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## **Introduction/Background**

Albumin is the most abundant protein found in plasma in healthy individuals. Intravenous human albumin is used as a plasma expander in various critical conditions, due to its osmotic effect. Recently, the Becker's Hospital Review and ASHP Drug Shortage both identified that albumin 5% and 25% products were affected by a critical shortage worldwide. The limited availability makes it essential to define evidence-based criteria for the therapeutic use of albumin. The use of albumin can be indicated in acute conditions such as:

### Ascites/Large Volume Paracentesis in patients with Cirrhosis

- A paracentesis volume > 5L can, in some cases, lead to hypovolemia and particularly unfavorable hemodynamic changes. Per the Association for the Study of Liver Diseases (AASLD) guidelines, post paracentesis albumin infusion may not be necessary for a single paracentesis of less than 4–5 L. However, for large-volume paracenteses, an albumin infusion of 6-8 g/L of fluid removed can be considered.

### Spontaneous Bacterial Peritonitis

- A common and severe complication of ascitic cirrhosis, can be characterized by spontaneous infection of the ascitic fluid, in the absence of abdominal sources of infection. The AASLD guidelines recommend albumin should be given when the serum creatinine is >1 mg/dL, blood urea nitrogen >30 mg/dL, or total bilirubin >4 mg/dL, but is not necessary in patients who do not meet these criteria.

### Hepatorenal Syndrome

- Hepatorenal syndrome consists of deterioration in renal function can be considered the extreme outcome of hemodynamic dysfunction of cirrhosis. The AASLD guidelines has a strong recommendation for albumin infusion plus administration of vasoactive drugs such as octreotide and midodrine in the treatment of type I hepatorenal syndrome. The guideline also recommends a two-day trial of albumin in the diagnosis of hepatorenal syndrome.

### Plasmapheresis

- The use of albumin is appropriate only for the exchange of large volumes of plasma: more than 20 mL/kg in a single session or 20 mL/kg/week in successive sessions. There are no clear guidelines on volume of 5% albumin should be infused. However, based on other institution guidelines, it is recommended to replace 70-80% of plasma volume removed. American Society for Apheresis (ASFA) guidelines suggest the use of albumin or fresh-frozen plasma based on the specific drug-binding affinities to help draw the medication into the intravascular space.

### Cardiac Surgery

- Albumin can be used as a post-operative volume expander, as a last choice of treatment after crystalloids or non-protein colloids, following heart surgery. Crystalloids are the first choice for priming the circuitry in the case of extracorporeal circulation. In a systematic review by Haynes, G R et al., albumin administration in cardiac surgery resulted in lower fluid requirements, higher colloid oncotic pressure, reduced pulmonary edema with respiratory impairment and greater hemodilution compared with crystalloid and hydroxyethyl starch, which increased postoperative bleeding.
- A retrospective cohort study conducted by Dingankar, Adil R et al., provides evidence that the use of crystalloids for volume resuscitation after pediatric cardiac surgery is superior to 5% albumin. The use of crystalloids was associated with reduced fluid administration despite the theoretical oncotic advantage of albumin.

### Intradialytic Hypotension

- According to the 2021 Clinical Journal of the American Society of Nephrology (CJASN), intravenous albumin may be administered to prevent or treat hypotension or to augment fluid removal, but this practice is controversial. In the 2004 Albumin versus Saline for the Treatment of Intradialytic Hypotension trial, it was concluded that 5% albumin is no more effective than normal saline for the treatment of IDH in chronic hemodialysis patients.

### Pump Priming in Hemodialysis

- A retrospective study Skagerlind, Malin et al. suggests that using a heparin and albumin mixture minimized the risk of clotting and enabled acute intermittent hemodialysis in vulnerable patients without increased bleeding.

### Organ Transplantation

- Albumin can be useful in the post-operative period following liver transplantation, to control the ascites and peripheral edema and to replace the loss of ascitic fluid through the drainage tubes.

### Sepsis/Septic Shock

- Based on the Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021 (SSC), patients with sepsis induced hypoperfusion or septic shock should be given at least 30 mL/kg of IV crystalloid fluid within the first 3 hours of resuscitation. The guideline suggests using albumin after patients received large volumes of crystalloids with no clear cutoff value for crystalloid infusion.

### Nephrotic Syndrome

- Patients with serum albumin < 2 g/dL, with hypovolemia and/or acute pulmonary edema and/or acute renal failure. The 2014 Japanese Society of Nephrology (JSN) suggests albumin administration does not improve hypoalbuminemia or edema in patients with nephrotic syndrome and may exacerbate hypertension. However, albumin administration may be useful in severe edema refractory to diuresis.

