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Workarounds: Trash or Treasure? (http://patientsafety.pa.gov/ADVISORIES/Pages/201709_Workarounds.aspx)
An enlightened understanding of workarounds can help healthcare facilities appreciate that workarounds are symptoms of a real or perceived workflow obstacle, and value the information that workarounds provide.

Saves, System Improvements, and Safety-II (http://patientsafety.pa.gov/ADVISORIES/Pages/201709_safetyII.aspx)
This recurring feature highlights successes of healthcare workers in keeping patients safe; in this instance, collaboration helps prevent an incorrect anticoagulant dosage.
Treating Hyperkalemia: Avoid Additional Harm When Using Insulin and Dextrose

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Abstract

Hyperkalemia is a fairly common, potentially life-threatening electrolyte disturbance encountered in hospitalized patients. Treatment of hyperkalemia with insulin and dextrose, without implementing clear protocols and error-reduction strategies, can lead to hypoglycemia and other patient harm. A total of 198 events involving insulin and dextrose for treating hyperkalemia were identified by analysts in reports submitted to the Pennsylvania Patient Safety Authority between January 1, 2005, and December 31, 2016. The three most commonly reported types of events were delayed dose (n = 42), wrong route (n = 41), and wrong dose/over dosage (n = 15). Hypoglycemic episodes were reported in 57 of 198 patients. Standardized treatment protocols, including proper monitoring, can help prevent and detect errors with insulin administration for this indication.

Introduction

Hyperkalemia can be a serious, sometimes life-threatening condition that is defined as a serum potassium level greater than 5 mEq/L.¹ Most (about 98%) of the body's potassium is located inside cells.¹ Potassium, which is a positively charged ion, plays a role in maintaining the cell's resting membrane potential; therefore, disturbances in the gradient (e.g., extracellular hyperkalemia) can negatively impact neuromuscular and cardiac excitability.² The effects of hyperkalemia on cardiac contractility can be detected on an electrocardiogram as peaked T-waves, a prolonged PR-interval, and a widened QRS-interval. In severe cases, this can lead to bradyarrhythmias, ventricular fibrillation, and asystole.¹²
About 80% of potassium is excreted renally, making patients with chronic kidney disease most at risk for developing hyperkalemia. Although decreased elimination is one factor, other causes for the development of hyperkalemia include increased potassium ingestion, iatrogenic causes, and the shifting of potassium from the intracellular to the extracellular space. Elevated potassium levels should be evaluated for accuracy because pseudohyperkalemia can result when a blood sample is hemolyzed, such as from a traumatic blood draw; when the leukocyte or platelet count is extremely elevated; or when the specimen is drawn above the site where a potassium-containing fluid is infusing.

Goals for treating hyperkalemia include stabilizing cardiac membranes with intravenous calcium, shifting potassium back into the cell, and enhancing potassium elimination. Short-acting insulin, usually given with dextrose to prevent hypoglycemia, rapidly redistributes potassium into the cells and is considered first-line treatment for severe hyperkalemia. However, this redistribution is temporary, so other therapies that enhance the elimination of potassium from the body should also be used.

Guidelines from the American Heart Association recommend treating adults who have severe cardiotoxicity or cardiac arrest due to hyperkalemia with an infusion of 25 grams of 50% dextrose mixed with 10 units of regular insulin infused intravenously over 15 to 30 minutes. However, in the literature there is extensive variability in the type of insulin that should be used, the dose, and the time over which it should be administered. The two types of insulins used for treating hyperkalemia include rapid-acting insulin analogs (i.e., insulin aspart and insulin lispro) and regular insulin. Doses between 5 and 20 units of insulin administered intravenously as a bolus or up to a 60-minute infusion have been reported in the literature. There is also inconsistency in the amount of dextrose that should be given with insulin, with doses ranging from 25 to 100 grams. Despite the use of dextrose, hypoglycemia is still a relatively common occurrence. The potential for error and patient harm is considerable because of the severity of the condition, urgency of the situation, the variability in dosing regimens described in the literature, and the use of insulin, which is included on the "ISMP List of High-Alert Medications in Acute Care Settings."

The purpose of this article is to identify the types of events, both harmful and harmless, that occur when insulin is ordered to treat hyperkalemia, to prevent harm by encouraging the use of best practices when using insulin to treat hyperkalemia, and to propose possible risk reduction strategies.

**Methods**

Analysts queried the Pennsylvania Patient Safety Reporting System (PA-PSRS) database for events in which insulin was used to treat hyperkalemia. PA-PSRS reporters can choose from ten different categories of event types to select the one they feel is most appropriate for a given Incident or Serious Event. For this reason, the query searched free-text data fields of the event description of all event types using variations of and wildcards for the following keywords: hyperkalemia, potassium, elevated potassium, high potassium, and critical potassium. The query also searched the drug-name fields of medication errors and adverse drug reactions (the two event categories that have discrete medication name fields) and the event descriptions of all events using variations of and wildcards for currently available insulin products (e.g., humul%, novol%), Kayexalate®, and polystyrene. One hundred ninety-eight events met the inclusion criteria and were included in the final analysis. Event reports were included if insulin was used for treating hyperkalemia and an error or adverse drug event occurred with insulin and/or dextrose. The initial search returned 1,565 events that occurred between January 1, 2005, and December 31, 2016, but 1,367 events were eliminated because they did not meet inclusion criteria. An example of an excluded event follows.
An order received in pharmacy at 2000 read “If K+ [potassium] 3.5 [lower limit of normal range] then give K-Lyte [potassium bicarbonate and potassium chloride; to treat low potassium levels] 50 mEq via peg tube BID x 1 day.” Order was entered and dispensed by the pharmacy as Kayexalate® [sodium polystyrene sulfonate to treat high potassium levels] 30 g PO BID. No potassium level was returned on the patient until 0600 [the next day]. The floor contacted the pharmacy to report the dispensing error. The Kayexalate was retrieved.

Reporters assigned harm scores, which are adapted from the National Coordinating Council for Medication Error Reporting and Prevention harm index, and categorized events based on the event type. Events classified as dose omission, wrong time, and prescription/refill delayed were combined and included in the analysis as "dose delayed" because reporters reported similar events using these three event types. An example of a dose delayed event follows:

The physician order was entered at 0600; [made] frequent phone calls to pharmacy requesting drug; K+ level 5.9; Kayexalate was [ordered to be given] now; did not arrive until 1000; insulin did not arrive until 0850; confusion about insulin in [the automated dispensing cabinet (ADC)] when it was not there.

The frequency of hypoglycemic episodes associated with insulin administration for treating hyperkalemia was studied in this analysis. Based on guidelines from the American Diabetes Association (ADA), blood glucose values less than 54 mg/dL are considered clinically significant. Results were stratified using 54 mg/dL as a marker for morbidity.

* The details of the PA-PSRS event narratives in this article have been modified to preserve confidentiality.

Results

Events involving insulin and/or dextrose to treat hyperkalemia were classified by reporters under several different event types (Figure 1). The majority of reports (66.7%; n = 132 of 198) were coded as medication errors. However, the event type selected by the reporter does not always match what is described in the event description. For example, the following report, which described a preventable event, was categorized as an unpreventable "adverse drug reaction (not a medication error):"

Physician used hyperkalemia order set to order insulin for hyperkalemia; however, ordered dose that was 10-fold too high, so patient had hypoglycemia that required additional dextrose bolus.
According to the reporter-assigned harm score, 90.4% (n = 179) of errors reached the patient (harm scores C through I; Figure 2). Four percent (n = 8) of the events were reported as causing patient harm (harm scores E through I). In this analysis, the most harmful event was defined by the reporter as category E, “an event occurred that contributed to or resulted in temporary harm and required treatment or intervention.” The following is an example of what reporters classified as a harm score E adverse event:

*The physician inadvertently ordered insulin 12 units/hr via IV [intravenous] infusion with dextrose to treat hyperkalemia when he meant to order insulin 12 units IV push times one dose. The patient received the insulin infusion over 1 hour and his blood glucose levels dropped to 32 [mg/dL]. At that time, the patient began to seize and went into cardiac arrest requiring resuscitation and intubation. The patient rapidly progressed and stabilized. The patient has since been discharged home in stable condition. Event recognized during review of code and disclosed to the patient.*
The top three patient care areas identified in events were emergency departments (31.3%, n = 62 of 198), medical/surgical units (15.2%, n = 30), and telemetry units (5.6%, n = 11).

**Medication Errors**

The most frequent event type category reported was medication error (66.7%, n = 132 of 198). The most common types of errors reported as medication errors were dose delayed (31.8%, n = 42 of 132); wrong route (31.1%, n = 41); and wrong dose/over dosage (11.4%, n = 15).

The primary reason for delayed doses was that insulin was ordered but not given prior to transferring the patient to another unit (35.7%, n = 15 of 42), most notably from the emergency department to another unit (73.3%, n = 11 of 15). Another reason for delayed doses was the ordering of IV insulin for patients on certain units where IV insulin is not permitted (4.8%, n = 2 of 42), so patients had to be transferred to receive IV insulin. A third reason for delayed doses was unavailability of the medication (4.8%, n = 2 of 42). An example of a delayed dose due to the patient being located on a patient care unit that prohibited IV administration of insulin follows:

> Critical potassium level 7.2 non-hemolyzed called to attending. Order received. EKG [electrocardiogram] obtained. Attending spoke to nephrology; more orders received. Physician ordered IV insulin, unable to safely give on general medical floor. Spoke to pharmacist and supervisor; told the patient needs to be transferred to cardiac floor.

There were 41 reports of insulin given via the incorrect route. Wrong-route errors were seen at both the prescribing (29.3%, n = 12 of 41) and administration nodes (58.5%, n = 24) of the medication-use process. Reports of wrong-route errors included orders for intravenous insulin given subcutaneously (n = 25), orders entered in the computerized prescriber order entry (CPOE) system for subcutaneous insulin when the IV route was intended (n = 10), and orders for subcutaneous insulin administered intravenously (n = 2).

Wrong dose/over dosage errors occurred during administration (33.3%, n = 5 of 15), preparation of the medication (26.7%, n = 4), and at the prescribing phase (26.7%, n = 4). An example follows.
A patient with potassium of 6.9, orders received for albuterol 0.5% inhalation x2, IV regular insulin 8 units, dextrose 50% 25 g IV, sodium bicarb 1 ampule IV. The nurse told the charge nurse he was unfamiliar with giving these medications. Another nurse assisted him with administration of medications and verified them in the MAR [medication administration record]. The insulin was not drawn up in an insulin syringe—it was drawn up in a 1 mL syringe. The insulin syringes used in this facility are not compatible with IV push. At 1600, the patient’s family member requested help from the nurse when checking on the patient. The patient was diaphoretic, shaky, and had a decreased level of consciousness. Blood sugar was checked and was 20.

Cases of Hypoglycemia

More than a quarter (28.8%, n = 57 of 198) of event descriptions mentioned an episode of hypoglycemia or blood glucose less than 70 mg/dL, with 70.2% (n = 40 of 57) of patients experiencing a blood glucose value less than 54 mg/dL, and more than a quarter (26.3%, n = 15 of 57) of patients having a blood glucose result less than 30 mg/dL (Figure 3). Of 198 reports, 9 (4.5%) mentioned errors with dextrose. In all but one case, dextrose administration was delayed or omitted. One of the reasons for delayed doses was the way dextrose was ordered in the electronic health record. Rather than being ordered as a one-time stat dose with a scheduled time populated on the MAR, 50% dextrose was ordered “as needed” for hypoglycemia. Overall, the most common medication errors contributing to hypoglycemia included delayed dose of dextrose (10.5%, n = 6 of 57), wrong dose/over dosage of insulin (10.5%, n = 6), and wrong route insulin errors (8.8%, n = 5).

Incorrect Laboratory Values

Incorrect laboratory values contributed to 9.1% (n = 18 of 198) of errors. The use of an incorrect potassium value to determine treatment accounted for most of these reports (55.6%, n = 10 of 18). Causes for treating an incorrect potassium level or failing to treat a critical potassium value included: the wrong patient’s critical potassium result was verbally communicated by the laboratory to the practitioner; results were incorrectly reported as hemolyzed; and an elevated creatinine value was confused for the patient’s potassium level. The second most common (22.2%, n = 4 of 18) error involving laboratory values involved improper blood collection technique, which occurred when a blood specimen was obtained above the site where fluids with potassium were infusing or the sample was collected using the wrong collection tube. Examples of errors involving laboratory values follow.
50 y.o. [year old] female on hemodialysis, presented to the ED [emergency department] with abdominal pain. On routine labs, patient had potassium of 6.9. Per interdisciplinary narrative, the nurse notified the physician of the critical result, but stated the potassium was hemolyzed. However, no visible hemolysis was seen. EKG was obtained which showed peaked T-waves. Calcium, insulin, and Kayexalate were not administered until 2300 when the overnight attending saw the patient and admitted her to Internal Medicine.

