Check Twice, Transport Once

The Case

Case #1: *A 26-year-old woman (Patient A) presented to the Emergency Department (ED) with abdominal pain and was diagnosed with "suspected ruptured ectopic pregnancy with hemoperitoneum." She was scheduled for urgent laparoscopic left salpingectomy in the main operating room (OR). Due to the urgency of the surgery, it was agreed by the ED and the OR charge nurse that the patient would be transported directly to the OR by the anesthesia care provider. The OR circulating nurse was unable to complete a full pre-operative interview. A second patient (Patient B) was a 54-year-old woman who presented to the ED the same evening with abdominal pain and bleeding from her stoma site and was scheduled for esophagogastroduodenoscopy (EGD) in the Gastrointestinal (GI) lab. Both patients had patient identifier wrist bands and were consented for their appropriate procedures. Patient B was transported directly from the ED to the OR instead of to the GI lab. The circulating nurse in the OR caught the error during the pre-procedure huddle and discovered that Patient B was not the correct patient. Patient B was transported back to the ED to await their GI lab procedure and Patient A was brought to the OR. The OR team completed the pre-procedure huddle, but during their check for availability of blood products, it was unclear whether blood type verification had been drawn on the correct patient in the ED, so another blood specimen was obtained, and uncrossed blood was sent for Patient A.*

Case #2: *A 36-year-old woman (Patient C), who was nine weeks pregnant, presented to the ED with nausea and vomiting, abdominal pain, and volume depletion. An intravenous (IV) line was placed to administer fluid. The obstetrics and gynecology (OB/GYN) team ordered a bedside ultrasound to rule out appendicitis versus miscarriage. Another patient (Patient D) was a 30-year-old woman with a history of asthma who presented to the ED at the same time with cough, wheezing, and chest discomfort. A chest x-ray was ordered for Patient D. Patient C was transported to Radiology by mistake and received the x-ray ordered for Patient D.*

Management of Cardiac Arrest in Unconventional Locations.

The Case

Case #1: *An 80-year-old man with history of Parkinson's disease and left iliac artery aneurysm underwent elective endovascular repair and endograft placement. Several days later, he developed sudden confusion, slurred speech, and tongue deviation with new bradycardia to the 30s. The primary bedside nurse attempted to contact the Rapid Response team; however, they were occupied in another emergent event. The primary vascular surgery team was paged, but that listed pager was not functional. A code stroke was called, neurology arrived at the bedside and transported the patient to the computed tomography (CT) scanner. Unfortunately, the patient lost pulses in the CT scanner and cardiopulmonary resuscitation (CPR) was initiated with return of spontaneous circulation (ROSC). The post-code rhythm on electrocardiography (ECG) was notable for new heart block. Atropine was administered, a transvenous pacemaker was inserted, and the patient was intubated for transport to the critical care unit. Despite intensive care, the patient's condition remained unstable, and he expired several days later.*

Case #2: *A 74-year-old man with a history of hypertensive end-stage renal disease and significant cardiac disease, including current antibiotic treatment for bacterial endocarditis, was seen in the outpatient renal transplant clinic for evaluation of medical stability. The patient's cardiac history*

included paroxysmal atrial fibrillation with ablation, balloon dilation of the right coronary artery, and a diffusely calcified left anterior descending artery. Recent radionuclide myocardial perfusion imaging showed a small inferolateral infarct with ischemia, a recent echocardiogram showed mild to moderate aortic regurgitation with a normal ejection fraction and no vegetations, and a recent ECG showed prolonged QT interval.

In the transplant clinic, the patient was undergoing pre-transplant evaluation. He was able to walk twenty minutes with no distress; however, he reported significant dyspnea after climbing three flights of stairs. He sat on a chair in the hallway and then became suddenly unresponsive. Physicians initiated CPR. Intubation was attempted but the vocal cords were not visualized, multiple intravenous (IV) access attempts were unsuccessful, and there was no nearby outlet for suction equipment. Emergency medical services (EMS) promptly arrived and assisted with CPR. ROSC was achieved after approximately four minutes. The patient was transported to the emergency department and admitted to the cardiology service, where he was found to have severe aortic insufficiency due to bacterial endocarditis. He underwent coronary artery bypass surgery (CABG), surgical aortic valve replacement, and left atrial appendage ligation with successful results.

Intraosseous Line Extravasation in a Pediatric Trauma Patient

The Case

An 18-month-old girl presented to the Emergency Department (ED) after being attacked by a dog and sustaining multiple penetrating injuries to her head and neck. On arrival to the ED, she was hypotensive, hypothermic, and obtunded. The trauma team identified early signs of hemorrhagic shock. After multiple unsuccessful attempts to establish intravenous access, an intraosseous (IO) line was placed in the patient's proximal left tibia to facilitate administration of fluids, blood products, vasopressors, and antibiotics. The patient was subsequently taken to the operating room for exploration and debridement of her injuries. She remained hypotensive requiring frequent boluses of crystalloid. Peripheral intravenous (IV) access was eventually obtained after which intraoperative use of the IO line was restricted to a low-rate fluid infusion. During surgery, her left lower extremity was palpated frequently and a pulse oximeter was placed distally on her left great toe to confirm continuous perfusion of the extremity. An hour into the operation, the anesthesiologist found her left calf to be warm and tense, presumably due to fluid extravasation from the IO line. The IO line was removed, and the Orthopedic Surgery service was consulted intraoperatively due to concern for acute compartment syndrome. At this point, the patient was hemodynamically stable with satisfactory peripheral IV access. The patient was transferred postoperatively to the pediatric intensive care unit (PICU) for close monitoring. Signs of compartment syndrome eventually resolved without any surgical intervention.

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Saline Flush Leads to Acute Paralysis of an Awake Patient: Risks of Improper Medication Labeling in an Operating Room

The Case

A 48-year-old man with colon cancer was booked for laparotomy and sigmoid colectomy. The patient was assigned an American Society of Anesthesiologists physical status classification of level III due to serious nature of his colon cancer.[1] *An intravenous (IV) cannula was inserted for preoperative fluids while the patient was in his hospital room. In the preoperative treatment area, the Anesthesiology resident flushed the IV cannula to ensure that it was patent and functional. The Anesthesiology department had run out of bright red labels for rocuronium, a non-depolarizing muscle relaxant, so syringes containing rocuronium were labelled with handwritten labels. Immediately after the IV fluid flush using a syringe labeled as "0.9% saline", the patient became unresponsive and immobile. The patient was speedily intubated in the Operating Room (OR) after being ventilated with sevoflurane, a halogenated inhalational anesthetic, and oxygen by the attending anesthesiologist. The operation was cancelled, and the patient was transferred from the OR to the ICU (Intensive Care Unit), mechanically ventilated and sedated.*

In the ICU, the patient started moving after about one hour, once muscle relaxant reversal medication was given, and the patient was extubated soon afterwards. On inquiry, he said that he initially felt "paralyzed" after the IV flush and could hear everything that was being said prior to his intubation and sedation. The patient was found to be medically stable and was scheduled for close follow-up to assess for any complications, including psychological consequences.

A Case of Mistaken Capacity: Why A Thorough Psychosocial History Can Improve Care.

The Case

A 72-year-old man with history of chronic obstructive pulmonary disease (COPD), tobacco and alcohol use disorder, and metastatic prostate cancer (not currently on therapy) was brought into the Emergency Department (ED) by his daughter from his board and care facility with weight loss and worsening pain. The patient was hypotensive on arrival, but his blood pressure improved with fluid resuscitation. He was cachectic with a body mass index (BMI) of 12.6. Laboratory tests were notable for acute kidney injury, metabolic acidosis, hypomagnesemia, hypophosphatemia, hypocalcemia, hypoalbuminemia, and pancytopenia. Chest imaging was unremarkable. Computed tomography (CT) of the abdomen/pelvis showed an enlarging prostate mass with invasion into the posterior bladder wall and worsening nodal and bony metastases. Urinalysis revealed large leukocyte esterase and many white blood cells.

The patient was given intravenous fluids with electrolytes and started on antibiotics for a presumed urinary infection. Preliminary chart review revealed multiple missed oncology appointments. The patient was a poor historian; he was alert and oriented to person and place but could not recall his prostate cancer diagnosis and was unaware that he was supposed to follow up with oncology. According to the patient's daughter, he had been living at the board and care facility for several months. She had not seen him since he was admitted, and she found him covered in urine and malnourished. She knew of his cancer

diagnosis but was unsure why he was not receiving treatment. The palliative care service was consulted to clarify goals of care.

Further medical record review revealed that the patient was incidentally diagnosed with prostate cancer, metastatic to bone, when he was admitted for a fall related to alcohol use six years earlier. He was seen in clinic one month after that discharge, without family present, and scheduled for outpatient biopsy. The patient showed up for his biopsy without adequate preparation and so it was rescheduled. He did not show up to the following four oncology appointments. His daughter was notified by phone, the patient re-established care in February of the following year, underwent biopsy in May, and started on androgen deprivation therapy in June. However, he continued to miss scheduled appointments. He presented to clinic in December with his nephew to re-engage with therapy; however, he missed his appointment in infusion clinic. His nephew called one year later to reschedule but the patient only received two doses of androgen deprivation therapy, with no further documentation in the electronic health record until he was readmitted one year before the current admission. During this prior admission, the Palliative Care team called the patient's daughter to obtain collateral information. According to the daughter, the patient had developmental delay and been conserved by his mother until she passed away a decade earlier. The daughter also reported that her family had difficulty locating the patient due to his history of alcohol abuse and marginal housing. On interview, it was determined that the patient did not have capacity to make complex medical decisions. He was discharged to a skilled nursing facility, and then to a board and care facility when he failed to improve. He missed two more oncology appointments before his current admission with cancer-related pain.

Based on the patient's poor functional status (Eastern Cooperative Oncology Group Performance Status 4), he was not considered a candidate for additional therapy. After a discussion of goals of care with the patient and daughter, he was enrolled in hospice.

A Loss of Trust and a Missed Diagnosis
The Case

A 65-year-old woman with a past medical history of hypothyroidism, depression, and 50 pack-years of cigarette smoking presented to her primary care physician (PCP), concerned about low back pain. She had sustained a minor fall a few weeks prior, although initially she did not have pain. At the time of her appointment, she described the pain as deep, and 6 out of 10 in severity, concentrated in her left low back. She was advised to apply ice and take ibuprofen. She returned to her PCP a few months later and reported persistent pain. A lumbar spine radiograph was performed that showed mild degenerative disc disease. The patient was prescribed hydrocodone/acetaminophen in addition to ibuprofen; she found these medications helpful. The PCP encouraged her to exercise more and try to lose some weight (her body mass index was 28 kg/m2).

At subsequent follow-up visits, her physician extended the hydrocodone/acetaminophen for an additional month and continued to encourage exercise and weight loss. In 2020, as the COVID-19 pandemic restricted in-person visits, she was seen by video twice for progressive pain—now 9 out of 10 in severity and limiting her ability to walk due to leg spasms. She requested an extension of her hydrocodone/acetaminophen prescription, which the PCP denied out of concern that she was 'drug seeking.' He encouraged exercise and attributed her pain to depression. Over the next several weeks, her pain continued to worsen. She began experiencing balance problems and leg spasms such that she required use of a walker to ambulate. Her family encouraged her to see her PCP; however, she refused to see him because she felt he didn't believe her symptoms. The patient now struggled so much with activities of daily living that she required her daughter and daughter-in-law to care for her.

Finally, a year after her initial evaluation for back pain, the patient's family brought her to the emergency room because she was unable to ambulate even to the bathroom due to pain. The emergency physician ordered spine, left hip, and chest x-rays. The chest x-ray showed a 5 cm lesion in her lung, the spine x-ray showed a small vertebral lesion, and the hip x-ray showed multiple lesions in her pelvic bones. A biopsy of the lung lesion led to a diagnosis of lung cancer, and magnetic resonance imaging (MRI) showed signs of metastases to the liver and bone, as well as multiple small fractures of the pelvic girdle. Given the extent of metastatic disease, the patient decided against aggressive treatment with curative intent and enrolled in hospice. She received morphine for pain while her family provided around-the-clock care. She died of metastatic lung cancer 6 weeks after her enrollment in hospice.

Delayed Diagnosis of Kidney Transplant Complications

The Case

A 69-year-old man with End-Stage Kidney Disease (ESKD) secondary to diabetes mellitus and hypertension, who had been on dialysis since 2014, underwent deceased donor kidney transplant. He was discharged home on postoperative day (POD) 4 with slow graft function. His serum creatinine decreased postoperatively but began to increase about a month later. A kidney ultrasound showed increased vascular resistance (a marker of atherosclerotic and hypertensive organ damage), decreased diastolic flow, moderate hydronephrosis and a peri-transplant fluid collection. Magnetic resonance angiography (MRA) with ferumoxytol injection revealed kinking of the left external iliac artery (EIA) adjacent to the transplant anastomosis.

Based on these imaging findings, Interventional Radiology (IR) was consulted for a transplant nephrostomy tube placement, percutaneous drain placement, and angiography with possible stenting of the kinked left EIA. The nephrostomy tube placement and angiography were noted to be difficult, but the tube was placed and serial balloon angioplasty of the EIA was done. The patient had persistent low urine output and increasing creatinine. A kidney ultrasound on post procedure day (PPD) 3 revealed a central hematoma, decreased systolic velocity and no diastolic flow. Computed tomography (CT) of the abdomen and pelvis was concerning for renal artery thrombosis. He underwent a transplant nephrectomy, which also found a large capsular hematoma. A strong EIA pulse was noted after nephrectomy. He was discharged home on POD 4, but on POD 9, during a clinic visit, the patient reported increasing left leg weakness/heaviness and claudication. His left leg was cool with absent pulses. The patient was readmitted and CT angiogram revealed a left EIA dissection and stenosis. The vascular surgery team then performed a right to left fem-fem bypass. The patient was recovering well when he left against medical advice 3 days later.

Delayed Diagnosis and Treatment of an Occult Hemothorax Following Complicated Central Line Insertion Leads to Cardiac Arrest

The Case

A 2-year-old girl with acute myelogenous leukemia and thrombocytopenia (platelet count 26,000 per microliter) with marked generalized petechiae and bruising was scheduled for implantation of a central venous catheter with a subcutaneous port. After reviewing the patient's electronic health records but without seeing the patient, who was in another hospital, the anesthetist asked the surgeon to order a platelet transfusion to increase the child's platelet count to above 50,000 per microliter. The patient was transported to the operating room while still receiving the platelet transfusion, so a follow-up platelet count had not yet been obtained.

After induction of general anesthesia, the assistant surgeon tried 10 times to cannulate either subclavian vein without using ultrasound guidance. He finally succeeded in cannulating the left subclavian vein and, after fluoroscopically confirming that the tip of the catheter was in the lower half of the superior vena cava, he closed the wound. The patient was then awakened from general anesthesia and transferred to the post-anesthesia care unit. The surgeons had not noticed a moderate left-sided hemothorax on the post-procedure chest radiograph. This finding was reported by the on-duty radiologist but not conveyed to the surgeons. The anesthesiologist, who remained in the operating room, was called to see the patient who was pale, crying inconsolably, with fluctuating blood pressure. Realizing the seriousness of the child's bleeding condition, he alerted the patient's surgeons and the pediatric intensive care physician, but they were unable to arrive at the child's bedside for 30 minutes and 45 minutes, respectively, so the anesthesiologist ordered blood for an urgent transfusion. Before the child could be transfused, she suddenly collapsed and developed cardiac arrest accompanied by pulseless electrical activity (PEA). A "code blue" was called and the child was successfully resuscitated after about 20 minutes, following insertion of a thoracostomy drainage (chest) tube.

Unfortunately, the surgeon had damaged an intercostal artery when he inserted the chest tube emergently, which caused further bleeding and two additional episodes of PEA arrest. The patient required bedside thoracotomy and a prolonged pediatric intensive care unit (PICU) stay, during which she developed a subdural hematoma and ischemic encephalopathy.

Patient Safety Events Involving Opioid Dose Stacking
The Case

Case #1: A 35-year-old male with a history of chronic opioid use, anxiety disorder, and major depression presented after a fall with a femoral fracture requiring stabilization. He underwent internal fixation without intraoperative complications and was admitted to a routine postoperative unit. Medication reconciliation was completed by the admitting team, confirming that he was opioid-tolerant. Upon admission, home doses of an antidepressant and lorazepam were continued. Through the first evening after surgery, the patient called for pain medications multiple times and consequently, two oral hydromorphone doses were given early, and two supplemental doses were given intravenously. When the morning shift started, the new nursing assistant called the team to bedside as the patient was lethargic with shallow, slow breathing. The rapid response team was called immediately. The patient was given naloxone and safely intubated to help protect his airway and improve ventilation. An arterial blood gas was done, which revealed a high carbon dioxide (CO2) level. After correction of his respiratory deficit, he was successfully weaned off mechanical ventilation and extubated.

Case #2: A 56-year-old female was sent to the Emergency Department (ED) from a skilled nursing facility due to a worsening wound from an amputation of the first metatarsal of right great toe at a different hospital. The patient had a past medical history of morbid obesity, hypertension, heart failure, chronic kidney disease (stage 3), diabetes, peripheral artery disease, and ischemic cardiomyopathy. The patient had two procedures during the previous week - an arteriogram followed by balloon tamponade of the left femoral artery.

Upon hospital admission, she was stabilized medically and sent to surgery for a trans-metatarsal foot amputation. Post-operatively, her pain was difficult to control and she received multiple interventions and pain assessments in the PACU, including a popliteal block by the anesthesiologist. She was transferred from the PACU to the inpatient floor that evening and started on a hydromorphone patient-controlled analgesia (PCA). That night, the patient continued with high pain scores and received additional hydromorphone as well as doses of hydrocodone with acetaminophen several times. When the nurse returned to the patient's room after providing a supplemental dose of intravenous hydromorphone, the

patient was found unresponsive, and a code was called. The code team attempted resuscitation for over one hour, but the patient expired less than nine hours after surgery. The code team focused on treating her ischemic heart disease and did not administer naloxone.

The Next Step: Use of a Pre-Operative Checklist to Prevent Missteps

The Case

A 52-year-old woman with no significant past medical history presented to a multidisciplinary breast clinic with a left-sided breast mass that was incidentally found on routine screening mammography. Diagnostic work up with ultrasound-guided biopsy led to a diagnosis of ductal carcinoma in situ (DCIS). A lumpectomy procedure with lymphoscintigraphy and sentinel lymph node biopsy (SLNB) was scheduled. A Magseed (5 mm sterile surgical steel rod) was inserted into the lesion using ultrasound guidance to help the surgeon localize the non-palpable mass during surgery. The patient was informed where and when to arrive for her procedure, and what steps to take before arriving. On the day of surgery, the patient was met in the pre-operative unit by several different provider teams to help prepare her for the lumpectomy with lymphoscintigraphy and SLNB.

In the pre-operative unit, the patient was assigned a nurse who recorded her demographic information, verified the procedure, and confirmed her medical history. Per protocol, the resident physician greeted the patient and initialed the left breast with a marker to verify the site of surgery. The attending physician stopped by to answer questions and to confirm that the procedure was running on schedule. The anesthesiology team prepared the patient for surgery according to their own protocol and rolled her to the Operating Room (OR).

In the OR, the surgical team (circulating nurse, surgical technician, anesthesiologist, attending and resident surgeons, and medical student) prepared the patient for surgery. Two separate time-outs were performed while the patient was being prepped, placed under general anesthesia, and draped. After the final time-out, the attending began operating. She tried localizing the Magseed as well as the expected Technetium-99 radiotracer dye, but quickly learned that no radiotracer dye had been injected for the SNLB – a key process step that was supposed to have occurred prior to the surgery. The nuclear medicine team never saw the patient preoperatively, and none of the staff members or teams realized this until the patient was under general anesthesia with an open incision. Subsequent investigation uncovered that the patient was properly scheduled on the nuclear medicine calendar, showing that the error could have been avoided if someone had discussed with the patient her attendance or someone from the surgical team team had called nuclear medicine before sending the patient to the OR. The attending physician decided to continue the operation without the radiotracer dye, given the practical difficulty of calling the nuclear medicine team urgently into the OR.

Fortunately, in this case, the sentinel lymph node was able to be localized even without the radiactive. However, the patient was put at risk for an adverse event that could have affected the outcome of her care and diagnosis. For example, if the sentinel lymph node was not correctly identified and instead a distant lymph node was sent to pathology, a lymph node metastasis may have been missed. Furthermore, the patient would have had a higher risk of lymphedema if a complete axillary lymph node dissection needed to be completed as a result of this error.

Culture Clash No More: Integration and Coordination of Disease Treatment and Palliative Care

The Case

A 77-year-old man with no significant medical history initially presented to the Emergency Department (ED) for abdominal pain. During the patient's evaluation, he was found to have a rectal mass. The patient

declined any surgical intervention or chemotherapy after discussing goals of care with an oncologist. He underwent two rounds of targeted radiotherapy and then was lost to follow up. The patient re-presented to the ED after a fall at home. He had been living independently. In the ED, slight left sided weakness was noted that contributed to dysarthria, difficulty ambulating, bathing/toileting, and feeding himself. Lung and brain imaging revealed new metastatic lesions in both lungs and numerous enhancing lesions in the brain. The patient was started on high dose steroids to reduce cerebral edema. Further discussions of the goals of care revealed that the patient desired to focus on comfort and on maintaining independence for as long as possible. He was discharged to an inpatient hospice for comfort care.

The inpatient hospice team discussed the potential role of brain radiotherapy for palliation to meet the goal of maintaining independence. The patient agreed to a radiation oncology evaluation and successfully completed a course of central nervous system (CNS) radiation in five divided doses. The patient's strength, energy, and speech improved, and he was able to feed himself, groom himself, and ambulate several feet with assistance. He was able to spend time with his friends and family and have clear conversations with them and participate in activities due to his improved function.

Hidden Danger! Insidious Postpartum Bleeding After Emergency Cesarean Delivery.
The Case

A 32-year-old pregnant woman presented to Labor and Delivery with prelabor rupture of membranes at 37 weeks' gestation. She had significant obstetric history with 5 prior vaginal deliveries, all at term, with no attendant complications. The fetal heart rate (FHR) at presentation was category 2, described as moderate variability with normal baseline; accelerations were present with sporadic variable decelerations. On vaginal examination, her cervix was noted at 7 cm, right occiput transverse, -1 station, with adequate contractions coming every 3 minutes. Regional anesthesia was requested.

After dosing of regional anesthesia, the patient was placed in supine position with a leftward tilt. The FHR and uterine monitors were adjusted when suddenly FHR dropped to 60 beats per minute below baseline. Oxygen via face mask and position change were initiated, but the FHR remained depressed for 120 seconds without signs of returning to baseline. Upon vaginal examination, the obstetric provider diagnosed umbilical cord prolapse and called for an emergency cesarean delivery for fetal bradycardia. The infant was born 10 minutes after the cesarean was called with Apgar scores of 4 (1 minute) and 9 (5 minutes). Umbilical cord gases showed mixed acidosis with an arterial pH of 7.0 and base excess of -12. Uterine atony was noted after delivery of the placenta, which quickly responded to oxytocin bolus and uterine massage with a quantitated blood loss (QBL) of 1200 ml. The patient was hemodynamically stable when transferred to the post-anesthesia care unit (PACU) with intravenous fluid running at 125 ml/hour, and vital signs to be checked every 15 minutes, according to protocol.

Through the first 90 minutes in the PACU, the uterine fundus remained moderately firm. Vital signs showed systolic blood pressure around 90 mm Hg, mean arterial pressure (MAP) 60-70, pulse 110-120/min, respiratory rate 24-28/min. The patient was deemed stable. All monitor alarm functions were silenced to help the patient rest until a bed became available on the maternity floor. After 180 minutes in the PACU, the patient's nurse discovered her unresponsive and the bedsheets were blood-soaked. The obstetrician and anesthesiologist were summoned and responded quickly. At that time, the patient's vital signs showed a blood pressure of 88/40, mean arterial pressure of 57, pulse 142/min, respiratory rate 26/min, and 98% oxygen saturation. The intravenous fluid was opened up as a bolus. The uterus was boggy on examination. Uterotonic medications were ordered and administered. Quantitated blood loss was estimated at 1500 ml. A massive transfusion protocol was ordered. The patient remained hypotensive and tachycardic with continued vaginal bleeding, so the decision was made to return to the operating room for laparotomy and possible hysterectomy. Upon abdominal entry, the uterus was noted to be atonic

despite uterotonic therapy. There was no other source of bleeding. Given the patient remained hemodynamically unstable, she underwent an emergency hysterectomy. As she continued to bleed after surgery, she had angiography and embolization of a small bleeding artery in the pelvis. She was transferred to the intensive care unit (ICU) and required intubation and mechanical ventilation for two days. She made a complete recovery without any sequelae.

To Dilute or Not Dilute: Drug Errors and Consequences in the Operating Room

The Case

A 78-year-old woman with a history of hypertension, hyperlipidemia, coronary artery disease, and macular degeneration presented for a pars plana vitrectomy (PPV) under monitored anesthesia care (MAC) with an eye block. She had undergone a similar procedure 4 weeks earlier and tolerated it well. In the preoperative holding area, the anesthesia team took the patient's history and performed a brief physical examination. The patient's daughter accompanied her for support and help with translation. Nothing had changed in her physical status since her prior procedure. She was bit slow to reply to questions, but this finding was attributed to the language barrier, as she had no reported history of cognitive impairment. The procedure was discussed with the patient and her daughter, and they agreed to proceed with the same MAC anesthetic that she had received during her prior procedure.