### Thermal Injury (hypovolemia)

- Per Legacy Protocol, this is an approved indication. Albumin is considered second line and must need Burn Attending approval.

### Acute Respiratory Distress Syndrome (ARDS)

- Albumin and furosemide therapy improves fluid balance, oxygenation, and hemodynamics in hypoproteinemia patients with acute lung injury, according to a clinical trial comparing albumin and furosemide versus dual placebo by Martin, Greg S et al.

### ECMO

- The Extracorporeal Life Support Organization (ELSO) guidelines do not specify which fluid to use to rectify low flow states. A retrospective study of adult patients treated with venovenous or venoarterial ECMO receiving crystalloid or albumin boluses for volume resuscitation showed there were no noted benefits of colloid versus crystalloid administration on hemodynamic or ECMO fluid response.

### Large Clinical Trials

Table 1: Select Studies Examining Albumin Utilization

<b>Study</b>	<b>Major Findings</b>
2004 Saline versus Albumin Fluid Evaluation (SAFE) trial	Trial randomized 6,997 ICU patients requiring IV fluids to either albumin or saline. There was no difference in all-cause mortality between the two groups.
2004 Albumin versus Saline for the Treatment of Intradialytic Hypotension trial	A randomized, double-blind, crossover trial was performed in 72 chronic hemodialysis patients to determine whether 5% albumin was more effective than normal saline for the treatment of intradialytic hypotension (IDH). It is concluded that 5% albumin is no more effective than normal saline for the treatment of IDH in chronic hemodialysis patients. Normal saline should be used as the initial fluid for the treatment of IDH.
2013 Colloids Versus Crystalloids for the Resuscitation of the Critically Ill (CRISTAL) trial	Trial randomized 2,857 ICU patients with hypovolemic shock, mostly with concurrent sepsis, to volume resuscitation with either colloids or crystalloids. There was no difference in the primary outcome of all-cause mortality at 28 days between the two groups, although colloids were associated with a reduction in the secondary outcome of all-cause mortality at 90 days.
2014 Albumin Italian Outcome Sepsis (ALBIOS) trial	Trial randomized 1,818 patients with severe sepsis or septic shock at 100 Italian ICUs in an unblinded fashion to albumin or no albumin. Both groups were treated with crystalloids as needed. There was no difference in all-cause mortality at 28 days and 90 days. There was no difference in overall Sequential Organ Failure Assessment (SOFA) scores between the two groups.
2022 Albumin in Cardiac Surgery (ALBICS) trial	Trial randomized 1,386 patients undergoing cardiac surgery with cardiopulmonary bypass. The results of this trial indicate that

	treatment with 4% albumin solution for priming and perioperative intravenous volume replacement compared with Ringer acetate did not significantly reduce the risk of adverse events over the following 90 days among patients undergoing on-pump cardiac surgery.
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### Current Order Sets

- IP - Hemodialysis - Adult - Procedure [1212]
- IP - Cardiac Surgery - Pediatric - Postoperative [1310]
- IP - Renal Replacement - ICU - Pediatric - Add on [1388]
- IP - Traumatic Brain Injury - ICU- Pediatric - Admission [2465]
- IP - Apheresis - Adult - Procedure [745]
- IP - Surgery - Oregon Burn Center - Adult - Procedure [557]
- IP - ECMO - Adult - Procedure [2084]
- IP - Surgery - Oregon Burn Center - Adult - Postoperative [2319]
- IP - Hemodialysis - Pediatric - Procedure [2555]
- IP - Apheresis - Pediatric - Procedure [2031]
- IP - Cardiac Surgery - Adult - Postoperative [1616]

