

# CRRT: QUALITY MANAGEMENT SYSTEMS

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# Disclosures and Funding

## 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

# How to optimize CRRT deliverables in the ICU?

## Multidisciplinary teams

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



# How to optimize CRRT deliverables in the ICU?

## 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

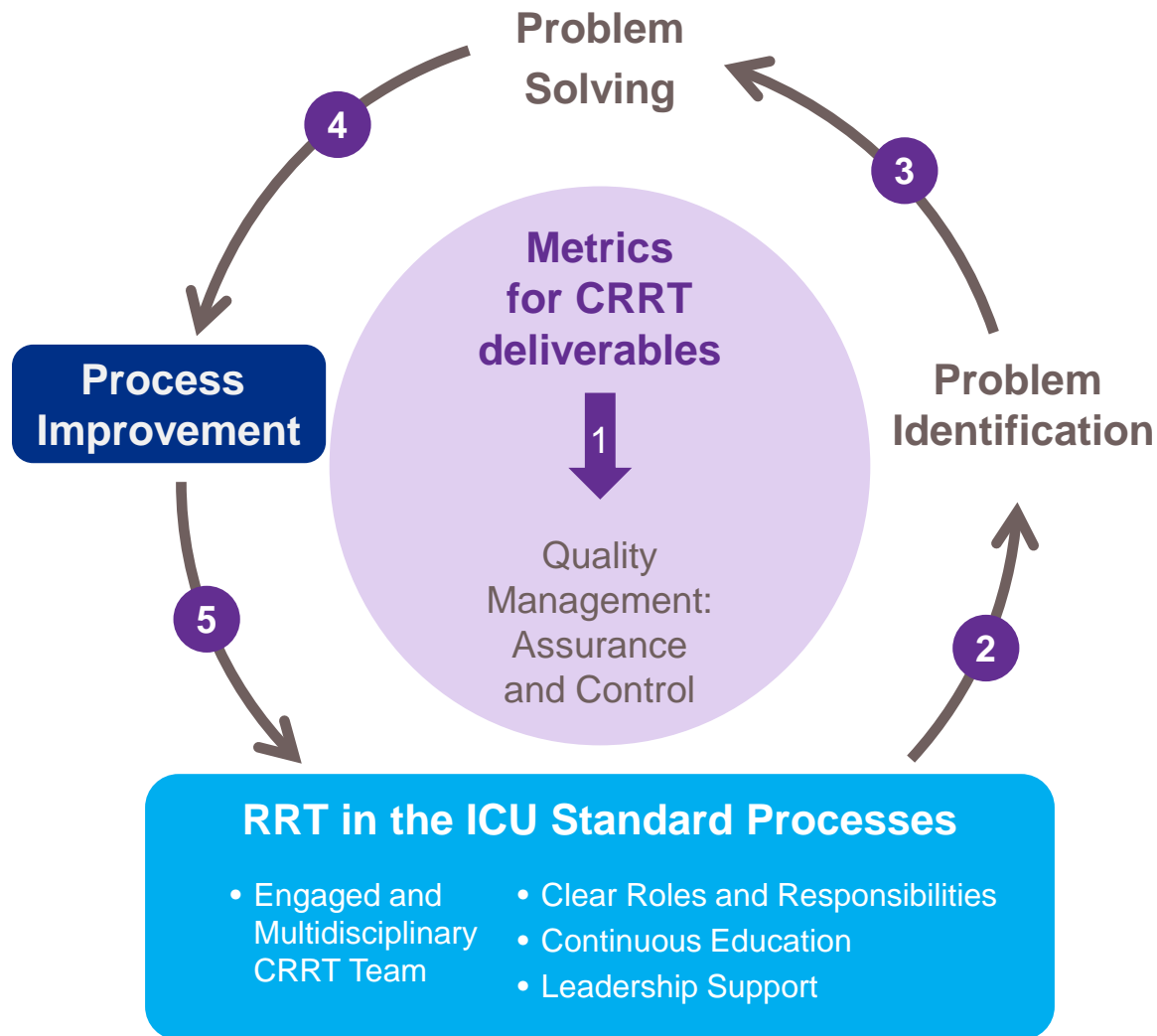


