

**INTERDEPARTMENTAL CORRESPONDENCE**

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TO: University of Iowa Hospitals and Clinics Staff  
College of Medicine Faculty and Staff

FROM: Paul Abramowitz, Pharm. D.  
Carol Scott-Conner, MD  
Co-Chairs, Adverse Drug Event Subcommittee

RE: **WHITE PAPER 2000: ADVERSE DRUG EVENTS**

Attached is a copy of White Paper 2000: Adverse Drug Events. This paper is being distributed to medical staff, nursing staff, pharmacy staff and others involved with medication use systems at the University of Iowa Hospitals and Clinics (UIHC). The paper provides background information on adverse drug events and their prevention and is intended to stimulate discussion of this important topic.

In addition to this paper, conferences are being held in various areas to promote discussion of strategies for preventing adverse drug events. If you are interested in participating in or assisting with setting up an adverse drug event conference, please contact one of us.

You are also invited to provide input to us on ideas for improving the medication use system and preventing adverse drug events at UIHC. Please contact us at [paul-abramowitz@uiowa.edu](mailto:paul-abramowitz@uiowa.edu) or [carol-scott-conner@uiowa.edu](mailto:carol-scott-conner@uiowa.edu).

Thank you for your interest in this important topic.

## WHITE PAPER 2000: ADVERSE DRUG EVENTS

The Adverse Drug Event Subcommittee of the Pharmacy and Therapeutics Subcommittee has been charged with the responsibility for:

“analyzing and identifying the scope of adverse drug events at UIHC and developing methods to develop a fail safe medication use system, educate healthcare providers, reduce costs, and conduct research in this very important area.”

As part of its responsibility to “educate healthcare providers,” the Adverse Drug Event Subcommittee has prepared this white paper to more fully acquaint physicians, nurses, pharmacists, and others involved with medication use with information related to adverse drug events (or ADEs). This document specifically defines the various types of occurrences which may be classified as an adverse drug event; examines current methods used to identify and prevent future ADEs; discusses evolving prevention strategies; and reviews research initiatives associated with ADE prevention. “White Paper 2000: Adverse Drug Events” is also intended to inform care providers about the UIHC’s processes for handling ADEs and serve as a primer for a topic which can have a major impact upon patient care and patient outcomes.

This white paper was prepared and edited jointly by members of the ADE Subcommittee White Paper Task Force whose members include Kevin Bebout, R.Ph.; James Flanagan, MD; Barbara Mutnick, MHP, R.Ph.; and Steve Nelson, MS, R.Ph.

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This white paper has been divided into the following sections:

- ◆ ***Introduction and Background***
- ◆ ***Current UIHC Methods to Identify and Prevent ADEs***
- ◆ ***Future Strategies to Prevent ADEs***
- ◆ ***Research Initiatives***
- ◆ ***Other Information Resources***



## WHITE PAPER 2000: ADVERSE DRUG EVENTS

### Introduction and Background

#### *Definitions and Incidence Rates*

A confusing proliferation of terminology ranging from “medication errors” through “drug-related problems”<sup>1-4</sup> has been narrowed to three clearly-delineated categories by Leape.<sup>2</sup> He defines an **adverse drug event** as “an injury related to the use of a drug (including failure to use).”<sup>2</sup> He also defines a **medication error** as “an error at any stage in the medication ordering, dispensing, and administration process.” He then goes on to define an **adverse drug reaction** as “an unintended physical reaction to a drug when it is used in the approved manner.”

Serious adverse drug events (ADEs) were estimated as long ago as 1971 to result in 140,000 annual fatalities.<sup>5</sup> A meta analysis completed in 1994 included 39 prospective studies (conducted from 1966 to 1996) and led to estimates of 106,000 deaths due to adverse drug reactions in 1994.<sup>4</sup> This estimate placed these adverse events between the fourth and sixth leading causes of death for that year. The definition used in this meta analysis was of an adverse drug reaction which did not include therapeutic failures, intentional or accidental poisonings, drug abuse, medication errors, and patient non-compliance – thus, this is an extremely conservative estimate.

Adverse drug events take place for a number of reasons, including errors on the part of health care providers; failure of patients to properly use medications; and unpredictable idiosyncratic, immunologic, or allergic reactions.<sup>6</sup> Some of these events are clearly both predictable and preventable. A number of studies have been carried out in an attempt to identify the proportion of ADEs that can be labeled as preventable. One study that prospectively reviewed the medical records of 452 consecutively admitted patients found that 49.3% of the 73 admissions caused by ADEs were deemed avoidable.<sup>7</sup> Another review conducted in an academic tertiary hospital found that 28% of the identified ADEs were preventable.<sup>8</sup> Similar percentages were found in a study assessing the number of admissions caused by preventable ADEs in an Emergency Room,<sup>9</sup> and also in the well known study by Bates, et. al.<sup>10</sup> The Bates study, which was conducted in two tertiary care hospitals, went on to show that preventable ADEs were found to be more serious in nature than non-preventable ADEs. In a later article, Bates and his colleagues continued this research and demonstrated a greater increase in length of stay and greater total cost of treatment associated with preventable versus non-preventable ADEs.<sup>11</sup>

#### *The Adverse Drug Event Subcommittee*

In 1999, the UIHC Pharmacy and Therapeutics Subcommittee created the Adverse Drug Event Subcommittee to serve in an advisory capacity about issues associated with adverse drug events. This interdisciplinary committee comprised of physicians, pharmacists, nurses, epidemiology specialists, and general administrative personnel was charged with responsibility to analyze and identify the scope of adverse drug events at the UIHC and then develop methods to improve the safety of the medication use system, educate care providers, reduce costs, and conduct research.

In response, the Adverse Drug Event Subcommittee has mapped out a plan to increase general awareness of ADEs by UIHC personnel and enhance medication use safety. Several task forces were appointed to spearhead work associated with:

- ◆ Gathering benchmarking data;
- ◆ Providing reference information to care providers (of which this paper is part);
- ◆ Initiation of quality improvement and research activities linked to ADEs; and
- ◆ Hosting an organization-wide event to spotlight ADEs, their impact, and their prevention.

The ultimate goals of the Adverse Drug Event Subcommittee are to increase awareness of the problem of adverse drug events and bring about changes which will reduce the opportunity for their occurrence.

