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UC San Diego SCHOOL OF MEDICINE
and
CRRT, INC.

Morning Symposium C – Optimization of the CRRT Program to Improve Outcomes

Harnessing Multimodal Data Streams to Improve CRRT Delivery

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Disclosures (1)

- I have received consulting fees from Baxter Healthcare Inc.
- I have participate on advisory boards with Baxter Health Inc. and Leadiant Biosciences

Disclosures (2)

- I am not a nephrologist but an intensivist in critical care nephrology with a focus on acute dialysis

- I have not had any formal training in Quality Improvement but have a keen interest in Quality Metrics and Key Performance Indicators and am leading an implementation science based program to improve acute dialysis in Alberta

Outline

1. Discuss what data streams might be used to obtain the information necessary to improve CRRT delivery

2. Outline how these may be represented and reported

3. Examples of Dashboards used to to improve the performance of CRRT

Where can data come from?

1. Machine data
2. EMR Data
3. Organizational data
4. Healthcare system data

Lin et al, Scientific Data 2019(6):313

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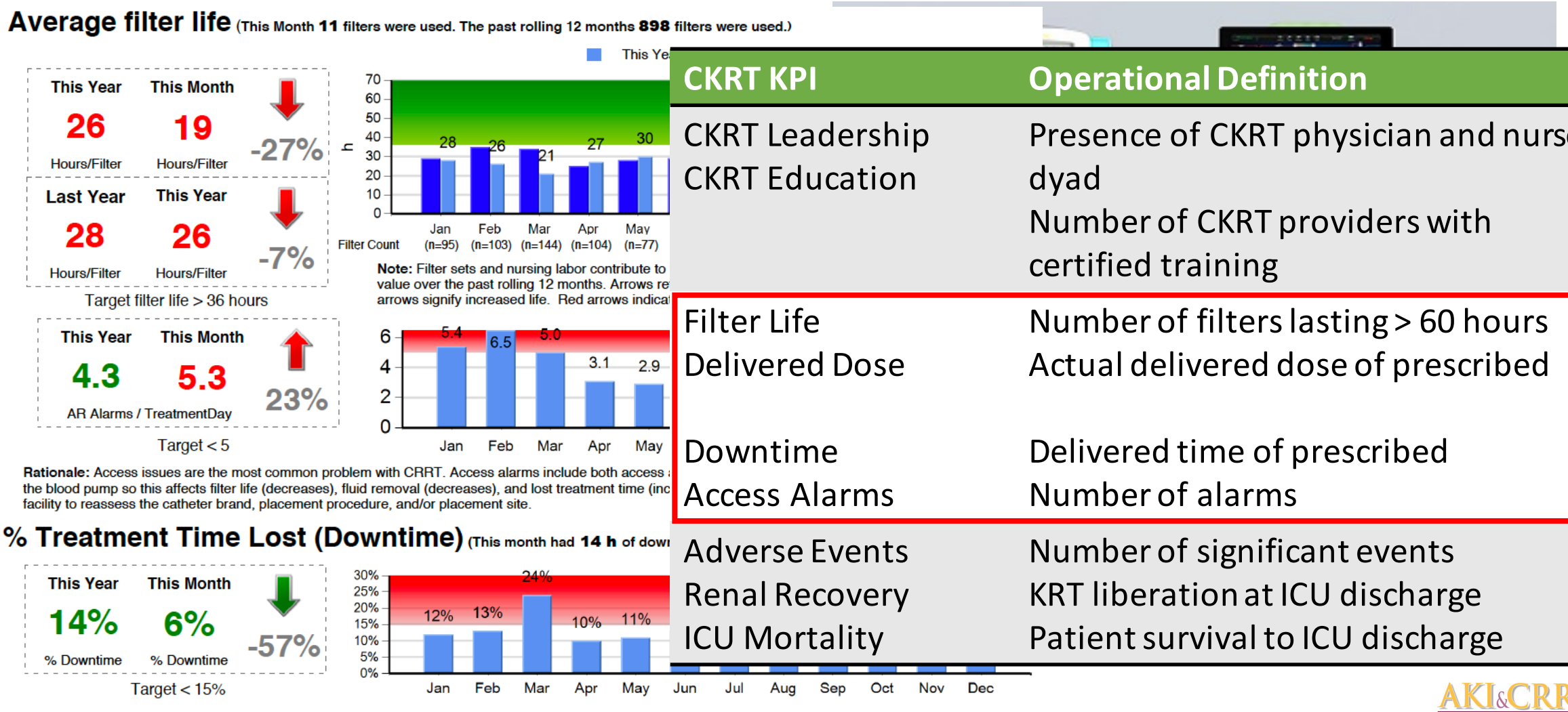
Machine Data



