Supplement Policy Statement

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Supplements to the Journal of Managed Care Pharmacy are intended to support medical education and research in areas of clinical practice, health care quality improvement, or efficient administration and delivery of health benefits. The following standards are applied to all JMCP supplements to assure quality and assist readers in evaluating potential bias and determining alternate explanations for findings and results.

1. Disclose the principal sources of funding in a manner that permits easy recognition by the reader.

2. Disclose the existence of all potential conflicts of interest among supplement contributors, including financial or personal bias.

3. Describe all drugs by generic name unless the use of the brand name is necessary to reduce the opportunity for confusion among readers.

4. Strive to report subjects of current interest to managed care pharmacists and other managed care professionals.

5. Seek and publish content that does not duplicate content in the Journal of Managed Care Pharmacy.

6. Subject all supplements to peer review.

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Kroon is working with community pharmacies to develop a pharmaceutical care practice model that increases pharmacists’ accessibility, allowing them to enhance the care they provide to patients. Other areas of research include the use of herbs and dietary supplements among people with diabetes and the development and dissemination of a tobacco cessation curriculum. She is involved in several professional organizations and is a past president of the Golden Gate Society of Health-System Pharmacists.

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He is a founder and past president of the Academy of Managed Care Pharmacy and continues his involvement as its current treasurer. He has given numerous presentations on all aspects of managed pharmacy. As a consultant, Penna continues to share his knowledge with managed care organizations, employers, the pharmaceutical industry, and the retail setting. He has participated as a managed care expert on many advisory committees for professional associations and the pharmaceutical industry.

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TARGET AUDIENCE
Managed care pharmacists and other health care practitioners.

LEARNING OBJECTIVES
Upon completion of this session, the participant will be able to
1. assess the prevalence and impact of diabetes on managed care;
2. describe the challenges associated with current insulin therapy including safety, dosing, health cost expenditures, and patient outcomes;
3. recall common medication errors associated with insulin therapy;
4. illustrate the importance of reducing errors and preventing complications associated with diabetes through improved patient compliance, improved self-management, and simplified treatment regimen;
5. describe strategies for preventing medical misadventures and improving insulin therapy for the effective pharmacologic management of diabetes; and
6. cite the opportunity for managed care pharmacy to positively impact achieving therapeutic goals, improving outcomes and reducing total health care expenditures through the implementation of system- and patient-oriented interventions.

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A total of .15 CEUs (1.5 contact hours) will be awarded to pharmacists for successful completion of this continuing education program (Program No. 067-999-03-016-H01).

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ABSTRACT

OBJECTIVE: The goal of this supplement is to increase awareness of and insight into the importance of preventing medication misadventures and provide new perspectives on effective management of diabetes through improved insulin therapy and review the issues that represent barriers to achieving treatment goals. Opportunities for managed care pharmacists and health care practitioners to influence enhanced quality of life, decrease mortality, and reduce health care costs will be highlighted. Attention will also be given to error prevention strategies, including improved preparation, storage, delivery, and administration of insulin products.

SUMMARY: The prevalence of diabetes mellitus continues to increase at an alarming rate, spurring a corresponding increase in the use of insulin. Insulin therapy, although currently the most effective treatment for patients with type 1 diabetes and many patients with type 2 diabetes, is fraught with safety concerns, especially those associated with medication errors. As glycemic goals have become more rigorous (ie, glycosylated hemoglobin levels of <6.5%-7%), clinical studies have clearly shown that intensive insulin therapy (3 or more injections daily) is often a necessary step toward achieving satisfactory glycemic control. This supplement explores the current level of diabetic care; the barriers to optimal insulin therapy, including medication errors; and the myriad factors that can increase the risks for medication errors among physicians, managed care pharmacists, and patients. Strategies for reducing medication errors in the management of diabetes are also considered.

KEYWORDS: Insulin, Medication errors, Diabetes, Glycemic control

Editor’s Note

The policy of the Journal of Managed Care Pharmacy is to eschew the use of trade names for drug products or commercial services. For prescription drugs, generic names are used unless the absence of the trade name would cause either confusion for readers or result in misunderstanding. In this supplement, we have permitted the use of trade names in the interest of the authors to cite specific examples of medication errors. Similar trade names and unfamiliarity with generic names are potential sources of prescribing and dispensing errors. Insulin is an example of a drug with similar generic and brand names. The tables included in this supplement cite available products and devices by trade name, in most cases.