## **Current UIHC Methods to Identify and Prevent Adverse Drug Events**

Through the years, the University of Iowa Hospitals and Clinics has utilized many strategies that reduce the opportunity for adverse drug events to occur. **General** strategies involve the use of safe medication preparation and distribution systems; educational initiatives about medication use directed toward care providers; the development of medication use protocols and guidelines; the implementation of automated technology; and quality improvement activities. Several medication safety-**specific** programs in place at the UIHC are intended to prevent as many adverse drug events as possible through the identification, reporting and monitoring of adverse drug reactions and medication errors.

### ***General ADE Prevention Strategies***

#### *Medication Distribution Systems*

Before the 1960's, medication preparation, distribution, and administration practices had relatively few in-process checks to ensure that patients received the proper doses of medication as prescribed by the physician. Most healthcare organizations utilized a "floorstock system" where the pharmacist dispensed multiple-dose, bulk supplies of drugs to the patient care area where the nurse then prepared all individual doses of medication intended for administration to the patient.<sup>12</sup> Supplies of medication sent to the patient care unit were not labeled for specific patients and were, therefore, available for several doses for numerous patients. The pharmacist did not review the patient's medication order written by the physician, and the doses prepared by the nurse were not double checked by anyone else prior to administration. The opportunity for medication errors was substantial.

During the 1960's and '70's, medication distribution systems in U. S. healthcare organizations changed radically. The floorstock system and other similar drug distribution methods gave way to a safer system which incorporated multiple dose checks before any medication is given to the patient. Allan and Barker have reviewed medication errors associated with various drug distribution systems.<sup>13</sup> Error rate reductions have been consistently demonstrated with the introduction of the unit dose system versus older floor stock systems. In the unit dose system, the pharmacist assumed more responsibility for medication safety through the routine review of physician-generated medication orders; preparation of patient-specific doses within the pharmacy; and maintenance of patient-specific drug profiles which permit the pharmacist to

monitor for drug allergies and interactions, patient organ function, and patient response to therapy. The pharmacist was also able to intercede with the physician and nurse to prevent problems before the medication reached the patient.

In the unit dose system, a series of double checks were instituted to ensure that patients received the right medication. A copy of the original medication order written by the physician is forwarded to the pharmacist who reviews and edits the order and compares it against previous drug orders and information contained within the patient's medication profile. If a problem is encountered, the pharmacist directly intervenes with the prescriber to recommend appropriate alternatives. Next, a pharmacy technician prepares patient-specific doses of the medication needed, and these are subsequently checked by a pharmacist for accuracy before being delivered to the patient care area.

Meanwhile, the nurse transcribes the medication order from the physician's original order onto a medication administration record (or MAR), which is subsequently verified by a pharmacist. When the dose of medication is provided by the pharmacy to the nurse, she compares the medication label on the drug product with the appropriate entry on the MAR. The nurse then administers the dose to the patient and records the fulfillment of the order on the MAR. Thus, the medication order cycle has come full circle, beginning with the physician's order based upon the needs of the patient and ending with the provision of the medication to the patient.

A central feature of the unit dose distribution system is unit dose (or unit-of-use) packaging. With this, each dose of medication is placed into a separate package that bears a label listing drug name, strength or concentration, lot or batch number, and expiration date. Use of such packaging permits the pharmacy to dispense only those doses needed by a particular patient during a designated period of time. While most medications are now commercially available in unit dose packaging, those that are not are prepared by pharmacists and pharmacy technicians using procedures that ensure drug integrity and patient safety. All doses sent by the pharmacy to the patient care area are securely stored in designated locations where nursing staff can easily access them at the times they are needed for administration. While the unit dose system came into being in the inpatient environment, key features of the system are also utilized in the preparation of medication for ambulatory patients, whether they are treated in a clinic or receive homegoing prescriptions.

### *Clinical Pharmacist Role*

Comprehensive pharmacy services include not only drug distribution activities but also pharmaceutical care, which includes clinical services provided by a pharmacist who actively participates in the care, treatment, and monitoring of patients who receive drug therapy. A recent study demonstrated that the presence of a pharmacist on rounds as a full member of the patient care team in a medical intensive care unit was associated with a substantially lower rate of adverse drug events (3.5 ADEs per 1000 patient days versus 10.4 before the study).<sup>14</sup> At the UIHC, clinical pharmacy services are provided in both the inpatient and outpatient care settings.

A clinical pharmacist reviews the medication order written by the physician and evaluates the order for therapeutic appropriateness. The medication is evaluated according to the patient's age, weight, underlying disease states, concomitant drug therapy, and renal and liver function. For all medications for which it is appropriate, the pharmacist performs a patient-specific pharmacokinetic evaluation of the appropriate dosing based on several patient variables including serum drug levels.

For high medication use areas within the UIHC, a clinical pharmacist is assigned to the patient care unit and participates in patient care rounds to consult with physicians and provide input on therapeutic decisions as medication orders are being written. In ambulatory care clinics where there is significant medication use, clinical pharmacists provide consultation to prescribers about medication use issues, educate patients about medications, and monitor patient drug therapy for effectiveness and / or the presence of adverse drug effects. For all other patient care units, clinical pharmacists interact with physicians in person or by telephone in response to medication orders or questions by the medical or nursing staff.

The Department of Pharmaceutical Care has developed a Selective Monitoring System (SMS) to further assess drug safety in certain subsets of patients. These groups includes patients who have underlying medical conditions or diseases that may predispose them to altered pharmacokinetics or who are treated with drugs that are associated with significant toxicities or adverse effects or that have a low therapeutic index.

In 1997, the Department of Pharmaceutical Care implemented a computer system (PharmNet, Cerner Corp, Kansas City, MO) in the inpatient care areas which provides automated screening for duplicate drug entries, patient allergies, potential drug interactions, drug/laboratory test interactions, and dosage ranges during medication order entry by Pharmacy staff. In addition, the system provides the pharmacist with an on-line documentation system, clinical reports, and the ability to have the system continually monitor changes in designated patient conditions.

Dose Range Management (DRM) rules evaluate the appropriateness of drug dosing based upon age, creatinine clearance, patient conditions, and other factors. Currently, DRM rules are in place for high-use medications used in pediatrics, chemotherapeutic agents, and miscellaneous agents with narrow therapeutic indexes (see Table 1).

