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ISMP An ECRI Affiliate

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Educating the Healthcare Community About Safe Medication Practices

Administration of concentrated potassium chloride for injection during a code: Still deadly!

Problem: Decades ago, ISMP became aware of multiple patient injuries and fatalities associated with the accidental intravenous (IV) administration of concentrated potassium chloride for injection prior to dilution. Back then, it was common to find potassium chloride vials on nursing units in US hospitals, and the occasional mix-ups due to look-alike medication vials or mental slips led to disastrous outcomes. By 1987, ISMP had already convened a national meeting that helped influence USP and the US Food and Drug Administration (FDA) to require vials of concentrated potassium chloride for injection to have black caps and closures as well as warning statements to prevent mix-ups with other parenteral drugs. Nevertheless, potassium chloride vials remained on nursing units, and unsafe practices, such as not labeling syringes of potassium chloride intended for IV admixture preparation, continued to contribute to fatalities.

In 1995, ISMP sent a nationwide mailing to US hospitals that strongly recommended the removal of vials of concentrated potassium chloride for injection from patient care areas. Three years later, in the very first *Sentinel Event Alert* (www.ismp.org/ext/711), The Joint Commission (TJC) asked hospitals to consider ISMP's recommendation to not allow the vials outside of the pharmacy. By 2003, TJC required hospitals to remove concentrated potassium chloride and other concentrated electrolytes from all patient care units outside of the pharmacy in its inaugural *National Patient Safety Goals*. Since then, ISMP has been aware of only one case of accidental IV push of concentrated potassium chloride in the US in 2007 in a non-Joint Commission accredited hospital…until now.

ISMP recently received a report of an error in which concentrated potassium chloride was administered IV push to a patient during a cardiac arrest (code). In this hospital, concentrated potassium chloride vials were only stocked in the pharmacy, not on patient care units. Hands down, this is the most effective safeguard to prevent inadvertent IV administration of undiluted potassium chloride. Still, the event happened when a clinical pharmacist called the central pharmacy to ask staff to bring a vial of concentrated potassium chloride to a code he was attending. Through a series of miscommunications and incorrect assumptions, the drug was administered undiluted to the patient.

The Event

A 70-year-old intensive care unit (ICU) patient in isolation with a contagious infectious disease (not coronavirus disease 2019 [COVID-19]) experienced a cardiac arrest. To prevent unnecessary staff exposure to the infectious disease, the code was not announced overhead hospital-wide but only in the ICU. This resulted in a small team responding to the code—an experienced ICU intensivist, an experienced ICU pharmacist, and a nurse fellow and his preceptor (an experienced ICU nurse). In this hospital, the nursing fellowship program offered licensed nurses with some generalized experience the professional development necessary to become successful in a specialty field—in this case, ICU nursing.

During the code, the ICU intensivist verbally requested "potassium chloride 20 mEq IV." The pharmacist, who was pulling and preparing the medications, assumed that the intensivist did not want to administer an infusion, which would have taken an hour to administer.

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what's in a Name?

The "-parib" drug stem name

Medications with the suffix "-parib" belong to a class of cancer drugs called PARP inhibitors. PARP stands for poly-ADP ribose polymerase, which is a type of protein that helps damaged cancer cells repair themselves and survive. By blocking the protein with the PARP inhibitor, the cancer cells are unable to repair themselves and will die, which slows tumor growth. These drugs are used to treat various forms of cancer including ovarian, fallopian tube, peritoneal, prostate, pancreatic, and breast. PARP inhibitors work particularly well against cancer cells that have a mutated BRCA gene 1 (BReast CAncer gene 1).

There are currently four PARP inhibitors available in the US (**Table 1**). They are all oral cancer therapies and are available as either tablets or capsules that are taken once or twice a day. Common side effects include fatigue; bleeding problems; or decreased blood cell levels including leukopenia, thrombocytopenia, and anemia, increasing the risk for infection. Other side effects include upset stomach, diarrhea, headache, and dizziness. Some PARP inhibitors affect the kidneys or liver so the prescriber will need to order blood-

Table 1. List of oral PARP inhibitors available in the US.

