the awareness and vigilance by the staff of the ITU.

References:

1. Francis A. Waldvogel. New resistance in *Staphylococcus aureus*. *The New England Journal of Medicine* 1999; 340: 556-557.
2. G. A. J. Ayliffe, A. Buckles, M. W. Casewell, B. D. Cookson, R. A. Cox, G. J. Duckworth *et al.* Revised guidelines on the control of MRSA in hospitals. *Report of a BSAC/HIS/ICNA working party* 1997; 4-28.
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Staphylococcus aureus. *The Ceylon Medical Journal* 1996; 41: 144-147.
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3. An audit of admissions to the intensive care unit of a teaching hospital. Inurika Ratnaweera, *Nelun de Silva* ; Journal of the Galle Medical Association Sept. 2002: OP:02

An audit of admissions to the Intensive Care Unit of a Teaching Hospital.

Inurika Ratnaweera [1], Nelun de Silva[2]
[1]Research student, [2]Senior lecturer, Department of Microbiology, Faculty of Medicine, Galle

Introduction:

Intensive care unit (ICU) care requires expensive technology and accounts for as much as 10 percent of all health care costs [1]. The outcome of critically ill patients is therefore of importance not only to the patients and their families, but also to society. Following admission to the ICU, the outcome is dependent upon both the primary illness and, in many cases, the presence or absence of multiorgan involvement.

The numbers of ICU beds required for an institution vary between 3% and 25% of the total hospital beds, with an average of 12% for major adult and general hospitals. Currently, ICU beds constitute 7–8% of all hospital beds. The number of beds required for any institution varies, depending on the patient population served.

It is still uncertain whether ICU care decreases patient morbidity and mortality. Reports in the literature are conflicting. Several early studies demonstrated a significant benefit of ICU care when specialty units were reviewed. A reduction in mortality has been reported for coronary ICU patients, burned patients, noncardiac surgical patients and trauma.

Methodology:

As part of an ongoing study of nosocomial infections in the ICU, an audit was carried out regarding all admissions to the six beds Intensive therapy unit (ITU) of TH Karapitiya for duration of one year. A register was maintained of each patient who was admitted to the ITU and data such as the duration of stay, clinical diagnosis, development of nosocomial infections and the outcome of each patient were recorded.

Results:

The total number of beds in the TH Karapitiya is 1100 of which 22 are allocated for intensive care. This does not include floor patients which consist of about 400-500 per day. There were a total number of 456 admissions to the ITU for one year. Males constituted 55% and females 45%. A diagnosis was documented in 324 of these cases.

Clinical entities for which ITU admission was sought are as follows:

Road traffic accidents	Poisoning	Cancer oesophagus	Pregnancy induced hypertension	Guillain-Barre synd.	PPH	Snake bite	Dengue
31(9.6%)	**23** (7%)	**18** (5.5%)	**15** (4.6%)	**13** (4%)	**12** (3.7%)	6 (1.9%)	**6** (1.9%)

Of the total admissions, 69% were sent back to the respective wards after successful ICU management. Deaths in the unit accounted for 30.87%.

301 patients had a short duration of stay in the ITU (<3 days). The majority of them were admitted for postoperative care. 155 patients stayed more than 3 days in the ITU with an average duration of 6.46 days. Among these patients, 101 ( ) were sent back to the ward and there were 54 deaths (31%). Bed occupancy was 134%.

Discussion:

The number of beds in ITU of TH Karapitiya in relation to the total number of in-patients is woefully inadequate. The mortality rate of 30-31% is compatible with other units world wide. There is high turn over indicated by a bed occupancy rate of 134%.

References

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2. Weiss, SM, Hudson, LD. Outcome from respiratory failure: Predicting intensive care unit outcome. Crit Care Clin 1994; 10:197.

4. Ventilator associated pneumonia in and intensive care unit of a teaching hospital. *Nelun de Silva, I. Ratnaweera,* Proceedings of the Annual Academic sessions of the Sri Lanka College of Microbiologists. June 2003: ØP23

Ventilator Associated pneumonia in an Intensive Care Unit

Inurika Ratnaweera [1], Nelun de Silva [2]

[1] ***Research officer*** [2]***Senior Lecturer, Department of Microbiology, Faculty of Medicine, Galle***

Introduction:

Ventilator associated pneumonia (VAP) refers to nosocomial bacterial pneumonia that has developed in patients who are being mechanically ventilated. Intubation increases the risk of nosocomial pneumonia 6 to 21 fold. Mortality for nosocomial pneumonia ranges from 20% to 50%.

Objectives:

The objectives of this study were to determine the prevalence of VAP in intubated patients, isolate and identify the bacteria causing VAP, determine the antibacterial susceptibility of the isolated bacteria and define the criteria that can be used for diagnosing VAP.

Design , Setting and Methods:

This was a prospective study undertaken in the Intensive Therapy Unit (ITU) of Teaching Hospital Karapitiya and Department of Microbiology, Faculty of Medicine, Galle. During a period of 14 months patients admitted to this unit and subsequently ventilated , were screened for bacterial colonization at 24 and 72 hours after admission. Subsequently, specimens were collected when there was evidence of clinical sepsis.

Results:

During this period 324 endotracheal aspirates were collected from 165 ventilated patients admitted to the six bed ITU. Of these, 119 patients stayed in the ITU for more than three days. Among the 165 patients, eleven (6.7%) developed VAP, of which one was early onset. Pseudomonas species (32%), *Staphylococcus aureus* (26%), Acinetobacter species (11%) and Klebsiella species (11%) were the predominant bacteria isolated.

Conclusions:

In the study, 6.7% of intubated patients developed VAP. The mortality rate of 27%, was comparable with rates found elsewhere. The isolation of multi resistant Gram negative bacilli and Methicillin resistant *Staphylococcue aureus* from patients with VAP is a cause for concern.

5. Blood Stream Infections in a general intensive care unit
Inurika Ratnaweera[1], Nelun de Silva[2] Journal of the Galle Medical Association Sept. 2003: OP 21

Blood Stream Infections in a general intensive care unit

Inurika Ratnaweera[1], Nelun de Silva[2]

1. Research student 2. Senior lecturer, Department of Microbiology, Faculty of Medicine, Galle

Introduction

Nosocomial blood stream infections (BSI) are an important cause of morbidity and mortality affecting more than 20,000 patients per year. They compromise about 14% of all hospital-acquired infections. BSI contribute to more extra hospital days and cause more deaths than any other nosocomial infection, and they rank second to lower respiratory infections in intensive care units (ICU).

BSI can be either primary (i.e. direct infection from a vascular line infection) or secondary. Secondary infections are related to infections at other sites, such as the urinary tract, lung, postoperative wounds, and skin. Primary BSI accounts for the majority (64%) of nosocomial BSIs.

Objectives

1. To determine the prevalence of blood stream infections among patients admitted to ICU.
2. To isolate and identify the bacteria causing BSI.
3. To determine the antibiotic susceptibility of the significant isolates causing BSI.

Materials and Methods

Patients admitted to the intensive therapy unit (ITU) of TH Karapitiya during a period of 14 months were included in this study. Specimens of blood for culture were collected when there was clinical suspicion of sepsis. Two specimens of blood were collected at an interval of not less than two hours and from two different sites. 5–6ml of blood was collected from an adult and 2-3ml from a child and inoculated into bottles containing 19ml and 9ml of growth medium respectively. The blood cultures were processed according to standard laboratory procedures.

Results

During the study period, 146 specimens of blood for culture were collected from 97 patients admitted to the 6 bed ITU. From 27 patients blood was cultured more than once.
Bacterial isolates were recovered from 40 specimens of blood of which 11 were considered to be contaminants. This was due to the incompatibility between the isolate and the clinical condition of the patient. Six of the significant isolates were recovered after 72 hrs incubation.
Among 97 patients, 28 patients (28.9%) developed a BSI. Of these, seven were considered to be primary BSI because of isolation of the same organism from the IV cannula tip and blood culture.
The predominant organisms causing a primary BSI were Coagulase negative *Staphylococcus* (85.71%). Secondary BSI were caused by *Aceinetobacter* (18.18%), *Klebsiella* (18.18%), *Pseudomonas* (13.64%) and *Staphylococcus aureus* (13.64%) were the most commonly isolated organisms in this study.

