Patient weighing, a long-standing practice in healthcare delivery, can contribute to serious and life-threatening medication errors if a patient’s weight is obtained, recorded, or communicated incorrectly. A snapshot look at medication errors reported to ECRI Institute PSO over a one-year period shows that weight-based dosing errors occur among patients of all ages. Yet these events are entirely preventable if organizations adopt a multipronged approach to promote prompt and accurate patient weighing, correct documentation of the weight, and easy accessibility to the patient’s information for those involved in medication management.

To accomplish these goals, organizations must strive for strategies that achieve the following:

- Establish processes for weighing and weight documentation
- Require pharmacy review of weight-based dosing regimens
- Ensure sufficient and convenient availability of appropriate and properly functioning equipment for patient weighing and medication delivery
- Use health information technology and clinical decision support software to promote safe and appropriate dosing
- Standardize where possible (e.g., obtain and document patient weight in metric units, set scales to default to metric)

Weight-Based Dosing Errors
Medication dosing is often calculated on the basis of a patient’s weight, particularly for pediatric patients, who require individualized dose calculations based on their size. Certain drugs given to adults—including some high-alert medications, such as anticoagulants and chemotherapeutic agents—must be administered at doses calculated on the basis of the patient’s weight. Programming an intravenous medication dose and delivery rate for an infusion pump can also be dependent on the patient’s weight. Mistakes can occur if the medication dose is calculated using an inaccurate patient weight. Therefore, healthcare organizations should have policies in place stipulating that a medication order can only be filled if information about the patient’s weight is available and documented in the medical record. Nevertheless, several event reports submitted to ECRI Institute PSO indicate that medication orders are sometimes filled even though information about the patient’s weight is not provided. Additionally, many of the event reports submitted to ECRI Institute PSO indicate that weight-based dosing errors can occur even when information about a patient’s weight is obtained or recorded. Examples of such errors include the following:

- Transposing the numerical value of weight taken in pounds as kilograms, resulting in near-double-dosing errors

Strategies to Prevent Weight-Based Dosing Errors
- Adopt processes to establish the timing and frequency of patient weighing.
- Document patient weight in metric units.
- Except in emergency situations, require pharmacists to ensure patient weight is documented before dispensing medications.
- Require pharmacists to independently double-check certain weight-based dosing calculations (e.g., for pediatric patients, chemotherapy, and high-alert medications).
- Provide a sufficient number of scales, conveniently located in care areas, and other properly functioning equipment to obtain patient weights.
- Ensure that scales measure in metric units or default to metric units.
- Harness the power of computers (e.g., alerts, hard stops) in safe medication dosing.
- Adopt standardized order sets for weight-based doses of certain medications.
- Educate staff about weight-based dosing errors and strategies to prevent them.

Top four medications associated with preventable adverse drug events.
Learn more on page 11.
In adult patients, weight is needed to accurately tailor a drug dose to the person’s weight, age, body surface area, and clinical condition (Levine et al.). Many medications only come in adult formulations or limited pediatric concentrations and, therefore, need to be carefully reformulated for a smaller person. Even small weight discrepancies can be significant in children. Because the therapeutic window for many medications is narrower in young patients than in adults, medication errors can affect pediatric patients more seriously than adults. Consequently, dosing errors, like those caused by inaccurate weight and height information, are among the most commonly reported drug errors in children (Stucky). Further complicating the problem, very young patients cannot communicate to their caregivers if something feels wrong when a drug is given.

Reports of weight-based dosing errors submitted to ECRI Institute PSO show that mistakes in weighing and recording weights also occur in adults. Although not all adult medications are tailored to the person’s weight, some (such as chemotherapeutic agents) require weight-based dosing. Also, certain patient groups—including those who are elderly, are immunocompromised, are extremely obese, or have impaired renal function—may require more careful attention to dosing.

