

Antibiotic Resistance: The Iowa Experience

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Background: In the past 10 years, the number of strains of *Streptococcus pneumoniae* and other common respiratory pathogens that are resistant to penicillin has increased.

Objective: The Iowa Department of Public Health convened a multidisciplinary task force in January 1998 to develop strategies to combat antibiotic resistance in the state because they were alarmed by these reports.

Methods: Within 18 months, the task force implemented statewide surveillance of resistant organisms and posted information about the surveillance on the Internet, distributed a public health guide on judicious antibiotic use and infection control measures to 7500 healthcare providers, and held a press conference to inform the public about antibiotic resistance. The task force collaborated with several major insurers in the state to profile the top prescribers of antibiotic agents in their plan.

Results and Conclusions: The profiling and educational interventions led to a substantial decrease in both overall antibiotic prescribing and drug costs. Other states may want to undertake similar programs to help protect their citizens from infections caused by resistant pathogens

(*Am J Manag Care* 2002;8:988-994)

increase in mortality from infectious diseases. Several recent reports have described the development of pneumococcal bacteremia in patients treated with macrolides.^{4,5} In addition, another study reported found a high rate of bacteriologic failure with azithromycin in patients with acute otitis media caused by *H influenzae*.⁶

One of the major contributors to the increase in resistant pathogens is the excessive and inappropriate use of antibiotic agents for treating respiratory infections.² It has been reported that more than 50% of patients diagnosed with common colds receive antibiotic agents, even though antibiotic agents are of no benefit in the treatment of viral illnesses.⁷ Another contributing factor is the treatment of bacterial respiratory infections with antibiotic agents that lack bacteriologic or clinical efficacy against resistant pathogens, which results in treatment failures. For example, in the recent study by Kelley et al,⁴ patients hospitalized with bacteremia after treatment with macrolide compounds all had pneumococcal strains that exhibited low-level resistance to macrolide antibiotic agents.

The potentially harmful results of the excessive and inappropriate use of antibiotic agents have been well documented,² and national panels of experts have developed guidelines for treating respiratory infections caused by resistant organisms in order to facilitate appropriate prescribing.^{8,9} However, changing clinical prescribing practices through provider adherence to guidelines and educating the public on appropriate antibiotic therapy still present major challenges to the public health and private medical sectors.

The World Health Organization has referred to the alarming increase in the number of bacterial pathogens that are resistant to antibiotic agents as a crisis in global health care.¹ *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis*, 3 organisms that cause the majority of common respiratory tract infections such as otitis media and sinusitis, have all developed rising resistance to many of the antibiotic agents currently available.² In a recent surveillance study in the United States, nearly half the pneumococcal isolates exhibited penicillin resistance.³ Prior to the discovery of penicillin, pneumococcal infections were among the leading causes of mortality worldwide. As pathogens become less responsive to existing antibiotic agents, we may see a renewed

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METHODS

Creating the Iowa Antibiotic Resistance Task Force

The Centers for Disease Control and Prevention (CDC) has been monitoring invasive pneumococcal disease at 10 to 20 sentinel sites in the United States for 2 decades. However, these data provide an indication of resistance at selected sites only, and not comprehensive, community-specific data, which would enable clinicians to select appropriate agents for empiric therapy for common infections.¹⁰ Nonetheless, the CDC has developed guidelines for the diagnosis, treatment, and prevention of common, community-acquired respiratory tract infections, as well as educational materials for healthcare providers and patients that promote appropriate diagnostic methods and antimicrobial use.¹⁰ The CDC has also been encouraging states to support and extend their efforts with statewide or local initiatives.

Consequently, in January 1998, the Iowa Department of Public Health (IDPH) convened a task force to determine what the Iowa healthcare community could do to address this serious problem. The IDPH began by creating a multidisciplinary group that represented the major healthcare providers in the state. These providers included the University of Iowa (the main research institute in Iowa), the University Hygienic Laboratory (UHL), and professional organizations representing hospitals, physicians, pharmacists, nurses, long-term care providers, veterinarians, and many others (Table 1).

The task force was given 2 objectives. The first was to evaluate and monitor the prevalence of antibiotic resistance in Iowa. Surveillance was thought to be the key to demonstrating to providers the magnitude of the problem locally as the basis for motivating changes in behavior. The second was to devise strategies that would diminish the risk of infections caused by antibiotic-resistant organisms by facilitating appropriate antibiotic use, discouraging prescribing practices that promote development of antibiotic resistance, and decreasing the spread of antibiotic-resistant organisms with appropriate infection control measures. In discussing these objectives, the task force focused efforts on 5 areas as listed in Table 2.

