Worldwide, nosocomial infections are a major health care problem. Hospital infection control programs in Brazil, England, Thailand, Sweden and Germany have all reported infection rates or outbreak investigations based on analysis of their own data. In many countries, including the United States, national health policies mandate infection control programs that measure the impact of nosocomial infections, and seek prevention methods.

In US hospitals, approximately 6% of hospitalized patients develop nosocomial infections (Table 1). The range is less than 2% for patients without surgery or invasive devices to more than 20% for surgical patients in critical care units.\(^1\)

**Mortality:** Approximately 20,000 US patients die annually as a result of their nosocomial infections. As many as 60,000 additional patients may die because nosocomial infections contributed to their demise (For comparison, about 160,000 persons died of stroke in 1982, and 59,000 died of chronic lung disease, Table 2).\(^2\)

**Financial cost of nosocomial infections:** Haley estimated these costs of hospitalization for nosocomial infections in 1986 (Table 3):

The national cost for hospital care for 150,000 nosocomial infections in 1991 would be approximately $274,950,000. Indirect costs such as days off work are not included in this figure, nor is the personal cost in pain and suffering to the person who has a nosocomial infection.

**Effective elements of infection control programs:** The Study of the Efficacy of Nosocomial Infection Control (SENIC) programs identified 4 important elements:\(^1\)

- Effective monitoring and reporting of nosocomial infections.
- Effective control measures, particularly for indwelling devices.
- Adequate resources for staffing the IC program: 1 trained coordinator for each 250 beds.
- Physician with training and interest in hospital infections.
Reducing risk for cross-transmission of organisms

Patients who acquire organisms that are new to them are much more likely to develop infections with those organisms. Several recent studies describe approaches that resulted in reduced transmission of organisms among hospitalized patients.

Lynch and colleagues demonstrated decreased infection and colonization with marker organisms when personnel put on clean gloves just before touching mucous membranes or nonintact skin. This is one of the major elements in Body Substance Isolation, a system for generic infection precautions based on patient-caregiver interactions rather than special precautions for patients diagnosed with certain diseases.

Klein found similar results with decreased infections in a pediatric intensive care unit when personnel wore clean gloves and disposable gowns for direct patient care. In another study, transmission of respiratory syncytial virus (RSV) among children declined when personnel wore gloves and gowns for care. Johnson reported that an outbreak of nosocomial Clostridium difficile diarrhea was terminated when personnel gloved appropriately while giving direct care.

Noninfectious complications

Although there have been a large number of studies of infectious complications of hospitalization, research into the epidemiology and prevention of noninfectious complications has lagged. In one retrospective review of approximately 6000 medical records of patients from four hospitals, the incidence of noninfectious complications was approximately three times more frequent and equally expensive when compared to infectious complications.

Personnel blood exposures

Patients are not the only people at risk for nosocomial infections: health care workers have acquired hepatitis B, hepatitis C, and HIV infections from occupational blood exposures to infected patients. Universal precautions were developed by the Centers for Disease Control to reduce risk for occupational blood exposures.

Punctures with hollow needles are the exposures that are most efficient for transmitting infectious agents; there are considerable differences between the risks for transmission for the various diseases. Many studies have evaluated transmission of hepatitis B, and the range is 6–30% from a single hollow needlestick from an infected person compared to a range of 0–0.4% for the same exposure from an HIV–positive person.

Since exposures are quite common in some occupations such as surgeon, scrub nurse and emergency department nurse, the cumulative risk for infection over the course of a career can be high. Several investigators have evaluated operative blood exposures (Table 4).

Each investigator has stated that a large proportion of these exposures could be prevented with clothing or other barriers, or by changing practices. Lynch suggested that it is very likely that the hospitals are unaware of the epidemiology of their own personnel exposures unless exposure monitoring is done. Thus, the best way to achieve a major decrease in exposures may be to collect enough data about the exposures in various locations such as the ORs and ICUs that a prevention program based on the actual experience can be undertaken.

In US and Canadian hospitals, information about blood exposures is recorded on an “incident report”, but some hospital departments are reluctant to complete incident reports and the data are flawed (Table 5).

The Collaborative Operative Blood Exposure (COBEX) study, directed by Lynch and White, and funded by 3M, is evaluating blood exposures in 9 hospital operating rooms. There have been 8300 cases monitored with 1054 blood exposures. The first phase of the study described the ex-

<table>
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posures and their epidemiology; the second phase will be to report the results to the participants so that they can improve their prevention programs with the information gained in the first phase. There will also be a toolkit of forms and tables to help operating room personnel monitor their own exposures and develop better prevention strategies.

