Patient Safety and Quality Measures for CRRT: The UAB Experience

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Quality Healthcare

- Quality is the extent to which health services for individuals and populations increase the likelihood of desired health outcomes are consistent with current professional knowledge (Institute of Medicine)

- Meeting the needs and expectations of patients and other customers with a minimum of effort, re-work, and waste (Berwick)
What are the technical goals of CRRT?

Volume control
Metabolic control
Solute clearance
Continuous therapy

Quality Indicators:
SAFE
COST-EFFECTIVE
DECREASED LABOR
The CRRT challenge.

- Key components of delivering CRRT to the patient:
  - 1. Ordering CRRT prescription ➔ PHYSICIAN
  - 2. Fluids and anticoagulation for CRRT ➔ PHARMACY
  - 3. Operation of CRRT device ➔ NURSE
UAB Fun Facts...

- 908 Bed Tertiary Care Center
- 8 ICUs
- > 130 ICU bed
- 500 + ICU RNs
Current CRRT Program

- 25 Prismaflex Machines
- Mode: CVVHDF
- Dialyzer: AN69 M100
- Blood Flow: 100-200 ml/min

- Anticoagulation
  - Citrate
  - None

- Fluids
  - Commercial
  - Customized
The UAB Model

- CRRT run by the nephrology acute consult service
- Dialysis Services are outsourced at UAB.
- The dialysis RN is responsible for initial set-up
  - Serves as in-house resource 24/7
- ICU RN is responsible for trouble-shooting and monitoring
- This model ensures we have 24/7 expert available and safety net for all CRRT patients
## UAB CRRT Program Growth

<table>
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<th>Year</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<td>18</td>
<td>18</td>
<td>19</td>
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<tr>
<td>Approx. Patient-days</td>
<td>___</td>
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<td>2,342</td>
<td>3,248</td>
<td>2,757</td>
<td>2,859</td>
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<td>3,251</td>
<td>3,866</td>
<td>4,581</td>
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<td>Average Number of Patients</td>
<td>___</td>
<td>323</td>
<td>355</td>
<td>400</td>
<td>359</td>
<td>385</td>
<td>444</td>
<td>460</td>
<td>504</td>
<td>553</td>
<td>588</td>
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<tr>
<td>Approx Days/Patient on CRRT</td>
<td>___</td>
<td>7.4</td>
<td>6.6</td>
<td>8.1</td>
<td>7.7</td>
<td>7.4</td>
<td>7.8</td>
<td>7.1</td>
<td>7.7</td>
<td>8.3</td>
<td>8.5</td>
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Delivery of CRRT to the Patient
Role of the Nephrologist
Role of the Nephrologist

- **CRRT Prescription**
  - Computerized order sets for CRRT

- **Education**
  - Fundamental CRRT lectures yearly
  - CRRT UAB Primer
CVVHDF ORDER SET

1. UNIT: _________________
2. Device: Prismaflex, Membrane M100 pre-pump infusion set
3. Record on CRRT flowsheet: pressure, flow rate, and CRRT fluid balance every hour
4. □  Heparin (10,000 units/ml) inject 10,000 units prn. Instill each dialysis catheter port with 5000 units of heparin mixed with 1 cc NS (for a total of 1.5cc in each port) if patient becomes disconnected.
   □  Alteplase injection (2mg/ml for open cath), 4ml instill prn. Instill each port with 1.5cc if patient becomes disconnected (HIT patients)
5. Dialysis catheter care: change sterile dressing once a day.
6. Notify the CRRT nurse if the unit becomes disconnected. Any questions please call the CRRT nurse or the nephrology fellow on call
   □  Normal Saline 1000ml. Prime with 2L of NS. Dialysis nurse to administer. (HIT patients)
8. □  Blood Flow Rate:
   200 ml/hr or __________ ml/min
9. □  Fluid removal Rate __________ ml/hr
10. □  Place patient on Prismaflex Warmer
Anticoagulation

Non citrate anticoagulation

- Pt receiving systemic a/c per primary team or no a/c needed
  - Heparin syringe pump with 0.9% saline

Citrate anticoagulation

- MD to nurse: Patient is to be started on CRRT with citrate in the replacement fluid
  - Check Chem10 q6hrs
  - Call Fellow if bicarbonate is <15 or >35 mEq/L
  - Please obtain both patient (systemic) and CRRT blue port ionized calcium levels
    - Check ionized calcium from the patient 1hr after start and then q6hrs
    - Call fellow if ionized calcium from the blue port is >0.5 mMol/L
    - Notify the fellow if the systemic ionized calcium is <0.9 or >1.3 mMol/L
Replacement fluid

Non citrate a/c

☐ **Standard 22 Bicarbonate Dialysate Solution (5L)**

Bicarbonate 22mEq/L, Potassium 4mEq/L; Final Concentration: Na 140mEq/L, K 4mEq/L, Cl 120.5mEq/L, Mg 1.5mEq/L, HC03 22mEq/L, Lactate 3mEq/L and Glucose 110mg/dL