The ability to continually monitor designated patient conditions is possible via a decision support module called Discern Expert. This module has the capability to monitor laboratory parameters, patient conditions, and pharmacy orders on a continual basis. "Rules" can be written to alert the user when certain conditions are met (e.g., a patient develops a high serum potassium while on angiotensin converting enzyme inhibitor therapy). Alerts will be printed as a report in the pharmacy responsible for the affected patient's care. In addition, alerts can appear as a banner across the computer screen during pharmacy or laboratory order entry.

Once the alert has printed, the pharmacist evaluates the alert to decide whether or not the prescriber needs to be consulted. The results of this contact are recorded in the Clinical Documentation Module (CDO). Discern Expert is currently evaluating approximately 30 separate patient conditions. Rules vary from informational to identification of conditions with a high potential for causing serious harm (e.g., an enoxaparin order in a patient with an epidural catheter in place).

A complete list of the current rules and the clinical conditions monitored by Pharmacy is depicted in Tables 2, 3, and 4 on the following pages.

**Table 1. Medications with Automatic Dose Checking upon Medication Order Entry by Pharmacy**

<b>Medication</b>	<b>Patient Population</b>	<b>Medication</b>	<b>Patient Population</b>
Acetaminophen	Pediatric	Doxorubicin	Adult
Altretamine	Adult	Etoposide	Pediatric BMT, Adult BMT, Adult
Amoxicillin	Pediatric	Famotidine	All patients
Ampicillin	Pediatric	Fluorouracil	Adult
Asparaginase	Adult	Furosemide	Pediatric
Bleomycin	Adult	Gentamicin	Pediatric
Busulfan	Adult BMT, Adult	Granisetron	Pediatric
Caffeine Citrate	Pediatric	Hydroxyzine	Pediatric
Captopril	Pediatric	Ibuprofen	Pediatric
Carboplatin	Pediatric BMT, Adult BMT, Adult	Ifosfamide	Adult BMT, Adult
Carmustine	Pediatric BMT, Adult BMT, Adult	Iron Products	Pediatric
Cefazolin	All patients	Ketorolac	All patients
Cefotaxime	Pediatric	Levofloxacin	Adult
Ceftazidime	Pediatric	Lorazepam	Pediatric
Ceftriaxone	All patients	Mechlorethamine	Adult
Chloral Hydrate	Pediatric	Melphalan	Pediatric BMT, Adult BMT
Chlorambucil	Adult	Meperidine	Pediatric
Chlorothiazide	Pediatric	Methotrexate	Adult BMT, Adult, Pediatric
Cimetidine	All Patients	Metronidazole	All patients
Cisapride	Pediatric	Midazolam	Pediatric
Cisplatin	Adult BMT, Adult	Mitomycin	Adult
Citalopram	All patients	Morphine	Pediatric
Cladribine	Adult	Nafcillin	Pediatric
Clindamycin	All patients	Nortriptyline	All patients
Clonidine IV	All patients	Ondansetron	Pediatric
Codeine	Pediatric	Paclitaxel	Adult
Colchicine	All patients	Phenobarbital	Pediatric
Contraindicated IV Meds	All patients	Piperacillin	Pediatric
Co-Trimoxazole	Pediatric	Promethazine	Pediatric
Cyclophosphamide	Pediatric BMT, Adult BMT, Adult	Propranolol IV	All patients
Cytarabine	All patients	Thiotepa	Pediatric BMT, Adult BMT
Dacarbazine	Adult	Tincture Of Opium	All patients
Dactinomycin	Adult	Tobramycin	Pediatric
Digoxin	Pediatric	Vancomycin	Pediatric
Diphenhydramine	Pediatric	Vinblastine	Adult
		Vincristine	All patients

BMT – Blood & Marrow

Pediatric – Less than 18 years

**Table 2. Current Rules and Clinical Conditions Monitored by the Pharmacy Computer System: Informational Type Rules**

- ◆ Antihemophilic Factor. Whenever an order is entered for antihemophilic factors for either adult or pediatric patients, purchasing staff are notified to ensure that pharmacy has adequate supplies on hand.
- ◆ Abnormal Serum Drug Levels. When an abnormal serum level is reported for any of 17 different medications with narrow therapeutic indexes, the pharmacist is notified.
- ◆ Vancomycin Resistant Enterococcus. If microbiology cultures indicate vancomycin-resistant enterococcus and the patient has an order for vancomycin, the pharmacist is notified.
- ◆ Lipid Therapy. If a high LDL cholesterol value is reported and the patient is not on current antilipemic therapy, a rule will print outlining the NCEP guidelines.
- ◆ Esmolol Bolus for ECT Patients. If esmolol is ordered for an ECT patient, a rule banner will alert the pharmacist to which esmolol concentration to send.
- ◆ Filgrastim Stop Criteria. If there are current orders for filgrastim and the absolute neutrophil count is greater than 2000 cells/mm<sup>3</sup>, the pharmacist is notified.
- ◆ Pediatric Patient on Adult Unit. Pediatric patients (less than 16 years old) housed on primarily adult units are identified to alert the pharmacist of the need to double check all medication doses.
- ◆ Albumin Administration. If a patient has an order for albumin and the current albumin level is greater than 3.5 g/dl, the pharmacist is notified.
- ◆ Anticoagulation Admit. If patients currently followed by the UIHC Anticoagulation Case Management Service are admitted as inpatients, the pharmacist and team members are notified.
- ◆ Heroic Drug Therapy. If orders are entered for 7 different agents considered "heroic drug therapies," Pharmacy administrative and purchasing staff are notified to ensure that there are adequate supplies on hand.
- ◆ DC Rule. This rule evaluates when the patient is on two agents that have a Medicom Level 9 (potentially fatal) drug-drug interaction and the precipitant drug is discontinued. The pharmacist is notified that the dose of the remaining agent may need to be modified.
- ◆ Phenytoin in Low Serum Albumin. Patients with orders for phenytoin, low serum albumin, and no free phenytoin levels are identified. The rule printout reviews the calculations used to calculate the free phenytoin level.

**Table 3. Current Rules and Clinical Conditions Monitored by the Pharmacy Computer System: Rules Which Identify Potentially Serious ADEs and Allow Intervention Before the Medication Is Administered**

- ◆ Epidural/Low Molecular Weight Heparin. If there are concurrent orders for a low molecular weight heparin and the patient has orders for an epidural, the alert will fire indicating the contraindicated use of the two together.
- ◆ Wrong Route for NG medications. If any solution or suspension is ordered by an injectable route, a pharmacy banner will alert the pharmacist of the contraindication and a report will print on the pharmacy satellite printer.
- ◆ Haloperidol Decanoate in the Elderly. If an elderly patient (greater than 65 years old) has an order for haloperidol decanoate, the pharmacist is notified of this relative contraindication.
- ◆ Teratogenic Drugs in Pregnancy. If the patient is on a potential teratogen and becomes pregnant, or is pregnant and a teratogen is ordered, the pharmacist is notified of the need to discontinue therapy.

