

Pharmacists as Clinical Toxicologists: Reflections on Evolution, Challenges, and Opportunities

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My first encounter with *The Annals of Pharmacotherapy*, known then as *Drug Intelligence & Clinical Pharmacy*, was as a high school student in the late 1960s, working in the pharmacy at Rockford Memorial Hospital in Illinois. With the arrival of the current issue of *Drug Intelligence & Clinical Pharmacy*, pharmacists would page through it as they did with many of the magazines at the pharmacy. The difference with this journal was that they would actually read an article or two and discuss it over a cup of coffee. It clearly was distinct—no ads, few pictures, and even the texture of the paper was different. My next encounter with *The Annals* came as a pharmacy student and again later as a budding clinician, educator, and researcher in clinical toxicology. For case presentations and topic reviews, *The Annals* seemed to be one of the journals that contained the key article or case report. It was uncanny how the editors of *The Annals* anticipated what topic I needed covered because, more times than not, a “clincher article” was in a recent issue. This was particularly true when I was looking for articles on poisonings, overdoses, and clinical toxicology. My third level of encounters was as a contributor and an editorial board member (1982 to 1988 and 2003 to the present). *The Annals* was the first general-topic journal that had an Editorial Board section on clinical toxicology, poison control, and substance abuse.

Since those early days of the journal, pharmacists have been involved in clinical toxicology in several ways. One of the first and most consistent roles has been the development, direction, and staffing of poison control centers. Pharmacist Louis Gdalmán of Chicago developed a hospital-based program of poison information and consultation in the 1940s and 1950s that later became the model for the first poison control center (1953). The program operated

out of the pharmacy department, served the hospital’s staff, and involved pharmacists and physicians in its operation. Gdalmán became the director of the Master Poison Control Center for Chicago in 1962 after local pediatricians concluded that he would enhance its operation.¹ The experiences in Chicago were adopted by communities throughout the US and led to the development of several hundred poison centers by the late 1960s. Poison control centers operated without much regulation or standardization and, despite the best of intentions, there was great variability in the level of service provided. The issue of quality was raised by a 1971 Drug Information Analysis Service column in *The Annals*, which described responses to several toxicology questions and decried the poor quality of response by some poison control centers at the time. The article described mercury poisoning treatment, treatment of white gasoline poisoning, a mixed antidepressant and antipsychotic overdose, toxicity comparison of isopropyl and methyl alcohol, and medicolegal issues concerning a glutethimide poisoning death.² In 1978, the minimum level of expected services provided by poison control centers would be addressed through certification standards prescribed by the American Association of Poison Control Centers. Pharmacists were involved in the development and implementation of these and other standards. Included were criteria for healthcare professionals in poison control centers to become accredited as Certified Specialists in Poison Information (CSPI). Certification was awarded by the American Association of Poison Control Centers (www.aapcc.org) beginning in 1983 and nonphysician clinical toxicologists achieved board certification as Diplomates of the American Board of Applied Toxicology (DABAT) starting in 1985 (www.clintox.org/abat). Pharmacists who practice in poison control centers, direct these programs, or practice in other settings requiring clinical toxicology expertise have sought such certification. The percentage of pharmacists in the poison control center workforce has declined yearly from 31% in 2000 to 28%

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in 2004, according to self-reporting by the centers to the American Association of Poison Control Centers. In 2004, 87% of these pharmacists were CSPIs.³ In two-thirds of the nation's 61 poison control centers, pharmacists with clinical toxicology board certification fulfill one or more leadership positions.⁴

The role of pharmacists as clinical toxicology consultants also began near the time of the beginning of the journal. These services and programs evolved from the same need that fostered the creation of poison control centers—the need for sound, patient-specific care. In 1978, *The Annals* published an article that described a pharmacist-based toxicology consultation service that began in 1971. This program served a large academic medical center and integrated services of the drug information center and the toxicology laboratory. It also served as a training opportunity for post-PharmD residents who helped provide the service.⁵ Clinical toxicology consultation was and still is an element of practices such as those in critical care or emergency medicine. Clinical toxicology has a long-standing history of being multidisciplinary in its interactions, and pharmacists have been recognized and accepted for their unique roles and contributions. In the 1980s, the contributions of pharmacists were also beginning to be recognized through the awarding of Fellow status in the American Academy of Clinical Toxicology, a multidisciplinary organization of physicians, scientists, pharmacists, and other disciplines (www.clintox.org). Pharmacists are involved in other toxicology organizations such as the Society of Forensic Toxicologists (www.soft-tox.org).

