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# Mandatory pharmacy residencies: One way to reduce medication errors

Rami B. Ibrahim, Lilian Bahgat-Ibrahim and David Reeves

We read with disbelief about a newly graduated pharmacist dispensing 30 times the amount of injectable sodium bicarbonate intended, an error that led to a patient's death.<sup>1</sup> As clinicians, we wondered what clinical scenario might mandate the large amount of sodium bicarbonate dispensed—the answer was *none*. So why did the pharmacist dispense it? The answer is all too clear: With rare exceptions, institutional pharmacists nationwide are largely focused on dispensing. Postgraduate clinical training in the basic aspects of pharmacotherapy is scarce and not viewed as essential. Inadequate pharmacist training and a staffing shortage were suggested as contributing to the death of a six-day-old infant who received 10 times the prescribed dose of i.v. potassium chloride at a university hospital.<sup>2</sup> These two sobering misadventures hint at a link between pharmacists' clinical training and patient safety.

We examined all medication errors reported in the 2006–08 newsletters from the Institute for Safe Medication Practices to determine which could have been prevented if the involved pharmacist had had a working knowledge of therapeutics. We found numerous incidents that could be attributed to pharmacists' unfamiliarity with the drugs they dispense. Collectively, these incidents suggest that pharmacist clinical training is inadequate in health care systems. This clinical deficiency is also perpetuating prescribing errors.

## Prescribing errors

Prescribing errors are common in health care systems and contribute to more than half of all significant adverse but preventable drug events.<sup>3</sup> In fact, drug-related injury has been described as a "hidden epidemic."<sup>4</sup> Medication errors still represent 20% of medical errors<sup>5</sup> and harm 1–2% of patients.<sup>6</sup> Most incidents resulting in harm originate in the prescribing process.<sup>6</sup> Medication errors parallel the complexity of drug therapy: Typical medical patients in a teaching hospital receive 15–30 different drugs during their hospitalization; patients in the intensive care unit and patients with cancer may receive twice that amount.<sup>4,7</sup> Two landmark studies published in the early 1990s alerted the medical community of this lurking health hazard.

One, the Harvard Medical Practice Study, found that adverse drug events (ADEs) in New York State were more common in teaching than in community hospitals; this was attributed to medical interns and residents doing most of the prescribing.<sup>8,9</sup> The second study, by Lesar et al.,<sup>10</sup> noted that prescribing errors were associated with a higher risk of consequences than were errors from other sources, with overdose being the most common prescribing error. Attending physicians had a high rate of prescribing errors, partly due to infrequent order writing, which increases the risk of erroneous orders. Errors originating from surgical services were likely related to a lack of emphasis on the nonsurgical aspect of patient care during training programs.

A study conducted in Utah and Colorado revealed that drug-related injury is a significant public health problem and that the error rate remained similar to that found by the Harvard Medical Practice Study.<sup>11</sup> Bates et al.<sup>12</sup> evaluated ADEs in 11 medical–surgical units in two tertiary care hospitals in the United States and found that 42% of serious and life-threatening ADEs were preventable. Wu et al.<sup>13,14</sup> reported that 45% of interns disclosed having made at least one clinical error; 29% were prescribing errors, 15% of which were fatal.

In general, wrong doses and drug–drug interaction omissions have been the most common prescribing errors and are most frequently associated with significant adverse events.<sup>3,4</sup> A survey of otolaryngologists in the United States described an estimated 14% medical management error rate.<sup>15</sup> In the United Kingdom, *The Guardian* newspaper quoted a hospital where 135 medication errors occur per week, of which 35 are of a serious nature.<sup>16</sup> A Swedish trial identified 114 drug-related problems in 58 patients on an oncology ward.<sup>17</sup> Fifty percent of adverse drug reactions on an Australian oncology ward were deemed preventable.<sup>18</sup> Recently, an analysis of studies of drug-related problems conducted from 1990 through 2005 revealed an error rate of 5.7% (range, 0.038–56.1%;  $n = 31$  studies), 1.07 errors per 100 days (range, 0.35–12 errors per 100 days;  $n = 9$  studies), and 6% of patients hospitalized (range, 0.93–24%;  $n = 7$  studies).<sup>19</sup> Drugs and drug classes associated with high rates of medication errors included antibacterials, cardiovascular drugs, oral anticoagulants, theophylline, and antineoplastic drugs. The rate of prescribing errors was 16.5% (range, 13–74%;  $n = 6$  studies).

