PREVENTING HIGH-STAKE RESUSCITATION-RELATED MEDICATION EVENTS

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ED resuscitations, regardless of their origin as a trauma, surgical, or medical emergency, are extremely stressful situations. Each second counts during these emergencies, leaving little time for discussion and verification of the patient's treatment plan, especially when it comes to medications. In these situations, the stakes are high, as "every errant action or inaction can result in patient harm or death."[1]

Several studies have documented the frequency of medication-related errors during resuscitation, varying from less than 1%[2] when studying reported events, to 15%[3] from observations during simulations of emergency situations, and as high as 50%[4] from observations made during an emergency. Unfortunately, patient harm from medication errors during emergent situations is thought to be quite high. For example, one study documented that medication errors during resuscitation events are 39 times more likely to result in patient harm and 51 times more likely to result in death than are nonresuscitation-related medication errors.[2] This finding is not surprising, because many of the drugs administered during a code are considered to be high-alert medications.[5] Additionally, patients are at their most vulnerable state at this time and are less likely to tolerate a pharmaceutical mistake.[1] Pediatric researchers who analyzed the actual drug content in syringes used during code simulations found significant deviations (16%) from the expected dose, suggesting that unrecognized medication errors may be a major source of morbidity and mortality in resuscitated patients, including children.[3] Unfortunately, it is difficult to even recognize such events because serious errors are often missed, even if the patient is harmed or has died, because often there is no suspicion that the drugs actually caused or contributed to the morbidity or mortality.[3,4]

Wide variation exists in the types of medication errors that occur during resuscitations, including prescribing errors, drug selection and preparation errors, labeling errors, drug dosing errors, administration technique errors, and omissions.[2–4,6] About a quarter of these errors originate during dispensing/preparation of the drug; about 28% to 50% originate during administration of the medication; and about 2% to 10% occur during the prescribing process.[2,4] In addition, a study of mock pediatric resuscitations showed that approximately 1 in 5 verbal orders did not specify an exact dose, and about half did not include the route of administration.[3] The wrong dose prescribing errors that occurred include such serious orders such as 10-fold overdoses, total daily doses ordered as a single dose, or ordering the wrong concentration of dextrose for an infant. Furthermore, about 12% of the ordered drugs in a resuscitation simulation study were omitted and never administered.[3]

The Institute for Safe Medication Practices (ISMP) has received a number of errors during resuscitations reported to its practitioner-based Medication Errors Reporting Program. Errors can be described as those involving over-reliance on human calculations, miscommunication, protocol deviation, knowledge deficit, or a dispensing device problem. Commonly reported contributing factors include look-alike product packaging or drug names; disorganized and nonstandard code carts; excessive stock in code carts, as well as multiple concentrations of a drug in the cart drawers; distractions caused by the hectic environment; poorly communicated verbal orders; inexperienced staff; alternative drugs in the emergency cart during a drug shortage; and confusing drug information or lack of drug information when it is needed. Additional error examples can be found in Table 1. Lipshutz et al[2] also point out that patients involved in codes are not the only ones who may be affected by medication errors during the code. Other patients may

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TABLE 1
Examples of hazards and medication errors associated with resuscitations[1]

Type of error	Error description
Wrong dose	A weight-based DOPamine drip was started, but the patient's weight in pounds was entered in the electronic health record as the kilogram weight and was used to calculate the dose[2]
	A physician prescribed 0.4 mg (0.033 mg/kg) of atropine IV for a 12-kg child, instead of the recommended dose of 0.12 to 0.24 mg (0.01 to 0.02 mg/kg).[3]
	A physician prescribed succinylcholine, 1.4 mg (0.2 mg/kg) for a 7-kg child instead of the recommended dose of 14 mg (2 mg/kg)[3]
	A DOPamine drip was programmed to infuse 10 mcg/kg/h instead of the intended 10 mcg/kg/min
Wrong concentration	A DOPamine 250-mL premixed bag containing 200 mg (0.8 mg/mL) was found in the drawer reserved for a 400-mg container (1.6 mg/mL)
	A physician prescribed dextrose 50% IV for a 4-kg infant instead of dextrose 10%[3]
	Pharmacy stocked the code cart with atropine, 0.5 mg, instead of 1-mg syringes; both concentrations came in almost identical packaging
Wrong drug	A nurse found a vial of furosemide instead of midazolam on the code cart; both products came in the same size vials with orange caps
	An infusion chart placed on a code cart had DOPamine information listed on the front and DOBUTamine information on the back, risking confusion with 2 known look-alike/sound-alike drug names
Delayed or omitted doses	An empty box of EPINEPHrine syringes was found in the code cart; the drug was not available immediately for administration;
	when the locked code cart was opened, a nurse found that the drug tray had not been exchanged after the prior code; key drugs needed during the code were missing
Medication delivery device problem	A health care provider injected his own thumb when attempting to administer EPINEPHrine to a patient using an EpiPen
	Prefilled syringes of adenosine (6 mg/mL, 2-mL syringes) were incompatible with the needle-free connectors

IV, Intravenous.
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experience "collateral damage" when staff supporting the code are not able to attend to their other patients, which is a common challenge in the emergency department. Luckily, these types of medication errors (mostly missed respiratory therapy treatments) were rarely harmful.[2]

Ideally, reducing the incidence of resuscitations would simultaneously reduce the incidence of medication errors during codes. Interventions such as ensuring adequate patient-to-staff ratios for appropriate monitoring and the ability to activate rapid response teams to address ongoing concerns with the patient's condition before it deteriorates can help in this regard. However, there will always be unstable patients and patients who arrive at the hospital in full cardiac and/or respiratory arrest. Thus, organizations need to address medication error risks that may be present during these unique and often chaotic situations.[1]

Emergency departments can work with their organizations in a number of ways to decrease medication safety risks associated with resuscitation efforts. Most importantly, emergency drugs should be *standardized* and *provided in a ready-to-administer form* as much as possible (to limit the need for any calculations). Often, the opportunity exists to *limit the number of concentrations* available. Storage configurations in emergency kits also should be standardized, avoiding a variable setup as a result of older cart size and different drawer configurations based on department.

Don't forget that pharmacists are invaluable members of the resuscitation team in an emergency. In addition to being Advanced Cardiac Life Support–prepared providers, they are essential consultants when dose decisions are made and complicated drug preparation is necessary. Although it is ideal for a pharmacist to always be available, many organizations in the United States have fewer than 100 beds, and thus a pharmacist may not be available around the clock to respond in an emergency. In this case, another nurse member of the team may need to step in to help.

It is important to *make sure that complete orders are given verbally,* repeated back, and confirmed by the providers.