☐ **High 32 Bicarbonate Dialysate Solution (5L)**

Bicarbonate 32mEq/L, Potassium 4mEq/L; Final Concentration: Na 140mEq/L, K 4mEq/L, Cl 113mEq/L, Mg 1.5mEq/L, HC03 32mEq/L, Lactate 3mEq/L, Calcium 2.5mEq/L, and Glucose 110mg/dL

☐ **High 35 Bicarbonate, 0 Potassium Dialysate Solution (5L)**

Bicarbonate 35mEq/L, Potassium 0mEq/L; Final Concentration: Na 140mEq/L, K 0mEq/L, Cl 109mEq/L, Mg 1.0mEq/L, HC03 35mEq/L, Lactate 0 mEq/L, Calcium 3.0 mEq/L, and Glucose 110mg/dL

☐ **Flow rate of replacement fluid**

_____________ ml/hr

Citrate anticoagulation

Trisodium Citrate 0.5% replacement solution (4L)

☐ **Final Concentration: Na 140mEq/L, Cl 89mEq/L, Citrate 17mmol/L**

☐ **Flow rate of replacement fluid**

_____________ ml/hr
Dialysate fluid

Non citrate a/c

- **Standard 22 Bicarbonate Dialysate Solution (5L)**
  - Bicarbonate 22mEq/L, Potassium 4mEq/L
  - Final Concentration: Na 140mEq/L, K 4mEq/L, Cl 120.5mEq/L, Mg 1.5mEq/L, HC03 22mEq/L, Lactate 3mEq/L and Glucose 110mg/dL

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- **High 35 Bicarbonate, 0 Potassium Dialysate Solution (4L)**
  - Bicarbonate 35mEq/L, Potassium 0mEq/L
  - Final Concentration: Na 140mEq/L, K 0mEq/L, Cl 109mEq/L, Mg 1.0mEq/L, HC03 35mEq/L, Lactate 0 mEq/L, Calcium 3.0 mEq/L, and Glucose 110mg/dL

- **Flow rate of dialysate fluid _____________ ml/hr**

Citrate a/c

- **Standard 22 Bicarbonate Dialysate Solution (5L)**
  - Bicarbonate 22mEq/L, Potassium 4mEq/L
  - Final Concentration: Na 140mEq/L, K 4mEq/L, Cl 120.5mEq/L, Mg 1.5mEq/L, HC03 22mEq/L, Lactate 3mEq/L and Glucose 110mg/dL

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- **Flow rate of dialysate fluid _____________ ml/hr**
Ca gtt orders:

- **Calcium gluconate drip**
  - Add 10 amps of calcium gluconate to 1L of 0.9% saline. Final calcium concentration 93mEq/L
  - Flow rate at 60ml/hr or _____________ ml/hr

- **Titration of the calcium gluconate drip:**
  - Check patient (systemic) ionized calcium q6hrs
  - Ionized calcium >1.3 mMol/L then decrease flow by 10 cc/hr. Ionized calcium 0.9 to 1.3 mMol/L, no change. Ionized calcium 0.8 to 0.9 mMol/L increase drip by 10cc/hr. Ionized calcium < 0.8 mMol/L increase drip by 20cc/hr and call fellow.
Delivery of CRRT to the Patient - Role of the Pharmacist
Pharmacy Challenges: Increased Workload

1. Variable replacement and dialysate solutions

2. Issues with delivery of solutions and ICU organization

3. Medication errors
Challenges with CRRT Solutions at UAB

- Nephrology Medical Team, Pharmacy, ICU Nursing, and Dialysis Nursing met and addressed various CRRT issues:
  - Better Management of CRRT Process
  - Standardized Solutions
  - Standardized Orders
  - Simplified Storage/Distribution Process
  - Simplified Scheduling/Charting
  - Prevent Medication Errors
Pharmacy Solution: Problem 1 (variable solutions)

- **Standardization of CRRT solutions**
  - $\text{HCO}_3^{2-} 22-4K$ as RF or dialysate
  - $\text{HCO}_3^{32-} 32-4K$ or $\text{HCO}_3^{32 0K}$ as RF or dialysate
  - Citrate 0.5% as RF

- **Standardized Order Sets developed in the Computer Physician Order Entry Pathway to decrease errors**
Pharmaceutical Preparation: Commercial or Compound?

Should hospital pharmacy compound CRRT solutions or purchase commercial CRRT solutions?
Compounding CRRT Solutions?

- Need to consider extra space in pharmacy for storing fluids
- Maintain adequate supply of fluid / bags/ additives in pharmacy
- Provide appropriate compounding machines
- Provide adequate staffing for preparing and checking CRRT solutions
Compounding CRRT Solutions?