**Table 4. Current Rules and Clinical Conditions Monitored by the Pharmacy Computer System: Rules Which Identify Potential ADEs and Allow Intervention to Prevent Patient Injury**

- ◆ Heparin and Low Platelets. If the platelet count falls below 100,000 and there is an order for heparin of any kind, the rule will fire.
- ◆ Electrolyte Parameters in Diuretic Use. If there are current orders for diuretics, electrolytes are monitored and the pharmacist is notified of abnormal lab values.
- ◆ Metformin in Renal Dysfunction. If metformin is ordered in patients with renal dysfunction, the pharmacist is notified.
- ◆ Metformin in Renal Dysfunction. If renal function worsens while on metformin, the pharmacist is notified.
- ◆ Creatinine Increases in Renally Excreted Drugs. Patients with orders for medications that are either renally excreted or have the potential for causing renal dysfunction are monitored. Patients with serum creatinines above 1 mg/dl that have a second creatinine level that is greater than 20% higher than the first will trigger the rule. The pharmacist will be notified.
- ◆ Patients on Medications with the Potential to Cause Neutropenia (excluding chemotherapies) and have a low absolute neutrophil count are identified.
- ◆ Patients on Anticoagulant Agents that Receive an "Anticoagulant Antidote" (e.g., vitamin K or protamine) are identified.
- ◆ Patients with High Serum Potassium that have an order for a medication that can cause hyperkalemia are identified.
- ◆ Patients Currently on a Medication that Can Cause Hyperkalemia and high serum potassium are reported to the pharmacist.
- ◆ Patients on Thiazolidinedione Oral Hypoglycemics (e.g., rosiglitazone or pioglitazone) with elevated liver function tests are reported to the pharmacist.

### *Education: Role of the Pharmacy and Therapeutics Subcommittee*

The Department of Pharmaceutical Care and the Pharmacy and Therapeutics Subcommittee, along with its advisor subcommittees, oversee the selection of drugs used in the UIHC and the formation of policies that ensure safe medication therapy.

The UIHC has published the *Formulary and Handbook* for 43 years. The Pharmacy and Therapeutics Subcommittee is responsible for the admission of new drugs into the hospital's formulary and the ultimate use of all drugs within the hospital. New agents are reviewed for clinical efficacy and safety before inclusion in the formulary. Periodic reviews are also conducted to determine whether drugs currently in the formulary merit continued inclusion. The *Formulary and Handbook* is now incorporated into the Virtual Hospital web site for use by UIHC staff and is updated monthly.

The Medication Use Evaluation (MUE) Subcommittee of the Pharmacy and Therapeutics Subcommittee meets the Joint Commission on Accreditation of Healthcare Organization's (JCAHO) standard which requires that: "Medication use evaluation is performed by the medical

staff as a criteria-based, ongoing, planned, and systematic process designed to continuously improve the appropriate and effective use of drugs.” The charge of the MUE Subcommittee is:

- To conduct a hospital-wide medication use evaluation program that is criteria-based, ongoing, planned, and a systematic process designed to continuously improve the appropriate and effective use of drugs.
- To recommend changes in prescribing guidelines, educational programs, and prescribing restrictions to achieve behavior changes when needed.
- To help assure that drugs are prescribed appropriately, safely, and effectively.

A sampling of the various types of MUE initiatives carried out within the UIHC includes:

- Coordination of the Protocol Anti-infective Program which was developed to address patient safety concerns and control the emergence of antimicrobial resistance.
- Ambulatory care initiatives which were developed to improve patient safety and education about medications such as sumatriptan and salmeterol.
- Expediting the removal from the formulary of alatrofloxacin/trovafloxacin after the receipt of new toxicity information from the FDA.
- Development and implementation of guidelines for the use of alteplase in catheter clearance and treatment of peripheral arterial occlusion after urokinase was no longer available due to nationwide shortages.

### *Use of Automation*

The use of automation has been recommended by several national medication safety organizations, including the National Patient Safety Foundation and American Society of HealthSystem Pharmacists (ASHP), due to the potential for simplifying systems and using technologies such as bar code scanning to replace data entry by humans. Based on studies that have been conducted, error rates have been reduced from one error per 200 character entries for key-board entered information down to one error per 1,000,000 for scanned bar codes.<sup>15</sup> Automation is an enabling technology; thus, the design of the medication use system incorporating automation is critically important. Studies have shown an increase in errors when automation has been used and important safety checks have been bypassed.<sup>16</sup> This concept has prompted organizations such as ASHP and the National Association of Boards of Pharmacy (NABP) to issue guidelines and model rules for the use of automation.

Early automation of unit dose drug dispensing focused on computer-controlled unit dose packaging systems such as the ATC-212. Beginning in the late 1980's, significant growth was seen in the use of patient care unit based cabinets. Later versions of these cabinets used an interface between the pharmacy computer system and the cabinet to display the patient medication profile at the cabinet and allow access to all medications ordered for the patient. A centralized approach to automation using robotics was also developed in the 1990's using bar code-labeled medications. As this concept developed, the two concepts were integrated and the robot focused on medications that were scheduled for administration to the patient, while the patient care unit cabinet focused on controlled substances, as needed (“PRN”) medications, and other medications that are required to be stocked on the patient care unit to meet urgent needs. The integration of these two concepts to use the robot to pick medication to be stocked in the patient care unit cabinet began development in the late 1990's.

During the 1990's the use of handheld, portable or bedside devices to scan the bar codes on medication at the patient's bedside to ensure the right drug is given to the right patient at the

right time was being investigated and implemented. Advances in the technology of handheld and wireless communications greatly stimulated the interest in this technology.

At the department level within the UIHC, the Dermatology Department is investigating ways to support the cost of supplying hand-held platform computers loaded with drug database software. One data base that can be downloaded from the Internet (LexiDrugs-K2 Consultants) is of particular interest because of the adverse drug event data that is available on the program. Ultimately, the department hopes to outfit all 13 of its residents with these computers.