# How to optimize CRRT deliverables in the ICU?

## Quality management systems



# Quality management systems in CRRT



# 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

**“If you can’t measure it...”**

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



# Clinical informatics and CRRT deliverables



It is not only about data,  
but clinical informatics  
development

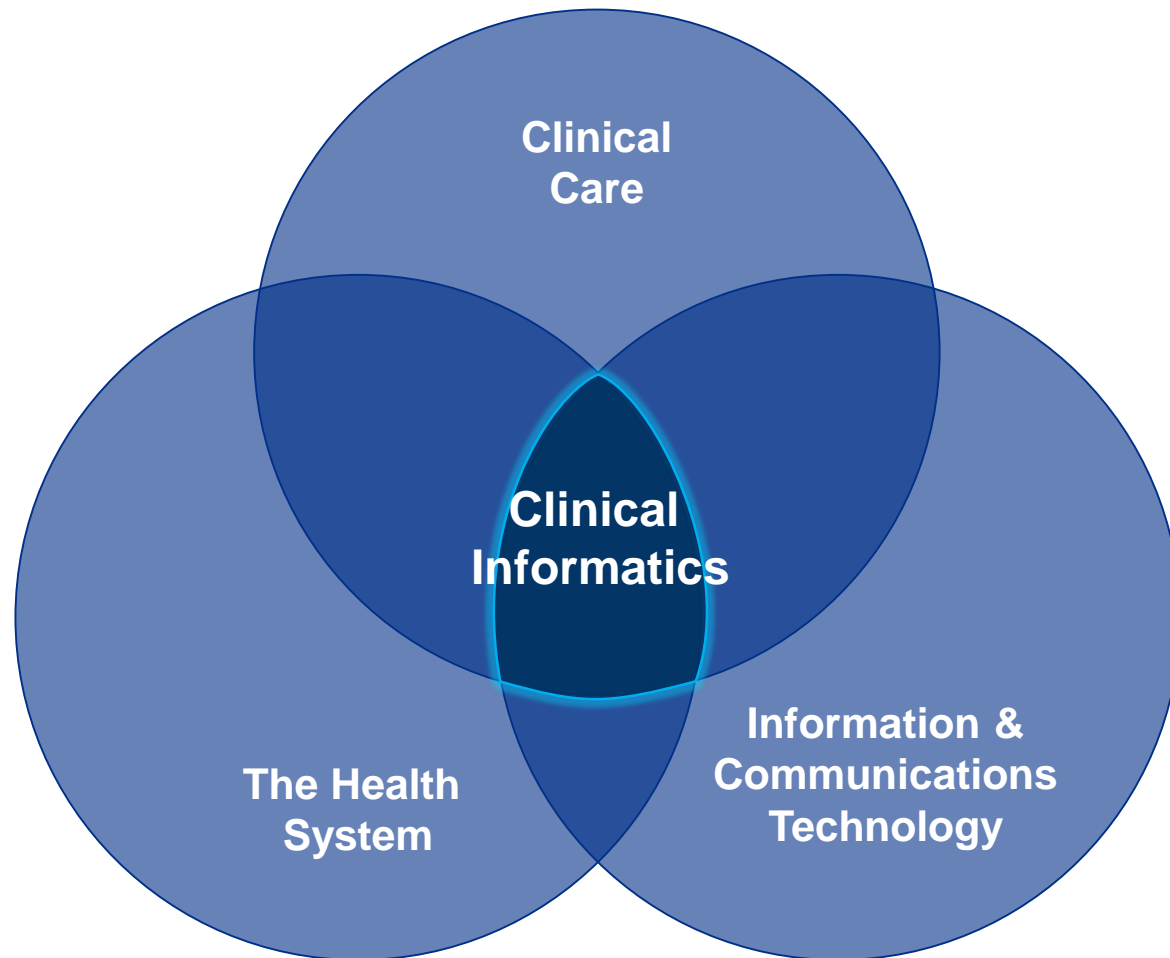
# Clinical informatics and CRRT deliverables

