

## Denver Health and Hospital Authority Guidance on Anticipated Shortages for Small and Large Volume Fluids

### Situation

Hurricane Helene impacted the entire Southeast in late September 2024. In addition to the large loss of life, a major manufacturing plant for Baxter Pharmaceuticals in North Cove, NC was damaged. This plant is responsible for manufacturing small and large volume fluid products. The fluids impacted include intravenous (IV) fluids (e.g., normal saline, Lactated Ringers, dextrose containing fluids, etc.), irrigation fluids mostly used in operating room settings, and peritoneal dialysis fluids. These fluids are also used as for IV electrolytes, antibiotics, and other medications so the impact will extend far beyond just resuscitation fluids. Baxter Pharmaceuticals supplies 50-60% of the fluids for the entire United States, including Denver Health, and at this time there are limited options to obtain fluids from other manufacturers.

As of yet, it is unclear what the impact will be or what the time frame is for the plant to resume operations. Baxter is implementing an allocations strategy to prevent scramble purchasing by health systems. As of now, hospitals that order fluids through Baxter are set to receive 40% of their typical order volume for many commonly used fluids. Therefore, every bag of fluid counts, and every bag saved will extend Denver Health's supply.

Careful consideration must be given to the manner in which fluids are being given (e.g., IV vs irrigation) and the type of fluid. Under normal circumstances, irrigation fluids cannot be substituted for IV fluids and hypotonic fluids cannot be substituted for isotonic fluids. The following table highlights the examples impacted routes of administration and the types of fluids.

<b>Administration Route</b>	<b>Fluid Type</b>
Intravenous (IV)	Hypotonic (e.g., sterile water, dextrose 5%, D5 1/2NS, etc.)
Irrigation (surgery, wound care, etc.)	Isotonic (e.g., Normal Saline (0.9% NaCl), Lactated Ringers, etc.)
Peritoneal Dialysis	Hypertonic (e.g., 3% Saline)

### Assessment

The Denver Health pharmacy teams, purchasing teams, and clinical teams are currently working to assess the situation and determine next steps. Currently, Denver Health will implement conservation/conventional strategies where we attempt to reduce utilization of impacted fluids through best or equivalently alternative practices. If the situation were to worsen, Denver Health is also exploring contingency and crisis strategies that would involve more restrictive allocations and, potentially, rationing of impacted fluids.

### Recommendations

At this time, Denver Health aims to implement conservation or conventional strategies to reduce our total utilization of impacted fluids. These strategies are designed to have minimal impact on patient outcomes. Conservation strategies will vary based on clinical site and individual patient needs. As such, recommendations are separated general recommendations followed by site specific recommendations.

### **Areas Where Fluid Management Should Not Change**

- Appropriate initial resuscitation of patients with hypotension and/or shock
- Resuscitation during prolonged surgeries
- Appropriate management of kidney injury
- Management of severe hypo- or hyperglycemia that cannot be corrected with oral intake.
- Other life-threatening situations where IV fluids would affect clinical outcomes and alternative approaches are not available.

### **Situational Awareness & Dissemination**

- Develop methods to assess fluid utilization across all clinical areas including ED/AUCC, inpatient units, critical care, minor procedures, surgery, infusion centers, etc.
- Maintain situational awareness about availability of crystalloid fluid types and volumes. Consider creating a dashboard that will inform providers and nurses which fluid type (e.g., NS vs Lactated Ringers) and volume bags (e.g., 500ml vs 1000ml) has greater availability on a given day so that informed decisions can be made in real time.
- Develop EPIC order sets for oral fluids, prompts and nudges for alternative options, and hard stops of certain restrictions.

### **Conservation Strategies to be Implemented in All Clinical Areas including Acute Care**

- Spiked IV bags can be maintained for up to 96 hours in a patient room. Do not routinely dispose of IV bags after 24 hours.
- Unspiked IV bags  $\geq 100$ ml in volume that are removed from the overwrap expire after 30 days and bags  $\leq 50$  ml in volume expire after 15 days. If brought into a patient's room but not used or spiked, they can be used for a different patient if cleaned with a purple wipe. For these fluids, ensure an appropriate expiration date is written on tape and affixed to the bag. Do not write directly on the bag.
- Do not use TKO ('to keep open') or KVO ('keep vein open') settings on pump. To preserve IVs, consider routine saline syringe flushes, saline lock, or hep-locks.
- Do not spike an IV bag 'just in case'. Ensure fluids are actually necessary for each patient.
- Encourage oral rehydration (e.g., Pedialyte or equivalent) over IV fluids for patients able to tolerate enteral intake (e.g., PO, NGT, PEG, etc.). See the associated Adult Oral Rehydration Therapy pathway documents for more information.
- Encourage oral intake over dextrose containing fluids for patients able to tolerate PO.
- Avoid orders for maintenance fluids unless absolutely necessary.
- Reassess all continuous fluid infusions at least every shift or every 12 hours. Orders for continuous fluid administration should have a specific volume and end time (e.g., 100ml/hr for 10 hours = 1 one liter bag).
- Utilize oral electrolyte repletion over IV repletion when possible.
- Convert medication infusions to IV pushes as able. Ensure adequate training for IV push medication administration.
- Most patients with short NPO durations do not require IV fluids. Do not routinely order IV fluids for NPO patients unless there is a clinical indication or if NPO status is planned for a prolonged period.

