

Supplemental Table 1. Specific definitions of 20 ERAS process measures for pediatric lower urinary tract reconstructive operations.

Phase of case	Measure	Definition
<i>Preoperative</i>	Counseling about ERAS	This will typically be done as part of the consent process. Patients/families should not have their sole counseling occur in the preoperative area. Patients/families will be provided a standardized handout on ERAS and what to expect from surgery throughout the process from preoperative all the way through follow up.
	Clear-liquid carbohydrate load	Patients will be provided a commercially-available complex clear liquid carbohydrate liquid preoperatively. Patients will drink 10 mL/kg up to maximum of 350 mL (1 bottle) in the 3 to 2 hours prior to surgery in concert with American Society of Anesthesiologists (ASA) guidelines. If not available, other carbohydrate-rich clear liquids are also permissible on protocol, including Gatorade, PowerAde, Pedialyte. If the patient has a G-tube, these liquids can be administered per G-tube. Water should not be used. Other liquids outside this list are not permissible as part of the protocol.
	Avoid prolonged fasting	Patients will remain adherent to ASA guidelines for pediatric patients. These include: solids up to 8 hours, non-human milk up to 6 hours, breast milk up to 4 hours, and clear liquids up to 2 hours prior to surgery. Patients should not be placed on an extended clear liquid diet prior to surgery. Patients should be encouraged to eat and drink normally up to the scheduled <i>nil per os</i> (NPO) guidelines stated above. If the patient does not eat > 24 hours prior to surgery or was placed on an extended clear liquid diet (no solid food on day before surgery) or did not receive normal G-tube feedings, if applicable, patient will not meet this criterion.
	No bowel preparation	Patients will not receive oral laxatives, suppositories, oral antibiotic agents or other bowel prep agents outside of the patient's normal regimen (if on one). Many patients undergoing urology reconstruction have concomitant neurogenic bowel and are already on bowel programs which may include daily antegrade or retrograde enemas or oral laxatives. These should be maintained up to the day prior to surgery. Patients should be evaluated adequately (clinical history) well in advance of surgery to ensure they are not constipated. Clinical judgement should be used to modify any bowel regimen program at least 4 weeks prior to scheduled OR date.
	Antibiotic prophylaxis	Perioperative antibiotics should be administered within the guidelines of the American Urological Association and best hospital practices. AUA guidelines state that prophylaxis should consist of a weight-based dose of 2nd/3rd generation cephalosporin (e.g., cefoxitin) or alternatively an aminoglycoside + metronidazole or clindamycin (e.g. gentamycin + metronidazole) to be administered within 60 minutes of procedure start time (cut time). If patients have allergies or clinical conditions that preclude these, alternatives include ampicillin/sulbactam, ticarcillin/clavulanate, piperacillin/tazobactam or a fluoroquinolone. If patient is felt to have a UTI pre-operatively or has colonization, alternative antibiotic regimens tailored to recent culture results may be used. Antibiotics in most cases should be re-dosed in the operating room according to local standard and be discontinued within 24 hours of surgery per guidelines, but may be continued at the discretion of the surgeon based on clinical circumstance.
	DVT prophylaxis	Patients with one or more risk factors should have sequential compression devices (SCDs) placed on the lower extremities prior to induction of anesthesia. This will be verified by intraoperative nursing documentation. Risk factors include obesity (BMI \geq 30), age \geq 14, history of malignancy, or history of venous thromboembolic event. Patients who do not have any risk factors may safely omit any prophylaxis per standard of care. SCDs should be removed at the end of the case to encourage early mobility once reaching the surgical floor.