Generic Name	Brand Name
niraparib	Zejula
olaparib	Lynparza
rucarparib	Rubraca
talazoparib	Talzenna

work to monitor kidney and liver function. Severe side effects may warrant dose interruptions or dose reductions. All PARP inhibitors have a warning in the

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Instead, the pharmacist thought the intensivist had purposely ordered the drug to be given undiluted via IV push, knowing it would stop the heart but assuming it was a new, unique treatment intended to save the patient, as the intensivist had used unique treatments previously during code situations with other medications. Furthermore, the pharmacist did not think to question the intensivist's order because they had developed a very strong, trusting, working relationship. The pharmacist called the central pharmacy to request a vial of concentrated potassium chloride 20 mEq since the vials were not available on the unit or in the emergency cart as a safety precaution. The pharmacy delivered the vial to the patient's room, without questioning why concentrated potassium chloride would be needed and assuming that the product would be diluted before administration.

The pharmacist asked the intensivist, "Do you still want to give potassium chloride 20 mEq IV?" while withdrawing the contents of the concentrated potassium chloride vial (20 mEq) into a syringe. When the intensivist said, "Yes," the pharmacist handed the syringe to the nurse fellow, who administered the concentrated potassium chloride IV push. All other code medications had been given IV push. So, prior to administration, the nurse fellow did not verify with the intensivist that he would be administering undiluted potassium chloride 20 mEq IV push, nor did he verbally confirm administration of the drug afterwards. The patient developed asystole and was unable to be resuscitated. The error was discovered when the intensivist asked how the potassium chloride had been administered.

Analysis of the Event

Storage of concentrated potassium chloride vials outside of the pharmacy did NOT contribute to this event, and removal of these vials from patient care units remains the primary risk-reduction strategy to prevent inadvertent IV administration of concentrated potassium chloride. However, the hospital identified four root causes of this event that should be addressed in US hospitals to prevent this specific type of error as well as other medication errors, particularly during codes. **Figure 1** (page 5) provides a visual "Swiss cheese" illustration of the four root causes of the error.

Root Cause ①: An inadequate number of caregivers were present during the code because the code was not announced hospital-wide due to infection control concerns. Under normal code conditions, in addition to the intensivist, pharmacist, and nurse fellow and preceptor, the code team would have included, at a minimum, two experienced nurses to administer medications and defibrillate/monitor the patient's heart rhythm; a respiratory therapist to maintain/monitor the patient's airway; a scribe to document the code; a house supervisor to monitor the code and direct staff in and out of the room; and a safety monitor (runner) to assist in obtaining personal protective equipment (PPE) and other equipment for staff as needed. In this case, because the code team was small:

- The pharmacist was asked to record the code, thus requiring him to document the code while preparing medications, distracting from his ability to focus on and validate the medications, doses, and drug preparation.
- Administration of all medications fell to the inexperienced nurse fellow.

Additionally, due to a lack of clarity regarding how to call and conduct codes on contagious patients with infectious diseases other than COVID-19, the ICU care team enacted the COVID-19 code protocol to limit staff exposure to the patient's highly contagious disease.

Root Cause ②: A lack of communication and incorrect assumptions among the code team led to the IV push administration of the concentrated potassium chloride. First, the intensivist did not communicate the reason for ordering potassium chloride, which is not an advanced cardiac life support (ACLS)-recommended medication. The intensivist did not share with the team that the patient's potassium level had been low that morning, nor did she think it was necessary to clarify that the potassium chloride was to be administered diluted in a piggyback infusion—she assumed everyone knew that.

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what's in a Name?

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prescribing information for myelodysplastic syndrome or acute myeloid leukemia (MDS/AML). So, patients should be monitored and treatment should be stopped if MDS/AML develops.