### *Electronic Physician Order Entry: A Strategy to Improve Patient Safety*

Preceding sections have defined adverse events as resulting from intervention and not from the underlying condition. It has been well accepted that many adverse events are preventable. One category of adverse event is the adverse drug event which is injury-related to the use of a drug. Attention has been focused on this problem as a result of the Institute of Medicine (IOM) Report which called for a national goal to decrease errors in medical interventions by 50 percent over the next five years.<sup>17</sup> Although there is good reason to question the magnitude of the problem as presented in the IOM Report, and even better reason to question their conclusion that nothing has been done about this in the past, there is no question that the problem is real and that initiatives will be able to realize serious improvements in the quality of patient care. It is well accepted that most interventions and almost all drug interventions are a result of a physician order in both hospital and outpatient settings. One of the most important strategies that was recommended by the IOM report and a number of others is **physician order entry**.

From several studies,<sup>11,14,18</sup> it has been shown that preventable adverse events involve a number of causes. Lack of information about the patient, wrong diagnosis, delayed therapy, use of an outmoded therapy, or failure to use a recommended treatment may occur. In the case of medication-related problems, breakdown of causes included lack of drug knowledge, ambiguous identification of the medication or the dose, insufficient information about the patient such as allergies or abnormal laboratory data, inaccurate order transcription, loss of the order, and poor or slow communication among services. In that breakdown, problems related to knowledge about the patient included 13.9 percent of cases where the physician did not know about abnormal renal or hepatic function, and 12.1 percent of the cases where the physician did not know about an allergy to the drug. Furthermore, 11.4 percent of cases involved the wrong drug name, form or abbreviation; 11.1 percent of cases involved the wrong dosage; and 10.8 percent of errors involved the wrong frequency of medication administration. Another large category of errors was associated with dosage calculations. A major category was lack of knowledge about drug interactions.

In trying to understand the causes of these errors, it is useful to review the overall medication use process. The process begins with prescribing, at which point the physician's knowledge of the patient, diagnoses in general, drugs in general, drug interactions, interactions with renal and hepatic function, dose calculations, and the hospital formulary become most relevant. The next step in the medication use process is review of the prescription by nursing staff and pharmacy staff. Next is the dispensing of the medication, followed by administration of the medication, and finally by monitoring the results of the medication's use. Physician order entry online can be expected to have the greatest impact on the first of these steps, of course, but it also impacts the remaining steps as well.

There are a number of useful system concepts in identifying the causes of and solutions to breakdowns in the system process (this process is often referred to as "safety analysis" or as "a

new look at error"). One of the important concepts is the recognition of *hindsight bias*. Analysis of major problems or catastrophes usually results in identification of a faulty human in the system. However, if one carefully tracks the history of the actual problem, this is clear only in hindsight, hence the term. Problems identifiable only in hindsight are difficult to prevent. Therefore, a more useful analysis of the system focuses on the *gaps in the process*. These gaps are points in the process in which information must make a transition from one level to another. The role of humans in systems is often to create safety by bridging these gaps. Often it is the combination of system failures plus failure of the human to intervene to catch the error that results in an adverse event. A system without points at which there is systematic human review may reduce the potential for error detection or eliminate the opportunity for a human to prevent an error. In the design of a system to enhance safety, it is important to eliminate gaps in information transfer that cause error, but it is equally important to preserve and enhance the ability for human review.

Some of the strategies recommended in the Institute of Medicine Report included the following:

- Provide information (patient / reference) at the time of order entry (decision support).
- Standardize prescription writing and order entry in general.
- Implement direct online physician order entry to facilitate the above.

Why should physician order entry have an impact on the kind of errors that are noted above? The first and foremost reason is that physician order entry requires that the orders entered be described in a highly structured manner. This requires that the physician choose the intervention that is desired in an unambiguous manner from predefined items. When this information is transmitted to the next point in the process, it will be done in an unambiguous manner that will not be affected by illegibility. Presented with a series of structured choices, the physician can be guided to choose only reasonable choices. The range of orders that can be written by any particular physician can be carefully tailored to a particular physician's area of practice.

While entering the order, the physician can be given ad hoc access to and automated prompts concerning computer-available information about the patient. This might include the documentation of the patient's previous medical problems with information such as diagnoses, medication history, and allergy history. This also includes results of the patient's laboratory tests, including renal and hepatic function. In addition, the physician would have ready access to online documentation regarding medications, drug interactions, and laboratory test result interpretation.

Automated processing by the computer system can provide information about drug interactions. In addition, the processing can check for any known patient allergies, and it can check for any recent laboratory results indicating problems with renal or hepatic function. In requiring a diagnosis for each order, the computer can perform processing to assist the physician in finding the most up-to-date treatments for the indicated diagnosis.

Another positive impact of physician order entry is that orders are communicated to other points in the medication use process such as the pharmacy, laboratory or nursing staff in a rapid and legible manner. Related to this is the fact that the orders are kept online in the computer system so that the physician who wrote the order can remain aware of orders that have been done previously, eliminating any unnecessary, or perhaps even dangerous duplication of orders.

It is important in this concept that the physician be at the computer at the time the order is entered in order to receive immediate feedback, resulting in an interactive process and a safer

order for the patient. The alternative, a system in which orders are processed after being hand-written by a physician potentially introduces two kinds of errors. One is errors in transcription, which result in the wrong information being entered. The other is lack of immediacy and lack of an interactive, iterative approach to the final prescribing decision.

There is reasonably good evidence that physician order entry has had very positive impacts in other settings. In one study,<sup>19</sup> it was found that physician order entry reduced non-intercepted errors by more than a factor of two, from 10.7 to 4.86 per thousand patient days. In that report it was estimated that the potential savings from avoiding these errors were on the order of \$10 million per year in a hospital about the size of the University of Iowa Hospitals and Clinics.

### ***Specific ADE Identification and Prevention Programs***

#### ***The UIHC Adverse Drug Reaction Reporting Program***

The World Health Organization defines an adverse drug reaction as “a response to a drug which is noxious and unintended, and which occurs at doses normally used in man for the prophylaxis, diagnosis, or therapy of disease, or for the modification of physiological function.”<sup>20</sup> This definition was used in the formation of the UIHC Adverse Drug Reaction (ADR) Reporting Program. The program is administered under the auspices of the Pharmacy and Therapeutics Subcommittee and is coordinated by the Department of Pharmaceutical Care.