Patient received in PPN [peripheral parenteral nutrition]: Na [sodium] 80 mEq, K [potassium] 50 mEq, Ca [calcium] 5 mEq, Mg [magnesium] 12 mEq, and Phos [phosphorous] 15 mmol. The patient’s labs today were: Na = 137, K = 6.2, Ca = 1.15, Mg = 3.0, Phos = 5.8, and glucose = 322. A repeat lab was ordered per pharmacy at 8 am. Results were within normal limits. Therefore, appears the lab drew the [first set of] levels from the PPN line. However, patient did receive corrective action for high K level with Kayexalate and insulin, treatment that was not required.

Discussion

Hyperkalemia severe enough to cause disturbances in cardiac conduction is considered a medical emergency. The most common event type reported in cases of hyperkalemia was a delayed dose of insulin. Treatment was often postponed until the patient was transferred to another unit, which frequently led to delays of an hour or more. Treatment should not be delayed, because even benign changes on electrocardiogram can quickly progress to lethal arrhythmias, and potassium levels greater than 7 mEq/L are associated with increased risk of cardiac arrest.

The second most frequently identified event type was insulin given via the wrong route. This type of error was seen during both the prescribing and administration nodes of the medication-use process. Insulin should be given via the intravenous route for treating hyperkalemia to ensure instant and consistent bioavailability.

Wrong dose/over dosage events were the third most common event type. The exact mechanism behind these errors was not clearly described in the event descriptions, but most mentioned measuring the insulin in "cc" or "mL" instead of units. A previous article by Grissinger about the misadministration of insulin for hyperkalemia treatment stated one of the reasons for wrong-dose insulin errors was a lack of understanding the difference between insulin syringes and other parenteral syringes. One consideration is that insulin for hyperkalemia must be administered with a syringe (e.g., one with a Luer Lock tip) capable of connecting to needleless access devices and lines in order to be given intravenously. However, most insulin syringes available in hospitals have an attached needle appropriate for subcutaneous administration. This needle and syringe does not connect to a needleless system. Also, some hospitals may use insulin pens for subcutaneous insulin delivery, so newer nurses may be unfamiliar with drawing up insulin from a vial with an insulin syringe.

More than a quarter (28.8%) of reports mentioned hypoglycemia after treatment with insulin for hyperkalemia. The incidence of hypoglycemia associated with the treatment of hyperkalemia in the literature has been reported to be between 6.1% and 75%. The wide range may be due to the variability in dosing of insulin and dextrose, the duration of infusions, the sequence in which dextrose and insulin are given, the type of insulin used, and patient-specific factors, such as chronic kidney disease. The plasma insulin concentration that causes maximal effect on the redistribution of potassium is 500 microunits/mL, whereas the concentration that causes a maximal glycemic effect is only 100 microunits/mL. Based on the pharmacokinetics of regular insulin, a bolus dose of 10 units results in insulin concentrations high enough to promote maximum potassium reuptake within 20 minutes after administration but also concentrations high enough to cause hypoglycemia for an extended period of time. Other factors that have been linked to a high risk of hypoglycemia include a lower dose of dextrose (e.g., 25 grams), administering the dextrose after the bolus of insulin, and lower pretreatment glucose levels. The use of a rapid-acting insulin instead of regular insulin may also decrease the incidence of hypoglycemia because it has a shorter half-life. In one study that used 10 units of a rapid-acting insulin and 50 grams of dextrose to treat hyperkalemia, only 6.1% of patients...
experienced a blood glucose value less than 70 mg/dL. Renal dysfunction may also predispose patients to hypoglycemia because of impaired insulin elimination and decreased renal gluconeogenesis. Nonetheless, hypoglycemia is a serious complication and steps should be taken to avoid it.

Limitations

In-depth analysis by the Authority of hyperkalemia events is limited by the information reported through PA-PSRS, including the event descriptions. As with all reporting systems, the type, quantity, and quality of reports depends on the reporter as well as the design and implementation of the reporting system. It is known that renal dysfunction and lower baseline glucose values contribute to hypoglycemia after insulin administration, but not all contributing factors, such as patient-specific information, were included in the event descriptions. Most reports also did not specify how much dextrose was given or the order of administration in relation to insulin.

Strategies

Insulin is a high-alert medication that is commonly involved in medication errors. It should not be assumed that all healthcare practitioners are familiar with the dosing, route, preparation, and administration of insulin and dextrose to treat hyperkalemia. Consider the following recommendations, based on events reported to the Authority, current literature, and observations from the Institute for Safe Medication Practices (ISMP) to prevent errors.

• Establish standardized, facility-wide hyperkalemia treatment protocols that address the dosing of insulin, type of insulin, route of administration, dose of dextrose, sequence of dextrose and insulin administration, and monitoring parameters.

• Create standardized order sets, automatically populated with the correct dose and route of insulin, to facilitate the appropriate prescribing of insulin in patients with hyperkalemia.

• Dispense insulin preparations for treating hyperkalemia from the pharmacy in a ready-to-use form (e.g., in a syringe that can connect to a needleless system). This workflow ensures that an independent double-check takes place. In organizations without 24-hour pharmacy services, pharmacy can create and provide hyperkalemia treatment kits that include a 3-mL vial of insulin, a Luer Lock insulin syringe, and directions for administration. The 3-mL vial of insulin is recommended, to reduce the potential amount of insulin a patient can receive if a dose of insulin is measured incorrectly.

• Stock insulin syringes with a Luer Lock tip on patient care units, but be sure to store these separately from other parenteral syringes so they are not inadvertently mixed up.

• Require an independent double check to evaluate the laboratory result, that the correct type of insulin is used, that the route is appropriate for the indication, and that the dose drawn up in the insulin syringe is correct.

• Provide education to all healthcare practitioners who are involved in insulin administration about the differences between insulin syringes and other parenteral syringes, how to measure doses, and how to administer the medication.

• Ensure adequate monitoring of glucose levels and for signs and symptoms of hypoglycemia for several hours after insulin administration. Symptoms of hypoglycemia may be delayed by as much as six hours after insulin and dextrose administration, especially if the patient has renal impairment.
Conclusion

Hyperkalemia can be a serious, sometimes life-threatening condition; however, it is clear from the analysis of events with insulin and dextrose used in treating hyperkalemia that steps can be taken to enhance the safety of patients treated for this life-threatening condition. Errors with insulin prescribing, preparation, and administration can have severe consequences on patients' health. Effective strategies should be implemented to prevent unnecessary delays in treatment, wrong route errors, over dosages, and hypoglycemia.

Notes


Promote a Culture of Safety with Good Catch Reports

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Abstract

A hospital good catch program can be an effective means to improve patient safety. Good catches occur up to 100 times more frequently than Serious Events, but often go underreported. Recognizing and rewarding staff can encourage good catch submissions and provide more opportunities to improve patient safety. Queried data in the Pennsylvania Patient Safety Reporting System was aggregated to calculate a ratio of good catches to Serious Events. Statewide data has shown an increase in this ratio from 5.6:1 in 2005 to 10.3:1 in 2016. The Pennsylvania Patient Safety Authority created a Good Catch Comparison report for hospitals to compare their own ratio with peer facilities. A literature review and interviews conducted with risk managers and patient safety officers at five Pennsylvania hospitals allowed the authors to recognize key components to useful good catch reporting. Overall, the Authority concluded that good catch programs can help hospitals more effectively analyze reported data and implement risk reduction strategies. Additionally, using the Good Catch Comparison report available through the Authority's Patient Safety Liaisons can identify facility-specific event types or care areas that are reporting above or below aggregate peer rates, potentially highlighting successful practices or targets for improvement efforts.

Introduction

A good catch may break the cycle in the chain of events that could lead to patient harm or even death.¹ Studies suggest that good catches occur as much as 7 to 100 times more frequently than Serious Events and can reveal gaps in a facility’s organization.² When healthcare employees report good catches through an adverse-event reporting system, facilities can analyze these events to proactively implement risk reduction strategies to improve patient safety.³
For example, a patient care assistant in a Pennsylvania hospital was transferring a patient into a bed with locked wheels when the bed moved, despite the wheels being locked. Although the patient was not harmed, the patient care assistant raised the issue during one of her unit’s daily safety huddles, which led to examining all of the beds on the unit. Facility personnel discovered that the wheel locks on 60% of the beds on the unit needed repair, which led to hospital-wide wheel-lock inspection and repair. The patient care assistant was recognized by the Pennsylvania Patient Safety Authority in the 2017 “I Am Patient Safety” campaign.

Healthcare facilities can implement structured good catch programs to promote reporting good catches to an adverse event reporting system or other reporting mechanism to initiate system improvements. Some programs launched in Pennsylvania provide staff recognition and offer rewards based on volume or quality of good catches.

Authors sought to compare good catch data with Serious Events reported through the Pennsylvania Patient Safety Reporting System (PA-PSRS) to create a "good catch-to-Serious Event" ratio. Further, the authors created a Good Catch Comparison report for facilities, organized by date range and event type and subtype, for the facility, its peer group, and the state as a whole.

**Methods**

For the purpose of this article, a good catch (i.e., PA-PSRS harm score* of A, B1, B2; also referred to as a near miss or close call) is defined as an event report about a circumstance that might have caused harm but was prevented from reaching the patient due to active recovery efforts by caregivers or by chance. The definition also includes unsafe conditions, which are circumstances that could cause an adverse event. Event reports based on retrospective recognition (e.g., harm score B1) were included because the reporting and examination of these events can add to our understanding of the mitigation of unsafe conditions.

Authors queried the PA-PSRS database for events submitted from hospitals to the Authority for the years 2005 through 2016. A "good catch-to-Serious Event" ratio was calculated by comparing the number of good catch reports (i.e., events submitted with harm scores A, B1, B2) to the number of Serious Event reports (i.e., harm scores E, F, G, H, I), creating a proportion that could be expressed as x:1, or simply x. This calculation was made in a variety of ways: by facility; by facility peer group; statewide; by month and year; and by event type and sub-types.

Additionally, ratios were calculated by peer group (facilities grouped by like size and primary service), using aggregate totals of good catches and Serious Events of the peer group. This allowed detailed comparisons of the data to detect trends or patterns.

Two authors (SW, CM) conducted semi-structured interviews with a convenience sample of six facility-designated patient safety, risk management, and quality leaders from four hospitals across Pennsylvania. The hospitals were identified by Patient Safety Liaisons (PSLs) as having a good catch program in place and varied in size from 36 to 464 beds. The interviews included the following topics:

- Program launch and promotion
- Nomination process
- Reward and recognition
- Resources needed
- Program benefits

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*Note: The PA-PSRS harm scores are used in this context to classify the severity of events reported, with A being the highest severity level and I being the lowest.
• Key components
• Process improvement initiatives

In addition, an interview was conducted with a quality leader from a 250-bed hospital recognized by a PSL as having a successful program for using good-catch report data for process improvements. Authors conducted a review of the literature, as well as an Internet search using terms such as "good catch," to identify strategies to implement a good catch program.

* The Pennsylvania Patient Safety Authority Harm Score Taxonomy (/ADVISORIES/Documents/Tool%20PDFs/201503_taxonomy.pdf) is available.

**Results**

**Event Ratio**

The ratio of good catches to Serious Events increased from 5.62 in 2005 (n = 33,777/6,008) to 10.34 in 2016 (n = 54,472/5,269). (See Figure)

Figure. Good Catch Events versus Serious Events, with Good Catch Ratio, 2005-2016

Note: As reported to the Pennsylvania Patient Safety Authority, January 1, 2005, through December 31, 2016.

**Interpreting Good Catch Data**
Statewide ratios for 2016 separated by hospital specialty and grouped by size range from a low of 0.51 to a high of 9.03 good catches per Serious Event, with a mean of 6.06 (see Table). The Authority can provide Pennsylvania hospitals with individualized ratios to help them compare with other Pennsylvania hospitals (statewide or by peer group) for any range of dates from 2005 through 2016, with a breakdown of event types for both their own data and the comparable information for the facility's peer group (see Using Your Good Catch Comparison Report).

Table. Good Catch Ratios by Peer Group for Hospitals in 2016

<table>
<thead>
<tr>
<th>Peer Group*</th>
<th>Number of Facilities (N = 237)</th>
<th>Good Catch Ratio†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute care hospitals, 0 to 100 beds</td>
<td>47</td>
<td>9.03</td>
</tr>
<tr>
<td>Acute care hospitals, 101 to 200 beds</td>
<td>43</td>
<td>8.23</td>
</tr>
<tr>
<td>Acute care hospitals, 201 to 300 beds</td>
<td>29</td>
<td>7.85</td>
</tr>
<tr>
<td>Acute care hospitals, more than 300 beds</td>
<td>36</td>
<td>8.82</td>
</tr>
<tr>
<td>Critical access hospital</td>
<td>14</td>
<td>5.66</td>
</tr>
<tr>
<td>Long-term acute care hospitals</td>
<td>23</td>
<td>4.06</td>
</tr>
<tr>
<td>Psychiatric hospitals</td>
<td>20</td>
<td>0.51</td>
</tr>
<tr>
<td>Rehabilitation hospitals</td>
<td>19</td>
<td>4.32</td>
</tr>
<tr>
<td><strong>Overall Good Catch Ratio</strong></td>
<td></td>
<td><strong>10.34‡</strong></td>
</tr>
</tbody>
</table>

* Peer groups with fewer than 10 facilities are not displayed.
† Proportion of good catches per Serious Event.
‡ Compilation of all Pennsylvania hospitals. (Ratios of peer groups with fewer than 10 facilities are not listed.)

