CHAPTER II

BACKGROUND

Nosocomial Infections (Hospital acquired infections, Hospital associated infections)

Nosocomial infections are the infections that develop within a hospital or are produced by microorganisms acquired during hospitalization (Bennett, Brachman, Finland, Craven and Altemeier, 1986). The criteria of nosocomial infection are :

a) Not present or incubating on admission

b) Infection temporally associated with admission to health care facility

c) An infection incubating at the time of admission related to previous hospitalization at the some facility (Soule, 1983)

There are specific definitions for each site of nosocomial infections such as surgical wound infection, urinary tract infection, respiratory tract infection, blood stream infection, skin and subcutaneous infection or other infections. Nosocomial infections have been a complication of patient hospitalization since the early nineteenth century (Ayliffe and Taylor, 1984). However, the subject was not seriously studied until 1950's. Around that time, it was suggested that every hospital should have a full time infection control officer in Great Britain (Ayliffe and Taylor, 1984). The United states of

America has focused on nosocomial infection since 1960's. Furthermore, in 1970, the Centers for Disease Control (CDC) started a National Nosocomial Infection Study (NNIS) involving about 338 hospitals in thirty-one states. Also the first international conference on nosocomial infections was held at the same year. In 1974, the Study on the Efficacy of Nosocomial Infection Control (SENIC) project was started by the CDC of U.S.A.

Nosocomial infections commonly involve four or five major sites. These are urinary tract infection, surgical wound infection, respiratory tract infection, bacteremia and skin and subcutaneous infection. Nosocomial infection rates vary from country to country. In the United Kingdom, the incidence rate of hospital acquired infection was 5% in 1980. The prevalence rate was 10% for the same year. From all the 10% of nosocomial infections, urinary tract infection was 30%, surgical wound infection 20%, respiratory infection 20% other infections 30% (Ayliffe and Taylor, 1984). In Belgium, in 1984, a national one-day survey of nosocomial infection in 106 Belgian acute care hospitals revealed a nosocomial infection rate 9.3% and the infection rate in surgical patients was higher (Mertens, et al., 1987). In the United states of America, the study on nationwide nosocomial infections in 6,449 acute-care U.S. hospitals in 1975-1976 revealed the nosocomial infection rate of 5.7 per 100 admissions and over 2 million nosocomial infections occurred in 12 month period. Of all infections, nosocomial urinary tract infection was 42%, surgical wound infections 24%, nosocomial

pneumonia 10%, nosocomial bacteremia 5% and other sites 19% (Haley, Culver, White, Morgan, and Emori, 1985). Nosocomial infection rates in USA., as the studies have shown, also varied according to types of hospitals. In university hospitals, the infections were about 4-9 per 100 admissions, averaging at 6 per 100 admissions (Wenzel, Osterman, and Hunting, 1976). In long term or chronic care facilities, the infection rates vary from 3.86 per 1000 patients care days to 0.85 per 100 patient care days (Farber, Brennen, Puntereri, and Brody, 1984; Alvarez, Shell, Woolley, Berk, and Smith, 1988).

In Thailand, the Ministry of Public Health did the pilot study on nosocomial infection by using a modified protocol from the CDC. The study was done from the 1st October to the 31st December 1985 involving seven regional and provincial hospitals of the Health Authority. The study showed the incidences of nosocomial infections varying from 27.3 - 64.3 per 1000 discharges, averaging 36.0 per 1000 discharges. Moreover, the bigger the hospitals the higher were the incidences of nosocomial infection (Pinyowiwat, et al.,1988). The latest nationwide study on nosocomial infections was done in May 1988 by Center for Nosocomial Infection Control, Siriraj Hospital using modified W.H.O. protocol. The study included seventeen provincial, four regional and one university hospitals. It was found that the average prevalence rate was 11.6%, 8.16% in the provincial hospitals, 18.8% in the regional and 9.2% for the university hospital (Danchaivijitr and Chokloikeaw, 1988).