- For patients receiving blood products, utilize the smallest volume of fluid to flush the line in compliance with blood bank regulations. Choose the isotonic fluid that is most available at the given time.

### **Emergency Department**

- Ensure enteral hydration for mild to moderate dehydration. For patients with nausea, utilize anti-emetics to facilitate.
- Use squeeze bottles for wound irrigation.
- Utilize pharmacy verification for IV fluid orders but maintain the ability to override the verification step to more rapidly access IV fluids for decompensating patients.
- Reconsider use of IV fluids in undifferentiated tachycardia if not thought to be primarily hypovolemic.
- Reconsider use of IV fluids for conditions with data for the lack of benefit of significant IV fluid resuscitation such as migraines, renal colic, acute alcohol intoxication, etc.

### **Minor Procedures and Surgeries** (including GI, cardiology, interventional radiology and pulmonary procedures and minor surgeries)

- Saline or hep-lock IVs rather than starting pre-operative fluids.
- Current Denver Health policy allows clear liquids up to 2 hours prior to most minor procedures and surgeries. Ensure patients are aware of this recommendation and take adequate clear liquid intake prior to the 2-hour NPO status. Do not routinely order NPO after midnight. Encourage use of the 'NPO for anesthesia' order.
- Implement 'Sip to Send' with clear liquids for all appropriate patients.
- Only utilize fluids during procedures when necessary (e.g., prolonged procedures or when patients experience hypotension).
- Consider anesthetics that are less likely to cause hypotension to reduce the need for intra-operative fluid boluses.

### **Major Surgery/Trauma**

- Current Denver Health policy allows clear liquids up to 2 hours prior to surgeries that are not emergent or Priority 1 or 2 surgeries. Ensure patients are aware of this recommendation and take adequate clear liquid intake prior to the 2-hour NPO status. Do not routinely order NPO after midnight. Encourage use of the 'NPO for anesthesia' order.
- Consider colloid resuscitation where appropriate rather than crystalloid.
- Minimize intra-operative fluids for patients without signs of volume depletion.
- Evaluate the appropriate quantity of irrigation fluids for a given procedure.
- Identify elective surgeries that typically use a large amount of fluid either via IV or for irrigation. Create strategies to space these cases out based on anticipated delivery of supplies (e.g., only 2 per week) or postpone until the shortage abates but do not implement yet.

### **Critical Care**

- Do not order routine maintenance fluids unless clinically indicated.
- Utilize finite boluses over maintenance fluids for patients with true volume depletion.
- For hypotensive patients that have already received appropriate resuscitation (e.g., have received appropriate sepsis bolus), use objective measures of fluid responsiveness to inform

further fluid resuscitation such as passive leg raises, NICOM, pulse pressure variation, ultrasound of the IVC, etc. Ensure learners are trained in these methods.

- For patients on continuous infusions of medications mixed with impacted fluids (e.g., vasopressors, some sedatives/analgesics, heparin products, etc.) use concentrated mixtures to reduce the overall infusion rate.
- In patients receiving mechanical ventilation, utilize free water via enteral access for prevention and management of hypernatremia rather than IV fluids.
- Be flexible with dextrose containing fluids based on availability. For example, if D5W is on shortage, substitute D10W at half the rate in DKA protocol.
- For pressure bags for things like arterial lines or IABP, explore alternatives to use of NS bags when in short supply.
- In the appropriate clinical setting, consider earlier initiation of vasopressors for the hypotensive patient over further fluid resuscitation.
- Require Renal or Neurocritical Care approval for hypertonic saline (e.g., 3% saline) and attempt to use other hyperosmolar agents (e.g., mannitol) when able.

### **Obstetrics**

- For induction patients, use saline or hep locks. In many cases fluids can be held until active labor starts.
- Adhere to Denver Health policy on NPO status for obstetrics patients. While there is controversy about solid foods, in most cases actively laboring patients can continue to take clear liquids which should reduce the quantity of IV fluids needed during the labor process.
- Reduce fluid bolus volume prior to C-sections when appropriate.

Table 1. Comparison of Selected Intravenous Fluid<sup>10-15</sup>

Product	mOsm/L	Na (mEq/L)	Cl (mEq/L)	Dextrose (g/L)	K (mEq/L)	Ca (mEq/L)	Lactate (mEq/L)	Mg (mEq/L)	Acetate (mEq/L)	Gluconate (mEq/L)
<b>0.9% Sodium Chloride</b>	308	154	154	---	---	---	---	---	---	---
<b>0.45% Sodium Chloride</b>	154	77	77	---	---	---	---	---	---	---
<b>Dextrose 5% plus 0.2% Sodium Chloride</b>	321	34	34	50	---	---	---	---	---	---
<b>Dextrose 5% plus 0.45% Sodium Chloride</b>	406	77	77	50	---	---	---	---	---	---
<b>Dextrose 5% plus 0.9% Sodium Chloride</b>	560	154	154	50	---	---	---	---	---	---
<b>Dextrose 5%</b>	252	---	---	50	---	---	---	---	---	---
<b>Lactated Ringers Solution</b>	273	130	109	---	4	2.7	28	---	---	---
<b>Lactated Ringers and Dextrose 5% Solution</b>	525	130	109	50	4	2.7	28	---	---	---
<b>Normosol-R</b>	295	140	98	---	5	---	---	3	27	23
<b>Plasmalyte-A</b>	294	140	98	---	5	---	---	3	27	23