RECOMMENDATIONS ON THE CARE OF HOSPITALIZED PATIENTS WITH COVID-19 AND KIDNEY FAILURE REQUIRING RENAL REPLACEMENT THERAPY

INTRODUCTION

The Corona Virus Infectious Disease 2019 (COVID-19) was first recognized in December 2019. It is caused by a novel coronavirus structurally related to the virus that causes severe acute respiratory syndrome (SARS). Primary mode of transmission is through droplets and close person-to-person contact. The COVID-19 has caused critical challenges to the public health, research and communities at large. Infectious respiratory pandemics often lead to severe acute respiratory failure and acute respiratory distress syndrome (ARDS) intensive care unit (ICU) admission and ventilator support.

Acute kidney injury (AKI) requiring acute renal replacement therapy (RRT) occurs in approximately 15% of all ICU admissions, but this rate is often increased greatly in the setting of severe respiratory failure and acute respiratory distress syndrome (ARDS). The exact incidence of AKI in patients with COVID-19 is unclear. In addition, patients with ESKD are exceptionally vulnerable to infections and many will require in-hospital care. This document provides general recommendations regarding in-hospital renal replacement therapy (RRT) for patients with COVID-19, and AKI or ESKD. Renal replacement therapy (RRT) should continue to be delivered in a safe and timely manner, while minimizing exposure to the staff, per the expertise of the individual institution.

The available modalities of RRT at most institutions in the US include continuous renal replacement therapy (CRRT), prolonged intermittent renal replacement therapy (PIRRT), intermittent hemodialysis (IHD), peritoneal dialysis (PD) either as continuous ambulatory peritoneal dialysis (CAPD) or automated peritoneal dialysis (APD).

1. PATIENTS WITH AKI AND ESKD IN THE ICU

PATIENT CARE

- If possible, we suggest patients be co-located or cohorted in dedicated ICUs per individual institution’s policies.

- Nephrologists, intensivists, dialysis and ICU staff will follow the CDC recommended PPE and safety guidelines during their interactions with the patient.

- Nephrologists should consider minimizing/avoiding daily patient contact by collaborating with the ICU team and relying on ICU personnel assessment to convey relevant physical exam and ultrasound findings, such as volume status. Each institution may have their own
guidelines to reduce exposure to healthcare providers. Tele-medicine may be instituted at some centers to reduce provider exposure to COVID-19.

- Indications to start RRT are similar to other patients with AKI. Accumulating evidence suggests that a delayed RRT initiation is safe, but this area is controversial. Loop diuretics may be used in the management of volume overload, per treating physician’s discretion.
- If patients develop indications to start RRT (or if an ESRD patient needs a dialysis catheter for vascular access), this will be placed by an ICU provider (or nephrologist) with significant expertise in placement of central venous catheters.

**MANAGEMENT OF RRT IN THE ICU**

- Each institution should use its established RRT practices and equipment to manage COVID-19 patients with AKI and ESRD. Hasty institution of new procedures (e.g. citrate anticoagulation) or methods of CRRT/PIRRT outside of a center’s expertise will likely increase errors that may affect patient safety.
- If available at an institution, the preferred modality for RRT in critically ill patients is CRRT or PIRRT, also known as sustained low efficiency dialysis (SLED) and other terminologies.
- CRRT machines (if available) are preferred over IHD in setting of biocontainment/isolation, as IHD requires 1:1 hemodialysis nursing support.
- In ICUs where ICU nurses are all trained and competent on the use of CRRT, hemodialysis nurses do not need to have direct contact with patients, thereby limiting healthcare staff exposure.
- In institutions where the hemodialysis nurses set up the machine and/or trouble shoots while the ICU nurses run the machine, the dialysis nurse should bring and set up the CRRT machine outside the patient room (or outside the dedicated biocontainment/isolation ICU). Then, the ICU nurse will take the machine into the room and connect the patient in the room in order to minimize exposure, and use of limited PPEs. Ideally, telemedicine (with a camera in the room) should be made available, so that the dialysis nurse or nephrologist can visualize the machine electronically and troubleshoot remotely, instead of entering the room.
- Intermittent hemodialysis (IHD) can also be performed in patients with critical illness, if CRRT and PIRRT equipment are not available.
- Institution specific policies for ordering and providing RRT including modality, dose adjustments, monitoring and therapy transitions should continue to be applied. In most US institutions, nephrologists remain in charge of providing RRT and will be responsible for
providing orders for RRT in a timely manner. At some institutions, ICU physicians are responsible for CRRT initiation and this should be continued per institution practices.