Through the years, clinical toxicology has also evolved in the realms of education and research. The need for better evidence to improve patient care has been the catalyst for reporting unique patient experiences, novel therapies, therapeutic outcomes, and the overall management of poisoning victims. Although funding opportunities for clinical toxicology research have historically been modest, researchers and clinicians have shared their findings through publication in *The Annals*. Pharmacy has led other health-care professions by including clinical toxicology as didactic and experiential courses in the curricula of many colleges of pharmacy. Approximately one-third of the nation's pharmacy programs offer a stand-alone course in clinical toxicology along with others, integrating the subject matter in courses of pharmacology, therapeutics, or substance abuse.⁶ For example, The University of Tennessee College of Pharmacy distributes clinical toxicology throughout the didactic portion of a pharmacy curriculum in 4 required courses, 3 elective courses, and a stand-alone elective course (Table 1). Integration of knowledge about pharmacology, drug products, pharmacokinetics, drug interactions, adverse drug reactions, and patterns of therapeutic drug use with the skills to perform the tasks of in-

formation retrieval, drug information evaluation, patient history-taking, and communication has been a strong asset in building a foundation for clinical toxicology practice. This is particularly relevant considering that at least 50% of poisonings involve drugs and many of the remaining chemical substances act like drugs.⁷ Today, not only do pharmacists practicing in the area of clinical toxicology have a role in dealing with poisonings, overdoses, and substance abuse, but those engaged in general practice, in various practice settings, can also exert a positive influence.

Acknowledgment that pharmacists could have an impact on drug toxicity through their daily practice was promoted by an editorial in *The Annals* as early as 1977.⁸ "Pharmacists often overlook a major component of drug toxicity—that produced from a large single dose."

One recommendation made in the editorial was that pharmacists could influence the potential lethality of acute drug ingestions at several steps, such as by being involved in drug selection for a patient and observing the regulations of the Poison Prevention Packaging Act through the proper dispensing of medications in child-resistant containers.

Pharmacists have incorporated clinical toxicology practices in many ways. For example, some pharmacists serve as consultants to analytical toxicology laboratories, some serve as expert witnesses in legal proceedings, and some work in safety offices of the pharmaceutical industry. In 1976, an editorial by Don Francke on the misuse of medicines presaged the current interest in medication safety, medication therapy management, and the consequences of direct-to-consumer advertising of prescription drugs.⁹

"...People have been conditioned to believe that medicines which can work such wonders for serious illnesses must have the same powers to alleviate more minor symptoms and the discomforts of life."

"Results of careless drug taking include increased adverse drug reactions and drug interactions, increased incidence of suicidal behavior, increased tendency to drug abuse, and of course, greatly increased economic costs."

"In the US, the pharmacist is too often behind the prescription counter while a clerical person talks to the patient. In other countries a trained technician fills the prescription while the pharmacist is more readily available to talk to the patient."

Pharmacists were challenged then, as they are now, to ensure the safe use of medications and, by doing so, to avoid potential toxicity.

Additional challenges currently face clinical toxicology; some are unique and some are shared with other practice areas. The fact that compensation for patient consultations is either limited or nonexistent is a major barrier to clinical

Table 1. Clinical Toxicology Lectures in Required and Elective Courses^a

Introduction to Pharmacy and Health Care (required) response to chemical/bioterrorism
Self-Care and Nonprescription Drugs (required) poisoning epidemiology and first aid
Pharmacology (required) environmental toxicology
Therapeutics (required) general management of poisoning acetaminophen antidepressants caustics chemical and biological terrorist agents CNS stimulants hydrocarbons opioids pesticides salicylates sedatives
Complementary and Alternative Medicine (elective) athletic performance-enhancing substances
Drugs and Substances of Abuse (elective) androgenic-anabolic steroids club drugs cocaine and other stimulants hallucinogens inhalants methamphetamines sedatives and anxiolytics testing for drugs of abuse
Public Health Pharmacy (elective) poison control centers as a public health program
Clinical Toxicology (elective) epidemiologic and psychosocial aspects of poisoning general principles of treatment supportive and symptomatic care the toxic placebo and nontoxic exposures acetaminophen salicylates iron anticholinesterase insecticides caustics cocaine and CNS stimulants opioids nitrites and methemoglobinemia ethanol and sedatives antidepressants and antipsychotics hydrocarbons carbon monoxide cyanide dietary supplements digoxin calcium-channel blockers ethylene glycol and methanol androgenic-anabolic steroids the toxicology laboratory poison prevention strategies and poison centers antidotes case discussions (4 sessions)
^a From the curriculum at the College of Pharmacy, The University of Tennessee.