Yet breakdowns are occurring in obtaining the weight of adult patients—even when the information is needed for dosing. One study found that fewer than 30% of patients in a hospital’s orthopedic and medical units were being weighed, even though they were taking medications that required weight-based dosing. Patients who had not been weighed were more likely to have more serious complications than those who had been weighed. (Hilmer et al.)

Reasons for not weighing adult patients include the following:

- Lack of access to weighing devices
- Impaired patient mobility limiting the provider’s ability to obtain a weight measurement
- Hospital admission outside regular hours, when fewer staff are available to weigh the patient
- Admission through the emergency department (ED), where because of the patient’s emergency condition, clinicians may have to estimate the patient’s weight to initiate treatment

Cascade of Effects from Inaccurate Weights

Ensuring that measures are in place to help clinicians and staff obtain accurate patient weights is essential to prevent patient harm. Additionally, these measures can protect the organization from the cascade of effects (e.g., accrediting and regulatory citations, medical malpractice claims, possible damage to the facility’s reputation) that often occur when mistakes happen.

Accrediting organizations and the Centers for Medicare and Medicaid Services (CMS) have established requirements for patient weighing. For example, the Joint Commission’s hospital accreditation standards for medication management stipulate the following (Joint Commission):

- Information about the patient’s weight is accessible to licensed independent practitioners and staff who manage the patient’s medications.
- Circumstances for weight-based dosing in pediatric patients are spelled out in writing.

CMS has similar requirements in its hospital Conditions of Participation, under pharmaceutical services, for facilities caring for Medicare or Medicaid patients (42 CFR § 482.25).

Not only can organizations be cited by accrediting agencies and CMS for failing to follow requirements to ensure medication safety, they could also face legal action if a patient is harmed. A report by the professional liability insurer the Doctors Company (Napa, California) found that
13% of all closed claims for medication errors in 2010 were for wrong-dosage mistakes. The analysis did not specify the reasons for the dosing errors; however, it does illustrate that dosing errors—which can occur as a result of weighing mistakes or other reasons—are among the top reasons for medical malpractice claims for medication errors. Medication errors represented 6.1% of all closed claims. (Troxel)

This issue of the national PSO Navigator summarizes the types of weight-based medication dosing errors voluntarily reported to ECRI Institute PSO’s event reporting program and recommends strategies to ensure patient weights are accurately obtained, documented, and communicated to the necessary staff involved in the patient’s care. Three categories of weight-based dosing errors are summarized in Tables 1, 2, and 3 in this advisory. Prevention strategies are summarized in the discussion Strategies to Prevent Weight-Based Dosing Errors and in Table 4, which appears later in this advisory.

What We Are Seeing

WEIGHT-BASED DOSING ERRORS OVER A ONE-YEAR PERIOD

Medication errors are among the event types most frequently reported to ECRI Institute PSO, representing about 25% of all reported events. ECRI Institute PSO examined events of weight-based dosing errors that were reported to the event reporting system from September 1, 2012, through August 31, 2013, and that indicated the level of harm to the patient. ECRI Institute PSO’s enhanced reporting system uses an index for categorizing errors by nine levels of harm—A through I. This index was originally developed by the National Coordinating Council for Medication Error Reporting and Prevention for reviewing medication errors. The review was limited to those events that resulted in patient harm scores of E (results in temporary harm and requires intervention) through I (contributes to or results in patient’s death).

The reports of weight-based dosing errors submitted to ECRI Institute PSO reflect three general concerns surrounding weight-based dosing errors:

1. Failure to obtain or document an accurate patient weight
2. Mistakes that arise in using the numerical value provided for the patient’s weight and, sometimes, height
3. Mistakes in selecting the correct medication dose for a patient because of confusion in using actual versus adjusted versus ideal body weight

Since the events are voluntarily reported by participating organizations, ECRI Institute PSO is unable to determine the rate of weight-based dosing errors; however, other studies provide insights, confirming the magnitude of these preventable mistakes in pediatric patients and adults.