CKRT KPI	Operational Definition
CKRT Leadership	Presence of CKRT physician and nurse dyad
CKRT Education	Number of CKRT providers with certified training
Filter Life	Number of filters lasting > 60 hours
Delivered Dose	Actual delivered dose of prescribed
Downtime	Delivered time of prescribed
Access Alarms	Number of alarms
Adverse Events	Number of significant events
Renal Recovery	KRT liberation at ICU discharge
ICU Mortality	Patient survival to ICU discharge

Opgenorth et al., BMC Nephrology 2020(23):369

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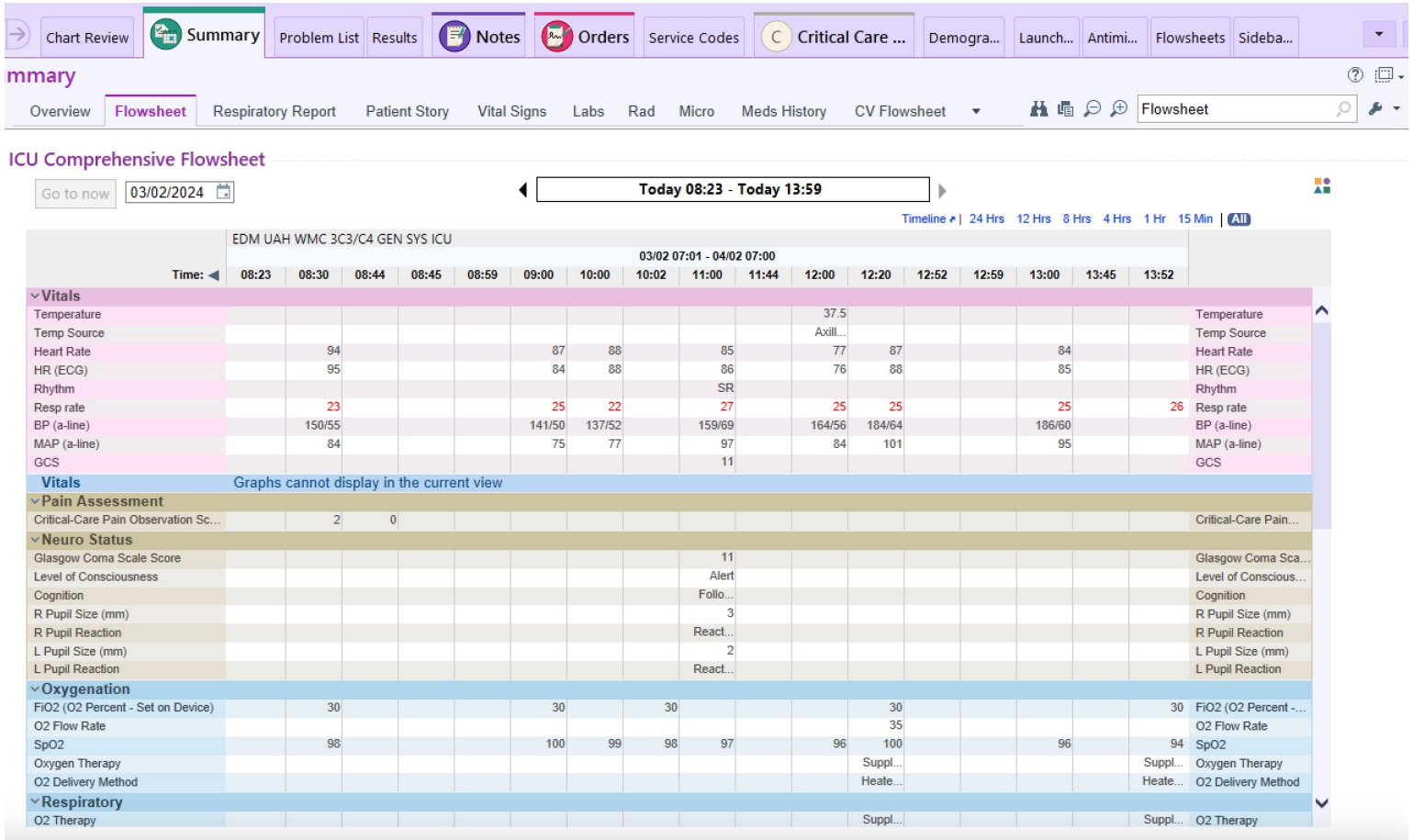
EMR Data