- In 2004, several patients who were receiving CRRT in Alberta, Canada died because KCL, rather than NaCL, was mistakenly added to custom-made dialysate solutions in hospital pharmacy.
Compounding CRRT Solutions?

- In 2006, 4 patients treated with Normocarb-based solution developed shock, hemolysis, and hyponatremia.
- Normocarb is a 240 ml concentrated electrolyte solution which must be mixed with sterile water prior to use.
- In these cases, Normocarb was not added to sterile water and patients were dialyzed against sterile water.

Prendergast et al. CCM 2006, 34:2666-2673
Compounding CRRT Solutions?

Health Quality Council of Alberta made following recommendations regarding preparation of CRRT solutions in hospitals:

✓ When possible, use commercial Ready-to-Use solutions

✓ When commercial solutions are not available, standardized solutions should be utilized
Compounding vs. Commercial CRRT Solutions?

Commercialized and Standardized Solutions provide **Greater Efficiency**:

- Decrease Labor
- Decrease Cost
- Decrease Waste with longer expiration dating
- Decrease Errors
- Provide greater Safety with industry quality standards
### Problem 2: Issues with delivery of solutions

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<tr>
<th></th>
<th>1999 (7/99 -12/99)</th>
<th>2000</th>
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<th>2002 (1/02 -6/02)</th>
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<tr>
<td><strong>CRRT Solutions</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Total Weight (lbs)</td>
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<td>218,856</td>
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<tr>
<td>Daily Weight (lbs/d)</td>
<td>320</td>
<td>418</td>
<td>600</td>
<td>1000</td>
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Pharmacy Solution: Problem 2
(Organization of delivery process)

- Nursing and Pharmacy jointly initiated a new process for managing CRRT solutions and making the overall distribution and administration process for CRRT more efficient

- Floor Stock concept
Pharmacy Solution: Problem 3
(Medication Errors)

- Standardization of solutions
- Outsourcing of CRRT solutions
- Organization of CRRT solutions on nursing units
Success of UAB’s CRRT Program

- Standardization of CRRT Solutions and Order Sets
  - Decreases Medication Errors from prescribing, preparation, and administration
  - Decreases Cost
  - Decreases Waste
Delivery of CRRT to the Patient - Role of the Nurse
Nursing Challenges

Need for standards of care

Need for education for critical care and dialysis nursing staff

Need for continuous dialysis nurse support
Standard Of Care

- Provides a guideline for the critical care nurse in determining their role vs. the role of the dialysis nurse.

- Sets the ground work for identifying the educational needs of the critical care nurse.
Documentation:

- Solutions are charted on e-MAR.
  - Explanation of high flow rates for CMS audits.

- “Filter Clogging” vs. “Filter Clotting”
  - Early Id → Early interventions and prolonged therapy
Just like hemodynamics we treat trends not individual numbers.

- Document the Rx every hour
- Document the Dose (infused solutions)
- Document pressures
- Document Fluid Balance removed
All ICU RN required to attend 4 hour initial training class for CRRT

- AKI
- Fundamentals
- UAB Protocol
- Hands On

Additional 2 hour “Update Class” offered
- For those interested
- Low use area “CRRT Champions”

Competency check off (simulation) at annual “ICU competency extravaganza”
Benefits of 24/7 Service

- Eliminates pts being off CRRT for long periods of time.
- Provides continuous support for the critical care nurse.
- Decrease errors.
- Eliminates call for the dialysis nurse.
- Decreases cost for the hospital in call back charges.
- Provides coverage for any stat hemo tx.
Role of Critical Care Nurse

- Monitor and record hourly rates and pressures.

- Hang and maintain dialysis solutions.

- Troubleshoot alarms and maintain machine.

- Temporarily disconnects and returns blood to the patient.

- Notifies dialysis of access issues.
Role of The Dialysis Nurse

- Initiates all new starts and restarts.
- ROUNDS once per shift.
- Provides support for troubleshooting.
- Assesses all access issues.
- TPA administration
Verifications..

- Dialysis RN does initial set-up
- ICU RN verifies fluids q 4 hours
- Dialysis RN verifies fluids with rounds
- Labs are recorded on flow-sheet
- Pertinent CRRT related notes
  - Allows to link data with clinical scenarios
CRRT does not make a “one-on-one”

Assignments are based on AACN “Synergy Model” matching RN to patient based on Patient needs, RN skill set

- For some units CRRT may be one-on-one
- Some CRRT pt easy to pair
- Some must be one-on-one
Key to Success...

- In order to maintain high quality and control cost in the overall CRRT process, all disciplines should continue to work together in identifying ways to simplify and standardize CRRT Processes which generally lead to consistency and safer process for patients.

- All changes are coordinated and communicated prior to implementation.

- CRRT is a TEAM SPORT!
  - Always go back to the patient – Are we providing ‘quality’ CRRT