The report can identify facility-specific event types or care areas that are reporting above or below aggregate peer rates, potentially highlighting successful practices or targets for improvement efforts.

For example, a Pennsylvania hospital was found to have an overall ratio of good catches to Serious Events that is triple the peer rate. Facility personnel could assume on the surface that they have a successful reporting culture. However, drilling down further into the data using the Good Catch Comparison report, it became clear that 98% of this hospital's good catches were related to medication errors and were well below the peer rate for good catches related to laboratory testing errors and other event types.

The hospital could use this information and approach staff involved in the medication process to discuss reasons for the high reporting rate and use lessons learned to develop strategies to implement in other areas. Recognizing and sharing the success of medication event reporting could have multiple benefits: rewarding the staff involved and motivating staff in other areas to replicate their achievement.

**Pennsylvania Hospital-Based Programs**

**Program launch and promotion.** Programs of the interviewed facilities began with either a kick-off event or a campaign using posters and other types of publicity between January 2012 and October 2016. Kristin M. Grande, MBA, director of operations and risk management, UPMC Hamot, said she knew good catches were happening in
her hospital and wanted a way to encourage employees to report these events. She established a good catch program with a kickoff in November 2015 including a presentation by Sorrel King, a patient safety advocate whose daughter, Josie, died from a medical mishap.

Two of the hospitals used a baseball theme to publicize their good catch programs. The majority promote their programs during daily safety huddles, in newsletters, on bulletin boards, and other means of communication.

**Nomination process.** Hospitals accept nominations in a variety of ways, which include an assigned e-mail address, an internal electronic reporting system, by phone, or by paper form. Some of the facilities allow anonymous submissions, and half of the programs exclude all executive leaders from being nominated. Examples of good catches that prevented harm include incorrect medication orders, wrong labeling or patient identification on specimens, missed information, insufficient follow-up, and patient consent inconsistencies.

**Reward and recognition.** The hospitals recognize winners on a monthly basis, with some selecting additional good catches for quarterly and annual special recognition. Two of the hospitals also recognize the nominators, to help encourage submission of good catches. Hospital employees receive rewards for good catches usually based on the quality of the submission. Selection processes ranged from a random drawing of nominees to a rating scale used by a committee to identify the top good catches.

All the patient safety, risk management, and quality leaders interviewed recognize that rewarding good catches is essential to a successful program. A good catch program acknowledges the effort from staff to engage in patient safety, said Maryann Jordan, RN, BSN, director of quality management, Eagleville Hospital. "Staff appreciate being recognized for their interventions that improve processes and prevent patient harm. This is a win-win. It creates positive energy."

At UPMC Hamot, four employees are recognized quarterly with a "Josie King Hero Award," Grande said. The chief executive officer or the chief operating officer along with the chief nursing officer, chief medical officer, and the unit director accompany the risk manager and patient safety officer to the department when the employee is working, to present a plaque, she said.

"We gather everyone on the floor and have a celebration," Grande said. "We read their hero story to their peers." Grande wanted the good catch program to change the culture of patient safety by rewarding employees. "There are great things happening and we want to recognize those heroes with a positive story," she said. Since the UPMC Hamot's program began, good catch reporting has increased by about 30%, according to Grande.

**Resources needed.** The programs varied in the amount and number of monetary rewards. Every facility provided winners with some form of thank you note, and the majority included that in their employee records. Other prizes used included pins, gift cards, meal vouchers, and extra paid time off.

Similarly, the leaders agreed that the workload and staff resources needed to carry on the programs were worth the benefits. Facility personnel investments ranged from one staff member spending about one hour per week reviewing nominations to a committee of individuals meeting to score and rank the nominations in order to identify winners.

**Program benefits.** Good catch programs give hospitals a platform to think of events in a different way and empower frontline staff. "The frontline staff is our biggest asset," said Abigail Halloran, MA, director of risk management & performance improvement, Haven Behavioral Health. "They see everything and know everything. The more sophisticated and proactive they become, the safer our patients are going to be." The program offers a way for hospitals to be open and honest about admitting mistakes, Halloran said. "You can't fix a problem if you don't know about it," she said.
**Key components.** Leadership support, staff feedback, a procedure for collecting good catch events, and an analysis process are key components to a successful program.6-10 “A unit director or clinician giving feedback to an employee who has reported a good catch makes it more impactful,” according to Jacqueline Morgan, MSN, RN, CMSRN, quality nurse coordinator II, patient safety, UPMC St. Margaret.10

Knowing about good catches guides the hospital on where to concentrate its efforts, according to Grande. “We wanted to take the harm out of the equation and catch these events before they reach the patient,” she said.9

**Process improvement initiatives.** Aria Jefferson Health established a good catch program to enhance its culture of safety, according to Janice Taylor, RN, MSN, director, risk management.6 “Good catches occur at a much higher rate than events that reach the patient, but are significantly underreported,” Taylor said. “These good catches represent processes that are not reliable.”6

Each of the hospital patient safety, risk management, and quality leaders interviewed reported an increase in good catch submissions after establishing a formal good catch program.6-10 Reporting these events is critical to strengthening Aria’s safety culture, Taylor said. “This enables investigation and follow up so events can be prevented from happening in the first place rather than reacting to mistakes that have been made,” she said.6

The program at UPMC St. Margaret has led to several improvements, including a change in the way a peritoneal dialysis solution is ordered, according to Morgan.10 The good catch was reported through the event reporting system and led to changes in how the solutions are ordered in the electronic health record, she said.10

**Discussion**

Analysis of PA-PSRS reveals an increase in the “good catch-to-Serious Event” ratio of Pennsylvania hospitals over a 12-year period. Good catch programs have helped Pennsylvania hospitals promote the reporting of good catches and support a nonpunitive safety culture with recognition and rewards.6-10 Analyzing and trending good-catch data may maximize its effectiveness and identify opportunities for system improvements.13

Studies have found that by using the larger number of events reported as good catches, analysis can be performed on common causes of system hazards or failures as a basis to drive improvements such as changing practices, upgrading equipment, or increasing educational activities, to decrease the possibility of the same event occurring to another patient.14,15 Through this vigilant monitoring, an event with serious patient harm may be averted.5

For example, in the good catch by the patient care assistant who reported a bed moved while transferring a patient despite the wheels being locked, a series of actions took place after the event was reported that led to hospital-wide improvements and decreased the possibility of the event reoccurring. After the patient care assistant noticed the problem and prevented harm, she did not just fix the problem at the moment and move on but also checked to see whether the problem was elsewhere in her unit, and the hospital subsequently took the information seriously and checked on the conditions throughout the facility.

**Six-phase framework.** Johns Hopkins Hospital used a six-phase framework to identify, report, analyze, mitigate, reward, and follow its good catches.13 The process examined 29 patient safety hazards identified by individuals or groups in the hospital, which led to sustained quality improvement initiatives.13

In one case, an anesthesiologist found a high-concentration heparin vial in a bin labeled for low concentration.13 This resulted in the removal of the vial, an investigation of why this occurred, and a process to prevent the stocking of high-concentration heparin throughout the institution. Further, the physician who identified the event received a reward, and more than a year's worth of monitoring verified that corrective measures were sustained.13
Event investigation. Mazur and coauthors found that a good catch program in the Department of Radiation Oncology at the University of North Carolina had a positive impact on the organization's quality and safety efforts, resulting in improvements in the patient safety culture and in patient satisfaction. After investigating 560 good catches, they discovered more than half of the good catches occurred in situations caused by performance issues such as not following standardized processes and poor communication.

The remaining events were caused by the lack of standardized processes and technological/environmental factors. Using a safety survey tool from the Agency for Healthcare Research and Quality (AHRQ), the department reviewed results from three different surveys before and after instituting their good catch program and found improvements in their safety culture. Mazur and co-authors in another study found that identifying behaviors of healthcare workers through direct observation led to filling in gaps of knowledge about what factors drive effective improvement efforts.

Increased reporting through recognition. The Children's Hospital of Penn State Health Milton S. Hershey Medical Center found its good catches increased by 240% after establishing a "Great Catch" program in the Pediatric Acute Care Unit. In the published study, employees found that reporting good catches resulted in immediate action from nursing leadership and led to increased reporting of good catches in other units within the hospital.

Limitations

The type and number of reports collected depend on the degree to which facility reporting is accurate and complete. Variations may be the result of reporting cultures and patterns and interpretation of how events are reported. No benchmark for the optimal number of reports or ratio of good catches to Serious Events has been established. Interviews may include unrecognized biases, and the sample may not represent the entire spectrum of facility types.

Good Catch Program Design

The following program design elements suggested in the literature, and by the Pennsylvania patient safety, risk management, and quality leaders noted above, may be useful to healthcare facilities seeking to establish a good catch program.

Program Kickoff

- Get support from top leadership. Present the program to the board and executive leadership prior to launch.
- Choose a theme and/or slogan to promote the program (e.g., baseball or fishing).
- Use positive language; collect "good/great catches" instead of "near-misses" or "close calls."
- Present and describe program to all staff in departmental meetings and through all communication methods available in the facility, such as newsletters, e-mail, and bulletin boards.
- Involve leadership in the kickoff and provide regular feedback on program actions.

Nominations

- Accept all nominations, but establish clear definitions of what constitutes a good catch for the group responsible for recognition.
- Make the submission process easy, streamlined, and available 24 hours per day.
• Provide as many submission methods as possible, including e-mail, phone/voicemail, electronic health record, and written nominations.\(^6,9,18\)

• Acknowledge all nominations in some way.\(^7,8\)

**Reward and Recognize**

• Recognize nominators, to increase the number of submissions.\(^8\)

• Use departmental meetings to review nominations with staff and share improvement actions.\(^3,6,9,11-13,18\)

• Recognize selected nomineees with one or more of the following:
  
  ◦ Description in newsletter or on website\(^8,9,11\)
  ◦ Thank you note or letter from administration\(^6,9\)
  ◦ Certificate or plaque\(^6,7,9,13\)
  ◦ Gift card or voucher\(^7,8,11,12\)
  ◦ Additional paid-time off\(^6\)
  ◦ Pin or other ornament\(^6,9,11\)
  ◦ Photo of winner(s) posted in staff area\(^6,7,9,12,13\)
  ◦ Presentation involving administration and direct supervisor\(^9\)
  ◦ Letter in personnel file\(^7\)

**Analysis and Improvement Activities**

• Analyze for patterns/trends by organizing submission into categories.\(^3,6-9,11-13\)

• Provide feedback to staff.\(^3,7,9,12,13\)

• Involve nominee and/or nominator in improvement efforts.\(^3,7,9,12,13\)

• Use a process life cycle algorithm such as Plan, Do, Study/Check, Act or the Define, Measure, Analyze, Improve, and Control method to help review good catch events and implement corrective actions.\(^9,12,20\)

• Evaluate program by surveying staff.\(^6,9,12,18\)

• Report follow up in PA-PSRS under recommendations for tracking and trending.\(^21\)

• Implement improvement actions based on what is learned from good catches.\(^21\)

**Conclusion**
Analysis of PA-PSRS reveals a positive increase in the ratio of good catches to Serious Events for Pennsylvania hospitals over a 12-year period. The hospital patient safety, risk management, and quality leaders interviewed concur that good catch programs help Pennsylvania hospitals promote the reporting of good catches and support a nonpunitive safety culture with recognition and rewards. Implementing and promoting good catch reporting may help facilities analyze events and proactively implement risk reduction strategies to improve patient safety. Pennsylvania hospitals may consider using their facility ratio provided by their PSL in the Good Catch Comparison report to compare their reporting performance to hospitals of similar type and size and statewide. Analyzing facility-specific "good catch-to-Serious Event" ratios by event type may help hospitals keep track of their good catches and emphasize successful practices or targets for improvement efforts.

Notes


15. Good catches result in system changes. MD Today. 2012 Fall.


Using Your Good Catch Comparison Report

The Pennsylvania Patient Safety Authority provides a hospital-specific Good Catch Comparison report that allows individual Pennsylvania hospitals to compare with hospitals of similar type and size. Children's hospitals can obtain their ratios separately from hospitals. The report contains the individual hospital's ratio of good catches to Serious Events and a breakdown of their own good catches and Serious Events by event type. Hospitals can view their own data side-by-side with statewide aggregate data to highlight potential areas for improvement.

Consider the following opportunities when reviewing a report:

- Target event types with a lower ratio of good catches to Serious Events.
- Identify effective practices in event types with a higher or increasing good-catch-to-Serious-Event ratio.
- Identify event types with lower ratios than peer groups.
- Review changes in data over time to categorize areas where reporting has shifted to either more or fewer good catches.