- Vitals
- Neurological Status
- Ventilatory Status
- Hemodynamic Status



Courtesy of AHS Connect Care, EPIC

Organizational Data

- Administration
- Prescription
- Provision
- Education
- Certification and Support

Table 2 Standardised elements of CRRT programmes

Programme element	Operational definition
CRRT leadership	Presence of both CRRT physician and clinical nurse educator
CRRT education	Number of CRRT providers with training/ total number of CRRT providers
Filter life	Number of filters lasting 72 hours/total number of filters used
Delivered dose	Actual delivered dose in mL/kg/hour/prescribed dose in mL/kg/hour
Downtime	Time CRRT not running per day/each day of CRRT prescription
Ultrafiltration	Actual ultrafiltration achieve in mL/kg/hour/prescribed ultrafiltration in mL/kg/hour
Access alarms	Number of alarms recorded per machine per day of therapy
Adverse events	Number of adverse events as per RLS per quarter
ICU mortality	Patient survival to ICU discharge
Renal recovery	Number of patients still requiring RRT at 90 days

Opgenorth et al., BMJ Open 2022 12e054583

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Healthcare System Data

- ICU Length of Stay
- Hospital Length of Stay
- Mortality
- Renal Recovery

Table 2. Primary and Secondary Outcomes.*

	Accelerated Strategy (N=1465)	Standard Strategy (N=1462)	Relative Risk or Difference (95% CI)
Primary outcome			
Death from any cause at 90 days — no. (%)†	643 (43.9)	639 (43.7)	1.00 (0.93 to 1.09)‡
Secondary outcomes			
RRT dependence among survivors at 90 days — no./total no. (%)	85/814 (10.4)	49/815 (6.0)	1.74 (1.24 to 2.43)‡
Death or RRT dependence at 90 days — no./total no. (%)	728/1457 (50.0)	688/1454 (47.3)	1.06 (0.98 to 1.14)‡
Major adverse kidney events at 90 days — no./total no. (%)	867/1131 (76.7)	860/1115 (77.1)	0.99 (0.95 to 1.04)‡
Serum creatinine at 90 days — mg/dl§	1.20±1.00	1.23±1.00	−0.03 (−0.11 to 0.06)¶
Estimated glomerular filtration rate‖			
At 90 days — ml/min/1.73 m^2	65±30	64±31	0.31 (−3.88 to 4.49)¶
Reduction of >25% from baseline at 90 days — no./total no. (%)	139/403 (34.5)	172/427 (40.3)	0.86 (0.72 to 1.02)‡
Death from any cause — no./total no. (%)			
At any time in the ICU	461/1464 (31.5)	468/1462 (32.0)	0.98 (0.88 to 1.09)‡
At 28 days	538/1465 (36.7)	523/1462 (35.8)	1.03 (0.93 to 1.13)‡
During hospitalization	552/1458 (37.9)	546/1459 (37.4)	1.01 (0.92 to 1.11)‡
Use of health services			
Median no. of days of use (IQR)			
RRT-free days at 90 days**	50 (0 to 87)	64 (0 to 90)	−2.62 (−5.66 to 0.42)¶
RRT††	4 (2 to 8)	5 (3 to 9)	−0.48 (−0.82 to −0.14)¶
Continuous RRT††	4 (3 to 8)	5 (3 to 8)	−0.40 (−0.78 to −0.02)¶
Sustained low-efficiency dialysis††	2 (1 to 4)	2 (1 to 4)	0.15 (−0.65 to 0.96)¶
Intermittent hemodialysis††	2 (1 to 4)	3 (2 to 5)	−0.45 (−0.80 to −0.09)¶
Median length of stay in ICU (IQR) — days			
Survivors	9 (5 to 16)	10 (5 to 19)	−1.58 (−2.90 to −0.26)¶
Nonsurvivors	7 (3 to 13)	7 (4 to 15)	−1.33 (−2.56 to −0.09)¶
Median length of hospital stay (IQR) – days			
Survivors	28 (16 to 50)	29 (17 to 54)	−1.23 (−3.87 to 1.41)¶
Nonsurvivors	8 (3 to 18)	9 (4 to 19)	−0.99 (−2.66 to 0.67)¶
Median no. of ventilator-free days at 28 days (IQR)	13 (0 to 24)	12 (0 to 24)	0.50 (−0.34 to 1.35)¶
Median no. of days free of vasoactive agents at 28 days (IQR)	21 (0 to 26)	20 (0 to 26)	0.31 (−0.57 to 1.18)¶
Median no. of days out of ICU at 28 days (IQR)	8 (0 to 21)	4 (0 to 20)	0.69 (−0.06 to 1.43)¶
Median no. of days out of hospital at 90 days (IQR)	10 (0 to 65)	9 (0 to 64)	0.55 (−1.82 to 2.91)¶
Rehospitalization at 90 days — no./total no. (%)	191/913 (20.9)	156/916 (17.0)	1.23 (1.02 to 1.49)‡
Health-related quality of life			
Median score on EQ-5D-5L at 90 days (IQR)			
Descriptive system‡‡			
Mobility	2 (1 to 3)	2 (1 to 3)	−0.07 (−0.23 to 0.08)¶
Self care	1 (1 to 3)	1 (1 to 3)	−0.10 (−0.25 to 0.05)¶
Usual activities	2 (1 to 3)	2 (1 to 4)	−0.15 (−0.31 to 0.01)¶
Pain or discomfort	2 (1 to 3)	2 (1 to 3)	−0.04 (−0.17 to 0.08)¶
Anxiety or depression	1 (1 to 3)	2 (1 to 3)	−0.06 (−0.19 to 0.07)¶