Conclusions

The prevalence of primary BSI seems to be low when compared to rates elsewhere. The removal of IV cannulae in 48 to 72 hours and minimal use of long term indwelling catheters could account for the lower rates. However the rate of secondary BSI is (75.86%) high. The mortality rate of 14.28% is compatible with those in other institutions world wide.

Acknowledgements

The authors acknowledge funds for the project from the Faculty of Medicine, Galle and the National Science Foundation.

6. Nosocomial infections in the intensive care setting: Guidelines for establishing a microbiological diagnosis and antibiotic therapy. *Nelun de Silva*, Journal of the Galle Medical Association Sept. 2003.

Nosocomial infections in the intensive care setting-Guidelines for establishing a microbiological diagnosis and antibiotic therapy. Dr. Nelun de Silva, Senior Lecturer, Department of Microbiology, Faculty of Medicine, Galle

Prevalence of Nosocomial or Hospital associated infections in intensive care units (ICU) is high and is associated with the use of various invasive procedures and devices that are used to keep the patients on life support. (1)These are mainly endotracheal tubes used for ventilating, urinary catheters and parenteral lines. These bypasses the normal immune mechanisms which are the sentinels for warding off infectious agents and the micro-organisms are literally given access to the routes to cause infections at various sites. The results are nosocomial infections such as urinary tract infections (UTI), ventilator associated pneumonia (VAP) and blood stream infections (BSI). For any infection to occur three factors are needed and the severity of the infection depends on the interplay between these three factors – namely a source of organisms, a route of infection and a susceptible host.

Source of organisms

Sources of infection in the ICU are both exogenous and endogenous. Exogenous sources are the microbes in the environment of the ICU, such as the multiply resistant Gram negative enterobacteria, Pseudomonas species and the Gram positive methicillin resistant Staphylococcus aureus (MRSA) and enterococci , which are the hospital resident microflora (2). These organisms can make their way into a patient through contaminated devices and water in humidifiers and nebulisers. But the most common way in which these organisms enter, colonise and perhaps cause infections in patients is through the hands of the doctors, nurses and all other health care workers (HCW's) attending on the patient.
The endogenous source is the patients' own microbial flora on the skin and mucous membranes. These are susceptible strains at the beginning of the patients stay in the ICU but which become altered very soon as days go by and patients get colonised by the resident ICU resistant flora, especially under the selection pressure of 'prophylactic ' antibiotics used widely and indiscriminately in the ICU's.
The routes of infection and the susceptible hosts are part and parcel of any ICU setting and are beyond the control of the caregivers. But the sources of infection are elements that we have some measure of control and this is where simple, non-antibiotic and sustainable interventions can help to prevent, control and limit the spread of nosocomial ICU infections.

Surveillance

When patients are admitted to the ICU, from the wards or from peripheral hospitals, they are invariably under cover of many antibiotics that have been started empirically. On admission it is necessary to assess and justify the need for the continuation of these antibiotics. For example if an obvious localised infection or sepsis is present, antibiotics are needed. The prophylactic use of antibiotics should be discouraged. Antibiotics are not indicated simply because the patient is in the ICU and is

being ventilated or catheterised. If the patient is already on a particular antibiotic for > 5 days, consider omitting the antibiotic or changing it if there is sepsis. Prior to changing the antibiotic, appropriate microbiological sampling should be undertaken: eg. Endotracheal aspirates, two specimens of blood for culture, surface swabs and a catheter specimen of urine (3). Fever, increased oxygen requirement, tachypnea, superficial wound or intravenous line infections, increased total white blood cell count with a polymorphonuclear leucocytosis and positive blood cultures are some of the clinical and laboratory criteria that can be taken to indicate the presence of sepsis.
After taking specimens empirical antibiotic therapy can be started if the patient is very ill and there is a dire need for antibiotic, otherwise it would be prudent to wait for 24 to 48 hours for laboratory reports and start on specific narrow spectrum antibiotics if and when indicated.
Currently, the antibiotics that are recommended as a first line empirical therapy for sepsis are a synergistic combination of coamoxiclav and an aminoglycoside. (this regime can change from time to time depending on the susceptibility patterns of the isolates of bacteria in the ICU and will be determined by the Microbiologist.). In the absence of sepsis and in the case of long term patients in the ICU, surveillance specimens for detecting nosocomial infections can be undertaken from time to time. Blood cultures, catheter specimens of urine, tracheal aspirates and surface swabs can be sent on a regular basis for microbiological diagnosis or whenever there is an indication of developing sepsis.

Specific Nosocomial infections – surveillance and antibiotic therapy

CATHETER ASSOCIATED UTI –
An algorithm for managing UTI in catheterised patients is given below.

Unexplained fever in a catheterised patient around the 6th to 7th day of the indwelling catheter
Collect an aspirated sample of urine from catheter and transport without delay for culture and ABST

Heavy growth of any organism ← ↓ → No growth → no intervention needed

↓

Change catheter and send a repeat sample of urine for culture & ABST

Growth persists + fever (no other cause is found) ← ↓ → No growth → no intervention

↓

Consider a narrow spectrum antibiotic or change antibiotic according to ABST report.
When indicated the narrowest spectrum antibiotic should be given and if there are no other associated infections, urinary antiseptics such as nitrofurantoin or nalidixic acid will suffice provided the isolated bacteria are susceptible to them.

VENTILATOR ASSOCIATED PNEUMONIA
Ventilator-associated pneumonia (VAP) refers to pneumonia occurring at least 48 hours after intubation in a mechanically ventilated patient without clinical evidence of pneumonia prior to intubation.
The two most important routes of bacterial invasion of the lower respiratory tract are aspiration of oropharyngeal secretions and inhalation of aerosols containing bacteria. Current evidence strongly supports aspiration as the most important cause of nosocomial pneumonia (4).
Etiology - Nosocomial pneumonias are frequently polymicrobial, with Gram negative bacilli predominating. Some of the common pathogens isolated are Pseudomonas aeruginosa, Staphylococcus aureus , Enterobacteriaceae species (eg. Coliforms , Klebsiella species, Escherichia coli), Haemophilus influenzae and Serratia marcescens.
Risk Factors And Prevention - The most significant risk factor for nosocomial pneumonia is mechanical ventilation. Intubation increases the risk of nosocomial pneumonia 6 to 21-fold. Other risk factors which have emerged from multivariate analysis include age >70 years, chronic lung disease, depressed consciousness, large volume aspiration, chest surgery, frequent ventilator circuit changes, H-2 blocker or antacid therapy, transport from the intensive care unit for diagnostic or therapeutic procedures, and previous antibiotic exposure, particularly to third generation cephalosporins used for empiric treatment of suspected gram-negative infections(5)
Ventilator circuits changes - in an attempt to lower the risk of infection; daily changes were done in many hospitals. However, changing ventilator circuits is not a benign procedure, particularly for critically ill patients and have no beneficial effect on the development of VAP.
Decontamination of the digestive tract – This is another strategy which aims to decrease the incidence of nosocomial pneumonia by preventing oropharyngeal and gastric colonization with aerobic Gram

negative bacilli and Candida species. In guidelines for the prevention of nosocomial pneumonia published in 1997, the Centers for Disease Control and Prevention stated that available data do not justify the routine use of SDD in intensive care unit patients (6).
Although no effect of patient positioning on mortality has been demonstrated, it seems prudent to preferentially place intubated patients in the semi recumbent position unless contraindicated.