## Clinical Informatics

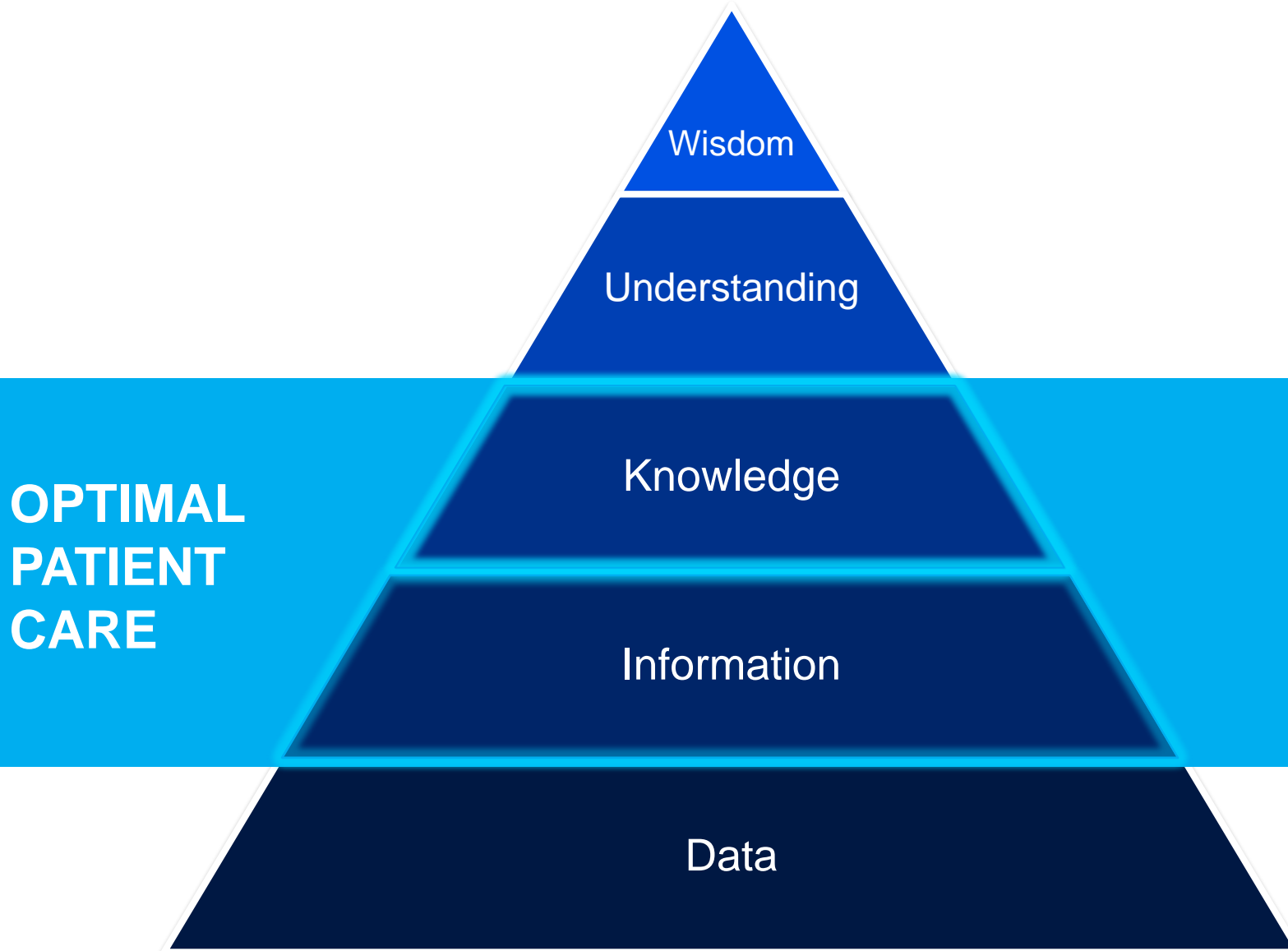
- The application of informatics and information technology to deliver safe, efficient, effective, timely, patient-centered, and equitable healthcare services
- Getting the right information, to the right health care team, at the right time to support effective patient care