This was one of many eye cases during a busy day at a large academic medical center. The anesthesia team consisted of an attending anesthesiologist and a resident from another specialty. At this academic center, eye cases under MAC are typically performed with an eye block by the surgeon after the anesthesiologist has administered some short-acting sedation, commonly with remifentanil. For this purpose, the pharmacy typically stocks 2 mL syringes with a prediluted mixture of remifentanil 50 mcg/mL in the "eye rooms." On this day, there was a shortage of premixed remifentanil. The only remifentanil available was a vial of 1 mg in powder form. The resident, who was unfamiliar with the process of drug dilution, assumed that this should be diluted into 2 mL to mimic the premade syringes, and mixed 1 mg of remifentanil powder into a syringe of 2 mL saline at a concentration of 500 mcg/mL.

The patient was brought into the operating room and monitors were applied. After the pre-induction briefing was completed, the patient received 1 mL of the remifentanil solution. Shortly thereafter, she became unresponsive, hypotensive, and apneic. After multiple attempts to stimulate her, an overhead code was called. The attending anesthesiologist verified with the resident that only 1 mL of Remifentanil had been administered, and checked the record to confirm that this dose had been well tolerated by the patient in the past. Vasoactive drugs were administered to recover the blood pressure and the patient was ventilated with an ambu-bag. A neurological exam confirmed that the pupils were equal and reactive, albeit pinpoint. The possibility of a stroke was discussed, and a computed tomography (CT) scan was ordered "stat." After approximately 30 minutes of resuscitation, the patient was hemodynamically stabilized, regained her respiratory function, and became increasingly responsive. She was transported to the recovery room in stable condition and examinations by the neurology and cardiology consultation teams were unremarkable.

Afterthe patient recovered, the case was reviewed. The process of dilution of the remifentanil was discovered to have yielded a 10-fold stronger concentration than anyone had realized at the time. Instead of 50 mcg, the patient had received 500 mcg of remifentanil, which explained the hypotension, apnea, and loss of consciousness.

The Hidden Danger of Unseen Intravenous Catheters

The Case

A 6-week-old infant underwent a craniotomy and excision of abnormal brain tissue for treatment of hemimegalencephaly and epilepsy. The infant had no other congenital abnormalities and was pre-operatively assigned an American Society of Anesthesiologists (ASA) physical status classification level III, indicating a patient with severe systemic disease, due to the underlying brain malformation.[1]

General anesthesia was induced with sevoflurane, a halogenated inhalational anesthetic, after which the patient was intubated and mechanically ventilated. A right femoral central venous catheter and an arterial catheter were inserted. A 22-gauge intravenous catheter was inserted into the external jugular vein. Surgical drapes were then placed over this intravenous catheter, making the external jugular vein cannulation site difficult to monitor by both the neurosurgeon and the anesthesiologist. During the surgical procedure, the neurosurgeon adjusted the patient's head, displacing the external jugular intravenous catheter into the subcutaneous tissue. The catheter's dislodgment went unnoticed due to its position underneath the surgical drapes.

The patient experienced significant blood loss during the surgical procedure and became hemodynamically unstable. Blood products and intravenous fluids were infused under pressure into the external jugular intravenous catheter rather than the femoral central venous catheter. Despite these resuscitative efforts, the patient developed severe hypotension and, ultimately, pulseless electrical activity. The surgical drapes were removed to facilitate chest compressions. At this time, marked subcutaneous fluid extravasation was noted at the site of the external jugular intravenous catheter. An emergency thoracotomy was performed but the patient could not be resuscitated and died in the operating room.

Dangers of Missing an Epidural Abscess: Multiple Visits and Delayed Diagnosis with a Severely Negative Outcome
The Case

A 44-year-old man with a recent history of interferon treatment for Hepatitis C infection and a remote history of cervical spine surgery requiring permanent spinal hardware presented to his primary care physician with complaints of new onset headache, photophobia, and upper respiratory tract infection symptoms. On physical examination, his neck was tender, but he had no neurologic abnormalities. Laboratory testing showed only abnormal transaminases. He was sent home from the clinic with advice to take over-the-counter analgesics.

Three days later, he presented to the emergency department (ED) with worsened headache and neck pain and was discharged without imaging or evaluation of cerebrospinal fluid (CSF). He returned to his primary care physician four days later with worsening headache, nausea, vomiting, and photophobia, and was given oxycodone for pain. He was next seen in the hospital's urgent care clinic where he had a fever of 101.4˚F, hallucinations, and neck stiffness. He was sent to the ED by ambulance for suspected meningitis. CSF obtained by lumbar puncture was cloudy with 692 white blood cells per microliter (80% neutrophils), low glucose, and high protein, but no visible organisms on Gram staining. Cultures of blood and CSF were obtained but imaging of the cervical spine was not ordered. He was diagnosed with viral meningitis and sent home with antiemetics and long-acting oral morphine sulfate. He was not treated with antibiotics. The next morning, two blood cultures returned positive for *Staphylococcus aureus* while CSF culture was negative. After being called at home, the patient returned to the hospital and was admitted with a presumptive diagnosis of Staphylococcal meningitis.

Despite initiation of intravenous antibiotic therapy, the patient developed worsening neurologic symptoms on his third hospital day including weakness, urinary incontinence, and urinary retention. He was unable to stand or walk. Cervical magnetic resonance imaging (MRI) showed a spinal epidural

abscess (SEA) adjacent to his surgical hardware. At that point, he was transferred to a tertiary care center where decompressive surgery was performed. Despite surgical intervention, the patient remained quadriplegic. He was unable to resume employment and required full-time home care after discharge. The patient committed suicide several years later.

Lost in Transitions of Care: Managing an Opioid-Dependent Patient with Frequent Hospitalizations

The Case

A middle-aged Black woman presented to the Emergency Department (ED) with sickle cell crisis and a history of multiple, long admissions related to her sickle cell disease, including avascular necrosis of the hip. In the previous 365 days, she had spent 199 days hospitalized (54% of the year) at one hospital. The following paragraphs summarize her course over this previous year. Of note, oral morphine milligram-equivalents (OME) in this case are calculated using the institutions' opioid equianalgesic doses. During these prior hospitalizations, her long-acting opioid requirements ranged from 120 to 300 OME.

Encounter 1

After a several-months-long hospitalization approximately one year ago, the patient was discharged to a skilled nursing facility (SNF) for post-acute care on long-acting oral morphine sulfate extended release (ER) 120 mg twice daily (240 OME). She was released from the SNF after about one month, but on follow-up with her primary care physician about two weeks later, there was uncertainty about her opioid dosing, apparently because of incomplete records from her multiple sites of care. For unclear reasons, the physician did not access the state's prescription drug monitoring program (PDMP) but instead referred her to clinical pharmacy for medication support. After this consultation, the patient was started on transdermal extended-release buprenorphine 5 mcg/hour (possibly ~11-63 OME).

The tables below show what the pharmacist and prescriber(s) saw, or would have seen, in the PDMP at key transition times. For each controlled substance prescription, the PDMP shows the date filled, the drug name and formulation, the quantity dispensed, and the number of days that quantity would be expected to last according to the instructions given.

On January 1, the patient received Morphine Sulfate ER (60 mg, 12 tablets for a 3-day supply) and Oxycodone (15 mg, 26 tablets for a 7-day supply), both dispensed from the SNF pharmacy. The following day, on January 2, the patient was prescribed Morphine Sulfate ER again (60 mg, 60 tablets for a 15-day supply) from the same facility. A week later, on January 9, the patient was given Tramadol (50 mg, 120 tablets for a 20-day supply), also from the SNF pharmacy.
Further prescriptions were recorded on January 13, when the patient again received Morphine Sulfate ER (60 mg, 60 tablets for a 15-day supply), and on January 15, when Tramadol (50 mg, 84 tablets for a 14-day supply) was dispensed—both from the SNF pharmacy.
On February 22, the patient was prescribed a Butrans patch (5 mcg/hr, 4 patches for a 28-day supply) from Pharmacy A, indicating a transition to outpatient care.
The note at the bottom clarifies that the recorded dates have been altered but maintain the actual duration between each fill date. This table highlights the patient's pain management regimen over time and the transition from inpatient SNF care to outpatient prescription fulfillment.

Encounter 2

Shortly after this primary care visit, the patient was readmitted for about two weeks with increased pain. She received oxycodone at 180-240 OME during this hospital stay and was discharged with instructions to take oxycodone 40 mg ER three times daily (180 OME), according to the discharge summary. However, her actual discharge prescription, which was not mentioned on the discharge summary, was for oxycodone/acetaminophen 5/325 mg 1-2 tablets by mouth every 4 hours as needed (45-90 OME), as oxycodone ER needed prior authorization and was not covered by her insurance. Ultimately, the oxycodone ER prescription was never filled.

Encounter 3

The patient was readmitted to the hospital several weeks later for increasing pain and was restarted on her previous inpatient regimen with oxycodone ER at 40 mg three times daily (180 OME). Within several days after admission, her pain was improved, but the pain pharmacy consultant noted that her self-reported home usage was only "possibly 23 OME," and as a result, they recommended tapering the oxycodone dose by 50% every 3 days. The patient's pain worsened within several days, and therefore her oxycodone ER was titrated back up to 40 mg three times daily, but continuing severe pain led to further up-titration to 60 mg three times daily (270 OME). Her 2-month hospital stay was complicated by severe hip pain due to avascular necrosis, which eventually required total hip arthroplasty. After routine postoperative recovery, she was discharged on oxycodone ER 80 mg three times daily (360 OME); but because this medication was still not covered by her insurance plan, the care team requested the hospital to cover a 30-day supply to avoid delaying discharge.

The table presents a record of a patient's prescription fills on June 17, listing two opioid medications dispensed from **Pharmacy B**. The first entry shows a prescription for **Oxycodone (30 mg, 30 tablets, with a 5-day supply)**, indicating an immediate-release formulation likely prescribed for acute pain management. The second entry for the same date records a prescription for **Oxycontin ER (80 mg, 90 tablets, with a 30-day supply)**, which is an extended-release formulation commonly used for long-term pain control.
This information suggests that the patient was prescribed both short-acting and long-acting opioid medications on the same day, likely to manage different aspects of their pain regimen. The data highlights controlled substance prescribing patterns and could be relevant for monitoring opioid use and compliance with regulatory guidelines.

Encounter 4

On follow-up with the primary care physician 4 weeks later, the patient was put back on long-acting oral morphine sulfate ER at 90 mg three times daily (270 OME, in addition to short-acting oxycodone/acetaminophen at 90 OME; see table 3 below) with plans to taper the dose. Prescriptions were sent to her pharmacy for a 7-day supply for 30 mg and 60 mg tablets of morphine sulfate ER with instructions to take one of each, for a total of 90 mg, three times daily. The outpatient pharmacy insisted on clarification of these instructions, so only 30 mg tablets were initially dispensed. Five days later, the 60 mg tablet prescription was filled. In the meantime, the patient's opioid dose gap was "covered" with oxycodone/acetaminophen.

*The table documents a series of opioid prescriptions filled between **July 5 and July 22** at **Pharmacy A**. The patient was prescribed **Oxycodone-Acetaminophen (10 mg-325 mg)** multiple times, suggesting ongoing pain management with a combination opioid and non-opioid analgesic. The first prescription on **July 5** provided **42 tablets for a 7-day supply**, which was repeated on **July 13**. A subsequent prescription on **July 21** was for a slightly lower quantity of **28 tablets for a 7-day supply**.*
*Additionally, the patient was prescribed **Morphine Sulfate ER**, an extended-release opioid formulation. On **July 17**, the patient received **21 tablets of 30 mg strength for a 7-day supply**, and on **July 22**, the prescription was increased to **60 mg strength, again with 21 tablets for a 7-day supply**.*
This pattern suggests a structured pain management plan, potentially transitioning the patient from short-acting oxycodone-acetaminophen to a longer-acting opioid (morphine sulfate ER) while still maintaining access to breakthrough pain medication. The frequent refills and controlled nature of these medications indicate careful monitoring of opioid use, likely under close medical supervision.
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Encounter 5

About 1.5 weeks after the last morphine sulfate ER fill shown in Table 3 above, the patient was readmitted for abdominal pain secondary to sickle cell pain crisis. She was started on morphine sulfate ER 60 mg twice daily (120 OME) but required up-titration to 120 mg twice daily (240 OME). The Pain pharmacy consultant recommended conversion to methadone, so she was discharged with a prescription

for methadone 10 mg tablets and directions to take three-quarters of a tablet three times daily (roughly 113-180 OME). The outpatient pharmacy wanted clarification of the prescription, but had difficulties reaching the care team, so the prescription was not filled. Several days later, the pharmacy received a fax request to deactivate the prescription; therefore, the patient never received methadone.

Encounter 6

The patient was re-admitted 2 weeks later with worsening pain. She was placed on morphine sulfate ER 60 mg twice daily (120 OME). Medication reconciliation by a pharmacy technician documented only the delayed fill of morphine sulfate ER 60 mg three times daily on July 22 (180 OME) and missed the fact that her prescribed dose was 270 OME. On discharge, the patient was instructed to continue morphine sulfate ER 60 mg three times daily, but she was only prescribed immediate-release oxycodone for 3 days at 180 OME. They failed to notice in the PDMP that her most recently filled long-acting opioid prescription was for morphine sulfate ER 90 mg three times daily (7-day supply) 2 months prior (see Table 3).

The table records two opioid prescriptions filled on **July 31** and **September 28**, indicating continued pain management. On **July 31**, the patient received **Oxycodone-Acetaminophen (10 mg-325 mg, 56 tablets for a 14-day supply)** from **Pharmacy A**. This prescription suggests an adjustment from previous 7-day supplies to a longer **14-day supply**, possibly indicating increased stability in the patient's pain management plan.

On **September 28**, nearly **two months later**, the patient was prescribed **Oxycodone (15 mg, 30 tablets for a 5-day supply)** from **Pharmacy B**. The shift from **Oxycodone-Acetaminophen** to **pure Oxycodone** and the change in pharmacy may suggest a new phase in treatment, a different prescribing physician, or a short-term acute pain management need. The gap between the prescriptions and the change in medication type may indicate a transition in pain management strategy, potentially tapering off or adjusting opioid use under medical supervision.

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Coming up for Err: Missed Diagnosis in a Patient with Recurrent Pneumothorax

The Case

A 31-year-old woman with no past medical history presented to the Emergency Department (ED) with worsening shortness of breath. On examination and plain radiography, she was unexpectedly found to have a moderate-sized left pneumothorax. A thoracostomy tube was placed resulting in immediate relief of symptoms. The patient had a computed tomography (CT) scan done as a part of the work-up and she

was told that she had some blebs and mild emphysema. Once the lung was fully expanded, the chest tube was removed and the patient was sent home with no specific follow-up instructions, except to see her primary care physician.

Three days later, the patient returned to the same ED with similar symptoms and again was found to have a left pneumothorax that required chest tube placement. At this time, another chest CT was obtained, and a pulmonology consultation was requested. The consulting physician explained to the patient that she had some small cysts and blebs in her chest. After this second episode of spontaneous pneumothorax, she was discharged to her home after the chest tube was removed.

Two weeks later, the patient was found on the floor of her kitchen by her husband with severe respiratory distress and a very thready pulse. He called 911. After hearing her recent history, paramedics immediately placed a needle in her left chest which gave prompt relief of symptoms and restored hemodynamic stability, strongly suggesting she had had another episode of left-sided pneumothorax with tamponade physiology (also known as a tension pneumothorax). She was taken to a different ED this time, where she had another chest CT. The ED physician was concerned by the CT scan and requested another pulmonary consultation. This time, the on-call pulmonary physician diagnosed cystic lung disease based on the CT findings, and decided to transfer the patient to an advanced lung center for further immediate work-up and treatment.

On arrival at the referral center, the patient had a left-sided chest tube in place with no air leak and a fully expanded lung. The patient's CT scan showed classic features of lymphangioleiomyomatosis (LAM), a rare cystic lung disease that is most often seen in young women.

After careful evaluation, the patient underwent video-assisted thoracoscopic surgery (VATS) pleurodesis on the left side. At the same time, a biopsy was performed to confirm the diagnosis. After surgery, the patient required about 2 liters/minute of oxygen by nasal cannula to prevent dyspnea and hypoxia with exertion. She was started on sirolimus to prevent progression of her bilateral extensive cystic disease, and she is now doing well, with no recurrences of pneumothorax, and being followed regularly through a comprehensive Advanced Lung Disease and Lung Transplant program.

Sudden Collapse During Upper Gastrointestinal Endoscopy: Expect the Unexpected

The Case

A seven-year-old girl had esophageal stenosis due to ingestion of a caustic substance as an infant *(Note: although not specified in this case, the most common caustic substances ingested by children are household cleaning agents)*. She required recurrent upper endoscopy with esophageal dilation under general anesthesia. During the procedure, she was fully monitored with a continuous arterial oxygen saturation probe, heart rate monitors, two-lead electrocardiography, continuous capnography, and non-invasive arterial blood pressure measurements.

The attending gastroenterologist and endoscopist were serially dilating the esophagus with larger and larger rigid dilators when the patient suddenly developed hypotension with a marked decrease in end-tidal carbon dioxide (CO_2). She was immediately given a fluid bolus, phenylephrine, and 100% oxygen but still developed cardiac arrest. Cardiopulmonary resuscitation (CPR) was initiated with cardiac massage, but she could not be resuscitated and died.

Local Anesthesia-Induced Coma During Total Knee Arthroplasty.

The Case

A 61-year-old male patient weighing 57 kg (126 lbs), with severe knee osteoarthritis and hypertension, was admitted for right total knee replacement under subarachnoid regional anesthesia.

The anesthesiologist performed a right femoral nerve block with 20 ml (100 mg) of 0.5% racemic bupivacaine for postoperative analgesia. Intraoperatively, the surgeon also infiltrated the arthroplasty wound with 200 mg of 0.5% ropivacaine, unaware that the anesthesiologist had already performed a femoral nerve block. The patient was sedated with an infusion of propofol throughout the procedure. To the surprise of the anesthesiologist, 100 mcg boluses of intravenous phenylephrine were required to maintain the patient's arterial blood pressure intraoperatively. At the end of the procedure, after stopping the propofol infusion, the patient remained unresponsive.

When the anesthesiologist inquired about the surgeon's use of local anesthesia, it was discovered that the surgeon had used a relatively large dose of ropivacaine. After diagnosing the patient with Local Anesthetic Systemic Toxicity (LAST), the anesthesiologist ordered an intravenous bolus and infusion of intralipid. The patient was observed in the surgical intensive care overnight. He recovered without further complications and was transferred to the surgical ward on the first postoperative day.

Medication Errors in Retail Pharmacies: Wrong Patient, Wrong Instructions.
The Case

Case #1: A 65-year-old woman with a history of acute myeloid lymphoma called her oncology physician's office with symptoms of chemotherapy-induced nausea. After a prescription was called into her local pharmacy, the patient presented to the pharmacy to pick up her prescription for ondansetron. She was asked to provide her last name, but no other identifying information. After several unsuccessful calls from the oncology office to check on the patient over the next few days, the physician's staff called 911. Paramedics found that the patient had collapsed at home. Upon arrival at the hospital, she was diagnosed with severe dehydration, hypotension, and acute kidney injury requiring aggressive fluid resuscitation. Upon further investigation, it was discovered that the patient was inadvertently dispensed spironolactone that was meant for a different patient with the same last name.

Case #2: A 66-year-old woman was prescribed estradiol vaginal tablets (10 mcg) for post-menopausal symptoms. After five weeks of taking the prescribed medication according to the instructions provided by her pharmacy, she noticed an increase in headaches and vulvovaginal itching, both of which were possible adverse effects listed in the medication handout. At her follow-up appointment to discuss her symptoms with her provider, it was found that the prescription instructions were incorrectly transcribed as "1 tablet twice per day" versus the prescribed "1 tablet twice per week". The patient was instructed to hold off taking the estradiol for one week and resume with the correct dose the following week. The patient informed the pharmacy of the error, for which the pharmacist acknowledged the mistake, apologized, and reassured the patient that they would investigate the matter. The patient was never given

any follow-up information by the pharmacy. When she went to the pharmacy a month later to pick up her refill, she noted that the refill still had the incorrect instructions on the package.

The Consequences of Miscommunication Regarding a Possible Artifact

The Case

A 52-year-old man complaining of intermittent left shoulder pain for several years presented to an orthopedic surgeon's office. He was diagnosed with a rotator cuff injury and underwent left shoulder surgery. The postoperative course was unremarkable. Four months later, the orthopedic surgeon ordered a routine follow-up X-ray of the left shoulder. The radiologist interpreted the film as a normal left shoulder radiograph but noted a "… soft tissue density in the left suprahilar region most probably artifact, however follow-up chest X-ray is advised for further evaluation." This report along with the images were sent to the orthopedic surgeon's office the same day. However, the orthopedic surgeon independently read and interpreted the same images as "slight loss of rotator cuff interval added to decompression of AC joint and undersurface of the acromion noted." The surgeon did not mention any soft tissue density, did not reference the radiologist's report, and did not order any follow-up study.

The patient saw the orthopedic surgeon multiple times after the initial follow-up X-ray without any knowledge of or follow-up for the "soft tissue density" in the left suprahilar region. Several months later, the patient's primary care provider noted the radiologist's finding during a routine visit for healthcare maintenance, and ordered a proper workup. Following needle biopsy guided by computed tomography, the lung mass was diagnosed as a Stage IIB adenocarcinoma with metastasis to one of ten parabronchial nodes. This diagnosis was quickly followed by surgical resection and several courses of chemotherapy. Upon review of the images, the mass had grown from an initial diameter of 3.5 cm to 7.0 cm just before resection.

Inadequate Anesthesia Preparation Leading to Difficult Intubation and Severe Hypoxemia

The Case

A 34-year-old morbidly obese man weighing 178 kg (392 pounds) was admitted for incision and drainage of a pilonidal abscess with fistulectomy under general anesthesia. He reported no major medical problems and no history of snoring. Upon initial evaluation by an anesthesiologist, he was found to have a short thick neck and a Mallampati score of 3, suggesting that endotracheal intubation might be difficult.

The patient was positioned supine with his head and neck in the ramped position plus sniffing position for endotracheal intubation. A high flow nasal cannula was used for preoxygenation and to help avoid precipitous desaturation in the event of difficulty intubating the trachea. A fellow anesthetist suggested that video-laryngoscopy equipment should be brought into the operating room, but the anesthesiologist assigned to the case rejected the suggestion. Anesthesia was induced with intravenous propofol and fentanyl, while neuromuscular block was obtained with intravenous suxamethonium. A first-year resident attempted to intubate the patient but failed. The attending anesthesiologist took over, but before intubation could be performed, the patient started to cough and desaturated to 40-50%. The anesthesiologist gave the patient rocuronium and sevoflurane, but he still could not intubate the patient and failed with a glide scope. He then gave 12 mg/kg of intravenous sugammadex to reverse the neuromuscular block. After about two minutes, the patient started to cough up bloody secretions and was administered 100% oxygen by mask. His arterial saturation increased rapidly to 100%.

Although the patient's saturation was less than 80-88% for at least 10 minutes, he suffered no apparent neurological sequelae. After a period of recovery, he was brought back to the operating room for the originally scheduled procedure, which was completed without further complications.

Paroxysmal Supraventricular Tachycardia Masquerading as Panic Attacks

The Case

At the age of 16, an otherwise healthy woman began feeling “woozy” after her high school gym classes. She described it as “not a black-out but a feeling of a white-out” occurring roughly once every month or two. Her symptoms were abrupt in onset and she felt her heart was racing and pounding like it was going to jump out of her chest. The symptoms lasted between 5 and 15 minutes, and then subsided after sitting down. There was no family history of heart disease. Over the ensuing years, similar episodes occurred occasionally, usually related to stress, such as while giving presentations to large audiences.

When the patient was in her 30’s, she went through a period of significant emotional and financial stress, having just broken up with her longtime boyfriend, and suffered some loss of income. At a time when she was feeling particularly stressed, she experienced a more severe episode that she described as “her heart pounding.” She went to a local emergency department (ED) thinking she might be having “a heart attack.” She had a normal electrocardiogram (ECG) and was discharged with a diagnosis of “likely stress reaction/possible panic attack.” She felt embarrassed for having gone to the ED and although she continued to periodically have these symptoms, she did not mention them to anyone. Two years later, the symptoms occurred while on a bicycle ride, requiring her to dismount and sit on the side of the road for 45 minutes until the symptoms subsided. After this attack, she scheduled a primary care appointment.

After taking her social history, the physician suggested that she see a psychiatrist for presumed panic attacks. Based on her internet reading, she asked if this could be a heart rhythm problem. The physician reluctantly ordered a 24-hour Holter monitor, which came back “normal,” although she did not have any symptoms while wearing the monitor.

At the age of 40, the patient had another severe episode during which she felt a twinge of chest pain, and again went to an ED. The ECG was normal and she was referred for a cardiac exercise treadmill test, which was normal for the first 8 minutes. However, at 9 minutes, she began to experience one of her “woozy” spells and the ECG showed a regular heart rate of 230 beats per minute with narrow QRS complexes. She was relieved to be “finally diagnosed” as having paroxysmal supraventricular tachycardia (PSVT) after more than two decades of experiencing these symptoms.

An Inadvertent Bolus of Norepinephrine.

The Case

A 64-year-old woman with a history of anxiety, depression, hypothyroidism, arthritis, paroxysmal atrial fibrillation, an ascending aortic aneurysm, and a bicuspid aortic valve, presented to clinic with several months of worsening dyspnea on exertion. An echocardiogram showed moderate-to-severe aortic stenosis. She then underwent surgery for an aortic valve replacement, ligation of her left atrial appendage, and repair of her ascending aortic aneurysm.