Patient Safety Officers may request a Good Catch Comparison Report by contacting their Patient Safety Liaison (PSL)—see a map identifying PSLs by region (/Pages/ContactPatientSafetyAuthorityStaff.aspx) or contact the Authority office at patientsafetyauthority@pa.gov (mailto:patientsafetyauthority@pa.gov) or (717) 346-0469.

http://patientsafety.pa.gov/ADVISORIES/Pages/201709_goodcatch.aspx
Optimal Use of Antibiotics for Urinary Tract Infections in Long-Term Care Facilities: Successful Strategies Prevent Resident Harm

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Abstract

Antibiotics are one of the most commonly prescribed medications in long-term care facilities (LTCFs), but up to 75% are incorrectly prescribed. The intensity of antibiotic use to treat urinary tract infections (UTIs) in LTCFs increases the risk for life-threatening adverse effects. Overuse and misuse of these lifesaving medications has contributed to the rapid emergence of antibiotic-resistant bacteria and *Clostridium difficile* infection. The Pennsylvania Patient Safety Authority analyzed UTI events reported from Pennsylvania LTCFs during the 30-month period from April 1, 2014, through September 30, 2016, to study (1) triggers for prescribing antibiotics for UTIs, and (2) the frequency of prescriptions for broad-spectrum antibiotics specifically associated with antibiotic-resistant bacteria and *C. difficile*. The analysis reveals deviance from national practice guidelines for treating UTIs and the suboptimal use of antibiotics for mixed growth and contaminated specimens. This crisis of incorrect antibiotic use and the downstream effects of antibiotic-resistant bacteria and *C. difficile* demonstrate an urgent need for immediate adoption of best practices for accurate identification and optimal treatment of UTIs in the elderly including: (1) integrating strategies to overcome barriers to antibiotic stewardship, and (2) improving communication between nursing, prescribing staff, and healthcare facilities in the continuum of care. A Pennsylvania LTCF shares its success story demonstrating the effectiveness of these strategies in reducing suboptimal antibiotic use.

Introduction

Since the discovery of penicillin in 1928 to treat serious infections, antibiotics have saved millions of lives. However, like all medications, antibiotic use includes the risk for mild to life-threatening adverse reactions. Antibiotic use is generally considered as a possible source when a patient develops a rash, but may not be recognized as the culprit in other adverse effects such as nausea, vomiting, diarrhea, stomach pain, fungal infections, or drug fever. People older than 65 years, who are the most common residents of long-term care facilities (LTCFs), are more susceptible to
severe adverse effects of antibiotics, including anaphylaxis, central nervous system and kidney toxicity, abnormal liver function, diarrhea from *Clostridium difficile*, and consequences of antibiotic-resistant bacteria. Adverse effects are often difficult to treat and can lead to hospitalization and death. A recent study by the Centers for Disease Control and Prevention (CDC) demonstrates that antibiotic overuse may predispose individuals to sepsis due to disturbance of the normal gastrointestinal (GI) bacteria microbiome.

Because of escalating bacterial resistance to antibiotics, bacterial infections impact the community at large and are once again a worldwide threat. Overuse and misuse of lifesaving antibiotics has resulted in dwindling or unavailable treatment options and contributed to the rapid emergence of antibiotic-resistant bacteria. In LTCF, up to 75% of antibiotics are misused and incorrectly prescribed. The largest percentage of misused or incorrectly prescribed antibiotics in LTCFs are used to treat misdiagnosed urinary tract infections (UTIs), the most common bacterial infection in LTCFs.

Common misperceptions about UTI diagnosis, testing, and interpretation of laboratory tests may result in inappropriate treatment of asymptomatic bacteriuria, overuse of broad-spectrum antibiotics, and failure to review or change empiric antibiotics based on culture results. Authority analysts queried the Pennsylvania Patient Safety Reporting System (PA-PSRS) database to obtain a snapshot of antibiotic prescribing practices in Pennsylvania LTCFs.

For a UTI to be reportable through PA-PSRS, the event must meet nationally accepted criteria for clinical symptoms and diagnostic tests. The diagnostic gold standard for UTI is qualitative urine culture in the presence of evidence-based symptoms.

The frequent use of antibiotics for UTIs in LTCFs merits adoption of best practices for (1) identifying and treating urinary tract infections in the elderly, and (2) improving communication between nursing, prescribing staff, and facilities in the continuum of care. Transfer of residents between the hospital and LTCF as their level of care changes increases the opportunity for transmission of antibiotic-resistant bacteria and continuation of inappropriate antibiotic prescriptions.

### Methods

The Pennsylvania Patient Safety Authority examined all UTIs reported by LTCFs through PA-PSRS during the 30-month period reported from April 1, 2014 (when the revised McGeer reporting criteria were implemented), through September 30, 2016. The 2014 revision of PA-PSRS criteria for LTCFs reporting infections includes new data fields to list organisms identified by laboratory tests and antibiotics prescribed. This new information provides valuable information on Pennsylvania LTCFs application of UTI criteria and antibiotic treatment decisions.

Key search terms included the following: symptomatic urinary tract infections (SUTI), catheter-associated urinary tract infection (CAUTI), urine cultures, treatment, antibiotics, organisms, voided urine, and positive culture. UTI events were analyzed by subcategory (e.g., SUTI or CAUTI), information about organisms and antibiotics (e.g., events listing organism and antibiotic ordered, events missing either a qualified organism or antibiotic ordered, events with antibiotics prescribed without culture results, and events with antibiotics ordered for contaminated specimens), and voluntary free-text comments regarding diagnostic and treatment decisions. A drug class was assigned to each antibiotic.
Results

The query of the PA-PSRS database during the 30-month study period from April 1, 2014, through September 30, 2016, resulted in 13,680 UTI events (i.e., 10,949 SUTI and 2,731 CAUTI). A majority of overall UTI reports (89.5%, 12,237 of 13,680) listed both the organism found in the urine culture and the antibiotic prescribed. A less significant number (5%, 678) reported that an antibiotic was ordered but no organism was identified, because there was no culture, the culture was pending, or it was done at a hospital and unavailable. About 1% of reports (119) showed an antibiotic was ordered although the specimen was contaminated or more than 2 bacterial organisms were found. The remaining 5% of reports (646) did not report the use of an antibiotic (Figure 1).

Figure 1. Antibiotics Prescribed for Suspected and Confirmed Urinary Tract Infection in Pennsylvania Long-Term Care Facilities

![Antibiotics Prescribed](image)

Note: Data reported through the Pennsylvania Patient Safety Reporting System, April 1, 2014, through September 30, 2016. An antibiotic was not reported in about 5% (n = 646) of all of urinary tract infection events.

The First-Choice Antibiotic Prescribed for UTI Events

Fluoroquinolones were the most frequently prescribed first-choice antibiotic class (32%), followed by nitrofurantoin (15%), trimethoprim/sulfamethoxazole (TMP-SMX; 14%), and penicillins (12%). The use of cephalosporins was less frequently reported: first-generation cephalosporins were used in 7% of events; second-generation in 3%; and third-generation in 5%. Carbapenems, tetracycline, and aminoglycosides were the least frequently prescribed classes of antibiotics at 1%, 2%, and 2% respectively. The remainder of a variety of infrequently used antibiotics encompasses the "other" category, including vancomycin, clindamycin, diflucan, and azithromycin. Antibiotics were unlisted in 5% of the reports (Figure 2).
Antibiotic Use for SUTI and CAUTI Events

The most commonly prescribed antibiotics in events that list organisms identified by urine culture for SUTI and CAUTI in descending order were fluoroquinolones, followed by nitrofurantoin and TMP-SMX.

The most commonly prescribed antibiotics for events without identifying organisms were as follows:

- For SUTI events: fluoroquinolones, followed by TMP-SMX and nitrofurantoin
- For CAUTI events: fluoroquinolones, followed by third-generation cephalosporins and "other" antibiotics

The most commonly prescribed antibiotics for specimens that did not meet Pennsylvania Patient Safety Authority criteria for an infection (mixed flora or contaminated culture results) were as follows:

- For SUTI events: fluoroquinolones, followed by nitrofurantoin and TMP-SMX
- For CAUTI events: fluoroquinolones, followed by first-generation cephalosporins and penicillins

Details are provided in the Table.

Table. First-Line Antibiotics Prescribed for Urinary Tract Infections in Pennsylvania Long-Term Care Facilities

<table>
<thead>
<tr>
<th>Antibiotic Class</th>
<th>SUTI EVENTS</th>
<th>CAUTI EVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events with Organism Identified</td>
<td>Events with No Organism Identified</td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Carbapenems</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>First-generation cephalosporins</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Second-generation cephalosporins</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Antibiotic Class</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Third-generation cephalosporins</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Fluoroquinolones</td>
<td>32%</td>
<td>40%</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>16%</td>
<td>11%</td>
</tr>
<tr>
<td>Penicillins</td>
<td>1%</td>
<td>8%</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Trimethoprim-sulfamethoxazole</td>
<td>15%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Note: Data reported through the Pennsylvania Patient Safety Reporting System, April 1, 2014, through September 30, 2016. Of the total 13,680 UTI events, 10,949 were SUTI and 2,731 were CAUTI. Events with no antibiotic listed and antibiotic classes with use of less than 1% across all categories were excluded.

CAUTI, Catheter-associated urinary tract infection; SUTI, symptomatic urinary tract infection; UTI, urinary tract infection.

**Discussion**

**Selection of Antibiotics**

The high incidence of testing for UTIs, identification of the organism, and reporting of antibiotics used provides valuable information that may help guide antibiotic conservation measures. Interestingly, PA-PSRS data reveals that fluoroquinolones—which have a high tendency for adverse effects—are most often selected as empiric and first-choice antibiotic treatments for both SUTI and CAUTI in Pennsylvania LTCFs, even when the organism is not identified or the specimen is contaminated. As shown in the table, antibiotics were prescribed in some Pennsylvania LTCFs for treating UTIs that failed to meet nationally accepted criteria for a true UTI. Although it is encouraging that these events were not reported in large numbers, it nonetheless is concerning that antibiotics with a high risk of adverse effects and used outside of contemporary treatment guidelines were prescribed for empiric treatment, for suspected UTIs in which no organism had been identified, or for culture results showing contaminated specimens not appropriate for treatment.

Multiple contemporary national guidelines advocate TMP-SMX or nitrofurantoin as the primary empiric and first-line treatment of acute uncomplicated UTI in older adults (see "UTI Treatment Guidelines"). Less effective first-line agents include fosfomycin and pivmecillinam. Second-line agents including beta-lactams and fluoroquinolones are recommended when first line agents fail, or there is a high local resistance pattern (≥20%) to TMP-SMX. Fluoroquinolones and extended-spectrum cephalosporins are not recommended as empiric or first-line therapy because of their significant, negative effect on normal fecal flora, risk of adverse drug effects, and increased prevalence of antibiotic-resistant bacteria and *C. difficile*.

UTI treatment guidelines outline appropriate dosage and short course regimens. From a single dose to five days of treatment is often recommended in uncomplicated cases to achieve symptomatic cure with fewer side effects (see "UTI Management Guidelines"). Clinical factors to take into consideration when selecting an antibiotic dose and duration include the resident's history and allergies, local resistance prevalence, and the percentage of local resistance rates. The higher the percentage of resistance, the lower the threshold for treatment failure.

Appropriate antibiotic use includes: (1) selecting the right drug, dose, and duration for the condition, (2) determining necessity based on national guidelines for site-specific infections, (3) aligning compatibility with the facility susceptibility patterns (antibiogram), and (4) using the narrowest spectrum antibiotic to achieve the adequate level of
therapy. Exposure to antibiotics and extended duration of therapy can lead to a shift in normal GI microbiota, resulting in increased susceptibility to infection and sepsis. Increasing incidence of *C. difficile* diarrhea has led to a shift away from use of broad-spectrum antibiotics to narrow-spectrum antibiotics. A 16-year study published in *The Lancet Infectious Diseases* in January 2017 described an 80% decline in *C. difficile* driven by a 50% reduction of fluoroquinolone use.

**UTI Management Guidelines**

**Risk Reduction Strategies**

The following strategies synthesized from the current literature demonstrate a streamlined framework to integrate antibiotic stewardship tasks into facility policies, programs, workflows, and quality-improvement projects.

**Before requesting antibiotic orders, validate the resident's symptoms for consistency with a true UTI.**

- Use nationally recognized criteria to identify a potential SUTI or CAUTI. Use surveillance definitions based on current evidence-based literature and expert consensus. This is critical to capture true UTI events.

**Train nursing assistants and staff nurses to understand, record, and report appropriate signs and symptoms associated with UTIs.**

- Institute training programs and documentation tools. This is especially critical for difficult-to-understand criteria, such as recognizing specific symptoms of what constitutes a true change in mental or functional status, determination of fever, and the role of leukocytosis in diagnosing a true UTI.

**Avoid urine testing as the only evaluation for nonspecific signs or symptoms.**

- Do not limit to suspicions about the urinary tract the clinical assessment for falls, foul-smelling or thick dark urine, and unspecified confusion. This practice may result in missed diagnosis of conditions unrelated to the urinary tract or to an infection, such as dehydration.

**Empower clinicians to withhold antibiotic therapy for asymptomatic bacteriuria (ASB).**

- Develop clinical pathways, protocols, and communication tools to clearly define facility-based policies on screening and treatment of ASB.

- Follow current guidelines recommending ASB screening only for pregnant women and patients undergoing elective urologic procedures.

