Consequences of Inaction: Importance of Infection Control Practices

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The increasing prevalence of antimicrobial-resistant pathogens in health care facilities is due in large part to overuse of antibiotics and poor compliance with recommended infection control practices. To control the spread of such pathogens, health care facilities must reduce overuse and abuse of antibiotics, and they must implement new multidisciplinary programs to improve hand hygiene practices among health care workers and improve compliance with recommended barrier precautions.

Earlier papers presented at this conference have discussed antimicrobial resistance from a global prospective. As a practicing hospital epidemiologist, I will focus on antimicrobial resistance in health care settings.

Dr. Levy briefly mentioned some of the costs associated with antimicrobial resistance in health care settings. Numerous studies have documented that infections caused by multidrug-resistant pathogens often result in prolonged hospital stays and excess hospital costs [1]. Increased per diem costs, and, to a lesser extent, pharmacy and laboratory costs are important contributors to excess hospital expenditures attributable to infections caused by resistant pathogens. In a few instances, the antibiotics required to treat patients with resistant pathogens may be more expensive. Potential costs of antimicrobial resistance that have not been well quantified might include loss of productivity of the affected patients and other quality-of-life issues associated with infections that are either difficult to treat or untreatable. On a national basis, projected costs of antimicrobial resistance in health care settings have been estimated to range from 1 million dollars to 30 billion dollars, with the best estimate being 4 billion dollars annually in the United States (Office of Technology Assessment, 1995). Clearly, the economic impact of antimicrobial resistance in health care settings is substantial.

Resistant organisms of special epidemiologic importance in health care settings include methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant enterococci (VRE), and gram-negative rods that produce extended spectrum \(\beta\)-lactamases (ESBLs). Clostridium difficile, which is usually not included in discussions of multidrug-resistant bacteria, is also an important pathogen resistant to many antimicrobial agents. Recently, vancomycin-intermediate \(S.\) aureus (VISA) infections have been documented in several patients, and there is concern that such strains will become more prevalent [2].

Data from the Centers for Disease Control and Prevention (CDC) National Nosocomial Infection Surveillance (NNIS) system have documented the progressive increase in the prevalence of MRSA. By 1997, more than 35% of nosocomial staphylococcal infections in large hospitals were caused by MRSA [3]. In medium-sized and smaller hospitals, 30% and 25% of such infections, respectively, were caused by MRSA in 1997. Unfortunately, the dramatic increase in the prevalence of MRSA occurred during the 1980s and early 1990s, when virtually all hospitals in the United States had written guidelines for infection control. One must conclude that either the guidelines in use at that time did...
not take into account all patterns of transmission, or that the poor compliance of health care workers with recommended practices permitted continued spread of MRSA. I suspect that poor compliance (an example of inaction) has played an important role in the emergence of MRSA.

The NNIS system has also documented a dramatic increase in the percent of nosocomial enterococcal infections that are caused by VRE. By 1997, 22% of nosocomial enterococcal infections in intensive care units (ICUs), and 15% of those in non-ICU wards were caused by VRE [3]. There is little doubt that the increasing use of vancomycin for management of MRSA and methicillin-resistant coagulase-negative staphylococci, and, perhaps, frequent use of oral vancomycin for C. difficile-related disease set the stage for the dramatic increase in VRE.

One issue that has not received enough attention, in my opinion, is that there is too little careful epidemiological analysis of sources of transmission and modes of transmission or resistant pathogens in many hospitals. The importance of establishing local transmission patterns is illustrated by the following example. Epidemiological analysis of a hospital-wide outbreak of nosocomial MRSA infection in one hospital revealed that a respiratory therapist who had chronic MRSA sinusitis was the source of the outbreak [4]. Failure to identify such an individual as a source would lead to poor control, despite implementation of other general control measures, such as isolating patients, use of recommended barrier precautions, and appropriate hand washing. In this example, the outbreak of infection was terminated only after the respiratory therapist, who was the source of the outbreak, was treated appropriately.

As mentioned by previous speakers, overuse and abuse of antibiotics is also a major factor in contributing to the problem of antimicrobial resistance in health care settings. For example, a study conducted by Pestotnik et al. [5] found that antibiotic use has changed dramatically in hospitals during the past 10 to 15 years. The study revealed that the percentage of hospitalized patients who have received antibiotics increased from 32% in 1988 to 53% in 1994. The percentage of such patients receiving broad-spectrum antibiotics increased from 24% in 1988 to 47% in 1994. Similar trends in antimicrobial use are likely to have occurred in many other hospitals.