### **Objective**

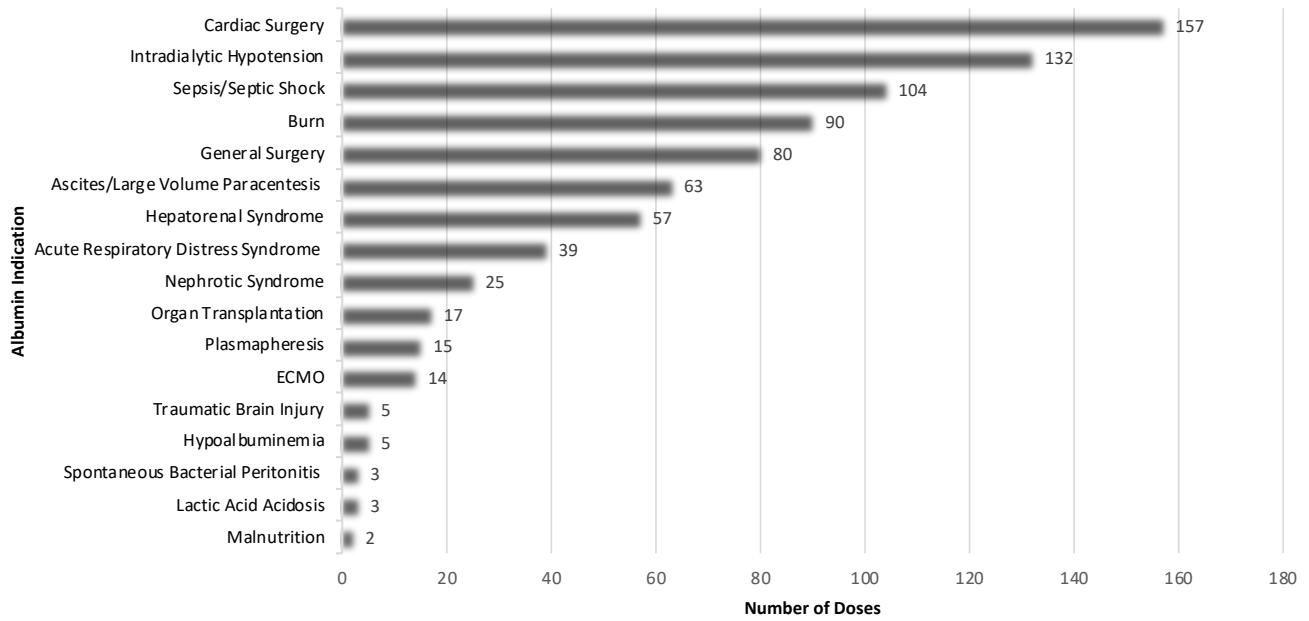
The albumin shortage provided an opportunity to evaluate the institutional pattern of albumin use across Legacy Health system using evidence-based criteria, to optimize albumin usage for only appropriate indications.

### **Methods**

PowerBI was used to generate a report of all albumin administrations from September 13 and September 17, 2022. This retrospective, observational chart review study included patients that received at least one dose of albumin at Legacy Health during the study period. All de-identified data was collected including patient age, facility, department, hospital site, order set, date/time, dose, quantity, frequency, prescriber, and cost. A thorough chart review was conducted to evaluate indication of albumin use, dosing appropriateness and any alternative medication use. The collected data was then analyzed using descriptive statistics to characterize albumin use within the Legacy Health system. External database searches, guidelines from AASLD, ASFA, SSC and recommendations developed by other healthcare organizations were used to evaluate the appropriateness of albumin use.

## Results

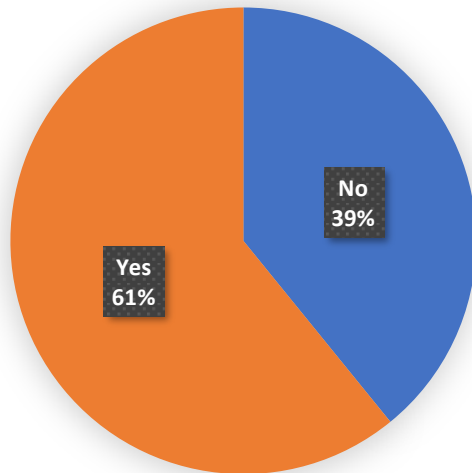
**Figure 1:** Albumin Administration by Indication September 1<sup>st</sup> – 30<sup>th</sup> 2022



**Table 1:** Albumin Administration by Order Set September 1<sup>st</sup> – 30<sup>th</sup> 2022

Order Set	Total Doses
No Order Set	570
Hemodialysis	104
Cardiac Surgery Postoperative	44
Peds Cardiac Surgery Postoperative	33
Large Volume Paracentesis	22
Oregon Burn Center Admission	14
Therapeutic Apheresis Procedure	13
IP Adult ECMO	11

**Figure 2:** Alternative treatment Tried first, for Select Indications (cardiac surgery, general surgery, intradialytic hypotension, organ transplantation, sepsis/septic shock, nephrotic syndrome, thermal injury, acute respiratory distress syndrome)



### Discussion/Conclusion

Treatments requiring albumin should be considered only after failure of first line regimens for the respective indication and situation. The use of albumin should be assessed daily and should be discontinued as soon as therapy is no longer required according to monitored parameters. Information for the albumin use criteria was based on guidelines from AASLD, ASFA, SSC, clinical trials, and guidelines from other institutions (University of Wisconsin, Stanford, and Providence). Overall, continued evaluation of evidence-based criteria should be performed to examine institutional use patterns, to determine the impact on patient therapeutic outcomes, and to identify modifications needed. The drug shortage offered an opportunity for our health system to evaluate usage patterns and develop evidence-based usage criteria to ensure ongoing stewardship of a medication that may be overutilized.

