Immediate Attention Required: Another Shortage

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To the Editor:

Hurricane Maria has devastated and displaced countless families in Puerto Rico. The unfortunate wrath of Hurricane Maria has also affected many patient lives here in the continental United States by wreaking havoc on the production of several critical medications and intravenous (IV) fluids. Manufacturers of affected products have advised their customers to conserve existing supplies of normal saline and dextrose IV fluid bags. University of Pittsburgh Medical Center (UPMC) began early, systemwide efforts to manage supply, to improve sourcing opportunities, and to implement clinical and operational changes to ensure that the shortage would have minimal impact on patient care.

UPMC developed a multidisciplinary leadership team with representation from supply chain, information technology (IT), physicians, nurses, and pharmacists. This IV Fluid Shortage Taskforce works to standardize and centralize rapid decision-making capabilities to support the UPMC system's utilization of precious IV fluid resources and antibiotics. Open, daily communication and interprofessional collaboration with diverse team members, including nonclinical partners, is responsible for the success of the Taskforce:

- Inventory and supply chain leaders determine the current and expected future availability of IV fluids and affected parenteral medications. This information is shared daily with the Taskforce and with various stakeholders across the UPMC system and partner facilities in the region. The on-hand supply status has become a critical component of the UPMC system approach to selection of viable clinical and operational changes.
- Surveillance data are collected by UPMC's IT professionals to develop reports to evaluate fluid utilization trends across the system. These reports allow for daily IV fluid monitoring and surveillance and support physicians and pharmacists in developing clinical guidelines for IV fluid administration. Most recently, the information provided by UPMC IT has supported development and implementation of an oral hydration protocol that has significantly reduced the strain on IV bags at some of the largest facilities in the system.

The unique expertise of each member allows the Taskforce to make rapid, informed decisions to maintain high-quality patient care and has equipped the UPMC system to focus on 3 main conservation efforts: (1) conversion of IV hydration to oral hydration, (2) IV fluid surveillance and discontinuation, and (3) evaluation of antibiotic alternatives.

Conversion of IV Hydration to Oral Hydration

All patients should be assessed for appropriateness of oral hydration prior to initiation of IV fluids. If IV fluids are deemed necessary, then the patient should be reassessed by nursing at change of shift handoff with the attempt to favor for conversion to oral therapy. Patients appropriate for oral rehydration should meet the following criteria:

- Patient is alert and can swallow
- Patient has an intact gastrointestinal (GI) tract
- Patient is hemodynamically stable; *not* on vasopressors*

*Patients who do require vasopressors should be converted to oral hydration as soon as possible after vasopressors are no longer required. Health care providers were also advised to consider:

- If a patient is on goal tube feedings, their hydration status may be maintained through salt and free water flushes via feeding tube as needed.

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Figure 1. Impact of shortage mitigation efforts by interdisciplinary team on identified critical supply medications including metronidazole, linezolid, and ampicillin/sulbactam. *Note.* Baseline patient charge data were collected from 4/1/17 to 9/30/17 (185 days) to estimate a daily benchmark use prior to shortage identification. Similar methods were applied to the intervention time period (ie, estimated use postshortage mitigation efforts), and charge data were collected from 10/1/17 to 10/22/17 to estimate daily use. Percent variation between premitigation and postmitigation efforts is depicted to confirm impact of interventions or identify additional opportunities of need. There was not a single direct oral antimicrobial agent for the transition of IV ampicillin/sulbactam. (Data courtesy of Tony Lacava and Lloyd Clarke, UPMC Presbyterian Data Analyst). PUH UPMC = Presbyterian; IV = intravenous; PO = by mouth; Amp/Sulb = ampicillin/sulbactam.

- There may be an opportunity to liberalize patients' diets to increase sodium intake and do not restrict access to water.
- Some oral hydration vehicles contain potassium, which needs to be monitored when appropriate.
- Oral hydration is a therapeutic modality, which needs to be monitored with weights and electrolytes when appropriate.
- Choice of oral hydration may be influenced based on patient preference. Many patients could be sufficiently managed with diet sodium and fluid liberalization alone—salt tablets may only be necessary in those with baseline electrolyte derangements or requiring significant volume repletion.

IV Fluid Surveillance and Discontinuation

The UPMC automation team developed reports of IV maintenance fluids to identify patients who were receiving IV hydration. Patients eligible to receive enteral hydration rather than IV hydration have IV fluids discontinued as soon as clinically appropriate and are converted to an oral hydration regimen. The IV fluids report is generated daily, and prescribers are contacted in person, by phone, or by pager about considerations for oral hydration

recommendations. The surveillance assignment is distributed between the pharmacist residents and the unit-based pharmacists.

In addition, clinical decision support was established in electronic health record (EHR) applications to enhance prescriber awareness of the shortage, to prompt consideration of more judicious IV fluid use, and to introduce an automatic 24-hour discontinuation of IV fluid orders.

Antibiotic Alternatives

The shortage has significantly affected many antibiotic classes. Representatives from the antimicrobial stewardship team contribute expert advice for IV to less impacted IV and IV to oral substitution of shortage-impacted antimicrobial agents when clinically appropriate. Shifting treatment away from less available options to more available antibiotic options has contributed significantly to shortage mitigation efforts. Additional opportunities are also being reviewed for alternative administration techniques to conserve fluids required for compounding sterile products including IV push administration and IV syringe pump administration. All patients receiving shortage-listed antibiotics are assessed daily. First-generation cephalosporins, ampicillin/sulbactam, and IV metronidazole are reserved for patients without clinically acceptable alternative options. All patients on antibiotic therapy are also assessed for the potential opportunity to transition to oral antimicrobial therapy or for switching to a therapeutically equivalent IV antibiotic agent that is more readily available. Oral metronidazole, oral linezolid, oral and IV clindamycin, lipoglycopeptides, third-generation cephalosporins, oral fluoroquinolones, and oral sulfamethoxazole/trimethoprim use has been impacted in response to the shortage mitigation efforts.

These interventions have led to a 53% reduction in IV fluid use in the largest UPMC acute care facility. Prior to implementing these changes, 160 patients per day were receiving IV maintenance fluids. Through combined IV hydration strategies of conversion to oral therapy, monitoring use for potential discontinuation/conversion to oral hydration, and removal of prechecked order sets in order entry, maintenance fluid orders were reduced to approximately 74 patients per day within a few weeks. In addition, there is a noticeable shift of antibiotic use away from the agents on shortage, IV metronidazole, IV linezolid, and IV ampicillin/sulbactam (Figure 1). These measures related to IV fluids and antibiotics have helped to mitigate the impact of the abrupt shortage in IV fluids resulting from Hurricane Maria's devastation of IV fluid manufacturing in Puerto Rico.

Hurricane Maria has ravaged lives across Puerto Rico. The UPMC IV Fluid Shortage Taskforce is working hard to ensure that lives are not interrupted in Pennsylvania. The Taskforce has enabled UPMC facilities to conserve fluids and medications during this critical national shortage.

Monitoring of patient care as a result of mitigation efforts will be evaluated by the Taskforce moving forward. The early success of the UPMC IV Fluid Shortage Taskforce demonstrates how collaboration among a diverse group of health care professionals can provide unprecedented results for streamlined and seamless shortage mitigation efforts. As the severity of this shortage becomes less acute, the Taskforce will begin to focus on evaluation of historical practices that may have contributed to the shortage situation and will explore recommendations for policy makers,

suppliers, and providers on how to prepare future shortage management and mitigation plans.

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