The majority of reports are submitted voluntarily by health care professionals. Pharmacy personnel use a pharmacy-specific form, while other health care professionals are encouraged to use special ADR cards available on the patient care units or to contact the Department of Pharmaceutical Care. A smaller number of reports are captured through the use of an automated system of “tracer” alerts. Drug agents commonly used as antidotes for potential drug-related injuries trigger reports that are then screened by a pharmacist. These tracer alerts are generated by both the pharmacy computer system and automated patient care unit drug dispensing cabinets. The rationale for this approach has been reported elsewhere in the literature.<sup>21,22</sup> Monthly reports are submitted for review and approval to the Pharmacy and Therapeutics Subcommittee and severe or fatal reports, as well as those occurring in an unusual frequency or in newly marketed agents, are forwarded to the FDA via the MedWatch program after approval by the attending physician. Patient and reporter confidentiality is maintained throughout this process.

Over the past five years, the average number of reactions reported annually is 444, and the average number of reports forwarded to the FDA is 89. The information from these reports is used in various ways. Semiannual reports are forwarded to the Pharmacy and Therapeutics Subcommittee and the Chiefs of Service. These reports discuss the agents that are most frequently associated with the occurrence of ADRs, emerging trends, and measures taken to address these trends. The information is subsequently provided to all members of the health care team following its publication in the *Formulary and Handbook* and various newsletters, including *P&T News* and *Rx Update*.

An important relationship exists between the ADR Reporting Program and The MUE Program. Examples of the exchange of information between the two programs are:

- *ADR data may be used as a MUE Program surveillance tool.* For example, the MUE Subcommittee determined that the primary H-2 Receptor Antagonist used in the hospital would be cimetidine. Although the review of current literature demonstrated no greater

incidence of ADRs or drug-drug interactions with cimetidine as compared to other agents in the class, there was concern that there would be a significant rise in the incidence of ADRs. Data from the ADR Program is routinely reviewed by assure that incidence of ADRs secondary to cimetidine does not demonstrate a significant increase.

- *The ADR Program data can be used to identify areas where current drug therapy practices may need to be improved.* At the UIHC, a review of ADR program data from January 1995 to July 1997 produced reports of 25 warfarin ADRs. Closer scrutiny by the MUE Program discovered that 36% of these ADRs were deemed to be preventable. After this review, a number of recommendations were put into place. They included:
1. The initiation of increased pharmacist involvement with patient teaching when warfarin therapy is started in the hospital;
  2. The documentation of teaching in the patient's medical record; and
  3. The development of educational material for prescribers and pharmacists about dosing, drug-drug interactions, and monitoring anticoagulation therapy.

Identification of ADRs also takes place through the use of review of various electronic systems. The Pharmacy computer system, PharmNet, generates a list of "tracer" drugs. Tracer drugs – such as naloxone, phytonadione, and flumazenil – included in a patient's medication list may indicate that an adverse drug reaction has been experienced by the patient. PharmNet generates lists of these agents along with patient information that allows for review to determine whether an ADR has taken place.

Newly installed automated drug dispensing cabinets (Pyxis MedStations), located in the patient care areas, are also capable of generating similar types of lists. The review of these lists has been employed to identify patients who have visited the UIHC Emergency Treatment Center because of an adverse drug reaction. As Pyxis MedStations are installed throughout the hospital, this source of information will become more widespread, potentially making ADR identification and follow-up more efficient.

### *Medication Error Reporting Program*

Medication error reporting, in a manner similar to adverse drug reaction reporting, is intended to document incidents in which a medication has been erroneously administered to a patient. While many medication errors go undetected and produce few or no consequences that adversely affect patients, some errors result in serious patient morbidity or even mortality. Medication errors include mistakes in prescribing, dispensing, administration to the patient, and patient compliance with prescribed therapy. Furthermore, medication errors may be further categorized as "potential," where a mistake in prescribing, dispensing, or planned medication administration is detected and corrected through intervention, or "actual," in which the patient ultimately receives or takes the medication in error.<sup>23</sup>

At the UIHC, the Medication Error Reporting Program is part of the hospital's larger unusual incident reporting system. In the past, whenever a medication error was detected, UIHC personnel completed a "Patient / Visitor: Unusual Incident, Medication Error & Accident Report" which was subsequently reviewed by the patient's physician and management staff on the patient care area where the error occurred. All reports were then forwarded to the Clinical Outcomes and Resource Management (CORM) Program, the hospital quality improvement /

risk control surveillance program, and the Pharmacy and Therapeutics Subcommittee for analysis and data trending. Finally data were reported back to each patient care area and clinical department so that focused follow-up action can occur. In the Fall of 2000, the reporting of medication errors will be automated so that hospital staff can document these occurrences via the hospital's mainframe computer system, and data can be searched and sorted more effectively.

Medication error reporting is voluntary at the UIHC; that is, staff are asked to voluntarily complete a medication error incident report whenever an error is discovered in the course of providing patient care. To ensure that all such incidents are reported, it is very important that the program be seen as an educational and quality improvement initiative with the stated goal of preventing similar kinds of errors in the future. Use of such a program to identify poor staff performance or punish care givers associated with an error inevitably reduces reporting and diminishes the opportunity to review systems and make operational changes that can prevent future errors. Ultimately, medication error reporting is a process for identifying problems with care delivery systems and permitting improved processes to be implemented.

The collective data obtained through a medication error reporting program is typically reported as a rate.<sup>24</sup> Use of a medication error rate would seem to be a logical way to measure the performance of an organization in preventing errors and perhaps to compare one organization to another. However, variations in the definition of a medication error, differences in reporting procedures or system sophistication, and staff perceptions of why medication error data are collected may contribute to widely varying amounts and quality of information obtained. In fact, some researchers have stated that inter-organizational comparisons of error rates are not likely to be meaningful and could be counterproductive. Thus, data showing that one institution has a rate of 2 errors per 10,000 doses are not likely to be comparable to a reported rate of 65 errors per 10,000 doses at another institution.<sup>25</sup>

Having noted this, error rate monitoring within an organization is important so that trends may be identified and the results of system changes evaluated. At the UIHC, error rates are reported monthly, quarterly, and annually. Data are exhibited as the number of documented medication errors per 10,000 doses administered. Quarterly results reported between July 1998 and June 2000 show that the total error rate at the UIHC has consistently remained between 4.0 and 7.3 errors per 10,000 doses of medication administered. The types of medication errors reported and trended over time are shown in Table 5.