## Recommendations

	Indication	Guideline	Dose
√	Ascites/Large Volume Paracentesis in patients with Cirrhosis	1 <sup>st</sup> Line: Dietary sodium restriction (2 g/day) & oral diuretics 2 <sup>nd</sup> Line: Albumin (only if >5 liters of fluid removed)	Albumin 25%: 6-8 g/liter of ascitic fluid removed
√	Spontaneous Bacterial Peritonitis (SBP)	Meets one of the following: 1. Serum creatine >1 mg/dL 2. Blood urea nitrogen >30 mg/dL Total bilirubin >4 mg/dL	Albumin 25%: Day 1: 1.5 g/kg given within 6 hours of diagnosis (Max: 100 g) Day 3: 1 g/kg (Max: 100 g)  Given in combination with antibiotic
√	Hepatorenal Syndrome (HRS) Type 1	For diagnosis of suspected: <ul style="list-style-type: none"> <li>○ Cirrhosis with ascites</li> <li>○ Serum creatine &gt;1.5 mg/dL</li> </ul> Confirmed: <ul style="list-style-type: none"> <li>○ Serum creatine &gt;1.5 mg/dL in presence of cirrhosis</li> <li>○ Absence of improvement in renal function after discontinuation of diuretics and trial of albumin 1 g/kg/day</li> <li>○ Absence of proteinuria (&lt;500 mg/day) or hematuria (&lt;50 red cells per high-power field) and/or abnormal renal ultrasonography</li> <li>○ Absence of shock</li> <li>○ No current or recent use of nephrotoxic drugs (NSAIDs, aminoglycosides, or iodinated contrast media)</li> </ul> Non-ICU: Albumin + Octreotide + Midodrine  ICU: Albumin + Norepinephrine	Albumin 25%: <ul style="list-style-type: none"> <li>○ Diagnosis: 1 g/kg/day for 2 days (Max: 100g)</li> <li>○ Confirmed: 20-40 g/day</li> </ul> Treatment can be continued until octreotide and midodrine are administered, or until adequate intravascular volume is achieved
√	Plasmapheresis	For large volume plasma exchange of greater than 20 mL/kg in one session or repeated sessions.*	Albumin 5%: Dose to plasma volume removed* (70-80%)
√	Cardiac Surgery Postoperative Volume Resuscitation	<b>Adult</b> <i>Restrict albumin for patients requiring &gt;2 liters of crystalloid in first 24 hours post-op of cardiac surgery</i>  1 <sup>st</sup> Line: Crystalloid Last Line: Crystalloid + Albumin [after failure of crystalloid attempt and at the discretion of the physician]	Albumin 5%: 12.5 g every 1-hour PRN

√	Intradialytic Hypotension	<p><b>Adult</b>  <i>SBP decreased by <math>\geq 10</math> mmHg from initial blood pressure OR SBP <math>&lt;90</math> or MAP <math>&lt;60</math> mmHg +/- symptoms of hypotension</i></p> <p>(1) Ultrafiltration rate should be decreased or stopped  (2) Patient should be placed in the Trendelenburg position  (3) <i>IV bolus of 250 mL NS</i>  (4) Reassess BP and symptoms of hypotension  (5) If no resolution <math>\rightarrow</math> <i>IV bolus of 250 mL NS</i>  (6) Reassess BP and symptoms of hypotension  (7) <i>Albumin 25%</i>  (8) Reassess BP and symptoms of hypotension  (9) If no resolution <math>\rightarrow</math> <i>Albumin 25%</i>  (10) Contact nephrologist</p>	<p><b>Adult</b>  Albumin 25%:  12.5 g or 25 g every 1-hour PRN</p> <p><b>Pediatric</b>  Albumin 25% or 5%  5%: 10 mL/kg  25%: 0.5 g/kg</p>
√	Postoperative Liver Transplantation	Control of ascites and peripheral edema if serum albumin is $<2.5$ gm/dL with hematocrit $>30\%$	Albumin 25%: 25 g/day
√	Sepsis/Septic Shock	<p><b>Adult</b>  <i>It is recommended to use crystalloids as first line for resuscitation. It is suggested to use albumin in patients who received large volumes of crystalloids</i></p> <p>1<sup>st</sup> Line: Crystalloids – at least 30 mL/kg of IV crystalloids should be given within the first 3 hours of resuscitation  Last Line: Albumin 5% - after failure of large volume of crystalloids, 4-5 liters</p> <p><b>Pediatric</b>  <i>It is suggested to use crystalloids, rather than albumin for the initial resuscitation of children with septic shock or other sepsis-associated organ dysfunction</i></p> <p>1<sup>st</sup> Line: Crystalloids – up to 40-60 mL/kg in bolus fluid (10-20 mL/kg per bolus) over the first hour, titrated to clinical markers of cardiac output and discontinued if signs of fluid overload develop. Repeat if no improvement after first infusion.  Last Line: Albumin 5%</p>	<p><b>Adult</b>  Albumin 5%:  12.5 – 25 g</p> <p><b>Pediatric</b>  Albumin 5%:  5-10 mL/kg</p>
√	Nephrotic Syndrome	Albumin $<2$ g/dL with hypovolemia and/or pulmonary edema with loop diuretic resistance	Albumin 25%: 25 g



