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INFECTIONS IN LONG-TERM CARE

The 1980's have seen a recognition of the problem of infections in long-term care facilities (LTCF's) and hospitals and the development of infection control programs. Research has delineated the descriptive epidemiology of nosocomial (institutionally-acquired) infections. Nevertheless, there are no well-controlled studies documenting the efficacy of infection control programs and specific infection prevention measures in LTCF's. The problem of infections is likely to increase due to the growing number of elderly requiring hospital and long-term care. In addition, the severity of illness has increased in LTCF's due to earlier transfer of hospitalized patients (following implementation of the DRG-based hospital reimbursement system) and in hospitals due to stricter admission and review criteria for hospitalization.

It is well known that older persons have a significantly increased incidence and severity of many infectious diseases. Older persons LTCF resident is a particularly susceptible host because of underlying diseases, a higher frequency of impaired immune response, a multiplicity of medications that affect resistance to infection (e.g., steroids), impaired mental status (predisposing to decubitus ulcers and aspiration pneumonia), incontinence, indwelling urinary catheters, and other factors. In addition, there are many reservoirs for infectious agents in health facilities. Most infections in facilities are endogenous, resulting from the resident's own flora of the perineum, skin, or nasopharynx. Infected residents serve as reservoirs for infectious agents (e.g., Salmonella), and visitors or staff may be sources of infections of particular concern to older persons (e.g., influenza). In hospitals and LTCF's, health care providers are important sources of cross-infection by the contact route. Vehicle transmission occurs via such items as food and water; airborne spread occurs by dissemination of droplet nuclei or particles in the air. A unique problem facing facilities is the ambulatory resident who may be incontinent or coughing and serves as a potential means for spread of infectious agents. Transmission in LTCF's is accentuated by frequent deficiencies in handwashing and isolation facilities.

State of the Science

Prevalence

Older persons in both hospitals and LTCF's have a substantial risk of nosocomial infection (Smith, 1989). The Centers for Disease Control (CDC) estimates that 1.5 million nosocomial infections occur in LTCF's annually; this translates to an average of one infection per resident per year (Haley et al., 1985a). Recent surveys of LTCF nosocomial infections demonstrated nosocomial infection rates ranging from 2.7 to 32.7 percent (Cohen et al., 1979; Magnussen & Robb, 1980; Garibaldi et al., 1981; Gambert et al., 1982; Farber et al., 1984; Nicolle et al., 1984; Standfast et al., 1984; Scheckler & Patterson, 1986; Setia et al., 1985; Price et al., 1985; Franson et al., 1986; Alvarez et al., 1988). The median infection rate is approximately five to ten percent, or five to ten

infections per 100 resident-months. Alvarez et al. (1988) reported a nosocomial prevalence rate of 6.6 percent in 689 nursing home patients; lower respiratory infections were the most common type. Schicker et al. (1988) point out that incidence of nosocomial infections in nursing homes is higher than in hospitals because of the low turnover rate in nursing homes. The most common infections found in surveys are urinary tract infections, respiratory infections (influenza, tuberculosis, pneumonia), infected decubitus ulcers, and gastroenteritis. In a study of one hospital's records of elderly with positive blood cultures admitted between 1984 and 1986, 83 percent were admitted from home, 14 percent from LTCF's, and three percent from other hospitals (Meyers et al., 1989). Of the total infections, 50 percent were nosocomial and 44 percent were home- or nursing home-acquired. An infection was considered to be nosocomial if it occurred more than 24 hours after admission. The death rate was 40 percent overall and 25 percent for those patients from nursing homes. Survival rates were poorest for patients with lower respiratory tract infections. The study concluded that antimicrobial therapy should be broad in scope and include coverage for *Staphylococcus aureus* (Meyers et al., 1989).