Some PARP inhibitors interact with other medications and should be avoided or may require PARP inhibitor dose adjustments. For example, avoid the use of CYP3A (cytochrome P450 3A) inhibitors (e.g., ketoconazole, ritonavir, ciprofloxacin, fluconazole, verapamil) or inducers (e.g., phenytoin, rifampicin, St. John's wort) with **LYNPARZA**. Also, avoid **TALZENNA** or reduce the dose when used with P-gp (P-glycoprotein) inhibitors (e.g., amiodarone, carvedilol, clarithromycin, verapamil). **RUBRACA** and **ZEJULA** have not undergone extensive drug interaction studies, so use with caution with other medications. And those taking Lynparza should avoid eating and drinking grapefruit, grapefruit juice, Seville (bitter/ marmalade) oranges, and Seville orange juice, which can increase drug blood levels.

SAFETY wires

Do not use Dr. Reddy's prefilled glass naloxone syringes with a MicroClave connector. A hospital reported several instances in which emergency department (ED) nurses experienced difficulty administering Dr. Reddy's Laboratories' prefilled naloxone syringes (NDC 43598-750-11) intravenously (IV). After connecting the prefilled syringe to a patient's IV line, which had a MicroClave (ICU Medical) needlefree syringe connector (**Figure 1**) attached, nurses had trouble pushing the plunger and administering an IV push dose. This forced the nurses to either use a new naloxone syringe or remove the syringe plunger and manually draw up the solution for injection using a different syringe.

Figure 1. MicroClave connector for use with a needlefree syringe.

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Next, the pharmacist did not clarify with the intensivist how she wanted the potassium chloride to be given (undiluted IV push or diluted infusion). Knowing that an infusion would require an hour, the pharmacist assumed the intensivist wanted to administer the drug faster. The pharmacist and intensivist had worked together in many code situations, and the pharmacist was used to the intensivist "thinking outside the box" in previous dire situations. Although he knew that IV push administration of undiluted potassium chloride would stop the heart, the pharmacist had total confidence in the intensivist's knowledge and skills and did not question what he assumed was a new and unique treatment. Also, when the pharmacist asked the intensivist, "Do you still want to give potassium chloride 20 mEq IV?" he did not specify "IV push." Likewise, the nurse fellow did not verify the medication and how it was being administered with the intensivist prior to administration, as the nurse fellow had never attended a code and had not yet started his ACLS training.

Root Cause ③: Expectations had not been established to prohibit the dispensing of concentrated potassium chloride vials outside of the pharmacy without question. The pharmacy had not established reasonable criteria (certain circumstances, if any) for dispensing concentrated potassium chloride vials to a patient care unit (e.g., for cardiac surgery in a sequestered kit). Thus, the pharmacist was able to request and approve the delivery of the vial to the patient's room without an explanation regarding its use.

Root Cause ④: A gap in supervision led the nurse fellow to practice beyond the scope of his training by administering medications during a code. The nurse fellow was just a few weeks into his training, had never participated in a code, and had not yet received ACLS training. The gap in supervision occurred when the nurse fellow's preceptor, an experienced ICU nurse, was busy getting the patient back on continuous renal replacement therapy (CRRT) during the code. Additionally, there was no formal description in the fellowship program regarding the nurse fellow's role during code situations.

Safe Practice Recommendations: Consider the following recommendations to avoid medication errors, including with concentrated potassium chloride, during codes due to inadequate caregiver presence, miscommunications, lack of concentrated potassium chloride dispensing safeguards, and gaps in nurse fellow supervision.

Attendance

Announce codes overhead. Announce all codes overhead (or via a standardized pager system) regardless of the patient's isolation status to ensure adequate, trained caregivers are present to carry out critical roles during the code, without multitasking (e.g., documentation during a code and preparing medications).

Establish guidelines to protect caregivers. Establish (or review) in-hospital resuscitation (code) guidelines and ensure they address caregiver protection from all highly infectious diseases. For example, some hospitals treat all patients as COVID-19 positive given the prevalence of asymptomatic disease in the population.

