

THE ANNALS: 40-YEAR EVOLUTION

2006 marks the 40th year of publication for *The Annals*. Over that time, *The Annals* has been an important contributor to the development of clinical pharmacy. Throughout 2006, we are publishing original articles reflecting on the history of clinical pharmacy through the eyes of practitioners, including those pioneering clinical pharmacy, as well as those who have more recently entered the profession and a well-established specialty. In addition, we are presenting articles from the early history of *The Annals* that have given direction and shape to the practice of clinical pharmacy (see page 309).

Pharmacy Infectious Diseases Practice

Robert P Rapp

Since the first issue of *The Annals* was published in 1967, the changes that have occurred in microbiology and infectious diseases clinical practice have been monumental. I have many memories as a pharmacist who was interested in the practice of infectious diseases and how antimicrobials were used in the 1960s and 1970s.

At that time, the infectious diseases attending physicians at my institution were totally puzzled as to why a pharmacist would be interested in their area. I remember one of the first times I was dosing gentamicin in a patient whose infection was not responding to ceftazidime given in combination with 80 mg of gentamicin every 8 hours. I called the clinical microbiology laboratory with the culture identification number and asked the person on the other end of the phone if I could speak to someone who could give me the minimum inhibitory concentration (MIC) for the isolate of *Klebsiella pneumoniae* that was causing the pneumonia in a 22-year-old neurosurgery patient. After a pause, the director of microbiology answered the phone. He asked me whether I was a physician and I replied no, I was a pharmacist. At that point he said they only gave MIC data to physicians because pharmacists would not know what the MIC meant! I had to ask one of the neurosurgery residents to return the call to obtain the MIC. Based on the patient's weight and renal function, we increased the dose of both ceftazidime and gentamicin (MIC

to gentamicin was 2 µg/mL) and the patient responded to the new regimen. In fact, not only was I questioned as to why I was on the floor by physicians and the microbiologist, but by many other healthcare professionals as well. I was very fortunate to have 2 mentors who continued to encourage me and others to continue to demonstrate how patient care would improve if we, as pharmacists, were in the patient care areas of the hospital. Those 2 mentors were Dr. Paul F Parker and Dr. Charles Walton.

Needless to say, over the past 30–40 years, the changes in infectious diseases practice and the role of the infectious diseases pharmacist specialist have certainly changed dramatically. In addition, emergence of both new pathogens and microbial trends has mirrored our changes in practice.

The most important of these changes are listed below.

1. the dramatic rise in the incidence of methicillin-resistant *Staphylococcus aureus*, first in hospitals and more recently in the community;
2. the development of AIDS and the discovery that AIDS was caused by a lente virus known as the human immunodeficiency virus;
3. the discovery and development of antiviral drugs active against HIV and the development of highly active antiretroviral regimens to treat AIDS;
4. the rapid increase in bacteria that have developed multidrug resistance including vancomycin-resistant *Enterococcus*, most of which are isolates of *Enterococcus faecium*; proliferation of gram-negative bacteria that produce extended-spectrum β-lactamases

Author information provided at the end of the text.

and new ways for clinical microbiology laboratories to screen and detect such bacterial isolates; and development of multidrug resistance in *Pseudomonas aeruginosa* and *Acinetobacter* spp. susceptible only to polymyxin B or colistomethate;

5. the combination of AIDS, broad-spectrum antibiotics, cytotoxic cancer chemotherapy, and transplantation immunosuppression, leading to a rapid rise in the number of patients developing invasive fungal infections;
6. the development of multidrug resistance in isolates of *Mycobacterium tuberculosis* (particularly resistance to both isoniazid and rifampin), making tuberculosis a much more difficult disease to treat;
7. the reduction in the number of new antimicrobial agents being developed and the number of major pharmaceutical companies that have either abandoned or curtailed research programs in the development of antibacterials and antifungals; and
8. the understanding and development of antimicrobial pharmacokinetics and pharmacodynamics primarily by pharmacists with training in pharmacokinetics and how these concepts can be applied to achieve better outcomes and less toxicity in patients with serious infections.