			Pediatrics: 0.5-1 gm/kg/dose, maximum 25 g/dose (rounded to 12.5 or 25 gm). Maximum 2 doses in 24 hours.  Given in combination with diuretics
√	Thermal Injury (hypovolemia)	See OBC Fluid Resuscitation Protocol  Albumin Protocol: 1. Current LR maintenance rate divided by 2 = _____ mLs/hr 2. Start Albumin 5% @ above rate 3. Reduce LR to above rate 4. Titrate Fluids together 1:1 per protocol	Albumin 5%  Per protocol - used 2 <sup>nd</sup> line, needs attending approval
√	Acute Respiratory Distress Syndrome (ARDS)	Patients with acute lung injury/acute respiratory distress syndrome, whose serum total protein concentrations are <6.0 g/dL	Albumin 25%: 25 g every 8 hours as needed for 3 days  Given in combination with furosemide
√	Extracorporeal Membrane Oxygenation (ECMO)	Utilize crystalloid first and alternate albumin and crystalloid.	Albumin 5% 12.5 gm, alternate with 500 mL crystalloid
X	Traumatic Brain Injury (TBI)	Albumin administration is associated with increased intracranial pressure, which led to increased mortality	
X	Trauma	Several trials show either no benefit, or in some cases worse outcomes, with albumin thus making this solution not recommended in the resuscitation of trauma patients	
X	Hypoalbuminemia	Little evidence to support practice of albumin supplementation. Hypoalbuminemia in the absence of edema or acute hypotension.	
X	Malnutrition	Nutritional supplementation is considered an inappropriate indication	

1. For IP - Cardiac Surgery - Pediatric - Postoperative [1310] order set:
  - a. Add crystalloid as a first-line option for volume resuscitation
2. For IP - Cardiac Surgery - Adult - Postoperative [1616] order set:
  - a. Add administration instructions to direct nursing staff to use crystalloids before albumin.

3. For IP - Hemodialysis - Adult - Procedure [1212] & IP - Hemodialysis - Pediatric - Procedure [2555] order sets:
  - a. Add crystalloids options to adult hemodialysis order set.
  - b. Implementation of an algorithm for the treatment of intradialytic hypotension for both adult and pediatric patients are needed to reduce albumin utilization.
4. For IP - Apheresis - Adult - Procedure [745] order set:
  - a. Change 3,000 mL dose to a variable dose or ability to enter a specific dose.
5. For IP - Traumatic Brain Injury - ICU- Pediatric - Admission [2465] order set:
  - a. Consider removal from the order set
6. Optimize ordering process in EPIC for all indications, either with order questions, an order panel, or an order set.