A serious and growing public health problem, diabetes mellitus afflicts almost 17 million people in the United States—or 6% of the population. Alarmingly, about 35% (6 million) of the individuals with diabetes are undiagnosed and, therefore, untreated.1,2 Diabetes imposes a substantial burden, not only to the affected individuals in terms of an increased risk for serious long-term complications but also to our economy in terms of burgeoning disease-related health care costs. Indeed, diabetes is a leading cause of blindness, end-stage renal disease, and nontraumatic lower-limb amputations as well as an important risk factor for heart disease and stroke. Heart disease and stroke account for about 65% of all deaths in individuals with diabetes.3 In fact, individuals with type 2 diabetes have the same risk for a myocardial infarction as nondiabetic individuals who have had a previous myocardial infarction.4 In the United States, the direct and indirect costs of diabetes now approach $100 billion yearly, or $1 out of every $7 spent on health care.5-7

Diabetes is a “hallmark” for chronic disease management—with proper monitoring and treatment, complications secondary to diabetes can be delayed, or even prevented. Health care organizations that devote resources to developing programs aimed at early detection and enhanced care can improve outcomes for many patients. Disconcertingly, the prevalence of diabetes has increased 33% among adults in general and 70% among individuals in their 30s.6 The increasing prevalence of diabetes is expected to have a direct impact on the insulin market. Of the almost 10 million individuals currently diagnosed with diabetes, 37% use insulin therapy, including 700,000 patients with type 1 diabetes and 3 million patients with type 2 diabetes.7 By 2006, however, insulin use is projected to increase 26% and 10% in patients with type 2 and type 1 diabetes, respectively.8 Since the prevalence of diabetes increases with age, and the U.S. population continues to live longer, the number of people with diabetes will continue to dramatically increase. Up to 16% of people age 65 years or older have diabetes.8 The elderly are more apt to be affected by vision or dexterity problems, an important consideration when using insulin therapy.
Insulin use is fraught with safety concerns, especially those associated with medication errors. Medication errors associated with insulin therapy are a result of multiple breakdowns that occur in the medication-use process or system. Examples of system-related errors include prescribing the incorrect drug or dose, unclear prescription order writing (including sliding-scale parameters), the use of an inappropriate syringe, drawing an incorrect dose into the syringe, selecting the wrong insulin product or drug, and the inability of the patient to properly self-administer the correct dose. The resulting medication errors can have serious ramifications for the patient and the health care provider. For instance, insulin medication errors jeopardize optimal blood sugar control, increase hospitalizations and office visits, and undermine the patients’ confidence in their health care plan.

**New Perspectives on Managing Diabetes and Improving Insulin Therapy**

The prevalence of diabetes, predominately type 2, increases progressively with age (Figure 1). Thus, it is important to examine diabetes therapies and to determine whether these therapies are user friendly and promote compliance, especially in elderly patients.

**Goals of Therapy**

The overall goals of insulin therapy are to minimize hyperglycemia and hypoglycemia if present; eliminate or minimize cardiovascular risk factors; achieve individualized glycemic goals; and reduce the development or progression of long-term complications. The goals for glycemic control in patients with diabetes are becoming more aggressive. The 2002 American Diabetes Association goals recommend a target glycosylated hemoglobin (A1C) of less than 7% (normal 4% to 6%) and preprandial plasma glucose levels 90 mg/dL to 130 mg/dL (Table 1). This is a therapeutically logical goal since reductions in A1C are correlated with reductions in microvascular complications. However, experience shows that, in many patients, this goal is difficult to achieve.

Patients with diabetes often have a host of comorbidities—hypertension, dyslipidemia, obesity, and depression—that must be addressed in order to reduce cardiovascular and other disease risks. The American Diabetes Association has recommended standards of care for patients with diabetes, including visiting an ophthalmologist yearly for a dilated retinal exam, regular blood lipid monitoring, yearly flu vaccinations, and regular foot exams and renal function testing.

**Current Level of Care**

Unfortunately, diabetic patient care typically falls well short of recommended standards. In a California HMO diabetic population, for instance, A1C levels were measured at least annually in only 44% of patients. And only 39% of patients with an A1C level of at least 10% were found to have annual measurements. Foot exams could be documented for only 6% of the patients, urine protein measurements to assess renal function for 48% of the patients, and referral to an ophthalmologist for only 22% of the patients. Moreover, an examination of the therapy used to treat patients with diabetes shows that only 14% of those with type 1 diabetes were receiving intensive insulin therapy (at least 3 injections daily), which published studies suggest is the most beneficial approach. Additionally, self-monitoring of blood glucose levels was performed once daily by only 40% of the type 1 and 26% of the type 2 diabetes patients. Patients with type 1 diabetes should self-monitor their blood glucose levels at least 3 or 4 times daily.

The current level of care for many patients with diabetes seemingly remains less than optimal, as does the patients’ knowledge about their disease. For example, only 43% of the patients with type 1 diabetes and 15% with type 2 diabetes had any knowledge whatsoever of the A1C test.