- Patient fluid removal rate will depend on various factors, and may be regulated by ICU physicians, if patients are undergoing CRRT or PIRRT.
- If patient surge overwhelms CRRT capacity at an institution, consideration should be given to using CRRT machines for prolonged intermittent treatments (e.g. 10 hours instead of continuous) with higher flow rates (e.g. 40 - 50 ml/kg/hour) and then using the machine for another patient, after terminal cleaning. Institutional policies.
- For patients with ESKD who have AVF or AVG, CRRT and PIRRT using AVF/AVG could be considered if 1:1 ICU nursing is available and careful monitoring of the patient is possible ([https://www.ncbi.nlm.nih.gov/pubmed/28295984](https://www.ncbi.nlm.nih.gov/pubmed/28295984)). Needle dislodgement and exsanguination is a major concern, and we emphasize the need for close monitoring if PIRRT and CRRT are performed using AVG or AVF.
- Due to cancelation of elective procedures, non-acute care and non-dialysis nurses may be recruited to monitor patients undergoing RRT, with the supervision of an ICU or dialysis nurse. HOWEVER, this should be under the purview of individual institutional policy.

2. PATIENTS WITH AKI AND ESKD IN THE GENERAL HOSPITAL FLOORS

**PATIENT CARE**

- Patients will be co-located or cohorted on a particular floor per each institution’s policies.
- **Nephrologists, dialysis and ICU staff will follow the CDC recommended PPE and safety guidelines during their interactions with the patient.**
- Nephrologists should consider minimizing/avoiding daily patient contact by collaborating with primary physician (most probably a hospitalist) and relying on them to convey relevant physical exam and ultrasound findings, such as volume status. Each institution may have their own guidelines to reduce exposure for the caregivers. Tele-medicine will be instituted at some centers to reduce exposure for the providers.
- Indications to start RRT are similar to other patients with AKI. Accumulating evidence suggests that a delayed RRT initiation is safe, but this area is controversial. Loop diuretics may be used in the management of volume overload, per treating physician’s discretion.
• If patients develop indications to start RRT (or if an ESRD patient needs a dialysis catheter for vascular access), this will be placed by a physician with the most expertise in placement of central venous catheters. This may involve general surgery or radiology consultation.

MANAGEMENT OF RRT IN NON-ICU PATIENTS

• Generally, patients with AKI or ESKD who are not admitted to the ICU are transported to a central acute dialysis unit for treatment. **This is NOT recommended** in the setting of active or suspected COVID-19.

• If hospitals are utilizing individual negative pressure rooms to take care of COVID-19 patients, then they will need 1:1 hemodialysis nursing for IHD in their rooms.

• If hospitals have isolated all COVID-19 patients in one floor, then one dialysis nurse may be able to monitor 2 or 3 patients during IHD, if video and electronic monitoring is available in the IMMEDIATE vicinity. The nurse will enter the room for trouble shooting the machine or if the patient needs assistance.

• In order to minimize exposure to dialysis staff, other equipment can be utilized to provide therapy on the hospital floor. Certain CRRT machines allow multiple 5-L bags of fluid to be hung simultaneously and have an effluent drainage lines. If such equipment is available at institutions, dialysis nurses can set these up in individual patient rooms in the hospital floor where COVID-19 patients are cohorted and then monitor multiple patients from a central location in the unit itself. This can be performed in lieu of doing 1:1 intermittent HD. This set-up can be utilized for both ICU and non-ICU patients.

• Due to cancelation of elective procedures, non-acute care and non-dialysis nurses may be recruited to monitor patients undergoing RRT, with the supervision of an ICU or dialysis nurse. HOWEVER, this should be under the purview of individual institutional policy.

• For patients with ESKD undergoing PD at home, PD can be continued as APD, to reduce exposure of the nursing staff. If volume control cannot be maintained with PD, then patient may need a temporary hemodialysis catheter placement and transitioned to IHD or CRRT.

3. **STAFFING AND PERSONNEL**

• Per institutional guidelines, trainees (fellows, residents, medical students) may be prevented from taking care of patients with COVID-19. Attending nephrologists should follow institutional and ACGME recommendations regarding trainee exposure. If patient surge results in need for more personnel, sub-specialty trainees may need to help care of the COVID-19 patients. This decision will be made at the institutional level.
• Institutions will need to consider getting additional staff trained on RRT equipment as patient surge may overwhelm dialysis-staffing capacity, especially if dialysis staff also become infected with COVID-19. If RRT is contracted out to external agencies, the medical director and institution will need center-specific protocols to address staffing capacity in the setting of patient surge.