Dosing errors, like those that can occur when a wrong weight is documented, are among the most frequently occurring types of medication errors for pediatric and adult patients. An analysis of medication errors reported to the U.S. Pharmacopeia’s Medication Errors Reporting Program between January 1, 1995, and December 31, 1999, found that dosing errors represented 47% of all pediatric medication errors and 28% of all nonpediatric drug errors. Dosing errors were the most frequently reported type of medication error for pediatric patients and the second most frequently reported type of medication error in nonpediatric patients, following errors using an unauthorized drug. (Cowley et al.)

An examination of event reports submitted to the Pennsylvania Patient Safety Authority from June 2004 through November 2008 found that of the 479 events identified as breakdowns in obtaining, documenting, and communicating patient weights, 67.2% of the events reached patients and 1.3% resulted in harm significant enough to require additional treatment. Almost 65% of the wrong-weight events in the analysis were associated with a patient receiving the wrong medication dose. Other mistakes occurred as a
result of incorrectly setting infusion pump rates or giving an extra drug. The report identified two general themes with weight-based dosing errors, similar to two of the three identified in the ECRI Institute PSO analysis: (1) breakdowns in obtaining an accurate patient weight and (2) errors from misusing the value for a patient’s weight (e.g., obtaining a weight in pounds and documenting that value as kilograms). (“Medication Errors”)

Failure to Obtain or Document an Accurate Weight
As many as 18% of all preventable medication errors are the result of not having the correct information about the patient available at the time of medication prescribing, dispensing, or administering (Leape et al.). As the reports submitted to ECRI Institute PSO demonstrate, errors can occur when there are failures to communicate or accurately document a patient’s weight. Refer to “Table 1. Failure to Obtain or Document an Accurate Patient Weight” for examples of such events reported to ECRI Institute PSO between September 2012 and August 2013 that resulted in patient harm.

One event underscores the key role of the ED in obtaining an accurate weight because the value recorded by the ED often becomes the value used throughout the patient’s stay if the patient is admitted from the ED. In the event reported to ECRI Institute PSO, the ED used an estimated weight but did not indicate in the patient’s record that the patient weight was estimated. Understandably, some patients treated in the ED are not in any condition to be weighed. But in this particular case, the ED provider’s weight estimate did not closely match the patient’s actual weight. Once the patient was admitted, other providers were unaware that the weight was estimated and used the information as the patient’s actual weight. Because the weight was incorrect, too little medication was given to the patient. The ED record should indicate that the weight is estimated so that the actual weight is obtained as soon as feasible. As one researcher notes, clinicians are “notoriously bad” at guessing weights. If caregivers relied on their best guesses of a patient’s weight, they would only be right 60% of the time (Clarkson).

Two other events involved children. In one case, an inaccurate estimated weight was used; as a result, the child received too much insulin, a high-alert medication known for causing serious harm if used in error. In the other event, the wrong weight for a child was documented in the electronic record. Although health information technology can provide clinical decision support to ensure accurate dosing by alerting the clinician when the dose entered is out of range for the patient’s weight, no electronic system can compensate for an inaccurately documented weight. Incorrect entries—whether documented on paper or electronically—can be perpetuated throughout the patient’s stay unless the patient

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Event Description</th>
<th>Patient Age</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated weight used as actual weight</td>
<td>The medical record did not indicate that the weight obtained in the ED was estimated. The documented weight, which deviated from the actual weight by more than 60 pounds, was used to calculate the medication dose for a pharmaceutical stress test. Because too little of the medication was used, the test had to be repeated the next day.</td>
<td>Older adult (64 to 84 years)</td>
<td>Medical-surgical unit</td>
</tr>
<tr>
<td>Incorrect estimated weight</td>
<td>The patient’s insulin infusion was calculated on the basis of an estimated weight that was higher than the patient’s actual weight. The patient became hypoglycemic and complained of palpitations and dizziness.</td>
<td>Child (1 to 12 years)</td>
<td>ED</td>
</tr>
<tr>
<td>Weight incorrectly documented</td>
<td>The wrong patient weight was entered into the electronic record. The patient has Kawasaki disease and received too much aspirin, resulting in aspirin toxicity.</td>
<td>Child</td>
<td>Inpatient unit</td>
</tr>
</tbody>
</table>
is reweighed and the entry is changed with the correct weight.

