

**A SOCIAL-ECOLOGICAL PERSPECTIVE ON NOSOCOMIAL INFECTION  
CONTROL IN DEVELOPING COUNTRIES: EXPLORING THE ROLE OF  
INTERNATIONAL NGOS**

by

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Nosocomial, or hospital-acquired, infection is a serious global public health issue that causes the suffering of 1.4 million people at any given time. This thesis uses the social-ecological model to frame the problem of nosocomial infection control in developing countries, and proposes roles for international non-governmental organizations in developing country settings. Using the social-ecological model reveals nosocomial infection control issues at the individual, hospital, and national policy and infrastructure levels. Interviews were conducted with four organizations: two international non-governmental organizations, the Pan American Health Organization, and the University of Pittsburgh Medical Center Infection Control Office. Two case studies are presented from Honduras, showing how the two international non-governmental organizations approached the infection control issue in two public hospitals in that country. Recommendations are given for possible intervention points in developing countries.

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## **PREFACE**

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Dr. Jeanette Trauth for her insight and comments on parts of this thesis, the staff of Global Links, CAMO, PAHO and UPMC Infection Control for their cooperation and willingness to be interviewed, my talented and dedicated thesis committee, and my family and friends for all the support during graduate school.

And especially my husband.

## **1.0 INTRODUCTION**

Nosocomial infection, also known as hospital-based infection or health care-associated infection, is a serious global public health issue, causing the suffering of 1.4 million people across the world at any given time (WHO, 2007). Honduras, the second poorest country in Central America, faces many challenges to providing quality public healthcare to its people, and high among these challenges is nosocomial infection. In Honduras, as in many developing countries, nosocomial infection is a devastating problem that impacts many vulnerable groups. For example, in 2002 30.4% of maternal deaths in Honduran hospitals were caused by nosocomial infections (PAHO 2002).

Nosocomial infection in developing countries is difficult to address because it is such a complex problem with diverse underlying causes. International non-governmental organizations (INGOs) and inter-governmental organizations such as United Nations agencies add a unique perspective to the push for infection control measures in hospitals in the developing world. However, these organizations have not been able to address all facets of the problem such as infrastructure, leadership and individual health care worker behavior. Nosocomial infection control is not simply a matter of encouraging hand hygiene in settings where clean water and soap may not be consistently available. Nor is infection control a matter of providing supplies to health care workers who are not trained to use them properly.

This thesis analyzes three international nosocomial infection control interventions in Honduras to better understand the current and future roles of international organizations in this field. Because the organizations did not collect evaluation data, it is impossible to compare the programs' effectiveness at reducing nosocomial infection rates. Rather, the discussion of nosocomial infection control is framed using the social-ecological model, which places an individual's behavior in the context of his or her peers, organization and national policy and infrastructure, recognizing that each level influences the others. Using the social-ecological model shows the gaps in current INGO and inter-governmental organization programming to guide future options for more complete nosocomial infection control.

Data were collected using telephone and face-to-face interviews with key staff of two INGOs and the Pan-American Health Organization. An additional interview was conducted with the University of Pittsburgh Medical Center Infection Control Department, whose program is an example of a well-supported, effective infection control intervention in the United States. The results reveal that most international interventions focus on national policy, individual health care worker and hospital infrastructure levels, leaving gaps at the hospital administration, community and outpatient healthcare, and infection control committee levels.

## **2.0 LITERATURE REVIEW**

A review of the literature was conducted using PubMed and Lexis-Nexis databases. Searches in PubMed included MeSH terms "Cross Infection/transmission," "Cross Infection/prevention and control," "Cross Infection/economics," "Cross Infection/history," "Cross Infection/ethnology" and "Developing Countries." Searches were restricted to English language results. In Lexis-Nexis, search terms included "Hospital Infection," "Infection Prevention" and "Developing Countries."

### **2.1 DEFINITION AND SCOPE OF NOSOCOMIAL INFECTION**

Infections are considered nosocomial when they become clinically evident during hospitalization (at least 72 hours after admission) and were not present or incubating before admission to the hospital; infections in newborn babies that occurred during or after delivery are considered nosocomial (Orrett, Brooks, & Richardson, 1998).

Health care-associated infection is such a severe problem that the World Health Organization (WHO) made it a priority in 2002, when member states approved a World Health Assembly resolution on patient safety (WHO, 2007). Nosocomial infection control interventions, although not an explicit target of the United Nations Millennium Development Goals, help support Goal 6 (Combat HIV/AIDS, malaria and other diseases), as tuberculosis and HIV are

common hospital-transmitted infections (UNDP, 2008). The WHO estimates that developing countries have as much as a 20 times higher risk of nosocomial infection than developed countries (WHO, 2007). To provide some context, the Centers for Disease Control and Prevention (CDC) estimate that there were 1.7 million nosocomial infections in U.S. hospitals in 2002, representing 4.5 infections per 100 hospital admissions. The result was 99,000 deaths in the U.S. associated with nosocomial infections in one year alone (Klevens, 2007).

## **2.2 HISTORY OF NOSOCOMIAL INFECTION CONTROL**

Active control of nosocomial infection has been a part of medicine for over 300 years. A Scottish doctor, Sir John Pringle, coined the term ‘antiseptic’ in 1750 and carried out experiments on septic substances during his career (Selwyn, 1970). Ignaz Semmelweis (1818-1865), a Hungarian-born doctor who practiced in Austria and is known as the “father of infection control,” observed that women who delivered their babies with midwives had a much lower rate of infection than those whose babies were delivered by doctors. He hypothesized that doctors were handling corpses during autopsies before delivering babies, which was causing infection (Best & Neuhauser, 2004). Semmelweis implemented a case-control study that involved mandatory hand-washing among physicians and washing of medical instruments, which reduced the nosocomial infection rate to below that of midwife-assisted delivery. Semmelweis was the first healthcare professional to demonstrate through experiments that hand-washing could prevent infections (Best & Neuhauser, 2004). Sir James Young Simpson, working in Scotland in the mid-1800s, campaigned against hospital cross-infection, or the transmission of infection from

one patient to another via doctors and nurses (Selwyn, 1991). Joseph Lister advanced the understanding of surgical site infection during his career in late-1800s Scotland (Selwyn, 1970).

The first nationwide commitment to researching and eradicating nosocomial infection in the United States came in 1958, in the midst of the first antibiotic-resistant *staphylococcus aureus* pandemic (Wise, Ossman, & Littlefield, 1989). During the 1960s, nurses became the primary infection control specialists due to their close contact with patients (Garcia, Barnard, & Kennedy, 2000), a trend that has continued around the world. Garcia and colleagues note that as medical equipment and treatment options expanded in the 1970s, so did the understanding of device-associated infection, such as catheter- and respirator-related infection. Although anecdotal evidence had been available for decades that nosocomial infection could be reduced with strategies such as hand-washing, the CDC's Study on the Efficacy of Nosocomial Infection Control (SENIC), published in 1985, provided the first scientific evidence that nosocomial infection in institutions could be reduced using organized infection control procedures (MMWR, 1992).

Since the late 1990s, infection control has become a global issue, with the WHO instituting a Patient Safety Initiative in 2002 (PAHO, 2007a). Many developing countries instituted national policies to promote infection control during the 1980s and 1990s, with varying degrees of success (see, for example, Ponce de León's 1998 research on infection control in Brazil). Global and regional initiatives have been formed, such as the SENTRY Antimicrobial Surveillance Program, which monitors infectious pathogens in the United States, Canada and Mexico for both frequency of occurrence and antimicrobial susceptibility, to determine how quickly infectious agents are becoming resistant to antibiotics and antimicrobials (Gales, Jones, Pfaller, Gordon, & Sader, 2000). In 2007, PAHO produced its first guidelines on controlling

nosocomial infections directed toward the Latin American and Caribbean region (PAHO, 2007a).

## **2.3 FACTORS UNDERLYING NOSOCOMIAL INFECTION**

This section describes the complexity of the infection problem, particularly for developing countries. Underlying factors are presented using the social-ecological levels. Some of the factors that underlie the transmission of nosocomial infection are remarkably constant across the world, and others vary across hospitals, countries, rural and urban settings, and types of procedures performed.