In a university hospital (Siriraj Hospital), the infection rates varied from 9.39% to 14.49% (prevalence rate)

during the years 1983-1986 (Danchaivijitr and Waitayapiches, 1988). The prevalences of nosocomial infection in other university hospitals have varied from 9.2 to 14.49% in recent years. (Danchaivijitr and Waitayapiches, 1988; Srisupan, Senarat, Pichiansathien, and Tongsawat, 1988; Danchaivijitr and Chokloikeaw, 1988).

As previously mentioned, it is clear that nosocomial infection has occurred in most hospitals in every part of the world. It is estimated that millions and millions of patients might be affected each year. The infections affect not only hospitalized patients but also health care facilities and workers who work and contact with these patients. Patients with nosocomial infections have increased morbidity, mortality, medical expenses and duration of hospitalization (The Committee on Control of Surgical Infections of the Committee on Pre and Post Operative Care, 1976; Spengler and Greenough III, 1978; Freeman, Rosner, and McGowan,Jr., 1979; Cross, Nue, Aswapokee, Antwerpen, and Aswapokee, 1980; Haley, et al. 1981a; Soule, 1983; Pinyowiwat, et al. 1988; Jamulitrat, Varindsathien, Ngo, and Thongpiyapoom, 1989). Nosocomial infections interfere with both lifestyles and economics of the patients. Increased duration of hospitalization due to nosocomial infections will limit the capacity of health care facilities to render services to new patients especially for hospitals that have fixed or limited numbers of beds or do not have extra beds for new admissions. Moreover, nosocomial infections increase the hospital medical expenses due to multiple-microbial resistance (Schaberg, et al.,

1981; Lejeune, et al., 1986; Alford and Hall, 1987; Terpenning, Zervos, Schaberg, and Kauffman, 1988;), requiring multiple and more expensive antibiotics. This does affect not only the hospitals own budgets but also the country finances. This problem is serious especially for a developing country such as Thailand which has to import those antibiotics from abroad. Nosocomial infections involve in health care personnels in health care facilities. These personnels are at risks of being infected by the patients affected with such agents as hepatitis and, nowadays, the Acquired-Immune Deficiency Syndrome (AIDS). Even though the rate of transmission to health care personnels is is very low, it can be important in view of the ever increasing prevalences of HIV positive and AIDS patients admitted to hospitals since the increase of HIV positive people in the community is tremendous.

Epidemiology of Nosocomial Infection

Common sites of nosocomial infections in decreasing order of frequencies are urinary tract infection, surgical wound infection, respiratory tract infection, bacteremia, and skin and subcutaneous infection.

Sources of nosocomial infections are either endogenous infection (autogenous infection, self-infection) and exogenous infection. An endogenous infection originates from the patient himself. The normal body microflora represent no great danger to untraumatized person but when the body's defenses are breached in some way, certain microorganisms become pathogens. An exogenous infection (cross infection) is an infection which originates from

another person or from the environment, such as from hospital personnel, other patients or contaminated medical equipments (Ayliffe, and Taylor, 1984).

The common reservoirs associated with nosocomial infection agents are (Soule, 1983) :-

1. Patients
2. Health care personnel
3. Health care equipment and environment

Components of nosocomial infection process are the same as other infectious disease process. The chain of infection is composed of six components, i.e. causative agent, reservoir, portal of exit, mode of transmission, portal of entry and susceptible host. The diagram is shown as following.