**Importance of Intensive Therapy**

The Diabetes Control and Complication Trial (DCCT) included 1,441 patients with type 1 diabetes who were followed for an average of 6.5 years. Intensive insulin therapy—at least 3 insulin injections daily or the use of an insulin pump—improved glycemic control and reduced the risk for microvascular complications, when compared with conventional therapy, defined as...
1 or 2 insulin injections daily.\textsuperscript{11} A principal goal of intensive therapy in this study was to reduce A1C levels to normal (6.5% to 7%) from close to 9% at baseline. After 6.5 years, A1C levels dropped to 7.2% in the intensive-therapy group but remained near 9% in the conventional-therapy group. Although the patients in the intensive-therapy group did not achieve the goal reduction in A1C, they did experience meaningful reductions (50% to 75%) in microvascular complications—retinopathy, neuropathy, and nephropathy—when compared with the conventional-therapy group. Macrovascular complications were also reduced (41%), but the reduction was not statistically significant. Thus, this study did not resolve the issue of whether glucose control reduces macrovascular complications in patients with type 1 diabetes.\textsuperscript{14} This landmark study compared the effects of intensive (sulfonylurea or insulin; goal FPG <6 mmol/L or 108 mg/dL) and conventional (diet alone initially; goal FPG <15 mmol/L or 270 mg/dL), therapy in these patients over a 10-year period. At the end of the study, A1C levels were 7% and 7.9% for the intensive- and conventional-therapy groups, respectively. A key finding from this study was that in the intensive-therapy group, all of the individual treatments permitted—insulin, sulfonylurea, and glyburide—were equally effective in terms of controlling blood sugar levels. It also became apparent during the study that patients with type 2 diabetes required additional therapy over time, with fewer and fewer able to rely on diet modifications alone (Figure 2). Indeed, by the ninth year, insulin was the principal treatment for most patients with type 2 diabetes.

The increased reliance on insulin over time likely resulted from the progressive decline in functioning beta cells observed in this study (Figure 3).

The progressive nature of type 2 diabetes was further underscored by findings that showed 50% of the patients required more than one medication after 3 years and 75% after 9 years. Again, intensive therapy decreased the risk for microvascular complications: for every 1% decrease in A1C level, microvascular complications decreased by 35%. However, as in the DCCT, intensive therapy did not significantly reduce macrovascular complications. The results of this study also suggest that introducing insulin therapy earlier in patients with type 2 diabetes may be an effective strategy for achieving more optimal A1C levels more quickly than could be achieved with alternative therapies. However, the insulin replacement strategy chosen can influence whether patients with diabetes will initiate, maintain, and accurately deliver insulin therapy when needed.

**Insulin Replacement Strategies**

The goal of insulin replacement therapy is to identify a regimen that mimics, as closely as possible, the insulin levels produced by a normally functioning pancreas. The pancreas normally secretes basal amounts of insulin—about one half to one unit per hour. The basal insulin suppresses hepatic glucose production. Prandially, the pancreas releases a quick burst of insulin. Rapid-acting insulins, such as Novolog and Humalog mimic the quick burst of insulin required at mealtime. This can be achieved by intensive insulin therapy (e.g., 3 or more injections daily or through the use of an insulin pump). Alternatively, a person can mix a shorter-acting insulin with a longer-acting-insulin themselves; while this can provide dosing flexibility, it also can lead to dosing errors due to improper mixing. Other newer insulins include mixtures of rapidly acting and longer-acting insulins, such as the Humalog Mix 75/25 and the Novolog Mix 70/30 (Table 2). The new long-acting insulin used to provide basal insulin is insulin glargine (Lantus).

What are the current insulin replacement strategies used in clinical practice? In the United States, the most common method for insulin delivery is still subcutaneous administration with a dis-
misadventures in insulin therapy: are your members at risk?

physiologic and practical issues (table 3).

the barriers to optimal insulin therapy can be divided into physiologic and practical issues when using self-mix preparations was examined in a clinical setting. when using either a 30-u or 100-u syringe, the error rates were unacceptably high for both patients and health care professionals who asked to draw and mix 2 insulin products, nph and regular insulin. more than a 20% error in drawing up an insulin dose occurred in about 70% of patients and health care professionals at low doses (<5 u). as the dose increased, the error rate decreased steadily for both patients and health care professionals. the errors principally involved mistakes in ratio rather than volume and were independent of patients’ age, duration of diabetes, experience in mixing insulin, or the size of the syringe. however, for patients and health care professionals, significantly greater accuracy was achieved when using a premixed insulin, such as novolin 70/30. these findings suggest that the use of self-mix insulins may be an important source of insulin injection error, especially at low doses.

the predominant insulin delivery method in europe is the insulin pen, which is now used by an estimated 400,000 to 500,000 patients with diabetes in the united states, accounting for only 8% of the insulin delivered. insulin pens are available in 2 types: prefilled and reusable. prefilled pens are discarded after the insulin is depleted, while the reusable pens contain a replaceable cartridge. prefilled insulin pens have been available in the united states since 1993 and include human insulin (novolin, humulin), insulin lispro (humalog), and insulin aspart (novolog) devices.