Following surgery, the patient experienced intermittent episodes of hypotension, for which she was given intravenous (IV) fluid boluses and vasopressor support. She received IV norepinephrine at a rate of 0.5 - 6 mcg/minute until 21:00 on postoperative day 1. At 08:00 on postoperative day 2, the patient’s blood pressure was 98/59 mmHg and a 250 mL fluid bolus was ordered. The fluid bag was attached to the IV line that had the vasopressor at a Y-site and the bolus was initiated. The patient developed diaphoresis, tachycardia to 114 bpm, and hypertension with an apex value of 271/161 mmHg. Once the inadvertent bolus was recognized, the vasopressor infusion was immediately stopped. In total, the patient received approximately 4.5 mL (or 160 micrograms) of norepinephrine infused over 15 minutes.

The patient was then closely monitored, and her hemodynamic parameters returned to baseline approximately 15 minutes later. However, the patient had ongoing hypotension in the hours following the inadvertent bolus of norepinephrine with a nadir of 54/38 mmHg, again requiring vasopressor administration and additional fluid boluses. The next day, the patient's blood pressure stabilized, and she was transferred to a stepdown unit, and later discharged home.

While the incident caused only temporary and minor harm to the patient, it was a cause of significant stress and anxiety throughout the rest of her hospital stay and persisted after her discharge. Under different circumstances, this error could have resulted in significant harm, including neurologic impairment and death.

Hyponatremia Secondary to Home Parenteral Nutrition Error
The Case

A 4-year-old (former 33-week premature) boy with a complex medical history including gastroschisis and subsequent volvulus in infancy resulting in short bowel syndrome, central venous catheter placement, and home parenteral nutrition (PN) dependence was admitted with hyponatremia (serum sodium 126 mmol/L) identified on routine outpatient laboratory screening. He had no clinical changes that would have predisposed him to electrolyte abnormalities: no reported changes in stool output, emesis, adjustments to his enteral feeding regimen, medication changes, or recent infections at the time of hospital admission.

Sodium levels normalized within 24 hours of initiating compounded IV fluids with similar dextrose and electrolyte content as the home PN solution. A pharmacist from the home infusion pharmacy notified the physician that an error in home PN mixing had been identified with omission of sodium acetate for several weeks prior to admission. Upon further review, it was discovered a new file had been created for this chronic PN patient by the home infusion pharmacy; the PN formula in this file was transcribed erroneously without sodium acetate by one of the home infusion center pharmacists. This error resulted in only 20% of the patient’s prescribed sodium being mixed into the home PN solution for several weeks, resulting in hyponatremia and unnecessary hospital admission. Previously written parenteral nutrition orders were reviewed by the physician and dietitian; the sodium acetate and other macronutrient and micronutrient components were confirmed as correct by the ordering physician and home infusion pharmacist. The patient returned home on a proper PN regimen, less than 48 hours after admission.

Norepinephrine Dosing Error Associated with Multiple Health System Vulnerabilities
The Case

A 65-year-old man presented to a Level III trauma center with bilateral lower extremity paralysis following a ground level fall. His past medical history was significant for type 2 diabetes mellitus, hypertension, and coronary artery disease status post coronary artery bypass grafting (CABG). The patient was then transferred to a Level I trauma center that could provide a higher level of care following an incidental finding of a 9-cm abdominal aortic aneurysm and cervical spinal cord injury. Post transfer, the patient was noted to have rapidly progressive ascending paralysis. Magnetic resonance imaging (MRI) revealed severe spinal stenosis involving C3-4 and post-traumatic cord edema/contusion involving C6-7. A continuous intravenous (IV) infusion of norepinephrine was initiated to maintain adequate spinal cord perfusion, with a target mean arterial pressure (MAP) goal of greater than 85 mmHg (also known as “MAP therapy”).

Norepinephrine was incorrectly programmed into the infusion pump for a weight-based dose of 0.5 mcg/kg/min rather than the ordered dose of 0.5 mcg/min, resulting in a dose that was 70 times greater than intended. The patient became hemodynamically unstable, alternating between hypertensive urgency

and hypotension. On four separate occasions, MAP increased by more than 80 mmHg immediately after restarting the infusion. He then experienced sudden cardiac arrest and was emergently taken to the cardiac catheterization laboratory to rule out acute coronary occlusion. Following a percutaneous cardiac procedure, the patient experienced bradycardia and cardiac arrest within 9 hours of admission to the hospital. Cardiopulmonary resuscitation was initiated but failed to achieve return of spontaneous circulation.

Two Cases of Retained Vaginal Packing: When Writing an Order is Not Enough
The Case

Case #1:

A patient underwent an open reconstructive urogynecologic procedure. A Foley catheter was placed to drain the bladder and lap pads were used during the operation. After completion of the procedure, the physician composed a dressing by cutting a vaginal packing sponge (which removed the radiopaque marker attached to the end of the sponge), coated it with estrogen cream and placed it in the vagina. Then 4x4 gauze dressings, a Kerlix™ fluff and a peri-pad were put on the perineum and secured with mesh pants. The nurse documented the surgical counts as correct and "vag pack with Premarin® cream by doctor, gauze 4x4's" was recorded as the dressing. The physician order was to remove the pack the next day when the Foley catheter was removed. The patient went to a medical floor postoperatively because no beds were available on the surgical ward. The next day, the ward nurse read the physician's order to remove the Foley and the packing. The nurse removed the Foley catheter and the 4x4's, the Kerlix™ fluff and the peri-pad, assuming this was the packing. Before discharge, the physician stopped by to see the patient, looked briefly at her perineum and did not see anything. The physician asked the patient if "everything" had been removed. The patient said "yes" and was discharged to be seen in the office for follow-up.

Ten days later the patient had a feeling of vaginal irritation and fullness and had burning with urination. When she was seen in the office, the physician told her she had a urinary tract infection and placed her on antibiotics. She developed a very malodorous vaginal discharge and would not go out of the house because she was so embarrassed by the persistent odor. Three weeks after the procedure, the patient went to the Emergency Department (ED) with a fever and pelvic fullness, feeling like something was "inside of her", and pain when sitting. A computerized tomography (CT) scan showed an amorphous density high in the vagina without evidence of perforation or abscess. A gynecology consultation was obtained, whereupon the physician removed a rust-colored, fetid, retained vaginal pack. Risk management was notified, and a disclosure discussion was held with the patient.

Case #2:

A patient underwent an anterior/posterior urogynecologic procedure. A Foley catheter was placed to drain the bladder and surgical sponges were used during the operation. After the procedure, the physician placed radiopaque vaginal packing in the vagina and a dressing on the perineum. In the nursing intraoperative record, the operating room (OR) nurse documented the surgical counts as correct and documented that an x-ray detectable pack was in the vagina and a Kerlix™ dressing was on the skin. The OR nurse did not complete the Orifice Packing Communication Tool nor did she place the colored armband with the words "remove packing before discharge" on the patient, as specified in the Orifice Packing Policy. The OR nurse could not find these materials, so she wrote "vaginal packing" on a slip of paper, which she put on the gurney mattress to which the patient was then transferred.

At the handoff to the post-anesthesia care unit (PACU) nurse, the OR nurse stated that there was packing in the vagina but did not ask for nor receive any repeat-back confirmation. The physician wrote an order to remove the vaginal packing when the Foley catheter was removed before discharge. Hours later in the PACU, a different nurse removed the Foley but did not see any vaginal packing and thus sought help from another nurse. The other nurse looked to see if the patient was wearing the colored armband and not seeing one, assumed there was no packing but did not actually examine the patient. The physician came by to see the patient just before discharge and asked the patient, using the patient's daughter to translate, if the Foley and packing had been removed. The patient said that, yes, "it" had been, and she was then discharged.

Two days later, the patient called the hospital and spoke with a patient safety officer speaking her native language. The patient said that while she was sitting on the toilet, she felt fullness and burning "down there" and saw something dangling out from inside her. She painfully pulled out a 3-foot-long piece of cotton gauze with a blue line in it. She asked the patient safety officer if that was a Foley and wanted to know why it was inside her. The physician was notified, and a disclosure discussion was held with the patient.

A Postpartum Woman with an Erroneous SARS-CoV-2 Test

The Case

A full-term pregnant patient was admitted in March 2020 for a scheduled Cesarean delivery, before being tested according to a universal inpatient screening protocol for severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). During surgery, the patient developed a fever and required oxygen supplementation. The facility implemented contact and droplet isolation precautions due to suspicion for COVID-19. The patient was transferred to a negative pressure room, the baby was isolated in the neonatal intensive care unit (NICU), and the patient's husband was instructed to self-isolate at home until the SARS-CoV-2 test results were available.

A specimen obtained via nasopharyngeal swab was sent to a commercial laboratory for reverse transcriptase polymerase chain reaction (RT-PCR) testing. However, due to delays in receiving those results, another sample was tested two days later with a newly developed in-house test and a third sample was sent to the state public health laboratory. The in-house test returned as positive for SARS-CoV-2. Blood and urine cultures showed no growth, and a chest radiograph was unremarkable.

When the patient left the hospital on her fourth postpartum day, she was in stable clinical condition. She reported feeling well, without cough, fever, or shortness of breath. Because she was assumed to be positive for SARS-CoV-2, but clinically healthy, she was advised to isolate herself at home for 14 days, and the hospital initiated contact tracing of all exposed persons, in consultation with the local public health department. In addition, because she had a newborn and a toddler at home, she was encouraged to be vigilant about wearing a mask, to stay in one room of the house if possible, and to focus on hand hygiene and surface cleaning.

Two days after the mother's discharge, the commercial and state lab tests were both reported as negative. The patient was concerned about SARS-CoV-2 transmission, so she chose to bottle-feed rather than breastfeed, despite her pediatrician's encouragement to breastfeed. An infant hearing test was deferred as the tester did not want to risk exposure to SARS-CoV-2. Ultimately, the patient and her baby did well clinically, although the false positive result caused substantial anxiety and alterations in home care (personal and parental) and health care during the critical transitional period of caring for a newborn

child. The patient and her family were extremely forgiving of the error, appreciating the uncertainties related to the pandemic and the care and communication from health care staff.

A thorough root-cause analysis subsequently determined that the positive test run on the in-house platform was due to cross-contamination from a neighboring positive sample. A follow-up test conducted on a remnant sample from the in-house assay, one week later, confirmed that the patient was negative. When it was determined that the in-house test was falsely positive, testing was shifted to other commercial platforms and to a second-generation in-house test. Since that time, more than 50,000 tests have been run, and there have been no other known cases of false positive tests due to cross-contamination

A Sweet Case of Hidden Hydrogen Ions
The Case

A 24-year-old, Arabic-speaking woman with a history of type 1 diabetes mellitus, gastroparesis, and severe erosive esophagitis presented to the emergency department (ED) with one day of worsening generalized abdominal pain, nausea, and vomiting. Her last dose of insulin was one day prior to presentation. She stopped taking her daily regimen of insulin because she was not tolerating any oral intake. Her past medical history was notable for a hospitalization two weeks earlier for the same complaints; at that time, her laboratory studies were normal, and she was diagnosed with severe erosive esophagitis by esophagogastroduodenoscopy.

Upon admission to the hospital, the patient was tachycardic (heart rate in 110's) and had diffuse abdominal tenderness. Laboratory studies were significant for hyperglycemia (blood sugar level of 387 mg/dL), an elevated serum beta-hydroxybutyrate, and mildly abnormal venous blood gases (pH 7.4, PCO2 37 mm Hg, HCO3 18 mmol/L), as well as an anion gap of 23 (anion gap=[Na+] - [Cl + CO3]), which was elevated and indicative of metabolic acidosis.

The admitting team thought the patient did not meet criteria for diabetic ketoacidosis (DKA) because the pH of 7.4 on the venous blood gas (VBG) was normal. The working diagnoses upon admission were severe esophagitis due to gastroparesis and poorly controlled diabetes. Dextrose-containing fluids were started as the patient was not tolerating any oral intake and an insulin sliding scale was ordered. Despite administration of increasing doses of subcutaneous insulin, maximal doses of prokinetics, and mucosal protective agents, she had persistent hyperglycemia in the 300-400 mg/dL range, abdominal pain, and vomiting. During the third night of hospitalization, the patient had a point-of-care fingerstick glucose measurement of 438 mg/dL. She reported having blurry vision, "not feeling well," and fell into the nurse's arms. The following day, she had a near fall, blurry vision, and change in mental status. An endocrinologist was consulted due to her poorly controlled blood glucose; the consultant diagnosed DKA. The patient was transferred to the intensive care unit (ICU) and an insulin drip was started, after which the patient's metabolic derangements normalized and her symptoms resolved.

Delayed Diagnosis in the Setting of Virtual Care: Remembering the Physical Examination
The Case

A 71-year-old frail, non-ambulatory woman a with history of multiple sclerosis and neurogenic bladder presented to the emergency department (ED) of an academic medical center with fever of two days duration, sweating, and dry cough. Labs showed leukocytosis (up to 11,100 cells per µL) and hyponatremia (128 mmol/L). She was admitted for work-up including a COVID-19 test, viral panel, urinalysis, and blood cultures – all of which were negative. She was deemed high-risk for COVID-19, but a second test was also negative. No source of infection was found, and she was discharged after three

days. Neither the ED staff nor the internal medicine team documented any rectal or genital examinations, and no additional testing or imaging was performed after the infectious disease evaluation remained negative.

The next day, her husband called her primary care office because she was feeling worse with rapid breathing, sweating, and diarrhea. During a video visit that afternoon, the symptoms were attributed to viral illness. The physician also noted that the patient described a skin breakdown on her "backside," but the affected area was not visualized by the physician. The plan was for a home health nurse to evaluate the skin breakdown later in the week.

Thirty-six hours later, she was brought to the hospital via ambulance due to her husband's concern about her altered mental status. On arrival, she was in septic shock with systolic blood pressure in the 80's. The physical examination triggered concern about a necrotizing soft tissue infection. In the operating room, a necrotizing infection that tracked from a perirectal horseshoe abscess, through the perineum, up onto the anterior abdominal wall was found. She underwent an extensive debridement. After further discussion with her family, she was transitioned to comfort care in alignment with her goals. She died the day after surgery.

The Impact of Communication on Medication Errors
The Case

A 93-year-old man with a history of chronic systolic heart failure and with a ventricular assist device (VAD) had been on warfarin for his VAD and for stroke prevention for his atrial fibrillation. He had been followed by an anticoagulation clinic at his local hospital for several years. He was admitted to the hospital after being referred by the VAD team for an elevated internal normalized ratio (INR) of 13.4. During medication review, the hospital team discovered that he was prescribed warfarin 4 mg daily on Mondays and Fridays and 3 mg daily on all other days of the week. The patient had multiple outpatient visits prior to his hospital admission at which both 1 mg and 5 mg strengths of warfarin were noted as active on his medication list. After discussions with the patient's family, it was determined that the patient's daughter had given the patient three 5 mg tablets of warfarin (total daily dose 15 mg) for two days in a row instead of three 1 mg tablets (total daily dose 3 mg). The patient received a daily dose of warfarin five times that of the intended dose. The patient did not experience any signs or symptoms of bleeding and was discharged the next day after a vitamin K infusion.

Delay in Appropriate Diagnosis and Treatment Leading to Death from Pulmonary Embolism

The Case

A 56-year-old woman with a history of mild, persistent asthma and recent Achilles tendon repair presented to the emergency department (ED) by ambulance for shortness of breath. Her symptoms, which developed over four hours and felt like prior asthma exacerbations, also included chest tightness that was relieved with Albuterol. Her vital signs in the ED were notable for a heart rate in the 90s and hypoxia requiring 2 liters/minute of supplemental oxygen via nasal cannula to maintain oxygen saturation above 90%. Physical examination revealed diffuse wheezing. A chest radiograph demonstrated mild pulmonary edema but no focal abnormalities. The emergency physician interpreted the electrocardiogram (ECG) as having ST depression in leads V2-V6, unchanged from a previous ECG, and new T-wave inversion in leads V2-V3.

The patient was admitted to hospital with a diagnosis of acute asthma exacerbation. She initially responded to treatment with aggressive pulmonary toilet and bronchodilator therapy administered on a step-down unit. Eight hours after admission, her serum lactate rose to 4.7 mmol/L (normal < 2.0 mmol/L) and her oxygen requirement increased to 3-4 liters/minute. Although she did not have a personal or family history of venous thromboembolism (VTE), pulmonary embolism (PE) was considered based on her limited mobility secondary to recent orthopedic surgery. Given this history and her continued clinical decompensation, a computed tomography (CT) angiogram of the chest was obtained. The radiologist's summarized impression, communicated by telephone to the primary team 12 hours after admission, noted bilateral filling defects to the subsegmental level in all five lung lobes without right heart strain or saddle embolus. However, the written radiology impression was not reviewed, nor did the care team independently review the CT images. In fact, the radiologist's full note mentioned "profound evidence of right heart strain." This critical finding was not conveyed to the primary team and the lack of independent image verification led to miscalculation of disease severity. The patient was started on a direct oral anticoagulant (DOAC).

On hospital day two, her serum lactate continued to rise and the rapid response team (RRT) responded for increasing tachycardia. She remained hemodynamically stable and did not appear to be in acute distress, so neither the RRT nor the primary team made changes to the care plan. However, the patient's condition worsened that evening; she became hemodynamically unstable with hypotension and increasing tachycardia. She was transferred emergently to the Medical Intensive Care Unit. A bedside point of care ultrasound (POCUS) demonstrated marked right heart strain. After arterial and central venous catheters were placed, she was given a reduced dose of tissue plasminogen activator (tPA). Approximately five minutes later, she developed acute signs of stroke. Seizure-like movements followed and her cardiac rhythm changed to pulseless electrical activity requiring closed chest compressions and cardiopulmonary resuscitation.After return of spontaneous circulation, the patient was cannulated for extracorporeal membrane oxygenation (ECMO). Ongoing resuscitation, including administration of vasopressor therapy, continued overnight. She ultimately transitioned to comfort care and died on hospital day three.

But See the Patient First
The Case

A 55-year-old man with acute myeloid leukemia presented to the emergency department (ED) with a chief complaint of fever. Five days previously, he had recently completed his third cycle of consolidation chemotherapy (high dose cytarabine). He reported no focal symptoms. His temperature was 38.8°C and his pulse rate was 110 beats per minute. Physical examination did not reveal a focal site of infection. He was found to have neutropenia (absolute neutrophil count, 120/microliter, reference 1,500-8,000) and thrombocytopenia (platelet count 22,000/microliter, reference 150,000-400,000). The patient was admitted, blood and urine cultures were obtained, and intravenous cefepime was initiated for neutropenic fever. He reported subjective improvement over the next 24 hours.

Overnight on hospital day 2, the patient's temperature was 38.7°C on a routine vital sign check, with no significant change to other vital signs. The cross-covering physician was paged and, following sign-out instructions from the primary team, requested repeat blood cultures. The cross-covering physician did not evaluate the patient in person but confirmed that the blood cultures obtained at admission still showed no growth.

On rounds the following morning, the patient reported new oral pain which had started early the previous day. On physical exam, he had grade 2 mucositis, as per the Common Terminology Criteria for Adverse Events (CTCAE) in cancer therapy from the National Cancer Institute (i.e., painful erythema, edema, or ulcers but eating or swallowing possible). Given his clinical stability and negative cultures, antibiotics

were not escalated. Mucositis was managed with supportive care, including salt and sodium bicarbonate mouthwash, lidocaine mouthwash for pain, and dietary modification. Both sets of blood cultures remained negative and the patient was discharged on hospital day five with clinical improvement and neutrophil count recovery.

Unintentional Ketamine Overdose in the Operating Room – Mixing Up the Ampules

The Case

A 50-year-old man with a history of cancer and previous airway operations was admitted for a rigid direct laryngoscopy. The anesthesiologist trainee staffing the case was first-year oral maxillofacial surgical resident working in the operating room by himself. The consulting physician anesthesiologist prescribed the resident to administer ketamine to the patient as part of the general anesthesia protocol. The resident unintentionally located two vials of 100mg/mL ketamine instead of the intended 10mg/mL vials that are used routinely. The provider intended to administer 95mg of ketamine intravenously, but erroneously administered 950mg. At the conclusion of the surgical case, the patient had delayed emergence from anesthesia. During assessment of the potential causes for this delayed emergence an empty vial of ketamine of the higher concentration of 100mg/ml was found. Based on this finding a provisional diagnosis of inadvertent ketamine overdose was made. The patient remained intubated and was transferred to the intensive care unit, where he was later extubated uneventfully. He was discharged home the following day.

Code Status vs. Care Status

The Case

A 65-year-old African American man with metastatic squamous cell carcinoma (SCC of unknown primary site) was admitted to the hospital after developing increasing back pain. His work-up revealed a T10 burst fracture. In addition to his cancer, the patient had a past medical history of schizophrenia, developmental delay (not conserved), and COPD. He received neurosurgical treatment for the fracture, but had a complicated post-operative course: aspiration, respiratory failure, intubation, new deep vein thrombosis and pulmonary embolism, and infection. Eventually, the ICU team was able to extubate the patient, but he continued to require intermittent high flow oxygen or bilevel positive airway pressure (BIPAP) to maintain his oxygenation.

The palliative care team, which included an expert in medical ethics, was consulted to discuss goals of care with the patient, particularly regarding further cancer treatment and the possibility of placing a permanent feeding tube. Prior to his admission to the hospital, the patient resided in a semi-independent living facility, where he was cared for by a devoted caregiver and received other supportive services for his developmental delay; he had no family involved in his life. The patient shared with the team that he had been in nursing home settings/institutions in the 1970s and that he would never want to go back to one. His ultimate goal was to go home. After multiple lengthy discussions with the patient, his caregiver, the agency managing his services, and the hospital teams involved in his care, the decision was made to transition the patient home with hospice care, honoring his wish to go home to live as well as possible for as long as possible, but without burdensome treatments such as chemotherapy. The palliative care team and discharge planner worked with the social services agency to coordinate the transfer home, including acquiring appropriate equipment, training the patient's caregivers on use of the equipment, and arranging home hospice and caregiving services.

The ICU team continued to optimize the patient's respiratory status as they prepared for his eventual discharge home. On a Friday afternoon, his care teams felt that the patient would benefit from ICU care

over the weekend to further improve his respiratory status and that he would likely be able to go home the following week with hospice. A timeline for the transition had not been established, given the complexity of the situation and the patient's clinical status. However, within hours of changing the patient's code status to "Do Not Resuscitate" (DNR) and after the palliative care team had left for the day, the patient was transferred out of the ICU to a medical/surgical floor. It is unclear who made this decision or why. With the transfer, he was given a new medical team. The patient was not rounded on by his new team of providers over the weekend. It seemed these new providers noted the patient's DNR code status and the plan to go home with hospice and felt no further interventions would be required.

Once outside of the ICU over the weekend, the patient's respiratory status deteriorated, reaching a level of severe oxygen desaturation. No one continued to emphasize to the patient the importance of BIPAP and other respiratory care to his ability to go home. In fact, the new medical team seemed to have not even ordered BIPAP or other non-invasive respiratory support measures for the patient. When a new medical team arrived Monday morning to receive sign-out report from the weekend team, they were unsure what to do about the patient's respiratory distress. They called the palliative care team for clarification about the plan of care. Once they understood the intended care, the Monday team attempted to improve the patient's respiratory status with all measures short of intubation. Unfortunately, they were not able to reverse the effect of the ineffective respiratory care from the weekend. The patient died in the hospital later that week; he was never able to go home as he had wished.

After the patient's death, a discussion was held between the neurosurgical teams(the patient's primary assigned service) and various providers about what DNR means and does not mean. To many, it meant the healthcare team was no longer needed because the patient was imminently dying, and so the team was going to focus its limited time and energy on patients who were "full code" which they equated with "full treatment."

Delayed Breast Cancer Diagnosis: A False Sense of Security.
The Case

A 60-year-old woman was seen for a routine visit by a physician assistant (PA) at a family medicine practice. A right breast mass was palpated and felt likely to be benign. However, the PA ordered a diagnostic mammogram and ultrasound examination. The radiologist reviewed the images, noting focal asymmetry in the right breast. The assessment was challenging due to dense breast tissue. Ultimately, the films were interpreted as "probably benign" findings (BI-RADS Category 3) and follow-up imaging at 6 months was recommended to ensure stability. The report noted that a biopsy should not be delayed if a "suspicious mass" is present on physical exam. Reassured by the report, the PA did not order a biopsy or refer the patient to a breast surgeon.

When the patient returned 5 months later for a follow-up appointment, the mass was found to have increased in size. She was referred to a surgeon for a biopsy, but there was confusion about whether the patient herself was to schedule the appointment or whether the surgeon's office would contact her. After an 8-week delay, the patient contacted the family medicine office. The PA was surprised that she had not yet seen the surgeon and arranged for an urgent surgical appointment and biopsy of the enlarging right breast mass. The biopsy showed invasive breast cancer, which, now 7 months after the initial presentation, was found to be metastatic to the axillary nodes and spine. It is unknown if an earlier diagnosis would have affected the outcome of this aggressive malignancy.

Mitigating the Risk of Intrahospital Transport for Pediatric Patients at Risk of Physiologic Instability
The Case

A 3-month-old twin male infant, born at 26 weeks' gestation and with a history of bowel resection and anastomosis due to necrotizing enterocolitis, was re-admitted to a children's hospital with abdominal distention and constipation three weeks after being discharged from the neonatal intensive care unit. Systemic inflammatory response syndrome developed with associated abdominal pain and worsening distention. The patient was transferred to the pediatric intensive care unit (PICU) for management of severe sepsis with fluid resuscitation and antibiotics. With an obstructive pathology highly suspected, an urgent exploratory laparotomy was scheduled.