# Clinical informatics and CRRT deliverables

## Domains of Clinical Informatics



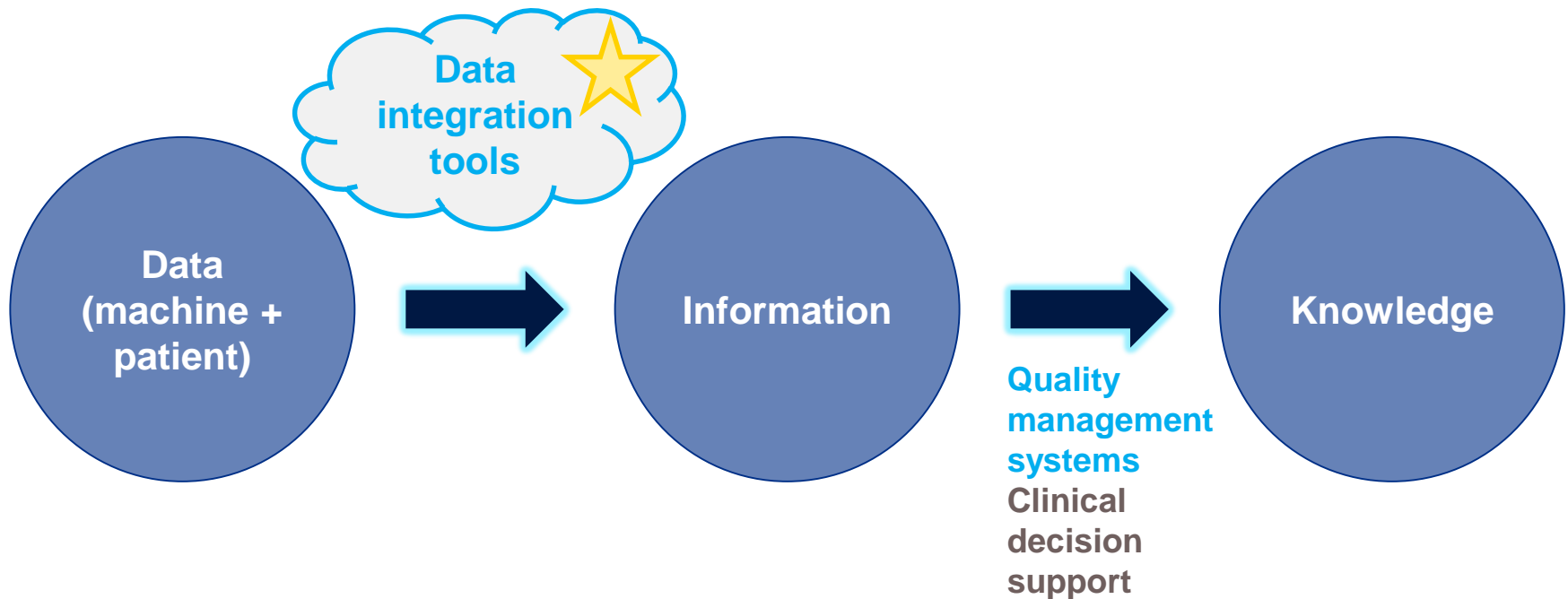
# Clinical informatics and CRRT deliverables





# CRRT-centric model

## Clinical informatics and CRRT deliverables



**PATIENT  
CARE**



Improve patient care  
Improve patient safety  
Decrease medical errors

# University of Kentucky CRRT Quality Management System

## Quality metrics: Tripartite data



**MACHINE**



**PATIENT**



**OUTCOME**

# CRRT Quality Management System

## 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

# Machine Data: Quality Metrics

- 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?