### **2.3.1 Hospital Personnel Level**

At the individual level, iatrogenic (unintentional physician error or oversight) behaviors are the most common. Iatrogenic behaviors may be due to a lack of knowledge or an unwillingness to adopt a new behavior. Most fundamental to nosocomial infection control is the challenge of persuading healthcare workers to change their hand hygiene habits; this is an obstacle all over the world. For example, analysis of a diarrhea outbreak in a pediatric hospital in Mexico revealed that only 30% of the nurses washed their hands before caring for an infant (Navarrete, Stetler, Avila, Garcia Aranda, & Santos-Preciado, 1991).

Overuse and misuse of antibiotics is a significant factor in the spread of antibiotic- and antimicrobial-resistant infectious agents across the world (Cavalcante, Braga, Teofilo, Oliveira, & Alves, 1991; Wolff, 1993). Nightingale (1993) found that hospitals generally treat infections



with a “cocktail” of two or more antibiotics, without knowing details about the virus or bacteria that caused the infection. This is expensive; for example, Nightingale’s hospital in Hartford, Connecticut, streamlined the use of antibiotics, resulting in a savings of US\$150,000-250,000 (Nightingale, 1993). The “cocktail” approach can also be very wasteful because even a combination of antibiotics may not be effective in treating the infection and promotes resistant strains (Nettleman, 1993). Another common use of antibiotics is as a prophylaxis before surgery to reduce surgical-site infection (Smith, 2006). This can be an important factor in preventing infection in the short-term but may increase the rates of resistant bacteria and viruses in the long-term.

Attitudes among hospital personnel, including staff and administrators, also contribute to nosocomial infection. Administrators and staff are understandably hesitant to measure infection rates in their hospitals for fear of damaging their reputations or being penalized by their supervisors (Damani, 2007; Nettleman, 1993; Schlabach, 1988). Administrative support underlies all successful infection reduction interventions (Srivastava & Shetty, 2007), including effective infection control committees (Danchaivijitr, 1991). However, the fear of penalty is generally unfounded; Mortensen (1991) found that documenting the magnitude of infection rates is the first step in generating interest and funding for adoption of control measures.

### **2.3.2 Hospital Level**

At the hospital level, it is important to differentiate between infrastructure and attitude issues that contribute to nosocomial infection. Infrastructure issues include contamination of food preparation areas within hospitals due to inadequate kitchen facilities that cannot be properly

cleaned (Hernandez, Mejia, Cazali, & Arathoon, 1996). Poor quality of hospital sanitary facilities and inadequate waste disposal (Sobayo, 1991) also contributes to nosocomial infection. Vermin and pest infestation may also be a contributing factor to the spread of infection (Schlabach, 1988). Overcrowding of patient wards is also a concern because disease can spread quickly. For example, a study in Trinidad and Tobago found that in a ward with a bed capacity of 38, 72 patients were present (Orrett et al., 1998).

Attitudes among hospital personnel, including staff and administrators, are discussed in more detail in section 2.3.1 above. It should be noted that hospital personnel issues also underlie the maintenance and care of equipment, which can be a major source of infection (Damani, 2007). For example, hospitals that are understaffed or experience low staff morale have more difficulty training and implementing measures such as equipment care and maintenance. This can have serious impacts on nosocomial infection rates; a study in Australia found that 86.8% of all sampled equipment was contaminated with infectious agents (Schabrun & Chipchase, 2006).

### **2.3.3 Community and Outpatient Healthcare Level**

The literature focuses on several factors at the community level that underlie nosocomial infection, although these factors are generally not as critical to understanding nosocomial infection as those at other socio-ecological levels. An issue that is fairly specific to developing countries is the presence and lack of regulation of visitors (Sobayo, 1991). Developing countries often have high rates of community-based infection that can contribute to infection in hospitals (Sobayo, 1991). Friends and family routinely bring food from outside the hospital that may be contaminated with food-borne bacteria, which can cause diarrhea outbreaks in the hospital (Hernandez et al., 1996). Patients and visitors to the hospital may already be infectious; though

not technically a nosocomial infection for that person it can become nosocomial if it spreads to other patients in the hospital. However, community-based infectious agents are usually not the more problematic resistant strains, and therefore are not as serious even if they spread to hospitals. In addition, doctors in Latin America frequently work at several clinics and hospitals, which can spread disease across health care settings (Pannuti & Grinbaum, 1995). Malnutrition and undernourishment due to poverty in the community can aid the spread of nosocomial infection because patients' immune systems are compromised (Darmstadt et al., 2004; Hernandez et al., 1996; Schlabach, 1988). HIV/AIDS positive patients and healthcare workers present a similar problem (Hall, 1998), although this is not a significant factor in Latin America, which has relatively low HIV/AIDS prevalence.

#### **2.3.4 National/Regional Policy and Infrastructure Level**

The literature discusses key national policy and infrastructure contributions to nosocomial infection. Although hand hygiene is known to be the most effective way of controlling infection, developing country hospitals often face shortages of clean water, soap and paper towels, which sabotage fundamental infection control activities (Orrett et al., 1998; Ramirez Barba et al., 2006; Schlabach, 1988; Sobayo, 1991). These shortages are typically not due to hospital infrastructure but rather a result of inadequate national infrastructure.

Even when hospitals have their own water source, problems can arise. One hospital in Guatemala used well water that was treated daily with chlorine tablets to disinfect it. For six months, the chlorine tablets were unavailable and so the water could not be disinfected, causing a bacteremia (bloodstream infection) outbreak in a neonatal intensive care unit (Pegues et al., 1994).

National and regional infrastructure factors that contribute to nosocomial infection also include the lack of laboratories and epidemiologists that are well-equipped and effective. The ability to detect outbreaks and determine which infectious agent caused it is crucial to treating nosocomial infection outbreaks properly. Unfortunately, laboratories in developing countries are often saddled with out-of-date equipment that may not function properly and lack standardized procedures and policies (Martin, Hearn, Ridderhof, & Demby, 2005).

National policy can help support infection control in hospitals. Mexico saw a strengthening of legal mandates and medical community norms around nosocomial infection control after the introduction of a national policy (Zaidi, 1993). However, Lynch, Pittet, Borg, and Mehtar (2007) found that only 57 of 192 countries have national infection control societies. Cavalcante, Braga, Teofilo, et al. (1991) found that the Brazilian government reimbursed hospitals for additional days that patients stayed due to infection, creating a disincentive for administrators to implement infection control programs. National policies and norms that encourage breastfeeding in the neonatal unit can reduce nosocomial infections; infant formula is often made using contaminated water and does not provide the same health benefits to the infant as breast milk (Edmond, Kirkwood, Tawiah, & Agyei, 2008).

Budget cuts in national public health systems can impact staff, equipment and maintenance, which have significant implications for infection control success (Zaidi, 1993). Financial barriers can also limit the availability of necessary equipment and services such as epidemiologic surveillance (Nettleman, 1993). Nettleman cites McKie when stating that “in a South American country, 40% of more than \$12 billion in equipment was not functioning” (pg. 647). Ramirez Barba, et al. (2006), in their study of four Mexican hospitals, found that “open rather than closed infusion systems were used for delivery of fluids and medications on all

patients...during the study period” (pg. 245). This represents one example of a shortage of equipment that could help prevent infection.

## **2.4 SEVERITY AND COST OF NOSOCOMIAL INFECTION IN LATIN AMERICA**

This section examines the costs of common nosocomial infections in Latin America, which can be measured in two ways: the costs associated with extra days in the hospital, and less traditional measurements such as quality-adjusted life-years (QALYs) that take into account patient suffering and impact on the community.

### **2.4.1 Methods of Calculating the Costs Associated with Nosocomial Infections**

Results related to average additional days and the associated costs vary widely in the literature, mostly due to varying methods of calculation. The most reliable method is to match patients with and without nosocomial infection based on age, sex, and clinical diagnosis (Starling, 2001). In Turkey, using this method, the presence of infection increased the patient’s hospital stay by an average of four days, with an average additional cost of US\$442 compared to a non-infected case (Khan & Celik, 2001). Sheng, Chie, Chen, Hung, Wang and Chang (2005) used case matching in Taiwan and found that the median additional hospital stay for patients with nosocomial infection was 15 days, representing an additional cost of about US\$3900 per patient.