for some patients, reusable pens permit greater dosing flexibility when changing the types of insulin injected. although quite portable, accurate, and easy to use, some insulin pens do require mounting separate needles before each injection and needle removal after each injection. additionally, insulin cannot be mixed in pens, resulting in the need for multiple injections for some patients. further, some insulin preparations—lente and ultralente—are not yet available in pen form. innolet, a new prefilled (novolin-r or novolin 70/30) insulin delivery device recently approved in the united states, has taken the insulin-device concept a step farther. this insulin doser has been tailored to address functional limitations such as poor vision and osteoarthritis that often accompany diabetes; it also simplifies the insulin administration process. the design features of this easy-to-handle device include a clock-like dial with a large dose-selector scale and audible clicks when selecting a specific dose. before choosing any insulin delivery system, the answers to the following questions should be considered. will the device enhance patient compliance? will it ease insulin administration? will it increase an individual patient’s confidence and comfort level?

barriers to optimal insulin therapy

the barriers to optimal insulin therapy can be divided into physiologic and practical issues (table 3).

physiologic barriers

important physiologic barriers to insulin therapy include patient resistance—basically, patients often have an enduring fear of injecting insulin. psychologically, patients with type 2 diabetes (who previously did not need insulin) may believe that if they take insulin injections, their condition must be quite serious, contributing to the anxiety associated with this disorder. patient education may alleviate some fears, if the patient understands that insulin therapy may be required due to the natural progression of type 2 diabetes. patients also may be concerned about the need to mix insulins, sometimes a daunting process, especially for the elderly. further, clinicians are sometimes reluctant to encourage their patients to begin insulin therapy because of the resources needed to initiate and monitor therapy; some clinicians also may be unfamiliar with insulin. nonetheless, it remains critical for clinicians to recognize when their patients require insulin therapy and to strongly advocate its use when deemed medically necessary to achieve glycemic control.

unfortunately, a few clinicians may use insulin therapy as a
Choice of an Insulin Delivery Device: Practical Considerations

Several practical issues must be considered when choosing an insulin delivery device for an individual patient. For some patients, the vial and syringe approach still may be the most appropriate. For instance, syringes may be better suited for delivering half-unit insulin doses, a requirement in some pediatric patients or patients counting carbohydrates. Currently, only one insulin pen, the NovoPen Junior, delivers doses in 1/2-unit increments. In addition, the vial and syringe is usually the only device covered by insurance, a compelling reason for patients and hospitals to select this form of delivery. Further, some patients who have a history of using the vial and syringe have become comfortable with this technique and are, thus, reluctant to change. Other patients find the vial and syringe attractive because they can mix 2 different insulins (eg., regular and ultralente) into 1 syringe, permitting a single injection instead of 2.

Insulin pens, on the other hand, may be ideally suited for patients with dexterity and vision problems, especially the elderly who may be unable to manipulate the syringe and vial or read the gradations on the syringe. The insulin pens are less complex than the vial and syringe, so patients may adapt more easily when starting insulin. In addition, because of their ease of use, the insulin pens should also promote patient compliance and reduce medication errors for many, if not most, patients with diabetes.

Patients’ attitudes toward pen devices were evaluated in 2 multicenter surveys that included 1,310 adult insulin users.22 In these surveys, patients expressed a positive attitude about pen devices, with 77% finding it easier to administer their insulin regimen using a pen versus a syringe. Importantly, compliance was enhanced with the use of a pen device: 85% of the pen users never missed an injection versus 72% of the syringe users. Further, 90% of the patients using the insulin pen reported no injection site pain versus 50% of those using a syringe.

In an open-label study designed to evaluate the patient acceptability of the Humulin/Humalog Pen, 299 patients with either type 1 or type 2 diabetes used the Humulin/Humalog Pen for 6 weeks, then completed a questionnaire examining their satisfaction with treatment.21 The results revealed that 78% of the patients were somewhat or extremely satisfied with the pen and would probably or definitely continue with this form of treatment. Additionally, 88% of the physicians felt it took less time to teach patients to use the pen, and 73% felt it took less time to initiate insulin therapy, compared with the vial and syringe delivery. These findings indicate that insulin pen devices typically are well accepted by patients and physicians.

The accuracy and patient acceptability of the new InnoLet device versus the Humulin pen and conventional syringe were examined in a randomized, multicenter, open-label study that included 86 insulin-naïve patients, average age 68 years, with insulin-dependent type 2 diabetes.22 Visual acuity ranged from 20/40 to 20/200 (corrected) and about 25% (22 of 86) of the patients were considered severely visually impaired. The proportion of patients able to read 4 randomly selected insulin doses was significantly greater with the InnoLet device (92%) than with the Humulin pen (45%) or syringe (61%). Additionally, the proportion of patients who were able to set and dispense 3 randomly selected doses after reading the manufacturer’s instructions was significantly greater with the InnoLet device (80%) than either the Humulin pen (61%) or the syringe (27%). Similarly, after 5 minutes of verbal instruction, a significantly greater proportion of patients were able to set and dispense 3 randomly chosen doses when using the InnoLet device (98.8%) versus the Humulin pen (84.9%) or the syringe (53.5%). In fact, most patients (87%) expressed a strong preference for the InnoLet system, while only 13% expressed a preference for the Humulin pen; no patients preferred the syringe. Moreover, at least 70% of the patients considered the InnoLet device easiest to hold and operate.