4. CARE AND DISINFECTION OF THE RRT EQUIPMENT

• CRRT filter changes can be performed every 72 hours or at longer intervals per institution protocols.
• After treatment, dialysis equipment should be cleaned with a disinfectant from the EPA List N (see below) per CDC and manufacturer’s recommendations. The equipment should be disinfected before removed from the room. Some institutions make require additional cleaning before machine can be used for another patient.
• All disposable RRT machine equipment (tubing/filter sets, CRRT solutions bags, etc.) should be discarded as directed by hospital infection control & policy.
• Further guidance regarding RRT Machine disinfection AND approved disinfection cleaning products for COVID-19 can be found at the CDC and EPA (List N) websites noted below:

   https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2

Note: Contributor disclosures may be found at this link: https://wwwASNOnline.org/g/blast/files/Disclosures_AKI_Recommendations_03.20.2020.pdf

REFERENCES

Scope of Committee – Review current evidence and outline treatment guidelines and protocols for the provision of acute hemodialysis for critically ill patients during a respiratory pandemic (i.e. 2020 COVID-19 & others).

*** Respiratory pandemics are rapidly evolving situations (as is the case with COVID-19). This document and the policies & procedures contained will require revisions and evolve throughout the course of a respiratory pandemic.***

Introduction:

Infectious respiratory pandemics often lead to a high-burden of severe acute respiratory failure and acute respiratory distress syndrome (ARDS) requiring invasive life support and intensive care unit admission and resources. Acute kidney injury (AKI) requiring acute renal replacement therapy (RRT) – often referred to as dialysis-dependent AKI (AKI-D) – occurs in approximately 15% of all ICU admissions, but this rate is often increased greatly in the setting of severe respiratory failure and acute respiratory distress syndrome (ARDS).

For example, during the current 2019-2020 SARS-CoV-2 pandemic, approximately 6-8% of all cases have required ICU-level of care. Reports have been highly variable, but some reports suggest that AKI-D has occurred in up to ~20-30% of critically ill patients with COVID-19. ICU patients with AKI-D have an increased risk of death with up to 50% mortality rate. It is unclear to the extent that AKI-D modifies mortality risk in COVID-19.

Purpose:

The purpose of this document & work-group is to describe, standardize, & harmonize guidelines, procedures, and practices surrounding the provision of Acute RRT therapies in the ICUs of Emory Healthcare (EHC) during a respiratory pandemic.

Guiding Principles:

1. Critically ill patients with acute respiratory failure and ARDS during a respiratory pandemic are labor and resource intensive.

2. RRT is a limited resource – in a respiratory pandemic surge, RRT plans in ICUs may have to be adapted to serve the greatest good to the greatest number of patients and rationing of RRT resources may be required (i.e. patients receiving less aggressive, less frequent, or shorter duration treatment sessions so as to maximize the number of patients that can be treated).
3. Provision of RRT will impact every member of the multi-disciplinary ICU care team (i.e. nursing, respiratory therapy, patient care technicians/assistants, physicians, advanced practice providers, pharmacists, dieticians, and therapists).

4. Members of the multi-disciplinary ICU care team will likely be experiencing physical, emotional, and moral distress, and they will need additional support and resources. The addition of RRT to a patient will further introduce several challenges to the team.

5. Policies and protocols for ICU RRT in a respiratory pandemic are & must be designed to minimize risk:
   A. to patients (i.e. care delivery errors)
   B. to staff (i.e. staff contamination)
   C. to the wider hospital community (i.e. unnecessary staff entry/exposure to patient care areas).