Bagshaw et al., 2020 383(3):240

How may these be reported?

- Software generated computer reports
- Online Reports
- Audit & Feedback report cards

Image courtesy of Health Quality Ontario

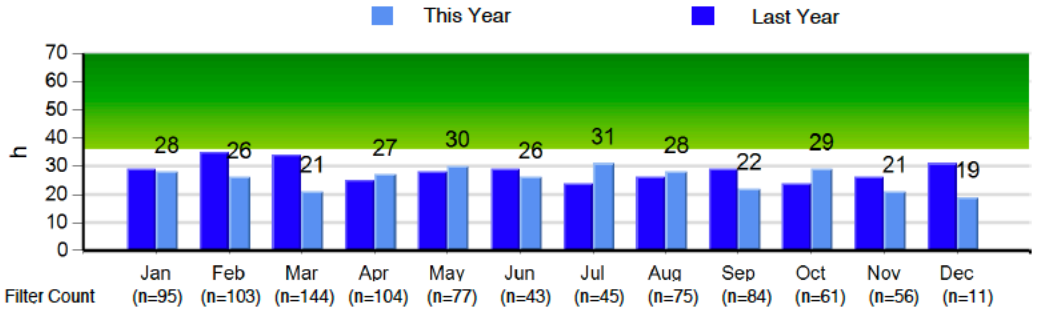
Software generated reports

Average filter life (This Month **11** filters were used. The past rolling 12 months **898** filters were used.)

This Year	This Month	
26 Hours/Filter	19 Hours/Filter	-27%

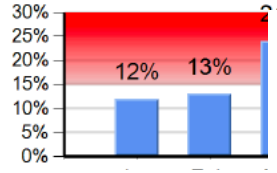
Last Year	This Year	
28 Hours/Filter	26 Hours/Filter	-7%

Target filter life > 36 hours

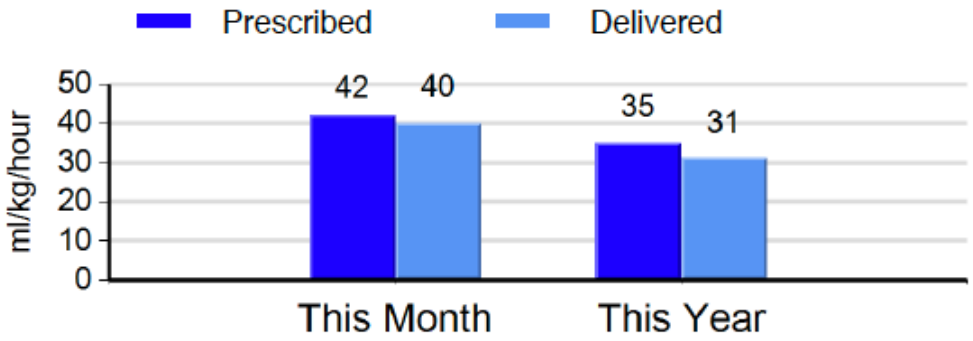


% Treatment Time Lost (Downtime) (This month had **14 h** of downtime and **215 h** of treatment time.)