The task force met on a monthly basis throughout 1998 and into 1999 and decided to focus its efforts on implementing statewide surveillance of resistant pathogens, provider education, and public aware-

ness. The members also recognized that, to strengthen their message, it was important to collaborate with insurers and pharmaceutical companies. Collaboration would ensure that a clear message about the problem of resistance would be used consistently by all. The educational outreach by insurers to health plan providers and members would expand the audience and impact of this message. Collaboration with pharmaceutical companies could provide resources, such as physician and patient educational programs and materials.

Expanding Surveillance

The University of Iowa was collecting isolates from approximately 15 centers around the state through a study entitled "Emerging Infections and Epidemiology of Iowa Organisms." However, the task force wanted a more comprehensive surveillance that would outlive any 1 study, provide ongoing regional data, and require mandatory reporting of specific resistant organisms isolated from invasive sites. One of the first issues the task force addressed was the selection of organisms to be reported. The task force decided that surveillance would include *Enterococcus* species, group A *Streptococcus*, methicillin-resistant *Staphylococcus aureus* and *S pneumoniae*, and vancomycin-resistant *S aureus* when isolated in invasive disease. The task force also developed an algorithm to facilitate submission of organisms to the UHL.

Table 1. Participants in the Iowa Antibiotic Resistance Task Force

- Association of Iowa Hospitals and Health Systems
- Iowa Academy of Family Physicians
- Iowa Chapter, American Academy of Pediatrics
- Iowa Department of Public Health
- Iowa Health Care Association
- Iowa Medical Society
- Iowa Nurses Association
- Iowa Pharmacy Association
- Iowa Veterinary Medicine Association
- Iowa's Statewide Epidemiologic Education and Consultation Program
- University of Iowa Hospitals and Clinics
- University Hygienic Laboratory
- Wellmark-Medicare

Table 2. Strategies for Diminishing the Risk of Antibiotic Resistance

- Implement permanent surveillance of resistant pathogens
- Educate providers about resistant pathogens and appropriate antibiotic utilization, and provide tools to bring this message to patients
- Increase public awareness of the consequences of antibiotic resistance and importance of appropriate use of antibiotic agents
- Collaborate with private and public insurers to profile antibiotic prescribing habits of their physicians, as a way to demonstrate the magnitude of the problem and as the basis for motivating changes in behavior
- Collaborate with pharmaceutical companies (which provided grant support for producing and mailing educational packets of CDC recommendations, posters, and other educational materials for providers)

On January 1, 1999, the IDPH initiated this comprehensive, statewide, population- and laboratory-based surveillance program. The UHL maintains a Web site with surveillance information, enabling clinicians to obtain data on resistance in their local area and make comparisons with data in the rest of the state. This information is available at <http://www.uhl.uiowa.edu/HealthIssues/IARQ/index.html>.

Provider Education

The task force concentrated on developing its final report, entitled *A Public Health Guide* (Figure 1), which represented a consensus of members' opinions. This outreach effort to providers included the following sections:

- Infection control in various settings, including primary care, acute care, long-term care, home care and hospice, hemodialysis, school/daycare, and veterinary medicine. A grid describing recommended practices for patients with drug-resistant organisms has been widely disseminated and utilized by long-term care facilities.
- General guidelines for prudent antibiotic use.
- Procedures for surveillance and reporting of resistant organisms to ensure consistency in laboratory identification.
- Bibliography and extensive references for use by healthcare providers.

On August 30, 1999, the task force mailed the public health guide to 7500 healthcare professionals in the state, including pediatricians, family practice physicians, general practice physicians, internists,

physician assistants, pharmacists, nurse practitioners, and others. This mailing was part of a packet containing numerous materials intended to help providers implement the recommendations in the guide and to educate patients. The other material included CDC treatment algorithms for various infections (eg, otitis media, sinusitis, bronchitis) and practice tips for educating patients (Figure 1); posters listing the differences between viral and bacterial infections for placement in patient areas; a brochure developed by the task force entitled *Your Child and Antibiotics*; another brochure from the Alliance for the Prudent Use of Antibiotics; and reference materials (Figure 2). The task force provided as many materials as possible to meet the needs of all types of providers and patients.