Mistakes in Using the Numerical Value for Weight or Height

Despite efforts to move the United States to a metric system, Americans remain committed to inches and pounds in their daily life. In our homes, we weigh ourselves in pounds. Many healthcare settings also obtain patient weights in pounds. Hospitals, for example, may have a variety of scales with options for weighing in pounds and/or metric units. Some scales can be locked to obtain weights in one unit only—preferably metric, since medication dosing is based on the metric system.

Because of our propensity to think in pounds and to calculate medication doses in metric units, numerous errors occur with recording a patient’s weight as kilograms even though the value obtained was in pounds. These mistakes can lead to doubling the appropriate dose for a patient because the value of a patient’s weight in pounds is more than double that amount in kilograms. Say a patient weighs 110 lb and that amount is mistakenly recorded as kilograms. The patient’s actual weight is 50 kg, or more than half the recorded weight. This type of mistake is one of the most common weight-based dosing errors reported to ECRI Institute PSO, as indicated by the number of events in this category in “Table 2. Mistakes in Using the Numerical Value Provided for a Patient’s Weight or Height.” In the Pennsylvania Patient Safety Authority analysis, confusion between pounds and kilograms was also the most frequently identified type of error, representing 27% of all wrong-weight medication errors (“Medication Errors”).

Several of the errors with recording a patient’s weight as kilograms versus pounds occurred with electronic health record (EHR) entries. Although some systems will alert a clinician to double-check the weight entered if the value is out of range for a patient’s age or height, other systems are not designed with these alerts or allow the alert to be optional, which may result in many mistakes going undetected. If the errors are not caught, the automated dose calculation features provided with many health information

Table 2. Mistakes in Using the Numerical Value Provided for a Patient’s Weight or Height

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Event Description</th>
<th>Patient Age</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculation error</td>
<td>The patient weighed 40 kg. There was a calculation error in administering two antibiotics that can affect kidney function. The use of two nephrotoxic agents led to toxic levels of the drugs. The drug dosages were reduced.</td>
<td>Older adult (64 to 84 years)</td>
<td>Not provided</td>
</tr>
<tr>
<td></td>
<td>The rate for the heparin drip was set too high for the patient’s weight. The patient’s partial thromboplastin time was longer than normal.</td>
<td>Older adult</td>
<td>Not provided</td>
</tr>
<tr>
<td>Confusion between pounds and kilograms</td>
<td>Weight was entered in the EHR incorrectly. The employee used pounds for kilograms. A low-molecular-weight heparin was dosed for more than double the patient’s weight. The pharmacy discovered the error, and the order was discontinued. The anticoagulation status of the patient was monitored.</td>
<td>Older adult</td>
<td>Not provided</td>
</tr>
<tr>
<td></td>
<td>The value for the patient’s weight was entered as kilograms instead of pounds. Pharmacy used the weight to calculate the dose for vancomycin, resulting in the patient receiving double the necessary dose for several days.</td>
<td>Older adult</td>
<td>Not provided</td>
</tr>
<tr>
<td></td>
<td>The patient’s weight was entered into the electronic record as kilograms, although the value reflected pounds. The patient received an overdose of an antiviral drug based on the doubled weight.</td>
<td>Adult (18 to 64 years)</td>
<td>Not provided</td>
</tr>
<tr>
<td></td>
<td>The value for the patient’s weight was entered as kilograms instead of pounds. The patient received two overdoses of a low-molecular-weight heparin.</td>
<td>Older adult</td>
<td>Medical unit</td>
</tr>
<tr>
<td>Confusion between inches and centimeters</td>
<td>The patient’s cardiac index was calculated using the patient’s height in inches. The value was recorded in the bedside monitor as centimeters. As a result, the patient’s dobutamine infusion was incorrectly titrated for the patient’s cardiac output, resulting in a longer hospital stay. Because the care areas use different measures for recording height in the bedside monitors, the hospital will standardize its approach by using centimeters to record patient height.</td>
<td>Not provided</td>
<td>Not provided</td>
</tr>
</tbody>
</table>
Top 10 Medications Associated with Wrong-Weight Errors

A report by the Pennsylvania Patient Safety Authority on medication errors from incorrect patient weights identified the top 10 medications associated with the errors. The report found that 5 of the 10 medications were high-alert drugs, which have an increased risk of causing patient harm if used incorrectly.