Endemic Infections

In most surveys, a leading nosocomial infection in LTCF's is urinary tract infection (UTI), generally related to an indwelling urinary catheter. Decubitus ulcers are also sites for common infections. Pneumonia is a frequent infection in LTCF's and hospitals. *Streptococcus pneumoniae* appears to be the most common etiologic agent, although aspiration pneumonia is also prevalent in LTCF's. The mortality rate for LTCF-acquired pneumonia is significantly higher than for community-acquired pneumonia in older persons (Marrie, Durant & Kwan, 1986). Because of impaired immunity, viral upper respiratory infections that are generally mild in other populations may cause significant disease in the institutionalized elderly. Pneumonia is the most common cause of death from nosocomial infection in hospitals (Gross et al., 1980). Influenza outbreaks in LTCF's are common and severe. Clinical attack rates range from 25 to 60 percent and case fatality rates average 10 percent (CDC, 1985). Tuberculosis also has caused extensive LTCF outbreaks, generally traced to a single ambulatory resident (Stead, Lofgren, Warren & Thomas, 1985). Viral gastroenteritis, salmonellosis, and *Clostridium perfringens* food poisoning cause diarrhea outbreaks in LTCF's. Recently, *Escherichia coli*, *Clostridium difficile*, and *Gardia* have been added to the list of enteric pathogens in this setting. Other infections encountered in long-term care include conjunctivitis, scabies, herpes zoster, herpes simplex, hepatitis, bacteremia, and cellulitis. The exact frequency and distribution of these nosocomial infections vary from institution to institution.

Epidemic Infections

Most nosocomial infections are sporadic, but epidemic clustering of infectious diseases can occur. Garibaldi and colleagues (1981) noted this phenomenon in upper respiratory tract infections, diarrhea, conjunctivitis, and multiple antibiotic-resistant bacteriuria. As noted above, devastating outbreaks of tuberculosis and influenza are well documented. A survey of Nebraska LTCF's found that 52 percent of nursing homes reported an infectious outbreak during the prior year, most frequently influenza (Chaulk, Gwartney & Smith, 1985). *Salmonella* has caused many of the large outbreaks of infectious gastroenteritis in LTCF's. Significant outbreaks of infection also have been ascribed to *Escherichia coli* and *Streptococcus pyogenes*. Antibiotic-resistant bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and multiply-resistant gram-negative bacteria, are no longer confined to hospitals, but cause outbreaks and colonization or infection in LTCF's (Storch, Radcliff, Meyer & Hinrichs, 1987; Hsu, Macaluso, Special & Hubble, 1988). Infections are an important cause for transfer of LTCF residents to acute-care hospitals (Irvine, VanBuren & Crossley, 1984). LTCF-hospital transfers result in a dynamic microbiologic equilibrium, making interinstitutional epidemics a concern.

Infection Control Programs

Program Components. The infection control program is directed by the infection control practitioner (ICP), usually a registered nurse. Many ICP's in LTCF's have little or no training in infection control. Because of size and staffing limitations, the majority of nursing home ICP's have other duties such as director of nursing, floor nursing, in-service coordinator, employee health, and quality assurance. An infection control program should include surveillance for infections, an epidemic control program, policy and procedure formation and review, education of employees in infection control methods, an employee health program, and a resident health program (Jackson & Fierer, 1985; Smith, 1984). The infection control program also may include antibiotic monitoring, quality assurance, product review/evaluation and reporting of diseases to public health authorities. Most infection control programs are considered inadequate to monitor and control infections.

Surveillance must be simple and pragmatic, particularly where the ICP may be able to spend only several hours per week in infection control activities. The purpose of surveillance in facilities is to collect information for planning control efforts; the discovery of infections should help in the early detection and prevention of epidemics and may lead to therapeutic intervention (Smith, 1991). Objective, valid definitions (criteria) of infections form the cornerstone of surveillance. The "gold standard" for hospitals refers to the CDC definitions from the National Nosocomial Infections Surveillance (NNIS) system (Garner et al., 1988), but no such standard exists for long-term care. NNIS definitions depend heavily on laboratory data and review of the medical record. Unfortunately, x-ray and microbiological data are often unavailable in nursing homes, physician examinations are often infrequent, and written physician notes in the medical record are usually extremely brief. Although modified, LTCF-specific criteria have been suggested (Vlahov, Tenney, Cervino & Shamer, 1987; Smith, 1987; McGeer, Campbell, Emori & Heirholzer, 1991), there are currently no validated or widely accepted, clear, clinical criteria for the diagnosis of nosocomial infections in the LTCF.

Isolation policies are required, as is monitoring to ensure compliance with isolation techniques. Isolation in LTCF's has been handicapped by lack of adequate handwashing facilities, private rooms, and ventilation systems (Price, Sarubbi & Rutala, 1985). Handwashing appears to be the most important infection control measure in the LTCF and in the hospital. Education is a key preventive measure, the importance of which is accentuated by the great turnover in personnel. A coordinated effective educational program has been shown to result in improved infection control activities, especially with respect to development of written definitions of infection and increased use of influenza vaccine by employees and residents (Rusnak, Daly & Smith, 1988). No guidelines for

personnel in LTCF's have been developed, although an employee health program including periodic health examinations to ensure the absence of communicable diseases is required. Initial assessment of employees and education in infection control are important, as is a reasonable sick-leave policy (Crossley et al., 1985).