This Year	This Month	
14% % Downtime	6% % Downtime	-57%



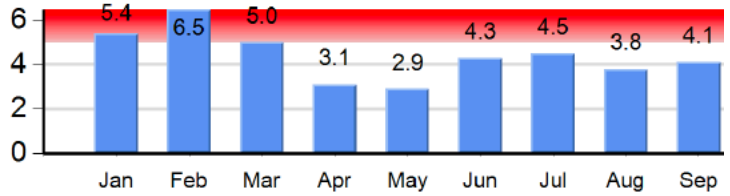
Dose (ml/kg/hour)



Number of Access Alarms

This Year	This Month	
4.3 AR Alarms / TreatmentDay	5.3	23%

Target < 5



Rationale: Access issues are the most common problem with CRRT. Access alarms include both access and return pressure alarms. Acc[illegible] the blood pump so this affects filter life (decreases), fluid removal (decreases), and lost treatment time (increases). A high number of access alarms may induce the facility to reassess the catheter brand, placement procedure, and/or placement site.

Courtesy of Baxter Healthcare Inc.

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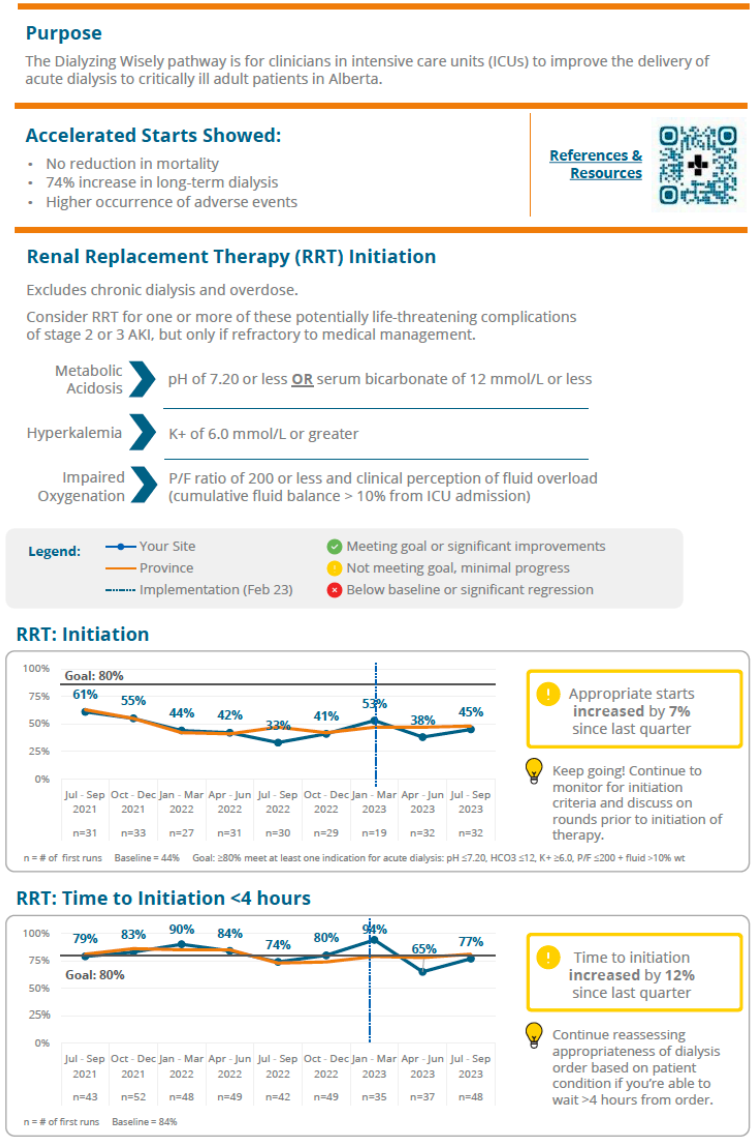
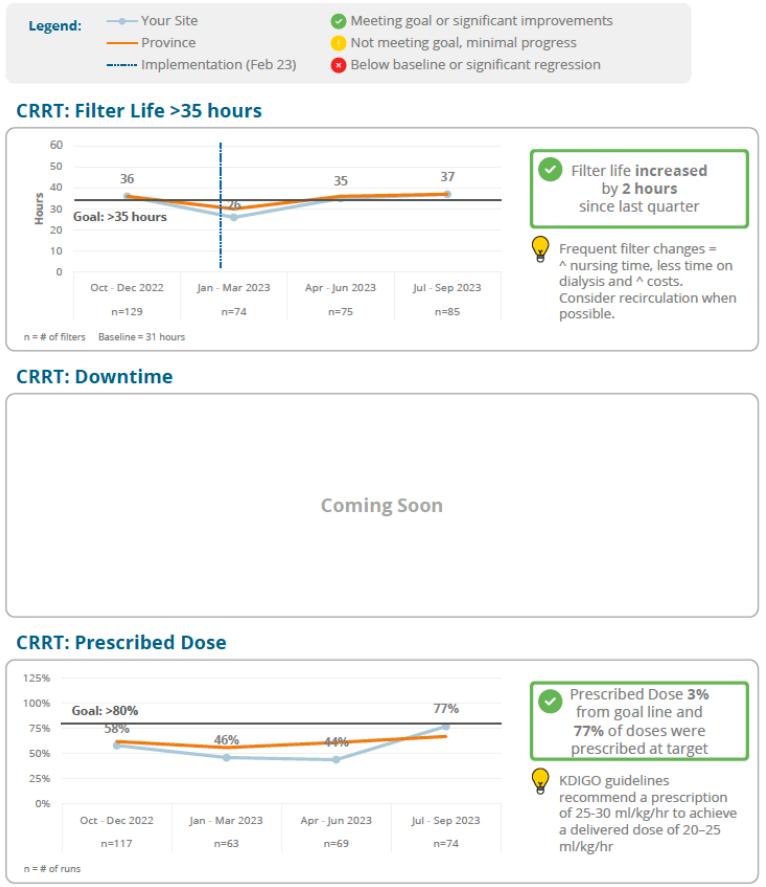
Online Reports