### **Stakeholder Input**

Input received from:

Pharmacy Clinical Managers

Dr. Nick Eshraghi

Dr. Vikas Grover

Dr. Andrew Tsen

Dr. Marc LeGras

Dr. James Kyser

Bob Morris, Perfusionist

Dr. Pasala Ravichandran

Dr. Oliver Padgett

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## Order Sets:

### IP - Hemodialysis - Adult - Procedure [1212]

#### ▼ Medications

##### ▼ Medications Dialysis

- lidocaine injection PF 10 mg/mL (1%)  
1 mL, IntraDermal, ONCE PRN, Other, prior to graft/fistula needle insertion
- Heparin (MINI) Bolus and Drip - For use in dialysis pump for Graft/Fistula  
1,000 Units, IntraVenous, PRN, For use in dialysis pump. Mini = 1000 unit bolus then 500 units/hour - stop 1 hour before end of dialysis. FOR DIALYSIS ONLY
- albumin human 5 % bottle - To prime dialysis pump.  
12.5 g, Extracorporeal, ONCE, To prime dialysis pump. FOR DIALYSIS ONLY
- albumin human 25 % infusion  
12.5 g, IntraVenous, EVERY 1 HOUR PRN, SBP less than\*\*\* or DBP less than\*\*\* during dialysis. FOR DIALYSIS ONLY, Other, for blood pressure support during dialysis
- mannitol 25 % injection  
12.5 g, IntraVenous, EVERY 1 HOUR PRN, for signs/symptoms of dialysis disequilibrium syndrome during dialysis, FOR DIALYSIS ONLY
- heparin lock injection 1000 units/mL  
Intra-Catheter, ONCE AFTER DIALYSIS, Lock dialysis catheter after each dialysis. FOR DIALYSIS ONLY
- heparin (PF) 100 units/mL syringe  
Intra-Catheter, ONCE AFTER DIALYSIS, Lock dialysis catheter after each dialysis. FOR DIALYSIS ONLY
- sodium citrate solution 4% - lock dialysis catheter after each dialysis ⓘ  
Dialysis, ONCE AFTER DIALYSIS, Lock dialysis catheter after each dialysis. FOR DIALYSIS ONLY
- epoetin alfa-epbx (Retacrit) injection  
IntraVenous, ONCE AFTER DIALYSIS
- alteplase (CATHFLO ACTIVASE) injection  
4 mg, Intra-Catheter, ONCE PRN, To de clot RED port of dialysis catheter, FOR DIALYSIS ONLY
- alteplase (CATHFLO ACTIVASE) injection  
4 mg, Intra-Catheter, ONCE PRN, To de clot BLUE port of dialysis catheter, FOR DIALYSIS ONLY
- paricalcitol (ZEMPLAR) injection  
4 mcg, IntraVenous, ONCE IN DIALYSIS, FOR DIALYSIS ONLY
- iron sucrose (VENOFER) IV  
100 mg, IntraVenous, ONCE IN DIALYSIS

### IP - Cardiac Surgery - Pediatric - Postoperative [1310]

#### ▼ IV Fluids

##### ▼ IV Fluids & Albumin: Age >6 months

- Pediatric Maintenance IV Fluid (4-2-1 rule)
- albumin human 5 % bottle 10 mL/kg (Dosing Weight)  
10 mL/kg, IntraVenous, PRN, Starting today at 0921, Until Discontinued, Post-op  
⚠ For poor perfusion/ SBP < \*\*\* and CVP < \*\*\*  
Other, Poor perfusion, Sign and Hold
- albumin human ⓘ  
↑ Frequency of **288 doses/day** exceeds recommended maximum of **6 doses/day**  
⚠ Missing Weight for dose checking
- heparin (PF) 500 Units in sodium chloride 0.9 % (NORMAL SALINE) 500 mL infusion  
Intra-Catheter, TITRATED, Starting today at 0945, Until Discontinued, Post-op, Sign and Hold
- sodium chloride 0.9 % (NORMAL SALINE FLUSH) injection  
1 mL, EVERY 8 HOURS, Post-op
- Total Fluids Rate  
Routine, UNTIL DISCONTINUED, Total Fluids Rate \*\*\*, Post-op
- Use air filters on all IVs except pressure lines  
Routine, UNTIL DISCONTINUED, Use air filters on all IVs except pressure lines, Post-op

#### ▼ Diuretics/Urinary Output

- furosemide (LASIX) injection  
1 mg/kg, IntraVenous, EVERY 6 HOURS, Post-op, Start 6 hours post-op
- albumin human 5 % bottle  
10 mL/kg, IntraVenous, PRN, Post-op, Other, urine output less than 1mL/kg/hour and CVP less than \*\*\*

## IP - Renal Replacement - ICU - Pediatric - Add on [1388]

### ▼ Priming Fluid

- NS infusion Primer 1000 mL  
1,000 mL, Extracorporeal, ONCE, Administer per dialysis circuit
- heparin (porcine) in sodium chloride 0.9 % infusion primer for children 20 kg and greater ⓘ  
Extracorporeal, ONCE, Administer per dialysis circuit
- heparin (porcine) in sodium chloride 0.9 % infusion primer for children less than 20 kg  
Extracorporeal, ONCE, Administer per dialysis circuit