The toll of medication errors is significant. It has been estimated that at least 1.5 million U.S. residents are harmed or killed each year by medication errors, the treatment of which costs at least \$3.5 billion annually.<sup>20</sup> Similarly, in the United Kingdom, about 1100 patients died in 2001 due to medication errors or adverse drug reactions, a fivefold increase over the previous 10 years.<sup>20</sup>

### **Causes of prescribing errors**

The cause of prescribing errors has been examined in multiple studies. In a U.S. study of 123 interns and residents and 52 medical students, 11% did not always check prescribing information before prescribing new drugs, 25% did not check for drug allergies, 41% did not double-check dosage calculations, 44% did not check for renal impairment, and 70% did not check for potential drug–drug interactions.<sup>21</sup> The authors concluded that prescribing behaviors were poor, partly due to inadequate training and a culture that did not support safe prescribing. In a 2005 survey of residents and fellows from different specialties, 78 medication-related adverse events were reported, and 13% of these were reported as fatal or life threatening.<sup>22</sup> Factors perceived by the respondents to lead to mistakes in patient care were residents working too many hours, poor handoffs, caring for or admitting too many patients, inadequate supervision, and providing cross-coverage for too many patients. Garbutt et al.<sup>3</sup> noted that routine safe prescribing behavior among interns was poor, with only 50% of interns double-checking their dosage calculations.

Learning how to choose the dosage seems to fall into a chasm between medical school and employment.<sup>19</sup> Physicians' computational skills are often inadequate to calculate drug dosage.<sup>23</sup> For example, 82 of 150 hospital doctors were unable to calculate how many milligrams of lidocaine were in a 10-mL ampul of lidocaine 1%.<sup>24</sup>

A British survey found that the majority of medication errors originated at the point of prescribing.<sup>25</sup> In an interview of 14 Australian intern prescribers involved in 21 errors, an underlying culture considered prescribing to be a repetitive, low-risk chore.<sup>6</sup> Lack of senior medical supervision, lack of knowledge about the drugs prescribed, and a high workload were also cited as contributing factors to medication errors.

Other authors have speculated about prescribers' insensitivity to ADEs.<sup>15,26</sup> Cullen et al.<sup>4</sup> suggested that medication errors are the result of a defective system of knowledge and skills and dysfunction of the educational and training systems. Prescribing checks are not supported by supervisors, and interns have insufficient knowledge to appreciate when they need to seek advice. Indeed, more prescribing errors occur in the first year after graduation from medical school than in any other year.<sup>10</sup>

To the best of our knowledge, the effect of the growing work force of midlevel providers on a safe-drug-use enterprise has yet to be studied. Although physician assistants and nurse practitioners legally must collaborate with a physician or work under physician supervision, the meaning of *collaboration* and *supervision* in practice is wide open.<sup>27</sup> In one fatal drug error discussed above, the physician extender failed to obtain the attending physician's approval.<sup>2</sup>

In relation to workload, a recent editorial discussed the need to set limits for medical residents' duty hours.<sup>28</sup> This issue came under public scrutiny in the aftermath of the 1984 death of 18-year-old Libby Zion in an emergency room in New York City. The editorial raised concerns about the current application of supervisory practices in the context of both learning and patient safety.

Computerized prescriber order entry (CPOE) has been shown to prevent many prescribing errors; however, CPOE varies considerably and fails to reliably prevent prescribing errors with the greatest potential for patient harm, such as errors in the dose or frequency, mistakes due to a deficient clinical knowledge base, no drug prescribed when one was needed, or drugs prescribed when they were not indicated.<sup>21,29–32</sup>

### **Pharmacists' contribution to errors**

Viewing the role of any 21st-century health-system pharmacist only as dispensing what the prescriber ordered is inconceivable and not viable from a public safety standpoint. Drug therapy has become more complex and errors more common.<sup>16</sup> Inexperienced physicians are put in the position of having to prescribe without knowing how to do so.<sup>19</sup> Similarly, pharmacists are put in a position to dispense drugs without clinical training. The result is patients being caught between the pincer of drug errors initiated by prescribers and missed by pharmacists.

At present, most health care stakeholders espouse a clear distinction between dispensing and "clinical" pharmacists, which results in a functional gap between the two positions, a far cry from the integration of the pharmacist's full role.<sup>33</sup> This dualism in job description is squarely untenable in the current climate of medication errors in modern health care systems. Regrettably, most pharmacists in all sectors of practice still spend most of their time on order processing and product handling.<sup>34</sup> Functions associated with medication order fulfillment continue to prevent pharmacists from becoming fully competent and proficient clinical pharmacists.<sup>35</sup>

This is a vexing situation for the patient, especially since the role of the pharmacist in curbing medication errors (“the safety valve”) is well defined.[36,37](#) In one trial, the physical presence of a pharmacist during medical rounds (the point of order writing) translated into a 72% reduction in the rate of preventable adverse events.[4](#) While there are highly clinically trained pharmacists practicing in the current health system (most of whom have extensive postgraduate residency training), they represent a minority of the health-system pharmacist work force, as only 20% of pharmacy graduates enter residency training.[38](#) They usually practice in large academic centers and primarily on weekdays, with a drop in the level of therapeutics expertise during off-duty hours or holidays. Pharmacies in community hospitals tend not to have the level of clinical expertise found in academic centers. In one community-based teaching hospital, prescription errors were the most common medical errors, and 50% of these were serious in nature (e.g., incorrect dose of drugs with a narrow therapeutic range).[39](#)