Courtesy of eCrtitical, AHS

Audit & Feedback Reports





Opgenorth et al., 2022(23):369

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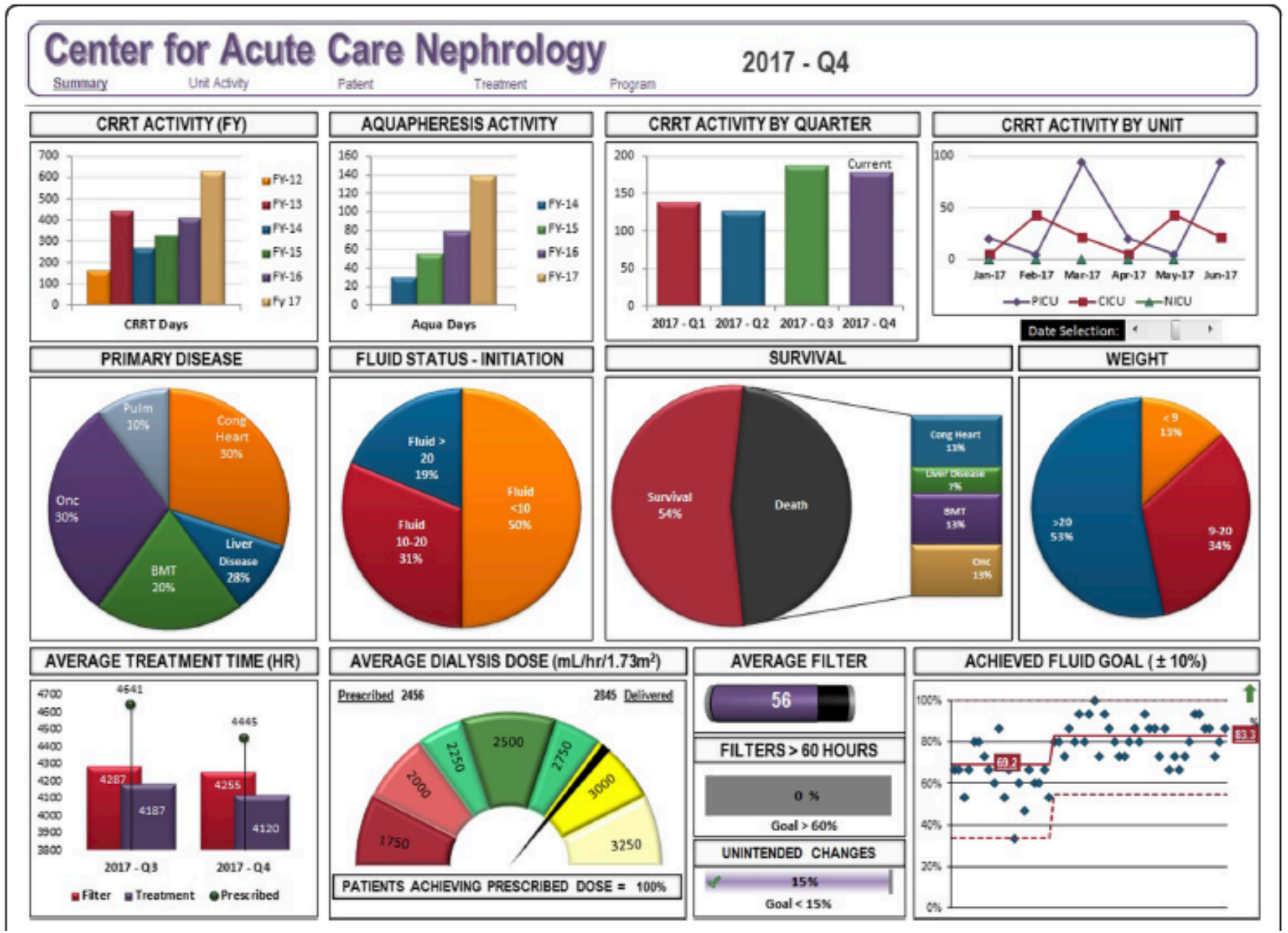
Dashboards