Although average additional days is the most common method of measuring the cost of nosocomial infection, that method does not take into account the wider societal costs of

infection, such as the impact of missed work for both patients and their visiting family members (Stone, Braccia, & Larson, 2005). Calculating quality-adjusted life years (QALYs) is a method of weighting health outcomes according to the *quality* of life, not just the *quantity* (i.e., living or dying). Only one article in the literature reviewed used QALYs, which reflects the dominance of average additional days as a measurement of infection costs. Graves, Halton, and Lairson (2007) used QALYs to compare six hypothetical infection control programs in a simulation of 50,000 patients at risk of surgical-site infection after hip replacement surgery in a U.S. hospital. The authors found that all the infection control programs resulted in QALY gains compared to a hypothetical status quo (a basic infection control program with no further investment), and all but one option led to total cost savings compared to the status quo. The hypothetical Option Four (no details on the option were given) provided such substantial QALY gains (about 1,600 total QALYs) with such significant cost savings (nearly halving the total cost of infection) that the authors concluded that it would be unethical not to implement it. Two additional hypothetical options are then compared with Option Four, to illustrate the common problem for health care budgeters: balancing increased QALYs with an increased program cost.

#### **2.4.2 Types and Severity of Nosocomial Infections in Latin America**

There are many types of nosocomial infections in Latin American hospitals. Certainly nosocomial transmission of tuberculosis, HIV, pneumonia and urinary tract infections are common in all developing countries (Gisselquist, Rothenberg, Potterat, & Drucker, 2002; Priddy et al., 2005; Starling, 2001). Diarrhea is an often overlooked, but common form of nosocomial infection (Guerrant, Hughes, Lima, & Crane, 1990; Navarrete et al., 1991). Spread of blood-borne pathogens through use of non-sterile needles and contaminated blood supply is common

throughout the developing world (Altaf, Janjua, & Hutin, 2006; Hutin & Chen, 1999; Kane, Lloyd, Zaffran, Simonsen, & Kane, 1999; Simonsen, Kane, Lloyd, Zaffran, & Kane, 1999). Drug-resistant strains, particularly of *staphylococcus aureus*, are very common in Latin America (Pfaller et al., 1999). The SENTRY survey found that 20.5% of nosocomial infections in Latin America are due to *staphylococcus aureus*, and 15.2% are caused by coagulase-negative *staphylococci*, making staph infections by far the most frequent type of nosocomial infection (Diekema et al., 1999). SENTRY revealed that e.Coli was the next most common, causing 12.1% of the total nosocomial infections.

Nosocomial infection control programs can be very effective in reducing rates and associated costs. The Hospital Sao Paulo in Brazil saw a 71% decline in all nosocomial infection rates in the intensive care unit when an infection control program was implemented, representing a savings of about US\$2 million (Cavalcante et al., 1991). The Neonatal Intensive Care Unit of Hospital General in Guatemala reduced nosocomial rates of bacteremia, a blood-borne infection, from 20% to 7% after the implementation of better infection control procedures (Pegues et al., 1994).

## **2.5 APPROACHES TO NOSOCOMIAL INFECTION CONTROL PROGRAMS**

As seen above, the nosocomial infection problem in developing countries is a very complex issue with many underlying factors. It is in this context that many authors propose programs to reduce or control infection. A CDC statistic that is often cited in the literature is that an effective infection control program can reduce infection rates in hospitals by about 30% (MMWR, 1992), and Damani (2007) cites Wenzel (1987) in claiming that more than 40% of nosocomial

infections in developing countries are preventable. The right program, therefore, has the potential to make a significant contribution to patient care. This section describes two types of approaches to programming, common components of an effective control program, and ethical issues faced by developing country hospitals.

The absolutely most effective way to prevent infections in healthcare settings is to practice good hand hygiene. Bottone, Cheng, and Hymes (2004) found that this meant washing hands with plain soap plus using an antibacterial or antimicrobial rub, or washing hands with an antibacterial or antimicrobial soap, then using paper, not cloth, towels to dry. However, in resource-poor settings these basic items are not always consistently available to enable hand hygiene.

### **2.5.1 Schools of Thought on Infection Control Programs**

Besides hand hygiene, there are two schools of thought on how to control nosocomial infection. The first is to control infection very thoroughly or not at all. Ponce de Leon (1991) typifies the first view; in his writing about infection control in Brazilian hospitals he calls for comprehensive measures such as laundry and kitchen renovation, complete staff training, hand hygiene, water supply to the hospital, thorough epidemiologic surveillance and use of microbiology laboratories to test infectious agents to develop the best methods for control. Hernández, Mejia, Cazali, and Arathoon (1996), studying a cholera outbreak in a Guatemala hospital, recommended strengthening the hygiene practices of food preparation personnel as well as visitors who bring food to patients. A very common component of infection control is the establishment of infection control committees or teams, made up of a special infection control nurse, an epidemiologist or microbiologist, an administrator and a doctor (el-Nageh, 1995; Ponce-de-Leon,



1991; Srivastava & Shetty, 2007). Many authors also called for global policy changes such as the implementation of a WHO program on infection control (Ponce-de-Leon, 1991) or regional infection control policy (Hall, 1998), changes to medical and nursing school curricula, and international support for research and training in developing countries. This way of thinking involves strictly following CDC or WHO guidelines on infection control, without room for improvisation based on local conditions. Ponce de Leon (1991) believes that even in developing countries, complete infection control measures can and should be implemented properly, both because infection rates are so high in developing countries and the WHO and CDC guidelines represent a gold standard to which all countries should adhere.

The second school of thought on infection control is that WHO and CDC guidelines represent an ideal that is very expensive and may be impossible to implement comprehensively given local conditions in developed as well as developing countries. Some practitioners, particularly Western doctors practicing in developing countries, advocate extreme improvisation, such as making colostomy bags out of tin cans and tire rubber (Meier & Tarpley, 1991), using fishing line dipped in alcohol for surgical suture (Meier & Tarpley, 1991; Schlabach, 1988), sun-drying surgical linens in lieu of sterilization (Meier & Tarpley, 1991; Schlabach, 1988), and diluting disinfectant solutions to cut costs (Cavalcante et al., 1991). Unfortunately, in many resource-poor settings health care practitioners are forced by their circumstances to adopt these very same techniques.

A more moderate view falls in the ‘appropriate technology’ category, a school of thought that proposes that developing countries should not necessarily follow all guidelines that were created in developed countries, but should adopt practices that fit in the cultural and economic contexts. The National Center for Appropriate Technology in Butte, Montana, defines

appropriate technology as “simple to apply; not capital intensive; not energy intensive (requiring little non-renewable energy to do, build, or maintain); uses local resources and labor; and nurtures the environment and human health” (NCAT 2008). This view also recognizes that many of the infection control practices that developing country hospitals already follow are wasteful and ineffective. Simpson (1984) states that circumstances in developing countries

necessitate a simplified and more fundamental approach that is both economically viable and effective. Although direct comparison with standards feasible in the West may not always be appropriate, it may be beneficial in stimulating a re-examination of conventional and possibly wasteful practices (pg. 1898).

Most developing countries have only a few, if any, microbiology laboratories that are capable of identifying infectious agents rapidly enough to treat patients who develop nosocomial infections. Similarly, thorough epidemiologic surveillance is an expensive undertaking that diverts staff time away from patients. Appropriate technology proponents such as Simpson (1984) and Damani (2007) believe that existing infection control programs should be improved gradually, global standards on infection control should be altered to fit the local situation and needs, and infection control needs in developing countries should be prioritized to maximize spending. For example, Srivastava and Shetty (2007) stated that neonatal infection could be controlled more effectively by “scrupulous cleaning regimens rather than adopting a policy of routine environmental surveillance” (pg. 301), since only three locations within the neonatal intensive care unit were found to be associated with nosocomial infections: baby placements, resuscitation equipment and cleansing solutions.