Chain of Infection

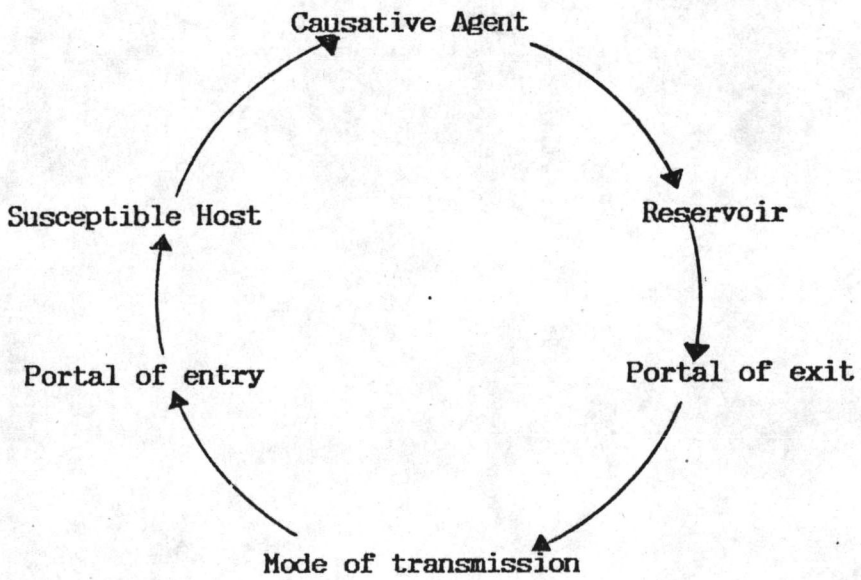

Figure 1

Once patients are admitted to the hospital or health care facility, they are at risk to contact nosocomial infection agents by various routes. All hospital acquired infections occur from any one or a combination of the following risks as outlined in the diagram below:

Risks to patients

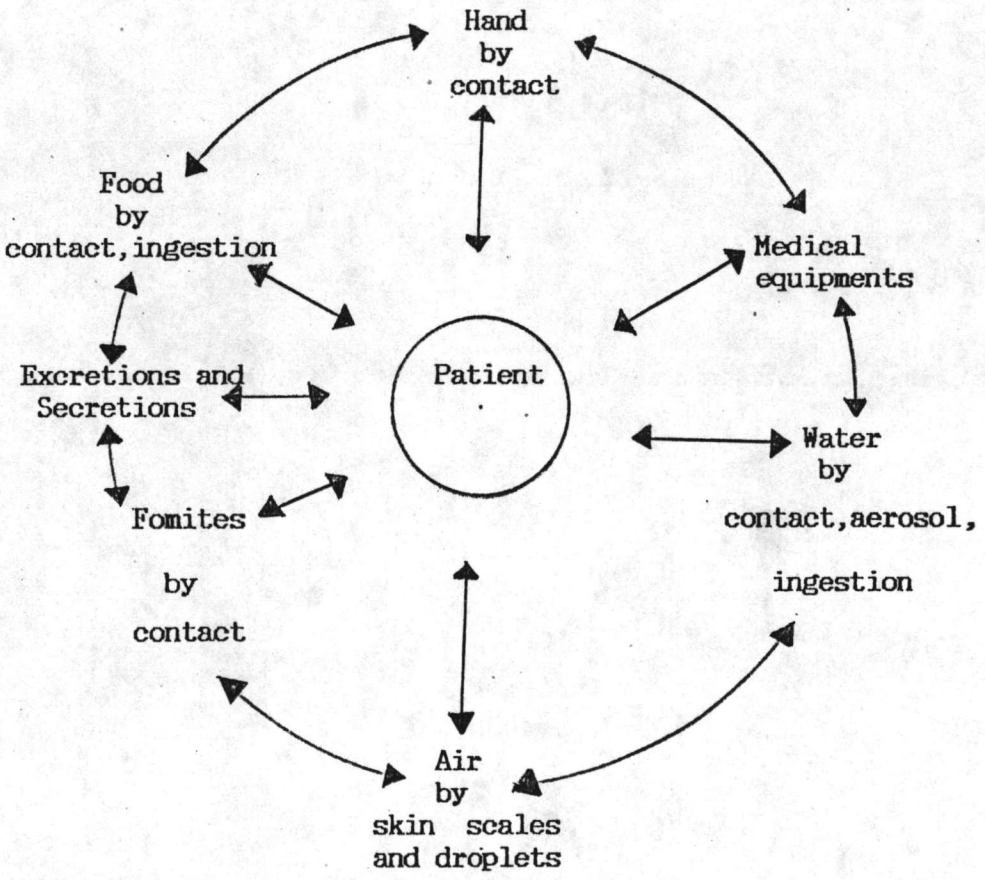

Figure 2

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All these risks remain in the three common reservoirs: patients, health care personnel and health care equipments and the environment. These reservoirs are associated with nosocomial infection agents as previously mentioned.

Nosocomial Pathogens

The majority of nosocomial infections are caused by bacteria and viruses (Bennett, Brachman, Finland, Craven, and Altemeier, 1986). Most bacterial agents are gram-nagative bacilli (Ayliffe and Taylor, 1984; Farber, Brennen, Puntereri, and Brody, 1984; Pinyowiwat, et al., 1988; Danchaivijitr and waitayapiches, 1988; Srisupan, Senarat, Pichiansathien, and Tongsawat, 1988; Jamulitrat, Ngo, Thongpiyapoom, and Varindsathien, 1989), including E.coli, Pseudomonas aeruginosa, klebseilla spp. and Enterobacter species. Multiple microbial resistant bacteria are also found, leading to more problems for treatment.

Spectrum of Occurrence of Nosocomial Cases

The occurence of nosocomial infection might be sporadic, endemic, epidemic or outbreak.

Sporadic :- means that the disease occurs with an ongoing frequency in a specific geographic area in a finite population and over a defined time period.

Endemic :- is what appears to be a gradual increase in the occurrence of a disease in a defined area beyond the expected number of cases.

Epidemic:- is a definite increase in the incidence of a disease above its expected endemic occurrence.

Outbreak:- is used interchangeably with epidemic. Sometimes it is defined as increased rate of occurrence but not as serious as epidermic (Bennett, Brachman, Finland, Craven, and

Altemeier, 1986).

Most nosocomial infections reported were endemic, constantly occurring in certain parts of hospitals such as medical, surgical, pediatric, intensive care unit and other specialized units. Epidemic or outbreak of infection occasionally occurs in the hospitals or health care facility but it is more serious because of rapidly increasing incidence cases. This event needs an immediate investigation for control measures. The reported rates of nosocomial infection vary from study to study. Some reported the incidence rates while others the prevalence rates.

Incidence :- is the number of new cases in a specific population in a defined time period (Bennett, Brachman, Finland, Craven, and Altemeier, 1986).

Prevalence :- is the total number of current cases of an infection in a defined population at one point in time or over a longer period of time.(Bennett, Brachman, Finland, Craven, and Altemeier, 1986)

People have used several of methods for calculating the nosocomial infection rate. Most studies used numbers of infected cases as the numerators and the numbers of patient admissions or discharges over a time period or daily census as the denominators. There has clearly been a variation in the use of the denominators for the calculation of infection rates. Most studies have not addressed the issue of the duration of hospital stay which might be of tremendous significance (Freeman and

McGowan,Jr., 1981; Saviteer, Samsa, and Rutala, 1988).

Nosocomial Urinary Tract Infection

Urinary tract infection is the most common site of nosocomial infections with a rate of approximately 40% of all nosocomial infections (Center for Disease Control, 1979). This average figure is from studies in U.S.A. which represents the approximate infection rates of U.S. hospitals. Similarly, many studies in Thailand have shown that nosocomial urinary tract infections varied from 30-40%, the highest rate among other sites of the infections (Pinyowiwat, et al., 1988; Danchaivijitr and waitayapiches, 1988; Danchaivijitr and Chokloikeaw, 1988; Sithikesorn, 1988; Limsuwan and Danchaivijitr, 1988). The only study of nosocomial infection in Chiangmai University hospital conducted in 1987 showed that the urinary tract infection was the most common site, about one fourth of all nosocomial infections.

