



Falsely elevated glucose readings from maltose-containing drugs

Nurses often use point-of-care (POC) blood glucose meters to assess patients' blood glucose levels at the bedside. Unfortunately, a number of cases have been reported in which falsely elevated blood glucose levels resulted in inappropriate insulin administration and subsequent hypoglycemia, coma, persistent vegetative state, and even death. The falsely elevated readings were caused by a drug-device interaction in patients receiving medications that contain maltose or metabolize into maltose. Examples of these products can be found in Table 1.

Extraneal and IVIG are two of the medications that can cause falsely elevated glucose readings.

Some POC blood glucose meters utilize test strips with glucose dehydrogenase pyrroloquinolinequinone (GDH-PQQ) or glucose-dye-oxidoreductase (GDO), which cannot distinguish between glucose, maltose, and other sugars. Glucose meters that use these types of test strips include Accu-Chek (Roche), FreeStyle (Abbott), and Ascensia (Bayer).** The maltose in the blood causes falsely elevated glucose read-

ings in meters using GDH-PQQ- or GDO-containing test strips. When the falsely elevated readings are used to guide insulin administration, inappropriate dosing can lead to hypoglycemia.

The US Food and Drug Administration (FDA) has identified 18 cases of hypoglycemic adverse events associated with **EXTRANEAL** (icodextrin), a peritoneal dialysis solution that is often delivered directly to dialysis units instead of being dispensed from the pharmacy. In seven of these cases, healthcare providers used glucose meters that relied on GDH-PQQ- or GDO-containing test strips. In some of the cases involving serious outcomes, staff had been informed by patients or the patients' families about the drug-device interaction, but staff still relied on erroneous blood glucose readings to treat these patients with insulin.

One of the most recent cases involved a 62-year-old dialysis patient who had been receiving Extraneal as an outpatient before hospital admission. Over the next few days, the patient's blood

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Table 1. Products that may cause a drug-device interaction with certain glucose meters and test strips.

Drug	Indication
EXTRANEAL (icodextran)	Peritoneal dialysis
GAMIMUNE N 5% and OCTAGAM (immune globulin intravenous, human)	Immunodeficiency
ORENCIA (abatacept)	Rheumatoid arthritis
WINRHOD SDF LIQUID [Rh ₀ (D) immune globulin intravenous (human)]	Idiopathic Thrombocytopenia Purpura (ITP) and Rh transfusion reaction
D-XYLOSE (d-xylose absorption test, blood and urine)	Test for malabsorption
HEPAGAM B [hepatitis B immune globulin (human)]	Acute exposure to HBSAG or HBV
ADEPT ADHESION REDUCTION SOLUTION (icodextran)	Reduce post surgical laparoscopic adhesions in gynecologic surgery

Source: Managing potential drug interference in point-of-care blood glucose testing. Roche 2007.

check it out! ✓✓✓✓

Follow these steps to reduce the risk of false glucose meter readings in patients receiving medications that contain maltose or metabolize into maltose.

✓ **Check your meters and test strips.** Determine whether the POC blood glucose meters in your facility use test strips with GDH-PQQ or GDO reagents that may cause false readings. (Other glucose meters that rely on glucose oxidase, glucose hexokinase, glucose dehydrogenase, nicotine adenine dinucleotide [GDH-NAD], or flavin adenine dinucleotide glucose dehydrogenase [FAD-GDH] are accurate even in the presence of interfering products.)

If you use maltose-sensitive glucose meters and test strips in your facility:

✓ **Treat the patient, not the glucose reading.** Verify directly with patients that they are not exhibiting any symptoms of hypoglycemia before administering any dose of insulin instead of relying on the glucose meter reading alone. If in question, the POC results should be validated with a serum laboratory test.

✓ **Label glucose meters.** Label meters and test strips with warnings regarding the drug-device interaction and the need for alternative glucose monitoring in patients at risk.

✓ **Increase awareness.** Educate all staff about the risk of falsely elevated glucose readings in patients receiving maltose-containing medications.

✓ **Flag at-risk patients.** While obtaining a medication history, identify patients who might be at-risk for this drug-device interaction and communicate this to the rest of the healthcare team. These include diabetic patients who are immunocompromised or on dialysis.

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glucose was monitored using an Accu-Chek Inform system and GDH-PQQ-containing test strips. Staff recorded three elevated glucose readings, which were treated with insulin despite laboratory values that were markedly lower than the meter readings. By the end of the week, the patient died from “severe hypoxia due to untreated hypoglycemia.”