### **2.5.2 What makes a good infection control program?**

As we have seen, there are several different models and priorities for implementing an effective infection control program in developing countries. Many authors simply advocate following CDC infection control guidelines. Pannuti and Grinbaum (1995) recommend epidemiologic surveillance, training programs, isolation of infected patients, control of antibiotic use, identification and management of epidemics, and control of disinfection, sterilization, and waste disposal. Pegues et al. (1994) suggest using a strong antiseptic handwash, monitoring water supply quality, and being very strict with hand hygiene and glove use when drawing up and administering medications and IV solutions. Cavalcante et al. (1991) advocate daily culturing of high-risk devices and fluids, including infant formula, dialysis water, and sterilizers, as well as the creation of incentives to spur administrators to implement programs. Many authors agreed that once a hospital adopts an infection control program, infection control committees or teams can be very effective in monitoring results if allowed and encouraged to do their job by hospital administration (see for example Lynch et al., 2007; Srivastava & Shetty, 2007).

### **2.5.3 Ethical considerations of prioritizing infection control**

In making decisions about nosocomial infection control procedures, hospitals in developing countries must grapple with ethical considerations that result from limited resources. Meers (1988) draws out the difficult ethical context in which developing country hospitals operate, one in which control of many other serious and fatal diseases may need to be prioritized over infection control. Pannuti (1991) points out that where resources are very limited, decision-making involves weighing one program against another because spending more on one initiative

will take money away from another critical program. In this context, Pannuti argues, a cost-benefit analysis will aid hospitals in determining how their scarce resources are best spent. Whichever program has the most benefit at the least cost should be implemented; this may mean that hospitals will prioritize other initiatives over infection control. As Meers and Pannuti demonstrate, tradeoffs in resource-poor settings is a very significant issue, one to which program planners need to be sensitive. This reality may conflict with the viewpoint of health as a human right, because prioritization in resource-poor settings may reduce programming that strengthens health. Strategic use of cost-benefit analysis, though not perfect, may help to justify programming choices and make the most of scarce resources. Starling (2001) points out the “tremendous difficulties” that developing countries face when trying to implement nosocomial infection control programs in times of war and in situations of deep poverty. He concludes that

infection control activities as well as other quality control programs are only possible when society is at least minimally stable and attended in terms of basic assistance. In other words, infection control has a better chance of growing in democratic societies living in peace, where citizens are aware of their rights and have channels to claim improved quality of life and quality of assistance (pg. 462).

## **2.6 THE ROLE OF INTERNATIONAL ORGANIZATIONS IN INFECTION CONTROL IN DEVELOPING COUNTRIES**

International organizations, whether intergovernmental or non-governmental, play a role in supporting the reduction of nosocomial infection rates in developing countries. In the literature, support activities are placed into three main categories of international assistance: funding; standards-setting; and material resources provision, including surveillance systems. All of these activities can take place at an international, national, or hospital/clinic level.

International organizations are perhaps best known for funding change efforts in developing countries. Although funding can be provided without strings attached, most often it is earmarked or conditional, intended to provide incentives for addressing health problems. Earmarked funding has become an increasingly common method through which international NGOs address certain diseases, particularly so-called “neglected” diseases that impact predominantly the world’s poor and for which pharmaceutical companies have little incentive to develop treatments (Mandelbaum-Schmid, 2004; Shiffman, 2006). The Bill and Melinda Gates Foundation and Médecins Sans Frontières are two organizations, among many others, that provide this type of funding (Mudur, 2003). The Global Fund to Fight AIDS, Tuberculosis, and Malaria is an example of an intergovernmental organization that provides earmarked funding for certain diseases (Richards 2001; Brugha, Walt 2001). Lagarde, Haines, and Palmer (2007) describe a system of cash incentives to increase health-seeking behavior in Latin America, and found that overall the incentives worked. This is one example of conditional funding; the Global Links infection control intervention described below is another.

International organizations, particularly intergovernmental organizations, have a significant impact on setting and improving medical standards around the world. The 2005 World Alliance on Patient Safety is one such initiative. The various UN Decades are also examples of bringing attention, resources, and standards to a variety of issues, including health and diseases. The WHO and its regional offices have published guidelines and protocols on many issues, including nosocomial infection control and hand hygiene techniques. The WHO also provides opportunities for member states to sign onto various pledges, making public their commitments and increasing accountability to the public. The PAHO member countries’ pledge-signing with the World Alliance on Patient Safety is one example (PAHO, 2007b).

Finally, international organizations are often involved with providing material resources to developing countries to support local activities. As noted above, regional epidemiologic surveillance systems have been created in recent years to collect data on rates of drug-resistant strains of infectious agents. The SENTRY program in the Americas is one such example (Gales et al., 2000). Chandiwana and Ornbjerg (2003) describe a 21-year partnership between research institutions in Zimbabwe and Denmark that focused on “institutional support, scientific training, joint research programmes, and technology transfer” (pg. 288). International medical supply recovery organizations are helping to supply nosocomial infection control efforts through donations of medical equipment and critical supplies (gloves, antiseptic handrub, etc.). Training programs, professional exchanges, and other activities also help to build the capacity of local hospitals as well as government officials to reduce nosocomial infection and other diseases.

Several authors have expressed concern that international activities that support health outcomes actually damage national health systems (Calain, 2007; Unger, De Paepe, & Green, 2003; Waddington, 2004). Unger, De Paepe, and Green (2003) note that it is very important for international efforts to collaborate with and support local health systems and describe best practices for disease control programs. Waddington (2004) explains how earmarked funding provides a disincentive for budget allocation to supplement the earmark; rather, budgets will allocate the funding that is received by the earmark into other activities. This can have a detrimental impact on national health budgets and create dependency on international assistance.

### 3.0 METHODOLOGY

This section describes the qualitative research that was conducted and the data that are analyzed and reported in the remainder of this thesis. Because of the non-invasive nature of the research, it was deemed to be “exempt” by the University of Pittsburgh Institutional Review Board (PRO07120235).

Interview questions were developed by the author for three categories of interviewees: staff at NGOs that conducted infection control interventions in Honduras, a U.S. hospital infection control officer, and inter-governmental infection control policy-makers (see Appendix B). The interview questions were not pre-tested. An organizational letter of support was received for interviews that were conducted in person at a facility that is not affiliated with the University of Pittsburgh or UPMC (see Appendix C.2).

Interviews were conducted with key staff of Global Links and Central American Medical Outreach (CAMO), the two organizations whose programs are compared in this thesis. Participants at CAMO and PAHO were recruited using direct email to key staff (see Appendix C.1). The author was an intern at Global Links and recruited key staff verbally during her internship. The author contacted the UPMC infection control director by telephone and was assigned an infection control officer as a contact person for her thesis research.

The interviews supplemented public information on the organizations’ infection control programs in Honduras, and provided insight into the organizational context in which the

programs were developed. To complement the perspective of the two international NGOs, interviews were conducted with personnel at two organizations who can add to understanding of the global nosocomial infection problem. One interview was conducted with an Infection Control Officer at the University of Pittsburgh Medical Center (UPMC) Infection Control Department, which is internationally renowned for its infection reduction policies and programs. A leader of the Pan American Health Organization (PAHO) Quality and Patient Safety Team was interviewed by telephone to provide perspective on PAHO's relationship with the Global Alliance for Patient Safety and PAHO's vision for how international NGOs can be involved in reducing nosocomial infection rates in Latin America.

All interviewees were read an introductory consent script to inform them of their rights as research subjects (see Appendix C.3). The interviews were not audio-recorded. Hand-written interview notes were shredded and typed interview notes were kept on a password-protected personal computer. Data were analyzed to look for themes and trends among respondents and then were placed in the context of the social-ecological model.



## **4.0 RESULTS**

This section reports on the results of the interviews described above. Two brief case studies of the response of international organizations to nosocomial infection in Honduras are presented in this section. Both Global Links and Central American Medical Outreach (CAMO) are medical supply recovery organizations (MSROs), which focus on collecting medical equipment and supplies from operating rooms and other areas of hospitals and sending them to partner hospitals and clinics in developing countries or equipping medical volunteer teams that work in developing countries. There are about 25 MSROs in the United States. Following the case studies, a summary of the perspectives of the University of Pittsburgh Medical Center (UPMC) Infection Control Department and the Pan American Health Organization (PAHO) Quality and Patient Safety Team are presented.