1. Heparin sodium*
2. Enoxaparin*
3. Acetaminophen
4. Dobutamine*
5. Dopamine*
6. Gentamicin sulfate
7. Vancomycin
8. Ibuprofen
9. Nesiritide
10. Propofol*

* High-alert drug


Technology systems will end up calculating doses based on an incorrect value.

In addition to weight, a patient’s height is sometimes used to calculate dosages, particularly with younger patients and patients receiving chemotherapy. For these patients, body surface area may be used to calculate medication doses. Just as caregivers have confused pounds and kilograms when documenting a patient’s weight, so too have they confused inches and centimeters when documenting height. One event summarized in Table 2 involved an error in recording a patient’s height as centimeters, even though the value was obtained in inches. The hospital recognized that the bedside monitors deployed in its care units recorded patient height in inches in some units and in centimeters in others. Recognizing that lack of standardization for documenting height contributed to an error in titrating a medication, the hospital adopted a policy to program the bedside monitors to document height only in centimeters.

Even when a correct weight is obtained, calculation errors with the patient’s weight can contribute to mistakes, as occurred with one of the events summarized in Table 2. In fact, in one study, mathematical incompetence was a significant source of error in tenfold medication dose mistakes (Doherty and McDonnell). Instead of relying on mathematical calculations, clinicians should use, whenever possible, standardized order sets, which provide the medication dose for a particular drug based on patient weight ranges, to prevent dosing mistakes.

Confusion about Weight-Adjusted Dosing

Sometimes, the clinician should not use the patient’s actual weight to calculate medication dose. For example, if a patient is dehydrated, the patient’s actual weight may be significantly lower than the patient’s typical weight. Formulas to calculate a patient’s ideal and adjusted body weight may be used to determine a dosage. These adjustments are particularly important to prevent overdosing of patients who are obese. If actual weight is used instead of ideal weight, which is calculated based on the patient’s height, an obese patient could receive too much medication. As shown in “Table 3. Confusion about Weight-Adjusted Dosing,” several events reported to ECRI Institute PSO reflect mistakes in using actual versus adjusted versus ideal body weight.

High-Alert Medications

In the analysis of weight-based dosing errors reported to ECRI Institute PSO between September 2012 and August 2013, several of the events that resulted in patient harm involved high-alert medications, such as anticoagulants, dobutamine, and insulin. These drugs bear a heightened risk of causing significant harm when they are used in error (ISMP “ISMP’s List”). In the analysis of weight-based dosing errors reported to the Pennsylvania Patient Safety Authority, half of the top 10 medications associated with these errors were high-alert medications, as shown in “Top 10 Medications Associated with Wrong-Weight Errors.”

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Event Description</th>
<th>Patient Age</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal versus actual body weight</td>
<td>The dose for the antiviral was calculated using the patient’s actual body weight. Because of the patient’s obesity, the dose should have been lower, using the patient’s ideal body weight.</td>
<td>Adult (18 to 64 years)</td>
<td>Not provided</td>
</tr>
<tr>
<td>Adjusted versus actual body weight</td>
<td>The drug label for an intravenous medication did not provide information on the dose for an obese patient. We decided to use adjusted body weight, which was covered in the dosing information. The nurse misunderstood the instructions for running the pump and set the rate incorrectly. The patient’s blood pressure dropped.</td>
<td>Adult</td>
<td>Not provided</td>
</tr>
<tr>
<td></td>
<td>The patient, who was markedly obese, had an acute pulmonary embolism. The heparin infusion was incorrectly dosed based on actual body weight. As a result, the patient’s partial thromboplastin time was longer than normal and the patient was coughing up blood. The heparin dose was lowered.</td>
<td>Not provided</td>
<td>Not provided</td>
</tr>
</tbody>
</table>
Lessons Learned