Keep those not providing direct care outside the isolation room. Minimize the code team who enters an isolation room to the smallest number of ACLS caregivers needed, requiring support staff (e.g., scribe, runner, house supervisor) to remain in the hallway outside the room, along with the full code cart. (An "immediate use drug bag/box" and defibrillator can be passed to caregivers in the room, along with other drugs and equipment as required.) Include an adequate supply of PPE near the code cart and require all caregivers who enter the isolation room to don the PPE.

Communication

Specify the route and method of administration. The intensivist/prescriber in charge of the code should specify the route and method of administration for all medication orders, clearly delineating between IV push and IV infusions.

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Not only does this delay lifesaving treatment, but the latter practice could be unsafe from an infection control perspective and because it sometimes results in unlabeled syringes.

Dr. Reddy's glass naloxone syringe is relatively new to the market, first approved last year. These syringes had recently been purchased due to a back-order with the hospital's usual naloxone supply from International Medication Systems (IMS). The hospital had not experienced a problem with the Amphastar/IMS product used previously.

Glass syringes used with MicroClave needlefree connectors have presented problems in the past. In a 2011 Safety Communication about adenosine and amiodarone in glass syringes (www.ismp.org/ext/663), the US Food and Drug Administration (FDA) noted that the action of inserting the glass syringe tip can cause the pin in the MicroClave access system to break off in the syringe tip, preventing delivery of the medication. There have been similar international reports involving EPINEPHrine injections (www.ismp.org/ext/671), and the package insert for at least one product in a glass syringe has identified an incompatibility problem with multiple needlefree connectors (www.ismp.org/ext/672). In the recently reported events, a piece of plastic had lodged inside the Dr. Reddy's naloxone syringe nozzle (**Figure 2**), effectively blocking the flow of medication.

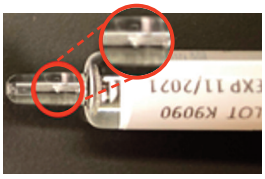

Figure 2. Silicone core appears in nozzle of Dr. Reddy's naloxone prefilled syringe.

The reporting hospital and ISMP notified Dr. Reddy's about this problem. The company did not provide either of us with a satisfactory response. In the US, BD, B. Braun, and Vygon all market similar needlefree connector products that have internal cannulas or pins, but we are not aware of similar reports of problems during administration. To address glass syringe incompatibility, ICU Medical has developed a syringe adapter, CS-25, which enables the use of glass syringes with

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Specify deviations from ACLS guidelines and medications. If time permits, the intensivist/prescriber in charge of the code should let the code team know when they order a non-ACLS medication and include a brief indication/reason.

Verify the medication. The caregivers preparing and administering each medication should repeat back the entire medication order (drug, dose, route, method of administration [including IV push or IV infusion, as applicable]) for confirmation during preparation and prior to administration. The entire medication order should again be repeated back after administration, so the intensivist/prescriber and recorder know what was administered.

Empower caregivers to ask for clarification. Create a safe environment and teach and empower caregivers to clarify questionable or incomplete medication orders. Do not make assumptions about a questionable or incomplete order, even in the presence of a strong and trusting working relationship, or one that may be condescending.

Practice communication. Hold mock code simulations, including ones in isolation scenarios, to reinforce the closed loop communication required among the team members and to acknowledge the challenges faced in this unique situation.

Evaluate communication post-code. Specifically evaluate the completeness and clarity of communication among the code team during the post-code debriefing. If applicable, add to your post-code debriefing form, "How was our communication during the code?" Plan and implement improvements as necessary.

Concentrated Potassium Chloride Safeguards

Limit access. Do not take injectable potassium chloride safety for granted, even after years of no reported events. Clearly define any specific circumstances when concentrated potassium chloride vials may be dispensed from the pharmacy and establish safeguards for those circumstances to avoid errors. (In the hospital where this event happened, there are no circumstances where dispensing of concentrated potassium chloride vials is ever allowed.) In the pharmacy, ask questions to all staff to make sure that any request to dispense the vials clearly falls within the preestablished criteria, and inquire whether the required safeguards are in place. If the request does not match preestablished criteria, question it. Remember, potassium chloride is not a life-saving medication. If a potassium chloride infusion is not available in a premixed bag, as a general rule, it should be prepared in the pharmacy where safety checks are in place.