- Define ASB as >100,000 CFU of a bacterial urinary pathogen in the urine of a resident without symptoms directly attributable to the urinary tract.

- Base protocols and education on current research: (1) ASB is a benign and transient condition; (2) high rates of bacteriuria are normal in the elderly; (3) antibiotics used for ASB have major negative consequences, but lack clinical benefit; and (4) untreated ASB has minimal risk of tissue invasions and sepsis.

**Avoid dependence on Dipsticks and urinalysis (UA) without culture to diagnose and treat UTIs.**

- Avoid using rapid urine tests to diagnose and treat a suspected UTI without appropriate indications and collection methods. This practice can result in misdiagnosis and unnecessary use of antibiotics. The diagnostic gold standard for UTI is qualitative urine culture in the presence of evidence-based symptoms.
The presence of white blood cells, nitrites, leukocyte esterase, red blood cells, or protein does not differentiate asymptomatic bacteriuria from symptomatic (true) UTI appropriate for antibiotic treatment.\textsuperscript{21} False readings may occur due to urinary seeding by some antibiotics, protein, ascorbic acid, glycosuria, and vaginal contamination.\textsuperscript{22}

Educate nursing staff on appropriate specimen collection methods to prevent contamination and limit bacterial growth.

- Replace indwelling urinary catheters if in place more than 2 weeks before aspirating a specimen from the port in the new tubing.\textsuperscript{11}
- Avoid common causes of specimen contamination: improper specimen collection, unclean hands, contaminated equipment, and improper storage and transfer to the laboratory.
- Follow acceptable methods of obtaining a urine specimen by clean catch, straight catheter, or indwelling catheter. Poor-quality specimens can result in mixed flora or contaminated specimen and treatment for nonpathogenic organisms.\textsuperscript{23}

Educate nursing staff to interpret a urine culture report.

- Learn the meaning of the sensitivity patterns and the minimum inhibitory concentration (MIC), which is the lowest concentration of drug that inhibits the growth of the organism. Reporting the MIC to the prescriber guides selection of the most appropriate, lower-spectrum antibiotic.\textsuperscript{24}
- Employ a consultant pharmacist to provide education and tools to differentiate broad-spectrum from narrow-spectrum antibiotics.
- Identify the organism (not just gram-negative or lactose fermenter), determine whether the colony count is appropriate for the method of specimen collection, and review the sensitivity and resistance patterns to identify the narrowest spectrum antibiotic that will kill the organism.\textsuperscript{24}

Review facility-specific resistance patterns to guide appropriate antibiotic selection.

- Guide empiric prescribing of antibiotics while awaiting culture results using an antibiogram table. This table demonstrates the percentage of effectiveness of commonly used antibiotics for organisms identified from cultures performed in the facility in the previous year.
- Work with the facility’s laboratory contractor to develop an antibiogram. Tools are available online at https://www.ahrq.gov/nhguide/index.html.
- Reevaluate appropriateness of antibiotics ordered in the hospital or emergency department upon readmission.

Employ a watchful waiting technique for residents with nonspecific or mild symptoms.

- Avoid empiric antibiotics for changes in condition such as falls or increased confusion in the absence of UTI-specific symptoms. Observe for 24 to 48 hours for resolution of symptoms, and search for other causes of the condition. Evaluate the residents’ hydration status, push fluids, and evaluate medication side effects or worsening of symptoms, such as hypoxia.\textsuperscript{25}
- Develop clinical pathways or order sets to guide empiric treatment or watchful waiting. The Infectious Diseases Society of America provides a clear decision-making algorithm to guide antibiotic selection.\textsuperscript{14}

Establish a protocol for a 48- to 72-hour antibiotic time out.
• Develop a procedure to consult with the prescribing physician to reevaluate empiric antibiotic appropriateness within 48 to 72 hours or when final culture results are available.26

Engage stakeholders in continuum of care stewardship efforts.

• Establish relationships with hospital antibiotic stewardship teams to improve understanding of the rationale for antibiotics prescribed and to streamline availability of hospital testing results.

• Work with consultants such as behavioral health and dialysis to establish stewardship goals and protocols.

• Educate and engage families and residents in the stewardship plan.16

Measure antibiotic prescribing processes and outcomes.

• Monitor compliance with proper application of UTI criteria, antibiotic prescribing documentation, and facility-specific treatment protocols.26

• Perform a point prevalence survey of antibiotic use and measure monthly rates of new antibiotic starts and cultures ordered.

Antibiotic Stewardship in Action: A LTCF Success Story

The findings below are based on the implementation of a UTI evaluation tool at two 70-plus bed continuing care retirement community nursing facilities in Pennsylvania, providing long-term and skilled nursing care. The UTI evaluation tool was implemented to improve accurate UTI diagnosis and to reduce prescriptions of unnecessary antibiotics. This information has been provided with explicit permission from Living Branches Dock Meadows, Souderton Mennonite Homes, Dock Woods.

While performing monthly surveillance using PA-PSRS definitions, the infection prevention analyst (IP) noted a large number of asymptomatic bacteria (ASB) cases treated with antibiotics. The IP, supported by the Quality Assurance/Process Improvement (QAPI) team, looked at unnecessary treatment of ASB as the first antimicrobial stewardship project for these facilities. The medical director identified that the improper ordering of urinalyses and urine cultures could lead to the inappropriate treatment of ASB. The QAPI team discussed using a tool to guide nursing staff in ordering urine tests only when indicated by the presence of urinary symptoms.

A proprietary UTI evaluation tool, developed in 2014 by the Pennsylvania Medical Directors Association (PMDA) was adapted to meet the facilities’ needs. Direct involvement of licensed nurses provided input to create a final tool that could be easily used by all nursing staff and increased their personal investment in implementation. The IP assured that the symptoms listed in the tool were in line with PA-PSRS UTI and CAUTI criteria for infections. Finally, the QAPI committee, including the medical director, approved use of the UTI evaluation tool. Numbers of urinalysis/urine cultures and outcomes were reported monthly at QAPI meetings. The UTI evaluation tool protocol was added to the infection control policy and procedures under the antimicrobial stewardship plan.

Care coordinators and the IP provided the tool to the certified registered nurse practitioners and physicians with an explanation of how it would be used by nursing as a decision-making aid. The staff were educated in May 2015 on PA-PSRS UTI and CAUTI criteria, ASB, and antimicrobial stewardship, and in July and August 2015 on the UTI evaluation guideline. Monitoring the new process, they found that new staff were ordering an increased number of urinalyses and urine cultures, compared with such orders by staff who had previously received antimicrobial stewardship education. One-on-one education was conducted for new staff until the urinary evaluation tool was
added to the monthly clinical orientations in September 2016. The staff now receive a monthly report on the number of urinalysis and urine cultures performed and outcomes at the monthly nurses meeting. The nursing staff are reminded to consistently use the tool for decision-making when they obtain an order for a urine specimen. In addition, it was found that several urinalyses were ordered by the psychiatric consultants as part of their routine evaluation. The IP requested that the consultants eliminate the urinalysis and subsequent culture from the evaluation unless urinary symptoms were present.

The two hospital-based laboratories used by the facilities were contacted to produce a yearly antibiogram and to continue monthly culture reports to make sure all urine cultures were evaluated. The antibiogram was used to educate prescribers about resistance patterns in the facility to guide antibiotic choice. Outcomes were evaluated and measured by analysis of the number of urine cultures performed, the number of treated symptomatic UTIs and treated asymptomatic bacteriuria, and the number of episodes of bacteriuria not treated. Figure 3 depicts the aggregated data from the two facilities under the same management.

![Figure 3. Effect of Interventions on the Number of Urine Cultures and Episodes of Treated Asymptomatic Bacteriuria at Two Long-Term Care Facilities](image)

May 2015—Initial education on UTI criteria/ asymptomatic bacteriuria/ antimicrobial stewardship
June 2015—UTI evaluation guideline developed
July/August 2015—Guideline initiated, RN/LPN/CNA/MD/CRNP education
September 2015—Discouraged psychiatric consultant ordering as part of their evaluation
April 2016—Obstacle: Family request for antibiotics. Solution: Family education by supervisors, charge nurses, and infection prevention analyst
May 2016—Obstacle: Suboptimal practices by new staff. Solution: UTI evaluation tool added to new employee clinical orientation

The IP reports that oversight of compliance has been necessary from the start. The tool is posted at each nurses station as a visual reminder and to encourage use. Care coordinators are empowered to look at reasons for urine culture orders and to follow through by evaluating the culture reports to make sure that the organism is susceptible to the empirically prescribed antibiotic. The care coordinators, charge nurses, and IP educate families of residents, who sometimes insist on antimicrobial treatment. Supervisors and charge nurses talk to the families about side effects of antibiotics and provide assurance that when symptoms are mild and nonspecific, the resident will continue to be monitored for the development of more specific symptoms and extra fluids will be provided, if indicated.
Physicians approved the tool and were grateful to have nurses provide more specific information during phone consultations. The evaluation guideline was particularly well accepted because it provides options without dictating a plan of care. The nursing staff have become better critical thinkers, and nurses and physicians work together to reduce unnecessary antibiotic use. The adaptation of the UTI Evaluation Guideline by the two facilities in combination with staff education has definitely had a positive impact on the antibiotic prescribing practices within the facilities (see Figure 3).

A copy of the tool (/ADVISORIES/Documents/Tool%20PDFs/MS17731.pdf) can be found on the Authority website.

Limitations

The results of this study may not be generalizable because the PA-PSRS reporting mechanism for LTCFs does not collect data on identification or treatment of asymptomatic bacteriuria. Further, the prompts in the PA-PSRS system for reporting the organism found in the culture and the antibiotic used are optional. Finally, event reports do not provide information on empiric versus culture directed antibiotic treatment, the culture sensitivity reports, allergies, or previous adverse effects of antibiotics.

Conclusion

The combination of inappropriate antibiotic prescriptions for UTIs and the growing emergence of antibiotic-resistant organisms create an urgent need for all LTCFs to institute programs to control antibiotic resistance and side effects by requiring judicious use of antibiotics. This snapshot of antibiotic use for UTIs in Pennsylvania LTCFs demonstrates a wakeup call for individual facilities to find the stewardship gaps in their facility. This is best accomplished within the framework of a structured antibiotic stewardship program. The program should be aimed at optimizing antimicrobial use, avoiding unintended consequences of antibiotic use, and improving clinical outcomes. Strategies to overcome stewardship barriers and reduce resident harm from adverse effects of antibiotic use include actions to standardize triggers for UTI surveillance and laboratory testing, as well as accurate laboratory-results interpretation, appropriate treatment, communication, and monitoring.

Reviewer Comments

This is a very helpful article for all nursing home providers, medical directors, and management staff who are interested in reducing inappropriate or misuse of antibiotic for UTIs. The success story at the end of the article helps validate the risk reduction strategies. It is very important that the emergency department and nursing directors are on board with the current PA-PSRS criteria for UTIs. It can be very challenging for providers to practice good medicine when the upper level management undermine the established criteria by requesting a UA for behavioral changes only. Avoid transferring residents to the local hospital emergency rooms, when appropriate, for a change in condition with normal vital signs and "NO" evidence of criteria for ordering a UA. In these situations if all blood work, x-rays, and the exam are normal, it is very likely that resident will return to the nursing home with a diagnosis of a UTI, which is really an ASB. This leads to the importance of working closely with the local hospital ER providers/hospital pharmacists so they understand the updated McGeer criteria for diagnosing a UTI and prescribing the appropriate antibiotics for an uncomplicated UTI. The Antibiogram ideally should be facility-specific, since there is a broad range of levels of quality care given among nursing home residents.
Acknowledgement

Edward Finley, BS, data analyst, Pennsylvania Patient Safety Authority, contributed to data acquisition for this article.

Notes


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**Supplemental Material**

**UTI Management Guidelines**


This web page outlines current evidence-based standards for the diagnosis and treatment of infections by body site, in pdf documents, slides with case studies, pocket cards, and mobile aps.


This article reviews successful antimicrobial stewardship strategies in the diagnosis and treatment of urinary tract infections (UTIs).


This article includes evidence-based guidance for the diagnosis and treatment of UTI in long-term care residents.

This evidence-based review describes the problem of over-diagnosis and overtreatment of UTI, presents appropriate clinical findings, and offers guidance for UTI testing and antibiotic prescription.


This article recommends approaches to managing common infections in long-term care residents and proposes minimal standards for reviewing use of antimicrobials.
Legionella: Could This Potentially Deadly Bacteria Be Lurking in Your Facility’s Water Distribution System?

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Abstract

Legionnaires’ disease is a serious, sometimes lethal pneumonia. The name of this illness originated from an outbreak of severe pneumonia among attendees at an American Legion convention in Philadelphia, Pennsylvania, in 1976. The Pennsylvania Department of Health reports one of the highest annual incidence rates by state. Numerous healthcare facilities have reported outbreaks of healthcare-acquired legionnaires’ disease, with transmission consistently linked to the hot water distribution system. Preventing healthcare-acquired legionnaires’ disease depends upon identifying possible sources where Legionella growth could occur and instituting control measures. Health departments and public agencies have issued infection prevention guidelines to prevent outbreaks. Proactive culturing for Legionella in the hot water distribution system before cases of healthcare-acquired legionnaires’ disease are discovered is an evidence-based method of prevention. Superheating and flushing or hyperchlorinating the hot water distribution system are short-term approaches to terminate an outbreak. Long-term systemic water treatment with copper-silver ionization, chlorine dioxide, or monochloramine has also been effective in controlling Legionella.