Intravenous immunoglobulin (IVIG) is another drug that has been linked to serious drug-device interactions. In one case, an elderly immunocompromised patient with sepsis was treated with OCTAGAM (immune globulin intravenous [human]), which contains maltose (100 mg/mL). Glucose meters and the maltose-sensitive test strips were used to monitor his glucose levels. Since the patient’s blood glucose readings were elevated, he was started on an insulin infusion. The patient experienced symptoms of severe hypoglycemia, which was confirmed by a laboratory blood glucose level of 12 mg/dL. The patient developed irreversible neurological damage, although

this outcome could not be definitely linked to severe hypoglycemia.

Many practitioners remain unaware of this significant interaction, particularly those who do not routinely care for patients receiving peritoneal dialysis solutions containing icodextrin, maltose-containing immunoglobulin therapy, D-xylose for evaluation of malabsorption syndromes, and other products containing maltose. See **checkitout!** for ways to reduce the risk of false glucose meter readings in patients taking these medications.

**** The list of products is not all inclusive.** Various manufacturers, including Abbott, Bayer, Roche, CH Diagnostics, and Home Diagnostics, have glucose strips that use GDH-PQQ. Some of the manufacturers have multiple approved test strips that use this technology, so the product-line names are not all inclusive. In some cases, product lines include test strips that use more than one type of enzyme methodology. For example, some Accu-Chek strips use GDH-PQQ and some use an enzyme that is not reactive to maltose interference. In addition, manufacturers can market devices under additional brand names (e.g., some major companies also make devices sold under distributor names) without obtaining FDA clearance, so it would be impossible to create a comprehensive, up-to-date list of all devices that use GDH-PQQ methodology.

QuarterWatch™: A new ISMP drug monitoring program

Earlier this year, ISMP started a pilot program to identify new drug risks and medication errors reported to the US Food and Drug Administration (FDA). Called **QuarterWatch**, the program analyzes and classifies reports submitted to FDA to look for repeated signals of safety problems with specific medications or classes of medications. In its first quar-



terly report, published in May 2008 (www.ismp.org/docs/vareniclineStudy.asp), ISMP identified multiple safety problems with the smoking cessation drug varenicline (**CHANTIX, CHAMPIX**), many of which are not included in product's prescribing information. Chantix is suspected of causing a spectrum of injuries, including serious accidents and falls, potentially lethal cardiac rhythm disturbances, severe skin reactions, seizures, diabetes, myocardial infarction, psy-

chosis, aggression, and suicide. This prompted the federal government to ban airline pilots and military missile crews from using varenicline. Now for the second straight quarter, varenicline remains the most frequent drug involved in reported adverse drug events.

With 1,001 new cases of serious injuries reported with varenicline, including 50 deaths, additional action is needed to make practitioners and consumers aware of the risks associated with this drug, particularly the risk of accidents due to sudden loss of consciousness. We recommend that FDA and the manufacturer add a prominent warning about accident risks to the patient Medication Guide and prescribing information. This warning should be similar to

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checkitout! continued from page 1

(The drug-device interaction can occur up to a week or more after receiving medications that contain maltose or metabolize to maltose.) In this case use an alternative glucose testing method.


✓ **Establish warnings.** Ask pharmacy to set up a special alert in the computer for maltose-containing medications so they can affix an alert sticker to these products. Add a cautionary note to the medication administration record and diabetic flow sheets. Place an alert sticker on the patient’s chart.

✓ **Develop protocols.** Include the risk of false glucose determinations, the specific circumstances surrounding this risk, and the need for laboratory glucose monitoring, in insulin administration protocols and order sets.

✓ **Be prepared for errors.** Establish guidelines for early recognition and treatment of a drug-device interaction or error (e.g., discrepancies between laboratory and glucose meter readings, symptoms of hypoglycemia or hyperglycemia). Conduct periodic reconciliation of laboratory and glucose meter readings whenever an insulin infusion is running, and take steps to verify a suspicious glucose reading.

✓ **Educate patients.** Let patients know why the glucose meter or certain test strips cannot be used for testing their glucose levels. Tell patients to alert any staff who may attempt to use a glucose meter during the course of their treatment with involved maltose-containing products.

to the point

 **Vision without action is a dream. Action without vision is simply passing the time. Action with vision is making a positive difference.**

---Joel Barker

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the drug's new warnings required by FDA regarding psychiatric side effects. Prescribers need to discuss these risks with their patients, and consider alternative treatments when appropriate.