STRATEGIES TO PREVENT WEIGHT-BASED DOSING ERRORS

Organizations must enlist multiple strategies to prevent weight-based dosing errors. ECRI Institute PSO recommends that facilities consider a combination of strategies. Some, such as staff education to prevent weight-based dosing errors, while important, are considered low-impact strategies and, by themselves, will not prevent all mishaps. They must be used with other higher-impact strategies, such as deploying infusion pumps with dose-error reduction capabilities, or with moderate-impact strategies, such as standardizing certain medication order sets for those drugs that are dosed on the basis of a patient’s weight. Refer to “Table 4. Strategies to Prevent Weight-Based Dosing Errors by Strength of Impact” for a summary of these prevention strategies, grouped by hierarchy as an error-reduction technique.

Of course, before any strategies are considered and adopted, the organization should conduct an assessment of current weighing practices to identify processes that are working and those that need fixing. The assessment should cover

Table 4. Strategies to Prevent Weight-Based Dosing Errors by Strength of Impact

<table>
<thead>
<tr>
<th>Low Impact</th>
<th>Moderate Impact</th>
<th>High Impact</th>
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<tbody>
<tr>
<td>Require documentation of a patient’s actual weight; only allow exceptions if a patient cannot be weighed.</td>
<td>Except in emergency situations, prohibit pharmacy from filling medication orders if a patient’s weight is not documented.</td>
<td>Lock scales to weigh in, or default to, metric units if the scales can weigh in both pounds and kilograms.</td>
</tr>
<tr>
<td>Establish processes for the timing and frequency for obtaining a patient’s weight.</td>
<td>Require pharmacy to independently double-check dose calculations for pediatric patients, chemotherapy, and high-alert medications.</td>
<td>Purchase infusion pumps with dose error reduction features.</td>
</tr>
<tr>
<td>Record and communicate a patient’s weight in metric units.</td>
<td>Whenever feasible, institute a 24-hour pharmacy service so that pharmacists are readily available to caregivers to answer questions that arise (if this is not possible, ensure that providers have access to on-call pharmacists when a pharmacist is not on-site).</td>
<td>Establish hard stops in electronic order entry systems if weight is not provided with a medication order.</td>
</tr>
<tr>
<td>Display a patient’s weight prominently in the medical record.</td>
<td>Provide weighing scales designed for pediatric patients, including in the ED.</td>
<td>Remove from clinical areas any high-alert drugs and other medications that have the potential to cause patient harm if weight-based doses are miscalculated.</td>
</tr>
<tr>
<td>Indicate whether a patient’s weight is estimated or measured.</td>
<td>Provide alternative methods to obtain patient weights (e.g., use beds and stretchers with scales).</td>
<td></td>
</tr>
<tr>
<td>Indicate the date when a patient’s weight was obtained.</td>
<td>Establish an inspection and preventive maintenance program for weighing scales.</td>
<td></td>
</tr>
<tr>
<td>Ensure access to documentation of a patient’s weight for all those who need the information.</td>
<td>Remove from service any weighing scales that are defective or inaccurate until they are repaired.</td>
<td></td>
</tr>
<tr>
<td>Provide pharmacy and prescribers with up-to-date resources for calculating medication doses (e.g., reference handbooks and software).</td>
<td>Incorporate clinical decision support in the EHR system to help with medication dosing and to alert the prescriber to potential dosing errors (e.g., dose is out of range for the patient’s weight and height, weight is not entered within a specified time frame after a patient’s admission, patient weight is out of range for age-adjusted norms).</td>
<td></td>
</tr>
<tr>
<td>Develop educational programs to heighten awareness of weight-based dosing errors and prevention strategies for staff involved in the medication-use process.</td>
<td>Program the EHR system to alert and to request the clinician’s confirmation if the patient’s weight has changed within a certain predetermined amount since the last visit.</td>
<td></td>
</tr>
<tr>
<td>Eliminate distractions when staff are prescribing, dispensing, and administering medications.</td>
<td>Require that a patient’s weight be reentered in the EHR with each admission; do not allow the weight to carry over from one admission or one visit to the next.</td>
<td></td>
</tr>
<tr>
<td>Involve patients and families in the medication process; if the patient is alert and wishes to know their weight, provide that information and confirm the unit of measure used.</td>
<td>Provide standardized weight-based dosing protocols when appropriate (e.g., order sets for insulin and heparin, specifying doses by patient weight ranges).</td>
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</table>
areas such as availability of equipment to obtain patient weights; measures to maintain and repair the equipment; documentation practices for recording patient weight, including practices for electronically documenting weights; use of standardized order sets for medications that require weight-based dosing; pharmacy involvement in review of weight-based dosing medication regimens; use of electronic clinical decision support for safe medication dosing; staff awareness of weight-based dosing concerns; and patient and family engagement in safe medication use.