The pediatric anesthesiologist arrived in the PICU to assess the patient and assist with transport to the operating room (OR). A verbal report was received from the PICU intensivist via phone, which included a brief history, recent changes in respiratory status, discussion of resuscitation for sepsis, and mention of newly confirmed bacteremia and the antibiotic therapy to target it that had been initiated earlier in the day. On exam, the patient was alert, interactive, but uncomfortable with abdominal distention; his breathing was non-labored while receiving humidified high-flow nasal cannula respiratory support. Discussion by the care team included whether the patient would require intubation prior to transport to the OR, and all parties agreed that the patient's clinical exam suggested he would be stable for brief transport from the PICU to the OR. Transport personnel included two PICU nurses and the pediatric anesthesiologist. During the intrahospital transport, the patient had a brief bradycardic episode without any changes to breathing or oxygen saturation, which self-resolved. At that time, a PICU nurse shared that similar and increasing numbers of bradycardic episodes had been occurring over the course of the day for this patient, sometimes associated with oxygen desaturation; these events had been brief and had resolved without specific intervention.

Transport continued, but just prior to reaching the OR, bradycardia recurred, with accompanying loss of muscle tone and upward deviation of both eyes. Positive pressure ventilation with 100% FiO2 was started immediately, along with chest compressions and intravenous epinephrine. The infant was rapidly moved into an OR bed while continuing resuscitation and intubation. Return of spontaneous circulation occurred within five minutes, although the patient remained acidotic and required vasopressor infusions. Exploratory laparotomy revealed complete bowel obstruction at the ileo-transverse anastomosis site with severely dilated proximal bowel. The stricture was resected, the bowel was left in discontinuity with ileostomy drainage, and an abdominal wound vacuum was placed. The patient remained intubated, and was transported back to the PICU without incident, although still requiring vasoactive support.

Premature Closure: Was It Just Syncope?
The Case

A 60-year-old man presented to the emergency department (ED) with a chief complaint of syncope. His partner reported he had been exercising when he became dizzy, passed out, then quickly regained consciousness. His initial vital signs in the ED were notable for a systolic blood pressure in the 100s and a heart rate of 56 beats per minute. Twelve-lead electrocardiogram (ECG) demonstrated ST segment and T wave changes but not ST-elevation myocardial infarction. A computed tomography (CT) scan of the brain was ordered and performed, but it is unclear whether the ordering physician ever reviewed the CT images.

Concerned for a cardiac etiology of syncope, the emergency physician administered aspirin, started the patient on an unfractionated heparin drip, and ordered an echocardiogram to assess cardiac function. However, the patient reported he felt well and wanted to pursue an outpatient workup. As an alternative to admission, the physician discussed the case with a cardiologist who recommended full-dose, therapeutic low molecular weight heparin (Lovenox) and cardiology follow up the next day.

While awaiting the echocardiogram, the patient became somnolent and his heart rate slowed. The emergency physician placed a transcutaneous pacemaker, intubated the patient, and ordered a full-body CT scan which demonstrated a large subdural hematoma with mass effect on the brain and surrounding cerebral edema. In the operating theater, a neurosurgeon performed an emergent craniotomy and placed an external ventricular drain. The patient's condition temporarily improved. However, serial brain imaging demonstrated expansion of the intracranial hemorrhage and ultimately brainstem herniation. He transitioned to comfort care and later died.

A post-mortem review of the patient's medical records indicated he had multiple ED visits with similar episodes of syncope in the preceding months all resulting in falls and head trauma. It was later acknowledged that the first CT scan of the patient's brain showed a small subdural hematoma that was not recognized by his clinical team. Ultimately, the initial ECG changes were retrospectively interpreted as consistent with intracranial hemorrhage.

Lack of Sepsis Recognition Leads to Delay in Care Following Cesarean Delivery.
The Case

A 26-year-old woman with a history of systemic lupus erythematosus and gestational hypertension was admitted to the hospital for induction of labor at 36 weeks due to intrahepatic cholestasis of pregnancy. The induction failed and the resulting cesarean delivery was complicated by significant postpartum hemorrhage. The infant was taken to the neonatal ICU (NICU) for sepsis evaluation. Approximately 8 hours after birth, the infant was found to have extended spectrum beta-lactamase (ESBL) producing Escherichia coli bacteremia and sepsis.

On the morning of the first post-operative day, the patient was noted to be dizzy and hypotensive and complained of severe perineal and abdominal pain. The obstetric team attributed the perineal pain to prolonged efforts to push during labor and offered symptomatic relief with cold packs and Benzocaine spray. They were more concerned about the hypotension, which was thought to be due to hypovolemia from peri-operative blood loss.

A SIRS (systemic inflammatory response syndrome) alert occurred later in the afternoon due to hypotension. Laboratory tests showed markedly elevated lactic acid (6.3), leukopenia and thrombocytopenia. The patient was given antibiotics, intravenous fluids, and blood. The unit nurses had significant concerns about the patient's status in the morning of the first postoperative day but were unable to get the physicians to intervene until the SIRS alert, and even then, the physicians were skeptical of the both the alert and the laboratory results. The physicians felt that they were adequately addressing the patient's problems, whereas the nurses did not feel that their concerns were being taken seriously. An Endocrinology consultation was obtained due to a suspicion for adrenal crisis associated with chronic steroid use. The patient was booked for an urgent exploratory laparotomy due to persisting concerns about postoperative blood loss. However, she stabilized after fluid resuscitation and a computed tomography (CT) scan was obtained instead. The CT scan showed no evidence of intra-abdominal bleeding, and therefore the laparotomy was cancelled.

After the CT scan, the patient went to the postpartum unit instead of the medical intensive care unit (MICU) due to miscommunication. Several hours later with persistent hypotension, she was transferred to the MICU where she was treated for putative adrenal crisis, hypotension, and septic shock. She was noted by the ICU physicians to have severe abdominal and perineal pain and was visibly ill. She had developed new ecchymoses of both flanks extending to the vulvar labia that were exquisitely tender in association with neutropenia and hypotension. The possibility of necrotizing soft tissue infection was considered.

Urgent consultations were obtained from Maternal-Fetal Medicine and Acute Care Surgery. They took her to the operating room (OR) together for suspected necrotizing fasciitis. The Pfannenstiel incision was opened and counter-incisions of the bilateral flanks and labia were performed. The tissues were found to be dusky, but necrosis was not found. She returned to the surgical ICU for fluid resuscitation. Later that day, the patient deteriorated and failed to respond to resuscitation. She was urgently taken back to the OR, where she was found to have necrotizing soft tissue infection, including in the flanks, labia, and uterus. She underwent a hysterectomy, bilateral salpingo-oophorectomy, and extensive resection of soft tissue including fascia and muscle. Her subsequent, lengthy hospitalization was notable for multiple wound debridements, rehabilitation, and skin grafts. Her son required antibiotic treatment for neonatal sepsis in the NICU.

Inpatient Stroke Management in an Adolescent with Type 1 Diabetes and Home Insulin Pump

The Case

A 14-year-old girl with a history of type 1 diabetes (T1D) presented to her local emergency department (ED) with two weeks of heavy menstrual bleeding. She was treated with tranexamic acid and oral contraceptive pills and was discharged from the ED. She presented the following day to a different ED with continued menorrhagia, as well as new blurred vision, headache, and left arm numbness. A head CT was normal, and she was transferred to an academic medical center for further management. Shortly after admission, she had worsening of her upper extremity symptoms and brain MRI revealed right middle cerebral artery (MCA) stroke. She was transferred to the pediatric intensive care unit. Further workup led to a diagnosis of antiphospholipid syndrome, and she was treated with aspirin, mycophenolate, hydroxychloroquine, and prednisone. The following week the patient developed new left upper extremity weakness and left upper extremity, chest, and facial paresthesia. Imaging identified a new MCA territory infarct, and enoxaparin treatment was initiated. Additional studies demonstrated splenic and bilateral renal infarcts. She was further treated with high dose steroids and three rounds of plasmapheresis and was discharged home three weeks later.

Throughout her hospitalization, the patient's T1D was managed using her home insulin pump and continuous glucose monitor (CGM). The patient's blood glucose values were routinely above 180 mg/dL during the hospitalization, likely due to her underlying illness, and rose further after glucocorticoid therapy was initiated. In addition, the patient had several instances of insulin pump infusion site leakage and multiple occurrences of incorrect management related to use of her home CGM for calculation of insulin doses. Despite the patient experiencing persistent hyperglycemia, her mother resisted recommendations by the neurology and intensive care services[1,2] to discontinue her pump and initiate intravenous insulin in order to optimize glycemic control.

Preventing Complications during Aneurysm Clipping – the Role of Neuromonitoring.

The Case

A 73-year-old female patient was transferred from an outside hospital to a tertiary center with subarachnoid hemorrhage due to a ruptured aneurysm. At approximately 1000 on the date of transfer, the patient was scheduled for right frontotemporal craniotomy and aneurysm clipping with neuromonitoring to start at 1930. Neuromonitoring was included on the booking slip, and the neurosurgery resident called the Operating Room (OR) front desk to confirm. The attending neurosurgeon was not present for the huddle but arrived for positioning of the patient and realized that the neuromonitoring technician was not present. The OR front desk stated that neuromonitoring had not been called, but the attending surgeon decided to proceed with the procedure. No problems were identified during surgery, but the patient emerged from anesthesia with left-sided paralysis, and post-op imaging showed evidence of a new stroke.

Postoperative morbidity and mortality review suggested that this stroke may have been prevented if neuromonitoring had been performed during the surgery.

When Looks Aren't All They Appear to Be: A Medication Error in an Uncommon Indication

The Case

A 58-year-old female patient with a history of liver cirrhosis and transformed lymphoma was admitted for inpatient administration of her chemotherapy with Rituximab, Ifosfamide, Carboplatin, and Etoposide Phosphate (R-ICE). She reported feeling well without any contacts with any sick individuals upon admission. After three days of her first cycle of therapy, she complained of diffuse abdominal pain that lasted all day with nausea and vomiting. She underwent extensive workup where she was found to have neutropenia, elevated lactic acid, leukopenia, elevated d-dimer, and low fibrinogen. An abdominal CT was consistent with inflammatory colitis with possible cholecystitis involvement. Computed tomography arterial portography (CTAP) was noted to have a neoplastic mass on the anterior abdominal wall. She became hypotensive with systolic blood pressures in the 80s and low oxygen saturations. She was determined to be experiencing septic shock and transferred to the intensive care unit (ICU). In the ICU, she was found to have E. coli bacteremia and colitis secondary to neutropenia. Her condition was made worse by the onset of ongoing hiccups of unknown etiology which lasted more than 48 hours. She was prescribed thioridazine (brand name Mellaril) 10 mg twice daily for the hiccups. The medication was verified, and she received four doses without resolution. This resulted in an increase in the thioridazine dose from 10 mg twice daily to 15 mg for one dose then again to 25 mg twice daily for an additional four doses.

When she was transferred back to the inpatient floor, a pharmacist reviewed the medical record. This review confirmed that the patient had been started on thioridazine and that she had not received this medication before admission to the hospital. When questioned by the pharmacist, the resident physician confirmed that thioridazine had been prescribed to treat persistent hiccups when chlorpromazine (brand name Thorazine) had been intended. The medication was discontinued as a result of altered mental status possibly secondary to medications. Ultimately, no Thorazine was needed.

When the Lytes Go Out: A Case of Inpatient Cardiac Arrest

The Case

A 44-year-old man with hypertension and diabetes mellitus complicated by diabetic retinopathy presented to the emergency department with right foot pain five days after stepping on a nail. On initial evaluation, vital signs were within normal limits, and physical exam was notable for an open, purulent, draining wound on right third metatarsal head that could be probed to the bone. Initial labs showed leukocytosis, low potassium, anion gap metabolic acidosis, and hyperglycemia, consistent with diabetic ketoacidosis. The patient was admitted to the general medicine ward and managed with antibiotics, subcutaneous insulin, and intravenous fluids and the orthopedic service was consulted. Over the subsequent six days, he had frequent nausea, ongoing poor oral intake, and was twice kept NPO (nothing by mouth) after midnight in advance of operative debridements that occurred late the following day. He had ongoing hypokalemia, as low as 2.5 mmol/L, and was repleted with low doses of oral supplements. A magnesium level was first checked on hospital day 4 and was found to be low; an electrocardiogram the same day showed a prolonged QT interval. On hospital day 7, potassium and magnesium remained low; subsequently, the patient had a cardiac arrest due to torsades de pointes and ventricular fibrillation. Luckily, the arrest occurred in front of a staff who called a code blue. He was transported to the cardiac intensive care with return of spontaneous circulation. He was discharged from the hospital a week later with an implanted cardioverter-defibrillator.

Multiple Levels Involved in Prescribing the Wrong Medication

The Case

A 65-year-old woman complained of some ongoing nausea two weeks after hernia repair surgery. The surgery itself had not been complicated and on her postoperative visit, her physical examination was benign. The only lab abnormality was a mild increase in her liver function tests which was attributed to her ongoing nausea and vomiting. The patient was encouraged to maintain her hydration status and to trial small frequent meals as conservative management of her nausea and vomiting.

On postoperative day 15, she called back again with ongoing nausea. She was asked to stop taking the pain medication (oxycodone) and given a prescription for trimethobenzamide (after noting her allergy to ondansetron) to be taken every 6 hours as needed for nausea. The patient filled her prescription the same day and started using the medication that same evening. The next day her nausea was worse, and she continued taking the medication, thinking that the drug would take time to work. That evening she was more tired, having had several episodes of vomiting. The next day her daughter found her extremely weak and took her to the Emergency Department (ED).

On arrival to the ED, the patient was profoundly volume depleted, confused, and had electrolyte abnormalities. On review of her medications, she was asked why she was taking topiramate; the daughter recalled her mother picking up a new medication for nausea two days prior. Once adequately volume-supported, the patient was able to answer all questions well and recalled starting the new medication two days ago. Further questioning revealed that the new medication was topiramate (Topamax™) instead of trimethobenzamide (Tigan™). Topamax™ had been accidentally selected by a nurse and pended to the physician who then prescribed the medication electronically to the patient for her ongoing symptom of nausea. The medication was then picked up by the patient from her usual pharmacy. The pharmacist had reviewed the medication with the patient, but with her state of mind she did not question the information being provided. Although no major complications occurred in this case, it is an example of how mistakes are made, despite multiple opportunities for cross-verification.

Too Many Cooks in the Kitchen

The Case

A 40-year-old man with diabetes, hyperlipidemia, hypertension, coronary artery disease (status post percutaneous coronary intervention), chronic renal failure (on hemodialysis), and severe aortic stenosis (aortic valve area 0.64 cm^2), was admitted to a major trauma center for a pathologic pelvic fracture (secondary to osteoporosis) after a fall from standing. The Nephrology, Cardiology, and General Internal Medicine services were involved, but, as per routine at this center, Trauma Surgery was the primary team. Orthopedics considered the fracture stable based on post-mobilization x-rays. The patient's recovery was slow due to ileus and severe deconditioning.

While being assisted to a standing position on hospital day 13, the patient’s left leg buckled and he developed hip pain. X-rays showed an intracapsular left femoral neck fracture with severe osteopenia secondary to renal osteodystrophy. Cardiology, Cardiothoracic Surgery, Trauma Surgery, and Orthopedics discussed this high-risk case extensively and ultimately planned operative hemiarthroplasty with a cardiac anesthesiologist, including intraoperative trans-esophageal echocardiography (TEE). The patient was not considered to be a candidate for preoperative open or trans-catheter aortic valve replacement or balloon valvuloplasty for his aortic stenosis. Due to limited operating room availability, his hip operation on hospital day 24 began at 16:00 and concluded at 22:30. The operation, performed with general anesthesia, was prolonged due to unsuccessful epidural catheter placement and an intraoperative periprosthetic fracture, requiring plating, but otherwise was uneventful. Neither a

cardiac anesthesiologist nor TEE was involved. The patient was hypertensive during his 90-minute stay in the Post-Anesthesia Care Unit (PACU). He was then transferred back to a surgical unit (not intensive care) with only routine vital signs and nursing checks every four hours for hemodynamic monitoring. His initial systolic blood pressure after transfer was 60 mmHg. The on-call Trauma Surgery team was notified one hour later and administered 500 mL of intravenous fluids. En route to the Intensive Care Unit, the patient arrested and died.

When the Meds Don't Reach the Bed

The Case

A 69-year-old man with cognitive impairment and marginal housing was admitted for acute exacerbation of chronic obstructive pulmonary disease (COPD). Over the course of a four-day admission, his condition moderately improved with bronchodilators, steroids, and antibiotics. The medical team planned to discharge the patient to his residential care home on a weekend day with conventional treatments for COPD exacerbations including doxycycline and prednisone along with control inhalers budesonide-formoterol and tiotropium, and nebulized albuterol for rescue.

The clinician caring for the patient scheduled transport for 4:00 pm and arranged for Meds-to-Beds (M2B), a service available in some hospitals to have a local retail pharmacy deliver medications to the bedside prior to discharge. Given the patient's inability to pay for the discharge medications, the social worker on the discharge planning team sent a voucher to cover the cost of medications to the commercial pharmacy around 11:00 am. The clinician later informed the nursing staff that he/she would personally pick up and deliver the medications due to concern about recent delays in M2B deliveries.

During the early afternoon, medication pick-up was delayed for several hours because the voucher amount sent by the social worker did not match the out-of-pocket cost of the medications. Around 3:30 pm, the social worker directly communicated with the pharmacy to resolve the voucher issue. However, the clinician was about to perform a high-risk procedure for another patient and no longer available to pick up the medications. Before performing the procedure, the clinician contacted the pharmacy with instructions to proceed with the medication delivery but did not communicate this change in plan to the patient's nurse or social worker. Scheduled transport arrived at 4:00pm and the patient was discharged without his medications.

After the procedure was completed around 4:30 pm, the clinician was informed that the medication delivery still had not arrived due to limited weekend staffing at the pharmacy. The discharge medications were delivered to the hospital at 4:45 pm, after the patient had been discharged and therefore too late.

The patient was subsequently readmitted to the same hospital approximately five hours after discharge due to dyspnea and hypoxia after shutting off his supplemental oxygen to smoke cigarettes. Unfortunately, he had been unable to relieve these symptoms with the medications he had available at the residential care home. His presentation likely represented poor pulmonary status secondary to end-stage COPD rather than an acute exacerbation of COPD. Both admissions were thought to be triggered by hypoxia secondary to being off home oxygen in the setting of smoking cigarettes. After discussion of goals of care with the family and patient during the second admission, the patient was transitioned to comfort care.

Nothing Called Small Surgery

The Case

A 56-year-old female presented to surgical clinic with pain and swelling in left great toe associated with progressive deformity of the toenail for past 6 months. On examination, she had a thick, brittle, deformed nail that was in-growing, and was diagnosed with onychogryphosis. The patient underwent ablation of the nail left great toe and wedge excision of the germinal layer of the nail edges on the medial and lateral sides under local anesthesia. The procedure was performed using a digital tourniquet made from the finger of a sterile surgical glove placed around the great toe base and clamped with an artery forceps. After the procedure, a dressing was applied, and the patient was discharged after 4 hours with instructions to follow up in clinic in 2 days.

Upon presentation to clinic two-days post-discharge, the dressing was removed and revealed that the glove tourniquet was still in place, causing a tight constriction ring at the base of the toe. The toe appeared dusky and swollen and was warm. The tourniquet was immediately removed, and gentle massage of the toe was performed at the constriction site. The patient reported mild hypoesthesia and was able to move the toe. She was prescribed Aspirin 100mg daily and Pentoxifylline 400mg three times per day for 15 days. The dressings were changed daily and frequent follow up was performed. The bluish discoloration of the toe increased progressively followed by skin necrosis. The patient ultimately developed gangrene of the left great toe distal to the site of compression. The care team decided to proceed with amputation at the base of the left great toe.

The NSTEMI Curbside Consultation

The Case

A 52-year-old woman with coronary artery disease (CAD) and a history of ST-segment-elevation myocardial infarction (STEMI) and drug-eluting stent placement in the left anterior descending artery (LAD) in 2013, complicated by ischemic cardiomyopathy, presented to the Emergency Department with dyspnea, cough and fever. She was found to have hypoxemia and her chest X-ray showed patchy consolidations bilaterally, confluent in the right upper lung. She had a positive troponin test without ischemic electrocardiographic changes. She was admitted and started on antibiotics for community-acquired pneumonia. Given her history of progressive dyspnea, a transthoracic echocardiogram was performed that showed her left ventricular systolic function had worsened from an ejection fraction (EF) of 50-55% to 25-30%, without new wall motion abnormalities. Her troponin continued to rise, from 0.09 to 0.15, without electrocardiographic (ECG) changes. The inpatient medicine team obtained a “curbside” cardiology consultation; the consultant felt that her condition was consistent with demand ischemia and that the worsening of her systolic function could be consistent with acute pulmonary edema. The patient was therefore diuresed and continued on antibiotics. Her hypoxemia improved with resolved infiltrates on chest radiography. She was discharged home after a four-day hospitalization to complete her antibiotic course; she was told to resume her home diuretic regimen and plan for cardiology follow-up within a week.

The patient’s follow-up with cardiology did not occur until two months after discharge. At that time, a nuclear stress test was ordered, which showed a large perfusion defect suggestive of infarction. Subsequent left heart catheterization with coronary angiography showed 100% mid-LAD occlusion and a hypokinetic scar in the distal anterior wall and apex. Cardiac magnetic resonance imaging (MRI) showed no viability of the mid-anterior wall of the left ventricle. A multidisciplinary conference with interventional cardiology and cardiothoracic surgery specialists concluded that there was no benefit to be gained by percutaneous or surgical coronary revascularization.

Misdiagnosis of a Pelvic Mass versus Pregnancy

The Case

A 28-year-old woman arrived at the Emergency Department (ED) complaining of back pain and bloody vaginal discharge. She reported some missed periods and a positive urine pregnancy test at home but had not received any prenatal care and was unsure of her expected due date.

The initial physician evaluating the patient was an intern on their first day of service in a busy Emergency Department. The intern suspected complications of early pregnancy including ectopic pregnancy, spontaneous abortion, and gestational trophoblastic disease. After cursory review by a more experienced physician, a pelvic ultrasound was ordered as a "first trimester" examination. Active labor was not suspected by the ED physicians.

The on-call sonographer was trained in abdominal ultrasound but had limited experience in fetal sonography. The patient's obesity limited the ultrasound assessment; the quality of the ultrasound images was poor. The sonographer did not recognize that the patient was in her third trimester based on a review of the images, and mistakenly identified the fetal head as a "pelvic mass." The radiologist on call was experienced in abdominal ultrasound but had limited experience in fetal ultrasound. The sonographic images were reviewed remotely, and the radiologist also failed to recognize that the "pelvic mass" was actually a fetal head. The radiologist did not repeat pertinent aspects of the ultrasound exam himself.

Subsequently, a consultation was sought from the obstetrics/gynecology team on call, which was completed four hours after the patient had arrived to the ED. Based on their evaluation, including a pelvic examination and repeated pelvic ultrasound at the bedside, they recognized that the patient was in her third trimester and in active labor. The patient was transferred to Labor and Delivery, where standard procedures for labor management were initiated. The initial fetal heart rate tracing (FHRT) was category 1 (normal), but variable decelerations were later noted (category 2) which deteriorated to fetal bradycardia. The obstetric team proceeded to an emergent cesarean section that was successfully accomplished. Apgar scores at one, five, and ten minutes were 2, 2, and 7, respectively. The infant then suffered a neonatal seizure. Subsequent investigation revealed a perinatal thrombotic infarct of the left basal ganglia that was confirmed on brain MRI. It could not be determined if the perinatal stroke was a result of an antenatal insult or a consequence of the labor and delivery.

Multiple High-Risk Events Involving Workflow for Wasting of Medications Used by Anesthesia

The Case

An anesthesiologist administered a dose of intravenous fentanyl to Patient #1 at the end of a surgical procedure. There was leftover medication in the syringe that needed to be safely disposed of, or "wasted"; the anesthesiologist placed a medication label on the syringe and then placed it in his pocket. The anesthesiologist proceeded to his next case, and after Patient #2 was induced and stable, the anesthesiologist placed this fentanyl syringe in the pocket of the automated dispensing cabinet (ADC) and notified the resident of the need to waste the medication. The resident mistakenly removed the syringe to be wasted from the ADC pocket during the procedure and administered the medication to Patient #2. Upon identification of the error, both patients involved were notified and an incident report was filed. When reviewing the event, investigators also noted several incidental findings of unsecured propofol in several areas including on top of a medication cart and in the computed tomography (CT) scan room.

Direct Oral Anticoagulants are High-Risk Medications with Potentially Complex Dosing

The Case

A male patient with a history of right axillofemoral and right to left femoral-femoral bypasses in September 2018 presented to the hospital 4 months later with right calf pain and evidence of popliteal artery occlusion. He underwent thrombolysis and thrombectomy and was discharged five days later. He was instructed to take rivaroxaban 15 mg twice daily for 19 days, to complete the full 21 day loading phase, and then 20 mg daily thereafter. The prescription and written instructions on the After-Hospital Summary (AHS) were correct, but nurse-generated check marks used when educating the patient on discharge medications incorrectly indicated that the 20 mg daily dose was to be given twice daily. This visual aid was included in the AHS indicating that rivaroxaban was to be administered at 9am and 9pm for both the 15 mg and 20 mg strengths. Relying upon the easy visual instruction sheet included in the AHS, as opposed to the prescription label, the patient reported taking 15 mg twice daily for 19 days (as prescribed) and then took 20 mg twice daily from the end of January until mid-February. This resulted in a six-day lapse between the day he ran out of his rivaroxaban and the day he could refill the 20 mg maintenance dose. He was readmitted shortly thereafter and found to have developed recurrent right popliteal and posterior tibial occlusion.