Phase of case	Measure	Definition
Intraoperative	Regional anesthesia	<p>Standard clinical judgement of the multidisciplinary team (urologists, anesthesia) in concert with patient/family wishes should be used to offer regional catheter-based anesthesia to all patients. Options include wound soakers, transversus abdominus plane (TAP) catheters, quadratus lumborum (QL) catheters, erector spinae plane (ESP) catheters, or epidural. If planning wound soakers, TAP/QL/ESP catheters at the end of the case, preoperative TAP blocks performed by anesthesia using 0.2 mL/kg of 0.2–0.5% Ropivacaine should be injected on each side under ultrasound guidance. Wound soakers, TAP catheters, quadratus lumborum catheters or wound catheter pain pumps should be filled with 0.2% ropivacaine and connected to an epidural infusion pump to provide a continuous rate determined by the patient's weight (0.05 mL/kg/hr, maximum 0.5 mg/kg/hr). The infusion rate can be adjusted or stopped to monitor alternative analgesics prior to catheter removal.</p> <p>Epidurals can be run according to standard of care at each institution, although by protocol should not include a narcotic/opioid. Initial concentrations and rates for all regional anesthetic regimens will be documented. Duration of therapy will be documented.</p> <p>Wound soakers, TAP/QL/ESP catheters, and epidural catheters are to be left in place up to 5 days post-operatively or at clinical discretion of treating physicians within standard of care. They can be removed on day of discharge. Those left in longer than day 5 should have documented reason. Drainage around pain catheters can occur. This is normal. Dressings should be reinforced prior to scheduled removal. The risk of infection of pain catheters is generally small, but if concern exists, clinical judgement should be used as to the disposition of the pain catheters and documented.</p> <p>If none of the above are deemed clinically appropriate, bilateral transversus abdominis plane (TAP) blocks, caudal blocks or paravertebral blocks can be performed by the surgical or anesthesia team either through the surgical field or ultrasound guided. These do not count, however, for this protocol item given their limited duration of effectiveness for the patient. Blocks (as opposed to catheter-based postoperative therapies) do not provide continuous post-operative anesthesia to the wound beyond 6-12 hours. Justification of the use of blocks over other continuous regional options should be documented.</p>
	Avoiding excess drains	<p>There is wide variability in the use of surgical drains by surgeons, according to local practice, experience and clinical scenario. Urologic reconstruction, though, typically requires drains in the form of catheters across newly-constructed catheterizable channels or catheters to drain the urinary tract to keep it under low pressure during healing. To meet this criterion, patients should not have a drain placed intraabdominally, in the space of Retzius, or subcutaneously. Acceptable catheters include: suprapubic tube, antegrade continence enema channel, appendicovesicostomy/ileovesicostomy/colovesicostomy, and/or urethral catheters. The duration of therapy will be according to surgeon preference.</p>

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	Euvolemia	<p>Hydration statuses of patients can vary greatly and are highly dependent on pre-operative fasting conditions, concomitant medical diagnoses like diabetes insipidus, and intraoperative fluid shifts related to insensible losses from an open abdomen, urine output and blood loss. Surgery involving the genitourinary tract can often be difficult because urine output cannot be recorded accurately throughout the case, which is often an indicator of fluid status and response to intraoperative intravenous fluid resuscitation. The goal is to maintain euvolemia and avoid bowel edema and subsequent ileus while maintaining safe cardiopulmonary function, end organ perfusion and offsetting bodily fluid and insensible losses.</p> <p>To meet this criterion, a goal of an average intravenous fluid volume between 3 and 7 mL/kg/hr as calculated according to the patient's preoperative weight and time from in room time to out of room time. Blood loss not requiring transfusion can be replenished in a 3:1 ratio of crystalloid to blood or 1:1 ratio of colloid to blood. Intravenous pressors should be considered to improve hemodynamics as opposed to fluid boluses. Some patients with preexisting comorbidities like diabetes insipidus may require greater than usual fluid volumes to maintain euvolemia. Such instances should be well-documented and justified.</p>
	Normothermia	<p>Patient's temperature should be maintained between 36°C to 38°C throughout the intraoperative period (skin-to-skin time). This can be done with a combination of warming blanket and/or alteration of the operating room environmental controls. To minimize variability, esophageal temperature monitoring should be used. Anesthesia record will be used to verify this item. Any value outside this range will not count.</p>
	Minimizing opioids	<p>There is no well-accepted clinical standard for minimizing intraoperative opioids. Data gathered during a pilot study were used as a basis for this definition. Patients will have met this criterion if they receive < 0.3 mg/kg IV morphine equivalents intraoperatively. This is equivalent to a total of 3.6 mcg/kg fentanyl IV. As a guideline for intraoperative opioid usage, providers may opt for no intraoperative opioids so long as the patient has some form of regional anesthesia on board starting at the beginning of the case and they show no signs of pain response. Alternatively, we recommend fentanyl may be administered in 1-2 mcg/kg doses with induction, prior to incision, and as deemed appropriate throughout the procedure by the anesthesiologist for analgesia. Opioids should only be used if clinically indicated. This total dosage equates to about 75% of mean post-operative day 0 IV morphine equivalent usage across all patients in the Phase I/II study. The last 25% of mean post-operative day 0 IV morphine equivalent is allocated toward post-operative pain control in the recovery unit or hospital ward.</p> <p>Patients should have their pain adequately controlled as necessary in accordance with standard of care. If pain assessments determine there is inadequate pain control, all pain pathway items should be reassessed by nursing, surgical and anesthesia teams to maximize pain control as best as possible in accordance to the ERAS pathway where possible.</p>
	Minimally-invasive assistance	<p>Where technically and clinically feasible, surgeons should endeavor to perform part of the surgery with either laparoscopic or robotic assistance. In many cases, the cecum, appendix and terminal ileum can be mobilized into the pelvis to allow for reconstruction through a smaller muscle-splitting Pfannenstiel incision with minimization of time the peritoneum is open. This minimizes insensible fluid losses and fluid shifts. Surgeon judgement and experience will heavily influence this part of the pathway, but should be given consideration. If laparoscopic or robotic assistance is used in any part, this criterion will be met. Of note, this item is not meant to indicate that the entire operation need be done laparoscopically or robotically. Surgeon judgement is paramount.</p>