Mottes et al., BMC Nephrology 2019(20):17

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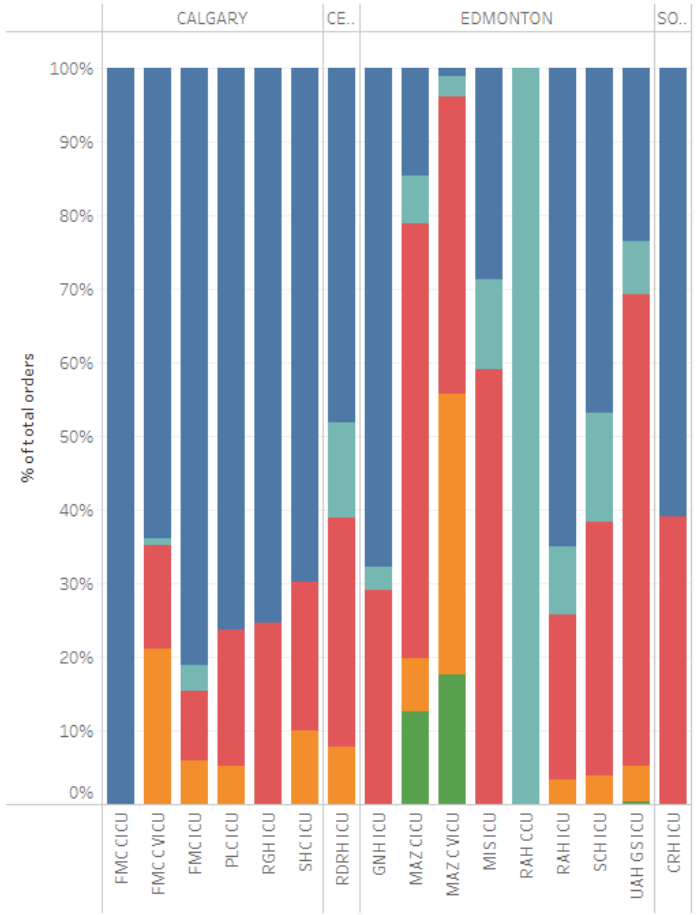
Dialyzing Wisely CRRT Prescriber Dosing