When the Indications for Drug Administration Blur

The Case

A 55-year-old woman was admitted to the intensive care unit (ICU) with necrotizing pneumonia and underwent a pneumonectomy and tracheostomy. While in the ICU, she had a seizure; however, the workup for the seizure did not reveal a clear etiology. After the seizure she was prescribed lorazepam 4 mg intravenously every 2 hours as needed for seizure. She tolerated the tracheostomy collar support and was stable for 24 hours and was then transferred from the ICU to the inpatient floor. The medication list was not revised during the transition.

On the inpatient floor she was generally stable, but on the night shift she became anxious and could not sleep. The nurse checked her vitals, which were normal and seeing lorazepam on her medication list, gave lorazepam 4 mg to help alleviate the anxiety. After the first dose, the patient was able to sleep for a short period but woke with more anxiety. The nurse repeated the lorazepam each time the patient complained of anxiety, resulting in a total of 4 doses, or 16 mg, of intravenous lorazepam over the course of 12 hours.

When the morning shift change occurred, the morning nurse evaluated the patient and found her to be barely arousable with a very low blood oxygen saturation of 89-90%. Only one dose of lorazepam had been documented as given during the night shift, and the night nurse did not communicate the additional undocumented doses when she signed out, leaving the morning nurse unsure as to the cause of the decrease in mental status and low blood oxygen. The Rapid Response Team was called immediately, and the patient was placed on a ventilator. Upon later finding out she had received 16 mg of intravenous lorazepam overnight, she was moved back to the ICU for treatment of altered mental status due to iatrogenic medication overuse. Subsequently, the patient improved, was extubated, and eventually returned to her baseline mental status and was safely transferred back to the floor.

Fatal Patient-Controlled Analgesia (PCA) Opioid-Induced Respiratory Depression

The Case

A 69-year-old man with a history of cervical stenosis, coronary artery disease, chronic kidney disease, and hypertension developed worsening neck pain in the previous year, which prevented him from working, performing household tasks, and socializing with friends. Due to severe osteoarthritis and pain in his knees, he used a motorized scooter. The patient was admitted for elective surgery for decompression and to extend a prior C3-C6 fusion down to T3. Surgery was performed which concluded

at approximately 13:00. The patient recovered in the post-anesthesia care unit (PACU), where he was placed on hydromorphone patient-controlled analgesia (PCA) for pain control and also received his usual home doses of gabapentin and acetaminophen. The patient was transferred from the PACU to the surgical floor at 20:00 where supplemental oxygen was placed for a peripheral oxygen saturation measurement (SpO_2) of 88%. The patient was awake and participating in care until 02:45. At 04:05, the patient was found unresponsive and a Code Blue was called. He was initially responsive to resuscitation efforts, and was transferred to the intensive care unit, where he arrested twice more. Tests the next day confirmed brain death and ventilatory support was withdrawn.

Wrong Catheter in the Right Patient

The Case

A 55-year-old man with history of emphysema was admitted to the hospital for pneumonia. The patient had two peripheral intravenous (IV) lines that infiltrated while he was receiving intravenous antibiotics with high dose steroids. When a third IV line also infiltrated, the nurse caring for the patient that night called the attending physician and asked for permission for peripheral intravenous central venous catheter (PICC) placement. She received a telephone order to place an interventional radiology (IR) consult for PICC insertion to be scheduled as soon as possible.

With the next shift change, a new team took over and after a few hours, the IR nurse called asking for a pre-procedure checklist. The IR nurse was given basic information including the patient's vital signs and hemodynamic parameters. Within 30 minutes, the patient was wheeled down, the procedure was completed uneventfully, and the patient returned to his room. When the unit nurse came in to assess the patient, the physician walked in at the same time and both were surprised to see that a tunneled dialysis catheter (TDC) had been placed instead of a PICC line.

On review of the electronic health record, it was found that the order had been entered for a TDC instead of a PICC by the night nurse who had taken the verbal order from the physician. During the shift change that morning, the sign-out to the day shift nurse indicated that PICC insertion had been arranged. The day shift nurse called to confirm the procedure without realizing that a wrong order had been placed. Unfortunately, since the pre-procedure checklist did not specify the need for a PICC, the physician placed a TDC instead. After the error was recognized, the IV team was called to place a midline catheter into the basilic or cephalic vein to give IV antibiotics. This plan was immediately explained to the patient as well. After all safety checks were completed, the dialysis catheter was removed without any untoward consequence to the patient.

Life-Threatening Infant Overdose of Sodium Chloride

The Case

An infant with trisomy 21 underwent repair of a complete atrioventricular canal defect and was subsequently cared for in the pediatric intensive care unit (PICU). Because of a prolonged low cardiac output state, total parenteral nutrition (TPN) was initiated two days following surgery. For pediatric patients, TPN at this hospital is ordered daily by 12:00 noon in order to allow adequate time for cross-checking the order with both the dietician and pediatric pharmacist, as well as preparing the new solution. Per PICU protocol, infusion of the new TPN solution starts early the following morning.

After several days of TPN, the current TPN ordered by the attending physician expired and was not reordered in time to be mixed for the following day. Since it was a weekend, a dietician was not on staff to flag the missing order. To maintain hydration and provision of calories, at 1:00 am an order was placed for replacement fluid, which should have included a standardized dextrose concentration of 20%, with

additives of sodium chloride 7.7 mEq/100 mL, potassium chloride 2 mEq/100 mL, and calcium gluconate 100 mg/100 mL. The dextrose, potassium chloride, and calcium gluconate orders were entered correctly. However, the free-text order concentration for sodium chloride was mistakenly entered as 77 mEq/100 mL, a ten-fold higher concentration than intended. The solution was verified and mixed by the overnight non-pediatric pharmacist, who was unaccustomed to working night shift and busy orienting a new pharmacist at the time. The custom intravenous fluid was verified and administered by the baby's PICU nurse.

After this fluid had been infusing for 16 hours, the PICU physician noted the error in the intravenous fluid order, discontinued the fluids, and ordered replacement fluids. Laboratory tests obtained at that time showed the patient's serum sodium at 188 mEq/L (normal range 133-142 mEq/L) and chloride at 166 mEq/L (normal range 95-110 mEq/L). The attending PICU physician who placed the incorrect fluid order met with the patient's family, expressed regret for the error, discussed the immediate effects and the next steps in the care of their baby, and addressed their questions. The patient's sodium and chloride levels were slowly and safely corrected to normal range. The patient's mental status remained at baseline. The infant's family and attending physician met regularly for discussions and reconciliation.

Delayed Management of Necrotizing Soft Tissue Infection – Who does the Patient Belong To?

The Case

A 52-year-old woman presented to the emergency department (ED) of a tertiary care university hospital after recently undergoing cosmetic abdominoplasty at a private community hospital. Upon evaluation in the ED, the patient was found to have a profound lactic acidosis and leukocytosis, and vasopressor medication was initiated through a peripheral intravenous catheter.

The Plastic Surgery service was notified and evaluated the patient; the team recommended debridement of a presumed necrotizing soft tissue infection (a.k.a., necrotizing fasciitis) by the Emergency General Surgery (EGS) service. An intern from the EGS service evaluated the patient and discussed the patient with the EGS attending on call. However, the EGS attending refused to see the patient because the patient had undergone a "plastic surgery procedure." The Emergency Medicine attending did not communicate the EGS attending's refusal to see the patient to the Plastic Surgery team who initially evaluated the patient. Four hours later, the Plastic Surgery attending realized the patient was still in the ED and had not been treated and decided to intervene. The delay in treatment allowed the infection more time to progress, and the patient ultimately required excision of a large area of skin and soft tissue. The patient was subsequently admitted to an Intensive Care Unit for several days.

Complications of ECMO During Transport
The Case

A 54-year-old woman with end-stage chronic obstructive pulmonary disease (COPD) was admitted with acute on chronic respiratory failure. She was placed on the list for a lung transplant. Due to severe hypoxemia, she was intubated, mechanically ventilated, and required extracorporeal membrane oxygenation (ECMO) support.

About six days into the hospitalization, the patient developed clotting problems, a known complication of the ECMO oxygenator. She was taken to the operating room and underwent an uneventful change of the ECMO circuit. On the way back to the intensive care unit (ICU), the team was moving the patient out of an elevator when a piece of equipment became snagged on the elevator door. The ECMO circuit alarmed,

but the patient remained stable. The circuit alarms were silenced and the decision was made to continue back to the ICU and recheck the system there.

After returning to the ICU, the nurse noted that the femoral cannula site was oozing. Some clots were also noted in the new oxygenator. A perfusionist was called to reassess the ECMO circuit. Usually, a perfusionist is expected to be at bedside to monitor all aspects of the ECMO system as soon as any patient has reached the ICU. However, in this case, the perfusionist was covering multiple floors, and the patient's arrival in the ICU was delayed by the elevator issue. Therefore, it took the perfusionist almost 30 minutes to see the patient after the patient left the operating room. The perfusionist immediately realized that the oxygenator was filled with room air. The air had been transmitted to the patient's circulation, leading to an air embolism. The team immediately instituted treatment but, within a few hours, the patient became severely hypotensive and bradycardic. A “code blue” was called. Despite aggressive attempts at resuscitation, return of circulation was not achieved. The patient's family decided to stop resuscitation efforts and she was pronounced dead.

Following this event, ICU nurses were trained in basic perfusion skills, and a protocol was instituted whereby all ECMO patients would be cared for by a nurse trained in critical care, with a perfusion-trained nurse as backup. The device was later sent to the company for further investigation and was found to have a small breach in the oxygenator, which was probably caused by the mishap in the elevator.

Some Patients Can't Wait: Improving Timeliness of Emergency Department Care

The Case

A 46-year-old woman with a history of a stroke ten months prior, methamphetamine use, and remote endovascular repair of a thoracic aortic dissection, presented to the emergency department (ED) triage nurse at 12:38am with a chief complaint of abdominal pain and vomiting. Her vital signs included: blood pressure 154/113 mmHg, heart rate 75 beats/minute, respiratory rate 16 breaths/minute, room air pulse oximetry 98%, and oral temperature 36.6˚C. The triage nurse assigned Emergency Severity Index (ESI) category 2. Because the ED was busy with no available beds, the patient remained in the waiting room. No further nursing assessments or vital signs were recorded until 5:40am when the patient became increasingly tachycardic, tachypneic, and pale, and began to scream in pain on the waiting room floor. She was taken immediately to the resuscitation room and was assessed by the Emergency Medicine attending and resident physicians. The ED care team obtained vascular access, sent a battery of laboratory tests, and ordered imaging studies. The lactic acid value was 10.2 mmol/L (normal 0.9 - 1.7 mmol/L). A contrast-enhanced CT scan of the abdomen and pelvis was performed at 7:00am and revealed a ruptured thoraco-abdominal aortic aneurysm. The emergency physicians immediately consulted the Vascular Surgery team, which evaluated the patient at 7:30am and agreed to take the patient to the operating room (OR). Surgery was scheduled at 7:54am as a 0-2 hour case while surgical staff prepared the specialized vascular OR. The patient’s ED nurse called the OR to arrange transport and was told someone would be down to transport the patient to surgery in 30 minutes when the room became available. At 8:57am, while still in the ED waiting for the OR, the patient developed hypotension and agonal respirations. She then became unresponsive and pulseless. The team called a code blue, initiated cardiopulmonary resuscitation, and administered blood products. Unfortunately, she could not be resuscitated and died in the ED.

Is that solution for IV or irrigation?: Fluid administration errors in the operating room.
The Case

Two different patients experienced similar events.

Event #1: A 28-year-old woman was admitted for deceased donor renal transplant surgery. A bag of 1000 mL normal saline with 160 mg gentamicin bladder irrigation solution was prepared prior to surgery and was hung on the patient's IV pole. When the nurse went to connect the irrigation solution to the patient's urinary catheter, it was found to be already connected and attached to the patient's IV tubing, though it had not yet been infused.

Event #2: A 50-year-old woman was admitted for deceased donor renal transplant surgery. A bag of 1000 mL normal saline with 160 mg gentamicin bladder irrigation solution was prepared in the operating room (OR) prior to surgery. The solution was labeled with the contents, date and time and placed in the warmer. When the nurse went to retrieve the solution, it was missing from the warmer. It was found hanging on the patient's intravenous (IV) pole attached to her IV, though it had not been infused.

Right Electrocardiogram, Wrong Patient
The Cases

Multiple electrocardiograms (EKGs) were incorrectly documented at a large urban tertiary care hospital over three months. All of the cases involved the nurse or EKG technician either entering the wrong medical record number (MRN), or not clearing the previous patient's MRN from in the machine, while entering a new patient's name. The incorrect patient documentation on the EKG caused EKG results to be uploaded to the wrong patients' charts.

One case involved a female infant whose treating physician received an electronic medical record (EMR) message shortly after her discharge from the hospital with the electrocardiogram result of sinus bradycardia and/or sinus arrest. Upon this physician's review, an EKG had never been ordered on this patient throughout her hospital stay, nor did the EKG diagnosis fit with the clinical history of the patient. Upon further review it was determined that the EKG recorded was from a patient in the medical intensive care unit (MICU) but had been recorded in the wrong patient chart.

Discharged with IV antibiotics: When issues arise, who manages the complications?
The Case

Patient 1

A 68-year-old male patient was hospitalized and treated with intravenous (IV) antibiotics for bilateral septic knee arthritis with methicillin-sensitive staphylococcus aureus (MSSA) bacteremia as a complication of bilateral corticosteroid knee injections. Other medical problems included type II diabetes mellitus, hypertension, hyperlipidemia, and right lower extremity deep vein thrombosis. He was discharged to a Skilled Nursing Facility (SNF) for continuation of IV antibiotics. There was no recommendation for a follow-up appointment at the Infectious Diseases clinic, and follow-up laboratory tests were recommended but never obtained. The patient was seen in the Orthopedics clinic one month after his transfer to the SNF. At that time, he still had a central venous catheter in place, despite the antibiotic course having been completed two weeks prior to that visit. The patient had no signs or symptoms of infection and his central line was removed without complications.

Patient 2

A 38-year-old male patient was hospitalized and treated with IV antibiotics for a traumatic injury with subsequent abscess of his right knee and osteomyelitis of the distal femur requiring bone resection, antibiotic-impregnated spacer placement, and external fixation of the right leg. Other medical problems included paraplegia and pneumonia. The patient was discharged to a SNF with orders to receive an

additional four weeks of intravenous antibiotics with follow up in the Orthopedics clinic in two weeks and in the Infectious Diseases clinic in three weeks. The surgical team also ordered weekly blood counts, metabolic panel, and Vancomycin trough levels. The patient was seen in the Orthopedics clinic 3.5 weeks after discharge, still on intravenous antibiotics with no signs of infection. Despite the discharge orders to schedule a follow-up appointment in the Infectious Diseases clinic in three weeks, the patient was not seen there until five weeks after discharge. Follow-up laboratory tests were either never obtained or were not available for review during these outpatient appointments. The delays in clinic follow up were potentially due to Christmas and New Years' holiday closures or difficulty in obtaining insurance authorization for this referral.

Pre-analytical pitfalls: Missing and mislabeled specimens

The Case

Case #1:

A 56-year-old man was admitted to the same-day surgery center for a planned biopsy procedure. Microbiological specimens were collected for culture and first transported to the central laboratory for processing at 1142. The samples were dropped off at the central laboratory receiving window where the time/date of receipt was recorded into a specimen tracking log and a temporary tracking barcode was issued at 1151.

At this institution, culture specimens are ultimately tested at the microbiology laboratory located 10 minutes away by courier (hourly pick up) at a satellite facility. Upon arrival at the satellite facility, samples are logged and accessioned for testing at their respective laboratory (*e.g.*, microbiology). In this case, receipt of the culture specimen was confirmed by the central laboratory, however, the specimen never arrived at the microbiology laboratory. Both the central laboratory and satellite facility were not aware that the sample was missing until the ordering provider queried the laboratory about the result five days later. The ordering physician was notified of the missing sample. Unfortunately, the specimen was never found. Incident review did not identify any adverse events associated with the missing specimen. The patient did not manifest any signs or symptoms of infection one week and up to one month following the procedure.

Case #2:

A 59-year-old man was treated for a suspected myocardial infarction due to erroneous cardiac troponin results. The patient presented to the Emergency Department (ED) with chest pain, shortness of breath, and a history of chronic obstructive pulmonary disease. Initial cardiac troponin I concentrations were 4400 ng/L (99^{th} percentile of the upper reference limit was 40 ng/L) with a B-type natriuretic peptide value of >5000 pg/mL. Aspirin, ticagrelor, and heparin were administered, and the patient was taken to the Cardiac Catheterization Lab. While undergoing catherization, it was revealed that the patient did not have any obstructed blood vessels. Chest, abdominal, and pelvis computerized tomography scans were also negative for pulmonary embolism and dissection. A repeat cardiac troponin I specimen was drawn, and the result was <10 ng/L. The Emergency Medicine physician contacted the Laboratory to determine the cause of such a large shift in results and the negative findings by the Cardiac Catherization Laboratory. As per routine procedure, the Clinical Laboratory immediately sequestered all samples related to the patient. Cardiac troponin I measurements were re-run and reported the same discrepancy. Blood typing of the two troponin specimens indicated they were not from the same patient. Follow-up investigation by the ED ultimately revealed the initial sample with the high cardiac troponin was from another patient presenting with septic shock and renal failure.

Timely diagnosis of esophageal perforation
The Case

A man with mixed connective tissue disease on low-dose prednisone and methotrexate presented moribund with chest and left shoulder pain, a left hydropneumothorax, and progressive respiratory failure. The initial diagnosis was community-acquired pneumonia (CAP) and treatment included ceftriaxone, azithromycin, and stress-dose hydrocortisone. Over the ensuing days, the patient's condition deteriorated with worsening respiratory failure, progressive encephalopathy, and septic shock requiring vasopressor medications. Antibiotics were changed to vancomycin, levofloxacin, and—due to the presence of hyphae on thoracentesis—anidulafungin. Blood and sputum cultures were negative, and pleural fluid cultures grew Candida albicans. Based on a diagnosis of fungal empyema, the patient underwent a left thoracotomy with decortication on hospital day 11. Postoperatively, a new right pleural effusion developed, and fluid from a second thoracentesis grew Candida albicans, Candida lusitaniae, Lactobacillus, and alpha-hemolytic Streptococcus. Antibiotic and antifungal medications were continued. On hospital day 26, the radiologist described an evolving mediastinal process with gas suggestive of an esophageal perforation. A Gastrografin (diatrizoate meglumine/ditrizoate sodium) esophagram demonstrated a small outpouching of the distal esophagus, and a computed tomography esophagram confirmed extravasation of contrast into bilateral pleural spaces. The patient underwent an urgent right thoracotomy with mediastinal debridement and wide drainage.

Incomplete Orders for Hypertonic Saline to Treat Hyponatremia
The Case

A 54-year-old man was brought to the emergency department by his family members who stated that they had found him unconscious at home with multiple empty bottles of alcoholic beverages nearby. The patient was found to be confused and severely hyponatremic with a blood sodium level of 109 mEq/L (the lower limit of the normal range in adults is 135 mEq/l). This level placed the patient at risk for life-threatening seizures, so he was admitted to the intensive care unit (ICU) and a nephrology consultant was urgently called.

The nephrologist briefly reviewed the laboratory results and asked the intensivist to administer hypertonic saline immediately to increase the sodium level, and to recheck the sodium level in one hour. ("Hypertonic" saline contains 3% sodium, compared to normal saline solutions which are composed of 0.9% sodium.) He did not specify how much hypertonic saline should be administered. When the nephrologist came to the ICU about two hours later, the patient's confusion had not improved. The repeat laboratory results showed that the sodium had risen to 130 mEq/dL, a rapid increase that put the patient at risk of severe neurologic complications.

Given this rapid correction, the nephrologist asked what medications had been administered and noticed that a 500 mL bag of hypertonic saline had nearly finished infusing. The infusion was stopped immediately, and the patient was administered dextrose, free water, and desmopressin to mitigate the effect of the rapid sodium correction. Fortunately, the patient's sodium stabilized and his mental status gradually improved. The next day, he was conscious, oriented, and answering questions appropriately. He was eventually discharged to an inpatient alcohol use disorder treatment center.

An incident report was filed due to the medication error. Investigation revealed that the intensivist had intended to order administration of 50 mL of 3% saline. However, the default intravenous fluid order in the hospital's computerized order entry system was for a 500 mL infusion. A separate, customizable order was available but not easily accessible. In a rush, the intensivist ordered the 500 mL infusion and added a

free-text comment to "infuse 50 cc then recheck sodium." Unfortunately, the free-text comment was missed both by the pharmacist and the ICU nurse, resulting in the patient receiving a much larger infusion at a faster rate than intended.

Patient Identification Errors: A Systems Challenge

The Cases

The following four events involving five patients all involved incorrect patient identification in a large tertiary care hospital; all cases were reported to the hospital's patient safety committee within a 4-week period. Together, these cases serve to highlight several important systems issues.

Event #1 involved a 68-year-old woman who presented to the emergency department (ED) from the ambulatory clinic with nausea, vomiting and altered mental status. She had a history of untreated deep vein thrombosis (DVT) in the right upper extremity and had erythema and signs of possible cellulitis. The emergency medicine physician ordered non-contrast computed tomography (CT) scans of the abdomen/pelvis and head. The patient was transported to radiology and mistakenly received a CT of the right upper extremity with contrast, which had been ordered for another patient with the same first name (but a different surname).

Event #2 involved two patients whose ED visits overlapped in time. Patient #1 was a 23-year-old man found unconscious outside a bar with multiple facial injuries and bruises on his chest and abdomen. Patient #2 was a 21-year-old man with facial injuries and head pain following a motor vehicle accident. These two patients, both with head and facial injuries and of similar age, were admitted to neighboring rooms in the ED and orders for CT of the head, face, and cervical spine without contrast were placed for both; each patient's scan was mistakenly performed under the other patient's name, and the wrong results appeared in both patients' charts. A CT of the abdomen and pelvis was also ordered for Patient #1 but was performed on Patient #2, for whom no additional CT had been ordered. Upon receiving all the CT results, the ED team recognized that the results were not consistent with physical exams and, subsequently, a CT of the abdomen and pelvis was appropriately carried out on Patient #1 and all results were correctly relabeled.

Event #3 involved a 2-year-old patient who presented to the ED, subsequently underwent surgery, recovered in the post-anesthesia care unit (PACU), and was admitted to the pediatric unit late in the day. The next day, the night shift RN discovered the child had another patient's identification (ID) band on her wrist. The ID band belonged to an 8-month-old baby boy who also had been seen in the ED the previous day but had been discharged home later that day.

Event #4 was a 21-year-old female patient seen in the ED. While receiving an electrocardiogram (EKG), this patient was found by the EKG technician to have another patient's ID band on her wrist. The ID band belonged to a 60-year-old male and had been placed on the patient by the triage nurse.

"This is the wrong patient's blood!": Evaluating a Near-Miss Wrong Transfusion Event

The Case

A 74-year-old male with a history of hypertension, hyperlipidemia, paroxysmal atrial fibrillation, coronary artery disease, congestive heart failure with an ejection fraction of 45%, stage I chronic kidney disease and gout presented for a total hip replacement. His home medications included lisinopril, metoprolol, colchicine, sertraline, acetaminophen and oxycodone as needed, and warfarin, which was withheld appropriately prior to the surgery.

The patient was seen by the surgical and anesthesia teams in the preoperative holding area the morning of surgery. An intravenous (IV) line was placed and a “type and cross for blood” request was sent along with baseline laboratory tests. At our institution, an initial blood sample is sent in a purple tube from the holding area and then the blood bank will request a second confirmatory sample in a pink tube. The anesthesiologist marks the first tube with a patient sticker, date, time, and initials. The blood bank then sends a pink tube with pre-made labels to the operating room (OR) for a second blood sample.

Shortly into the case, the patient became hypotensive and vasopressors were initiated. During this time, the patient's pink tube for the confirmatory blood sample was delivered to the room. The anesthesiologist filled the tube with blood and sent it back to the blood bank. About an hour into the case significant bleeding was encountered and a blood transfusion was needed. The patient information on the blood bags was checked per institution policy, which requires a witness signature. It was quickly discovered that the blood delivered contained the wrong labels. The blood bank was notified, the blood returned, and a new blood sample sent. Because the patient was persistently hypotensive and still bleeding, a massive transfusion protocol was initiated to rapidly get blood to the room. Uncrossed universal donor blood was delivered and administered, and the patient's hemodynamic parameters recovered appropriately.

A Mistaken Dose of Naloxone
The Case

A 55-year-old man with widely metastatic gastric cancer presented to his oncologist's office for a follow-up appointment. He had just completed cycle 2 of FOLFOX chemotherapy and reported feeling relatively well. His symptoms included some fatigue in the week after chemotherapy, but his abdominal and bony pain due to metastases was well controlled with opioid therapy (approximately 200 oral morphine equivalents per day). Examination and imaging confirmed that the disease was responding, so they planned to continue chemotherapy with the next dose scheduled for the following week.

At the end of the visit, the oncologist electronically ordered refills of the patient's pain medications, and a best practice alert (BPA) prompted him to also prescribe naloxone (a medication that can reverse an opioid overdose) intranasal spray. The naloxone BPA was part of the cancer center's new initiative to reduce opioid-related adverse events. The oncologist followed the prompt and ordered the naloxone but did not inform the patient or educate him on its indication and appropriate use. The patient then picked up his medications at his usual local pharmacy, but the pharmacist also did not provide any naloxone education to the patient.