Once an assessment of patient weighing practices is complete, the organization can begin to address areas that need improvement. A proactive risk assessment, such as a failure mode and effects analysis, should be considered before any proposed improvements are implemented to evaluate their potential impact on the organization’s processes and to make any necessary changes to ensure the measures have the intended effects. The following sections provide a brief summary of the measures listed in Table 4.

Practices for Obtaining and Documenting Patient Weight

The organization’s policies and processes for obtaining a patient weight should establish the timing and frequency for patient weighing. The patient’s weight should be obtained as soon as possible after admission. The frequency for weighing will vary on the basis of patient age and needs (RCN) and should be documented in the patient’s care plan. For example, a neonate may require daily weighing, whereas an adult patient may only need to be weighed upon admission.

The organization’s policy should require that the patient weight be documented in metric units. Additionally, any verbal communication involving a patient’s weight should use metric units as a standard measure. If the patient’s weight cannot be obtained at the time of admission, any documentation about the patient’s weight should specify whether the figure is an estimate. The Institute for Safe Medication Practices (ISMP) lists measurement and communication of patient weight in its ED, where children may be treated.

Pharmacy Review

Organizational policies should, except in emergency situations, prohibit the pharmacy department from dispensing medication if a patient’s weight is not provided. Additionally, pharmacists should review all medication orders that require dosing on the basis of patient weight and independently double-check the dose needed for certain medications (e.g., medications dispensed for pediatric patients, chemotherapy agents, high-alert medications). If the pharmacy department is not continuously staffed, on-call pharmacists should be available to staff to answer questions that arise about medication dosing.

Equipment

Weighing scales should be available in all areas where patients are treated, including the ED. Because not all patients will be able to step on scales, alternative means to obtain patient weights must be available. Some beds and stretchers, for example, are designed to obtain patient weights. Facilities that provide pediatric care must provide weighing scales designed for infants and children. Even if the facility does not provide pediatric care, it should ensure pediatric scales are available in its ED, where children may be treated.

The organization’s biomedical engineering department should establish a schedule for routine inspection and preventive maintenance of the equipment. One study found that nearly one-third of hospitals visited did not routinely inspect their scales (RCN). Any defective equipment should be removed from the care area to ensure that it is not used in patient care until it is repaired. Equipment should also be recalibrated after it is moved around (Clarkson).

Because many scales can obtain weights in either pounds or metric units, the organization should ensure that the equipment is set and locked, if possible, to obtain weight in metric units or defaults to metric units.

Electronic Systems

While computers can be a “powerful intervention” in promoting medication safety, they can also contribute to dosing errors if they are not used appropriately (Kaushal et al.). For example, electronic systems can only work effectively if the data provided is correct. Providers must be
vigilant in recording patient weights accurately and in kilograms.