The resident health program should consist of providing vaccinations, screening new residents for infectious diseases, and performing periodic checks for certain conditions (e.g., tuberculosis). Recommended immunizations for LTCF residents include tetanus, diphtheria, influenza, and pneumococcal vaccines. About five percent to ten percent of LTCF residents are receiving antibiotics, often inappropriately, that contribute to the cost of long-term care as well as to the risk of selecting antibiotic-resistant bacteria (Zimmer, Bentley, Valenti & Watson, 1986; Jones et al., 1987). Infection control and antibiotic review should be part of an overall quality assurance program.

Current Status of Infection Control Programs. In a Utah survey, it was noted that all LTCF's had

regular meetings on infection control but none performed systematic surveillance for infections or conducted regular infection control in-services (Garibaldi et al., 1981). All LTCF's had policies regarding the maintenance and care of catheters although the policies were not uniform. Price and colleagues (1985) surveyed 12 North Carolina LTCF's and found that although all 12 had a designated ICP, none had received special training in this area. Ten of the 12 LTCF's conducted surveillance; all had an employee health program and a urinary catheter policy. Deficiencies were noted in isolation facilities, particularly inadequate sinks and recirculated, inadequately filtered air. A Minnesota survey by Crossley and Colleagues (1985) found that the majority of LTCF's had an infection control committee and a designated ICP although there were significant deficiencies in resident and employee health programs. For instance, only 61 percent offered the influenza vaccine to residents and one-third did not screen new employees for infectious disease problems. A Maryland survey (Khabbaz & Tenney, 1988) found that one-third of LTCF's still routinely did useless environmental cultures, and more than half lacked proper isolation policies.

Research Needs and Opportunities

In the last 10 to 20 years a great deal of information has become available about the demographics and characteristics of infections, including data on the overall frequency of nosocomial infections in hospitals and LTCF's, the leading sites and microbiologic causes of endemic infections, and the most important epidemics. However, few intervention studies have been done with older patients for several reasons. First, such research is much more labor-intensive than simple information-gathering. Second, there is little information available in the LTCF's records because of very brief physician notes and minimal laboratory and radiologic information. And third, obtaining informed consent in LTCF's is difficult. Because many residents are mentally incompetent, consent must be obtained from relatives; this is often a problem. One longitudinal intervention trial with hospitalized children showed that increased compliance with glove and gown precautions can substantially reduce nosocomial transmission of respiratory infection (Leclair et al., 1987). Similar studies in nursing homes are needed. Research needs to evolve from passive data collection to evaluation of infection control measures. For instance, is a particular vaccine (e.g., pneumococcal vaccine), a particular infection control measure (e.g., handwashing after resident contact), or a particular nursing measure (e.g., having one infection control practitioner per 250 or 300 beds) effective and/or cost effective?

Host Factors

Some interesting basic research is being done on immunosenescence. However, a great deal of additional work needs to be done on specific immune markers and the risk of infection in the LTCF. For example, what are the important risk factors for infection in the LTCF: Anergy? Decreased antibody response to an antigen? The presence of other underlying diseases, such as diabetes mellitus and heart failure? Older persons often have a suboptimal febrile response to infection. It would be extremely interesting to study in detail the normal baseline temperature of older persons and to determine how much increase in temperature signifies infection. How does the presence of underlying diseases affect febrile response? What nursing measures can be used to prevent and detect infections and to encourage early and appropriate treatment?

The long-term care setting, like the hospital setting, is in need of a practical, accurate severity-of-illness scale for infections. This would facilitate longitudinal descriptive studies as well as controlled, prospective comparative intervention studies. Numerous broad epidemiological studies still are needed. Examples include an overall study of the mortality rate of nosocomial infections in the LTCF's, the microbiology of hospital-LTCF patient transfers, and the effect of DRG's on LTCF nosocomial infections. It has been well demonstrated that following the DRG prospective payment system there was a shift of more critically-ill hospital patients to LTCF's, and the LTCF death rate increased. Was this a shift in mortality, or did the actual cumulative hospital/nursing

home infection rate increase because of lower staffing ratios in the LTCF?