Upon arriving home, the patient took out his new medications and administered an intranasal dose of naloxone (4 mg). Within a minute, he developed severe abdominal pain and bone pain. He called the 24 x 7 cancer center helpline and described what happened. They diagnosed the patient as having developed a pain crisis due to the effects of the naloxone and advised him to come to the urgent care center, where intravenous opioids were administered for uncontrolled pain. He was monitored for a few hours, and his home pain regimen was reinitiated.

A root cause analysis was performed by the hospital's safety committee, which revealed that pharmacists were tasked with reviewing naloxone prescriptions and providing education for patients within the health system's pharmacies, but no such mechanism existed for "outside pharmacies." They identified a need for alternative, proactive education plans for situations in which prescriptions are sent to pharmacies outside the health system. Additionally, they realized BPAs should be paired with sufficient staff training and clear role designations for prescribing physicians, pharmacists, and nurses.

The Need to Eat

The Case

A 62-year-old man with a history of Wernicke–Korsakoff encephalopathy – a degenerative brain disorder caused by the lack of vitamin B1 – was admitted for possible aspiration pneumonia complicated by empyema and coagulopathy. The patient was alert and oriented to his name, but not the date or location, on admission. He became agitated and uncooperative during the hospitalization, with presumed delirium. Soft restraints with mitts were required to maintain life-sustaining lines and chest tubes. Over the first 10 days of hospitalization, the patient refused most oral nutrition and medications. On day 11, he was taken to the operating room for video-assisted thoracoscopic (VATS) decortication of his pleural space due to his persistent empyema. After returning to the ward, his diet order was not restarted. The patient received maintenance intravenous fluids but had no other nutrition for four days postoperatively, until he finally expressed hunger and it was noted that he was not receiving meals.

During this time, the nursing staff had also stopped offering oral medications because of the patient's numerous prior refusals. As a result, he did not receive any of his prescribed oral medications for hypertension or his metronidazole for the aspiration pneumonia. Once the patient expressed hunger, the diet order was restarted, and a feeding consult was ordered. The patient was identified as having difficulty swallowing and ultimately a percutaneous endoscopic gastrostomy (PEG) tube was placed to deliver both nutrition and medications.

"Do You Want Everything Done?": Clarifying Code Status

The Case

A 63-year-old woman with a history of liver transplantation secondary to hepatitis C, low back pain, and depression presented to the emergency department with hematemesis. Despite her chronic conditions, she was generally quite healthy, working as an office manager and frequently traveling to see her children and grandchildren. She was admitted by a second-year medical resident who ordered the appropriate diagnostic and therapeutic interventions for her upper gastrointestinal (GI) bleeding.

As asking about code status is a normal part of the admission process, the resident asked the patient if "she would want everything done" if she were to get sicker. The patient paused and replied, "You know, I don't think I'd want to be kept alive on machines, that's for sure." The resident interpreted this to mean the patient would not want resuscitation under any circumstances, and thus felt that her code status should be do not resuscitate and do not intubate (DNR/DNI). Unfortunately, the resident did not enter this order into the computer, although he mentioned it in his progress note. So, per the admission orders, the patient was listed as a "full code" by default.

In the morning, the admitting resident presented the case to the daytime medical team, including the DNR/DNI code status. The team was somewhat surprised by the code status given the patient's general good health. Early in the afternoon, the attending physician and intern on the team met with the patient to discuss her wishes. In a longer conversation, the patient clarified that she would not want chest compressions (as she had seen her husband receive these in the past when he died) but would accept short-term mechanical ventilation for reversible causes. She repeated that she would not want prolonged mechanical ventilation. Based on this, they deemed her code status to be "partial code."

The patient was taken for an endoscopy for the upper gastrointestinal bleeding about that same time and was intubated for the procedure. In parallel, the intern placed the order to change the patient's code status from "full" to "partial" code. Right after intubation in the endoscopy suite, the anesthesiologist and gastroenterologist noticed the change in code status. They were no longer comfortable proceeding with

the endoscopy, because they lacked the ability to respond fully with resuscitation if something were to go wrong during the procedure. Yet, the patient was already intubated and sedated.

They urgently contacted the daytime medical team, and the teams met briefly in the endoscopy suite. Under the circumstances, they realized they had three options: (a) proceed with the procedure without changing the code status and assume the risk that, if something went wrong with the procedure, the patient could not receive chest compressions and may die; (b) extubate without performing the procedure, discuss the decision with the patient, and potentially reintubate if that was consistent with her wishes; or (c) change the code status without the patient's explicit consent and proceed with the procedure.

In the end, they believed the third option from above best respected the patient's wishes and minimized harm, so they temporarily changed her code status to "full code," completed the procedure, and then discussed the situation with the patient afterward. The endoscopy was performed without any complications and the patient was extubated afterward.

Missed Opportunities for Suicide Risk Assessment

The Case

Patient 1

A 46-year-old homeless male was found in the parking lot of the emergency department (ED) expressing suicidal ideation (SI) and was brought into the ED. The triage nurse entered a positive suicide screen in the flowsheet which triggered an evaluation by Psychiatric Emergency Services (PES).

The patient's medical record indicated he had multiple chronic diseases and, of note, a suspicious lesion (revealed by a recent CT scan) that the patient had been told may indicate lung cancer. This patient was a well-known "frequent flyer" with multiple ED visits associated with excessive alcohol consumption and SI. In fact, the patient had six ED visits in the previous three months and in half of those visits he had expressed SI. On one of those visits, he stated that he had tried to hang himself the day before. When seen by a social worker the next day, he denied having thoughts of suicide and was discharged; he did not qualify for a 5150 hold at that visit.

During this current ED evaluation, prior to being seen by PES, the patient was intubated due to acute hypoxia; he was extubated within 12 hours. A suicide assessment by the ED physician was not noted in chart; however, the nursing flowsheet contained two documented assessments stating no SI. No psychiatric evaluation was carried out.

The ED staff arranged for placement in a boarding home (licensed or unlicensed, short-term housing with limited care) and the patient was discharged after being prescribed Valium for delirium tremens, cardiac medications, and antibiotics for a respiratory infection. Two days later the hospital was notified by a relative that the patient was found deceased, of unknown cause, behind a retail store.

Patient 2

A 76-yr-old male with a history of hypertension and depression was brought into the hospital via ambulance after his wife reported that he was unconscious following three days of altered level of consciousness. Alcohol intoxication with possible withdrawal seizures was the admitting diagnosis. The patient was intubated and placed on continuous EEG monitoring and Neurology noted moderate to severe encephalopathy likely due to medications. The drug screen came back negative except for abnormal

levels of Fluoxetine, Amitriptyline, and Nortriptyline. A social worker reviewed the case in the ED but did not see the patient after he was admitted.

The patient was extubated on hospital day two and Internal Medicine noted that a social service evaluation for alcohol abuse intervention was considered but, for some reason, was not ordered. After extubation, the patient wanted to go home and became agitated, cursing and stating, "it is wasting time" and "I should not be here." No suicide risk assessment was conducted by nursing or social services staff after the patient was extubated and able to communicate. The patient left the hospital against medical advice and was found dead by a neighbor the next day from a self-inflicted gunshot wound to head.

Cardiac Arrest in a Woman with UTI: A Case of QT Prolongation

The Case

A 36-year-old woman with a history of depression, bipolar disorder and a recent manic episode requiring inpatient psychiatric hospitalization presented with complaints of abdominal pain, decreased appetite, nausea, and generalized weakness. On admission, she was found to have a urinary tract infection and was started on intravenous levofloxacin. She was severely volume depleted and received intravenous hydration, including her home medications, which included quetiapine, an atypical antipsychotic and lithium for her bipolar disease. She also received multiple doses of intravenous ondansetron and metoclopramide as treatment for nausea.

Eighteen hours after admission, she was observed to be bradycardic with a widening QRS complex on telemetry. On bedside evaluation, the patient was found to be unresponsive and pulseless; cardiopulmonary resuscitation was initiated. A quick chart review revealed that the patient was receiving her multiple antipsychotic medications, intravenous levofloxacin and several doses of ondansetron and metoclopramide. She was resuscitated according to the advanced cardiac life support protocol and received intravenous calcium, magnesium and sodium bicarbonate. She achieved return of spontaneous circulation. At that time, her electrocardiogram showed a prolonged QT interval of 610 msec, which was attributed by the clinical team to concomitant use of multiple QT-prolonging medications. No electrocardiogram had been obtained at the time of admission, so the patient's QT interval on antipsychotic medications alone could not be ascertained.

Complications of Vascular Access Procedures in Patients with Kidney Disease

The Cases

Three patients were at the same hospital over the course of a few months for vascular access device (VAD) placement and experienced adverse outcomes. The adverse outcomes of two of them were secondary to drugs given for sedation, while the third patient's situation was somewhat different.

Patient 1:

A 31-year-old woman with end stage renal disease (ESRD) and pulmonary hypertension presented in the Vascular Access Unit for revision of a malfunctioning right internal jugular tunneled dialysis catheter. Her home medications were reviewed by a nurse and it was documented that she had been taking hydrocodone/acetaminophen 5/325 mg as needed for pain. She was not noted to be on any benzodiazepines or other opioids at the time of admission. The patient reported anxiety in the pre-operative area and received 1 mg of lorazepam followed by 50 mg of diphenhydramine intravenously. The patient then became very sleepy and was unable to maintain her airway; insertion of a nasopharyngeal airway was therefore required to continue the procedure. Her vital signs were stable throughout the procedure and no additional sedation was necessary. After the procedure, she remained

very sleepy but arousable. After several hours of observation, her condition was considered to be stable and she was discharged. The day after the procedure, the patient was found at home in cardiac arrest and was pronounced dead at a different community hospital. Her toxicology report in the hospital emergency department was positive for amphetamines, opiates and benzodiazepines.

Patient 2:

A 52-year-old man with a history of ESRD, heart failure, human immunodeficiency virus (HIV), and venous thromboembolism was admitted for left arm swelling and pain. The patient was taken to the Vascular Access Unit for a fistulogram and was given 100 mcg fentanyl and 2 mg midazolam intravenously for sedation. The patient became apneic and was unable to maintain his airway, so an oral airway was inserted, and naloxone 0.2 mg was given for reversal. The patient became arousable and able to maintain his airway without further incident.

Patient 3:

A 47-year-old woman with ESRD, cardiac sarcoidosis, and type 2 diabetes mellitus presented in the Vascular Access Unit for outpatient percutaneous thrombectomy for a clotted fistula. Procedural sedation with 175 mcg fentanyl and 3.5 mg midazolam was given intravenously and the procedure was successful. Afterward, the patient became unresponsive due to a cardiac arrest during transport and a Code Blue was called. She was then transferred to the emergency department where she experienced another cardiorespiratory arrest and expired.

The Safety Challenges of Supervision and Night Coverage in Academic Residency
The Case

A 64-year-old man was admitted to the hospital because of bilateral pleural effusions and pulmonary emboli in the setting of newly diagnosed metastatic cholangiocarcinoma. He remained short of breath and required anywhere from 6 to 10 liters of oxygen by nasal canula to maintain adequate oxygen saturation. Thoracentesis was performed on both sides to remove the pleural fluid. Ultimately, he required placement of bilateral pleural catheters to manage reaccumulation of the pleural fluid.

His overall clinical status remained tenuous, and he was followed closely by the hospital's rapid response team. One night, he developed acute worsening of shortness of breath and altered mental status. The bedside nurse paged the intern night float, who was cross-covering this patient, to come to the bedside to assess the patient's condition. The intern looked up the patient on her signout sheet and in the electronic medical record to check the patient's code status, clinical history, recent labs, and imaging. The signout did not provide a contingency plan explaining what course of action to take should the patient worsen. Moreover, although the patient was officially listed as a full code, the intern could not clearly determine the patient's overall goals of care from the signout. She ordered a stat chest radiograph, electrocardiogram, head CT, and laboratory tests. The patient continued to desaturate, and his blood pressure fell. The intern tried to call the rapid response team to switch the patient to high-flow oxygen by nasal canula, but she was unaware that she was using an incorrect paging number. When the intern asked the nurse to page them, the rapid response team finally arrived. The intern tried to page the senior resident responsible for assisting her overnight, but she also did not have the correct pager number for the resident. She could not leave the bedside to look for the resident because the patient was too unstable.

After an hour at the bedside, the intern saw a senior resident in the hallway and asked him to assess the patient and to assist in managing the patient's care. After reviewing the patient's laboratory test results (including a blood gas that revealed worsening oxygenation, hypercarbia, and an elevated lactate), the

senior resident paged the ICU fellow and suggested to the intern that they call the patient's family to provide an update regarding the patient's worsening status and to determine if the family would want the patient intubated and placed on a ventilator if he continued to worsen. The family decided against intubation, changed the patient's code status to DNR/DNI, and, after talking in depth with the overnight intern and resident, transitioned the patient to comfort-focused care. The intern ordered a morphine drip for air hunger and symptom management. The patient died several hours later. The primary hospital medicine attending was not notified of the patient's change in clinical status overnight and did not learn of the patient's death until the following morning.

The senior resident who assisted the intern overnight debriefed the intern about the case. In the discussion, he learned that the intern had never before rotated at this particular hospital and had been pulled from the jeopardy pool to provide nighttime coverage over the holidays for another intern who was sick. When they reviewed the signout that had been provided by the primary team, they realized it had not been updated for several days and that the family had already decided the patient should be transitioned to comfort care should he worsen clinically. In addition, another senior resident who was supposed to oversee the intern overnight had become busy with emergency department admissions early in the evening and never formally introduced himself to the intern, so the intern never realized which resident was supposed to help her, nor did she know how to contact him. After this case, the internal medicine residency program reviewed its practices for signout and nighttime coverage. The orientation for interns and residents rotating at night was formalized, and detailed contact information for all essential teams and resources available overnight was widely distributed and clearly posted in the residents' workroom.

The Lost Start Date: an Unknown Risk of E-prescribing
The Case

A 71-year-old man underwent resection of a colorectal cancer. Unfortunately, his hospitalization was complicated by an acute pulmonary embolism (PE), which was treated with rivaroxaban (a new oral anticoagulant).

At the time of his discharge home, the physician electronically prescribed his medications; the prescription was sent to an outpatient pharmacy. He required two prescriptions for rivaroxaban (per protocol), one for 15 mg twice a day for 10 more days, and then 20 mg daily after that. The discharging nurse reviewed the full medication list (13 medications) with the patient and his wife. The prescriptions were filled by the pharmacy.

Ten days later, the patient's wife returned to the pharmacy requesting a refill of the rivaroxaban 15 mg twice a day. On re-reviewing the medications, the wife explained the patient had been taking both prescriptions at the same time (a total daily dose of 50 mg daily). This overdose had placed him at very high risk for bleeding complications. Fortunately, he did not experience any adverse events. The outpatient pharmacist worked with the physician, wife, and patient to clarify the proper dosing.

The patient safety committee at the hospital performed a full review of the case. The hospitalist had appropriately entered the prescriptions in the electronic health record, including the appropriate start and stop dates for the rivaroxaban. However, when they reviewed the prescriptions in the outpatient pharmacy system, there was no start date associated with the 20 mg rivaroxaban. Further testing revealed that neither the start nor stop dates were transmitted to the outpatient pharmacy.

Moreover, the patient safety committee learned that transmission of start and stop date fields in electronic prescriptions is not required, and there is no national standard. The committee realized that every patient discharged from the hospital with an electronic prescription was at risk for adverse events because of this

issue. They wondered what other important information was not transmitted and what individuals and institutions could do to try to prevent such adverse events.

Misidentifying the Unidentified – John Doe and the EHR

The Case

Two male patients of similar age arrived at the same time to the emergency department (ED) after sustaining falls. Both patients were triaged as major trauma patients and were evaluated by the full ED trauma response team. The two patients' identities were not known upon their arrival; therefore, both patients were initially registered under "Doe" names and assigned medical record numbers. Because Patient 1's injuries were more severe, he was urgently admitted to the hospital by the trauma surgeon and quickly sent to the operating room. Soon thereafter, the "Doe" name assignments were transitioned to their actual names. Their actual names were also similar, although the medical record numbers were clearly different.

Patient 1, who was the more critical of the two patients, was mistakenly booked for emergent trauma surgery under Patient 2's name. Patient 1 (the correct patient for trauma surgery) was taken to the Operating Room for his surgery but arrived with no identification band, which was still in process of getting made. He arrived accompanied by a cooler of blood, having received blood in the Emergency Department and with more left to give as part of the massive transfusion protocol that had been correctly ordered for him. The Operating Room nursing staff expressed concern because the name on the massive transfusion protocol order (Patient 1's "Doe" name) did not match the name they had been given by the ED nurse (Patient 2's "Doe" name). Multiple phone calls ensued between the operating room nursing staff and the emergency department, the blood bank, the surgeons and, ultimately the OR nurse was able to confirm the correct identity and name of the patient. The OR nurse then looked Patient 1 up by his real name in the hospital system and found a medical record for him. Patient 1's surgery then took place as planned, though he did not survive his hospitalization.

Meanwhile, Patient 2 was in the emergency department receiving care, but the care team had difficulty charting his care because the electronic health record indicated he had been transferred to the operating room.

Think Like a Surgeon

The Case

A patient with a history of T6 paraplegia due to a motor vehicle accident was brought to the emergency department due to delirium. He was found to be hypotensive and febrile. Laboratory tests revealed a high white blood cell count and mild elevation of his bilirubin and liver enzymes. His physical examination was unremarkable, but given the laboratory findings, the emergency physician was concerned for hepatitis or cholecystitis (inflammation of the gallbladder due to obstructing gallstones) as the cause of his hypotension. A stat CT scan of the abdomen and pelvis was performed that showed a mildly thickened gallbladder wall but no definitive evidence of gallstones, acute cholecystitis, or liver findings. The patient was admitted to the intensive care unit (ICU) with a provisional diagnosis of septic shock. He was empirically treated with broad-spectrum antibiotics and intravenous fluids.

The patient's delirium and hypotension improved and he defervesced. However, results of blood and urine cultures were negative, and no clear source of infection was found. His bilirubin and liver enzymes remained elevated. He was transferred to the ward on hospital day 2. Shortly after arriving on the ward, he had a low-grade fever. The hospitalist who received the patient on the ward examined the patient and realized his diagnosis was still unclear. She noted the CT findings of a thickened gallbladder wall and

decided to obtain another CT scan. Results showed that the patient had a 6 cm abscess adjacent to the liver, likely arising from an acutely inflamed gallbladder that had perforated. A surgical consultation was immediately obtained, and the patient underwent an urgent open cholecystectomy and drainage of the abscess. He remained hospitalized for several more days, but he was ultimately discharged home in good condition.

On reviewing the case, the surgeon thought that the patient had in fact presented with acute cholecystitis and that surgery consultation should have been obtained earlier. The ICU physician expressed surprise when the surgeon brought this up with him, as the patient did not have any abdominal symptoms during his stay in the ICU.

Getting the Diagnosis Both Right and Wrong

A 27-year-old woman with a history of acute myeloid leukemia was sent to the emergency department (ED) from the outpatient oncology infusion center for shortness of breath after receiving chemotherapy. On arrival in the ED, the patient was hypotensive and intravenous fluids were rapidly administered. Laboratory tests showed acute kidney injury with markedly elevated levels of potassium, phosphate, and uric acid. This constellation of findings was highly suggestive of tumor lysis syndrome—metabolic abnormalities due to rapid destruction of cancer cells by the chemotherapy drugs. The patient's oncologist was contacted, who agreed with this provisional diagnosis.

The decision was made to start emergent hemodialysis to address the electrolyte abnormalities. The patient's blood pressure improved with fluids. Further laboratory results showed neutropenia (low white blood cell count) and a chest radiograph showed a right-sided infiltrate. After a dialysis catheter was placed, the patient began experiencing worsening dyspnea and was emergently intubated. She was then transferred to the intensive care unit. Consultants from nephrology, oncology, and intensive care had all seen the patient while she was in the ED, and the consultants and primary team agreed on the need to start treatment for tumor lysis syndrome with hemodialysis and other measures.

Six hours after admission, the patient's blood pressure started to drop, requiring further intravenous fluids as well as vasopressor administration. Despite aggressive measures to maintain her circulation, blood pressures further dropped, and a code blue was called. Despite 45 minutes of resuscitative efforts, the patient never regained a heartbeat and was pronounced dead less than 9 hours after presentation.

While the patient was being coded, the laboratory called the ICU to report that the patient had blood cultures positive for gram positive cocci. Review of the laboratory results and chart revealed that the ICU team had ordered blood cultures and broad-spectrum antibiotics while the patient was in the ED, but the antibiotics were not administered until after the patient was transferred to the ICU. An autopsy was performed, which confirmed that although the patient did have tumor lysis syndrome, the cause of death was septic shock due to a disseminated *Staphylococcus aureus* infection.

A formal case review was conducted and the case was discussed at the departmental Morbidity and Mortality conference. The review revealed missed opportunities to detect sepsis at multiple points in the care of the patient. Antibiotic orders were placed, but the ED nurse did not see the order because she was busy assisting with the multiple procedures the patient required while in the ED. Moreover, these orders were not placed until more than 3 hours after the patient had presented. The major cause of the missed diagnosis of sepsis was thought to be the focus on tumor lysis syndrome. The priority for the primary team and consultants was around managing this oncologic emergency, with the result that a concomitant serious infection was not considered.

Renal Failure Due to Benign Prostatic Hyperplasia

The Case

A 65-year-old man was referred to urology for a 5-year history of progressive urinary frequency, nocturnal urination, and difficulty initiating a stream, which had worsened considerably in the past month. In the 1990s, his father had undergone TURP (transurethral resection of the prostate) surgery that resulted in "miserable incontinence and impotence" for the remainder of his life. His father's experiences made the patient reluctant to seek care for his own symptoms lest he require surgery and develop similar complications.

At his first visit to the urologist's office, the patient was seen by a physician assistant who inquired about prior prostate specific antigen (PSA) results. According to the patient, when he answered that he had never had PSA testing, he was berated for not having obtained what the physician assistant stated was an important and essential test. The patient, who was a research scientist, explained that he had reviewed the literature and most recent recommendations, which suggested that the risks of testing outweighed its benefits. The patient felt that the physician assistant seemed both unaware of these controversies as well as dismissive of his choice.

Later in the visit, an in-office bladder scan read 999 mL, the upper limit of detection for the machine. A subsequent scan after voiding was 500 mL. Despite the patient's expressed views on PSA testing, the physician assistant proceeded to order laboratory work including a PSA test, scheduled a cystoscopy, and urged the patient to self-catheterize should his symptoms worsen (without any instructions or demonstration). Because of this negative interaction and resulting mistrust of the provider, the patient elected not to follow up with laboratory work and canceled his scheduled cystoscopy, as he felt that no one had adequately explained to him why it was needed. The urology physician assistant also prescribed tamsulosin (an alpha-blocker), but the patient quickly discontinued the drug after experiencing severe lightheadedness.

Ten weeks after the initial visit at the urologist's office, the patient began to feel progressively "woozy, headache-y, and dizzy," but without acute changes in urinary symptoms. He saw a nurse practitioner at his primary care physician's office, who felt he looked urgently ill and found his blood pressure to be dangerous elevated (230/170 mm Hg). She directed him to the nearest emergency department, where his creatinine was found to be markedly elevated at 14.9 mg/dL (normal range 0.6–1.2 mg/dL). A urinary catheter was inserted, with 2 L of urine immediately drained.

He was admitted to the hospital for the next 6 days, during which his renal function gradually improved. His creatinine came down to 4.3 mg/dL. He was discharged home with an indwelling urinary catheter and a follow-up appointment with the same urologist's office where he had first presented.

At that follow-up appointment, he was told he was "ready for surgery"—despite his fears of potentially developing a bad outcome based on his father's experience—and was told that the department would be in touch to schedule a TURP. He never received a call back, however, and having decided he would have nothing further to do with that urology office, he instead contacted a urologist at another hospital. Several months later, the patient underwent a TURP without complications and eventually was able to have the catheter removed with return of normal voiding. His renal function also slowly improved; however, 1 year later it remained abnormal with a creatinine of 2.0 mg/dL.

Anemia and Delayed Colon Cancer Diagnosis

The Case

An 81-year-old man with a history of atrial fibrillation on rivaroxaban presented to his primary care physician (PCP) with a hemoglobin of 11.1 g/dL (normal range in men: 13.5 to 17.5 g/dL). His hemoglobin had been normal 6 months earlier. A colonoscopy for colorectal cancer screening was normal 2 years prior to this presentation.

At this visit with his PCP, his vital signs were normal and physical examination was unremarkable. A fecal occult blood test was not performed. The patient was referred for an upper endoscopy, which showed mild gastritis. He was prescribed a proton-pump inhibitor and oral iron, and his dose of rivaroxaban was reduced. He was told that he would not need a repeat colonoscopy because his had not shown any lesions 2 years earlier. The patient had no family history of colon cancer.

Two months later, the patient's hemoglobin was found to be 8.5 g/dL. He was given two doses of intravenous iron and continued taking oral iron. His hemoglobin subsequently improved to 12 g/dL over the next 2 months.

Eight months later, the patient reported progressive fatigue and shortness of breath. A repeat hemoglobin was found to be 6.7 g/dL. A capsule endoscopy study and repeat upper endoscopy were performed and both were normal. He received a blood transfusion as well as additional iron infusions, resulting in an improvement in his hemoglobin to 10 g/dL.

Four months later—2 years after his initial presentation—his hemoglobin fell again to 7.4 g/dL, and the patient received another blood and iron transfusion. Two days after this infusion, he presented to the emergency department with a bowel obstruction and was subsequently diagnosed with colon cancer. He underwent surgery to excise the mass and fortunately remains in remission.

