CRRT: QUALITY MANAGEMENT SYSTEMS

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Disclosures

- Consulting agreement with Baxter Healthcare Inc.
- No stock or income from CRRT-related activities

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- Charles and Jane Pak Center of Mineral Metabolism and Clinical Research (UT Southwestern)
- Early Career Pilot Program (CCTS, University of Kentucky)
- Clinical trials/registry support: STARRT-AKI, CRRTnet
- Industry support for clinical trials: Prismocitrate (no COI)
Outline

- CRRT deliverables that need improvement
- How to optimize CRRT deliverables in the ICU?
- Clinical informatics and CRRT deliverables
CRRT deliverables that need improvement

• Timing of CRRT initiation
• Iterative changes in CRRT prescription and goals of therapy in the context of critical illness, fluid overload and multi-organ failure
• Assessment of renal recovery and effective RRT de-escalation
• Risk-stratification of recurrent AKI and incident or progressive CKD or de novo ESRD
• Post-AKI outpatient care
Do we provide optimal CRRT care (1999-2002)?

- Average filter life = 12.7 hours
- Average time for restart > 6 hours
- Delivered dose < 70% of prescribed dose
- Preventable significant errors ~ 1 per month
- Average number of filter changes per day > 7
- No standards
- No tracking of quality parameters
How to optimize CRRT deliverables in the ICU?

Three essential elements

1. Multidisciplinary team work dynamics
2. Iterative assessment and adjustment of RRT goals
3. Quality management systems

8:00 AM
Early sepsis
MAP <55
SVV >20%
collapsible IVC
AKI on CRRT, UF zero

8:00 PM
Late sepsis
s/p 5L IVF, on pressors
MAP ~60
SVV <10%
distended IVC
AKI on CRRT, UF -50 ml/hr

AKI, acute kidney injury; CRRT, continuous renal replacement therapy; ICU, intensive care unit; IVC, inferior vena cava; IVF, intravenous fluid; MAP, mean arterial pressure; RRT, renal replacement therapy; s/p, status post; SVV, stroke volume variability; UF, ultrafiltration
How to optimize CRRT deliverables in the ICU?

Multidisciplinary teams

- Intensivists
- Nephrologists
- Pharmacists
- Nurses
- Nutritionists
- PT/OT
- Data analysts
- Computer scientists

CRRT, continuous renal replacement therapy; ICU, intensive care unit; OT, occupational therapy; PT, physical therapy

Iterative assessment/adjustment of CRRT goals

• Electronic Health Record Tools (some data points from CRRT machine)
  – Customized order set (monitor prescription)
  – Customized flowsheets (monitor RRT deliverables: dosing, solutions, fluid removal, access/return pressures, TMP, filter pressure drop, filtration fraction, etc.)

• Who, When and How? (integration of machine and patient data)

• Solute clearance and fluid regulation need
  – Monitoring of clinical status of the patient
  – Static/functional/respiratory variation tests/POCUS to guide fluid therapy
How to optimize CRRT deliverables in the ICU?

Quality management systems

- **Standardization**
  - Protocols (dynamic)

- **Problem identification**
  - Monitoring (effective and sustainable), reporting *quality metrics*

- **Improvement in CRRT deliverables**
  - Innovation

CRRT, continuous renal replacement therapy; ICU, intensive care unit
Quality management systems in CRRT

RRT in the ICU Standard Processes
- Engaged and Multidisciplinary CRRT Team
- Clear Roles and Responsibilities
- Continuous Education
- Leadership Support

Problem Identification

1. Problem Solving
2. Metrics for CRRT deliverables
3. Quality Management: Assurance and Control
4. Process Improvement
5. RRT in the ICU Standard Processes

Adapted from: Neyra JA and Goldstein SL. Clin Nephrol. 2018. In press
How to optimize CRRT deliverables in the ICU?

Development of quality metrics for CRRT

- Dose
- Modality
- Anticoagulation
- Filter life
- Downtime
- Fluid removal
- Access/return alarms
Clinical informatics and CRRT deliverables

“There can’t be any disease you can’t measure it…”

- You can’t manage it
- You can’t improve it
- You can’t provide timely and effective therapy

CRRT, continuous renal replacement therapy
Clinical informatics and CRRT deliverables

It is not only about data, but clinical informatics development
Clinical informatics and CRRT deliverables

Clinical Informatics

- The application of informatics and information technology to deliver safe, efficient, effective, timely, patient-centered, and equitable healthcare services
- Getting the right information, to the right health care team, at the right time to support effective patient care
Clinical informatics and CRRT deliverables

Domains of Clinical Informatics

- Clinical Care
- Information & Communications Technology
- The Health System

Clinical Informatics

CRRT, continuous renal replacement therapy
Clinical informatics and CRRT deliverables