Introduction

Legionellosis, a respiratory infection caused by Legionella bacteria, can manifest as legionnaires’ disease or Pontiac fever. Legionnaires’ disease is a serious, sometimes lethal pneumonia accompanied by dry cough, fever, and myalgia. Gastrointestinal tract, central nervous system, and renal manifestations also may be associated. Pontiac fever is a less serious influenza-like, self-limiting illness.¹ Risk factors for legionellosis include advanced age, male gender, cigarette smoking, alcohol abuse, chronic pulmonary disease, and renal failure. Immunosuppressed hosts, particularly those receiving corticosteroids or those who have undergone a solid organ transplant, are most frequently involved in healthcare-acquired cases.² The incubation period for legionnaires’ disease is 2 to 10 days and 1 to 2
days for Pontiac fever. Legionnaires’ disease can be treated successfully with antibiotics in most cases.\(^1\) Case fatality ranges from 13% for community-acquired cases up to 33% for healthcare-acquired legionnaires’ disease.\(^2\) Millions of healthcare dollars are spent annually treating patients who have legionnaires’ disease.\(^3\)

Legionellosis is acquired by inhaling aerosols that contain the bacteria or aspirating drinking water that contains the bacteria. Possible sources for water droplets contaminated with \textit{Legionella} include man-made water distribution systems, such as those in buildings, that provide favorable water temperatures, physical protection within biofilms, and nutrients that promote the growth of \textit{Legionella}.\(^2\) Studies have shown that 20% to 70% of hospital hot water systems have been colonized with \textit{Legionella} bacteria.\(^4\) Numerous healthcare facilities have reported outbreaks of healthcare-acquired legionnaires’ disease with transmission consistently linked to the hot water distribution systems. Decorative water fountains have also been linked to clusters of legionnaires’ disease in healthcare facilities.\(^2\)

The Centers for Disease Control and Prevention (CDC) investigated the first outbreak of legionnaires’ disease, involving delegates to the American Legion Convention held at a Philadelphia, Pennsylvania, hotel in 1976.\(^5\) Legionellosis is a nationally reportable disease, and CDC estimates legionnaires’ disease was diagnosed in 5,000 people in 2014, a four-fold increase since 2000.\(^6\) The Pennsylvania Department of Health (PA DOH) reports between 300 and 500 total cases each year, one of the highest annual incidence rates by state.\(^7\) The true incidence of legionnaires’ disease is likely higher because of missed diagnosis and underutilization of diagnostic testing.\(^8,9\) CDC also reports 20 or more outbreaks of legionnaires’ disease nationally each year, most of which are in buildings with large water systems, such as healthcare facilities.\(^6\) CDC’s investigation of legionnaires’ disease outbreaks revealed that healthcare-acquired legionnaires’ disease was responsible for 57% of cases and 85% of deaths from legionnaires’ disease.\(^10\) The waterborne disease investigative branch of CDC also found \textit{Legionella} to be responsible for 66% of all waterborne disease outbreaks in the United States between 2011 and 2012.\(^11\)

Although there are more than 60 species in the \textit{Legionella} family, \textit{Legionella pneumophila} causes 80% to 90% of legionnaires’ disease in the United States, with 75% caused by \textit{Legionella pneumophila} serogroup 1. Only about half of the more than 60 other \textit{Legionella} species have been implicated in human disease and some species are quite common in the environment but rarely cause infection. Some \textit{Legionella} organisms are among a group of species that fluoresce blue-white under long-wave ultraviolet light. They are referred to as blue-white fluorescing species and include \textit{Legionella anisa}, \textit{Legionella bozemanii}, \textit{Legionella dumoffii}, and \textit{Legionella gormanii}. To read more about \textit{Legionella} species, visit \url{http://www.specialpathogenslab.com/legionella-species.php}. The most commonly used diagnostic test is the \textit{Legionella} urinary antigen test, which is specific for \textit{Legionella pneumophila} serogroup 1.\(^8\)

Analysts sought to evaluate the incidence of definite and possible healthcare-acquired legionellosis cases and healthcare-acquired legionellosis outbreaks in Pennsylvania from 2007 through 2016.

**Methods**

Analysts used data from Pennsylvania’s version of the National Electronic Disease Surveillance System (PA-NEDSS) to review the incidence of legionellosis cases identified and reported in the state. PA-NEDSS receives legionellosis reports from laboratories and healthcare facilities, which is more comprehensive than the Pennsylvania Patient Safety Reporting System or the National Healthcare Safety Network databases that receive legionellosis reports from healthcare facilities only.

PA-NEDSS case definitions are as follows\(^12\):
1. A “case” is defined as healthcare-acquired legionellosis if a patient, employee, visitor, or volunteer spent any amount of time in a healthcare facility (i.e., inpatient or outpatient visits, emergency departments, doctor offices, or long-term care facilities) in the 10 days prior to onset of illness.

   a. A case is defined as “definite” healthcare-acquired legionellosis if the individual spent the entire 10 days in a healthcare facility before symptom onset.

   b. A case is defined as “possible” healthcare-acquired legionellosis if the individual spent a portion of the 10 days in or at a healthcare facility before symptom onset.

A healthcare-acquired legionellosis “outbreak” is defined as the occurrence of two or more cases that are epidemiologically linked (i.e., time, location, and illness characteristics).13

Results

Pennsylvania’s healthcare-acquired legionellosis cases have trended upward over the past 10 years. The numbers of definite healthcare-acquired and possible healthcare-acquired legionellosis cases reported to PA-NEDSS are shown in Figure. The number of healthcare-acquired legionellosis cases doubled from 45 in 2007 to 91 in 2016. Thirteen healthcare-acquired legionellosis outbreaks were reported to PA-NEDSS from 2007 through 2016.

Figure. Healthcare-Acquired Legionellosis Cases in Pennsylvania

![Bar chart showing healthcare-acquired legionellosis cases from 2007 to 2016]

Source: The Pennsylvania version of The National Electronic Disease Surveillance System.

Discussion

http://patientsafety.pa.gov/ADVISORIES/Pages/201709_Legionella.aspx
The incidence of healthcare-acquired legionellosis is increasing in Pennsylvania. The reason for the increase is unknown, but many factors play a role. A true increase in the frequency of disease includes human factors of more people at risk due to an aging population and people with weakened immune systems due to underlying illness or immunocompromising medications; and environmental issues of aging plumbing infrastructure and climate change. Increased diagnostic testing and more reliable reporting to PA-NEDSS are also factors.\(^8\)

The prevention of healthcare-acquired legionnaires’ disease depends on identifying possible sources where \textit{Legionella} growth could occur and instituting control measures.\(^14\) The Allegheny County Health Department in Pittsburgh, Pennsylvania, published the first guideline for preventing healthcare-acquired legionnaires’ disease in the 1990s, based in part on the experience of Pittsburgh investigators at the Veterans Affairs Medical Center. This guideline, “Approaches to Prevention and Control of \textit{Legionella} Infection in Allegheny County Health Care Facilities,” reviews diagnostic testing for \textit{Legionella} infection, advocates for proactive environmental surveillance culturing for \textit{Legionella} in hot water systems, and recommends options for controlling \textit{Legionella} in water distribution systems.\(^15,16\)

Routine annual environmental monitoring of water distribution systems—or more often if transplant surgery is performed at the facility—followed by implementation of disinfection methods if indicated, was later shown to significantly reduce healthcare-acquired legionnaires’ disease in Allegheny County and Western Pennsylvania.\(^17\) In July 2016, New York passed the first statewide regulation addressing building-associated legionnaires’ disease by mandating proactive culturing of healthcare facility water systems. Hospitals and residential healthcare facilities in New York are required to implement an environmental assessment, develop a \textit{Legionella} sampling and management plan for their cooling towers and potable water systems, and take necessary responsive actions.\(^18\)

The process to develop the first national standard for preventing legionellosis in the United States began in 2005. This process culminated in 2015 with the approval of a new industry standard developed by the American Society for Heating, Refrigerating and Air-conditioning Engineers (ASHRAE). This standard, titled ANSI/ASHRAE Standard 188-2015, Legionellosis: Risk Management for Building Water Systems, is a risk management approach to the control and prevention of building-associated legionnaires’ disease. ASHRAE Standard 188 applies to buildings with any of the following: (1) multiple rooms served by a centralized water heater, (2) 10 or more stories, (3) healthcare facility where patient stays exceed 24 hours, (4) housing immunocompromised individuals, (5) cooling towers, ornamental fountains, and/or whirlpools, and (6) housing occupants older than 65 years. To comply with ASHRAE Standard 188, facility managers need to assess the potential risk in their buildings by performing a survey for devices and building characteristics that have been associated with increased risk for legionnaires’ disease. A program team makes many of the decisions for implementing the standard requirements, including when, where, and how to test for \textit{Legionella}. This decision-making responsibility can also be a source of liability, including litigation and unfavorable publicity, should the team not seek advice from knowledgeable partners such as water treatment providers and consultants. CDC recognizes this potential gap in knowledge for those implementing ASHRAE Standard 188 and has written “A Practical Guide to Implementing Industry Standards.”\(^4,19\)

Most recently (in June 2017), the Centers for Medicare and Medicaid Services (CMS) issued a policy memorandum for hospitals and long-term care facilities to raise awareness about facility requirements to prevent \textit{Legionella} infections. CMS expects Medicare-certified healthcare facilities to develop and adhere to policies and procedures that reduce the risk of growth and spread of \textit{Legionella} and other opportunistic pathogens in building water systems. CMS surveyors will review policies, procedures, and reports documenting water management implementation results to verify that facilities have taken the following steps:

1. Conduct a facility risk assessment to identify where \textit{Legionella} and other opportunistic waterborne pathogens could grow and spread in the facility water system.
2. Implement a water-management program that considers the ASHRAE industry standard and the CDC toolkit and includes control measures such as physical controls, temperature management, disinfectant level control, visual inspections, and environmental testing for pathogens.

3. Specify testing protocols and acceptable ranges for control measures, and document the results of testing and corrective actions taken when control limits are not maintained.

CMS expects healthcare facilities to comply with the new requirements to protect the health and safety of its patients. Noncompliance with the requirements will be cited accordingly.20

Detection of Legionella

When to Test

Environmental testing can be proactive as described above or can follow identification of a case or outbreak. According to CDC, environmental testing should be performed if a single case of definite healthcare-acquired legionnaires’ disease has been diagnosed (the individual spent the entire 10 days in a healthcare facility before symptom onset) or two or more cases of laboratory-confirmed possible healthcare-acquired legionnaires’ disease (the individual spent a portion of the 10 days in or at a healthcare facility before symptom onset) occur within six months of each other.21

How to Test

Both the ACHD guideline and the New York regulations, for a 500-bed hospital, recommend selecting and testing a minimum of 10 distal sites, faucets or showers, that roughly represent the water distribution system (i.e., sites on multiple floors and wings, and include high-risk units such as hematology and oncology, transplant, medical/surgical, intensive care, and neonatal intensive care).15,18 Note that for sampling potable water systems, testing only hot water systems can be sufficient. The concentration of Legionella recovered from a given outlet has not been shown to correlate with disease risk. Rather, a distal-site positivity rate of 30% or greater for Legionella in a hospital water system has been shown to be a better indicator of risk for healthcare-acquired legionellosis.16,22,23

Routine surveillance can be performed using either swab or water samples. The results will be affected by the type of sample collected and the method of sample collection. Stout and Yu recommend collecting swab samples before water samples and after removal of the faucet aerator to achieve maximum recovery of Legionella from the biofilm within the fixture. If aerators are not removed, biofilm cannot be adequately sampled and the results can show a false negative. Water samples should be collected from the initial flow of hot water with no flushing of the outlet prior to sample collection. Flushing can reduce the recovery of Legionella. A volume of 250 mL is collected in a sterile bottle. Sample collection supplies are usually provided by the laboratory at no charge. In the context of a case investigation, Stout and Yu recommend that both swab and water samples should be collected from the water outlets in the immediate environment of the suspected case, to optimize sensitivity.24

For laboratories performing Legionella testing, the standard for environmental microbiology and laboratory quality management is International Organization for Standardization (ISO) 17025. Microbiological culture for Legionella on selective media remains the gold standard for detection per ISO 11731 Water quality - Enumeration of Legionella or ISO 11731-2 Water quality - Detection and enumeration of Legionella.18,25 No other methods, such as direct fluorescent antibody (DFA or dFA) or polymerase chain reaction (PCR), have proven more sensitive or specific for detecting Legionella pneumophila.2

Disinfection of Water Systems
More than one method can be used to disinfect hot water systems, such as the following: (1) chemical disinfection, such as copper-silver ionization, chlorine dioxide, and monochloramine and (2) physical, such as point-of-use filters placed in high-risk units such as neonatal intensive care or transplant.