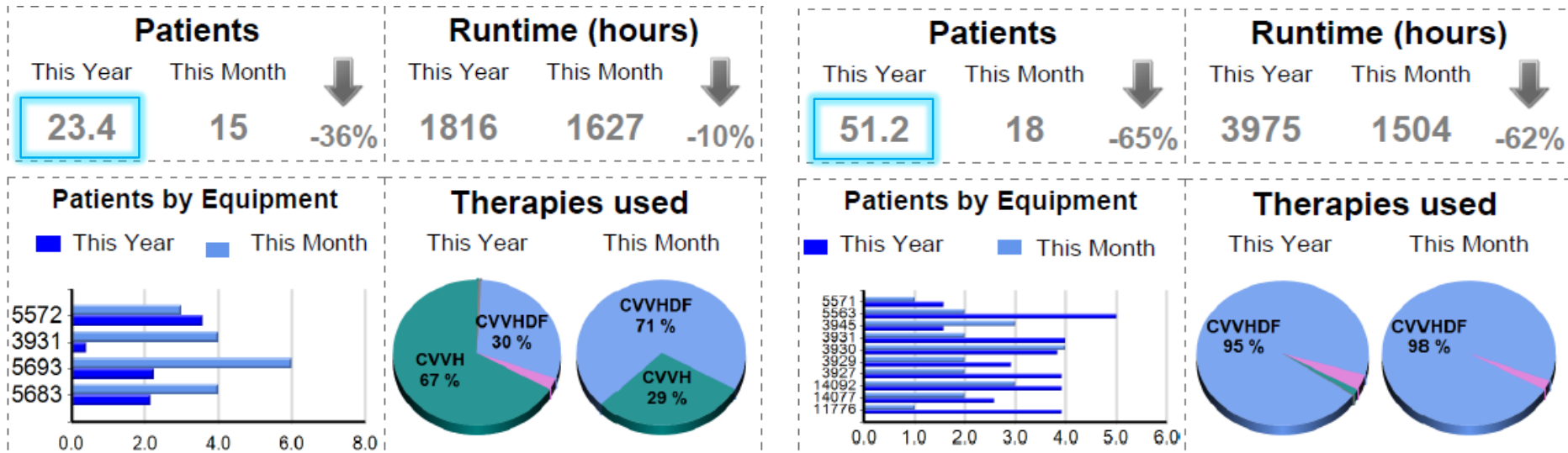
# Machine Data: Quality Metrics

- CRRT modality
- CRRT dose
- Fluid removal
- Filter life
- Downtime

# CRRT modality: UK experience

## September 2016

## January 2018

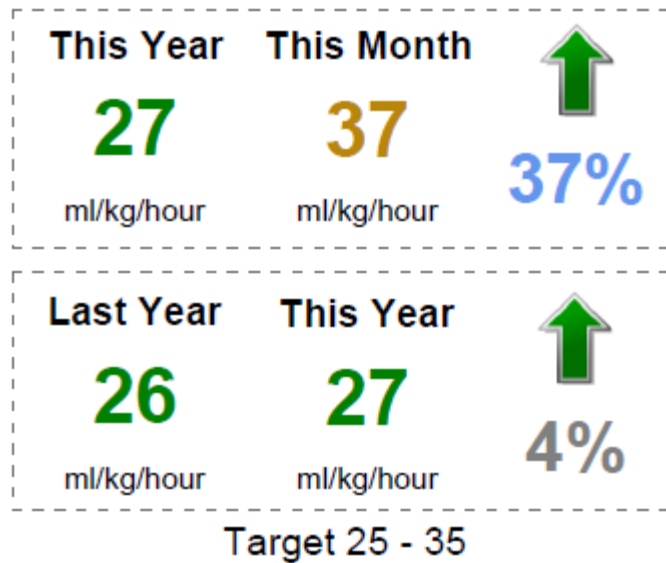


- CRRT protocol review and update
- **CRRT order set modifications to accommodate CVVHDF**
- Development of a comprehensive CRRT flowsheet in the EHR
- CRRT education
- **CRRT machine management for data card access**

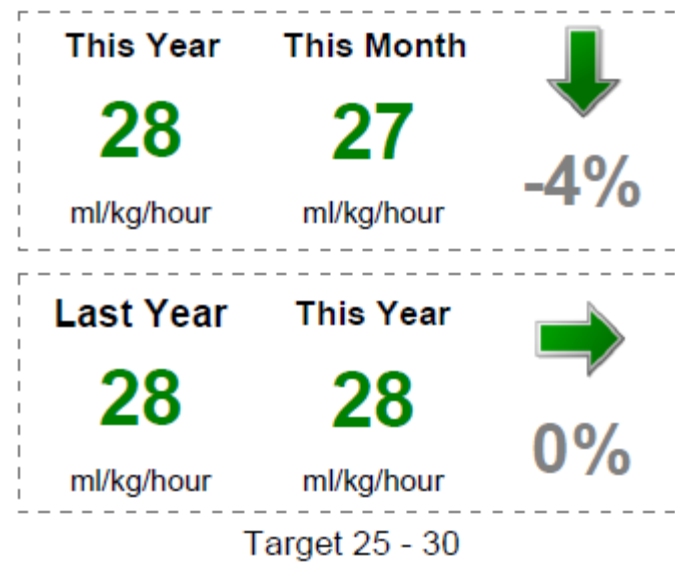
CRRT, continuous renal replacement therapy; CVVH, continuous veno-venous hemofiltration; CVVHDF, continuous veno-venous hemodiafiltration; EHR, electronic health record; UK, University of Kentucky