### **4.1 CASE STUDIES**

Honduras has a per capita GDP of US\$3,100, and 53% of its population of 7.5 million lives below the poverty line (CIA, 2007). Public health indicators in Honduras reflect its poverty: an infant mortality rate of 25.21 deaths/1000 live births and an overall life expectancy of 69.35 years (ibid.). Maternal mortality is 110 per 100,000 and only 30% of the population has access

to sanitation (NationMaster, 2007). The Honduran government spends US\$74 per person per year on health care (ibid.).

The two organizations took unique approaches in their interventions, each addressing different underlying causes of infection. Central American Medical Outreach (CAMO) sought to overcome structural and facility factors through extensive renovation of hospital kitchen and laundry facilities. Global Links collaborated with PAHO to support the adoption of nosocomial infection control protocols through a tailored shipment of donated equipment and supplies. The data presented in this section come from two sources: personal interviews and organizational documents including organizational websites.

#### **4.1.1 Case I: CAMO's Structural Support for Infection Control in Honduras**

Central American Medical Outreach, Inc. (CAMO) is a non-denominational Christian organization founded in 1993. Based in Ohio, CAMO also has an office and distribution center in Honduras, built in 2003. CAMO's primary 16 programs focus on donating medical supplies, equipment and education to hospitals and clinics in Central America. In addition to the ongoing programs, CAMO implements one or two community development projects per year in Honduras, supporting its vision of sustainable, long-term programming that integrates into the public health systems of the target countries. CAMO's capital improvement projects address underlying structural causes of nosocomial infection and improve the quality of patient care at its primary partner location, the public Western Regional Hospital (Hospital Regional de Occidente, HRO) in Santa Rosa de Copán, Honduras. The projects include kitchen and laundry renovation and electrical rewiring, and were funded by individual donations, fundraising dinners held in

Ohio, and the resale of the trucks that CAMO uses to transport its program donations, supplemented with money from CAMO's general fund.

CAMO's first renovation project addressed an often-overlooked source of hospital infection: the kitchen. The kitchen at HRO served 1,000 meals per day from a facility that used wood-burning stoves, had no refrigerator or freezer, and had an insecure food storage area that was infested with rats. Staff worked in smoky, unsanitary conditions and suffered from health effects of the wood-burning stoves. Forty-three women died from the effects of working in those conditions over an unspecified period of time, probably years. The women of the kitchen approached CAMO for help, because the Honduran government would not agree to renovate or maintain the public hospital's kitchen. Working with the women, CAMO planned the renovation and then fundraised to carry out the project. The kitchen renovation project was implemented in 1995 and resulted in an entirely new kitchen and staff cafeteria, with electric appliances, a walk-in refrigerator and freezer, secure food storage area, and plenty of sanitary space for food preparation.

The laundry renovation project of 1999-2000 created a safer working environment for the laundry staff and improved the availability of clean linens for the hospital, thus increasing patient safety. Before the project, four women staff members washed about 800 pounds of laundry by hand every day, using buckets and washboards. Linens (including surgical linens) were dried outside on clotheslines, exposed to the elements. HRO reported that surgeries were often cancelled or postponed due to a lack of clean surgical linens. There were shortages of clean linens for patients, too; many patients either lay on dirty linens or directly on the mattress without linens. The US\$100,000 laundry renovation project modernized the laundry facilities at the hospital, installing institutional quality washing machines and dryers. CAMO worked with

HRO to design the new laundry room according to the specific needs of the hospital. To further reduce nosocomial infection, the laundry room is organized so that soiled linens never come into contact with clean ones. A sufficient supply of sterile surgical linens and patient linens is now available throughout the hospital.

The ambitious electrical rewiring project, which CAMO undertook with funding from the Inter-American Development Bank and the Noble Foundation in Ohio, modernized the electrical system of the 100-year old hospital building. This rewiring reduced electrical power outages and allows for the operation of more equipment and more modern equipment. Although electrical wiring is not directly related to nosocomial infection control, this project is an example of a supportive activity that enabled other infection control activities, such as laundering, cooking and sterilizing.

No data are available about the impact of CAMO's capital improvement projects on the reduction of infection at the HRO, although certainly conditions are much better for the staff at the hospital. A major challenge for CAMO is the lack of competent leadership in the highly politicized and corrupt public health system of Honduras, in which hospital directors are political appointees. Poor leadership impacts morale at every level of the hospital and contributes to poor maintenance of the equipment in the renovated areas. For example, laundry staff dumped buckets of water on the electrical circuitry of one of the high-heat dryers, causing a permanent malfunction. Head nurses and physicians also lack leadership skills, which impacts patient care. CAMO's permanent presence in Santa Rosa de Copán allows its staff to be involved in maintaining equipment, but staff are aware that the government, rather than an international organization, should be maintaining the hospital.

#### **4.1.2 Case II: Global Links' Incentivizing Infection Control in Honduras**

Global Links, founded in 1989, is a Pittsburgh-based medical donation organization that collects over 30 tons of medical supplies each year and sends them in 40-foot containers to eight countries in Latin America and the Caribbean. Global Links has a unique partnership with the Pan American Health Organization (PAHO), which facilitates cooperation with the ministries of health in the target countries. Global Links has a variety of long- and short-term partner hospitals and clinics throughout the eight countries, enabling it to have an impact that is both broad and deep. Other Global Links programs include a worldwide surgical suture donation program and 'special projects' (one-time donation shipments to targeted institutions outside the main programming area).

One such special project occurred in 2000, when Global Links received a request for assistance with nosocomial infection control in Honduras at the Maternal and Infant Teaching Hospital in Tegucigalpa (Hospital Escuela Materno-Infantil). The hospital is one of five that make up the public Hospital Escuela, the largest hospital in Honduras. PAHO had been working with hospital administrators on nosocomial infection control, so the administrative motivation was strong. However, conditions and infrastructure in the hospital were so poor and there were so few materials that few of the PAHO protocols could be implemented properly. When Global Links staff traveled to Honduras and visited the hospital, they found that the labor and delivery rooms were decrepit, with wooden delivery tables that were rotting, for example. When equipment has reached that stage of deterioration, it can no longer be cleaned properly, not to mention causing patient discomfort.

PAHO's work with the hospital focused on training hospital staff and other activities linked to implementing nosocomial infection control protocols at the hospital. Global Links

collaborated with PAHO and the hospital to determine what materials and supplies were needed to support the PAHO activities and enable a clean and sterile environment. The primary needs were for an autoclave machine to sterilize equipment and for more modern equipment such as delivery tables, as well as gloves, soap, and other supplies.

Once Global Links had completed the needs assessment process, staff in Pittsburgh began to put together the shipment. Most of the supplies and ‘furniture’ (such as delivery tables) were already in stock in the Global Links warehouse. The autoclave machine had to be purchased, so Global Links approached the Rotary Club of Pittsburgh for funding, making a series of presentations at Rotary meetings to highlight the needs at the hospital. Once funding was in place, a new autoclave was purchased and the first 40-foot container was assembled and shipped.

The Global Links shipment provided an incentive to the hospital and also facilitated the existing motivation of hospital administrators to reduce nosocomial infection in the labor and delivery rooms. Although long-term results were not tracked, the hospital maintained PAHO’s infection control standards for at least six months. Global Links views the project as a success, since it helped prevent maternal illness and death, which takes a large toll on society and the family. However, the interviewee at Global Links noted that hospitals in Latin America often discharge women quickly after giving birth, so infection acquired in the hospital may not be apparent until after the new mother has returned home. This can skew hospital nosocomial infection reporting.

Global Links would like to implement similar projects with other partner hospitals in the future, recognizing that nosocomial infection control can make a huge impact. Some factors that the organization considers are the importance of research and partnership to determine what the true needs are at the hospital and what Global Links can provide in terms of supplies and

equipment. The hospitals themselves have to be motivated to use the donated equipment and supplies in the best way possible, which takes strong leadership and the willingness to incorporate infection control procedures into the day-to-day processes at the hospital.