**When to Disinfect**

Healthcare facilities can consider the following questions to decide whether to install a disinfection system:

1. How extensive is the colonization? (Are >30% of outlets positive?)
2. Is *Legionella pneumophila* serogroup 1 present?
3. Have cases of healthcare-acquired legionnaires’ disease (definite or possible) been diagnosed?
4. Is the facility housing at-risk individuals?

If the answer is yes to one or more of these questions, then consider disinfection. Finding species other than *Legionella pneumophila* would warrant continuous disinfection if found in a high-risk unit such as bone marrow or solid organ transplant units.

The decision regarding selection of the disinfection method for a healthcare facility is best made by a task force consisting of administrators, infection preventionists, and hospital engineers. Input from the facility’s Infection Prevention and Control Department will help ensure that there will be an evidence-based approach to selection and will include review of relevant literature. Pitfalls exist for choosing a disinfection system based solely upon a vendor’s recommendation. Evaluation of disinfection efficacy can include both *Legionella* distal site positivity and disinfectant concentrations at select locations. Issues to consider include the necessity for maintenance, regular monitoring, and possible permitting requirements. Objective assessments from other hospitals’ infection preventionists and engineers that have used the systems being evaluated may provide information to help facilities make decisions about what type of disinfection system might be appropriate for their facility. Four standard criteria have been recommended to evaluate disinfection methods:

1. Documentation of efficacy in vitro against *Legionella*
2. Anecdotal reports of efficacy in controlling *Legionella* contamination in individual facilities
3. Peer-reviewed and published reports based on controlled studies of prolonged duration (years) demonstrating the efficacy of controlling *Legionella* growth and preventing cases of healthcare-acquired legionnaires’ disease in individual facilities
4. Confirmatory reports from multiple hospitals with prolonged duration of follow-up as validation

**How to Disinfect**

The most common methods for controlling *Legionella* in the water distribution system of hospitals and other large buildings are listed in Table. The United States Environmental Protection Agency offers a literature review document of *Legionella* control measures at: [https://www.epa.gov/ground-water-and-drinking-water/technologies-legionella-control-premise-plumbing-systems](https://www.epa.gov/ground-water-and-drinking-water/technologies-legionella-control-premise-plumbing-systems). Preference is given to application to the hot water only because this has been shown to be effective in preventing illness, does not add additional chemicals to the drinking water, and requires less chemical addition because the volume of treated hot water is a fraction of the cold water used in a facility.

Table. Disinfection Methods for Controlling *Legionella* in Hospital Water Systems
<table>
<thead>
<tr>
<th>Disinfection Method</th>
<th>Intermittent or Emergency Short-Term Applications</th>
<th>Continuous Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal shock treatment (superheat and flush)</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Shock chlorination (&gt;10 mg/L residual, may require water tanks to be at a level of 20 to 50 mg/L)</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Continuous chlorination (2 to 4 mg/L)</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Copper-silver ionization</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Chlorine dioxide</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Monochloramine</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Point-of-use filtration</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>


Mg/L, milligrams of chlorine per liter of water.

Conclusion

The increasing incidence of legionnaires' disease, the millions of healthcare dollars spent annually in treating these patients, and the high morbidity and mortality associated with legionnaires' disease provide compelling arguments for a focus on prevention. Evidence-based risk reduction strategies may control and proactively prevent healthcare-acquired legionellosis. Implementation of prevention strategies may save lives and healthcare dollars and control litigation and unfavorable publicity. Healthcare facilities are encouraged to renew their focus on prevention in an attempt to reverse the trend of increasing rates of legionnaires' disease and devastating outbreaks.

Acknowledgments

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Notes


50. Also available: http://dx.doi.org/10.1016/j.ajic.2014.06.032 (http://dx.doi.org/10.1016/j.ajic.2014.06.032). PMID: 25444274.


Introduction

Feeding tubes, intravascular catheters, and other tubes and lines are routinely and safely used in healthcare, but tubes or lines that become dislodged can have fatal consequences, depending upon the type of tube or line used and how quickly the dislodgement is recognized and treated. But are some dislodged tubes and lines more harmful than others? Pennsylvania Patient Safety Authority analysts queried the Pennsylvania Patient Safety Reporting System (PA-PSRS) database to answer this question and others.

In March 2017, the Authority published an analysis of 1,858 gastrostomy tube events reported through PA-PSRS from 2011 through 2015. Analysts identified dislodgement as the most frequently reported problem, described in 996 reports. Of these, 73 (7.3%) were reported as Serious Events resulting in patient harm, including nine deaths.¹

Analysts reviewing these events questioned whether other dislodged tube and line types were reported to the Authority and how reports for dislodged gastrostomy tubes compared with these other types of tubes and lines, in terms of the number of events, severity of patient harm, and potential causes for dislodgement.

Methods

Analysts queried the PA-PSRS database for events involving dislodged tubes and lines that were reported in 2015. Events were identified using the following search criteria: (1) event subtypes included a catheter or tube problem, or removal of a tube or other medical device by a patient; (2) event descriptions contained the term “self remove” or derivative terms such as removed, removal, or removing; or (3) event descriptions contained terms used to describe tubes and lines in combination with terms to describe dislodgement. Terms used to describe tubes and lines included: catheter, drain, line, stent, tube, gastrostomy, PEG, mickey, button, jejunostomy, gastrojejunostomy, nasogastric, nasoduodenal, nasojejunal, orogastric, Dobhoff, Moss tube, Entec, intravenous, PICC, Medcomp, Broviac, port, Cordis, trach, ETT, or Hemovac. Terms used to describe dislodgement included deflate, disconnect, discover, dislodge, dislocate, displace, fell out, found, insert, leak, loose, lying, laying, misplace, malposition, move, out, patient pulled, patient pulling, position, place, pull, pull out, or tip. Wildcard characters and abbreviations were used in the search to include variations and misspellings of tube names. Harm scores for events were assigned by facilities at the time of reporting. (A list of harm scores and their definitions (/ADVISORIES/Documents/Tool% 20PDFs/201503_taxonomy.pdf) is available from the Authority.)
Analysts reviewed all reports to: (1) eliminate reports that did not involve a dislodged tube or line, (2) classify tubes and lines into six categories according to body system or placement: vascular, gastrointestinal, pulmonary, urinary, surgical and wounds, and cerebrospinal, (3) identify specific tube and line types according to anatomic location and/or function (e.g., nasally inserted enteral access devices, peripheral intravenous catheters, indwelling urinary bladder catheters, surgical-site drains), (4) tabulate harm scores reported for all dislodged tube events, and (5) identify potential causes for tube dislodgement included in the event descriptions.

Results

The query produced 8,067 event reports; 4,583 were excluded because they were unrelated to the scope of the query, leaving 3,484 events confirmed to involve dislodged tubes and lines. Figure 1 shows the harm scores reported for these events.

The majority of dislodged tubes and lines were reported as Incidents (harm scores A through D), without harm to patients (n = 3,377, 96.9%). Of these, 91 reports were submitted for events considered as not reaching the patient (i.e., harm scores A, B1, and B2). Analysts reviewed each of these reports a second time and confirmed that a dislodged tube or line was involved in each of these events.

Figure 1. Harm Scores* for Events Involving Dislodged Tubes and Lines (N = 3,484)


The following are examples of events involving dislodged tubes or lines reported through PA-PSRS, assigned different harm scores.*
Harm Score B2 – An event occurred, but it did not reach the individual (“near miss” or “close call”) because of active recovery efforts by caregivers:

*The patient had been restless and was found with her tracheostomy ties untied and the tracheostomy tube three fourths of the way out of her neck. The tracheostomy tube was easily reinserted and the patient did not sustain an injury as a result of this event. The patient’s medical provider and the patient’s family were made aware.*

Harm Score D – An event occurred that required monitoring to confirm that it resulted in no harm and/or required intervention to prevent harm:

*The patient yelled out in room for help. Staff responded and the patient was noted to be attempting to get one leg over the side of the bed. When repositioned safely in bed, the urinary catheter was noted to be removed entirely with the balloon intact and stat-lock in place.*

Harm Score F – An event occurred that contributed to or resulted in temporary harm and required initial or prolonged hospitalization:

*The patient had a pleural catheter placed after developing subcutaneous emphysema following pacemaker implantation. The patient became confused and pulled out the catheter. A chest tube was placed for pneumothorax.*

Harm Score I – An event occurred that contributed to or resulted in death:

*The patient underwent tracheostomy and percutaneous endoscopic gastrostomy (PEG) tube placement without complications. Four days later, he was noted to have increased abdominal distension and hypotension requiring vasopressors. A computerized tomography scan showed the PEG tube terminating outside the gastric lumen, with pneumoperitoneum. The patient underwent emergency surgery, including closure of the gastrostomy site and abdominal washout. Following surgery the patient continued to decline. The patient was made comfort care and passed away the next day.*

The top three categories of dislodged tubes and lines identified in event reports were vascular (n = 1,189), gastrointestinal (n = 1,064), and pulmonary (n = 1,015); see Table 1.

<table>
<thead>
<tr>
<th>TUBES AND LINES</th>
<th>INCIDENTS</th>
<th>SERIOUS EVENTS</th>
<th>TOTAL (%)</th>
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</table>

*Table 1. Dislodged Tubes and Lines Identified in Event Reports, by Category Type (N = 3,484)*
<table>
<thead>
<tr>
<th>Vascular</th>
<th>1,150</th>
<th>39</th>
<th>1,189† (34.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral intravenous catheters</td>
<td>436</td>
<td>7</td>
<td>443 (12.7)</td>
</tr>
<tr>
<td>Peripherally inserted central venous catheters</td>
<td>383</td>
<td>14</td>
<td>397 (11.4)</td>
</tr>
<tr>
<td>Centrally inserted central venous catheters</td>
<td>267</td>
<td>13</td>
<td>280 (8.0)</td>
</tr>
<tr>
<td>Dialysis access catheters and needles</td>
<td>37</td>
<td>2</td>
<td>39 (1.1)</td>
</tr>
<tr>
<td>Implanted central venous port access needles</td>
<td>36</td>
<td>0</td>
<td>36 (1.0)</td>
</tr>
<tr>
<td>Arterial lines</td>
<td>31</td>
<td>1</td>
<td>32 (0.9)</td>
</tr>
<tr>
<td>Central venous introducers and sheaths</td>
<td>10</td>
<td>1</td>
<td>11 (0.3)</td>
</tr>
<tr>
<td>Transvenous pacer wires</td>
<td>7</td>
<td>0</td>
<td>7 (0.2)</td>
</tr>
<tr>
<td>Central venous pressure monitoring lines</td>
<td>5</td>
<td>1</td>
<td>6 (0.2)</td>
</tr>
<tr>
<td>Pulmonary artery catheters</td>
<td>3</td>
<td>0</td>
<td>3 (0.1)</td>
</tr>
<tr>
<td>Extracorporeal cannulae and intraaortic balloon pumps</td>
<td>1</td>
<td>2</td>
<td>3 (0.1)</td>
</tr>
<tr>
<td><strong>Gastrointestinal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasally inserted enteral access devices</td>
<td>611</td>
<td>4</td>
<td>615 (17.7)</td>
</tr>
<tr>
<td>Surgically placed enteral access devices</td>
<td>330</td>
<td>31</td>
<td>361 (10.4)</td>
</tr>
<tr>
<td>Orally inserted enteral access devices</td>
<td>64</td>
<td>0</td>
<td>64 (1.8)</td>
</tr>
<tr>
<td>Biliary drains</td>
<td>10</td>
<td>2</td>
<td>12 (0.3)</td>
</tr>
<tr>
<td>Rectal tubes</td>
<td>9</td>
<td>0</td>
<td>9 (0.3)</td>
</tr>
<tr>
<td>Enteral access devices - tube types not specified</td>
<td>4</td>
<td>0</td>
<td>4 (0.1)</td>
</tr>
</tbody>
</table>
### Pulmonary

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>Count</th>
<th>Frequency</th>
<th>Total Count</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endotracheal tubes</td>
<td>574</td>
<td>16.7%</td>
<td>997</td>
<td>29.1%</td>
</tr>
<tr>
<td>Tracheostomy and laryngectomy tubes</td>
<td>289</td>
<td>8.5%</td>
<td>296</td>
<td>8.5%</td>
</tr>
<tr>
<td>Chest tubes</td>
<td>134</td>
<td>3.9%</td>
<td>137</td>
<td>3.9%</td>
</tr>
</tbody>
</table>

### Urinary

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>Count</th>
<th>Frequency</th>
<th>Total Count</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indwelling urinary bladder catheters</td>
<td>173</td>
<td>5.0%</td>
<td>197</td>
<td>5.9%</td>
</tr>
<tr>
<td>Nephrostomy and urostomy tubes</td>
<td>12</td>
<td>0.5%</td>
<td>19</td>
<td>0.5%</td>
</tr>
<tr>
<td>Suprapubic tubes</td>
<td>9</td>
<td>0.3%</td>
<td>9</td>
<td>0.3%</td>
</tr>
<tr>
<td>Ureteral stents</td>
<td>2</td>
<td>0.1%</td>
<td>3</td>
<td>0.1%</td>
</tr>
<tr>
<td>Ileal conduits</td>
<td>1</td>
<td>&lt;0.1%</td>
<td>1</td>
<td>&lt;0.1%</td>
</tr>
</tbody>
</table>

### Surgical and Wounds

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>Count</th>
<th>Frequency</th>
<th>Total Count</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical-site drains (bulb and accordion style)</td>
<td>65</td>
<td>1.9%</td>
<td>89</td>
<td>2.7%</td>
</tr>
<tr>
<td>Miscellaneous surgical and wound drains</td>
<td>24</td>
<td>0.8%</td>
<td>27</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

### Cerebrospinal

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>Count</th>
<th>Frequency</th>
<th>Total Count</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial drains and catheters</td>
<td>19</td>
<td>0.5%</td>
<td>19</td>
<td>0.5%</td>
</tr>
<tr>
<td>Spinal drains and catheters</td>
<td>13</td>
<td>0.4%</td>
<td>13</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

**Note:** Data submitted to the Pennsylvania Patient Safety Authority in 2015.

* Some event report narratives described more than one dislodged tube or line, within and across categories; therefore, the number of dislodged tubes and lines exceeds the total number of event reports.