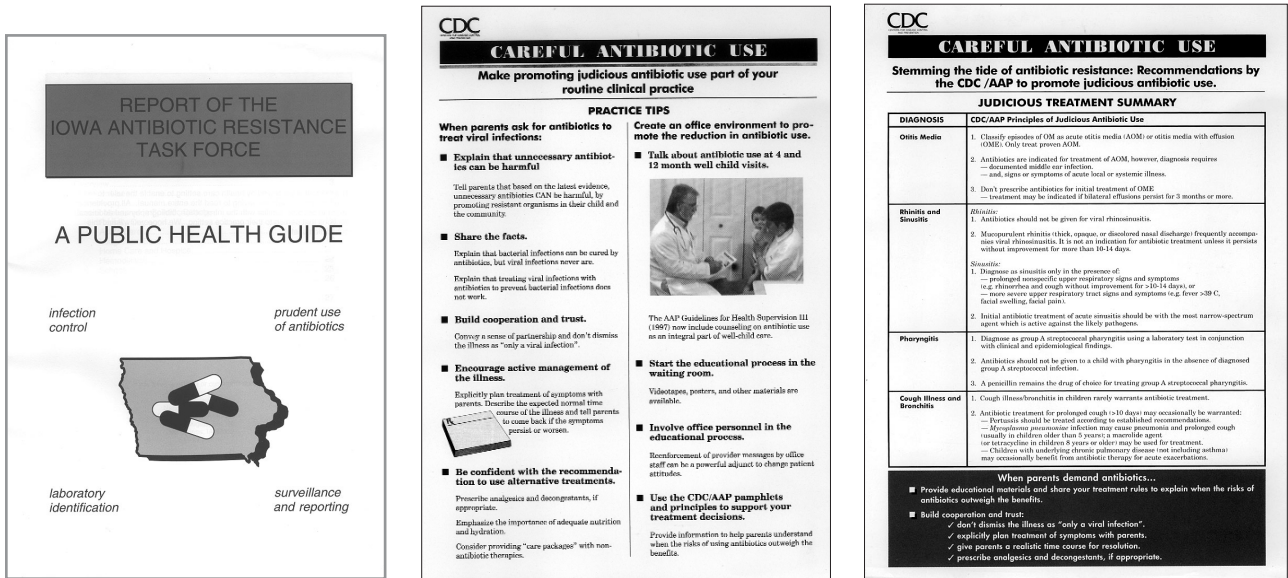
Task force members representing various organizations developed for their members educational programs on respiratory infections, proper treatment of these infections, and implications of the development of resistance. Many organizations also published articles in their newsletters and journals, some of which were created by the task force.

Wellmark participated in an educational initiative, Managing Appropriate Antibiotic Utilization™ (MAAU), sponsored by SmithKline Beecham Pharmaceuticals. Because both the task force and the pharmaceutical company shared a common goal of preserving the efficacy of antibiotic agents through appropriate prescribing, SmithKline Beecham provided grant support for producing and mailing educational packets of CDC recommendations, posters, and other educational materials for providers.

Public Awareness

Distribution of the education packets to providers coincided with the beginning of the cold and flu season and with press conferences held at 3 locations (Des Moines, Iowa City, and Sioux City), which were intended to raise public awareness of antibiotic resistance. At the conferences, the Iowa State epidemiologist and members of the task force delivered several strong, simple, and consistent messages: that antibiotic resistance is not just a problem in large metropolitan areas but is occurring throughout the state; that antibiotic resistance has implications for each individual Iowan; and that there are simple things the public can do to help minimize the problem of antibiotic resistance. These messages received extensive statewide coverage in the print and broadcast media (Figure 3). Task force members were also featured on National Public Radio.

Figure 1. A Public Health Guide* and Centers for Disease Control Materials†



*The publication of the Iowa Antibiotic Resistance Task Force (available online at www.idph.state.ia.us/pa/ic/antibioticreport.pdf).
 †Both forms are available from the CDC at www.cdc.gov/drugresistance/community/orderform.htm.

Figure 2. Materials Included in the Mailing to Healthcare Providers



*Posters provided by GlaxoSmithKline, Philadelphia, Pa.
 †Brochure provided by the Alliance for Prudent Use of Antibiotics.
 ‡Brochure produced by Iowa Antibiotic Resistance Task Force.