6. In a respiratory pandemic critical-illness ICU surge situation, EHC will likely employ 1 of 2 ICU admission/census strategy (see Table 1):

**TABLE 1**

<table>
<thead>
<tr>
<th></th>
<th>ICU Cohort Strategy</th>
<th>ICU Room Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location of pandemic ICU patients</strong></td>
<td>Co-locating / cohorting of all suspected &amp; confirmed pandemic patients in specific ICUs at the ICU level</td>
<td>Certain ICU rooms in the hospital designated for suspected or confirmed pandemic patients</td>
</tr>
<tr>
<td><strong>Location of non-pandemic ICU patients</strong></td>
<td>Non-pandemic patients are excluded from designated pandemic ICU</td>
<td>Non-pandemic patients are co-located in any given ICU with pandemic patients</td>
</tr>
<tr>
<td><strong>PPE zone</strong></td>
<td>Entire pandemic ICU may be designated a PPE zone in which PPE would be worn at all times while in the ICU (per hospital infection control guidelines &amp; recommendations)</td>
<td>PPE zone is at the patient room level. The rest of the ICU is not considered PPE zone (i.e. it is not contaminated)</td>
</tr>
<tr>
<td><strong>PPE don/doff</strong></td>
<td>Don occurs prior to entering the designated ICU</td>
<td>Don occurs prior to entering the individual pandemic patient room</td>
</tr>
<tr>
<td></td>
<td>Doff occurs as leaving the designated ICU</td>
<td>Doff occurs as leaving the individual pandemic patient room</td>
</tr>
</tbody>
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7. **Surface disinfection of RRT machines** (i.e. Prismaflex/Prismax CRRT machines) and other ICU related durable medical equipment (ventilators, IV pumps, ultrasound machines, etc) occurs in standard practice in ICUs between patients use and will still be required in a respiratory pandemic surge.
**Acute RRT Modality**

Continuous renal replacement therapy (CRRT) or prolonged intermittent RRT (PIRRT) are the most common modality of RRT provided for AKI in US ICUs. CRRT and PIRRT have advantages over intermittent hemodialysis (IHD) for critically ill patients especially in that CRRT & PIRRT induce less hypotension or hemodynamic instability, provide superior removal of fluid and resolution of fluid overload, and are well tolerated in general.

In EHC ICUs, CRRT is the dominant modality of RRT provided. All ICU bedside nurses are trained and competent in providing CRRT independently.

**Practice Guideline:**

1. Throughout EHC, **CRRT machines are the preferred machine for acute RRT in biocontainment/isolation situations**
   
   a. CRRT machines can provide both CRRT and/or hybrid hemodialysis prolonged intermittent RRT (PIRRT)
   
   b. ICU RNs at EHC are all trained and competent on the use of CRRT → no additional Hemodialysis RNs must thus be exposed to patient for provision of RRT
   
   c. CRRT machines sequestered in a pandemic biocontainment/isolation ICU can be used on all patients in that given location with using standard disinfection techniques after a given patients use (see more below in Infection Control section)

2. Both CRRT and/or PIRRT (using a CRRT machine for 8-12 hrs per day) may be prescribed for patients in the biocontainment/isolation ICU.

3. In a large surge situation, as CRRT machines are limited, PIRRT use for may increase as a means to provide sufficient RRT treatments for a higher number of AKI-D patients

4. Intermittent hemodialysis (IHD) may be employed as a **second-line option**.
   
   a. IHD requires dedicated Hemodialysis RNs 1:1 to manage and deliver dialysis. This exposes additional staff to the infected patients and isolation environment
   
   b. IHD also requires sufficient water and drain resources with high water pressure/flow rates to generate dialysate. These water resources may not be available in all biocontainment/isolation environments/locations. CRRT devices only requires a drain/toilet location.

**Timing of Initiation of Acute RRT**

Clear data on the optimal timing for initiation of dialysis for AKI in critically ill patients remains elusive. Death from AKI is most commonly due to complications of AKI – hyperkalemia, acidemia, and fluid/volume overload. Acute RRT is recommended in AKI to control, prevent, or manage the complications of AKI

**Practice Guideline:**

1. Nephrology, critical care medicine, bedside nursing, and patient/surrogate decisions makers should **collaborate** regarding the decision of if & when to start renal replacement therapy.
2. Nephrology, critical care medicine, and bedside nurse should collaborate daily to decide on the daily goal(s) for acute RRT

**Acute RRT orders**

**Practice Guideline:**
1. The nephrology attending/team remains the primary providers of acute RRT
2. The nephrology attending/team has responsibility for entering, maintaining, and communicating all RRT-related orders
3. Critical care medicine & nephrology should collaborate on fluid management targets
4. Critical care medicine is NOT to adjust CRRT effluent/therapy fluid flow rates independently but may be empowered by the nephrology team to adjust fluid removal targets.

**CRRT Anticoagulation**

COVID-19 infection seems to induce a *hypercoagulable state* and CRRT circuit clotting has been occurring frequently.