Analysts identified 29 types of tubes and lines described in the event narratives. Nasally inserted enteral access devices (i.e., nasogastric, nasoduodenal, nasojejunal tubes) were the dislodged tube type most frequently reported to PA-PSRS, followed by endotracheal tubes and peripheral intravenous catheters. Figure 2 shows the top types of dislodged tubes and lines.
Surgically placed enteral access devices (e.g., gastrostomy tubes and buttons, jejunostomy tubes) were the dislodged tubes most frequently identified in reports for Serious Events resulting in patient harm (n = 31 of 107, 29.0%), followed by peripherally inserted central venous catheters (PICCs; n = 14, 13.1%) and centrally inserted central venous catheters (e.g., non-tunneled and tunneled intravenous catheters; n = 13, 12.1%). Figure 3 shows the top types of dislodged tubes and lines identified in Serious Event reports.

Data Snapshot: Dislodged Tubes and Lines | Advisory

Figure 2. Top 10 Types of Dislodged Tubes and Lines Identified (n = 3,353) in Event Reports Regardless of Category*

* The top 10 types of tubes and lines were identified in 3,484 total event reports involving dislodged tubes and lines. Some event report narratives described more than one dislodged tube or line.

Note: Data submitted to the Pennsylvania Patient Safety Authority in 2015.
Patients pulling on or moving tubes and lines was the most frequently reported potential cause for tube dislodgement, identified in about half of reports (n = 1,772 of 3,484, 50.9%). See Table 2 for a full list of potential causes for dislodgement identified in the event narratives.

Table 2. Potential Causes for Tube and Line Dislodgement* Identified in Event Reports (N = 3,484)

<table>
<thead>
<tr>
<th>Potential Causes for Dislodgement</th>
<th>Reports (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient pulling on or moving the tube</td>
<td>1,772 (50.9)</td>
</tr>
<tr>
<td>Movement of the tube during patient transfer, repositioning, or other care</td>
<td>578 (16.6)</td>
</tr>
<tr>
<td>Patient fall</td>
<td>206 (5.9)</td>
</tr>
<tr>
<td>Inadequate securement</td>
<td>119 (3.4)</td>
</tr>
<tr>
<td>Increased intra-abdominal pressure (i.e., coughing, sneezing, crying, vomiting)</td>
<td>74 (2.1)</td>
</tr>
<tr>
<td>Balloon deflated or ruptured</td>
<td>46 (1.3)</td>
</tr>
<tr>
<td>Tubing broken or ruptured</td>
<td>2 (0.1)</td>
</tr>
</tbody>
</table>

* The top 10 types of tubes and lines were identified in 107 Serious Event reports involving dislodged tubes and lines. Some event report narratives described more than one dislodged tube or line.

Note: Data submitted to the Pennsylvania Patient Safety Authority in 2015.
No reason reported 760 (21.8)

**Note**: Data submitted to the Pennsylvania Patient Safety Authority in 2015.

* Potential causes for tube and line dislodgement were identified through qualitative analysis of event-report narratives.

† Some event narratives described more than one potential cause for dislodgement; therefore, the number of events totals more than 3,484, and the total percentage exceeds 100.

* The details of the PA-PSRS event narratives in this article have been modified to preserve confidentiality.

**Conclusion**

Pennsylvania healthcare facilities have reported patient safety events involving dislodged tubes and lines across a variety of categories and tube types. Although the vast majority of these events were reported as Incidents without patient harm, Serious Events have been reported that resulted in patient harm up to, and including, death. Dislodgement of surgically placed enteral access devices (including gastrostomy tubes) is of particular concern, compared with other tube types, representing 30% of the Serious Events reported. Patients pulling on or moving tubes and lines is the potential cause for dislodgement most frequently identified in event reports to the Authority. Hospitals seeking to avoid this adverse event are encouraged to implement risk reduction strategies to prevent, recognize, and manage dislodgement—such as those shared in the Authority’s March 2016 Pennsylvania Patient Safety Advisory article, Dislodged Gastrostomy Tubes: Preventing a Potentially Fatal Complication.†

**Notes**

Workarounds: Trash or Treasure?

Author
Ellen S Deutsch, MD, MS, FACS, FAAP, CPPS
Editor, Pennsylvania Patient Safety Advisory
Medical Director, Pennsylvania Patient Safety Authority

Workarounds

Workarounds are actions performed by an individual to circumvent or temporarily fix real or perceived workflow hindrances or system design flaws or to cope with exceptional patient care circumstances.\textsuperscript{1-10} The intent of a workaround is to achieve a healthcare delivery goal or achieve it more readily or efficiently.\textsuperscript{2,6,10}

Workarounds are ubiquitous in healthcare delivery, and numerous events reported through the Pennsylvania Patient Safety Reporting System (PA-PSRS) include descriptions of workarounds. Examples of workarounds in PA-PSRS reports include medication dosages based on estimated rather than actual patient weights; consents for treatment obtained from surrogates under circumstances that make it difficult to obtain consent directly from the patient; and substitutions of equipment, medication, or other resources because of shortages. Some event report narratives describe only the immediate problem, but others address underlying causes. In some instances, the patient was well served by the workaround, and in others, the workaround created a hazard for the patient.

Examples of Workarounds

The following PA-PSRS narratives describe workarounds that involve similar actions with varying consequences:\textsuperscript{*}

\textit{A nurse was unable to scan the barcode before administering a medication because the barcode was incomplete. Pharmacy was called, and the nurse was instructed to type in the patient’s name and medical record number and to document the confirmation of the medication manually.}

This “first order” workaround\textsuperscript{11} benefited the patient, but did not address the underlying problem.

\textit{The barcode reading indicated the barcode was invalid. The nurse spoke with Pharmacy who determined that the medication was non-formulary. Pharmacy approved overriding the error message and administering the medication.}

\textit{Pharmacy also requested that the event be reported to the facility’s incident and serious event reporting system.}

This patient benefited, and documentation was requested to support investigation to prevent similar problems in the future.

\textit{After signing out a high-risk medication, the RN brought the medication to a patient in respiratory isolation.}
Once in the patient’s room, the patient’s bracelet was scanned, and upon trying to scan the medication, an error message was received. The RN discovered that a portion of the barcode was missing and therefore the label would not scan. The medication was given and then the RN returned to where the high-risk medications are held to scan an undamaged one for documentation purposes.

The scanner indicated that this was not the correct medication for this patient.

This workaround bypassed a safety mechanism, creating a patient hazard.

* Details of event narratives received by PA-PSRS have been modified to preserve confidentiality.

**Why do Providers Use Workarounds?**

Healthcare has a workaround culture, which values expertise in overcoming obstacles to get the job done for the current patient. Dedicated patient care providers feel a professional and ethical responsibility to provide the best, safest care possible to each patient, and they will try to overcome any impediments they encounter. The resultant workarounds may be identified by explicit evidence, such as posted notes or visual reminders, or implicit evidence, such as clinicians ignoring guidelines in favor of alternative procedures.

Because of factors such as incompletely understood or underspecified work conditions, resource constraints, and changing environmental conditions (e.g., patient care emergencies, surges in patient volume, malfunctioning technology), healthcare providers continually adjust how they work, which may include implementing workarounds. Healthcare delivery is not a static process; it is a complex, adaptive system. Constantly evolving conditions make it impossible to anticipate all of the consequences of process or resource decisions.

**Workarounds as Trash**

Workarounds can create short-term hazards, such as when a workaround is used to overcome an intentional barrier, which may result in bypassing a purposeful and appropriate safety intervention, creating a hazardous situation for a patient. For instance, providers may hoard or hide scarce equipment or supplies (e.g., infusion pumps, suture removal kits), which can ensure availability for the provider’s next patient, but, in the long run, exacerbates the shortage.

Long-term hazards may develop when providers use workarounds to manage an immediate problem without addressing its source. Lack of communication about failures decreases the opportunity to recognize system vulnerabilities, investigate problems, and address underlying causes. Similarly, if a workaround is superior to the current standard practice, a lack of discussion about the need for change limits its diffusion.

**Workarounds as Treasure**

Workarounds are frequently undertaken to ensure patient safety and provide efficient care. Some workarounds become embedded and accepted as the norm in patient care processes, which can make them hard to detect.
In other circumstances, workarounds may be more obvious. For example, during an unusual surge in patient volume, triaging and caring for the most critical patients takes precedence, and some documentation tasks may be temporarily deferred.20 Workarounds have value as elastic adaptivity; providers implement workaround processes to overcome inadequate or defective systems, or, more abstractly, providers sacrifice lower-order goals in order to accomplish higher-order goals.20

**Workarounds as Learning Opportunities**

Workarounds contain useful information. Viewed as problem-solving processes, workarounds can help identify flaws, provide important evidence about system function and vulnerability, and serve as input for user-centered design and alignment between work context and available tools and resources.4,9,21 While some organizations adapt clinical practice to the system, others adapt the system to clinical practice—the latter may be the most effective, reconciling design, function, and availability with real-life workflows.7 Seeking, recognizing, appreciating, and spreading improved practices could improve overall performance.11

Tucker asserts that “the challenge of workarounds is to capture their positive aspects—frontline resiliency and creativity—while simultaneously avoiding pitfalls from relying too heavily on ad-hoc solutions to long-standing problems. Health care organizations must solve this challenge if they are to deliver care as efficiently and safely as possible.”11

PA-PSRS offers the opportunity to collect and evaluate information about workarounds. Harm score A (unsafe conditions) or B2 (event prevented from reaching a patient because of intervention)22 may be appropriate for reporting events involving workarounds that successfully avert patient harm. Event report narratives that describe the workaround and its impact can provide useful information to improve healthcare delivery.

**Summary**

Individual workarounds may be seen as problematic “trash” or pragmatic “treasure.”8,10 Analysis of the context and circumstances that prompted a workaround can provide useful information that may lead to improving the safety, efficiency, and effectiveness of healthcare delivery processes. An enlightened understanding of workarounds can help healthcare facilities appreciate that workarounds are symptoms of a real or perceived workflow obstacle, and value the information that workarounds provide.

**Notes**


**Supplemental Material**

This video, adapted from a webinar recorded August 8, 2017, explores both sides of workarounds, and provides strategies to improve the safety of patient care delivery by leveraging information gleaned from workarounds.

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**Workarounds: Trash or Treasure?**

![Play button](https://via.placeholder.com/150)
"Saves, System Improvements, and Safety-II" is an occasional feature in the Pennsylvania Patient Safety Advisory, highlighting successes of healthcare workers in keeping patients safe. The Safety-II approach assumes that everyday performance variability provides adaptations needed to respond to varying conditions and that humans are a resource for system flexibility and resilience.

Collaborating To Catch Inaccuracies

The following event was reported through the Pennsylvania Patient Safety Reporting System (PA-PSRS):*

Physician called pharmacy because the anticoagulant dose calculated by the computerized order entry system seemed incorrect. Working together, they realized that the patient’s weight in the medical record was inaccurate (14 Kg instead of 147 Kg) and that was the reason the dose seemed to be low. Nursing identified and corrected a keystroke error in the weight documentation so the appropriate dose for DVT [deep vein thrombosis] prophylaxis could be ordered. The facility applauds this example of maintaining a questioning attitude and interdisciplinary teamwork.

As appreciated by the reporting facility, this successful intervention involved multiple laudable capabilities and actions. First, the physician who intended to order an anticoagulant to prevent DVTs recognized that the dose calculated by the computerized order entry system was incorrect, based on his or her medical knowledge. Then, instead of simply overriding the computer’s calculation, the physician searched for an underlying cause. In this search, the physician included other providers involved in patient care. This leveraged the insight of multiple professionals, who each contribute differently to patient care, and therefore understand—and can troubleshoot—different components of patient-care processes. Once the source of the problem was identified, correcting the underlying erroneous information not only allowed the correct medication dose to be calculated for the immediate purpose of prescribing an anticoagulant, but also prevented errors in future weight-based interventions for this patient.

* The details of the PA-PSRS event narrative in this article have been modified to preserve confidentiality.
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