### ▼ Additional Priming Fluid

- albumin human 5 % - For children 10-20 kg  
250 mL, Extracorporeal, ONCE, Prime dialysis circuit before initiating or re-initiating CRRT.
- Nursing Communication - Prime with blood (children less than 10 kg)  
ONE TIME, Additional prime with blood before starting CRRT

## IP - Traumatic Brain Injury - ICU- Pediatric - Admission [2465]

### ▼ IV Fluids

- NS bolus  
IntraVenous, ONCE, Maximum: 1000 mL
- albumin human 5 % bottle  
10 mL/kg, IntraVenous, ONCE
- D5 LR + KCl 20 mEq/1000 mL (premix)  
IntraVenous, CONTINUOUS
- D5 NS + KCl 20 mEq/1000 mL (premix)  
IntraVenous, CONTINUOUS
- LR 1000 mL + KCl 20 mEq  
IntraVenous, CONTINUOUS
- NS + KCl 20 mEq (premix)  
IntraVenous, CONTINUOUS
- heparin (PF) 500 units in 0.9% sodium chloride 500 mL (Arterial Line)  
Intra-Catheter, CONTINUOUS
- heparin (PF) 500 units in 0.9% sodium chloride 500 mL (Central Line)  
Intra-Catheter, CONTINUOUS

## IP - Apheresis - Adult - Procedure [745]

### ▼ Medications

#### ▼ Medications - Apheresis Procedure

- citrate dextrose (ACD) A solution  
1,000 mL, Intra-Catheter, ONCE, 1 dose, today at 1000  
For apheresis procedure
- 0.9% NaCl (premix)  
⚠ 1,000 mL, IntraVenous, CONTINUOUS, Starting today at 1000, Until today at 1759  
For prime and rinse back during apheresis procedure. Bolus 200 mL prn for low blood pressure according to parameters.
- ⚠ calcium infusion
  - calcium gluconate in sodium chloride 0.9 % IVPB  
IntraVenous, ONCE, The calcium dose is based on the total volume of replacement fluid ordered. For calcium gluconate, order 1 gm for every 1 liter of replacement fluid. Infuse over duration of procedure.
  - calcium chloride in sodium chloride 0.9% IVPB  
IntraVenous, ONCE, The calcium dose is based on the total volume of replacement fluid ordered. For calcium chloride, order 0.5 gm for every 1 liter of replacement fluid. Infuse over duration of procedure.
- albumin human 5 % bottle  
3,000 mL, IntraVenous, ONCE, For apheresis procedure
- IP MED DIPHENHYDRAMINE IV OR PO PANEL
- acetaminophen (TYLENOL) tablet  
650 mg, Oral, ONCE, Give 30 minutes prior to apheresis. Maximum dose of acetaminophen is 4000 mg from all sources in 24 hours.
- methylPREDNISolone (Solu-MEDROL) IV  
40 mg, IntraVenous, ONCE PRN, Other, for reaction to apheresis procedure

## IP - Surgery - Oregon Burn Center - Adult - Procedure [557]

### ▼ IV Fluids

#### ▼ OBC Fluid Resuscitation

- Follow OBC Fluid Resuscitation Protocol  
UNTIL DISCONTINUED
- lactated ringers infusion - Adults  
1,000 mL, IntraVenous, TITRATED, Follow OBC resuscitation protocol. Maintenance fluid goal = \*\*\* ml/hr.
- albumin human 5 % bottle  
IntraVenous, CONTINUOUS, Follow OBC resuscitation protocol. Titrate LR and albumin together 1:1 per protocol.
- lactated ringers infusion  
1,000 mL, IntraVenous, CONTINUOUS