These results suggest that the design of the InnoLet insulin delivery system may enhance the quality of insulin delivery by improving dosing accuracy and patient acceptability, especially in patients with poor vision. The choice of an insulin delivery system should be based on the needs and limitations of the individual patient and whether the system selected will be a step forward in achieving optimal glycemic control, a goal that often requires intensive insulin therapy.

Strategies for Preventing Medication Misadventures

The choice of a delivery system is not the only source of medication errors in diabetes treatment. Indeed, the nature of medication errors in insulin therapy is typically multifactorial. Many factors, both active and latent, must be present simultaneously for medication errors to occur. Active factors involve actual dispensing and administration of the medication. By contrast, latent factors encompass educational and staffing issues, look-alike products and drug names, and inappropriate drug information. In fact, medication errors are a property of the drug delivery system as a
whole rather than the individual acts or omissions of a single patient or pharmacist. Thus, performance improvements that would reduce medication errors necessitate changing the system, not the people involved.

Unfortunately, the individuals involved—pharmacists and patients, for instance—are set for failure, and this situation is usually unrecognized. Some are quick to say, “Why don’t we get rid of the pharmacist who makes a mistake? He’s a problem pharmacist!” However, this step often could be counterproductive since it would not necessarily reduce medication errors; and many good pharmacists, nurses, and patients make mistakes. The dissemination of information about the fundamental causes of medication errors is essential to improving performance and accurately reducing errors among managed care pharmacists and patients, and this can be accomplished only by evaluating the components of the drug delivery system.

The components that have the greatest relevance for high-alert medications, or medications that can cause the greatest harm if misused, such as insulin, include drug information, communication, drug labeling, and packaging nomenclature as well as staff and patient education.

### Drug Information

Too often, pharmacists and other health care professionals do not have access to the most up-to-date drug information. In fact, it is not uncommon for pharmacists and clinicians to use a Physician’s Desk Reference that is out of date. This may not seem critical to accurate dosing, but drug information is frequently updated to correct errors as well as to add new products. For instance, Mosby’s Nursing Drug Reference recently corrected a potentially serious mistake: the pharmacokinetic properties of Novolog and Lantus insulins were switched. In addition, computer systems designed to detect unsafe orders often are not up to the task. These systems, although helpful in detecting some prescription irregularities, cannot decipher sliding scale insulin orders that may lead to dispensing doses much higher than actually prescribed.

Additionally, the formulary process should provide managed care pharmacies with the opportunity to proactively address medication errors. A benefit of a managed care pharmacy is the use of a formulary system, which, by its very nature, reduces the chances for medication errors by limiting the number of drugs per indication. Formulary inclusions are usually cost driven, but the potential for medication errors with a new product is often ignored.

When adding a new drug to a formulary, those involved should ask what could go wrong with the medication. The issues of error-prone packaging and labeling should be considered at the time of formulary inclusion so that proactive steps can be taken to reduce the risk for medication errors. For instance, in the retail pharmacy refrigerator, insulin products such as Humulin-N, Humulin-R, Humulin-L, Humulin-U, and Novolin-N and Novolin-R are often grouped together, increasing the risk of selecting the incorrect insulin product.

Ambiguous or difficult-to-read labels, sound-alike product names, dosing confusion, narrow therapeutic index, special drug administration, or patient monitoring are all characteristics of a new drug that should be examined before formulary inclusion for their potential to cause medication errors. Unfortunately, such information is often overlooked. The key point is, if a new medication displays characteristics that increase the risk for medication errors, these features should not be used as a sole basis for rejecting formulary inclusion. Rather, pharmacists should be notified and educated about the risk of medication errors with new medications added to the managed care pharmacy’s formulary.