Role of Nurse Fellows

Observation and shadowing. Nurse fellows (and other caregivers) who have not completed ACLS training should only be allowed to observe during a code. After ACLS training, the nurse fellow and preceptor should function as one unit, with the fellow shadowing the preceptor during the code, without taking a primary or separate role during the code. Preceptors should also receive specific guidance in advance of any assignment regarding any limitations of the nurse fellow's role.

Conclusion

Let this error serve as a call to action for code teams across the nation to evaluate their systems and processes to determine if any of these risk factors could be present in their facilities. One of the benefits of learning from the mistakes of others is realizing you could make the same errors. Please implement the above recommendations to avoid a repeat of those failures. As the familiar saying tells us, "An ounce of prevention is worth a pound of cure." We also hope you will incorporate this error story, analysis, recommendations, and the results of your internal evaluation into your ACLS training scenarios and practitioner competencies. Lastly, please remember that second victim support should be considered and provided after any event that causes significant patient harm.

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needlefree connectors when prefilled plastic syringes are not available. However, it is unlikely that these will be routinely used by all who administer an IV injection. If used, these should be provided in a kit along with the prefilled syringe. The hospital will be using other naloxone products or, if using the Dr. Reddy's syringe, will administer the medication intramuscularly or via the nasal route using an atomizer, not IV through a MicroClave connector.

Preferred vs. legal name of transgender patients. ISMP received a report from a hospital about a transgender patient who had not legally changed their name, but used a preferred name. This resulted in a delay of care during a cardiac emergency. When the patient coded, the team was told to remove medications from the automated dispensing cabinet (ADC) using the patient's preferred name; however, the patient's legal name, which was unfamiliar to the code team, was listed in the ADC. Although the electronic health record (EHR) included extra fields for the patient's preferred name and gender assignment at birth, ADCs receive only the legal name from the EHR, not the documented preferred name. Similar issues have also been emerging in behavioral health settings.

To ensure standardization, vendors should consider updating ADC technology to allow the preferred name to transfer from the EHR along with the legal name. On medication labels, the patient's legal name and preferred name should both be documented accordingly. It is important to recognize the potential for name confusion that this may cause during patient care, as we strive to treat all patients with respect and dignity while preventing medication harm.

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Read the past six issues of **Nurse AdviseERR** (January - June 2021), then go to the *Continuing Education Credit for Nurses* page on our website (www.ismp.org/nursingce) to take a short 10-question test. Once you pass, the certificate will be automatically sent to your email.