**Practice Guideline:**
1. Anticoagulation is required
2. Follow CRRT Anticoagulation Guidelines (Figure)

**CRRT Anticoagulation Guidelines – COVID-19**

**Goal:** Maximize CRRT circuit survival in any patient running continuously to max 72 hrs

**Regional Citrate Anticoagulation**
- Standard EHC Citrate CRRT Protocol

**Low-standard Therapeutic Heparin**
- Infuse *via pre-filter pigtail catheter* on CRRT machine
- Measure heparin levels *from patient* & adjust to based on heparin level target
- Stop citrate protocol

**Direct Thrombin Inhibitor**
- Argatroban preferred
- Bivalirudin alternative
- Infuse *via systemic IV*
- Adjust by PTT levels
- Stop heparin infusion

**Daily Patient-centered rounds**

In biocontainment/isolation settings, EHC policy is that direct access/contact with patient should be limited to only those immediately necessary. Thus, in order to minimize staff contamination risk, only providers performing an essential task requiring direct patient access should the biocontainment/isolation environment (ICU or patient’s room depending on hospital strategy).

Physical exams will be performed by a qualified provider at least once daily and findings shared with all consultant services (i.e. nephrology). Thus, nephrology consultants should not enter the

*Last updated: 4/6/2020*
biocontainment/isolation unit (or room) for rounds every day. Much of the care can be provided at a designated remote facility outside of the biocontainment facility or patient room.

**Practice Guideline:**
1. Multi-disciplinary rounds (to include nephrology team, critical care medicine, bedside ICU RN (or nursing representative), and ICU clinical pharmacist should occur at least once daily (preferably in the morning) for all patients receiving RRT.

2. Daily AM Rounds should review physical exam findings, fluid balance, daily weight, pertinent labs/medications, CRRT system performance, etc for each patient receiving RRT

3. RRT-specific goals should be established for each patient, communicated to bedside RN, medication dosing adjusted (as needed), and orders updated (as needed) for each patient receiving RRT

**Dialysis vascular access:**

Nephrology, critical care medicine, interventional radiology, surgical services, and others all have expertise to insert dialysis vascular catheters.

**Practice Guideline:**
1. To minimize exposure/contamination risks, critical care medicine will the primary team responsible for insertion and maintenance of all central venous lines (including non-tunneled temporary dialysis vascular catheters) in biocontainment/isolation environments/ICUs

2. For IJ or subclavian dialysis catheters, the goal is for the tip of the catheter to reach the right atrium or caval-atrial junction.

**EHC Acute Dialysis Vascular Access: Catheter Guidelines**

<table>
<thead>
<tr>
<th>Patient Height: 170-200cm (5'4&quot; – 6'5&quot;)</th>
<th>Catheter Length for Patient Height: &lt; 170 OR &gt; 200cm</th>
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<tbody>
<tr>
<td><strong>1st preference: RIGHT IJ Vein – 20cm 14F dual lumen</strong></td>
<td><strong>RIGHT IJ Vein = (Hgt (in cm) / 10) + 1-2cm</strong></td>
</tr>
<tr>
<td>Tip in RA or caval-atrial junction</td>
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<td><strong>GOAL:</strong> Tip in RA or caval-atrial junction</td>
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| **2nd preference: LEFT IJ vein – 24cm 14F dual lumen** | **LEFT IJ vein = (Hgt (in cm) / 10) + 4-5cm** |
| Tip in RA or caval-atrial junction     | Tip in RA or caval-atrial junction 14F Dual Lumen |
| Alternative 13F 24cm Trialyxis catheter | Alternate: 13F 24cm Trialyxis catheter |

| **RIGHT or LEFT Femoral Vein – 24cm 14F dual lumen** | **RIGHT or LEFT Femoral Vein – 24cm 14F dual lumen** |
| (alternate: 24 or 30cm 13F Trialyxis catheter) | (alternate: 24 or 30cm 13F Trialyxis catheter) |
| Shallow angle of insertion | Shallow angle of insertion |

| **Subclavian Vein - 14F dual lumen** | **Subclavian Vein - 14F dual lumen** |
| R SCV = 20cm; L SCV = 24cm | R SCV = 20cm; L SCV = 24cm |
| Tip in RA or caval-atrial junction | Tip in RA or caval-atrial junction |
CRRT Machine Disinfection

Disinfection of dialysis machines will be required whenever a given patient is finished using that equipment. This occurs as part of standard ICU practice in non-pandemic situations. In usual practice, dialysis machines (including CRRT machines) receive a surface disinfection with appropriate disinfecting wipes after all disposable material has been removed and appropriately discarded.