In a highly publicized case of a patient receiving fatal overdoses of chemotherapy, none of the institution’s inpatient bone marrow transplantation pharmacists were clinically trained.[40](#) In our own experience, we have witnessed prescribing errors involving duplication of therapy and incorrect doses. In almost all of these instances, the prescribers were residents-in-training, and the pharmacists who handled the erroneous orders were not clinically trained, decreasing the likelihood of error detection. Although many pharmacists have some clinical knowledge or skills or some clinical functions, these are not comprehensive.[35](#)

### **Residency training for all pharmacists**

Burke et al.[35](#) hold that any pharmacy experience deemed to be equivalent to residency training must allow for involvement in the direct care of a sufficient number of patients over a period of time long enough to foster the development of clinical judgment. This is rarely feasible outside a residency format. Without the necessary level of judgment gained from residency training, practitioners are limited in their ability to make patient-specific decisions and to know when a situation extends beyond their limits of knowledge and expertise. While accreditation standards for the doctor of pharmacy curriculum state that “graduates must possess the basic knowledge, skills and abilities to practice pharmacy, independently, at the time of graduation,” an American College of Clinical Pharmacy (ACCP) task force described this statement as unrealistic.[35](#) That group reasoned that, upon entry into the profession, pharmacy graduates are novices at managing pharmacotherapy and lack the clinical proficiency and judgment typically developed through formal training and practice experience.

So why is it that all pharmacists are not clinically trained? The answer is this: Clinical training is not required to practice pharmacy. Drawing on the medical training path is instructive: Residency is a time of consolidating medical school education through continued learning and acquisition of knowledge and skills under direct supervision.[6](#) No such track is mandated for health-system pharmacists, since they are viewed by various stakeholders as drug dispensers.

The American Society of Health-System Pharmacists’ long-range vision for the pharmacy work force in hospitals states that pharmacists in focused, direct patient care roles should complete an accredited postgraduate year 1 pharmacy residency in a hospital or health system and, preferably,

become board certified in a pharmaceutical specialty.<sup>41</sup> In parallel, ACCP issued the call that all new pharmacy graduates involved in direct patient care should have residency training.<sup>38</sup>

Practical application of this vision is plodding. Despite the compelling case for public safety, most pharmacy departments nationwide are unlikely to embrace this about-face to an integral pharmacist role. Notwithstanding clinical training not being a requirement to practice or obtain professional credentials, another impediment is ebbing hospital recruitment. The current pharmacy work-force shortage makes widespread training impractical, if not impossible.<sup>38</sup> Most new pharmacy graduates are joining the retail pharmacy work force, largely driven by tantalizing financial incentives. Hospitals will be reluctant to institute a residency requirement for hiring for fear of deterring future prospects. In institutions with clinical pharmacy services, on-the-job clinical training is customarily implemented. The latter is invariably subjective, and the training requirements vary among departments, with little or no external peer review or measures.

While we admit that there are excellent clinical pharmacists in practice today who have not completed residency training, we maintain that the preferred method for acquiring the competencies of a clinical pharmacist is through formal residency training.<sup>35</sup> In response to those who contend that there is no scientific evidence showing a reduction in medication errors with pharmacist residency training versus the current pharmacist model, we draw on the example of our medical colleagues. They can practice without residency training, yet the latter is a well-accepted standard.<sup>38</sup> Indeed, physicians without residency training are not embraced into practice, despite the absence of scientific evidence of a difference in patient endangerment between nonresidency-trained and residency-trained physicians. Pharmacy has the social responsibility to follow suit.

To stem the rising tide of prescribing errors, pharmacy residency training should be a legal requirement. Like other health care professionals, pharmacists should be accountable for the individual patient outcomes of the medication therapy they manage.<sup>41</sup> In a recent commentary, English<sup>42</sup> admonished pharmacists to help people make the best use of medications. This should be the role of all pharmacists, not just a certain group of pharmacists. He also called for abandoning the distinction between “staff” and “clinical” labels.

Current doctor of pharmacy curricula do not produce graduates with the skills necessary to manage complex drug therapy. A completion of accredited residencies that focus on clinical practice should provide the pharmacist with a foundation of knowledge and practice experience.

## **Conclusion**

We conclude with this patient case. A 29-year-old woman with a history of a hyper-coagulable state was hospitalized for full-term delivery. She was given subcutaneous heparin therapy, which was to continue for 48 hours after cord clamping and then be changed to low-molecular-weight heparin (LMWH) treatment. The obstetrics resident mistakenly prescribed both anticoagulants concurrently, and the pharmacist on duty dispensed both without questioning the order. The patient, familiar with her pharmacotherapy plan, declined the LMWH and thus prevented a duplication of therapy that could have produced catastrophic bleeding. If a clinically trained pharmacist able to critically evaluate the patient’s medication profile and confident in interacting

with other health care professionals had been on duty, this near miss may have been averted. This patient was the first author's wife. Medication errors are never someone else's problem.

## Footnotes

The authors have declared no potential conflicts of interest.

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