To ensure accurate weight-based dosing, organizations should harness the capabilities available in electronic systems. For example, EHR systems can incorporate forcing functions, such as hard stops if a patient’s weight is not recorded, to promote safe medication dosing. The systems can also be programmed to not automatically repopulate data fields with the patient’s weight from a previous admission in order to prompt caregivers to obtain the current weight. Additionally, EHR and electronic ordering systems can be programmed to alert if certain medication doses are out of range for a patient’s weight and height. Infusion pumps, often referred to as “smart pumps,” that incorporate software to reduce errors in medication dosing should also be used.

Not all electronic systems and technologies are developed with the needs of pediatric patients in mind. In fact, ECRI Institute has named the risks to pediatric patients from “adult” technologies as one of its top 10 health technology hazards for 2014. Organizations that care for children should ensure that electronic systems for medication ordering and prescribing include features to promote pediatric safety. These features include child-specific medication libraries, normative references, and child-specific weight-based dose calculations and alerts. Refer to “Online Resources” for information on obtaining ECRI Institute’s report of the top 10 health technology hazards, as well as a report from the American Academy of Pediatrics (AAP) on safe practices for electronic prescribing in pediatrics.

**Standardization**

Standardization is a proven strategy to enhance medication safety and can be used to prevent weight-based dosing errors. Options include prescribing high-alert medications in a manner that requires no calculation by using electronic systems to help in calculating doses and by using standardized drug order sets based on a patient’s weight and other factors. Refer to “Online Resources” for a link to ISMP’s tips on developing standardized order sets.

Other opportunities for standardization to prevent weight-based dosing errors include limiting the number and concentrations of high-alert medications and infusion solutions, removing from clinical areas any high-alert medications and other medications that have the potential to cause harm if weight-based doses are miscalculated, and prescribing high-alert medications in a manner that requires no dose calculations.

**Safe Medication Use**

Safe medication dosing depends on an alert and vigilant staff aware of the potential for patient harm if inaccurate patient weights are used to calculate medication doses. Organizations must provide staff involved in the medication-use process with education on weight-based dosing errors and the organization’s policies to prevent such errors. Healthcare providers should also involve patients and their families in the medication-use process (e.g., ensure that patients understand the importance of obtaining accurate patient weights to promote safe drug dosing) and encourage patients and family members to speak up if they hear or see anything involving the patient’s care that is inaccurate or seems out of place. Organizations should provide safety zones where staff can prescribe and prepare medications without distractions and interruptions.

Finally, staff should be reminded that the organization supports a culture of safety and seeks their support in reporting weight-based dosing mistakes and near misses so that the organization can conduct detailed root-cause analyses of weight-based dosing errors to identify the causes of these errors and to address the systems issues that contribute to such events.
REFERENCES

42 CFR § 482.25 (2013).


Data Snapshot

Top Four Medications Associated with Preventable Adverse Drug Events during Hospital Stays by Age Group, 2011

An estimated 380,000 to 450,000 hospitalized U.S. patients experience a preventable adverse drug event each year. The top four drug types associated with preventable adverse drug events during an inpatient stay are steroids (occurring at a rate of 19.7 events for every 10,000 discharges), antibiotics (12.9 per 10,000 discharges), opiates and narcotics (11.2 per 10,000 discharges), and anticoagulants (6.7 per 10,000 discharges). The figure illustrates the rate of adverse drug events for these four drug types by age group. The highest rates of adverse drug events occur in individuals age 65 or older.

Rate per 10,000 Discharges

Adverse Drug Event Cause

- Steroids
- Antibiotics
- Opiates and narcotics
- Anticoagulants

* Denotes differences in rates of 20% or greater between the reference group (adults age 18 to 44) and other age groups.


http://www.hcup-us.ahrq.gov/reports/statbriefs/sb164.jsp

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MISSION STATEMENT

ECRI Institute PSO’s mission is to achieve the highest levels of safety, quality, and cost-effectiveness of healthcare by collecting and analyzing patient safety information and sharing lessons learned and best practices.