**Practice Guideline:**

1. Per CDC guidance, following CRRT machine use on a patient with SARS-CoV-2 (COVID-19) infection, the CRRT machine should undergo disinfection with a rigorous surface cleaning & disinfection using the “Sani-Cloth Germicidal Wipes” (PURPLE Top) [EPA Reg. # 9480-4] with a 2 minute wet contact time on all readily-accessible machine surfaces.
   a. If any EHC facility is NOT stocking/using the “Sani-Cloth Germicidal Wipes” (PURPLE Top) disinfection wipes, then that institution **must** select and use an alternative EPA-registered, hospital-grade disinfectant product that has qualified under the EPA’s emerging viral pathogens program (EPA List N) for use against SARS-CoV-2 (https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2)

2. Per CDC guidance, following step 1 (rigorous surface cleaning), **no additional terminal disinfection procedure is required** for CRRT machines prior to exiting a COVID-19 room or dedicated COVID-19 ICU.

3. **TABLE 2** describes RRT Equipment Disinfection procedures

### TABLE 2 – RRT Equipment Disinfection

<table>
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<tr>
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<th>ICU Cohort Strategy</th>
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<tr>
<td><strong>At end of RRT session</strong></td>
<td>All disposable RRT machine equipment (tubing/filter sets, CRRT solutions bags, etc) should be discarded as directed by hospital infection control &amp; policy.</td>
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<td><strong>RRT Machine Disinfection</strong></td>
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<td></td>
<td><strong>No additional disinfection steps required prior to use on next pandemic patient.</strong></td>
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</table>

**No additional disinfection steps required before machine can:**
- leave pandemic patient’s room
- move to another patient’s room
- used on a different pandemic or non-pandemic patient
Further guidance regarding RRT Machine disinfection AND approved disinfection cleaning products for SARS-CoV-2 (COVID-19) can be found at:

CRRT Supply Chain

**Practice Guideline:**
1. EHC Supply Chain Management will be responsible for maintaining sufficient supply of disposable CRRT supplies (filter/tubing sets, effluent bags, CRRT solutions)
2. Central Supply & central pharmacy should review with the biocontainment/isolation ICU at least twice per day which CRRT solutions and supplies require restocking AND deliver required supplies promptly.
3. To minimize contamination risk in the hospital, it is NOT recommended that the staff from the biocontainment/isolation ICU retrieve supplies themselves from central supply

COVID-19 Pandemic 2020 Committee Members:

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- Mardi Davis
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- Sarah Nicholls
Quick Reference – Improving CRRT Circuit Performance (COVID+ Patients)
Pandemic RRT & RRT Surge Committee

1. **Excellent CRRT access is of paramount importance**
   - ensure dialysis vascular access appropriate length & tip at desired depth

### EHC Acute Dialysis Vascular Access: Catheter Guidelines

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<td><strong>Alternative: 13F Trialysis catheter</strong></td>
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<table>
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<th><strong>RIGHT or LEFT Femoral Vein – 24cm 14F dual lumen</strong></th>
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<tr>
<td>(alternate: 24 or 30cm 13F Trialysis catheter)</td>
</tr>
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</tr>
</tbody>
</table>

2. **CRRT anticoagulation is required** in COVID+ patient (unless contraindicated)

### CRRT Anticoagulation Guidelines – COVID-19

**Goal:** Maximize CRRT circuit survival in any patient running continuously to max 72 hrs

**Regional Citrate Anticoagulation**
- Standard EHC Citrate CRRT Protocol

**Infuse via pre-filter pigtail catheter on CRRT machine**
- Measure heparin levels from patient & adjust to based on heparin level target
- Stop citrate protocol

**Low-standard Therapeutic Heparin**
- Argatroban preferred
- Bivalirudin alternative
- Infuse via systemic IV
- Adjust by PTT levels
- Stop heparin infusion

**Direct Thrombin Inhibitor**

Last updated: 4/6/2020
Emory Healthcare
Renal Replacement Therapy Surge Plan

EHC RRT Surge Planning Committee
Last Update Date: 4/6/2020

EHC RRT Surge Planning Committee

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- William Bender
- MaryBeth Sexton
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Renal Replacement Therapy (RRT) During ICU Surge Situation

**Background**
- RRT is commonly required life-support tool for critically ill ICU patients
  - 15-30% ICU patients require RRT
- Multiple methods to provide RRT
  - All methods effective when used appropriately

**Challenge**
- RRT is a finite resource due to limitations in:
  - Machines
  - Supplies
  - Personnel depending on the type of RRT performed
- Surge in ICU census → surge RRT needs

RRT Surge Plan

**Goal:**
- Use multiple methods of RRT to maximize # of patients who can receive appropriate RRT to meet their individual support needs.
- Equitable distribution and utilization of RRT resources to provide benefit to the most patients.