Diagnostic Methods -
The diagnosis of nosocomial pneumonia usually relies upon the following constellation of findings:
- Peripheral leukocytosis (>10,000/mm3)
- Fever
- New or persistent infiltrate on chest x-ray, with a concurrent deterioration in gas exchange.
- Change in the color and consistency of sputum is helpful in ventilated patients.
- Purulent sputum

(>25 polymorphonuclear leukocytes with less than 10 squamous epithelial cells per power field)
- A significant respiratory pathogen predominating on Gram stain and culture

However, many non-infectious causes of fever and pulmonary infiltrates can also occur in these patients, making the above clinical criteria non-specific for the diagnosis of VAP.
Microbiological specimens for culture and ABST :
Airway Sampling – Sputum/ tracheal aspirates are routinely obtained for Gram stain and culture. Although Gram stain may be useful, culture results tend to be unreliable due to contamination with bacteria colonizing the oropharynx, other than when S. aureus is isolated. Bronchoscopic sampling of the lower airways or bronchoalveolar lavage is accepted as the most accurate method of diagnosing VAP. Tracheal aspirates are nonspecific for establishing the diagnosis of VAP, because tracheobronchial bacterial colonization is common in critically ill patients. Quantitative bacterial cultures are some of the methods to improve diagnostic specificity of tracheal aspirates. But tracheal aspirate cultures can be used to guide antibiotic therapy in long-term mechanical ventilation who have clinical pneumonia. When antibiotics have been given previously, the sensitivity of Gram stain & culture is reduced. But in superinfection, lower airway cultures can predict reasonably the causative microorganisms.
Potassium hydroxide staining for the presence of elastin fibers (which are an indication of parenchymal necrosis due to VAP) in sputum or ET aspirates is said to increase the specificity of the isolate on culture.
Blood cultures are extremely helpful when positive, but the yield is only six percent.
Radiographic diagnosis – The finding of air bronchograms was the only radiographic sign that might predict the presence of VAP.
Interpretation of cultures of tracheal aspirates or sputum
The isolation of a bacterial species in such specimens does not always imply an infection but may reflect oropharyngeal colonisation. Points in favour of a pathogen are the presence of pus cells / hpf, absence of epithelial cells and a high colony count together with the clinical signs mentioned earlier. Invariably any isolate is tested for its antibiotic susceptibility and reported but caution is indicated before changing or starting an antibiotic simply because an ABST report is available.

Treatment
If treatment is indicated, the choice of antibiotic should be based on patient's recent antibiotic therapy, the resident flora in the ICU, the presence of underlying diseases, and available culture data.
If no specific pathogen is identified empiric treatment is given to cover Enterobacter sp., Klebsiella sp., E. coli, Proteus sp., S. marcescens, Haemophilus influenzae, methicillin-sensitive S. aureus, and Streptococcus pneumoniae. (coamoxiclav + aminoglycoside)
Patients who have aspirated, have underlying conditions (eg, recent abdominal surgery, coma, head injury, diabetes mellitus, renal failure, structural lung disease), are being treated with steroids or antibiotics, or have had a prolonged ICU stay may also require coverage for anaerobes, methicillin-resistant S. aureus (MRSA).., coverage of P. aeruginosa and antibiotic-resistant Gram negative bacilli, such as Acinetobacter sp., should be considered. Vancomycin or teicoplanin + antipseudomonas agent
The duration of therapy is based upon the clinical response, but the usual initial course is 10 to 14 days for most pathogens, and approximately three weeks for S. aureus, P. aeruginosa, Acinetobacter sp.

BLOOD STREAM INFECTIONS

A primary bacteraemia or septicaemia is one, which arises out of a line infection and caused by the surrounding colonising skin flora such as coagulase negative staphylococci, micrococci and diptheroids.

Secondary bacteraemia arise from a focus of infection elsewhere in the body from which bacteria are shed intermittently into the blood stream.

Host risk factors commonly associated with nosocomial bloodstream infections are extremes of age, increased number and severity of underlying illnesses, malnutrition, loss of skin integrity, as with burns and immune system debilitation especially neutropenia

Other risk factors

Other than the type of catheter itself, the most important extrinsic risk factors associated with the development of intravascular catheter associated bloodstream infections include the location of the catheter, duration of catheterization, conditions of insertion, catheter-site care and the skill of the catheter inserter.

Risk factors for infection with peripheral intravenous catheters include lower extremities more than upper extremities, wrist more than hand and placement longer than three days. Risk factors for infection with arterial catheters include colonization at catheter site and catheterization longer than four days. Risk factors for infection with pulmonary artery catheters include catheterization longer than three days, colonization of skin at insertion site, and internal jugular more than the subclavian .

Risk factors for infection with central venous catheters include internal jugular more than subclavian , repeated catheterization, presence of septic focus elsewhere and nontunnelled more than tunnelled.

Catheter care factors – The following catheter-care factors affect the risk of infection:

- Insertion circumstance – emergency more than elective
- Skill of the inserter – general more than specialized
- Type of dressing – transparent more than gauze
- Skin under dressing – moist greater than dry
- Cutaneous antiseptics
  – 70 percent alcohol and 10 percent povidone iodine more than 2 percent chlorhexidine

Laboratory Diagnosis

Apart from the clinical signs of sepsis, laboratory confirmation of bacteraemia with positive biood cultures is useful to ascertain the pathogen and its antibiotic susceptibility to optimise treatment. Isolation of bacteria from the blood is usually indicative of a bacteraemia if measures have been taken to prevent contamination at source and in the laboratory. To prevent contamination at source and increase the specificity of blood cultures, the site from which blood is drawn must be cleaned and disinfected thoroughly. An effective antiseptic such as 70% alcohol, povidone iodine of chlorhexidine can be used singly, or in combination, but sufficient time must be given for the antiseptic to achieve its bactericidal action. Aseptic procedures must be maintained throughout the procedure. Blood should be collected by separate venipuncture, and not through indwelling vascular catheters.

The other factors that affect the sensitivity and specificity of blood cultures are:

Volume of blood collected – a minimum of 5 ml of blood from an adult, 2-3 ml from a child and 1-2 ml from a neonate should be collected

The dilution factor of blood to media which should be maintained between 1:10 to 1:5

Taking blood prior to antibiotic therapy

Presence of an anticoagulant such as liquoid in the media to neutralise inhibitory activity of serum

Time of collection – In bacteraemia and septicaemia there may be intermittent release of organisms and taking blood for culture at the height of a spike of fever may increase the chance of isolation.

Site of collection- sites that are heavily colonised with skin bacteria such as the femoral vein may not be ideal since vigorous methods need to be employed to get rid of the colonising flora (7)

Interpretation of positive blood cultures and antibiotic treatment:

The isolation of an organism such as coagulase negative staphylococci, diptheroids etc. in a single blood culture, is difficult to interpret and may not be evidence of the presence of septicaemia. It should be accompanied by clinical features of sepsis such as fever (>38°C); hypotension (systolic pressure <90 mmHg); or oliguria (>20 mL/h.). If however the same organism is isolated in two blood cultures taken from different sites, then it is significant and implies underlying sepsis. Specific antibiotics according to the ABST should be chosen and treatment started as soon as possible.

General guidelines in the choice of antibiotics

Determine if the isolate is the pathogen or whether it is colonising flora or a contaminant

Consider the ABST profile of the likely pathogen – the organism should be susceptible

Consider the availability of the antibiotic as well as a regular supply of the chosen antibiotic especially when the antibiotic is not available in the indoor pharmacy and has to be purchased locally.
Definitive antibiotic therapy have to be continued for at least 10 – 14 days if the patient is responding.
A narrowest spectrum antibiotic is better if the organism is known
Synergistic combinations such as beta lactam + aminoglycoside achieve better therapeutic responses.
In documented MRSA infections (not colonisers) vancomycin or teicoplanin is the drug of choice.
Enterobacteria that are isolated in ICU's may be producers of extended spectrum beta lactamases (ESBL). Cephalosporins are then not effective but carbapenems should be used instead.
Infection control measures in the ICU
It cannot be overemphasised that hand washing by the health care staff before and after patient care is one of the most important ways of controlling cross infection between patients, from HCW to patient and vice versa. Barrier nursing and source isolation should be instituted whenever patients are detected with MRSA, pulmonary tuberculosis, rabies and other infections that have the propensity to spread readily and easily in patients in the ICU (8).
Optimum utilisation of the laboratory and effective communication between the microbiologists, infection control officers, pharmacists ensuring a multidisciplinary approach is essential to control and prevent nosocomial infections in the ICU.