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	No nasogastric tube on leaving operating room	No nasogastric (NG) tube shall be placed intraoperatively by the anesthesia team. An orogastric (OG) tube may be placed temporarily to drain stomach contents if felt necessary, but should be otherwise avoided. Placement of OG intraoperatively by definition must be removed at the end of surgery. Placement of NG tube on leaving the OR shall be documented and not qualify for this item. Patients who develop ileus and clinically require NG tube during the post-operative period still qualify for this item if no NG tube was used on leaving the OR. Such patients will require documentation of circumstances of secondary NG tube placement.
Postoperative	Nausea/vomiting prevention	Patients without clinical contraindications shall be written for weight-based anti-nausea prophylaxis, typically ondansetron to be given as needed on admission to the PACU or floor. Orders will be used to verify this item. Alternatives to ondansetron such as promethazine, diphenhydramine or a scopolamine patch may be used at the discretion of the ordering physician. Regimen will be documented.
	Early feeding	Patients should receive clear liquids on the evening of surgery (counted as postoperative day 0) and regular diet starting on day after surgery (postoperative day 1). Regular diet should have no restrictions outside of clinically-indicated patient needs (e.g., soft, bland, purée, etc.). Presence of orders to this effect on the specified days will be used to verify this item.
	Early mobilization	Patients should be out of bed in some fashion on post-operative day 1. This may include transfer to a chair, ambulation with or without assistance as deemed clinically safe and feasible by the surgical team and nursing staff. Patients who do not get out of bed will not have met this criterion. Similarly, sitting on the edge of the hospital bed is not considered sufficient to meet this criterion. Activity should be encouraged and increased each subsequent hospital day. Nursing documentation of activity will be used to verify this item.
	Adjunctive pain medication	<p>Patients should be scheduled initially (not written prn or as needed) to receive a weight-based based dose of acetaminophen and/or NSAID therapy. These may be given orally or parenterally. To meet this item, these should be scheduled after surgery for 24 hours and can then be transitioned to as needed at the discretion of the care team. If these are written as needed on leaving the operating room, patient will not receive credit for this item. In accordance with clinical standard of care, patients who have contraindications to receiving either medication (e.g. allergy, liver disease, chronic kidney disease, etc.) should not be written for them.</p> <p>Patients should have their pain adequately controlled as necessary in accordance with standard of care. If pain assessments determine there is inadequate pain control, all pain pathway items should be reassessed by nursing, surgical and anesthesia teams to maximize pain control as best as possible in accordance to the ERAS pathway where possible.</p>
	Early stoppage of intravenous fluids	Patients who have tolerated oral intake (no prerequisite amount is defined) and who are clinically stable according to standard of care should have their intravenous maintenance fluids turned off (saline locked) by post-operative day 2. "To Keep Open" or TKO rates are permissible. Patients who are not well, are vomiting, have ileus or have an NG tube should not have their IV fluids removed and will not meet this criterion.
	Early removal of extra drains/catheters	If no drain was left outside the urinary tract at the time of surgery, then the patient will automatically qualify for this ERAS protocol item. If a drain was left intentionally outside the urinary tract, then it should be removed by or on post-operative day 4. If there are clinical circumstances that require the drain be continued, then the clinical team should keep it in place and document reasoning.

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	Minimizing opioids	<p data-bbox="667 352 1349 604">There is no well-accepted clinical standard for minimizing postoperative opioids. Data gathered during a pilot study were used as a basis for this definition in addition to prior study data regarding the decreased need for postoperative opioids in the setting of wound soakers. Patients will have met this criterion if they receive < 0.15 mg/kg/day IV morphine equivalents averaged over the first 3 post-operative days. This equates to less than all the postoperative IV morphine equivalent usage for 11 of 13 patients in the pilot study, where nurses were informed to use opioids only for breakthrough pain control. This is equivalent to an average of 3 weight-appropriate doses of IV morphine, IV hydromorphone or oxycodone per day. Communication with nursing staff (day and night shift nurses) and anesthesia team is key to minimizing opioid usage.</p> <p data-bbox="667 632 1305 743">Patients should have their pain adequately controlled as necessary in accordance with standard of care. If pain assessments determine there is inadequate pain control, all pain pathway items should be reassessed by nursing, surgical and anesthesia teams to maximize pain control as best as possible in accordance to the ERAS pathway where possible.</p>