**Challenge:**
- Develop resource distribution systems to meet this goal.
  - Staffing
  - Supply chains
  - Machine use → when machines are limited, system to minimize machine down-time
Acute RRT Options in ICU

**CRRT – 24h**
- Prismaflex CRRT machine
- 24hr continuous RRT
- Work force = ICU RNs

**Shift-based CRRT**
- Prismaflex CRRT machine
- 10-12 hr RRT sessions
- Work force = ICU RNs

**PIRRT/SLED**
- Conventional HD machine
  - or Tablo®
- 6-8 hr RRT sessions
  - Usually overnight
- Work force = collaborative:
  - HD RNs: set-up, start, & terminate HD
  - ICU RN: monitors & calls HD RN for issues

**Intermittent Hemodialysis (IHD)**
- Conventional HD machine
- 3-4 hr RRT sessions
- Work force = Hemodialysis RN

**Peritoneal Dialysis (PD)**
- 2 Options:
  - Continuous treatments (CAPD)
  - Automated PD (APD)
- CAPD: exchanges q3-4 hrs, 24 hrs/day by ICU or general ward RN
- APD: HD RN sets up & starts APD session lasting 10-12 hr
**EHC: Pandemic ICU RRT Surge Plan**

**Plan A: Conventional Operations**
- 24h CRRT
- IHD if when clinically indicated
- CRRT preferred to decrease exposure of additional RNs needed for HD

**Plan B: Machine Load Balance**
- 24h CRRT
- IHD only if clinically indicated
- Intermittently move CRRT machines between EHC institutions as load balance needed
- CRRT preferred to decrease exposure of additional RNs needed for HD

**Plan C: Mixed CRRT Duration**
- Mix of CRRT-24h & shift-based CRRT based on clinical needs of patient
- Some CRRT machines will perform RRT on 2+ patients per day
- IHD only if clinically indicated
- CRRT machine use preferred to decrease exposure of additional RNs needed for HD

**Plan D: Mixed CRRT + HD/SLED**
- Mix of CRRT-24h & shift-based CRRT based on clinical needs of patient
- Some CRRT machines will perform RRT on 2+ patients per day
- Overnight SLED with HD machines
- IHD as soon as clinically appropriate

**Plan E: CAPD + all hemoRRT**
- Acute bed-side PD catheter insertion & CAPD
- Sedated/mech vented COVID+ patients
- Mix of CRRT-24h & shift-based CRRT based on clinical needs of patient
- Overnight SLED with HD machines
- IHD as soon as clinically appropriate

**Determinant of RRT Surge Plan**

**Plan A: Conventional Operations**
**Plan B: Machine Load Balance**
**Plan C: Mixed CRRT Duration**
**Plan D: Mixed CRRT + HD/SLED**
**Plan E: CAPD + all hemoRRT**

Total # of Patients needing ICU RRT
RRT Surge Plan: contingency vs crisis

Contingency Plans/Mode

Plan A: Conventional Operations

Plan B: Machine Load Balance

Plan C: Mixed CRRT Duration

Plan D: Mixed CRRT + HD/SLED

Plan E: CAPD + all hemoRRT

Risk of errors

Disposable Supplies & Machines

Crisis Plans/Mode

No significant new risks

Supply Chains Intact

Staffing Intact (generally)

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RRT Surge Plan – EHC Current State (4/6/20)

Current Location

Contingency Plans/Mode

Plan A: Conventional Operations

Plan B: Machine Load Balance

Plan C: Mixed CRRT Duration

Plan D: Mixed CRRT + HD/SLED

Plan E: CAPD + all hemoRRT

Crisis Plans/Mode

Total # of Patients needing ICU RRT
Plan A – Conventional Operations

**Challenges**
- No specific new challenges
- Enough machines & disposable supplies to meet ICU RRT demands with 24h CRRT & IHD
- Usual challenges:
  - ICU RN & HD RN staffing
  - Adequate distribution of supplies including filters, CRRT solutions, citrate/calcium availability