Filter Life Ordering Practices

Orders by Anticoagulation Type

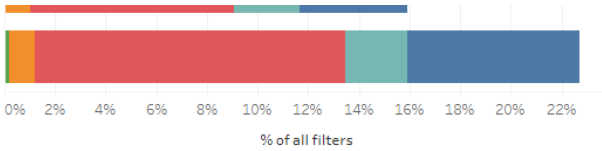


Filter Life by A

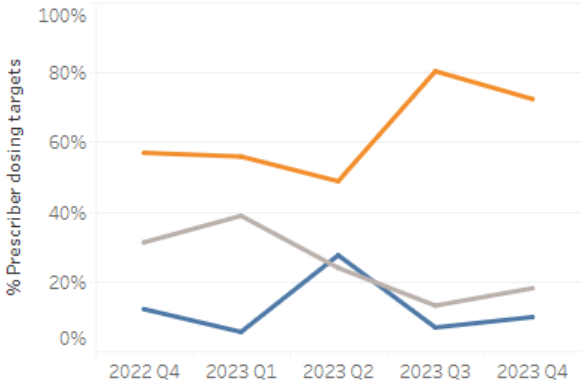
70.0

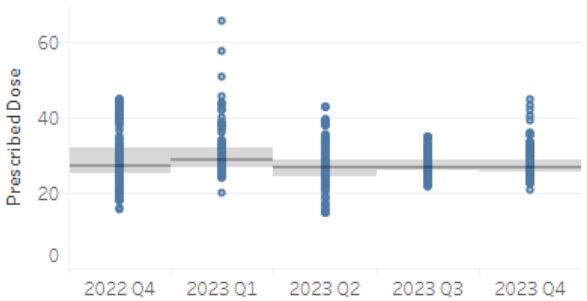
Filters by

- Code Blue
- Unresolvable Machine Fail
- 72 hour change
- Patient for Test/Procedure
- Filter clotted/high TMP
- Access/Return/Filter Pres
- Air in blood
- Lab confirmed blood leak
- Death
- No stopped reason
- Other (add comment) 22.74%



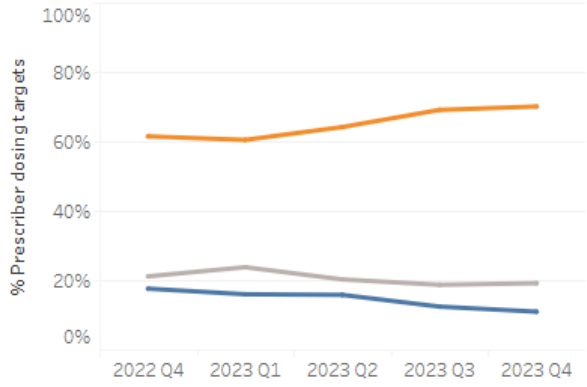
Selected Site(s) Values

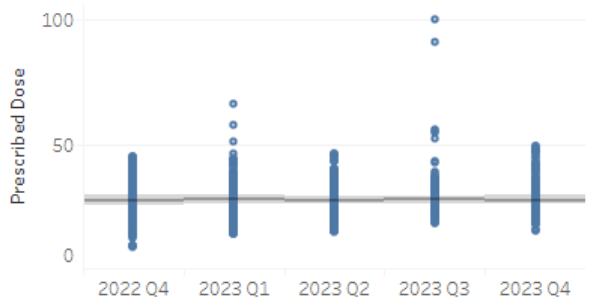




Prescribed Dose Range (5 levels)	2022 Q4	2023 Q1	2023 Q2	2023 Q3	2023 Q4
In target range (25-30)	56.9%	55.8%	48.7%	80.3%	72.3%
Above target (30-35)	14.3%	24.5%	14.0%	11.7%	15.4%
Above target (>35)	16.9%	14.3%	9.8%	1.3%	2.6%
Below target (20-25)	8.3%	5.4%	19.7%	6.7%	9.7%
Below target (<20)	3.7%		7.8%		

Provincial Values





Prescribed Dose Range (5 levels)	2022 Q4	2023 Q1	2023 Q2	2023 Q3	2023 Q4
In target range (25-3..	61.4%	60.4%	64.1%	69.0%	70.0%
Above target (30-35)	12.1%	18.9%	15.9%	14.9%	15.5%
Above target (>35)	9.0%	4.8%	4.3%	3.7%	3.6%
Below target (20-25)	12.7%	11.4%	13.1%	11.7%	9.7%
Below target (<20)	4.8%	4.5%	2.6%	0.6%	1.2%

Citr.. Hepa.. No ATC N.. No ATC Syste.. Regic..

Site
UAH GS ICU

Select Aggregation:
Quarter

Prescribed Dose Range
- Above target (>30)
- Below target (<25)
- In target range (25-30)

Average by CRRT run?
No

Select Date Range:
10/4/2022 12/31/2023

Q4

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QUESTIONS/COMMENTS

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