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Section 4

– Impact of research results

1. Guidelines were established in the ITU for collection of appropriate specimens for microbiological investigations and also for management of nosocomial infections. These were given to the ITU in the form of charts and algorithms.

CHART:
MICROBIOLOGICAL INVESTIGATIONS OF PATIENTS ADMITTED TO INTENSIVE THERAPY UNIT OF TH KARAPITIYA

TYPES OF SPECIMENS

Surveillance samples samples

Diagnostic

Surveillance samples

SAMPLES FROM BODY SITES WHERE POTENTIAL PATHOGENS ARE CARRIED

e.g throat swabs, MRSA screening swabs

Time of collection of surveillance samples

★ On admission to the ITU.
★ Twice weekly thereafter.
E.g. Mondays & Thursdays

Diagnostic samples

SAMPLES FROM BODY SITES THAT ARE NORMALLY STERILE.

Time of collection of diagnostic samples

★ Samples are obtained whenever there is clinical indication of inflammation.

Methods of collection of appropriate diagnostic samples

Tracheal aspirate -

- **Rinse the lower airway with 5 ml of sterile saline. (Use a maximum of 40 ml of saline)**
- **Suction out the secretions into a sterile vial.**

Urine -

- **Catheter tubing is clamped distally from the sampling site.**
- **Disinfect the site with 0.5% chlorhexidine or 70% alcohol or betadine.**
- **Take 2-3 ml of urine from that point using a sterile needle.**

Blood -

- **Disinfect the peripheral vein area where blood is going to obtain using 0.5% chlorhexidine in 70% alcohol or betadine.**
- **Collect two appropriate specimens of blood at an interval of not less than 2 hours & from two different sites.**
- **Collect 5-6 ml of blood from an adult and 2-3 ml from a child & put into bottles containing 19 ml & 9 ml of BHI broth respectively.**

ALGORITHM FOR MANAGEMENT OF CATHETER ASSOCIATED UTI

Unexplained fever in a catheterised patient around the 6th to 7th day of the indwelling catheter

↓

Collect an aspirated sample of urine from catheter

& transport without delay for culture &ABST

↓

Heavy growth of any organism ←→ No growth → no intervention needed

↓

Change catheter and send a repeat sample of urine for culture & ABST

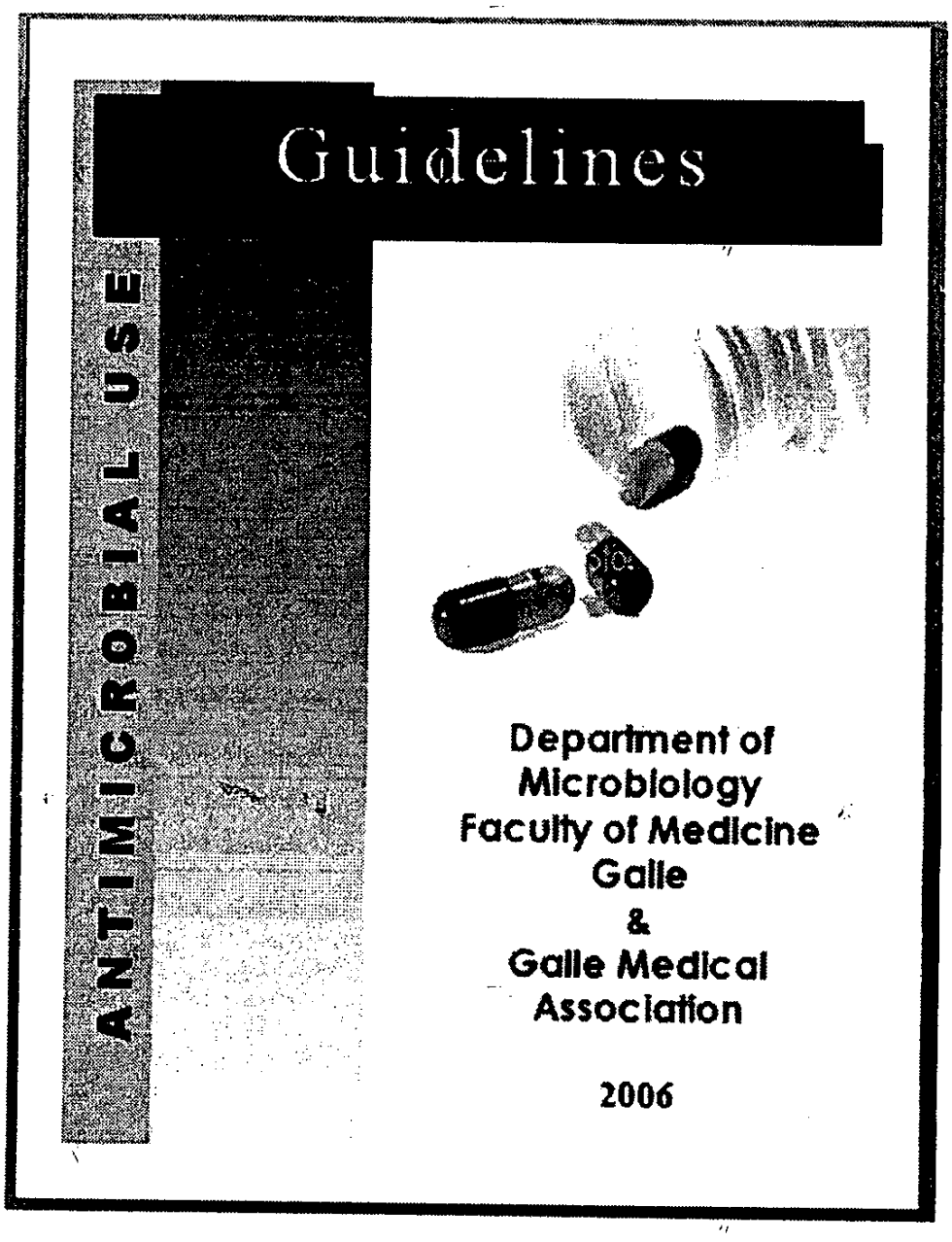
↓

Growth persists + fever (no other cause is found) ←→ No growth → no intervention

↓

Consider a narrow spectrum antibiotic or change antibiotic according to ABST report.

2. The Department of Microbiology, Faculty of Medicine, Galle together with the Galle Medical Association developed guidelines for antimicrobial use in TH Karapitiya and TH Mahamodera. The guidelines for antibiotic usage in the Intensive Therapy Unit (ITU) of TH Karapitiya were developed as a result of our study conducted in the ITU.