### Communication of Drug Information

Communication of drug information describes the process of how the drug order is transmitted from the prescriber to the pharmacist. Several barriers lead to ineffective prescriber-pharmacist communication. Among these are illegible handwriting, dangerous abbreviations and dose designations, look- and sound-alike drug names, sliding-scale orders, ambiguous orders, and fax-related
problems. For instance, illegible prescriptions can easily lead to error and misinterpretation on the part of the nurse (Figure 4) and pharmacist (Figure 5).24,25

Other examples of errors that can occur with the communication of insulin orders include confusion between orders for Lente and Lantus insulin, and an order for “Human Log” changed to Humulin-L, as well as the letter “U” for units misread as a “0,” resulting in a tenfold overdose. There are other error-prone abbreviations as well, including qid, qd, and not using leading or trailing Os. From a managed care perspective, promoting the use of standardized drug ordering can overcome some of these barriers. For example, mailers can be sent to physicians and pharmacists to educate them about the abbreviations that can lead to incorrect dosing. Eliminating the use of verbal prescription orders and non-standard symbols, such as slash marks that can be read as a number, also can reduce the likelihood for misinterpretation and error.

Drug Labeling, Packaging, and Nomenclature
Whether in the hospital, nursing home, or at home, unlabeled insulin syringes can be an important source of medication errors. For instance, patients at home may be taking different insulin formulations, such as Humulin-N and Humulin-R and Novolin-N and Novolin-R. If the visiting nurse draws a week's supply of syringes for the patient without labeling each syringe, the patient can easily confuse the insulin types. Ambiguous labeling and the packaging of drugs with similar names can also result in choosing the incorrect drug type. For instance, in the hectic clinical environment, it is quite easy to confuse Humulin-R and Humulin-N because of their similar labels. Also, elderly diabetic patients may not have the visual acuity to discern these subtle differences in insulin labeling.

Patient and pharmacist education that provides recommendations for safely separating drugs with potentially confusing labels and names is one strategy managed care organizations can implement to reduce medication errors. For example, drugs with similar packaging or names can be stored separately. Upper-case lettering can be used on the computer screen displays for the dis-similar portion of the confusing drug name—HumALOG versus HumULIN, for instance. The use of colorful stickers also may be helpful in distinguishing insulin products with similar labels. The key point is to take the time necessary to separate and distinguish potentially confusing products. From a managed care perspective, implementing drug utilization review alerts for drugs at high risk for error can warn pharmacists about potential problems. For instance, when a Humulin-R prescription is filled, a computerized warning would appear advising the pharmacist to check carefully since this product is often confused with Humulin-N. Further, the pharmacist should routinely review medications that have a history of medication errors (eg., Lantus and Lente).

Staff and Patient Education
The best way to educate clinical staff and patients about medication errors is to learn from past mistakes. Information about the nature of medication errors should be shared with others involved in the drug delivery process. Merely knowing the number of errors that occur each month provides little useful information for avoiding those errors in the future. It is critical to establish the root causes of medication errors. An important part of any managed care education process aimed at reducing medication errors by clinicians and pharmacists is to provide information on new drugs, devices, and insulin monitors that enter the market, emphasizing any feature that may lead to medication errors.

Patient education about their drug treatment remains indispensable to the success of any program to reduce medication errors. Yet, such patient education is often inadequate for several reasons, including the virtual absence of pharmacist involvement in patient education due to the ever-increasing prescription workload and shortage of pharmacists plus failure on the part of clinicians to provide patients with understandable written instructions. Optimally, when a drug is dispensed to the patient, the pharmacist should take the time needed to educate the patient about the dosing requirements, preparation, and administration and to instruct the patient to call with any questions or concerns that arise once therapy is underway. Further, the clinician and pharmacist should educate the patient about the nature of diabetes and the need for chronic treatment to avoid downstream complications. Patients should be informed about the potential for dosing errors in the home, for instance, confusing Humulin-R with Humulin-N. Improving patient education is an essential step in minimizing dosing errors and sustaining compliance with the treatment regimen.

Noncompliance
Noncompliance or nonadherence is a major issue in diabetes therapy and includes not filling the prescription initially, not having the prescription refilled, omitting doses, terminating medication without physician guidance, taking medication incorrectly, or even taking another person's medication. Patients at the highest risk of noncompliance are those taking more than one medication or more than one dose of a drug daily, those with a chronic condition that requires a complex dosing regimen, and those with a condition that is asymptomatic—all of which characterize patients with diabetes. As a group, the elderly run an even higher risk for medication noncompliance. Elderly patients are more likely to experience poor visual acuity, mental confusion, poor coordination, and an absence of family or caregiver support, factors that can contribute to noncompliance and dosing errors.26-27

An often-overlooked impediment to compliance is illiteracy: 40% of the patients with chronic illness are functionally illiterate.28 Before handing patients a 50-page booklet on diabetes management, for example, it is important to ensure that patients have the reading skills to understand the educational information given to them. In the case of illiteracy, a video may provide an alternative educational route. Further, 23% of the population has less than a 5th-grade education, yet 75% of the drug information provided to patients is written at the 10th-grade level. These educational bar-
riers require that clinicians and pharmacists identify the patients who need extra attention, beyond just mailings and stapling a leaflet to the prescription bag, so that they understand their medications and dosing requirements. This extra educational effort should improve compliance and reduce medication errors for many patients. An informed patient is one of the best safeguards against medication errors.