Specific Infections

Influenza is an extremely important LTCF infection and a number of excellent studies of epidemics have been done. The influenza vaccine is safe and universally recommended in the LTCF but is not always effective at preventing epidemics. Compliance with influenza vaccination recommendations needs to be monitored. Additional data on predictors of vaccine response in older persons, herd immunity levels, and the role of personnel in propagating epidemics would be useful. Better studies of the etiology of pneumonia in older persons are needed; in most cases current laboratory techniques do not provide a specific microbiological diagnosis. The pneumococcal vaccine is the most important preventive measure for pneumonia, but some elderly have a suboptimal antibody response. Would a program to vaccinate at an earlier age be effective? Is a "booster" necessary? Which residents are at greatest risk of aspiration pneumonia and which preventive measures are effective? Tuberculosis has been well studied in a number of LTCF's. Issues deserving of further study include the sensitivity of the standard Purified Protein Derivative (PPD) skin test in older persons, the regional prevalence of tuberculosis in LTCF's, and clinical indicators of early infection. The epidemiology of *Clostridium difficile* diarrhea, which appears to be increasing in importance, is not yet well delineated in the LTCF. Does incidence correlate with the use of antibiotics? Of specific antibiotics? Are the environment or the hands of personnel involved in the spread of this organism? A rapidly emerging pathogen of importance is MRSA. This organism may become endemic in LTCF's as well as in hospitals; it can cause severe epidemics. We need broad-based studies on MRSA in the LTCF, the interinstitutional spread of MRSA, and the efficacy of isolation, cohorting, and antibiotic treatment programs. In general, LTCF epidemics must be better defined and detected. What are the correlates of institutional epidemics? The financial costs? The morbidity and mortality? The sensitivity of various surveillance methods for detecting epidemics?

Nosocomial Infection Data Collection

Information on LTCF infections is available from approximately a dozen surveys. These studies are skewed towards large, skilled-care LTCF's; in many instances data were collected by an external data collection team with special culture techniques, chart reviewing skills, etc. There is still a need for prospective (incidence) studies of LTCF nosocomial infections, especially in smaller, free-standing nursing homes. Perhaps the single greatest deficit relevant to data collection is the absence of concise infection definitions or criteria. A standardized set of infection definitions would facilitate both internal data collection for purposes of infection control and external data collection for study of national trends. Hospital infection control has been advanced greatly by the clearly written, objective, widely-accepted definitions of infection developed by the CDC (Garner, 1988). These definitions are laboratory-based. In the LTCF, no such standard definitions exist, and laboratory-based definitions are not practical. A number of data collection studies have used the CDC hospital criteria, while other investigators have modified them for use in the LTCF. A consensus conference developed criteria to be tested in the LTCF (McGeer et al., 1991). It is possible that clinically-based criteria with a high degree of specificity and sensitivity cannot be developed for LTCF's. For example, in the absence of a chest x-ray, pneumonia is very difficult to diagnose. Fever, cough, and signs of consolidation on physical examination can be due to many noninfectious causes. The best compromise is to develop several levels of criteria for the LTCF and to test these against the modified CDC criteria for sensitivity and specificity. For example, one might have both an elaborate set of criteria based on the best mixture of physical signs and symptoms possible and a simple set of criteria that depends on elevation in temperature or other signs easily documented by nursing staff. The sensitivity and specificity of the simple criteria would be practicable and provide useful information. The differing sets of criteria need to be tested side-by-side in the field.

Infection Control Programs

It is interesting to note the parallels between LTCF and hospital infection control programs. In the 1950's and 1960's, staphylococcal epidemics spawned hospital infection control programs. Although initial research focused on passive data collection, in the last 10 years a number of innovative intervention studies have been conducted in hospitals. In LTCF's, recognition of the infection problems recently led to widespread infection control programs. Good descriptive data collection studies have been conducted, but logistic and funding difficulties have hindered intervention studies. Of course, the ultimate study would be of the effect of infection control programs on infection rates in LTCF's. The only study of this type that has been done in hospitals is the CDC study of several hundred thousand medical records that demonstrated the efficacy of hospital infection control programs (Haley et al., 1985b). Although it is unlikely that a study of similar magnitude could be carried out in LTCF's, a uniform data collection instrument could be used to study the efficacy and cost-containment of individual components of an infection control program on a smaller scale.