Review of the data obtained via the Medication Error Reporting Program has led to the further evaluation of error occurrences with high frequencies. In 1998, the high incidence of transcription errors led to the formation of a multidisciplinary quality improvement team which was asked to provide recommendations for reducing this type of error. Similarly, serious errors which have had the potential to cause significant patient harm have prompted the hospital to perform root cause analyses. This permits an in-depth review of past practices to be undertaken and revised procedures which decrease the opportunity for repeat errors to be implemented. These strategies are an important component of the hospital's quality improvement program and are frequently linked to educational initiatives directed toward staff.

<b>Table 5. Types of Medication Errors Reported at the UIHC</b>
<b>Contraindication</b>
<b>Discontinued</b>
<b>Duplication</b>
<b>Omission</b>
<b>Wrong Route</b>
<b>Wrong Dose</b>
<b>Wrong Med Administered</b>
<b>Wrong Patient</b>
<b>Wrong Rate of Flow</b>
<b>Wrong Time</b>
<b>Transcription Error</b>
<b>Wrong Med Ordered</b>
<b>Other</b>

## Future Strategies to Prevent Adverse Drug Events

While the UIHC has long employed several traditional methods to track and prevent adverse drug events, there is now a national awareness that more must be done. As was noted previously, in November 1999, the Institute of Medicine released a report on medical errors entitled, "To Err is Human: Building a Safer Health System."<sup>17</sup> In the study, the IOM notes that medical errors – including medication errors – kill thousands of people in the U. S. each year. Broad recommendations contained within the report to reduce errors lay out a four-tiered approach:

- ◆ Establish a national focus to create leadership, research, tools and protocols to enhance knowledge about safety.
- ◆ Identify and learn from errors through reporting efforts.
- ◆ Raise standards and expectations for improvements in safety through the actions of oversight organizations and professional groups.
- ◆ Create safety systems inside health care organizations through the implementation of safe practices at the care delivery level.

Several of these approaches have been or are being implemented or developed at the UIHC to prevent not only medication errors but all types of adverse drug events. Other similar strategies worthy of consideration include:

- ◆ Education of patients, as advocated by the "Partnership for Patient Safety," about the important information patients or their family members need to be able to provide to health care providers about their drug therapy.<sup>26</sup>
- ◆ Increased education to care providers about incident reporting to national databanks. A recently published report stated that only one eighth of cases reported to the FDA's

MedWatch program are submitted by health care providers.<sup>27</sup> The author of this article speculates that the disincentives to reporting for health care providers include fear of litigation, inadequate time to report, and lack of knowledge about the reporting system.

### *Electronic Reporting of Adverse Drug Events*

As noted previously, the UIHC has long employed manual, or paper driven, reporting systems to document and track adverse drug reactions and medication errors. However, the use of such systems makes it difficult to completely sort and carefully trend the data associated with these types of incidents, and the data itself may not be collected in a uniform or consistent manner. In response to concerns that the UIHC needed to be able to more effectively react to adverse drug event occurrences, in 1999 the hospital initiated the development of an electronic system which would permit UIHC staff to document incidents via the hospital's mainframe computer system.

Initially focusing on unusual incidents (which included medication errors), a multidisciplinary development team working on the new system was charged with responsibility to redesign the manual reporting system to:

- ◆ Improve compliance with the reporting process.
- ◆ Improve staff convenience (so that reporting is less burdensome and more likely to be completed).
- ◆ Improve access to data for personnel who need to review it.
- ◆ Improve timeliness of reporting and follow-up action.
- ◆ Eliminate the need for paper copies.
- ◆ Maintain patient confidentiality.

The first phase of the Automated Incident Reporting System is scheduled for implementation in October, 2000. It will include user modules that permit UIHC care providers to report and document errors associated with medications, IV solutions containing medications, and IV solutions without medications. Eventually, it will also permit UIHC staff to report adverse drug reactions. Following generation of these electronic reports, area supervisors, physicians, the Department of Pharmaceutical Care, the Clinical Outcomes and Resource Management Services, and hospital risk managers will receive automatic notification so that appropriate and timely follow-up action can be orchestrated and data sorting and trending can take place.

## **Research-related Initiatives**

### *Outpatient Prescribing*

Physicians in the UIHC Division of General Internal Medicine have recently been awarded external funding to evaluate the efficacy of a new intervention - Enhanced Pharmacy Care - that is designed to decrease the risk of ADEs. The intervention will involve a formal medication review by a clinical pharmacist and geriatrician and will be targeted to outpatients age 65 years and older who are at high risk of ADEs, on the basis of having prescriptions for five or more medications. To improve the potency of prior pharmacist-based interventions, Enhanced Pharmacy Care will have the geriatrician be responsible for reviewing recommended medication changes with patients' primary care providers and facilitating implementation of the changes.

The three-year study will involve a randomized comparison of 300 patients receiving

Enhanced Pharmacy Care and 300 patients receiving usual outpatient care. Outcomes that will be compared in the two groups include:

1. Medication appropriateness;
2. Number and cost of prescribed medications;
3. Rates of ADEs;
4. Patient compliance and knowledge of medications;
5. Health-related-quality-of-life;
6. Patient perceptions of care; and
7. Inpatient and outpatient health care utilization.

These measures will be obtained at enrollment and at 3 and 12 months after enrollment. The study will also examine primary care providers' attitudes about the intervention and seek to identify barriers to acceptance of the intervention. In addition to improving medication prescribing, the investigators hope that the study will provide valuable insight on how to most effectively structure pharmacist involvement in the care of older patients.

### *Continuity of Care Initiative*

Pharmacists in different practice environments (community, hospital, home health care) have facilitated the care of patients by utilizing their drug therapy knowledge to work with physicians and nurses to maximize the outcomes which medications have in controlling and preventing disease in their patients. Pharmacists, as a profession, however, have done little to facilitate the transfer of medication-related information as the patient moves from one setting of care to another (e.g., hospital to community and visa-versa). It is along this continuum that pharmacists have begun to facilitate the exchange of information to improve the care of patients. Health system pharmacists and community pharmacists have partnered in order to share their knowledge of patients' medication therapy. The information exchange is expected to ensure consistent therapy by aiding in the prevention of duplicative therapy, drug-drug interaction, and inadvertent oversights in drug therapy that will result in an overall safer medication environment for the patient. The project was implemented between the Department of Pharmaceutical Care at the UIHC and the Certified Pharmaceutical Care Network Pharmacies (CPCN).