- Data
- Information
- Knowledge
- Understanding
- Wisdom

OPTIMAL PATIENT CARE

CRRT, continuous renal replacement therapy
USMP/MG230/18-0006  3/18

Clinical informatics and CRRT deliverables

Data (machine + patient) → Information → Knowledge

Data integration tools

Quality management systems
Clinical decision support

PATIENT CARE

Improve patient care
Improve patient safety
Decrease medical errors

CRRT, continuous renal replacement therapy
USMP/MG230/18-0006 3/18

Quality metrics: Tripartite data
Example of machine data

• Programmatic Data
  – Filter/circuit life
  – Time on machine/treatment lost
  – Complications: access, clotting

• Therapy Data
  – CRRT dose: prescribed vs. delivered
  – Daily fluid goals: prescribed vs. achieved
What is the average filter life?
  – Why are we changing filters?
  – How many filters do we lose due to clotting?
  – What is the cost of replacing filters?
    • Filter costs • Nursing time • Waste

How much treatment time is lost?
  – On machine time loss
  – Downtime

How are we tracking toward our dosing target?

How much fluid was removed per treatment day?

How many access return alarms do we have?
Machine Data: Quality Metrics

- CRRT modality
- CRRT dose
- Fluid removal
- Filter life
- Downtime
CRRT modality: UK experience

September 2016

- CRRT protocol review and update
- CRRT order set modifications to accommodate CVVHDF
- Development of a comprehensive CRRT flowsheet in the EHR
- CRRT education
- CRRT machine management for data card access

January 2018

- CRRT protocol review and update
- CRRT order set modifications to accommodate CVVHDF
- Development of a comprehensive CRRT flowsheet in the EHR
- CRRT education
- CRRT machine management for data card access

CRRT, continuous renal replacement therapy; CVVH, continuous veno-venous hemofiltration; CVVHDF, continuous veno-venous hemodiafiltration; EHR, electronic health record; UK, University of Kentucky

Case Study – University of Kentucky Medical Center
CRRT dose: UK experience

September 2016

- This Year: 27 ml/kg/h
- This Month: 37 ml/kg/h
- Increase: 37%

Last Year: 26 ml/kg/h
This Year: 27 ml/kg/h
Increase: 4%
Target: 25 - 35

January 2018

- This Year: 28 ml/kg/h
- This Month: 27 ml/kg/h
- Decrease: -4%

Last Year: 28 ml/kg/h
This Year: 28 ml/kg/h
Decrease: 0%
Target: 25 - 30

- CRRT protocol review and update, recommended effluent dose ~30 ml/kg/h
- Development of a comprehensive CRRT flowsheet in the EHR
- CRRT education

CRRT, continuous renal replacement therapy; EHR, electronic health record; UK, University of Kentucky
CRRT dose: prescribed vs delivered

- CRRT protocol review and update, **recommended effluent dose ~30 ml/kg/h**
- Development of a comprehensive CRRT flowsheet in the EHR
- CRRT education

CRRT, continuous renal replacement therapy; EHR, electronic health record; UK, University of Kentucky

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Case Study – University of Kentucky Medical Center
Fluid removal: UK experience

**September 2016**

Q. 4) **How much fluid was removed per TreatmentDay?**

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<tr>
<th>Month</th>
<th>Fluid Removed (Liters)</th>
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<tr>
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**January 2018**

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- CRRT and FO/fluid regulation education
- ICU standardized daily weights
- Automated CRRT flowsheet for hourly suggested fluid removal based on UF goal
Filter life: UK experience

September 2016

Q. 1) What is our average filter life?

Why are we changing filters?

• Clotting issues *performance
• Treatment interruption
  *education/recirculation
• Treatment ended
• Other

• CRRT protocol review and update
• CRRT new order set
• Development of CRRT flowsheet in the EHR
• CRRT education
• Citrate anticoagulation education
What events account for time lost?

- Bag change/recirculation performance
- Filter change performance
- Patient time off
- Access/return/other alarms performance

- CRRT protocol review and update
- CRRT new order set
- Development of CRRT flowsheet in the EHR
- CRRT education
- Right internal jugular preferred access
Quality metrics: Tripartite Data

MACHINE  PATIENT  OUTCOME
UK-CRRT Quality Management System

- Integrates utilization, technical, machine data and patient’s outcomes
- ~40-50 patients per month
- 60-75% utilization of CRRT machines
- Identified 3 machines to be replaced (technical issues)

CRRT, continuous renal replacement therapy; UK, University of Kentucky
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Case Study – University of Kentucky Medical Center
Conclusions

It is critical to measure key CRRT deliverables that can be improved: delivered dose, achieved fluid removal and resource utilization.

The use of clinical informatics is readily available to be implemented in our CRRT practice: integration of machine and patient data in the EHR is the first step!

It is important to develop effective (multidisciplinary) quality management systems: what we are doing and how we can do it better!