Guidelines for antimicrobial use in special units- Empiric therapy in ITU

Subset	Usual pathogens	Preferred IV therapy/duration	Alternate therapy Remarks
Respiratory Infections			
Epiglottis	*Haemophilus influenzae*	Amoxycillin /clavulanic acid 1000/200 mg 8 hourly	Cefotaxime 1gm 8 hourly
Community acquired pneumonia, admitted & transferred to ITU within 48 hrs.	pneumococci, *Haemophilus influenzae, Mycoplasma pneumoniae, Chalmydia pneumoniae, S. aureus, Klebsiella pneumoniae*	Ceftriaxone 2 gm 12 hourly **OR** cefotaxime 2gm 6 hourly + clarythromycin 500 mg 12 hourly.	No response in 48 hrs. consider de escalation therapy on advice by microbiologist. Imipenem 1gm 6-8 hourly **OR** meropenem 1 gm 8 hourly + vancomycin 1 gm 12 hourly
Overwhelming pneumonia in otherwise healthy hosts; consider melioidosis	*Pseudomonas pseudomallei*	Meropenem 2gm 8hriy + ciprofloxacin 800mg bd	
Community acquired pneumonia, admitted & treated for > 72 hrs		Consider de escalation therapy on advice by microbiologist. Imipenem 1gm 6-8 hourly **OR** meropenem 1 gm 8 hourly + vancomycin 1 gm 12 hourly +ciarythromycin 500 mg 12 hourly .	
Ventilator associated Pneumonia	Pseudomonas Acinetobacter Klebsiella enterobacteria – coliforms' MRSA	Ceftazidime 1-2 g 8 hourly **OR** Imipenem 1gm 6-8 hourly + amikacin 15 mg/kg or 1g once daily OR netilmicin 7.5 mg/kg daily	Poor response refer to Microbiologist. Consider cover for MRSA vancomycin 1 gm 12 hourly
Abdominal Infections			
Sepsis with intra abdominal source – Community acquired Post surgical- complicated procedures	E. coli, enterobacteria enterococci, anaerobes	Amoxycillin /clavulanic acid 1000/200 mg 8 hourly + metronidazole 500 mg 12 hourly	Poor response refer to Microbiologist
Primary Peritonitis		Cefotaxime 1-2 gm 8 hourly **OR** ceftriaxone 2 gm 12 hourly	
Pancreatitis (acute haemorrhagic)		Imipenem 1gm ,6-8 hourly **OR** meropenem 1 gm 8 hourly	De escalation therapy essential
CNS Infections			
Cerebral abscess – primary/contiguous source	Streptococci, Bacteroides, EnterobacteriaS. *aureus*	Cefotaxime 2 gm 6 hourly **OR** ceftriaxone 2 gm 12 hourly + metronidazole 500 mg 12 hourly	Poor response refer to Microbiologist
Cerebral abscess- post surgical /post traumatic	Enterobacteria, *S. aureus*	Cloxacillin 2 gm 6 hourly + cefotaxime 2 gm 6 hourly **OR** ceftriaxone 2 gm 12 hourly	
Bacterial meningitis- post neuro surgery or trauma	Pneumococci, *S. aureus*, coliforms, pseudomonas	Ceftazidime 2 g 8 hourly + vancomycin 1 gm 12 hourly.	
Sepsis			
Severe sepsis, source unclear, life threatening	aerobic Gram-ve bacilli & Gram +ve cocci	Imipenem 1g, 6 hourly **OR** meropenem 1 g 8 hourly + vancomycin 1 gm 12 hourly.	No response in 48 hrs. Refer to microbiologist
Sepsis related to biliary source	Enterobacteria	Ampicilin 1gm 6 hourly + ceftriaxone 2 gm 12 hourly	Ampicillin/sulbactam 3 gm 6 hourly
Intra abdominal source	Enterobacteria Enterococci	Ampicilin 1gm 6 hourly + ceftriaxone 2 gm 12 hourly **OR** ceotaxime 2 gm 6 hourly + metronidazole 500 mg 12 hourly	Imipenem 1gm, 6-8 hourly **OR** meropenem 1 gm 8 hourly
Sepsis related to UTI	Enterobacteria	Cefotaxime 2 gm 6 hourly **OR** ceftriaxone 2 gm 12 hourly	Aztreonam or ceftazidime
Sepsis related to cellulitis, necrotising fascitis, cutaneous abscesses	Streptococci, Staphylococci anaerobes	Imipenem 1g, 6-8 hourly **OR** meropenem 1 g 8 hourly + vancomycin 1 gm 12 hourly	

Section 5

– **Miscellaneous**

i) List of major equipment acquired during the project

- None

ii)

A. List of publications/communications arising from the project

1. An outbreak of methicillin resistant Staphylococcus aureus in an intensive care unit of a teaching hospital . *Nelun de Silva*, Inurika Ratnaweera, Shalini Perera. Journal of the Galle Medical Association Sept. 2002: 26-28
2. Bacteriuria and candiduria in catheterised patients in a general intensive care unit. Inurika Ratnaweera, *Nelun de Silva*, Asoka de Silva, Harindi Abeykoon. Proceedings of the Annual Academic sessions of the Sri Lanka College of Microbiologists. June 2002: OP5
3. An audit of admissions to the intensive care unit of a teaching hospital. Inurika Ratnaweera, *Nelun de Silva* ; Journal of the Galle Medical Association Sept. 2002: 02
4. Ventilator associated pneumonia in and intensive care unit of a teaching hospital. *Nelun de Silva, I. Ratnaweera*, Proceedings of the Annual Academic sessions of the Sri Lanka College of Microbiologists. June 2003: OP23
5. Blood Stream Infections in a general intensive care unit
Inurika Ratnaweera[1], *Nelun de Silva*[2] Journal of the Galle Medical Association Sept. 2003: OP 21
6. Nosocomial infections in the intensive care setting: Guidelines for establishing a microbiological diagnosis and antibiotic therapy. *Nelun de Silva*, Journal of the Galle Medical Association Sept. 2003

B. Presentations made at seminars, workshops etc.

1. Bacteriuria and candiduria in catheterised patients in a general intensive care unit. Inurika Ratnaweera, *Nelun de Silva*, Asoka de Silva, Harindi Abeykoon. Oral presentation at the Annual Academic sessions of the Sri Lanka College of Microbiologists. June 2002
2. An audit of admissions to the intensive care unit of a teaching hospital. Inurika Ratnaweera, *Nelun de Silva* ; Presentation at the Annual sessions of the Galle Medical Association Sept. 2002
3. Ventilator associated pneumonia in and intensive care unit of a teaching hospital. *Nelun de Silva, I. Ratnaweera*, Presentation at the Annual Academic sessions of the Sri Lanka College of Microbiologists. June 2003
4. Blood Stream Infections in a general intensive care unit,
Inurika Ratnaweera[1], *Nelun de Silva*[2] Journal of the Galle Medical Association Sept. 2003: OP 21

Section 6

– Summary statement of expenditure

Contract No: - **RG/2002/M/03**

Cheque No: - **792433**

Date of award of grant - **20-02-2003**

Date of receipt of funds - **10-03-2003**

Total allocation - **Rs. 150,360/-**

Total expenses

Year	Item	Total cost / Rs
2004	API Kits(Rapid onE) API Kits(Rapid NF Plus)	50,892.10
	Petri dishes	23,875.00
	Total expenses	**74,767.10**
	Balance	**75,592.90**
2005	CLED Agar	7,500.00
	Blood Agar Base	25,512.75
	MacConkey agar	17,675.50
	Petri dishes	23,875.00
	Total expenses	**74,563.25**
	Balance	**1,029.65**
2006	No expenses **Balance of the year 2006**	1,029.65
2007	No expenses **Balance of the year 2007**	1,029.65
2008	Report writing & printing	1,029.65
	Balance	Nil

Ventilator Associated Pneumonia (VAP) in an Intensive Care Unit.

Inurika Ratnaweera,
Nelun de Silva.

INTRODUCTION

- VAP - Nosocomial bacterial pneumonia developing in mechanically ventilated patients
- Intubation increases the risk of nosocomial pneumonia 6 – 21 fold.
- Mortality in VAP ranges from 9% - 60%.

OBJECTIVES

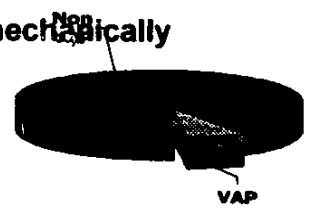
1. To isolate and identify the bacteria causing VAP.
2. To determine the prevalence of VAP in intubated patients.
3. To determine the antibiotic susceptibilities of the isolated bacteria.

METHODOLOGY.