Our second **QuarterWatch** report revealed other drugs associated with serious injuries. Table 1 lists the top 10 drugs in this report. Ranked second this quarter was heparin, the subject of a major product recall after a potentially lethal contaminant was identified and traced to suppliers in China. FDA received 779 reports of serious injuries, including 102 deaths, in which heparin was suspected. However, not all injuries were a result of contamination. Recalls and alerts were issued by Baxter, FDA, and other manufacturers of affected heparin, once the issue was detected and understood. Hospitals should no longer have any affected heparin products in stock.

Another striking change this quarter was that 10 drugs could be linked to 100 or more deaths (see Table 2). In the previous quarter, only three drugs accounted for 100 or more deaths. Many of these medications (e.g.,

oxyCODONE, fentaNYL, ALPRAZolam, methadone) have been the subject of previous safety warnings from FDA and ISMP.

Acetaminophen and ibuprofen, two of the most widely used over-the-counter drugs in the nation, are on this list, too. An overdose of acetaminophen can result in irreversible injury to the liver and death. Ibuprofen, like other nonsteroidal antiinflammatory drugs, carries warnings that sustained use can result in serious gastrointestinal side effects and increase the risk of a myocardial infarction.

QuarterWatch data have some limitations, primarily because of the voluntary nature of reporting adverse drug events. Results should be interpreted with caution. Yet, our analysis has yielded important information healthcare providers and consumers need to know. When used as prescribed, most medications provide much needed benefits. However, this data clearly indicates opportunities for better communication and management of risks associated with medication use.

The full **QuarterWatch** report can be found at: www.ismp.org/QuarterWatch/2008Q1.pdf.

Table 1. Drugs linked to serious injuries Jan-March 2008

Drug Name	Cases	Rank
varenicline	1,001	1
heparin	779	2
fentaNYL	631	3
interferon beta	582	4
inFLIXimab	463	5
etanercept	401	6
clopidogrel	297	7
pregabalin	280	8
acetaminophen	273	9
oxyCODONE	272	10

Table 2. Drugs linked to deaths Jan-March 2008

Drug Name	Cases	Rank
oxyCODONE	185	1
ALPRAZolam	163	2
acetaminophen	160	3
acetaminophen, butalbital, caffeine	156	4
fentaNYL	131	5
morphine	115	6
ibuprofen	114	7
methadone	111	8
acetaminophen, HYDROcodone	111	9
heparin	102	10

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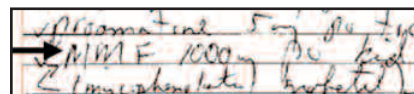
Report medication errors to ISMP at 1-800-FAIL-SAF(E).

did you know...

? **A shortage of pens.** Healthcare professionals can often be seen using pens provided at no cost by pharmaceutical companies, but that will soon change. The Pharmaceutical Research and Manufacturers of America (PhRMA) announced revisions to its voluntary Code on Interactions with Health Professionals. The Code will soon prohibit incentives and the distribution of non-educational items—such as pens and notepads with company logos—for healthcare professionals' use that do not advance disease or treatment education (www.phrma.org/files/PhRMA_20_Marketing_20Code_202008.pdf). The Code goes into effect in January 2009. The change was made to avoid misperceptions that company interactions with healthcare professionals are not based on informing them about medical and scientific issues.

All is not as it seems...

Avoid drug name abbreviations. A 44-year-old man was admitted to a hospital with hypotension. His past medical history included an orthotopic liver transplant 2 years prior, with chronic rejection, possible alcoholic hepatitis, and end-stage, chronic kidney disease. Among other medications, the immunosuppressant mycophenolate mofetil (**CELLCEPT**) was prescribed using an abbreviation, "MMF 1000 mg po BID" (see below).



Order for "MMF" (arrow) mistaken as M-W-F (Monday, Wednesday, Friday).

The physician then decided to write out the name of the drug below this entry. Unfortunately, the pharmacist and nurse misinterpreted the "MMF" as M-W-F, or every Monday, Wednesday, and Friday. Liver transplants were not performed at this hospital, so staff were not familiar with the proper dosing of this drug. The error, which wasn't noticed until the next day, could have led to organ rejection if it had not been recognized early. ANY drug name abbreviations are potentially dangerous and should not be used. In this case, the abbreviation was misunderstood as days of the week; in other cases, they have been misunderstood as a different drug. Drug name abbreviations should be added to your "Do Not Use" list.