### Conclusions

The management of diabetes remains suboptimal. For many patients with diabetes, intensive therapy is required to achieve the more rigorous goals for glycemic control established by the American Diabetes Association and other organizations to reduce the risks for the serious end-organ complications secondary to this disease. Achieving these goals will remain a daunting task for many patients. Insulin therapy is often delayed, and, because of systemic problems in the entire drug delivery process, including confusing drug labeling, unclear physician orders, and insulin self-administration errors, patients with diabetes often receive suboptimal or incorrect insulin treatment.

Reducing errors and maximizing the benefits of insulin therapy will require a concerted effort involving the prescribing clinician, the managed care pharmacist, and the patient. Key steps must include not only education about the sources of potential medication errors but also strategies for avoiding those errors in the future. Further, the choice of an appropriate insulin delivery system can be an important step in reducing medication errors. The choice of a delivery system should be based on the individual patient’s needs, as well as whether the delivery system will promote patient compliance. For many patients, especially those with a new diagnosis of type 1 diabetes and the elderly with type 2 diabetes, the commonly used vial-and-syringe approach to insulin delivery can be cumbersome and complex, undermining dosing accuracy and, therefore, glucose control. Alternative insulin delivery methods, such as the Novolin 70/30, insulin lispro (Humalog), and human insulin (Humulin) insulin pen devices and the Innolet system, should be considered for patients at risk for poor compliance or dosing errors.

### REFERENCES

1. Roper Starch Worldwide, 2000 [survey].
Date: __________________________

In order to receive CE credit for this program, you must complete this form and the Program Evaluation form in addition to completing the posttest with a score of at least 75% (forms may be photocopied). Please mail all materials to The University of Texas at Austin Pharmacy Continuing Education, 1 University Station A1904, Austin, TX 78712-0123. If you have any questions about the program, please call (512) 471-4512. To receive credit, these forms must reach the University of Texas College of Pharmacy by February 1, 2005. CE certificates will be mailed to your address (below) 6-8 weeks after receipt of the Record of Attendance/Posttest/Program Evaluation forms and the posttest is graded and successful completion is determined.

Prior to July 1, 2004, there will be no cost to pharmacists to receive CE credit for successful completion of the CE offering. After July 1, 2004, a check in the amount of $15 made payable to the University of Texas will need to be included with the Record of Completion/Posttest/Program Evaluation forms for CE statement processing.

This continuing education program is made available through an educational grant from Novo Nordisk Pharmaceuticals.

All information will be kept confidential; it is used only for the processing and mailing of your CE statement. You must complete and sign this form in order to receive CE credit for completing this program.

☐ I verify that I have completed the program and posttest for “Misadventures in Insulin Therapy: Are Your Members at Risk?”

Signature: ____________________________________________

Please print your name as you would like it to appear on the CE certificate:

Last name: __________________________ First name: __________________________

Company: __________________________ State & License No: __________________________

State: __________________________ License No: __________________________

Address: __________________________________________

City: __________________________ State: __________________________ ZIP: __________________________

Daytime phone: __________________________ Social security #: __________________________

Fax number: __________________________ E-mail: __________________________

Member Type:                  ☐ Active ☐ Supporting Associate ☐ Student ☐ Nonmember

Posttest Answers:

1. A B C D E
2. A B C D
3. A B C
4. A B C D E
5. A B C D
6. A B
7. A B
8. A B C
9. A B C D E
10. A B C D E
11. A B
12. A B
13. A B C D E
14. A B C D E
15. A B C D E
16. A B C D E
17. A B C D E
18. A B C D E
19. A B C D
20. A B C D E

The University of Texas College of Pharmacy is approved by the American Council on Pharmaceutical Education (ACPE) as a provider of continuing pharmaceutical education. A total of .15 CEUs (1.5 contact hours) will be awarded to pharmacists for successful completion of this continuing education program. Successful completion is defined as receiving a minimum score of 75% on the posttest and completion of the program evaluation form. Continuing education statements will be mailed to pharmacists within 6-8 weeks of receipt of the Record of Attendance/Posttest/Program Evaluation.

Universal Program No. 067-999-03-016-H01 (Expiration date: 3/1/05).
1. Diabetes mellitus is a serious growing health problem that afflicts almost ____% of the U.S. population.  
   A. 2  
   B. 4  
   C. 6  
   D. 8

2. In the United States, the direct and indirect costs of diabetes now approach $______yearly.  
   A. 50 million  
   B. 100 million  
   C. 50 billion  
   D. 100 billion

3. Medication errors associated with insulin therapy are a result of multiple breakdowns that occur in the medication use process or system.  
   A. True  
   B. False

4. Insulin medication errors  
   A. jeopardize optimal blood sugar control  
   B. increase hospitalizations and office visits  
   C. undermine the patient's confidence in their health plan  
   D. all of the above