- **Duration of study**
  - **14 months**
- **Population**
  - **Intubated patients in ITU**
    - **Endotracheal & tracheal aspirates collected**
    - **At 24 and 72 hours**
    - **Thereafter when there was evidence of sepsis**
- **Analysis of specimens**
  - **Microscopy – pus cells / organisms**
  - **Culture**
  - **ABST on significant isolates**

RESULTS

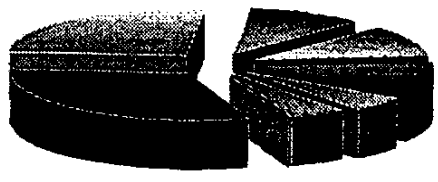
- **324 specimens from 165 mechanically ventilated patients.**
  - **Non VAP – 93.3% (154/165)**
  - **VAP- 6.7% (11/165)**



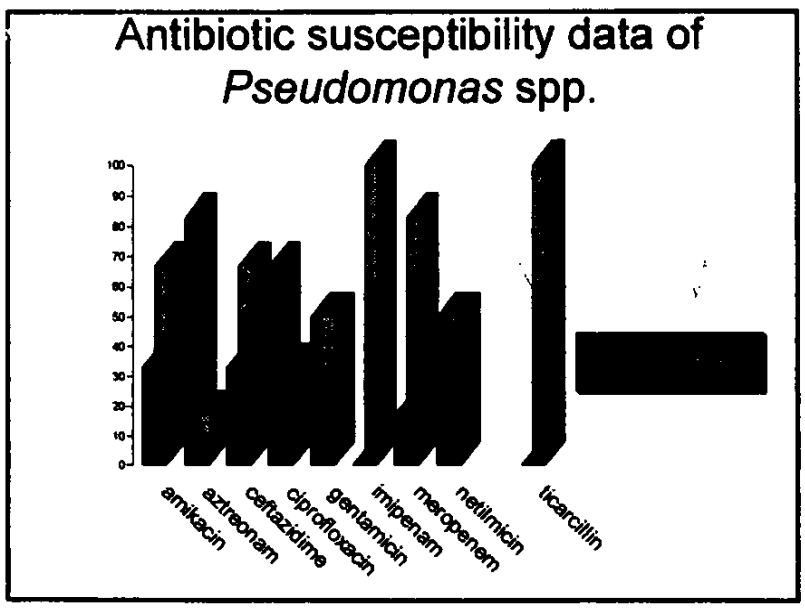
- **Mortality rate – 27.3%**

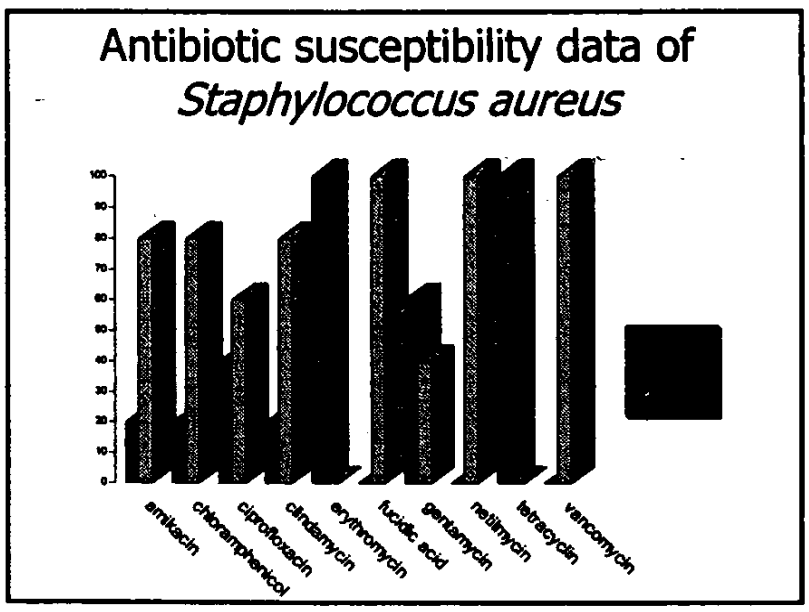
Predominant bacterial isolates –

- ***Pseudomonas* spp. - ( ) 32%**
- ***Staphylococcus aureus* - 26%**
- ***Acinetobactor* spp. - 11%**
- ***Klebsiella* spp. - 11%**



- **Psudomonas spp.**
- **Acinetobactor spp.**
- **Escherichia coli**
- **Streptococcus pneumoneae**
- **Staphylococcus aureus**
- **Klebsiella spp.**
- **Proteus spp.**





CONCLUSION

- 6.7% of ventilated patients developed nosocomial VAP.
- The mortality rate of 27.3%. was comparative to the rates found world wide.
- *Pseudomonas aeruginosa* was the major bacterial isolate identified
- With proper management & minimal antibiotic therapy only a small number of patients developed VAP.

Acknowledgements

- Dr. Wasantha Abeywardane, and other Consultant Anaesthetists of ITU
- Staff - ITU of Teaching Hospital, Karapitiya,
- Staff - Department of Microbiology, Faculty of Medicine, Galle

Thank you !

BLOOD STREAM INFECTIONS IN A GENERAL INTENSIVE CARE UNIT.

Inurika Ratnaweera
Nelun de Silva

Introduction

- Nosocomial blood stream infections (BSI)
  - Important cause of morbidity & mortality in our hospitals.
  - Comprise about 14% of nosocomial infections
  - Rank second to lower respiratory tract infections in intensive care units (ICU)

BSI
- Primary (i.e.direct infection from a vascular line infection)
- Secondary (i.e.infections related to infections at other sites)

- Primary BSI accounts for the majority (64%) of nosocomial BSIs.

Objectives

1. To determine the prevalence of BSI among patients admitted to ICU.
2. To isolate and identify the bacteria causing BSI.
3. To determine the antibiotic susceptibility of the significant isolates causing BSI.

Methodology

➢ **Setting:** TH Karapitiya
Intensive Therapy Unit (ITU)

➢ **Duration of study :** 14 months

➢ **Specimens for Microbiology:**
- Blood for culture
  - Two specimens of blood collected
  - Interval of not less than two hours
  - From two different sites.
  - When there was evidence of infection.

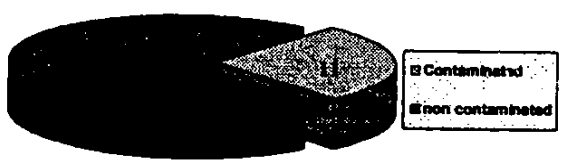
- Volume of blood required for culture

Age group	Volume of Blood /ml
Child	2-3
Adult	5-6

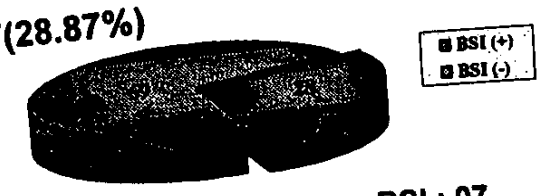
➢ Laboratory procedure for blood cultures
- Sub cultured after 24 hrs incubation
- Negative cultures incubated for 10 days
- Antibiotic susceptibility test on all isolates

Results

- Total No. of patients admitted to the ITU: 308
- No. of specimens : 146 from 97 patients
- Total no: of positive blood cultures : 40 (27.39%)
- Total no of contaminated blood cultures : 11/40 (27.5%)



- Total No. of patients who developed BSI: 28 /97(28.87%)



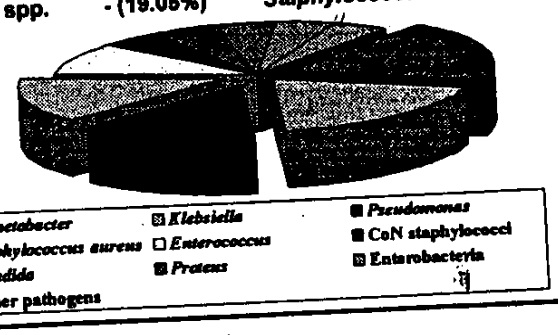
- Total No. of patients had primary BSI : 07
- Total No. of patients developing secondary BSI :21

- Mortality rate: 14.28%

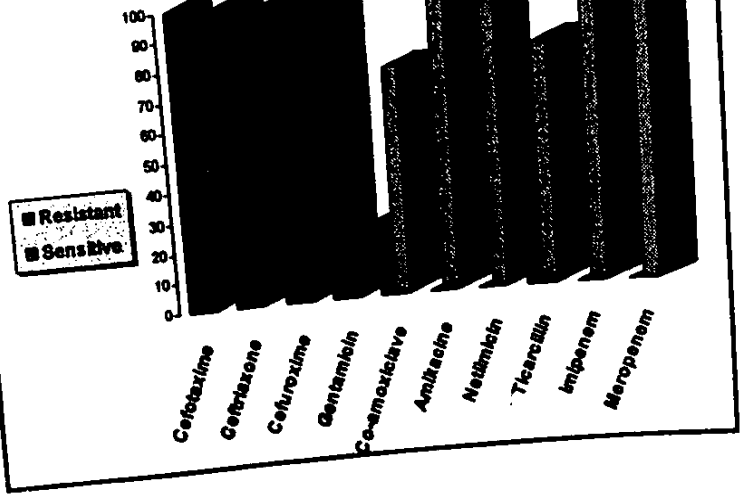
Bacterial isolates

- Organisms causing primary BSI:
  - Coagulase negative Staphylococci 6/7 (85.71%)
  - Enterobacteria 1/7 (14.29%)
- Organisms causing secondary BSI:

Acinetobacter spp. - (19.05%)
Klebsiella spp. - (19.05%)
Pseudomonas spp. - (14.29%)
Staphylococcus aureus - (14.29%)



Antibiotic Susceptibility Data of *Klebsiella*



Antibiotic Susceptibility Data of CON Staphylococci

Discussion

- Prevalence of primary BSI seems low, compared to rates elsewhere.
- However, rates of secondary BSI are high (75.86%).
- Mortality rate of 14.28% is compatible with those in other institutions world wide.