From the above information, it is clear that the proportion of urinary tract infection has been unduly high. For many patients, this infection and its associated adverse effects could have been avoided.

Catheter associated urinary tract infections are generally assumed to be benign. However, occasionally infection persists and leads to other complications such prostatitis, cystitis, pyelonephritis or gram-negative bacteremia in high-risk patients (Kunin, 1979). The mortality rate of patients who have catheter-associated urinary tract infection is three times that of the patients who do not (Platt, Polk, Murdock, and Rosner, 1982).

The organisms causing urinary tract infection which commonly are bacteria usually invade urinary tract by two routes : bloodstream and urethra or so-called ascending route. The urethra or the ascending route is the most common (Ayliffe, et al., 1982; Infection Control Committee, Ramathibodi Hospital, 1988). The organisms are usually of faecal origin which are found on the perineum or in the anterior urethra. Infection occurs by retrograde spread of large numbers of patient's own organisms. Moreover, cross-infection from other patients is likely to occur by hands of health care personnels. Infections are more common in female owing to shorter urethra (Ayliffe, et al., 1982). However, about 66-90% of urinary tract infection usually occurs after instrumentation (Martin and Brookrajian, 1962; Infection Control Committee, Ramathibodi Hospital, 1988). Reported rates of infections have varied from 1-5% after a single brief catheterization (Truck, Goffe, and Peerdorf, 1962). Infection rates resulting from indwelling urinary catheters were reported at 20%, 27.2% and 50% after indwelling catheter for 24 hours, 72 hours and 7 days respectively (Nimmannit, et al., 1979). Rates of hospitalized patients undertaken instrumentation of urinary tract have varied between 7-25% (Infection Control Committee, Ramathibodi Hospital, 1988). Therefore, many patients are potentially at risk of acquiring nosocomial urinary tract infections.

The risk of acquiring a urinary tract infection, apart from host susceptibility, depends on the method of catheterization, catheter indwelling duration and quality of

catheter care by health personnels.

Control of Nosocomial Infection

It has been clear that the nosocomial infection is a significant problem in the institutes providing health care like hospitals. Nosocomial infection has hazardous effects on hospitalized patients, and possibly the community, health care personnel as well as hospital and the country finance. Prevention and control of this problem is not impossible. Although total problem cannot be solved, part of it, at least about 30%, can be prevented (Haley, et al., 1981b). Thirty percent of total number of infections is certainly a significant magnitude. For example in the United States of America, in 1976, there was an estimated of 2.1 million nosocomial infections out of 37.7 million admissions to the acute care hospitals (Haley, et al., 1985). If thirty percent of nosocomial infections could have been prevented, about six hundred thousand infections per year would have been avoided. In Thailand, it was estimated that nosocmial infections have affected about 200,000 patients per year with 13,400 deaths and many other sequalae (Danchaivijitr, 1988). If fully controlled, about 60,000 nosocomial cases, 4,000 deaths would be avoided.

One inevitable factor among other factors contributing to nosocomial infections is the health care personnel (Soule, 1983). Health care personnels are the essential elements in health care service. Their knowledge, skill, and approach to the work is important (Sitthi-Amorn, 1989). Most nosocomial infections result from contamination with pathogen organisms

induced by health care personnels, especially through their hands (Ayliffe, et al., 1982). Improvement of practising health interventions given to patients requires knowledge and skills. It is necessary for health personnel to be vigorously strict to good standards of care in order to prevent cross infections. Maintenance of a good standard of care among health personnels can be done by education, use of guidelines, and regulation implemented according to a comprehensive organization policy.