## **4.2 UPMC AND PAHO PERSPECTIVES AND INVOLVEMENT**

This section reports on two interviews that were conducted with staff from the University of Pittsburgh Medical Center (UPMC) Infection Control Department and the Pan American Health Organization (PAHO) Quality and Patient Safety Team. PAHO's interventions focus on national and hospital policy and training. UPMC provides an example of a well-supported infection control environment at the system of hospitals in the United States. Data presented here come from two sources: personal interviews and organizational documents including organizational websites.

### **4.2.1 UPMC**

The University of Pittsburgh Medical Center (UPMC) is a system of 19 hospitals and many other health care facilities located across western Pennsylvania. It is the largest employer in the region, and is also a world leader in infection control, particularly in its collaboration with the Pittsburgh Veterans Affairs Hospital. For several years, UPMC's Presbyterian hospital was the site of an innovative pilot project to reduce MRSA (methicillin-resistant *staphylococcus aureus*) in the medical intensive care unit (Fabregas). UPMC is also a leader in the Pittsburgh Regional

Healthcare Initiative (PRHI), founded in 1997 to improve patient care in 44 hospitals in 12 counties in southwestern Pennsylvania (Sirio, 2003).

UPMC infection control practitioners (ICPs) are assigned to specific departments within the hospital (for example the intensive care unit, the dietary departments, and the physical therapy unit). The ICP who was interviewed covers four departments at two UPMC hospitals. Most ICPs are registered nurses, and some have additional laboratory science education. UPMC's infection control structure is highly inter-departmental. A weekly working group meeting includes all the ICPs at the hospital plus representatives from environmental services (janitorial and laundry), hospital laboratories, hospital maintenance staff, and food preparation. Monthly hospital infection committee meetings are system-wide, including representatives from all departments plus all the ICPs from all the UPMC medical facilities.

The ICPs see themselves as patient advocates, working closely with bedside nurses who are the primary patient advocates. The ICP activities include weekly surveillance of patient charts and records for incidence of MRSA and VRE (vancomycin-resistant *enterococci*) and other infections that may be nosocomial. The ICP makes weekly rounds in his/her departments with a team from each department that includes environmental services and a nurse. ICPs occasionally conduct environmental culturing in their departments, and may also obtain and review microbiology reports.

If the ICP detects a problem, s/he will go to the unit and collaborate with nurses and physicians to try to identify the cause of the problem. If infection rates are above average for two weeks in a row, the ICP contacts the unit director and head clinician to gain their support for an intervention. The ICP typically prepares visual material to show the spike in cases, and a simple information sheet explaining the problem and the steps to resolve it. These documents



are used for the inservice trainings that the ICP conducts with every nurse in the unit over several days. After about one month has elapsed, the ICP will follow up with the nurses and unit director, using graphs to represent the progress in infection rate reduction since the intervention.

The ICP who was interviewed identified two main challenges to the work: the nurse shortage and prioritizing infection control. The shortage of nurses means that hospital department nurses are typically overworked and overburdened. ICPs are aware that asking a nurse to pay attention to one additional detail, or take one additional step in care, may be perceived as burdensome. The nurses' attitudes, though considered justified given the shortage, are a deterrent to the ICP's communication and activities. Secondly, infection control is very difficult to convince staff to prioritize, especially in the intensive care unit where patients are severely ill. Bedside nurses must prioritize immediate care needs, plus keep track of changing medications, technologies, and regulatory agencies. In this context, infection control takes second place to the other pressing care needs.

These challenges are addressed using several strategies. First, the ICPs focus on building relationships and mutual respect with the nurses and other staff in their assigned departments. All communication is conducted in a very respectful way, without blame. Second, UPMC is training its present and future staff in the importance of infection control. New and current employees and medical students are trained to increase their understanding of and commitment to infection control.

The ICP who was interviewed identified knowledge, attitudes, and beliefs (KAB) about nosocomial infection control as the most important component of implementing an effective infection control program. The second most important component was organizational support, and the third was having the actual supplies to carry out infection control. The ICP noted that if

the staff genuinely want to prevent infections and the administrators support them, the only supplies needed are soap and water.

#### **4.2.2 PAHO**

During the past two years, the Pan American Health Organization (PAHO) has strengthened its nosocomial infection control and patient safety policies and practices through its involvement with the World Alliance for Patient Safety (a collaboration between WHO and the Joint Commission International). In April 2007, PAHO produced its own guidelines for preventing nosocomial infections, published in Spanish and English. PAHO adopted Resolution CSP27.R10, the “Regional Policy and Strategy for Ensuring Quality of Health Care, Including Patient Safety,” at its annual conference on October 5, 2007. The Resolution was based on a set of recommendations (CSP27/16) that outlined the systemic and individual causes that underlie the lack of quality health care in the Americas. These two documents provide the basis for how PAHO member countries, PAHO itself, and other international actors can work to improve health care quality and patient safety, including nosocomial infection reduction.

PAHO’s nosocomial infection control work takes a top-down approach, changing policy with governments that then effect change with the hospitals and health care personnel in their countries. This is a consolidated, comprehensive approach, building on the PAHO antimicrobial resistance and surveillance network, and represents an opportunity to gather all of PAHO’s internal work on the patient safety issue and consolidate it into one approach. PAHO works with, among others, the Japan International Cooperation Agency (JICA) for funding and technical support.

The top-down approach has two emphases: political and technical. The political work is for PAHO to obtain ministry of health ratification of the resolution and recommendations described above. At the time of writing, 31 of 35 ministries of health in the region had signed on.

The technical component involves three programs: alcohol-based handrub, training and regional networking. In November 2007, PAHO began pilot-testing the technical interventions at the Costa Rica Children's Hospital. The aim of the pilot project is to test the implementation of alcohol-based handrub at the hospital and to establish a network of hospitals in Costa Rica to implement the handrub. PAHO also provides training for health care workers to teach them how to evaluate the level of compliance with handrub use and the intervention's impact on nosocomial infection rates. The Costa Rica pilot project is an important test of the logistics involved with nosocomial infection control procedures, including training the health care workers who will implement the procedures, how to provide dispensers for the alcohol-based handrub, and what technical support is needed for introducing the procedures and making them sustainable in the hospital setting.

In 2008, three countries will establish a model of the nosocomial infection control network: Argentina, Brazil and Honduras. The Quality Director at the Honduran Ministry of Health and the national epidemiologist represented Honduras at the October 2007 PAHO conference and at the launching of the pilot project in Costa Rica. Honduras is currently developing a proposal for implementation of the model project to present to PAHO this year.

## 5.0 DISCUSSION

This section discusses nosocomial infection control in Honduras using the social-ecological model as a framework. The social-ecological model places individual behavior in the context of peers, organizational policy, national policy and national and regional infrastructure. This way of framing the problem is critical because nosocomial infection is a very complex issue that requires intervention on multiple levels. For purposes of this thesis, the social-ecological framework has six levels (see Figure 1).



**Figure 1: Social-Ecological Framework of Nosocomial Infection**

Based on the literature review, a chain of events that needs to be in place before nosocomial infection control can occur was created. This chain of events is presented first and then the remainder of the discussion is presented. At each level, the interventions that are

profiled in this thesis are examined, gaps are identified, and possible interventions to address the gaps are suggested.

## 5.1 CHAIN OF EVENTS

One way of envisioning the problem of nosocomial infection is to set out a chain of events that are necessary in order for nosocomial infection control to occur.

**Table 1: Chain of Necessary Events for Nosocomial Infection Control**

1	Continuous supply of clean water, soap, paper towels and alcohol handrub Clean and safe kitchen and laundry facilities Continuous supply of cleaning agents for disinfection/sterilization Hospital equipment that can be cleaned (i.e. not rotted or rusted)
2	Knowledge, attitudes and beliefs (KAB) of hospital personnel to practice hand hygiene and other surgical, equipment, and maintenance procedures that support nosocomial infection prevention.
3	Administrative support for detecting nosocomial infection Administrative support for infection control committees
4	Infection control committees that are supported and well-led
5	Epidemiological capacity to detect outbreaks of nosocomial infection Laboratory capacity to determine what the infectious agent/strain is
6	Adequate supply of appropriate antibiotics to treat the specific agent/strain that was detected KAB of hospital personnel to use antibiotics appropriately Space at the hospital for patient isolation, if needed
7	National policy and funding to support all of the above

The chain of events is daunting, but should not be discouraging. All the steps in the chain need adequate resources and political will to achieve, but all are equally important to the control of nosocomial infection. The emphasis here is that the problem is very complex, and thus needs a complex, multi-tiered intervention or series of interventions.