Acknowledgements

- Dr. Wasantha Abeywardane and other Consultant Anaesthetists of the ITU
- Staff of the ITU, Teaching Hospital, Karapitiya,
- Staff of the Department of Microbiology, Faculty of Medicine, Galle
- Faculty of Medicine, Galle and the National Science Foundation (NSF grant No. RG / 2002 / M / 03) – for providing funds for the project.

Thank you

Bacteriuria and candiduria in catheterised patients in a general intensive care unit

Inurika Ratnaweera,
Nelun de Silva, Asoka de Silva,
Harindi Abeykone

Introduction

- Catheterisation is a risk factor for development of UTIs.
- 80% of hospital acquired UTIs are associated with catheters.
- Bacteria produce a biofilm on catheter surface
  - Increases adherence
  - Impairs elimination by host defenses.

Objectives

- To determine the relevance of bacteriuria and candiduria to sepsis in patients catheterised for a long time
  - Isolate and identify bacteria and yeasts causing colonization or infection.
  - Determine the antibiotic susceptibility of bacteria isolated.
  - To determine significance of pus cells in bacteriuria and candiduria in determining sepsis.
  - To formulate guidelines for urinary catheter management.

Methodology

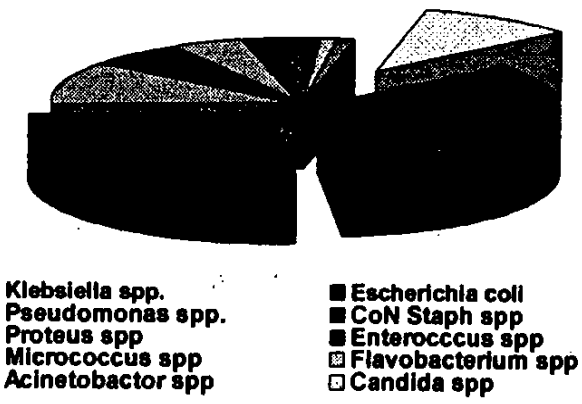
- Population
  - Catheterised patients in ITU
    - Urine collected by aspiration
    - At 24 and 72 hours
    - Thereafter when there was evidence of sepsis
- Duration
  - 10 months
- Analysis of specimens
  - Microscopy – wet mount → pus cells
  - Culture
  - ABST on significant isolates

Results

- 330 specimens from 195 catheterized patients
  - bacteriuria - 20.5% (67/330)
  - candiduria - 8.5% (28/330)

- Significant bacteriuria (>10^5 CFU/ml)
  - 73.9% (49/67)

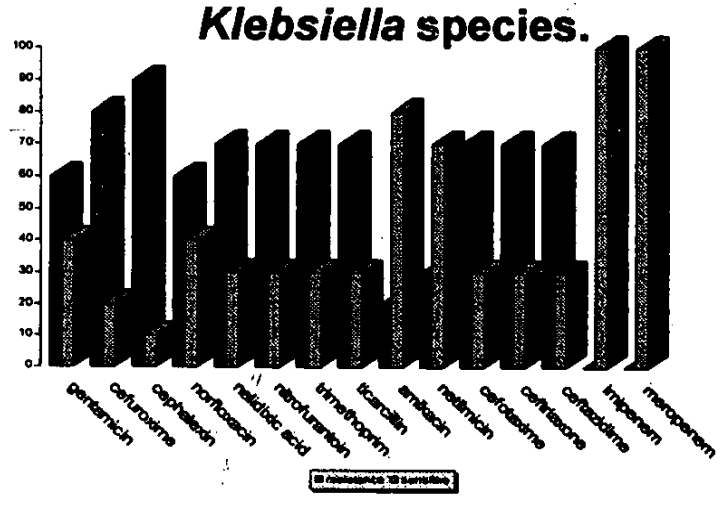
- Total number of isolates – 102
  - *Klebsiella* spp. - 27.5% (28/102)
  - *Escherichia coli* - 20.6 % (21/102)



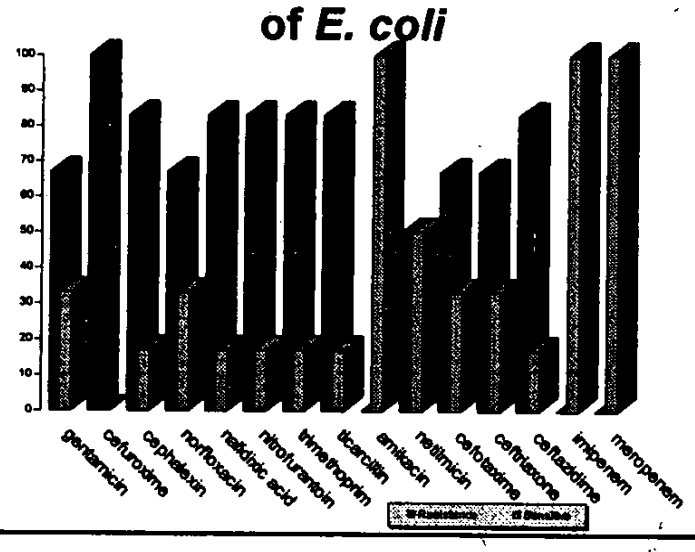
Results

- Patients with bacteriuria from day 01 = 32
  (Previously catheterised in ward)
- Patients catheterized in ITU and whose stay in ITU ≥ 3 days = 90
  - No. who developed bacteriuria
    - 20/90 (22.2 %)
      - Total no. of isolates = 23
      - *Klebsiella* 10/23 (43.5%) -*Escherichia coli* - 06/23 (26%)
    - No. who developed significant bacteriuria
    - 15/90 (16.7 %)
  - Evidence of developing clinical sepsis
    - 05/90 (5.6 %)

Antibiotic susceptibility data of *Klebsiella* species.



Antibiotic susceptibility data of *E. coli*



Results

Significance of pus cells

- Patients did not develop bacteriuria = 70
  - Total No. of urine specimens = 126

<5 / HPF	6-20 / HPF	>20 / HPF
121	05	00

- Patients developed significant bacteriuria = 15(>10^5 CFU/ml)
  - ≥ 2+ pus cells / HPF - 02/15 (13.3 %)
  - ≤ 2+ pus cells / HPF - 13/15 (86.7 %)

Results

Effects of catheter changes on significant bacteriuria

- No: with catheter changes on 5th to 7th day
  - 16/20
- No: who had reduction in colony count to < 10^4 CFU/ml
  - 13/16 (81.3%)

Candiduria

- Presence of candiduria – 17 (≥10^5 CFU/ml)
  - From day 01 – 10/17 (58.8%)
  - After day 03 – 07/17 (41.2%)
- *Candida albicans* – 35.3% (06/17)
- *Candida* spp. Other than *albicans*– 64.7% (11/17)
- Effect of catheter changes
  - No: with catheter changes on 5th to 7th day
    - 05
  - No: who had reduction in colony count
    - 05/05 (100%)

Candiduria

- Significance of pus cells
  - ≥ 2+ pus cells / HPF - 04/17 (23.5%)
  - ≤ 2+ pus cells / HPF - 13/17 (76.5%)

- Total No. of specimens = 28

<5 / HPF (1+)	6-20 / HPF (2+)	>20 / HPF (3+)
22	06	00

Conclusions

- Patients catheterised for a long time, need not always develop bacteriuria or candiduria.
- With proper management only a small proportion develop UTI and needs antibacterial therapy
  - Candiduria disappear with a catheter change.
- The presence of pus cells do not correlate with significant bacteriuria or subsequent UTI.