## IP - ECMO - Adult - Procedure [2084]

### ▶ Vasoactives and Volume Management

- norepinephrine in 0.9% NaCl (Levophed) 32 mcg/mL 250 mL CENTRAL infusion premix  
0-3 mcg/kg/min, IntraVenous, TITRATED, Starting today at 1000, Until Discontinued  
Initiate infusion at 0.05 mcg/kg/min. Titrate by 0.03 mcg/kg/min every 5 minutes to achieve MAP 65+.
  - norepinephrine  
Missing Weight for dose checking
- albumin human 5 % bottle 12.5-25 g  
12.5-25 g, IntraVenous, EVERY 1 HOUR PRN, Starting today at 0939, Until Discontinued  
For hypotension, administer as bolus over 5-10 minutes; for all other indications, infuse over 1-2 hours  
Other, For ECMO venous chatter
  - albumin human
    - ↑ Daily dose of **300-600 g** (12.5-25 g EVERY 1 HOUR PRN) exceeds recommended maximum of **125 g** by **380%**
    - ↑ Frequency of **24 doses/day** exceeds recommended maximum of **6 doses/day**
    - Missing Weight for dose checking
- metoprolol (LOPRESSOR) injection 2.5-5 mg  
2.5-5 mg, IntraVenous, EVERY 5 MIN PRN, Starting today at 0939, Until Discontinued, Other, for HR > 100 bpm.  
Hold if MAP < 65 mmHg or requiring >0.1 of norepinephrine or HR < 60 beats/min.

## IP - Surgery - Oregon Burn Center - Adult - Postoperative [2319]

### ▼ IV Fluids

#### ▼ OBC Fluid Resuscitation

- OBC Fluid Protocol
- albumin human 5 % bottle  
IntraVenous, CONTINUOUS, Post-op, Follow OBC resuscitation protocol. Titrate LR and albumin together 1:1 per protocol.
- lactated ringers infusion  
1,000 mL, IntraVenous, CONTINUOUS, Post-op

## IP - Apheresis - Pediatric - Procedure [2031]

### ▼ Priming

- 0.9% NaCl (premix)  
Extracorporeal, Administer per apheresis circuit
- Albumin for children 10-20 kg
- Nursing Communication - Prime with blood for children less than 10 kg  
Prime with blood (children less than 10 kg) One time additional prime with start of apheresis
- Nursing Communication - Rinseback Blood Prime
- Nursing Communication - DO NOT Rinseback Blood Prime

## IP - Hemodialysis - Pediatric - Procedure [2555]

### ▼ Medications

#### ▼ Dialyzer Priming

- 0.9% NaCl (NORMAL SALINE) infusion  
1,000 mL, Extracorporeal, ONCE, To prime dialysis pump. FOR DIALYSIS ONLY
- albumin human 5 % bottle  
12.5 g, Extracorporeal, ONCE, To prime dialysis pump. FOR DIALYSIS ONLY
- Neonatal Prepare and Transfuse Exchange RBC

#### ▶ Heparinization

- heparin (PF) 100 Units/mL in sodium chloride 0.9 % (PF) 50 mL IV Syringe  
IntraVenous, CONTINUOUS, Starting today at 1000, Until Discontinued  
**⚠** Administer during dialysis only  
5-25 Units/kg/hr

#### ▼ Blood Pressure Support

- albumin human 5 %  
10 mL/kg, IntraVenous, EVERY 1 HOUR PRN, SBP less than \*\*\* or DBP less than \*\*\* during dialysis. FOR DIALYSIS ONLY, Other, blood pressure support
- albumin human 25 %  
0.5 g/kg, IntraVenous, EVERY 1 HOUR PRN, SBP less than\*\*\* or DBP less than\*\*\* during dialysis. FOR DIALYSIS ONLY, Other, blood pressure support
- NS bolus  
IntraVenous, CONTINUOUS PRN, Other, Blood pressure support
- mannitol 25 % injection  
12.5 g, IntraVenous, EVERY 1 HOUR PRN, for signs/symptoms of dialysis disequilibrium syndrome during dialysis, FOR DIALYSIS ONLY

## IP - Cardiac Surgery - Adult - Postoperative [1616]

### ▼ Fluid Management

- LR (premix)  
500 mL, at 1,000 mL/hr, IntraVenous, EVERY 1 HOUR PRN, Starting today at 0947, Until Discontinued, Administer over 30 Minutes, Post-op  
Alternate LR 500 mL with Albumin 5% 250 mL. Notify LIP when the total of LR and Albumin equal 2000 mL  
Other, Per protocol, Sign and Hold
  - albumin human 5 % bottle 12.5 g  
12.5 g, IntraVenous, EVERY 1 HOUR PRN, Starting today at 0947, Until Discontinued, Post-op  
Alternate LR 500 mL with Albumin 5% 250 mL. Notify LIP when the total of LR and Albumin equal 2000 mL  
Other, Per protocol, Sign and Hold
- ⓘ albumin human**
- ↑** Daily dose of **300 g** (12.5 g EVERY 1 HOUR PRN) exceeds recommended maximum of **125 g** by **140%**
  - ↑** Frequency of **24 doses/day** exceeds recommended maximum of **6 doses/day**
  - ⚠** Missing Weight for dose checking