Spinal Epidural Abscess

The Case

A 30-year-old woman with a history of prior spine surgery presented to the emergency department with a few days of progressive low back pain. She had undergone spinal fusion 1 year prior and was generally healthy and functional. She described the pain as moderate-to-severe, radiating down the left leg and buttock. Because of her prior surgery, a magnetic resonance imaging (MRI) scan was ordered and showed lumbar degenerative joint disease as well as a small L5–S1 disc herniation. She was referred for physical therapy and prescribed a muscle relaxant, nonsteroidal anti-inflammatory medications (NSAIDs), and opioids.

Because of her previous spinal fusion, she made an appointment at the orthopedic clinic 1 week after her initial presentation in the emergency department. At this point, she continued to have back pain and was developing progressive difficulty walking due to the pain. The orthopedic surgeon agreed with the emergency department evaluation and made no further changes.

Ten days later, she presented to a community hospital. She was febrile, unable to ambulate, numb from the waist down, and using a wheelchair. She had a white blood cell count of greater than 30,000 (normal range 4,000–11,000) and was found to be in acute renal and liver failure with a creatinine of 3.6 mg/dL (normal range 0.4–1.0 mg/dL) and markedly elevated liver function tests.

She was immediately transferred to a neurosurgery service at an academic hospital where an MRI showed a T6–T10 thoracic epidural abscess. The patient was taken to the operating room for drainage of the abscess. Postoperatively, she had multiple complications including a pulmonary embolism. She only partially recovered function of her legs and was mainly using a wheelchair.

Subsequent review of the initial MRI to determine why the lesion was initially missed found that the MRI was a lumbar view, which captured the levels T11 through S1 but did not include the affected spinal level (T6–T10).

Failure to Rescue the Mother

The Case

A 27-year-old woman, G5 P2 A2, was first admitted to the hospital at 25 weeks of pregnancy for vaginal bleeding. An ultrasound showed an anterior placenta, low lying and covering the cervix. She received 4 units of packed red blood cells and 2 doses of iron injections, and she was discharged after 3 days with an improved hemoglobin level.

The patient continued to have regular visits to her obstetrics clinic for monitoring. At 32 weeks, she was readmitted for vaginal bleeding, received 1 unit of packed red blood cells, and was then discharged. An ultrasound at 34 weeks revealed a central placenta previa covering the internal os and evidence of placenta percreta, with part of the placenta growing into the uterine wall. The scan results were discussed by the patient's obstetrician, the obstetrics and gynecology department chief, and a urologist, and they recommended that the delivery be done by elective lower segment cesarean delivery with possible hysterectomy.

At 35 weeks, the patient was admitted for the elective cesarean delivery. Intraoperatively, placenta previa and percreta were confirmed, an upper uterine segment incision was made, and the newborn was delivered in good condition. Immediately after, a subtotal hysterectomy was performed, during which the urologist dissected the bladder so that the cervix could be removed with a vaginal cuff. The anesthesiologist then noted that the patient was hypotensive; blood was transfused. A rash developed surrounding the transfusion site and then widespread ecchymosis appeared as the patient became more unstable. The physicians attempted to stabilize the patient with fluids and medications. Cardiopulmonary resuscitation was performed for 60 minutes, but the patient died.

Root cause analysis of the case revealed several crucial missed steps in preparing for this procedure, including failure to order a complete blood count on admission, failure to ensure blood availability for the surgery, lack of knowledge by the anesthesiologist of the patient's history of bleeding and prior transfusions, slow response to the patient's deteriorating condition, and failure to detect the early signs of a potential transfusion reaction.

Delayed Clozapine Prescription in an Elderly Man With Dementia

The Case

An 86-year-old man with neurodegenerative dementia, epilepsy, type 2 diabetes, and hypertension was admitted for agitation and suicidal ideation. Psychiatry was consulted and recommended initiation of clozapine at a dose of 12.5 mg daily. Because of the drug's risks for adverse effects, clozapine must be prescribed and dispensed in accordance with Food and Drug Administration regulations, which mandate a Risk Evaluation and Mitigation Strategy (REMS) from manufacturers. The clozapine REMS program requires both prescribers and patients to be registered in an online database, in which laboratory monitoring results are regularly reported.

The REMS-registered psychiatry attending entered the initial order (12.5 mg) per hospital protocol. However, during the hospitalization, the medicine intern, who was not registered with the REMS program, titrated the dose to 25 mg daily. The intern was able to modify the dose in the hospital without any alerts because he was not writing a new order or prescription (which would have required REMS

registration). Moreover, despite having had no experience with or education about REMS, the intern also wrote the discharge prescription because he was unaware that he was ineligible to prescribe clozapine.

Upon receipt of the prescription, the outpatient pharmacist checked the REMS registry and noted the medicine intern was not a registered prescriber. He contacted the attending psychiatrist, who then wrote a new prescription. However, the patient's family was unable to pick up the prescription for 3 days. During this gap in therapy, the patient experienced recurrence of paranoia and required readmission to the hospital for worsening psychiatric symptoms.

Diuretics and Electrolyte Abnormalities

The Case

A 62-year-old woman with morbid obesity and a past medical history of chronic obstructive pulmonary disease, hypertension, heart failure with preserved ejection fraction, diabetes mellitus, and a previous hospitalization for hyponatremia was seen by her primary care provider for a routine visit. At the visit, the patient complained of worsening lower extremity edema over the prior few weeks. She had no shortness of breath nor other new symptoms.

On examination, her blood pressure was well controlled (128/55 mm Hg) on an angiotensin-converting enzyme inhibitor, and her other vital signs were normal. She did have 1–2+ pitting edema of the bilateral lower extremities, slightly worse than her usual. Her primary care provider decided to prescribe chlorthalidone 50 mg daily for the edema, thinking it might also help with the patient's blood pressure. Her baseline creatinine was normal.

Ten days later, the patient presented to the emergency department (ED) with 3 days of worsening somnolence and confusion. Laboratory results revealed a serum sodium of 105 g/dL and a potassium of 2.3 g/dL. She had a seizure in the ED, which was treated with lorazepam, and she was admitted to the intensive care unit. The critical care provider consulted a nephrologist, and both agreed the severe symptomatic hyponatremia and hypokalemia had been caused by the chlorthalidone.

The patient was treated with hypertonic (3%) normal saline, potassium repletion, and supportive care. She had gradual improvement in her serum sodium and mental status over the next few days, and she was discharged home on hospital day 5.

If You Say So: Taking a Syringe at Face Value in the Operating Room

The Case

A 43-year-old woman was admitted for open reduction and internal fixation of a forearm fracture. She was overweight but otherwise healthy and was not taking any medications prior to admission.

The procedure was staffed by a resident who had been rotating from another specialty for approximately 3 months and was being supervised by a consultant anesthesiologist. The consultant happened to also be working as an intensivist, so after inducing anesthesia and maintaining the patient on inhalational anesthesia, the consultant stepped out to tend to another patient in the intensive care unit (ICU). In the operating room, the patient's heart rate dropped below 50 beats per minute, and the resident asked the anesthesia technician to draw up 0.5 mg of atropine. The technician returned with an unlabeled 2 mL syringe without the original ampule. The resident was reluctant to administer the drug without verifying the product, but the anesthesia technician insisted it was atropine so a double check was not performed.

As the resident injected the drug, the consultant returned to the operating room. Over the next few minutes, the patient's blood pressure skyrocketed to 250/135 mm Hg. The consultant emergently administered labetalol, glycopyrrolate, and high-concentration sevoflurane to antagonize the effect of the drug, which he assumed was some kind of vasoconstrictor.

Upon further investigation, it was discovered that the ampule the technologist used to make the 2 mL syringe actually contained 10 mg of phenylephrine instead of 0.5 mg of atropine. The patient was observed in the ICU overnight and did not experience any lasting harm from the incident.

Delayed Sepsis Management Due to Ambiguous Allergy

The Case

A 75-year-old man with a past medical history of hemorrhagic stroke, coronary artery disease, and severe aplastic anemia required immunosuppressive therapy (antithymocyte globulin, cyclosporine, and prednisone) and regular blood and platelet transfusions. On the day of presentation, the patient arrived at the infusion center for a scheduled platelet transfusion. Prior to starting the infusion, he became unresponsive and hypotensive (59/26 mm Hg). The patient was immediately transported to the emergency department (ED) where, after resuscitation, he described a 1-day history of lethargy, abdominal discomfort, diaphoresis, and bloody bowel movements. Additionally, the patient had an allergy to penicillin, with a reaction of hives documented in the electronic health record. However, it was unclear when this reaction had occurred or whether it had been witnessed by a health care provider.

In the ED, the patient's vital signs were initially stable: temperature 36.7°C, blood pressure 110/60 mm Hg, heart rate 57 beats per minute, respiratory rate 18 breaths per minute, and SpO2 94%. Physical examination was notable for a tired-appearing man with slight abdominal distention without significant tenderness or peritoneal findings. A complete blood count was notable for platelets of 8000/µL, white blood cell count of 2300/µL, and absolute neutrophil count of 1230/µL. Chemistry panel and liver function tests were within normal limits, and urinalysis was unremarkable.

Soon after the initial evaluation (during which he appeared hemodynamically stable), the patient developed hypothermia (35.3°C), hypotension (70/40 mm Hg), and worsening mental status. The patient promptly received 3 L of intravenous fluid. Given continued instability and concern for septic shock, vancomycin was administered. However, neither gram-negative nor anaerobic coverage were ordered due to concern for the penicillin allergy and unknown infection source.

The patient remained hypotensive, and a lactate level returned at 3.5 mg/dL. A CT scan of the abdomen/pelvis with contrast suggested colitis as a possible source of infection. The absence of gram-negative coverage went unrecognized until the primary admitting team took over 4 hours after the patient's initial presentation, at which point they ordered aztreonam. However, the aztreonam was not administered for another 2 hours. As the aztreonam was being given, anaerobic coverage with metronidazole was also ordered but not administered for another 9 hours. Thus, despite the patient's immunocompromised state (neutropenia and on active immunosuppressive therapy) and sepsis from a likely intraabdominal source, ordering and administration of antibiotics with gram-negative and anaerobic coverage was significantly delayed.

Following the patient's prolonged ED course, he was admitted to the intensive care unit where his sepsis worsened. Antimicrobial therapy was broadened to meropenem, caspofungin, azithromycin, and vancomycin. The patient developed anuric renal failure necessitating continuous renal replacement therapy. Ultimately, he was transitioned to comfort care and died. Autopsy revealed the likely cause of death to be septic shock due to neutropenic enterocolitis.

The cause of the patient's death was deemed to be multifactorial (i.e., high medical complexity, delayed sepsis recognition, unfamiliarity with antibiotic coverage, prolonged ED boarding time, and multiple involved services). However, given the data on relationship between time to antibiotic administration and sepsis mortality, the delayed antibiotic administration likely contributed to the death. Furthermore, the documented penicillin allergy may have contributed to this delay by preventing reflexive administration of empiric gram-negative antibiotic treatment with piperacillin-tazobactam or cefepime. Moreover, the lack of familiarity with the limited efficacy of aztreonam in anaerobic coverage led to a delay in the addition of appropriate anaerobic treatment.

Speaking Up for Patient Safety: What They Don't Tell You in Training About Feedback and Burnout

The Case

A 78-year-old man presented to the hospital with shortness of breath. He was admitted to the medicine service and chest radiograph revealed large bilateral pleural effusions. The bedside procedure service was consulted to perform a thoracentesis for both diagnostic and treatment purposes.

The proceduralist received a page from the medicine team requesting the procedure. The page contained the last name and room number of the patient. The physician entered the patient's room, identified the patient by his last name, introduced himself, and asked the patient's permission to use the ultrasound machine to assess the effusions. A patient care assistant was sitting by the patient's bedside and watching the patient closely. The patient care assistant explained to the physician that the patient had underlying dementia and was frequently confused. The physician scanned the patient and noted a small effusion on the right side. He was a bit surprised that the effusion wasn't larger given what he had been told by the patient's primary medicine team. He then called the medicine team and mentioned that he found a very small effusion on the right side, which he could attempt to sample if the team still felt it was clinically indicated.

The patient care assistant who overheard the phone exchange followed the physician out of the patient's room and politely informed him that he had in fact examined the incorrect patient. The proceduralist logged into the electronic health record to verify the patient information he had received in the page. He was shocked to find that the correct patient was in the next room and happened to have the same last name as the patient he had evaluated by mistake.

The physician immediately apologized to the patient with dementia and thanked the patient care assistant for pointing out his mistake. He then went to examine the correct patient and found that large bilateral pleural effusions were indeed present, just as the medicine team had stated. The physician nominated the patient care assistant for the hospital's Stand Up for Safety Award, designed to recognize providers and staff for speaking up and making good catches in the name of patient safety.

Good Catch in the Operating Room

The Case

A 46-year-old woman with extensive history of back pain from lumbar stenosis was scheduled for an elective laminectomy and spinal fusion. The procedure initially started well and the surgeon followed his expected operative plan. About halfway through the procedure, the anesthesiologist noticed that the patient's blood pressure was dropping, and she alerted the surgeon. Since the surgeon did not notice excessive bleeding, he initially continued with the procedure. The anesthesiologist administered a bolus of intravenous fluids, but over the next few minutes the patient's blood pressure continued to drop.

The anesthesiologist was very concerned about the patient and said to the surgeon, "I think we have an unsafe situation. I can't explain her hypotension. Are you sure she isn't bleeding? We should stop the procedure and figure out what's wrong." Although the surgeon was surprised by the anesthesiologist's forcefulness, he recognized her concern, stopped the procedure, and began searching for a source of bleeding. He quickly realized that the blade of the laminectomy tool was damaged and a fragment was missing, raising concern that a blood vessel may have been damaged. A vascular surgeon was urgently consulted. Upon exploration, the team realized that the damaged blade had torn the patient's iliac artery, and she was hemorrhaging into her pelvis. The patient required transfusion of multiple units of blood, and fortunately the injury was repaired before more serious consequences occurred. The patient required care in the intensive care unit postoperatively, but she recovered and was discharged home in good condition several days later.

The Magnetic Deflection
The Case

A 68-year-old woman with a prior history of cerebrovascular accident and hypertension presented to the hospital with new left-sided weakness and hypertensive urgency. The duration of her symptoms was unclear, and she was not a candidate for thrombolytic therapy. She was admitted to the stroke unit and received aggressive treatment to control her blood pressure. A neurologist was consulted and ordered an urgent magnetic resonance image (MRI) of the brain.

The MRI staff informed the bedside nurse that the patient could be brought down for the study. At that time, the patient's blood pressure was still elevated, requiring pushes of intravenous antihypertensives. Nevertheless, the physician told the nurse that the study was urgent and the patient should be taken down for it.

After the patient was brought to the radiology department, she was identified and situated inside the MRI machine. The technician left the room and went back to his work station. The nurse decided to check the patient's blood pressure one more time before leaving her and found that it was improving. Reassured, she also left the room but forgot to notify the MRI technician that the blood pressure cuff was still attached to the patient.

Within a few seconds after starting the scan, there was a loud noise in the MRI room and the technician stopped the scan immediately. He entered the room and realized that the blood pressure cuff had a metal bar (around which the Velcro looped) that had been brought into the magnetic fields of the MRI scanner, which caused it (and the patient's arm) to be drawn to the MRI scanner wall with considerable force. The technician removed the offending piece of equipment and the scan was completed without further incident; luckily, the patient was not injured.

Updates in the Management of High-Risk Pulmonary Embolism
Case and Commentary—Part 1

A 45-year-old man with obesity presented to the emergency department with shortness of breath and hypoxia. The evaluating physician ordered a CT scan of his chest, which revealed a large saddle pulmonary embolism (PE). The patient was tachycardic (heart rate 100 beats per minute), but not hypotensive. His oxygen saturation was 92% on room air. The patient's electrocardiogram (ECG) showed evidence of right heart strain, and laboratory results were notable for elevated brain natriuretic peptides (BNP) and troponin. Bedside ECG revealed right ventricular dysfunction.

Pulmonary embolism (PE) is a form of venous thromboembolism (VTE) where a clot dislodges from a deep vein and embeds in a pulmonary artery. Once in the pulmonary vasculature, the obstruction can increase pulmonary artery pressure and right ventricular afterload and can lead to right heart failure. Pulmonary embolism is common, with 500,000 to 600,000 people diagnosed each year in the United States. (1-3) The cost associated with caring for patients with PE is high; a 2013 study suggests that each case costs approximately $8764.(4)

Although nearly half of all PEs are idiopathic, numerous factors ("provoking factors") are known to increase the risk of PE. The factors most commonly implicated are a history of recent surgery, active cancer, pregnancy or being postpartum, estrogen exposure, prolonged limb immobility or bed rest, and the presence of indwelling catheters. Other conditions, such as advanced age, cirrhosis, rheumatological disease, antiphospholipid antibody syndrome, smoking, obesity, and heart failure also put patients at greater risk for developing PE.(5)

This patient's presentation, which included shortness of breath, hypoxemia, tachycardia, evidence of right heart strain on ECG, and elevated brain natriuretic peptides (BNP) and troponin, represents a classic presentation of PE. In addition to these signs, there are several other common signs and symptoms of PE. Dyspnea is the most common symptom, followed by chest pain, cough, low grade fever, and syncope.(5) Unfortunately, many patients present atypically and symptoms typical of PE are also typical of other common conditions, so correctly diagnosing PE can sometimes prove challenging.(5)

While PE can be fatal and is responsible for 180,000 deaths annually in the US alone (1,6), for most patients with PE, outcomes are quite favorable. Certain presentations are associated with a higher risk of short-term mortality. Patients who present with hemodynamic instability, often defined as sustained hypotension (5,7) Hemodynamically stable patients who have evidence of right ventricular dysfunction suggested by elevated BNP or ECG changes, or myocardial necrosis suggested by elevated troponin, (referred to as "submassive" or "intermediate-risk" PE) have a mortality rate of 5%–15%.(7) For patients without these features ("low-risk" PE), PE-related mortality is 1%–2%.(8) Thus, when the diagnosis of PE is made, patients should be risk stratified based on the presence of hemodynamic instability, right ventricular dysfunction, and myocardial necrosis (Table). Risk stratification can help clinicians determine whether the patient requires admission to a hospital floor or to an intensive care unit, whether a pulmonary embolism response team should be activated, and whether advanced therapy such as thrombolysis or surgery is indicated.

Case and Commentary—Part 2

The admitting ICU attending physician and the interventional radiologist discussed the case and decided to take the patient to the interventional radiology (IR) suite for catheter-guided thrombolysis. The procedure went well, and the patient was monitored in the ICU after the procedure. The following day, the catheters were removed in the IR suite.

The management of PE is based on initial risk stratification. For low-risk PE and many intermediate-risk PEs, anticoagulation remains the mainstay of treatment. Early anticoagulation reduces both PE mortality and recurrence rates.(9) Although unfractionated heparin and warfarin have historically been the anticoagulants most commonly used in the treatment of PE, treatment with direct-acting oral anticoagulants is increasingly common.

For high-risk PE, many experts recommend reducing clot burden through thrombolytic therapy or thrombectomy. For hemodynamically unstable patients (by definition, massive PE), treatment with systemic IV thrombolysis has been shown to improve survival and is clinically indicated.(10) However,

for patients like this one (submassive PE), the use of systemic thrombolysis is much more controversial. Large studies have shown that while systemic thrombolysis can reduce clinical deterioration in patients with submassive PE, it is associated with an unacceptable rate of major bleeding, and in particular, intracranial hemorrhage.(11) The decision to use systemic thrombolytics is difficult and associated with risk, so it is not surprising that registry data show that treatment with systemic thrombolysis is rare (12)

Naturally, there is a great deal of interest in finding an approach that will reduce PE thrombus burden (and associated right heart dysfunction) without increasing the risk of bleeding. Catheter-directed thrombolysis (CDT) offers this potential. It involves delivery of a relatively low dose of thrombolytic drug (typically between 6 mg to 24 mg given over 12 to 24 hours—compared to 100 mg of systemic tissue plasminogen activator [tPA] given over 2 hours) directly into the pulmonary artery at the site of the PE. A CDT procedure is typically performed by an interventional cardiologist, interventional radiologist, or vascular surgeon. To date, only one small randomized clinical trial and several single-arm studies have evaluated CDT.(13-15) Because the patient population most likely to benefit remains unknown, the decision to perform CDT is often a challenging one to make and is frequently clinician- and institution-dependent.

Relatively new to PE management is the concept of the pulmonary embolism response team (PERT). Pulmonary embolism response teams may aid in the decision to recommend CDT by providing a framework for multidisciplinary discussion of the potential risks and benefits for an individual patient. A PERT is a multidisciplinary team of experts in the management of VTE who, together, rapidly assess patients with high-risk PE, recommend the most appropriate treatment, and mobilize resources necessary for treatment. Although PERTs are structured like other rapid response teams, unlike single-specialty approaches focused on expediting access to a particular treatment (e.g., percutaneous intervention for myocardial infarction), the PERT process invites discussion among a multidisciplinary team of medical, procedural, and surgical specialists. Such multidisciplinary discussion may reduce individual biases that any one physician or specialty might bring to a particular case.

From the clinician's perspective, the consensus-based team approach of PERT may relieve some of the anxiety associated with recommending a high-risk therapy for a hemodynamically stable patient with submassive PE. Recent studies show that implementation of a PERT is associated with an increase in the use of thrombolysis or thrombectomy (without an apparent increase in bleeding), and a subjective sense among residents and fellows that the care of patients with high-risk PE is improved.(16,17)

Case and Commentary—Part 3

The patient was sent from IR to the postanesthesia care unit for recovery, after which transfer to a telemetry bed on the stepdown unit was arranged. The ICU resident provided the accepting medicine team with signout but did not explicitly discuss the plan regarding anticoagulation.

Typically, patients who undergo thrombolysis, whether systemic or CDT, should be admitted to an intensive care unit for close monitoring. We also believe that patients with submassive and massive PE should be closely monitored even if thrombolysis is not planned, so that hemodynamic deterioration can be identified and managed immediately.

This case highlights another area of uncertainty—the restarting of anticoagulation after catheter-directed thrombolysis. While it is universally accepted that anticoagulation should be given post-thrombolysis, when and how to resume anticoagulation is not standardized. One survey of 113 PE specialists found that the most common approach was to continue heparin throughout thrombolysis with a subtherapeutic target (i.e., aPTT) for anticoagulation, though there was substantial variation in practice.(18) Regardless of the

approach, a plan for post-thrombolysis anticoagulation including dose and timing of initiation should be clearly communicated when handing off care from one team to the next. In this case, the lack of communication regarding the need to restart heparin after CDT might have been avoided if the procedural specialists performing CDT, intensivists, and hematologists were on a single team that discussed the overall treatment plan.

Case and Commentary—Part 4

The patient received a bed on the stepdown unit several hours later. When the nurse went to check his vital signs, he noted the patient to be lethargic, tachycardic, and hypoxic, with oxygen saturations in the mid-80s on room air. The patient quickly lost his pulse and a code was called. He was intubated emergently and the code team discovered that the patient had never continued on a heparin drip after having the catheters removed. Although the code proceeded for about 40 minutes, there was no return of spontaneous circulation and the patient died.

This case represents a challenging one in which clinicians made many of the right choices, but the tools to support optimal care were not in place. The patient presented with signs and symptoms consistent with PE and providers ordered the appropriate diagnostic study, a pulmonary embolism CT study. An ECG was obtained, as were cardiac biomarkers, which suggested that the patient had a submassive PE (elevated troponin and BNP). He was tachycardic but not hypotensive, and so he did not clearly have a massive PE. At this point, it may have been helpful to have a PERT in place to optimize coordination of the patient's care. Pulmonary embolism response teams, in addition to advising on initial management, help manage patients throughout their hospital stay, intervene when needed, and coordinate long-term follow-up. In addition, having an institutional program such as a PERT in place often leads to the development of clear care pathways, including standardized postprocedure and admission order sets.

After the patient's successful catheter-directed thrombolysis procedure, the vignette notes that an explicit conversation about anticoagulation did not take place. Although we do not know for certain why this patient arrested, the most likely scenario is recurrent thromboembolism due to inadequate anticoagulation. Handoffs represent a vulnerable time for patients and inadequate communication can lead to medication errors, as in this case. The use of standardized handoff tools has been shown to decrease adverse events and improve safety.(19) Implementing such a tool may have helped the patient in this case. The use of standardized postprocedure order sets may also have facilitated correct ordering of anticoagulation for this patient after CDT. In addition, once the patient arrested, the presence of a team capable of rapidly mobilizing resources, such as extracorporeal membrane oxygenation (ECMO), might have been lifesaving.

Hip Fractures in Older Patients: the Case for Geriatrics Comanagement
The Case

An 82-year-old man with a past medical history of dementia, coronary artery disease, hypertension, and diabetes slipped on a rug at home and fell, fracturing his left hip. In the emergency department, a head CT was negative for any evidence of bleeding. Radiographs and CT scan of the pelvis and hip showed a left intertrochanteric hip fracture. Electrocardiogram showed the patient to be in normal sinus rhythm without any signs of ischemia or infarction. Laboratory results revealed normal electrolytes, kidney function, and complete blood count.

The patient was admitted to the orthopedic surgery service to fix the fracture; the surgery was initially scheduled for the following day. However, surgery was delayed by 3 days due to several emergent trauma

cases and lack of surgeon availability. The patient was not placed on venous thromboembolism prophylaxis prior to surgery. While in the hospital, he was frequently agitated, disoriented, and combative in the evening hours.

He ultimately underwent surgery and was discharged to home a few days later. However, he was readmitted to the hospital several weeks later with chest pain and shortness of breath and was found to have a pulmonary embolism. Treatment with anticoagulation was initiated. The patient's rehabilitation was delayed, his recovery was prolonged, and he never returned to his baseline functional status. After discussion with his family, the patient was ultimately transitioned to hospice and died several months later.