**Pandemic Surge Preparations**
- Plan adapted for pandemic isolation needs
- Prefer CRRT use to minimize additional staff exposures to isolation environment
  - HD RN to deliver IHD
- IHD may continue in ICUs
  - Facilitate liberation from CRRT for PT/OT
  - ESRD patient with native AVF/AVG

Plan B – Machine Load Balance

**Surge Challenge**
- Surge of patient at a given EHC facility → do not have enough machines to meet demand at a given facility
- Supply chains intact:
  - RRT supplies come from EHC offsite warehouse → easy to increase deliveries to meet demand
- Limited staffing impact

**Pandemic Surge Preparations**
- Move RRT machines periodically between EHC institutions to meet RRT demands
- Coordination between:
  - Biomedical engineering departments
  - Clinical leadership teams
  - Asset administration
  - Movers
  - Others
- Takes time to implement
Plan C – Mixed CRRT Durations

**Challenges**
- **Unable to meet RRT demands**
  - # of ICU RRT pts > CRRT machines
- **Different patients will require different RRT plans**
  - One shift-based RRT plan will not fit all
- **Highly complex to orchestrate**
  - Matching available machines to appropriate pts
  - Complex scheduling

**Surge Preparations – Needs**
- Operational expertise to implement
- Daily CRRT machine deployment schedule
  - Staff to develop deployment schedule
- Staff to orchestrate machine deployment
- Appropriate RRT orders to match plan

Plan D – Mixed CRRT + HD/SLED

**Challenges**
- **Unable to meet RRT demands**
  - # of ICU RRT pts > CRRT machines (even with shift-based CRRT implementation)
- **Will have to more widely use HD machines & HD RNs for ICU HD & SLED**
  - HD RN staffing impact \(\rightarrow\) ? less non-ICU HD
- **Highly complex to orchestrate**
- **ICU RNs unfamiliar with HD equipment**

**Surge Preparations – Needs**
- New machine: Tablo\textsuperscript{®} – 10 have been ordered
- EHC Fresenius HD Machines: require chip upgrade to perform SLED
- Operational expertise to implement
- Daily CRRT & HD machine & staff deployment schedule \(\rightarrow\) staff needed to develop schedule & orchestrate deployments
- SLED: Overnight HD RN(s) to set-up, initiate, terminate HD sessions & to make rounds while patients are running on SLED.
Plan E – CAPD & all HemoRRT

**Challenges**

- Unable to meet RRT demands
  - # of ICU RRT pts > CRRT + HD machine + staff availability

- ICU RNs CAPD educational needs
  - CAPD performed rarely in EHC ICUs

- Bed-side PD catheter insertion → surgeons

- CAPD charting

**Surge Preparations – Needs**

- Identifying & train surgeon partners
- RN training for and delivery of CAPD versus
  - HD RN performing APD with limited ICU RN involvement
- Continue need for CRRT & HD machine & staff deployment program/resources

- Determine supplies for CAPD & purchase soon
  - Surgeons’ & nephrologists’ preferred PD catheter
  - Disposable supplies for PD exchanges
  - PD solutions

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**ICU RRT for ESRD Patients**

- During pandemic, RRT for ICU patients with ESRD should be guided by:
  1. Patients preferred outpatient dialysis method
     - HD via AVF/AVG
     - HD via Permcat (PC)
     - PD
  2. Native dialysis vascular access
  3. Clinical condition

- **Native AVF/AVG**: preference is HD via AVF/AVG unless too hemodynamically unstable
- **Native PC**: HD via PC or CRRT-24h/CRRT-shift via PC
- **PD**: PD
RRT Surge Plan

Ethical Considerations

- No strong data that 1 method of RRT is clearly superior to another
  - When prescribed & performed well, all methods of RRT are effective at achieving patient-centered goals (correction of acid-base or electrolyte disorders, fluid management goals, etc)

- Provided EHC can provide appropriate RRT to meet a patient's needs, then there are little (if any) ethical implication of any of these techniques

- Ethical issues arise if/when we do not have the supplies or capacity to meet a given patient’s needs
Summary

- System-wide RRT surge plan is **required**

- System-wide expertise will be needed to operationalize & implement any RRT surge plan
  - MDs, APPs
  - RNs & staff
  - Educators
  - Administrative leadership
  - Administrative expertise
  - Supply Chain Management

**ACUTE RRT IS A TEAM SPORT**