For each priority health problem, it is important to determine a specific action or intervention which has been carefully appraised to be useful (Sitthi-Amorn, 1989). The various elements in the Guidelines for infection control practice have been known. However, the CDC, which is a reliable institute for disease control, has been instrumental in packaging these elements into logical sequence. It is beleived that the introduction of a logical guideline to health personnel will improve their routine service. The possible benefits resulting from such an intervention are twofold: i.e. the improvement of control behaviour and the reduction of infection rates. Control behaviors of health care personnel should be regularly monitored and maintained at a certain standard level.

The major group of health care personnels who have direct contact with patients is the nursing team. Hospitalized patients need care from these personnels 24 hours a day. Therefore, the nursing personnels should be the target of intervention because there is a high possibility to create problems. The study on the efficacy of nosocomial infection

control (SENIC) which was done by the Centers for Disease Control (CDC), U.S.A., in 1974, established that intensive infection surveillance and control programmes were strongly associated with reduction in nosocomial infection rates. Essential components of effective programmes were Conducting organized surveillance, Control activities, Effectual infection control physician, Infection control nurse per 250 beds and a Reporting system (Haley, et al., 1985).

To prevent and control nosocomial infections, the use of guidelines to assist health care personnel in improving the quality of patient care is one feasible strategy (Bureau of Infection Control and Health Services Directorate, 1985).

The Centers for Disease Control (CDC) of United States has developed the guidelines for infection control in three Categories.

Category I : Strongly Recommended for Adoption

Measures in Category I are strongly supported by well designed and controlled clinical studies that show effectiveness in reducing the risk of nosocomial infections or are viewed as useful by the majority of experts in the field. Measures in this category are judged to be applicable to the majority of hospitals regardless of size, patient population, or endemic nosocomial infection rate and are considered practical to implement.

Category II : Moderately Recommended for Adoption

Measures in Category II are supported by highly suggestive clinical studies or by definitive studies in institutions that might not be representative of other hospitals. Measures that have not been adequately studied, but have a strong theoretical rationale indicating that they might be very effective, are included in this category. Category II measures are judged to be practical to implement. They are not considered a standard of practice for every hospital.

Category III : Weakly Recommended for Adoption

Measures in Category III have been proposed by some investigators,authorities, or organizations, but, to date, they lack both supporting data and a strong theoretical rationale. Thus, they might be considered as important issues that require further evaluation and they might be considered by some hospitals for implementation, especially if such hospitals have specific nosocomial infection problems or sufficient resources.

Since the control measures Category I is most effective, this study will emphasize the strategy of application of the CDC control guidelines Category I combined with education in the routine service. The application of the control guidelines combined with education and feedback is expected to produce a

desired impact than introducing only the guidelines. Use of the control guidelines is practical and more convenient for continuous monitoring and evaluation personnel control behaviors. The SENIC study has shown about 30 - 40% of nosocomial urinary tract can be prevented by the an active control programme in the hospital (Haley, et al., 1985). This study sets priority to control of urinary tract infection because of its highest rate.

Most previous studies on nosocomial urinary tract infections were conducted on the issues of detection of infection rates and associated factors (Clarks and Joress, 1961; Cox and Hinman, 1961; Truck, Goffe, and Peerdorf, 1962; Sanford, 1964; Thornton and Andriole, 1970; Garibaldi, Burke, Dickman, and Smith, 1974; Casewell and Phillips, 1977; Nimmannit, et al., 1979; Kunin, 1984). The studies on issue of control and prevention of this infections were mostly done on testing the efficacy of a single measure (Desautels, 1960; Kunin and McCormack, 1966; Viant, Linton, Gillespie, and Midwinter, 1971; Burke, et al., 1981; Holliman, Seal, Archer, and Doman, 1987). Systematic control programmes have rarely been studied.

Our study is designed not to test the effectiveness of any single control element in isolation but rather to combine these elements into a comprehensive guideline plus education and feedback. It is hoped that our study will make a significant reduction of nosocomial urinary tract infection resulting from improved personnel control behaviours.