## **Other Information Resources**

### *National Organizations Associated with Adverse Drug Event Prevention*

In addition to the Institute of Medicine, several other national organizations have devoted considerable resources to the study and prevention of adverse drug events. This broad interest indicates that the ADE problem is significant and requires additional examination and research. While there are likely many causes for adverse drug events, the recent acceleration in drug approvals by the Food and Drug Administration has increased the potential for these incidents to occur as clinicians use more drugs with which they have limited experience. In response, these organizations are trying to increase the knowledge base about adverse drug events. A brief summary of these organizations' activities follows.

**American Society of HealthSystem Pharmacists (ASHP)**

**[www.ashp.org](http://www.ashp.org)**

ASHP is the largest national professional association that represents pharmacists who practice in hospitals, health maintenance organizations, long-term care facilities, home care agencies, and other components of the U. S. health care industry. In its educational role, ASHP has developed extensive practice guidelines on preventing medication errors in hospitals. The organization has sponsored several educational programs for pharmacists on ways to reduce adverse drug events and medication errors and in 1994 co-sponsored with the AMA and ANA a conference on understanding and preventing drug misadventures.

**Food and Drug Administration (FDA)**

**[www.fda.gov](http://www.fda.gov)**

FDA has the responsibility for assuring the safety and efficacy of all regulated marketed medical products, including: drugs, biologics, medical and radiation-emitting devices, and special nutritional products. FDA uses *MedWatch*, its Medical Products Reporting Program, to educate health professionals about the critical importance of being aware of, monitoring for, and reporting adverse events and problems to FDA and/or the manufacturer. FDA ensures that new safety information is rapidly communicated to the medical community, thereby improving patient care. The FDA has also sponsored conferences on minimizing medical product errors.

**Institute for Healthcare Improvement (IHI)**

**[www.ihl.org](http://www.ihl.org)**

IHI is an independent, non-profit organization working to accelerate improvement in health care systems in the U.S., Canada, and Europe by fostering collaboration, rather than competition, among health care organizations. IHI has sponsored two large, multiple-organization projects in the U.S. to identify methods to reduce adverse drug events and medical errors. IHI also sponsors educational symposia on ways to reduce adverse drug events, and it publishes "Improvement Guides" based on the experiences of healthcare organizations participating in the "Breakthrough Series Collaborative."

**Institute for Safe Medication Practices (ISMP)**

**[www.ismp.org](http://www.ismp.org)**

ISMP is a nonprofit organization that works closely with healthcare practitioners and institutions, regulatory agencies, professional organizations, and the pharmaceutical industry to provide education about adverse drug events and their prevention. The institute provides an independent review of medication errors that have been voluntarily submitted by practitioners to a national *Medication Errors Reporting Program (MERP)* operated by the United States Pharmacopeia (USP). All information derived from the MERP is shared with the FDA and pharmaceutical companies whose products are mentioned in the reports. Information from the reports may be used by USP to set drug standards. ISMP distributes a biweekly newsletter (*Medication Safety Alert*) via the Internet to UHC members.

**Joint Commission on Accreditation of Healthcare Organizations (JCAHO)**

**[www.jcaho.org](http://www.jcaho.org)**

The mission of the JCAHO is to improve the quality of care provided to the public through the provision of health care accreditation and related services that support performance improvement in health care organizations. The JCAHO's Sentinel Event Policy is designed to encourage the self-reporting of medical errors in order to learn about the relative frequencies and underlying causes of sentinel events, share "Lessons learned" with other health care

organizations, and reduce the risk of future sentinel event occurrences. This policy provides an opportunity to expand JCAHO's database of sentinel events that occur with significant frequency. The database will also categorize the most common underlying causes of these events. Information about sentinel events, and how they can be prevented, will then be regularly distributed by JCAHO to the health care community in an effort to reduce the frequency of medical errors – thus, ultimately improving the care delivered to the public.

**National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP)**

***www.nccmerp.org***

NCCMERP is comprised of delegates from 18 organizations representing pharmacy, nursing, medicine, pharmaceutical manufacturers, regulatory bodies and the healthcare industry. NCCMERP encourages health care professionals to routinely educate patients and caregivers to enhance understanding and proper use of their medications and related devices. NCCMERP also encourages health care professionals to regularly participate in error prevention training programs and, when medication errors do occur, to actively participate in the investigation. NCCMERP has developed a taxonomy for classifying medication errors.

**National Patient Safety Foundation (NPSF) at the American Medical Association**

The NPSF's central goal is to create a coordinated, collaborative movement dedicated to ensuring that all patients in all settings receive health care services safely. Some of its specific goals and activities are to:

- Promote discussion within the health care and scientific communities about the causes and prevention of health care errors and patient injuries.
- Build knowledge about health care errors, patient injury, and effective strategies for patient safety.
- Establish a clearinghouse for patient safety information.
- Support original research.
- Develop consensus-based standards.

The NPSF co-sponsored a conference in November, 1998, "Enhancing Patient Safety and Reducing Errors in Health Care" ([www.mederrors.org](http://www.mederrors.org)).

**United States Pharmacopeia (USP)**

***www.usp.org***

The USP promotes the public health by establishing and disseminating officially recognized standards of quality and authoritative information for the use of medications and other health care technologies by health professionals, patients, and consumers. In this role, USP sponsors two national drug error reporting databases:

- *USP Medication Errors Reporting Program (MERP)*, cosponsored by ISMP) which permits health professionals to confidentially submit medication error reports via mail or telephone to USP.
- *USP MedMARx* which permits health care organizations to anonymously submit error reports via the Internet; this system also permits users to organize internal error data in a standardized format for error data collection, reporting, and analysis. MedMARx is designed to "perform trend analysis of errors and eventually benchmark against 'best practice' facilities with similar profiles." The system includes a template for producing a root cause analysis report.

**University HealthSystem Consortium (UHC)**  
***www.uhc.edu***

UHC is an alliance of the clinical enterprises of major academic health centers in the U.S. As an idea-generating and information-disseminating enterprise, UHC helps its members pool resources, create economies of scale, improve clinical operating efficiencies, and influence the direction and delivery of health care. UHC recently coordinated a *Medication Use Process Benchmarking Survey* to provide participants with information comparing their practices and performance levels for select areas of the inpatient medication use process with other UHC institutions; topics surveyed included medication errors and the handling of hazardous medications. The UIHC participated in this survey. UHC also sponsors Advisory Councils with member participation committees.



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