E-cigarette Explosion in a Patient Room
The Case

A 49-year-old woman was admitted for an exacerbation of chronic obstructive pulmonary disease (COPD) without any signs of infection. Her baseline oxygen requirement at home was 2 liters via nasal cannula, and she used a continuous positive airway pressure (CPAP) machine at night; however, her machine stopped working prior to the hospitalization. Throughout her hospital stay, the patient continued to require 5 liters of oxygen by nasal cannula.

When asked about her smoking history, the patient reported receiving smoking cessation education in the past and that she no longer smoked regular cigarettes, but she did continue to vape with an electronic cigarette (e-cigarette). Having not been told to avoid vaping in the hospital, the patient asked her friend to bring her e-cigarette so she could use it during her hospitalization.

The patient took a puff on the e-cigarette while she was receiving oxygen through her nasal cannula and sparked an explosion. The patient ripped off the nasal cannula, which had melted, and sustained first- and second-degree burns to her face and hand. This resulted in a prolonged hospitalization for burn care and extensive pain management. In addition, the facial burns made it difficult for her to use CPAP as she had been doing at home.

The exact type of e-cigarette the patient used was not known. It did contain a heating element to vaporize the e-liquid, but it is unclear which piece of the device triggered the explosion. Regardless, the vendor who sold the e-cigarette to the patient stated it was safe to use while on oxygen.

What Happened on Telemetry?
Case and Commentary—Part 1

A 78-year-old woman with a history of advanced dementia, chronic obstructive pulmonary disease, hypertension, and congestive heart failure (CHF) was brought to the hospital from a nursing facility with fevers and confusion. At baseline, she was minimally verbal and required assistance with all her activities of daily living.

In the emergency department, the patient had a fever and met criteria for sepsis. She had a mild leukocytosis, evidence of mild acute kidney injury, and a urinalysis positive for infection. Her other laboratory values were normal. Her admission electrocardiogram was unchanged from a prior one and showed no evidence of cardiac ischemia. She was given intravenous fluids and antibiotics. Because of her history of CHF, she was admitted to a unit with telemetry monitoring. At this institution, telemetry monitoring was done remotely, with the monitoring equipment and team stationed in another part of the hospital.

When the patient arrived on the telemetry unit, the nurse performed a full evaluation. The patient had a low-grade fever (38.2°C) and a heart rate of 102 beats per minute, but her vital signs were otherwise normal. She was awake but neither communicating nor following commands. The nurse checked to make sure the patient had received the intravenous fluids and antibiotics.

Continuous monitoring of a patient's electrocardiographic (ECG) waveform is ubiquitous in hospitals. In an intensive care unit (ICU), the patient is hard-wired to a cardiac monitor at the bedside. On non-ICU units, patients typically wear a portable telemetry monitor that transmits to a receiver, allowing the patient's ECG waveforms to be displayed on a central monitor bank. The central monitor with the tracings is sometimes on the same unit as the patient and sometimes in another part of the hospital (as in this case). Most non-ICU patients on telemetry are hemodynamically stable, whereas those in ICU may not be.

This patient seemed to be hemodynamically stable and did not need to be in an ICU, but did she need to be on telemetry? As a general principle, patients should only be placed on telemetry if they meet specific indications for monitoring. According to the Update to Practice Standards for Electrocardiographic Monitoring in Hospital Settings (a consensus set of recommendations from several key professional organizations societies) (1), although acute decompensated heart failure is an indication for ECG monitoring, a history of heart failure is not. However, because this patient met the criteria for sepsis and was receiving aggressive fluid resuscitation, she was at risk for fluid overload and decompensation of her heart failure. Therefore, telemetry monitoring was appropriate for her, though surveillance monitoring with continuous pulse oximetry may have been considered instead.

Who was watching the monitors? Responsibility for observing telemetry monitors varies across hospitals. At some hospitals, no one person is solely assigned to watch the monitors; instead, bedside nurses periodically observe the monitors and listen for alarms while also delivering patient care. Some smaller hospitals require ICU nurses to be responsible for watching monitors for patients on other units, in addition to providing care to their own critically ill patients. Other hospitals have dedicated monitor watchers who watch a bank of monitors but do not have responsibility for direct patient care. Monitor watchers have been described as "personnel whose job it is to watch the central cardiac monitor and alert clinicians of patient events."(2) In some hospitals, nurses are monitor watchers, whereas in others technicians (supervised by a registered nurse) serve in this role. In all circumstances, personnel assigned to watch telemetry monitors should receive appropriate training.(2)

The use of monitor watchers may be increasing. In 2011 and 2016 national surveys on clinical alarms, the Healthcare Technology Foundation found that 47% and 48% of respondents, respectively, reported that they worked in hospitals that use monitor watchers.(3,4) One national survey specifically addressing the use of monitor watchers found that 61% of respondents worked at hospitals that used monitor watchers.(2) In this case, the monitor watchers were "stationed in another part of the hospital." In the same national survey, 62% of respondents who worked at hospitals that used monitor watchers reported that those monitor watchers were stationed off the patient care unit—either in a centralized location elsewhere in the hospital (56%) or in a separate building (6%).(2) Remote telemetry monitoring may be a growing trend as hospitals are consolidated into larger health systems and may even occur in another geographic area. Evidence is lacking to guide the use of remote telemetry monitoring.

One benefit of having monitor watchers on the clinical unit is their ability to review and validate an alarm with immediate patient assessment.(5) They also may be more likely than busy bedside nurses to ensure proper electrode placement and the setting of appropriate alarm parameters. However, given the frequency of false-positive alarms, many alarms need to be validated by a qualified clinician laying eyes on the patient. With monitor watchers at a remote location, timely patient assessment, proper electrode placement, and appropriate alarm settings may be less likely.

Other risks related to remote telemetry monitoring include the potential mesmerizing effect of viewing multiple monitor screens simultaneously, causing fatigue and decreased vigilance. One study (6) reported that responsibility for more than 40 patients at a time significantly delays identification of serious arrhythmias. A second risk is the potential for fragmented care. If the responsible health care provider has questions about a patient's rhythm history, how the patient is tolerating a given rhythm, or the effect of an antiarrhythmic medication, the bedside nurse may not be able to provide this information expeditiously.

Case and Commentary—Part 2

After entering the patient's room to check morning vital signs 6 hours later, the nurse found her to be unresponsive and apneic, with no palpable pulse. A Code Blue was called, and chest compressions were initiated. The patient was found to be in asystole and after about 20 minutes of resuscitation efforts with no return of spontaneous circulation, she was pronounced dead.

The nurse manager for the unit led a root cause analysis to determine what had happened. The group reviewed the telemetry tracings and discovered that the technician who was remotely watching the telemetry monitor recognized progressive bradycardia and called the hospital floor several minutes before the code. The nurse caring for the patient was busy with another patient, so the technician was placed on hold. He continued to wait; while on hold, he observed worsening bradycardia on the telemetry monitor, eventually transitioning to asystole. He tried to call back the unit and no one answered. He wondered if either they were already caring for the patient or maybe it wasn't truly asystole. By that point, the nurse had discovered the patient and initiated the Code Blue.

The institution wanted to explore this incident and the other common safety issues with telemetry monitoring, particularly remote monitoring, and identify best practices for preventing such errors in the future.

Do we assume that no one saw this patient for 6 hours until this nurse came to obtain vital signs? Six hours is a long time to go without observing a patient. Unfortunately, as is possibly true in this case, telemetry monitoring may be seen by the prescriber or bedside nurse as a surrogate for closer observation or a solution to inadequate staffing. The primary purpose of telemetry monitoring is to observe ECG waveforms, not serve as a substitute for assessment of breathing, trends in vital signs, neurological status, or numerous other assessments. Each hospital has standards of care, which include frequency of checking a patient's vital signs or performing certain assessments. A full assessment of the hospital's standards for patient assessment should have been part of the root cause analysis. (Consideration of the patient safety issues related to frequency of patient assessment in the hospital is beyond the scope of this commentary.)

The frequency of harm related to remote telemetry monitoring is not known. The Joint Commission does not currently collect data on telemetry monitoring errors as part of their sentinel event reporting (J. Aleccia, written communication, November 2018).

The remote telemetry monitoring technician's phone call to the unit went unanswered. Thus, essential information was not communicated and the patient died. This case illustrates a clear breakdown in communication. Organizations must develop and implement an effective communication process that begins with the remote telemetry monitoring system and ends with appropriate assessment and care provided to the patient.(7) A communication protocol that identifies backup coverage and ensures notification of other staff—for example, a rapid response team—when the patient's bedside nurse is not available is essential. The communication process must be clear, with escalating alert procedures and backup methods.

Some hospitals have incorporated a bidirectional voice communication badge system (8) that employs a two-way communication device that bedside nurses wear clipped to their clothing or on a lanyard around the neck as an alternative to relying on phones for primary communication, but this can be distracting to both nurses and patients. Alternatively, the voice badge system could serve as a secondary notification strategy when no one on the unit is answering the phone or for select life-threatening arrhythmias. The fact that no one answered the phone in this case also raises the issue of the adequacy of staffing.

Leaders at institutions considering implementing remote telemetry monitoring must incorporate perspectives from an interprofessional team, including bedside nurses, clinical nurse specialists or educators, cardiologists, hospitalists, monitor watchers, biomedical engineers, risk management personnel, and hospital administrators. Practical aspects of safety in the use of remote telemetry monitoring can only be identified by structured procedures to "walk through" the process of telemetry monitoring, from the moment the monitor is placed on the patient to the moment the bedside nurse is notified of the abnormal rhythm. Such an interprofessional team should discuss all potential problems including lack of staff availability to answer a phone call, phone outage, incorrect phone numbers, computer downtime, and printer malfunction (if relying on print-outs for new admissions).

Reviewing remote telemetry monitoring policies from other institutions can also be helpful. After evaluating policies for remote monitoring from 75 Veterans Health Administration hospitals, George and colleagues (9) developed a comprehensive policy that could be used at all sites. It specified that bedside nurses are required to respond immediately to any STAT calls or requests from the remote telemetry monitoring personnel. Each facility is responsible for identifying the response process.

The Table outlines critical safety points to consider when deciding whether to incorporate remote telemetry monitoring or as part of an ongoing evaluation of its effectiveness. These points are based primarily on clinician expertise, as evidence to support specific practices is limited.

To maximize the benefits and minimize the risks of telemetry monitoring, the Practice Standards for Electrocardiographic Monitoring (1) specify which patient populations should be monitored and for how long. In addition, these standards provide recommendations for the education of nursing and monitoring staff and for alarm management and documentation that is accessible interprofessionally.

A risk of telemetry monitoring is alarm fatigue, or desensitization from overexposure to alarms that are false (inaccurate) and nonactionable (accurate, but clinically irrelevant). Alarm fatigue has resulted in missed patient events and preventable deaths. An observational study (10) suggested that, by intercepting alarms, monitor watchers could reduce nurses' exposure to alarms and the resulting alarm fatigue. Determining the validity and relevance of an alarm to a particular patient is a complex task requiring contextual information about the patient, which necessitates close communication between the monitor watcher and the bedside nurse.(11) Close communication clearly did not happen in this case. When the technician tried to call the unit a second time and no one answered, he "wondered if either they were already caring for the patient or maybe it wasn't truly asystole." Because no one answered the phone, he could only surmise contextual information.

Likewise, the bedside nurse and other clinicians need the contextual information provided on the monitor. A method should be in place for them to see a patient's waveform, especially when a life-threatening rhythm is suspected. Auxiliary monitor screens in convenient locations around the unit or a waveform display on the patient's telemetry box would provide essential information on the unit. An alarm that is audible on the patient care unit could be useful if set to sound only for life-threatening rhythms verified by the remote telemetry monitoring staff.

In their implementation of a remote telemetry monitoring unit at four hospitals, Cantillon and colleagues (12) included the following: (i) designated lead technicians on-site for real-time rhythm interpretation and management for escalation to "charge nursing personnel," (ii) a telephone system with continuously updated nurse assignments that were reviewed each change of shift, and (iii) direct mobile phone for nurses as well as a crisis phone for emergencies.

Implemented thoughtfully by an interprofessional team with ongoing evaluation, remote telemetry monitoring may be an effective way to monitor patients at risk for deterioration; however, more evidence is needed. This case illustrates the challenges of remote telemetry monitoring and the need for a detailed closed-loop communication protocol with explicit escalation strategies.

Duplicate Insulin Order

The Case

A 45-year-old man with a history of insulin-dependent diabetes mellitus was seen in the emergency department (ED) for complaints of lethargy and decreased oral intake. Tests revealed blood glucose levels in the 800s with an anion-gap acidosis and positive beta hydroxybutyrate. The patient stated he had not been able to afford insulin and had not taken any for the last 3 days. A bed was requested in the intensive care unit (ICU) for treatment of diabetic ketoacidosis.

After administration of fluids, an insulin drip was started and blood sugars were monitored hourly. The patient was more awake and able to ask for food after a few hours in the ED awaiting the ICU bed. His blood sugar levels were slowly normalizing and the gap acidosis improving. Once the acidosis normalized, the team decided to convert the patient's insulin drip to subcutaneous long-acting insulin ("bridging").

The fellow asked the resident to place an order for 50 units of insulin. The resident called the ED and asked if the insulin was given. A covering nurse answered the phone and said she had not given any insulin. The resident instructed the nurse to administer 50 units of insulin and stop the insulin drip in about 1 hour. After about 30 minutes, the patient's nurse came back from break and found him to be lethargic. She immediately called the ICU team. The team instructed her to get a stat blood glucose level, which was found to be in the 30s. The insulin drip was stopped and IV dextrose pushes were given. The patient was started on dextrose 10% IV solution and blood glucose levels were monitored every 15 minutes. Within about 1 hour, the patient's blood glucose levels stabilized (> 75 mg/dL), and he became more alert.

Chart review revealed that both the resident and the intern had placed orders for 50 units of insulin without either of them cross-checking the orders. In addition, the patient's assigned nurse did not communicate to the covering nurse that she had given a dose of insulin, nor had the covering nurse checked the chart to see if any other doses of insulin had been given. The pharmacy noted the duplicate order, but by the time they called the ED and spoke with the patient's nurse, the patient had already received the two 50-unit doses while still on the insulin drip.

The patient recovered from the incident without apparent adverse effects. After this event, the team received training on the ED's insulin protocol for diabetic ketoacidosis and adjustments were made to the pharmacy protocol for checking duplicate orders and dispensing insulin.

Premature Extubation

The Case

A 73-year-old woman with a history of carotid artery stenosis was admitted for an elective carotid endarterectomy. The procedure was initially thought to be uncomplicated, and the patient was extubated in the operating room. After extubation, the patient was safely brought back to the recovery area, but within 30 minutes she developed respiratory distress necessitating urgent reintubation. The reintubation required multiple attempts but was ultimately successful. The patient was taken back to the operating room and found to have an expanding neck hematoma, which was drained safely. She was then transferred to the intensive care unit (ICU).

The patient gradually improved and was alert with intact mental status. The ICU physician felt it was appropriate to wean the patient from the ventilator with the goal of extubation later in the day. While on rounds, the intensivist planned to ask the respiratory therapist to test for a cuff leak prior to extubation. (Testing for a cuff leak involves deflating the cuff of the endotracheal tube. Patients should have normal airflow around the endotracheal tube after the cuff is deflated. If there is no cuff leak, it suggests that laryngeal edema or another type of laryngeal injury has reduced the space between the endotracheal tube and the larynx. This places the patient at risk for breathing difficulty after extubation.) However, no formal order for a cuff leak test was placed.

After a half hour weaning trial, the patient was ready to be extubated. The respiratory therapist extubated the patient without checking the cuff leak. Within about 15 minutes, the patient developed acute shortness of breath and stridor, progressing quickly to hypoxemic respiratory failure. She required urgent reintubation, which was technically difficult because her vocal cords were edematous. Eventually, an airway was established. The patient remained intubated for 2 more days and required intravenous steroids to reduce laryngeal edema. She was eventually successfully extubated and discharged home in good condition.

The ICU medical director reviewed the case and discovered that the physician had forgotten to place an order for cuff leak and had assumed that the respiratory therapist would know to perform the test, given the patient's history of difficult intubation. The respiratory therapist was covering extra patients that day due to another staff illness, which led him to overlook the need to check for a cuff leak. The medical director also realized that the ventilator weaning process was not standardized.

The ICU decided to implement a standardized protocol for positive pressure weaning trials, which also required a cuff leak test be performed, documented, and the results communicated to the physician before extubation. One year later, the ICU had seen a significant drop in unplanned reintubations after extubation.

Which Line: Ordering Provider or Proceduralist?
The Case

A 58-year-old woman with multiple myeloma required placement of a central venous catheter for apheresis, a blood-straining procedure to lower the level of abnormal proteins in her blood.

In general, two types of central venous catheters may be used for apheresis, a tunneled central venous catheter and a nontunneled central venous catheter. (Tunneled catheters enter the skin and then go through a tunnel right beneath the skin before entering a large central vein. A nontunneled catheter goes directly through the skin into a large central vein [e.g., internal jugular lines and subclavian catheters].) Placing tunneled catheters involves a more specialized and high-risk procedure; however, they are associated with fewer infections than nontunneled catheters and can be used for longer periods of time.

The outpatient hematology–oncology provider ordered the procedure via computerized provider order entry. The oncologist intended to order a nontunneled catheter, as a tunneled catheter was not necessary for this indication (although it would also work). But she accidentally ordered a tunneled central catheter to be placed by the interventional radiologist.

Although interventional radiologist reviewed the order and thought it was somewhat unusual that a tunneled catheter was ordered for apheresis, she didn't contact the oncologist. The patient was consented for the procedure and a tunneled catheter was placed without complications.

When the patient presented for apheresis treatment, providers recognized that the wrong catheter had been placed. The oncologist and interventional radiologist discussed the case and decided it would be safest and most appropriate to remove the tunneled catheter and replace it with a nontunneled catheter. The error was disclosed to the patient, the tunneled catheter was removed, and the appropriate catheter was placed. There were no complications but a slight delay in initiating apheresis. Moreover, the extra procedure placed the patient at risk for procedural complications.

Diagnostic Failure: The Growing Deficit

The Case

A 65-year-old woman with a history of diabetes and hypertension was admitted to a hospital's telemetry floor for management of uncontrolled hypertension and palpitations. She was seen by a hospitalist, who ordered an echocardiogram, instituted treatment for hypertensive urgency, and consulted a cardiologist. On the afternoon of the first hospital day, the patient complained of right arm numbness and weakness. The nurse found the patient to be oriented but with new difficulty answering questions. The nurse found no objective evidence of arm weakness.

The nurse called the hospitalist to relay the new symptoms of arm weakness, along with her assessment that the patient had normal strength in her arm. She did not report the new speech difficulty. The hospitalist asked the nurse to call for a neurology consultation and told the nurse that he would come by to see the patient later.

Four hours later, the patient's weakness had progressed; she was now completely unable to move her right arm. The hospitalist had not yet evaluated the patient in person, and the neurology consultant also had not seen the patient. The nurse called the hospitalist and a stat CT head was ordered, which revealed large ischemic stroke. A Code Stroke was called. On review of telemetry, the patient was noted to be in paroxysmal atrial fibrillation, which was felt to be the likely cause of her stroke.

The patient was urgently transferred to the ICU and received thrombolytic therapy, with some improvement in her symptoms. She was eventually discharged to a long-term facility for neurorehabilitation.

The telemetry floor charge nurse referred the case to the hospital's risk management department due to the delay in physician assessment. Formal review confirmed that the initial symptoms of arm weakness were not acted upon by the hospitalist, and that the patient had not been seen for more than 4 hours by either the hospitalist or neurologist despite the new symptoms. The telemetry tracing had also not been formally reviewed by a physician.

Following this case, the hospitalist group instituted new policies mandating a face-to-face assessment by the hospitalist within 1 hour of patients being admitted to the floor and mandated that subspecialty consultants should be contacted directly by the hospitalist instead of by nursing staff.

Adverse Event During Intrahospital Transport

The Case

A 4-year-old boy underwent surgery under general anesthesia for correction of a congenital intestinal abnormality. The procedure was uneventful, and he was extubated in the operating room and brought to the postanesthesia care unit (PACU). The patient appeared stable in the PACU, but due to his age and length of the procedure, the PACU anesthesiologist ordered him to be placed on continuous pulse-oximetry monitoring for 24 hours.

The patient was deemed stable to leave the PACU and be transported to the regular floor. However, he was not placed on pulse oximetry during the transport itself, which took about 10 minutes. On arrival to the floor, the patient transporter brought the patient to the designated room and alerted nurses that he had placed a new patient from the PACU there. The transporter did not communicate any concerns about the patient to the nursing staff. The bedside nurse had received signout from the PACU that the procedure had been uncomplicated and the patient had done well, so she felt no urgency to assess the new arrival. A few minutes later, the nurse went to assess the patient. She placed him on pulse oximetry and immediately realized that he was markedly hypoxic. She immediately administered oxygen by face mask, but he quickly became bradycardic and hypotensive, and a Code Blue was called. The patient went into cardiac arrest. He was eventually resuscitated but was left with significant neurological injury as a result of hypoxic brain injury.

The hospital performed a root cause analysis of the case. The investigation found that the PACU staff understood the order for "continuous pulse oximetry for 24 hours" was to begin when the patient arrived on the ward. The patient's oxygen saturation had probably started to drop shortly before he left the PACU and had progressively worsened during transport, while he was not monitored. Had the patient been monitored during the transport, his deterioration might have been detected earlier. The transport staff member stated that he thought the patient might be experiencing breathing difficulty during the transport but did not voice his concern as he had been assured the boy was stable and he did not trust his own judgment.

Triaging Interhospital Transfers

The Case

A 63-year-old man with a history of hypertension, coronary artery disease, and diabetes was evaluated by his primary care physician for a rash. The physician noted the presence of high fevers and headache, and so he sent the patient to the emergency department (ED) for further evaluation and possible admission. Repeat vital signs in the ED were notable for a slightly low blood pressure and elevated respiratory rate. His rash was worsening, with sloughing of his skin. Laboratory test results showed an elevated lactate and white blood cell count, both concerning for possible sepsis. Fluids and antibiotics were administered. The patient was started on IV norepinephrine through a peripheral IV to maintain his blood pressure, but no central line was placed.

The admitting physician was concerned that the patient might require subspecialty care, including dermatology consultation and critical care interventions not available at the local hospital. The physician arranged to have the patient transferred to a large academic medical center that could provide these services, but he was not familiar with any formal process to do so. He called a colleague at the receiving hospital to make the request for transfer. The colleague secured a bed through the bed control department and suggested he send the patient over.

The details of the patient's current clinical condition and clinical data were not formally transmitted to the receiving hospital. Not knowing that the patient required pressors to maintain his blood pressure and that he was likely developing worsening shock, the accepting physician booked a general ward bed for the patient rather than an intensive care unit (ICU) bed. He did not inform the hospital's transfer center.

Four hours later, the patient arrived at the academic medical center and was placed on a telemetry floor. His mentation was altered and he was breathing rapidly. The bedside nurse realized that norepinephrine was infusing through a peripheral IV. He called the rapid response team and ICU fellow to arrange for transfer to the ICU. Unfortunately, in the interim, the patient went into cardiac arrest and was pronounced dead about an hour after transfer.

In reviewing the case, the accepting physician was not aware of how critically ill the patient had become prior to transfer and did not have access to laboratory and imaging data from the referring institution. The ambulance transport team was not trained to provide critical care and did not recognize that the patient's condition was deteriorating quickly while en route.

One Bronchoscopy, Two Errors
The Case

A 67-year-old man with a history of hypertension was admitted to the intensive care unit (ICU) with hypoxic respiratory failure secondary to community-acquired pneumonia. For his severe hypoxia, he was managed with high-flow nasal cannula and did not require mechanical ventilation. He was given intravenous fluids and antibiotics.

On the second hospital day, the patient had increased pulmonary secretions. The critical care provider decided to perform bronchoscopy at the bedside. After informed consent and a procedural time out, the patient was given 2 mg of intravenous midazolam, a sedating agent. Once he was lightly sedated, a flexible bronchoscope was introduced.

The airways were inspected throughout. Then, per usual protocol, bronchoalveolar lavage was performed by introducing 20 mL of normal saline to the right middle lobe. This fluid was suctioned out and sent to the laboratory for analysis.

The bronchoscope was removed without any complications. However, the patient was difficult to arouse after the procedure. This was unexpected given that only a small amount of midazolam had been used. The patient was nearly apneic with very shallow breaths and the decision was made to intubate. The patient did not need any further sedation during the intubation.

The entire care team paused in real time to review the events. The critical care provider noticed that the syringes that contained the different fluids were not labeled and were both stored on the same shelf of the procedure cart. It was discovered that after the 2 mg of intravenous midazolam was given, instead of flushing this with normal saline, it had been flushed with an additional 10 mg of midazolam (the nurse had flushed with 2 mL and the midazolam concentration was 5 mg/mL). This high dose of midazolam had led to the respiratory failure requiring intubation.

On top of that, instead of normal saline, lidocaine had been used for the lung lavage. The lidocaine was available in a syringe for the bronchoscopy, as occasionally patients have severe discomfort or coughing from the bronchoscope and the lidocaine can be used to treat this. The lidocaine syringe was also not labeled and was sitting next to the syringe with normal saline. Fortunately, the patient did not experience

any adverse consequences from the use of the lidocaine for the lavage (high doses of lidocaine can enter the systemic circulation and lead to neurological and cardiovascular adverse effects).

The patient remained intubated until the midazolam wore off. He woke up and was able to be extubated safely later that day. He slowly improved with treatment of his pneumonia and went home a few days later. The care team disclosed the errors to the patient including a commitment to making improvements to prevent such an error in the future.