In 1996, CDC and the National Foundation for Infectious Diseases published guidelines for improving antimicrobial use in hospitals [6]. Some of the strategies recommended in the guideline are the following:

1. Optimize perioperative prophylaxis
2. Improve both the choice and duration of empiric therapy, and
3. Use both educational and administrative measures to improve antimicrobial prescribing practices of physicians.

Examples of administrative measures include use of an antibiotic order sheet to guide selection of antibiotics, or implementation of computerized physician order entry to provide physicians with guidance on antibiotics selection [5]. The guideline recommended that hospitals monitor both antimicrobial use and antimicrobial resistance. Unfortunately, despite publication of these guidelines in 1996, there are many hospitals that perform on very rudimentary, if any, monitoring of antimicrobial use. Many facilities do not express the use of individual antimicrobial agents as grams per 1000 patient-days or defined daily doses (DDDs) per 1000 patient-days. Expressing antimicrobial use in such a fashion facilitates comparison of rates of use in different hospital services or wards, and permits comparison of use patterns between facilities of varying size [7]. Hospitals and other health care facilities, such as long-term care facilities, that have not monitored antimicrobial use in this manner are strongly encouraged to do so.

Additional guidelines for improving the use of antimicrobial agents in hospitals have also been published jointly by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America [8]. Implementation of clinical practice guidelines is one of several recommendations made to improve use of antimicrobial agents. For example, many hospitals have adopted the Hospital Infection Control Practices Advisory Committee (HICPAC) guideline for appropriate use of vancomycin [9]. Educational efforts, such as lectures dealing with appropriate use of antimicrobial agents, are still recommended, although a number of studies have demonstrated that periodic lectures often have little long-term impact on physician prescribing practices. For this reason, hospitals also should seriously consider utilizing administrative measures (such as those mentioned earlier as well as antibiotic stop orders), having pharmacists interact with physicians in patient wards, or forming a multidisciplinary antibiotic management team. Selective reporting of antibiotic susceptibility test results by clinical microbiology laboratories is another example of an administrative measure that can affect physician choice of antimicrobial agents.

Some hospitals require an infectious disease physician to approve the use of restricted antibiotics. For example, White et al. [10] implemented a program that was designed to reduce antibiotic costs and antimicrobial resistance. The program required that infectious disease attending physicians approve the use of certain antimicrobial agents, including ceftazidime, amikacin, ticarcillin-clavulanate, aztreonam, and intravenous ciprofloxacin. Outcome measures included the level of susceptibility of gram-negative bacilli, patient survival, and duration of hospital stay. The investigators found that the percentage of isolates of Escherichia coli, Pseudomonas, Enterobacter cloacae, and Acinetobacter species that are resistant to ceftazidime decreased significantly in an ICU after the intervention. Similar decreases in the prevalence of antimicrobial resistance were
Table 1. Compliance of health care workers with recommended handwashing practices.

<table>
<thead>
<tr>
<th>Author [reference]</th>
<th>Clinical setting</th>
<th>Rate of compliance, %</th>
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<tbody>
<tr>
<td></td>
<td>ICU</td>
<td>30</td>
</tr>
<tr>
<td>Albert et al. [12]</td>
<td>ICU</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>ICU</td>
<td>28</td>
</tr>
<tr>
<td>Larson [13]</td>
<td>All wards</td>
<td>44</td>
</tr>
<tr>
<td>Donowitz [14]</td>
<td>PICU</td>
<td>30</td>
</tr>
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<td>Graham [15]</td>
<td>ICU</td>
<td>32</td>
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<tr>
<td>Dubbert et al. [16]</td>
<td>ICU</td>
<td>81</td>
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<tr>
<td>Pettinger et al. [17]</td>
<td>SICU</td>
<td>51</td>
</tr>
<tr>
<td>Larson et al. [18]</td>
<td>NICU/others</td>
<td>29</td>
</tr>
<tr>
<td>Doebbeling et al. [19]</td>
<td>ICU</td>
<td>40</td>
</tr>
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<td>Zimakoff et al. [20]</td>
<td>ICU</td>
<td>40</td>
</tr>
<tr>
<td>Meengs et al. [21]</td>
<td>Emergency department</td>
<td>32</td>
</tr>
<tr>
<td>Pittet et al. [22]</td>
<td>All wards</td>
<td>48</td>
</tr>
</tbody>
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**NOTE.** ICU, intensive care unit; NICU, neonatal intensive care unit; PICU, pediatric intensive care unit; SICU, surgical intensive care unit.