Newsletter also partially supported by an educational grant from NeoMed®

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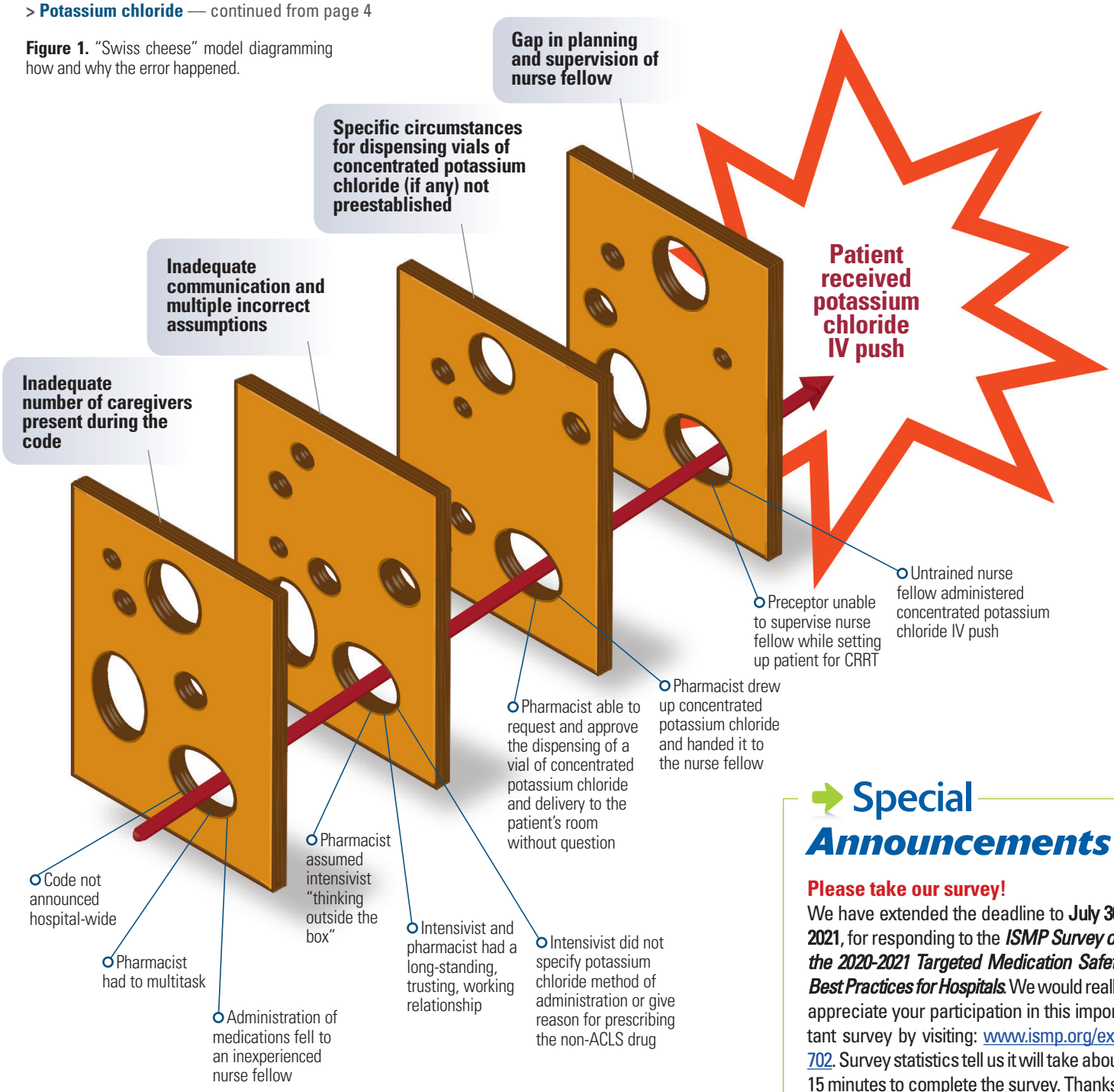
Figure 1. "Swiss cheese" model diagramming how and why the error happened.



Special Announcements

Please take our survey!

We have extended the deadline to **July 30, 2021**, for responding to the ***ISMP Survey on the 2020-2021 Targeted Medication Safety Best Practices for Hospitals***. We would really appreciate your participation in this important survey by visiting: www.ismp.org/ext/702. Survey statistics tell us it will take about 15 minutes to complete the survey. Thanks!

Practitioner in Residence (PIR) program

Our next virtual ***Practitioner in Residence (PIR)*** program is scheduled for **August 23-27, 2021**. The PIR program is designed to meet the specific safety and planning needs for practitioners with oversight of medication safety in their organizations. Participants will learn to use ISMP's unique model for identifying and controlling areas of risk exposure. To learn more or to enroll, call (215-947-7797) or visit: www.ismp.org/node/872.

If you would like to subscribe to this newsletter, visit: www.ismp.org/node/138

Report medication and vaccine errors to ISMP: Please call 1-800-FAIL-SAF(E), or visit www.ismp.org/report-medication-error. ISMP guarantees the confidentiality of information received and respects the reporters' wishes regarding the level of detail included in publications.

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