## **5.2 HOSPITAL PERSONNEL LEVEL**

Although some hospital personnel knowingly do not practice procedures that could reduce nosocomial infection, the vast majority of health care workers are committed and knowledgeable, and do their best for patients in the context in which they work. This is a context in which the availability of clean water, soap, and quality equipment is not a given. Nevertheless, the knowledge, attitudes, and beliefs of hospital personnel are critical to nosocomial infection control. Humans are, by nature, resistant to change, so the implementation of new practices regarding hand hygiene, antibiotic use, and equipment maintenance must be presented in ways that allow them to be adopted easily. Interventions at this level should be highly participatory, to increase the buy-in of health care workers and to draw on their expertise.

PAHO's trainings of healthcare workers to facilitate the implementation of alcohol-based handrub are a good example of an intervention at the hospital personnel level. The literature review shed light on iatrogenic behaviors such as misuse and overuse of antibiotics. These can be addressed through interventions involving education and training at the personnel level. Another factor that emerged through the interviews conducted for this thesis was the lack of strong leadership in hospitals, causing motivation problems among staff. Leadership training represents another potential intervention point.

### 5.3 INFECTION CONTROL COMMITTEE LEVEL

UPMC's infection control committees can serve as a model in that they are effective, well-led, and well-supported by both health care workers and hospital administrators. At this level, interventions should help to support and supply the committees, which at their most basic should be composed of an infection control nurse, an epidemiologist, and a physician. The UPMC model also involves the head of the unit, a laboratory technician, a janitorial/maintenance staff member and a kitchen staff member. In the UPMC model, the infection control committee conducts active surveillance, reviewing patient charts and conducting weekly walk-throughs of all units in the hospital. Infection control officers communicate respectfully and in partnership with the health care personnel in their units.

Although infection control committees are common throughout the developing world, very few international interventions focus on strengthening them. From the UPMC example, we learned that support from hospital administrators and floor staff is critical for an effective infection control committee. Other lessons learned are equally applicable even in resource-poor settings. For example, regular meetings involving representatives from all hospital departments were held. ICPs had access to organized data in the form of patient charts and laboratory and microbiology reports. Strong leadership capability among ICPs and their supervisors is also critical. The infection control committee can also help encourage hospital policy changes, such as encouraging breastfeeding and reducing the patients' length of stay. Each of these points represents an intervention opportunity for international organizations.

## **5.4 HOSPITAL ADMINISTRATION LEVEL**

PAHO, CAMO and Global Links worked with hospital administrators to implement their interventions. Each encountered barriers of poor leadership, lack of resources and skills, and problems that stem from hospital directors being political appointees. Administrative attitudes and leadership are crucial for the success of any intervention in a hospital, whether at the infrastructure, infection control committee, or health personnel level.

Global Links targeted 'political will' barriers of administrative attitudes and motivation for implementing infection control by linking its donation to the implementation of infection control protocols. Until there are changes in national policy regarding hospital directors being political appointees, international organizations must work within that system. Possible interventions at this level include leadership training for hospital directors, heads of departments and other hospital leadership staff. Participatory planning and implementation can facilitate leadership skills and buy-in from administrators.

## **5.5 HOSPITAL INFRASTRUCTURE LEVEL**

Both of the international NGOs profiled in this thesis intervened at the hospital infrastructure level. CAMO targeted structural (facility) barriers to infection control by renovating two common sites of nosocomial infection: the kitchen and laundry. Both organizations reduced barriers by creatively applying their existing programming expertise to a new need. In CAMO's case, the existing model for organizational decision-making and strategic planning was to elicit the needs of stakeholders and beneficiaries. The women who worked in the kitchen and laundry



expressed a need for renovation, which was supported by information from the doctors and nurses that food preparation and hospital linens were underlying causes of a lack of patient safety at the hospital. Global Links also used an existing program strategy (shipping donations) to meet the need (motivation) of a partner hospital, and provided material supplies such as delivery beds and an autoclave.

Gaps in international interventions at this level include support for laboratories and epidemiologists, supply of antibiotics, and supporting patient isolation areas in hospitals. Potential interventions would include donating material supplies and equipment and renovating facilities, in line with the activities of CAMO and Global Links. Training and educating epidemiologists and laboratory staff should be done in the national curricula for those fields; however, increasing hospital administrative leadership and support will also strengthen them.

## **5.6 COMMUNITY & OUTPATIENT HEALTHCARE LEVEL**

Community-based infections are not significant contributors to the nosocomial infection problem, as noted above, but there are some aspects of community and outpatient care that can impact nosocomial infection prevention efforts. The presence of malnutrition or under-nutrition in the community makes patients more susceptible to nosocomial infection, as does the prevalence of immuno-compromising diseases such as HIV/AIDS and cancer or other diseases that require a course of treatment that weakens the patient's immune system. Interventions include reducing malnourishment and under-nourishment of the general population through food and vitamin supplements and economic development. Also, as noted above, many doctors in Latin America work in multiple healthcare settings, including hospitals, private practices and

clinics, so potentially can carry infections on clothes or briefcases from one setting to another. This, again, is not a significant contributor to the nosocomial infection problem, but could be a point for interventions of training or education about how to avoid cross-contamination.

The most important factor at the community and outpatient care level is the misuse of antibiotics in outpatient care settings, such as clinics, which can create and perpetuate resistant strains of infectious agents. Therefore, the priority interventions at this level would target the misuse of antibiotics through training, health communication campaigns, and improved epidemiological surveillance and laboratory testing of infectious strains to tailor antibiotic use to the strain.

## **5.7 NATIONAL/REGIONAL POLICY & INFRASTRUCTURE LEVEL**

As noted above, PAHO adopted Resolution CSP27.R10, the “Regional Policy and Strategy for Ensuring Quality of Health Care, Including Patient Safety,” at its annual conference on October 5, 2007. The Resolution was based on a set of recommendations (CSP27/16) that outlined the systemic and individual causes that underlie the lack of quality health care in the Americas. These two documents provide the basis for how PAHO member countries, PAHO itself, and other international actors can work to improve health care quality and patient safety, including nosocomial infection reduction, at the national policy level.

The PAHO policy proposal details twelve causes of lack of quality, six at the systemic level and six in the actual delivery of health services. As we saw above, PAHO is working directly with member governments to effect change in national policy and implementation of alcohol-based handrub and other technical components of nosocomial infection control. PAHO

is perfectly suited to national policy level change, as it is an inter-governmental organization with the technical expertise and political clout to influence government policy change. PAHO seems to be aware of the importance of the other social-ecological levels for implementing its patient safety agenda, since training and logistics are part of the implementation plan. The important thing is for PAHO to collaborate with other types of organizations, such as international NGOs, to present a coordinated and unified intervention at all the social-ecological levels. Another key intervention point is the reform of health care hierarchies so that hospital directors are no longer political appointees. Hospital directors in countries like Honduras may not have the necessary knowledge and leadership skills to run a hospital effectively. This is a critical issue that was brought up by each of the three international organizations profiled in this thesis.

For national and regional infrastructure, the major actors are the big international aid and development agencies, such as the United States Agency for International Development (USAID), JICA, or others like them. These organizations work with developing country governments to improve infrastructure, such as water and sanitation, governance, roads, and communication. The literature reveals a surprising lack of intervention examples regarding strengthening laboratory and epidemiology capability. Several international efforts are being made to increase standardization of procedures and availability of resources to these critical actors, particularly around HIV/AIDS detection and prevention. Activities that strengthen health sciences education are also critical.