I am sure I have neglected many areas, particularly those in other countries where infectious diseases such as malaria, the hemorrhagic fever viruses (Ebola, Marboro), the severe acute respiratory syndrome, West Nile Virus encephalitis, anthrax as a weapon of mass destruction (including the US), and avian influenza outbreaks continue to be major concerns.

Today, infectious diseases-trained pharmacists are now active in many national organizations including the Infectious Diseases Society of America (IDSA), the American Society of Microbiology, the National Committee on Clinical Laboratory Standards, and the Food and Drug Administration (FDA).

The active participation by pharmacists in all aspects of infectious diseases pharmacotherapy, including direct patient care, antimicrobial management, antimicrobial stewardship, and the development of academic research training programs, has been one of the more remarkable advancements relative to clinical pharmacy practice. While there are still disagreements about postdoctoral fellowship training versus clinical pharmacology PhD programs, the importance of these training programs to prepare pharmacists for academic careers cannot be underestimated.

Another important advancement in infectious diseases pharmacotherapy is the number of peer-reviewed publications by pharmacists in major infectious diseases and pharmacology journals such as *The Annals of Pharmacotherapy*, *Pharmacotherapy*, *Clinical Infectious Diseases*, *Jour-*

nal of Infectious Diseases, *Antimicrobial Agents and Chemotherapy*, and the *Journal of Antimicrobial Chemotherapy*. Pharmacists also serve as editors and reviewers for many of these journals.

The establishment of an organization of pharmacists who have a primary interest in infectious diseases practice and research, the Society of Infectious Disease Pharmacists (SIDP, which now has >400 members) was also an important milestone in the development of pharmacist involvement in infectious diseases pharmacotherapy. This organization now meets on a yearly basis at the annual International Conference on Antimicrobial Agents and Chemotherapy (ICAAC) meeting and publishes a quarterly newsletter that is rich in continuing education and other information for SIDP members. I believe it is also important to note that there are now jointly sponsored programs (with SIDP) at both the ICAAC and the IDSA annual meetings.

Summary

The early and pioneering work of pharmacists working in infectious diseases practice and research has led to many expanded opportunities for all pharmacists to make major contributions in the field. Pharmacists now serve as primary investigators in Phase I, II, and III FDA antimicrobial drug trials, offer training programs at both the research fellowship and PhD level, offer specialty residencies in infectious diseases pharmacotherapy, and work on a daily basis with colleagues who are microbiologists, infectious diseases physicians, infection control nurses, and epidemiologists. For pharmacists who specialize in this area, the future indeed is bright.

We have come a long way, but we still have far to go. Therefore, what might be the goals for infectious diseases pharmacy practice in the future?

1. As more hospitals recognize the only way to control antimicrobial resistance is through outstanding infection control and antimicrobial management, I can see the day where infectious diseases-trained clinical pharmacists will be mandatory in every major hospital in the US. Working with our infectious diseases colleagues and infection control practitioners, there is an urgent need to monitor each order for antimicrobials to ensure that it is appropriate;
2. Major efforts must be made to optimize the use of pharmacokinetic and pharmacodynamic principles in the practice of antimicrobial pharmacotherapy; this will, in turn, maximize antimicrobial effectiveness and minimize resistance;
3. Adequate funding sources must be obtained and continued to train many more preceptors who will, in turn, train many more residents as pharmacy specialists in infectious diseases; and

4. Colleges of pharmacy should be convinced to support residency training in the same manner as they currently support graduate programs. Residency training, in my opinion, is the future of pharmacy practice, and I can see a need not so far in the future where virtually every graduate of PharmD programs in the US will require residency training.

Robert P Rapp PharmD FCCP, Professor of Pharmacy, College of Pharmacy; Professor of Surgery, College of Medicine, University of Kentucky, Lexington, KY; Associate Director for Clinical Services, Department of Pharmacy Services, University of Kentucky Hospital, University of Kentucky Medical Center, Lexington

Reprints: Dr. Rapp, C114D, 00848, University of Kentucky Chandler Medical Center, 800 Rose St., Lexington, KY 40536-0082, fax 859/323-2049, rprapp01@pop.uky.edu

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