5. The 2002 American Diabetes Association goals recommend a target glycosylated hemoglobin A1C of  
   A. <4 %  
   B. <7 %  
   C. >8 %

6. A1C reductions have been correlated with reductions in microvascular complications.  
   A. True  
   B. False

7. It is important to examine diabetes therapies to determine whether these therapies are user friendly and promote compliance.  
   A. True  
   B. False

8. Insulin delivery via subcutaneous administration with a disposable syringe, the most common method in the United States, can be complex and fraught with dosing errors.  
   A. True  
   B. False

9. Insulin dosers tailored to address functional limitations such as poor eyesight and manual dexterity can  
   A. simplify the insulin administration process  
   B. reduce dosing errors  
   C. enhance patient compliance  
   D. A and B  
   E. all of the above

10. Significant practical barriers to insulin therapy include patient  
    A. fear of injecting insulin  
    B. anxiety associated with diabetes  
    C. regimen complexity  
    D. all of the above

11. By obviating the need to draw the dose from the vial, insulin devices can ____patient variability and ____dosing accuracy.  
    A. increase, minimize  
    B. reduce, increase

12. Medication errors in insulin therapy are not typically multifactorial in nature.  
    A. True  
    B. False

13. If medication errors are a property of the drug delivery system as a whole rather than individual acts or omissions of a single patient or pharmacist, then performance improvements that would reduce medication errors necessitate changing the system, not the people involved.  
    A. True  
    B. False
14. The dissemination of information about the fundamental causes of medication errors is essential for improving performance and accurately reducing errors among managed care pharmacists and patients.
   A. True
   B. False

15. The components that have greatest relevance for high-alert medications such as insulin include
   A. drug information
   B. drug labeling and packaging nomenclature
   C. staff and patient education
   D. B and C
   E. all of the above

16. Formulary inclusions
   A. are not usually cost driven
   B. may ignore the potential for medication errors with a new product
   C. should consider error-prone packaging and labeling
   D. B and C
   E. all of the above

17. Before formulary inclusion, characteristics of a new drug that should be examined for its potential to cause medication errors include
   A. difficult-to-read labels
   B. sound-alike product names
   C. special drug administration
   D. all of the above

18. Barriers leading to ineffective doctor-pharmacist communication include
   A. abbreviations and dose designations
   B. legible handwriting
   C. sliding-scale orders
   D. A and C
   E. all of the above

19. Insulin drug packaging can play an important role in increasing the risks for insulin medication errors.
   A. True
   B. False

20. Establishing drug utilization review alerts for drugs at high-risk for error can alert pharmacists to potential problems.
   A. True
   B. False
PROGRAM EVALUATION

Misadventures in Insulin Therapy: Are Your Members At Risk?

Participant’s name: ___________________________ Date: _______________________

Your assistance in the evaluation process is greatly appreciated. Please return this form with the posttest answers.

Scale For Questions 1–6

1 = Not at all
2 = Not very well
3 = Somewhat well
4 = Well
5 = Very well

Scale For Questions 7 and 8

1 = Poor
2 = Fair
3 = Good
4 = Very good
5 = Excellent

Using the scale above for questions 1-6, please rate how well you will be able to accomplish the following objectives based upon successful completion of the program.

Objectives:

1. Assess the prevalence and impact of diabetes on managed care

2. Describe the challenges associated with current insulin therapy including safety, dosing, health cost expenditures and patient outcomes

3. Recall common medication errors associated with insulin therapy

4. Illustrate the importance of reducing errors and preventing complications associated with diabetes through improved patient compliance, improved self-management and simplified treatment regimen

5. Describe strategies for preventing medical misadventures and improving insulin therapy for the effective pharmacologic management of diabetes

6. Cite the opportunity for managed care pharmacy to positively impact achieving therapeutic goals, improving outcomes in diabetic patients and reducing total health care expenditures through the implementation of system and patient oriented interventions

Using the scale above for questions 7 and 8, please indicate the number that best expresses your opinion.

7. What is your overall rating of this program? __________

8. How would you rate the pertinence of this program material to your practice? __________

9. To what degree was there promotional bias (check one):
   a. Not at all __________
   b. Somewhat __________
   c. A great deal __________

10. To what degree do you anticipate changes in patient care as a result of the material presented? (circle one)

   No change
   1 2 3 4 5
   Significant change

11. Please indicate the length of time it took to complete this program: (circle selection)

   Hours: 1 2 3
   Minutes: 0 15 30 45

12. Please rate the difficulty factor for completing this CE program: (circle selection)

   Easy     Moderate     Difficult

13. Please rate your willingness to recommend this program to colleagues: (circle selection)

   Very willing     Willing     Not willing

14. Please indicate which venue you prefer for obtaining continuing education: (circle selection)

   Written monograph     Slides     Videos     Internet-based

   Live sessions     Other:_________________________

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