Profiling of Provider Prescribing Practices

Task force members were enthusiastic about including insurers in the outreach process. They approached major organizations in the state through their contacts at Wellmark-Medicaid and other

healthcare providers. The task force asked the insurers to profile the antibiotic prescribing habits of their physicians and to expand their educational outreach to both providers and members regarding appropriate use of antibiotic agents. Insurers who

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Table 3. Prevalence of Resistant Organisms in Iowa for Invasive Site Isolates, 1999–2000

Pathogen	Number of Statewide Isolates	
	January 1, 1999– December 31, 1999	January 1, 2000– December 31, 2000*
Total <i>Streptococcus pneumoniae</i>	532	388
Penicillin-resistant pneumococcus (%)	129 (24%)	105 (27%)
MDR pneumococcus (%) [†]	84 (16%)	68 (18%)
Total <i>Enterococcus</i> species	186	161
VRE (%)	27 (14%)	22 (14%)
Total <i>Streptococcus pyogenes</i>	63	61
Penicillin-resistant <i>S pyogenes</i> (%) [‡]	0	0
Macrolide-resistant <i>S pyogenes</i> (%) [§]	2 (3%)	4 (6%)
Total MRSA	102	126

“Resistant” includes isolates with an interpretation of “intermediate.” Invasive site isolated indicates pathogens isolated from any site that should normally be sterile (eg, urine, blood, cerebrospinal fluid).

*4% of isolates awaiting results.

[†]Isolates of *S pneumoniae* resistant to penicillin and 1 or more of the following drugs: erythromycin, azithromycin, clarithromycin, clindamycin, chloramphenicol, tetracycline, or trimethoprim/sulfamethoxazole.

[‡]Currently no isolates of *S pyogenes* are resistant to penicillin.

[§]Macrolide resistance represents isolates resistant to 1 or more of the following drugs: erythromycin, clarithromycin, or azithromycin.

MDR indicates multidrug resistant; VRE, vancomycin-resistant *Enterococcus*; MRSA, methicillin-resistant *Staphylococcus aureus*.

Source: Adapted from <http://www.uhl.uiowa.edu/HealthIssues/IARQ/index.html>.

agreed to participate, in addition to Wellmark Blue Cross and Blue Shield, included the Iowa Medicaid Drug Utilization Review Commission, John Deere Healthcare, Secure Care of Iowa, and United Health Care. Each group undertook its own intervention—some were aimed at antibiotic agents prescribed only for respiratory illnesses and others were more broad (see individual descriptions below). All efforts were aimed at the highest prescribers of outpatient antibiotic prescriptions for patients of all ages for that particular plan. All educational efforts were based on making prescribers aware of the CDC guidelines regarding first-line antibiotic agents for most treatment regimens.

RESULTS

Through combined efforts of the task force, the IDPH, the UHL, and laboratories across the state,

2 years of surveillance data on the prevalence of resistant organisms statewide are now available (Table 3). This accomplishment is unique in that few state departments of health have the resources to compile such information. Healthcare providers are able to access this surveillance information online and use it to treat patients more appropriately with consideration for local resistance patterns (Table 4).

Profiling and educational efforts by insurers had a dramatic impact on physician prescribing behavior and on the costs of antibiotic therapy. In the beginning of 2000, the task force started receiving reports from several public and private insurers on the results of both their educational efforts and their first 3 months (ie, fourth quarter, October–

December 1999) of profiling provider antibiotic-prescribing patterns.

The Iowa Medicaid Drug Utilization Review Commission profiled the top 70 prescribers of antibiotic agents and compared the number of outpatient prescriptions and the average antibiotic prescription costs. These providers then received educational letters of intervention regarding their prescribing patterns along with the CDC recommendations for judicious antibiotic use.⁸ The CDC recommendations provide a reliable source for the most recent and comprehensive data. Providers were asked to be certain antibiotic agents were indicated for patients and were encouraged to prescribe according to these CDC recommendations.

Figure 3 is a treatment algorithm based on these recommendations. An article was also published in the Medicaid provider newsletter on combating antibiotic resistance.¹¹ Fourth quarter (1999) results showed that 81% of providers profiled reduced their

outpatient antibiotic prescribing-rates compared with the previous year (1998). In addition, there was a 21% reduction in the number of antibiotic pharmacy claims and a 20% reduction in the number of patients receiving antibiotic agents.