Analyzing and listing all the regional and national infrastructure projects are beyond the scope of this paper. National and regional infrastructure improvement is also beyond the scope of the majority of international NGOs. The important thing to note is that infrastructure

improvements are taking place on a large scale in developing countries. In the meantime nosocomial infection control activities can still progress.

## **5.8 BRINGING IT ALL TOGETHER**

The problem of nosocomial infection in developing countries is extremely complex and requires targeted, nuanced interventions. The advantage of breaking the problem of nosocomial infection into social-ecological levels is that we can easily see points for intervention, a combination of top-down and bottom-up, as well as how activities on different levels interact with one another.

Public health programming models can help international organizations plan interventions to reduce nosocomial infection rates. As we saw in the discussion above, interventions at most levels should be highly participatory and should incorporate needs assessments into program planning. Strengths-based approaches, a style of needs assessment that examines not only the ‘needs’ in a setting but also its ‘strengths,’ can increase beneficiary buy-in and reveal what types of programs are already being carried out. This is important for long-term sustainability of interventions; those that have the support of beneficiaries and recognize and build on existing strengths will have more impact. Models such as PRECEDE-PROCEED, developed by Green and Kreuter, can be tailored to fit the context of the intervention, and can provide international organizations with a foundation for program planning and evaluation.

Reducing nosocomial infection in developing countries will have a spillover effect on many other health and development issues. The literature review revealed that the costs of nosocomial infection include the caretaking burden on the family, missed work, the cost to

society of managing drug-resistant strains of infectious agents, and reduced lifetime productivity due to long-term effects of infections. Improving nosocomial infection rates will bolster economic and educational aspects of development as well as health.

## 6.0 RECOMMENDATIONS AND CONCLUSIONS

This section summarizes how international organizations can make a difference in infection control in developing countries, and will provide programming recommendations for international organizations that are considering implementing nosocomial infection control programs in developing countries.

As revealed in the literature, international interventions at any level should be careful not to inadvertently weaken public health systems in the target country. Each organization profiled in this thesis expressed the need for a thorough understanding of the context before planning a program, and the importance of collaborating with local practitioners in program design and implementation. The major public health program planning models (such as PRECEDE-PROCEED) offer frameworks for organizations to plan participatory and evidence-based interventions. The social-ecological planning model, which is based on the social-ecological model, is another tool that can help organizations understand how specific activities at each of the social-ecological levels support one another.

Since nosocomial infection in developing countries is such a complex problem, international interventions must consider all the social-ecological levels. Of course, not every organization should or could address all the issues that underlie nosocomial infection. International organizations like the three profiled in this thesis each intervened according to its strengths and the scope of programming that its size and funding allowed. However,

understanding how an intervention fits into the bigger picture represented by the social-ecological model is critical. This will enable the critical collaboration between a variety of organizations, including inter-governmental, non-governmental and bilateral organizations.

This thesis proposed many possible points of intervention for international organizations. International NGOs, including Global Links and CAMO, should consider intervening on other social-ecological levels besides the hospital infrastructure level, and should take into account the underlying issues explored in the literature. PAHO is in the unique position of being able to influence both national and hospital policy, and therefore is a critical actor in the international reduction of nosocomial infection rates. The chain of necessary events, presented in Section 5.1, reveals that national policy and funding to support all the other links in the chain is one of the most fundamental components of successful nosocomial infection prevention. PAHO must focus its policy change efforts on two points: ending the practice of hospital directors as political appointees and increasing national public health budgets. Leadership training for hospital administrators is another crucial area of intervention, and PAHO can exercise its position as an inter-governmental organization with significant credibility and resources to strengthen leadership. PAHO should also include broader forms of hand hygiene than alcohol handrub, since hand-washing with soap is fundamental to many aspects of patient safety including nosocomial infection control. Collaboration with INGOs to monitor and evaluate programs and to ensure that PAHO programs dovetail with INGO programs is another role for PAHO.

APPENDIX A

MAP OF HONDURAS



Figure 2: Map of Honduras Source: CIA World Factbook, 2007



## **APPENDIX B**

### **INTERVIEW QUESTIONS**

#### **B.1 NONPROFIT INTERVIEW QUESTIONS**

- Tell me about your organization's program to reduce hospital-based infection in Honduras.  
When did it start? How long did the program last?
- Tell me about the funding sources and timeframe of the program.
- How did the funding and timeframe context impact the program design?
- What do you think are/were the strengths of your organization's program?
- Are there any gaps in service or challenges in implementing the program?
- How do you see the infection control program fitting into the public health system of Honduras?
- When implementing your infection control program, do/did you work with partners in Honduras? What are the strengths and challenges of your relationship with that partner/those partners?
- Would you consider expanding your infection control program to other hospitals/cities/countries? Why or why not? Which other hospitals/cities/countries are priorities?

- What recommendations would you make to other international organizations that are considering designing or implementing infection control programs in developing countries?

## **B.2 PAHO INTERVIEW QUESTIONS**

- How does PAHO work with international nonprofits that wish to make systemic public health changes in Latin America?
- Tell me about the development of PAHO's nosocomial infection prevention guidelines.
- What support does PAHO give to Honduras to implement those guidelines?
- What do you think are some important components of an infection control program in Honduras?

## **B.3 UPMC INTERVIEW QUESTIONS**

- Tell me about UPMC's nosocomial infection control program(s).
- What challenges does UPMC face in implementing the program(s)?
- What do you feel are the most important components of an effective infection control program?
- What types of organizational (staffing, structures) components need to be in place for a hospital to implement an infection control program?
- What types of material components need to be in place? (Supplies)
- What types of attitude components need to be in place? (Knowledge, Attitudes, Beliefs)

- If you could compare organizational, material, and attitudinal components, which one do you think is the most important when it comes to a hospital's ability to implement an effective infection control program?

## **APPENDIX C**

### **RECRUITMENT AND CONSENT DOCUMENTS**

#### **C.1 RECRUITMENT EMAIL SAMPLE**

Dear CAMO staff,

I'm a student at the University of Pittsburgh, doing a Master of Public Health and a Master of International Development. I'm going to write my thesis on international programming to address hospital-based infection in developing countries, and would love to learn more about CAMO's work in this area.

I learned about CAMO during an internship with Global Links, a Pittsburgh-based nonprofit that collects and sends medical equipment and supplies to public hospitals in Latin America and the Caribbean.

I would like to write a short case study of CAMO's infection control programming in Honduras, and interview by phone two or three key CAMO staff members to learn more about the strengths and weaknesses of CAMO's approach. I'd like to complete the interviews by the end of February if possible.

According to Institutional Review Board guidelines, I will maintain strict confidentiality about the identifying information about my interviewees, and I am happy to show you anything I write. My goal is to strengthen the knowledge about programming options for infection control for a variety of types of US-based organizations. I've attached a copy of my thesis proposal for your information.

Thanks very much for your attention, and please let me know if there's any other information I can provide.

Best Regards,

Sonja Likumahuwa  
MID/MPH Candidate  
University of Pittsburgh

## **C.2 PERMISSION LETTER TEXT (FOR FACE-TO-FACE INTERVIEWS)**

“We give Sonja Likumahuwa permission to come to our office in \_\_\_\_\_ and conduct interviews with staff and board members for the purpose of gathering data for her master’s thesis at the Graduate School of Public Health, University of Pittsburgh.”

## **C.3 CONSENT STATEMENT**

The purpose of this research study is to determine the strengths and challenges of two types of interventions to address hospital-based infection in Honduras. For that reason, I will be asking key staff and board members from two nonprofit organizations and the Pan American Health Organization, as well as an infection control officer at the University of Pittsburgh Medical Center, to complete a brief (approximately 30 minute) interview. If you are willing to participate, my questionnaire will ask your opinions about the infection control program(s) or policies your organization has implemented, whether in Honduras or in the United States. There are no foreseeable risks associated with this project, nor are there any direct benefits to you. You will not receive any payment for participating in this interview. This is an entirely anonymous questionnaire, and so your responses will not be identifiable in any way. All responses are confidential, and results will be kept under lock and key. Your participation is voluntary, and

you may withdraw from this project at any time. This study is being conducted by Sonja Likumahuwa, who can be reached at 412.xxx.xxxx, if you have any questions.

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