# CRRT dose: UK experience

## September 2016



## January 2018



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

# CRRT dose: prescribed vs delivered

This Year **9%** This Month **7%**  
 % Delta of Prescribed vs Delivered

Target < 20%



	Jul	Aug	Sep	Oct	Nov	Dec	Jan
% Delta of Prescribed vs Delivered	12%	11%	6%	13%	9%	12%	11%
Prescribed Dose	32	35	38	32	34	32	35
Delivered Dose	28	31	35	28	31	29	32

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

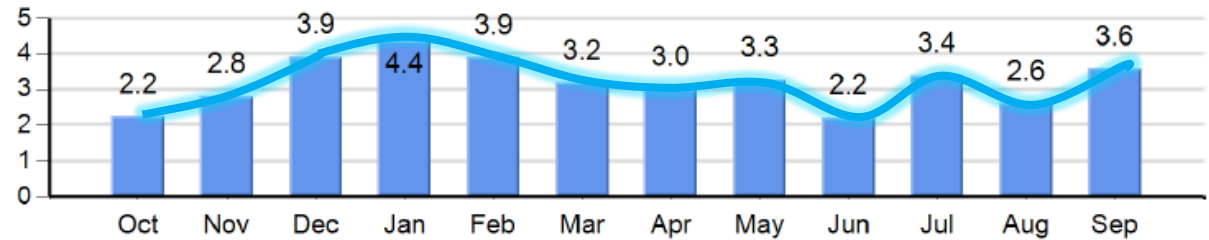


# Fluid removal: UK experience

## September 2016

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

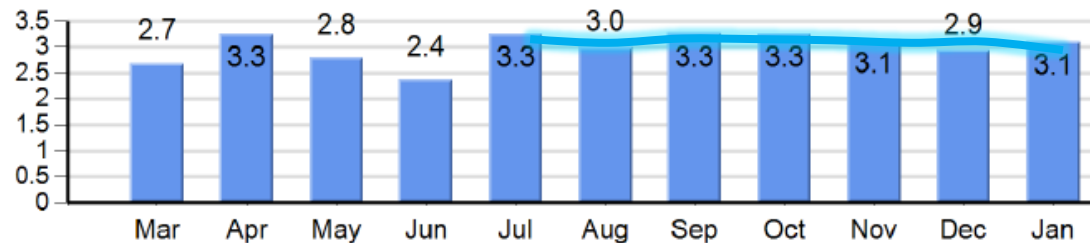
This Year  
**3.2**  
Liters



## January 2018

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

This Year  
**3.0**  
Liters



- CRRT and FO/fluid regulation education
- ICU standardized daily weights
- **Automated CRRT flowsheet for hourly suggested fluid removal based on UF goal**

## 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**

## September 2016

*Q. 2) How much treatment time is lost?*

### 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**

# University of Kentucky CRRT Quality Management System

## Quality metrics: Tripartite Data



**MACHINE**



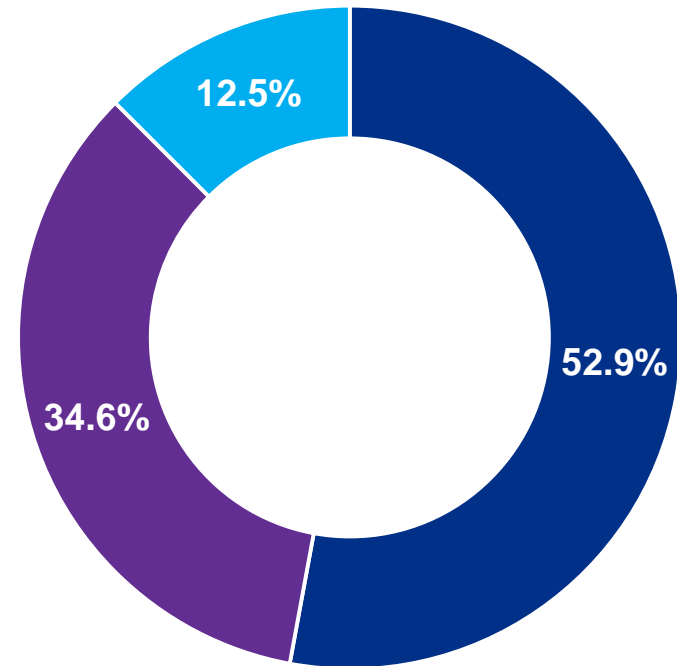
**PATIENT**



**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)



- Hospital death
- Alive at discharge
- Hospice

# 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!