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Thank you

Antimicrobial use in ITU ,TH Karapitiya

Nelun de Silva
Varuna Navaratne

Principles of antimicrobial therapy

Get rid of pathogens from tissue

Factors that play a role

- Susceptibility of organism
- Concentration of drug at site
  - Dose and route of administration
  - Adequate levels for a defined period
- Local factors at site
  - Serum binding , pH
- Host defences to aid microbial clearance
- Adjunctive therapy
  - Drainage, relief of obstruction

Differences between in vitro testing and in vivo conditions

In vitro testing

- pH 7.2, aerobic
- Exponential growth
- Standard inoculum
- Constant concentration of drug

Conditions in vivo

- More acidic, anaerobic
- Organisms in lag phase
- Variable density
- Varying

Why treatment fails in clinical practice

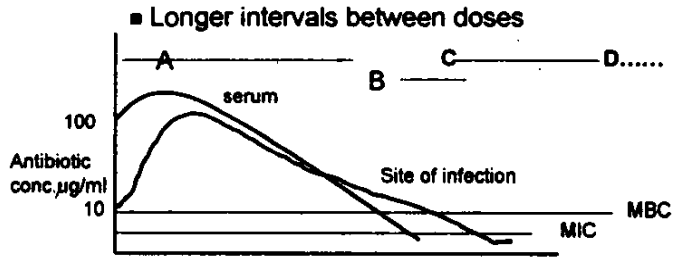
- Wrong organism
- Wrong drug
- Wrong dosage – fear of toxicity
- Wrong route of administration
  - Poor penetration to affected site
- Wrong treatment
  - Antibiotics alone are not enough
- Sub standard antibiotics

Prescribing antimicrobials in clinical practice

- Compromised patients
  - Immune compromised,
  - Underlying medical & surgical conditions
  - Invasive procedures
    - lines, catheters, ventilated
- Multi resistant resident flora
  - Pseudomonas, aceinetobacter
    - Moist niches – masks, ventilators, suckers etc.
  - Klebsiella, E.coli & other coliforms
  - MRSA,Vancomycin Resistant Enterococci
- Previous antibiotic use in wards
- Initiating & changing antimicrobial Rx
  - Whose responsibility is it ?

Pharmacokinetics

- Availability of antibiotics
  - Erratic
    - Weekends
    - Nights
    - Inadequate doses
    - Longer intervals between doses



A- free drug exceeds MBC B-free drug < MBS at site C- PAE D- regrowth

Rational antimicrobial therapy

Impact of rational antimicrobial Rx

- Not evident in rapidly fatal patients
- But in other categories of patients
- Over a period of time
- Improves patient outcome
- Reduces cost
- Decreases emergence of resistant strains
  - patient mortality
  - length of stay in ICU and the in the hospital
  - Cost of therapy & cost of management

Respiratory infections in ventilated patients

- **De escalation Rx**
  - Carbapenam (imepenam/meropenam) →Gram -ve
  - + glycopeptide (teicoplanin/vancomycin)→ MRSA & other Gram +
  - Or clarythromycin → Mycoplsma
  - Or quinolone – levofloxacin/ciprofloxacin
    - cannot guess
- **Duration**
  - Good response – maximum 6-7 days
  - Poor response
    - change after 3-4 days
    - Guided by culture reports & ABST of likely infecting flora

Respiratory infections in ventilated patients

- microbes
  - pneumococci, *Haemophilus influenzae, Mycoplasma*
  - *Staphylococcus aureus, Klebsiella pneumoniae*
- antibiotics given in ward
  - What were they? Dosage (adequate or not)
  - Duration - > 3-4 days → no response
- Sputum and blood for culture
- WBC/DC
- Chest X-ray
- Immediate de escalation Rx with antibiotics

Nosocomial infections in ventilated patients

Organisms	Antibiotics	
	1st line (community acquired)	2nd line (Hospital acquired
E. coli, coliforms	co amoxiclav gentamicin	amikacin netilmicin
Enterococci	ampicillin /co amoxiclav	vancomycin for ampicillin R strains
Anaerobes	metronidazole	
Pancreatitis - carbapenam - de escalation Rx is essential		

- 2nd line antibiotics supported by laboratory evidence
- No response after 3 days
  - U S scan for collections – repeat if necessary
  - drain pus
- Specimens – pus in syringe not on a swab

Nosocomial infections in ventilated patients

- **Colonisation by resident flora**
  - occur after 48 hrs.
  - Pseudomonas, Aceinetobacter, Klebsiella
  - Other Gram negative enterobacteria – 'coliforms'
  - MRSA
- Fever, ↑ O2 requirement
- X ray findings, raised neutrophil counts
- Endotracheal aspirates & blood for culture
- Antibiotics
  - Previous antibiotic therapy
  - guided by ABST patterns
  - Advice by Microbiologist

Antimicrobial prophylaxis in surgery

- Routine surgery
  - Keep under observation
    - Temperature, ...
  - Antibiotics not needed
  - Send back to ward soon
- Complicated procedures
  - Oesophagitis , resections
    - co amoxiclav + metronidazole

CNS infections

Cerebral abscess – primary /contiguous source		
Organisms	**Primary Antibiotics**	**Alternatives**
Streptococci, Bacteroides, Enterobacteria, *S. aureus*	cefotaxime or ceftriaxone + metronidazole	pen. G + metronidazole
Cerebral abscess- post surgical /post traumatic		
Enterobacteria, *S. aureus*	Cloxacillin + cefotaxime or ceftriaxone	Vancomycin + Cep 3
Bacterial meningitis- post neuro surgery or trauma		
Pneumococci, *S. aureus*, coliforms, pseudomonas	Vancomycin + ceftazidime	Cefotaxime or ceftriaxone

Sepsis

Severe sepsis, source unclear, life threatening	**aerobic Gram-ve bacilli & Gram + cocci**	Imipenem or meropenem + Vancomycin	APAG + Cep 3/4 or TC/CL
Sepsis related to biliary source	**Enterococci & aerobic Gram –ve bacilli**	Ampicillin sulbactam or Ticarcillin clavulanic	Cep 3 + metro
Intra abdominal source	**Aerobic & anaerobic Gram –ve bacilli & enterococci**	Imipenem or meropenem	Ampicillin +metronidazole +APAG OR Amp+metro+Cip
Sepsis related to UTI	**aerobic Gram –ve bacilli & enterococci**	ABST	
Sepsis related to cellulitis, necrotising fascitis, cutaneous abscesses	**Streptococci S. aureus Anaerobes Aerobic Gram -ve**	**Vancomycin** + Imipenem or meropenem	

Empiric therapy

- Febrile neutropenics not responding to antibacterial therapy
- Lab. evidence
- Persistent infections with no response
- Suspicion of superinfections

Treatment

- Candida
  - fluconazole or amphoterecin
  - voriconazole

Empiric therapy not indicated

- Guillain Barre
- Envenomation
  - Except when entry wound is infected
- CVA, MI
- OP poisoning
  - Except when aspiration & ARDS is suspected
- .....
- .....
- .....

Extended spectrum beta lactamase ESBL producing Gram negatives

- Many hospital strains of Gram negatives now produce ESBL
- Related to overuse of 3rd gen. cephalosporins
- Not detected during routine susceptibility tests
- Resistant to many classes of antibiotics
- Resistant to all beta lactam drugs except
  - Cephamycin & carbapenems
- Reducing the use of cepahlosporins

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