Please see pages 4 and 5 for information regarding our Fundraising Campaign ◀



Institute for Safe Medication Practices
A nonprofit agency since 1994

Actively caring for safety: One team, one goal, the power of many We need your help...



Key Accomplishments in 2008

- Granted federal certification as a Patient Safety Organization (PSO)
- Established **Quarter:Watch™**, an adverse drug event monitoring system
- Strengthened the ISMP Medication Safety Fellowship program
- Conducted AHRQ-funded research on high-alert medications in community pharmacies
- Developed a risk assessment model for community pharmacies
- Built a consumer website, consumermedsafety.org
- Established Automated Dispensing Cabinet Guidelines
- Held a vendor-user summit on smart pumps to identify best practices
- Established Label Format Guidelines
- Built a Toolkit for Anticoagulation Safety
- Standardized a list of Look-alike Drug Name Sets with Recommended Tall Man Letters

For more accomplishments, please visit: www.ismp.org/about/merpimpact.asp.

Dear Friends

As we near a close to 2008, ISMP has been busy making plans for 2009 to further our mission to serve the healthcare community as a vital resource for medication safety. If you glance to the right at our **Key Plans for 2009**, you will see that our work will be expanding to reach consumers while maintaining our ever-important focus on you, the providers of healthcare services. Our plans are ambitious, but our dedicated staff are committed to strengthening our ability to help you prevent medication errors.

You Can Make a Difference

In 2009, we plan to roll out our inaugural fundraising campaign. We are starting today with the individuals who know us best: our newsletter readers. You are truly the cornerstone of ISMP, serving as the predominant conduit for time-critical medication safety information that now reaches millions of healthcare professionals. As newsletter readers, you have been on an extraordinary journey with us—many since our first publication in 1996—serving witness to needless tragic errors as well as partnering with us to achieve transformational changes to improve medication safety.

We invite you to make a tax-deductible donation to ISMP to help us achieve our goals in 2009. Your gift, small or large, will further our lifesaving work and enhance our capacity to help you protect your patients from medication errors. We thank you for making an investment in our future. Together we are **Actively caring for safety: One team, one goal, the power of many.**

To Make a Donation

To make a donation, please use the form on the next page or visit: www.ismp.org/about/support.asp.

We thank you for your support!



Building relationships with patients



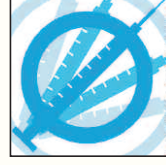
Ensuring safe packaging of products



Educating through publications



Consulting to offer guidance



Learning from error-reporting

Key Plans for 2009

- Launch consumermedsafety.org
- Establish a consumer medication error-reporting program
- Begin a mentorship program for healthcare professionals at ISMP headquarters
- Enhance our position as the nation's early warning system for medication safety
- Increase the reach of medication error-reporting programs
- Launch a distance learning certificate program for medication safety
- Begin a 3-year research project in community pharmacies on patient counseling for high-alert medications and bar-coding technology
- Develop a human factors simulation lab to test error-reduction strategies
- Strengthen our ability to function as a Patient Safety Organization (PSO)
- Conduct a vendor-user summit on bar-coding to identify best practices
- Expand international collaboratives to promote medication safety worldwide

ISMP Inaugural Fundraising Campaign

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We need your help... Please support ISMP by making a charitable donation.

The transformational change necessary to improve patient safety will always depend on actively caring individuals who, never satisfied with being a bystander, selflessly and passionately get drawn in to the lifesaving work of keeping our patients safe from harm.

—**Michael R. Cohen, President, ISMP**

The vision, persistence, dedication, and cooperative spirit that has been shown by ISMP since the early days is an inspiration for all of us working to improve the well-being of patients—its day-to-day work in preventing medication errors has echoed around the world. ISMP has provided a voice in the wilderness, waking us up to the need to enhance medication safety.

—**Don Berwick, President and CEO, Institute for Healthcare Improvement**

It is principally through the efforts of ISMP that we have all gained a rich understanding both of the underlying causes of medication errors and steps that can and should be taken to prevent their occurrence.

—**Dennis O’Leary, former CEO of The Joint Commission (TJC)**

ISMP also has assembled a remarkable multidisciplinary team of experts in patient safety; their team serves as a model of the collaborative practice of nurses and pharmacists for both the clinical and academic worlds.

—**Ginny Pepper, Professor, University of Utah College of Nursing**

For additional testimonials, please visit: www.ismp.org/about/testimonials.asp.

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