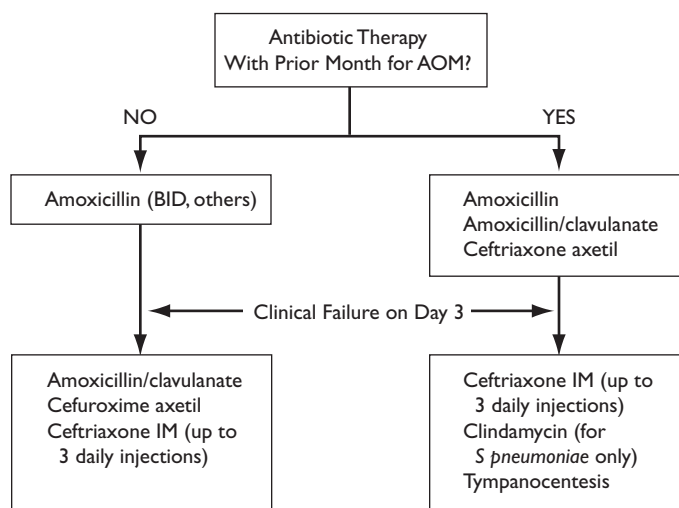
John Deere Healthcare held discussions with providers in their medical practices on respiratory disease treatment pathways to be certain that all prescribers would act in unison with the CDC guidelines. They also distributed script pads, which contained several generic first-line medications that could be checked off, rather than writing a prescription. The plan made patient education materials and cold kits containing several items to aid in symptom relief for viral infections available at its pharmacies. John Deere also provided monthly feedback on outpatient antibiotic prescribing to its primary care providers. Clinic and provider profiling compared peers in terms of percentage of first-line prescriptions, number of prescriptions, and average costs of outpatient antibiotic prescriptions for used for treatment of respiratory illnesses. Reports from 4 clinics demonstrated an increase in first-line antibiotic prescriptions from 61.0% to 75.8% (a shift away from second-line antibiotic agents) and a 10.5% decrease in the number of overall outpatient antibiotic claims compared with the same quarter in the previous year. Wellmark Blue Cross and Blue Shield profiled the top 20% of prescribers of outpatient antibiotic agents for their plan in the specialties of family practice, internal medicine, ear/nose/throat, and pediatrics, comparing the percentage of first- and second-line outpatient antibiotic prescriptions and the average costs. Wellmark then sent a letter to these prescribers with a personalized report comparing each physician's prescribing of first- and second-line antibiotic agents with other physicians in the specialty and with Wellmark's physicians overall. As a result of these efforts, Wellmark reported a

Table 4. Organization Intervention Results

Organization	Results
Medicaid	81% of providers ↓ their overall prescribing 21% ↓ number of claims (3224 fewer claims) 20% ↓ number of patients (2234)
John Deere Healthcare	↑ first-line therapy from 60% to 75.8%* 10% ↓ antibiotic claims (641 fewer claims) ↓ average claim from \$21.97 to \$18.07
Wellmark	23% ↓ penicillin prescriptions (2765 fewer claims) 23% ↓ macrolide prescriptions (2186 fewer claims) 20% ↓ cephalosporin prescriptions (1802 fewer claims)

*Data represent a shift away from providers prescribing inappropriate second-line agents as first-line therapy.

Figure 3. Centers for Disease Control Treatment Algorithm for Acute Otitis Media



AOM indicates acute otitis media; BID, twice a day; IM, intramuscularly.

23% decrease in penicillin prescriptions, a 23% decrease in macrolide prescriptions, and a 21% decrease in cephalosporin prescriptions among these providers compared with the same quarter in the previous year.

Thus, insurers participating in the program demonstrated that changing prescribing behavior produced multiple benefits: more first-line prescribing of antibiotic agents, less prescribing of unneces-

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sary antibiotic agents, and reduced costs of antibiotic medication prescriptions. Because of the continued surveillance of organisms, the task force can track resistance of organisms to antibiotic agents. The combined efforts of the task force and insurers would not be expected to affect resistance immediately; in fact, resistance as measured by the surveillance increased slightly during the intervention year. However, the task force hopes to see the impact of efforts over time on the development of antibiotic-resistant organisms in Iowa.

CONCLUSIONS

The Iowa Antibiotic Resistance Task Force initiatives in surveillance, provider and public education, and provider profiling have suggested approaches other states may want to undertake to help protect their citizens from infections caused by resistant pathogens. The task force is continuing its public education and surveillance efforts. Increased awareness of the problem of resistance has resulted in a study, now being conducted by Wellmark and the University of Iowa, to investigate in greater depth the correlation between physician antibiotic-prescribing habits and resistance patterns in Iowa. The study has been completed and is awaiting publishing. The task force recently sponsored grand rounds of the state to familiarize providers with all of its initiatives and interventions and the outcomes of these efforts. The initial response is encouraging. Early data indicate a trend toward more first-line antibiotic selection through the use of the CDC recommendations. The extensive efforts of the Iowa Antibiotic Resistance Task Force can provide a model for other states in tackling this issue.

Acknowledgments

We thank the Iowa Antibiotic Resistance Task Force for their efforts and for providing information for the arti-

cle. Thanks to the Alliance for the Prudent Use of Antibiotics, the Centers for Disease Control, and GlaxoSmithKline for providing educational materials.

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