toxicology's development into a stand-alone practice. In poison control centers, information is given without financial charge, which is consistent with the centers' primary mission. Local philanthropic groups, state governments, and federal funding have subsidized much of the financial burden of poison control center services, but the long-term sustainability of this funding formula is uncertain.¹⁰ Today, virtually all 61 poison control centers share in the annual federal appropriation of approximately \$20 million, which supports less than one-fourth of the total expenses for 78% of poison control centers.³ Half of poison control centers receive more than 50% of their total funding from state government sources, with 92% of centers reporting some amount of state funding. In the past 5 years, 29% of poison control centers have reported facing the threat of closure.³ Consultants often give their advice freely, without regard to compensation, as part of their activities in critical care or emergency medicine units. In order to sustain, let alone expand, such specialized services, financial support needs to come from somewhere. Overt and hidden costs need to be borne by someone when a reimbursement mechanism does not exist. Demonstration projects through grant support or a university subsidy only go so far. What sustainable practice model should be pursued to both maximize the contributions of the pharmacy profession and ensure payment for services rendered? Given the current funding dilemma, should poison control be incorporated into pharmacy practices in emergency medicine?

The prevention of childhood poisonings was a major impetus for the development of poison control centers. Since inception of poison control centers in the 1950s and 1960s to the present, the number of poisoning deaths in preschool-aged children has declined from approximately 500 per year to 50 per year. Multiple initiatives and developments, in addition to the efforts of poison control centers, have contributed to this decline. Although poison control centers have focused on the prevention of poisoning in children, mortality due to unintentional poisoning in adults has grown steadily; it is now second to motor vehicle accidents as a cause of death from unintentional injury in the US.

According to a report¹¹ by the Centers for Disease Control and Prevention on trends in mortality due to unintentional poisoning, mortality rates have increased every year from 1999 to 2004; the mortality rate has increased 62.5% during those 5 years; drug poisoning deaths increased 68.3%, while non-drug-related deaths rose 1.3%; the greatest increase occurred among persons aged 15–24 years, although the highest rates of death were reported for 35- to 54-year-olds; and most drug poisonings are associated with the abuse of prescription medicines (eg, psychotherapeutic drugs, opioid analgesics) and illegal drugs.

The increase in deaths from unintentional drug poisoning was not attributed to changes in the rates of abuse of heroin, methamphetamine, or other illegal drugs. In 2004,

19,838 deaths were due to drugs, representing 94.7% of all 20,950 deaths due to unintentional poisoning.¹¹ A total of 30,308 people died from poisoning due to all circumstances (intentional, unintentional, unknown). The data present a clear challenge: the focus of and strategies for prevention and treatment should be broadened to include contemporary high-risk groups.

In the past decade, the availability of information has increased dramatically with greater use of computerized databases and mobile electronic devices. The challenge for clinical toxicologists is to provide value-added services beyond “just the answer.” It is not uncommon for clinical settings to have computerized information systems, but someone is still needed to interpret (and occasionally find) the relevant information and apply it to the situation. An experienced clinician is usually the arbiter to provide sound clinical correlation. For simple questions, finding an answer is often a straightforward look-up. In complex situations, the best solution among the options needs to be considered, and that involves the application of experience, evidence, and judgment, with the patient’s welfare as the ultimate outcome measure.

There are several opportunities for the field of clinical toxicology in the future, regardless of its position in pharmacy practice. Clinical toxicology should be integrated into the growing number of emergency medicine practices that are driven by the overall patient safety initiatives of healthcare systems. A significant portion of the training of clinicians in those practices should be based in clinical toxicology to enable them to meet the expectations of emergency departments and provide services beyond institutional systems improvement and medication reconciliation. With only 6 postgraduate residency programs in clinical toxicology available in the US,⁶ alternative strategies to train these clinicians are needed. The growing practice of public health pharmacy often involves directing the care of patients and developing policies for the treatment of substance abuse. With increasing death rates due to unintentional drug poisoning, new policies and approaches are warranted. Research that is oriented to improving pharmacovigilance may lead to a better understanding of adverse drug events and how to prevent them. Other opportunities and challenges include the identification of competent instructors and determination of an adequate timeframe in pharmacy curricula in which to teach the fundamentals of clinical toxicology to all pharmacists. Without an apprecia-

tion for the issues related to clinical toxicology, pharmacists may not pursue careers in this area nor be able to apply their knowledge and skills to assist a patient who may be or become a victim of unintentional poisoning or intentional drug abuse and overdose. Whether the practice of clinical toxicology can stand alone or becomes part of another specialty practice remains to be seen; in large measure, this will be determined by the marketplace and the practitioners’ imaginations.

For the past 40 years, *The Annals of Pharmacotherapy* has provided a forum for clinical toxicology. A fundamental function of *The Annals* is to inspire, inform, and involve current and future clinicians, educators, and researchers—just as it influenced a high-school boy in Rockford, Illinois, 40 years ago.

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