Table 2. Compliance of personnel with barrier precautions for vancomycin-resistant enterococci.

<table>
<thead>
<tr>
<th>Author [reference]</th>
<th>Personnel observed, no.</th>
<th>Rate of compliance, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morris et al. [25]</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Shay et al. [26]</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Slaughter et al. [27]</td>
<td>4364</td>
<td>71</td>
</tr>
</tbody>
</table>

noted for other antimicrobial agents as well. No increase in patient mortality was noted during the study period, and there was no adverse effect on the duration of the patient’s stay.

Although it is widely accepted that most multidrug-resistant pathogens are spread in hospitals via the hands of health care workers, many studies performed during the past 10 to 15 years have demonstrated that the compliance of health care workers with recommended hand washing practices is unacceptably low. Table 1 demonstrates that the percentage of health care workers who comply with recommended handwashing practices has varied from 16% to 80%, with an average rate of compliance of 40%. The increasing spread of resistant nosocomial pathogens should serve as an impetus for hospitals to develop innovative methods to improve hand hygiene among health care workers [23].

In 1996, HICPAC published guidelines for isolation precautions in hospitals. These guidelines are summarized briefly [24]:

1. Place patient in private room, or cohort patients
2. Wear gloves to enter room
3. Wear gown if substantial contact with the patient or the patient’s environment is anticipated
4. Remove gloves (and gown) upon leaving room
5. Wash hands with antimicrobial soap or waterless antiseptic agent
6. Dedicate noncritical medical equipment to patient’s room, and
7. Limit transport of patient to essential purposes.

Despite publication of the guideline more than 3 years ago, actual compliance of health care workers remains suboptimal in many hospitals. For example, in 3 hospitals where VRE was endemic or epidemic, the compliance of health care workers with recommended to barrier precautions ranged from 28% to 71% (table 2) [25–27]. Such poor compliance with recommended infection control practices is another example of how inaction on the part of hospitals is likely to have contributed to the spread of resistant pathogens.

In intensive care units, where the incidence of infections caused by resistant organisms continues to be high despite implementation of recommended control measures, some investigators have recommended “universal glove use.” This strategy requires that every health care worker wear gloves when caring for every patient in the unit, regardless of whether or not the patient has been identified as having a resistant organism. Reports by Hartstein et al. [28] and others [29] suggest that universal glove use has contributed to the control of outbreaks of MRSA and VRE.

Because colonized and infected patients represent the major reservoir for many resistant pathogens encountered in health care settings, administering decolonization therapy to affected patients is another strategy that has been useful in some settings [30]. In hospitals where MRSA has been highly endemic or epidemic, treating colonized patients with intranasal mupirocin ointment, when combined with other infection-control barriers, appears to have contributed to the control of nosocomial MRSA on a number of occasions.

Unfortunately, in the late 1980s and early 1990s, when the prevalence of MRSA increased substantially, health care workers and administrators in some hospitals adopted the attitude that it was impossible to control transmission of the organism, and they abandoned many of their efforts to control the spread of MRSA. In more recent years, a similar attitude has been adopted in many hospitals where VRE has become prevalent. However, there are a number of examples demonstrating that appropriate surveillance and barrier precautions can limit the spread of VRE. In a hospital where VRE had not yet become endemic, focal outbreaks of vanB-type VRE and vanA-type VRE were controlled by performing frequent culture surveys of patients and by requiring the use of gloves and gowns by health care workers who entered the rooms of patients with VRE [31, 32]. Anglim et al. [33] reported successful control of VRE by using a combination of aggressive barrier precautions, culture surveys
of high-risk patients, and decreased use of vancomycin. More recently, Montecalvo et al. [34] reported that a combination of surveillance cultures, patient and nurse cohorting, wearing of gloves and gowns for entering VRE patient rooms, and monitoring of compliance with recommended procedures resulted in a significant reduction in the incidence of VRE bloodstream infections. Similar success has been reported in several other institutions where VRE had become endemic [35, 36].

In summary, controlling the spread of antimicrobial resistance in health care settings requires improved infection control practices and more prudent use of antibiotics. Infection control efforts must include ongoing laboratory-based surveillance, identifying colonized patients and placing them in isolation, and improving compliance of health care workers with recommended barrier precautions and hand hygiene practices. Hospitals administrators and department heads must provide visible support for infection control policies, and must provide the necessary resources for improving use of antimicrobial agents. Inaction will lead to continued emergence of multidrug-resistant pathogens in health care settings.

References