Policies and procedures need to be studied; there is little data on isolation policies and procedures in the LTCF. Which system (disease specific vs. category specific) is being used? What are the relative costs of the two systems? What is compliance with isolation policies and procedures? Does compliance with standards correlate with improved epidemic prevention? Acquired Immunodeficiency Syndrome (AIDS) is important in the LTCF; issues such as attitudes towards persons with AIDS, policies on accepting persons with AIDS, and adoption of Universal Precautions in the LTCF still need to be studied. What is the effect of accepting a person with AIDS on nursing care resources and on infection control for employees and residents? Although the most important infection control measure is probably handwashing, there are no studies on handwashing compliance, frequency, and efficacy in the LTCF. Is bar soap as good as an iodophor disinfectant? If there are no sinks, would a non-water-based handwashing agent improve compliance? What is the microbiology of hands pre- and post-washing?

Education is extremely important. There is underway currently a three-year PHS-supported study of a two-day LTCF infection control training program in Nebraska. Very few such programs exist, and few studies have been done on the effectiveness of various educational programs in terms of knowledge retention and application of learned principles in the LTCF setting (Rusnak et al., 1988). What are the best training methods (workshops, courses, videotapes, self-learning modules)? Ideally, one should attempt to correlate the effectiveness of education with the infection rate in the institution.

Resident health programs have not been extensively studied. What are usual practices and findings with respect to resident screening on admission? Are screening evaluations, tuberculosis skin tests, and x-rays sensitive and cost-effective? In addition, studies are needed in the area of antibiotic use, including prevalence, appropriateness, cost and side-effects. Does inappropriate antibiotic use correlate with epidemics or resistant bacteria? Employees are an important component of an infection control program, both in terms of using proper techniques and serving as vectors for infection. Employee health programs in LTCF's must be reviewed. Is influenza vaccination of employees cost-effective? What are current sick-leave policies? Do restrictive sick-leave policies correlate with LTCF epidemics?

Further research on the control of infections in long-term care requires development of a detailed data base to facilitate the conduct of correlation studies that consider the incidence and types of nosocomial infections, and variables such as resident characteristics (age, cognitive functional status, nutritional status), facility characteristics (skill level, staffing ratios, staff turnover, licensing review outcome), and ICP characteristics (training, experience).

Nursing Interventions

Infection control practitioners are growing in importance. Over 80 percent of the 7,000 members of the Association for Practitioners in Infection Control and many of the 2,000 persons certified in infection control are professional nurses (Larson, Butz & Korniewicz, 1988). Most hospitals have a person designated as responsible for infection surveillance and control (Larson et al., 1988). However, nursing homes have not had trained and responsible infection control practitioners. Nursing clearly has a critical role to play in infection control in hospitals and LTCF's because nurses are responsible for clinical practices and management of facilities and have the most direct contact with patients. Unfortunately, the infection control role has not been well developed in long-term care, even though patients in nursing homes appear to be at higher risk than in hospitals. Only a few nurses (less than 2%) have formal doctoral education or education in research methods and epidemiology (Larson et al., 1988), and few have any advanced training in the area of infection control. Because of this shortage, the first nursing postdoctoral fellowship program in infection control was established at Johns Hopkins University School of Nursing in 1987 (Larson et al., 1988) to prepare nurses with advanced skills and knowledge in research in the area of infections. This type of specialty training is particularly needed, with a special focus on older persons who are susceptible to nosocomial infections. What effect can the introduction of trained ICP personnel have on nosocomial infections in LTCF's? Research on the relationship of clinical nursing practices and infection control on direct patient outcomes is needed. Nursing intervention studies in infection control using clinical trials also are needed.

Recommendations

Based on the foregoing assessment of research needs and opportunities in "Infections in Long-Term Care," the Panel has made the following recommendations concerning research in this area over the next five years.

- Identify host factors and the etiology of infections in older persons; both longitudinal descriptive studies and controlled, prospective intervention studies are needed.
- Develop methods for clinical detection and diagnosis of infection; in addition, formulate and test concise, standardized definitions of infection to facilitate data collection for purposes of infection control and for the study of national trends.
- Develop effective infection control programs including effective, routine surveillance mechanisms; evaluate the efficacy of individual components of LTCF infection control programs.
- Conduct clinical nursing intervention studies in LTCF's on the relationship between clinical nursing practices in infection control and direct patient outcomes.

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