Since many Asian countries have been affected by hepatitis B and HIV, it may be very important to assess operative blood exposures and prevention strategies in these countries; a small study will begin in Taiwan in 1993.

**Nosocomial Methicillin Resistant Staphylococcus Aureus (MRSA)**

The National Nosocomial Infections Study (NNIS) is an 80 hospital collaborative data pool managed by the CDC. In 1984, MRSA was associated with: 11% of all nosocomial infections. 18% of surgical wound infections. 13% of pneumonias. 14% of bacteremias.

MRSA infections present a treatment problem, but are not more virulent or more transmissible that Methicillin-Sensitive *Staphylococcus aureus*. MRSA is becoming a community-acquired organism; in 1991, approximately 1/3 of the MRSA infections at Harborview Medical Center were community-acquired.

Some important risk factors for MRSA have been identified:
- Longer length of hospitalization
- Invasive procedures, devices
- Preceding antimicrobial therapy
- Burns, especially major burns
- Care on a unit where MRSA is common

MRSA is transmitted person-to-person via hands of health care workers; putting on clean gloves just before contact with mucous membranes or nonintact skin for all patients has been reported to reduce risk.

Special isolation procedures for patients diagnosed with MRSA infection or colonization often provide an ineffective approach, since many more patients are colonized or infected than are clinically or laboratory diagnosed. Generic precautions may provide more comprehensive protection than diagnosis-based precautions since patients are always infected and therefore infectious before they are diagnosed.

**HIV Infection**

In the US, approximately 300,000 persons have been diagnosed with Acquired Immunodeficiency Syndrome (AIDS). Possibly as many as 1.5 million people are infected with HIV, but only a small proportion have developed AIDS at this point in time. The Global AIDS Project estimates that by the year 2000, 40–100 million people in the world will be infected. Most of these cases are predicted to be in African and Asian countries, associated with heterosexual transmission.

There have been several advances in treatment of people with AIDS:
- Pneumocystis pneumonia prophylaxis
- Zidovudine (AZT)
- Combination therapy, chiefly AZT and other drugs
- Early treatment before disease manifests

The result is that people with HIV infection live much longer than the 14 months after diagnosis that was the mean in 1985: many live more than 5 years after diagnosis. Because of this, they receive more inpatient and outpatient care, and there is more risk for transmission as the pool of infected persons increases. In the US now, heterosexual young women have the greatest increase in disease.

**HIV Infection and Tuberculosis**

In African countries where HIV has been prevalent longer than other places, tuberculosis has become a major problem. For HIV infected persons who already have TB infection (are tuberculin-positive), the risk of developing active TB is 7–10% annually. HIV-negative people with positive tuberculins only have an annual risk of 0.3% annually. For HIV infected persons who acquire new tuberculous infections (become PPD-positive), active TB develops rapidly and often becomes fatal. TB in patients with HIV infection does not have the typical clinical or radiologic presentation, so it is difficult to diagnose, especially in persons who already have existing pulmonary disease.17

In all countries with HIV and TB in the same populations, tuberculosis has become one of the most important opportunistic infections of AIDS. It is also often one of the early complications, and requires hospitalization. Transmission from hospitalized patients with unrecognized, infectious TB has occurred. The emergence of strains
of TB that are resistant to most or all of the drugs commonly used to treat TB is another difficulty. Although multi-drug resistance is uncommon in the US, it presents a real problem when it does occur; drug resistance is more common in some other countries and imported cases are certain to occur.

Seven institutional outbreaks of nosocomial multi-drug resistant TB have been investigated; more than 200 nosocomial cases occurred; mortality ranged from 72–89% because effective drug therapy was unavailable. Nine personnel developed occupationally-associated TB and five of these have died.17)

Infection control programs are quickly developing comprehensive tuberculosis control programs to reduce risk for transmission to patients, visitors and personnel. These programs all emphasize:

- Rapid evaluation of pulmonary disease, especially in HIV positive persons.
- Improved ventilation of high risk areas in the hospitals such as radiology departments, pulmonary therapy, and emergency rooms
- Tuberculin testing employees who are believed to be tuberculin-negative to detect and treat new tuberculosis infections.
- Isolation for infectious patients.

All these hospital infection control problems—MRSA, tuberculosis, blood exposures—have one thing in common: they are unscheduled and very time consuming to deal with. They demand immediate attention when they occur, and leave little time for the infection control coordinator or the infection control committee to attend to routine surveillance of nosocomial infections.

References