# Implementation of an Automated AKI Risk Stratification Algorithm is Associated with Improved Outcomes in Critically Ill Children Receiving CKRT

Michaela Collins BA, Kelli A Krallman RN MS, Natalja L Stanksi MD, Stuart L Goldstein MD

## Background

Starting July 2017, an acute kidney injury (AKI) risk stratification algorithm, Taking Focus 2 (TF2), was implemented in the PICU.

TF2 uses Renal Angina Index (RAI) directed NGAL measurement for clinical decision support to mitigate 20% fluid overload (FO) from ICU admission.

RAI considers risk and injury factors into its calculation, with scores ranging from 1-40:

| Risk Score | | |
|---|---|---|
| Patient Type | Risk Level | Score |
| ICU admission | Medium | 1 |
| History of Transplantation (Solid Organ or Bone Marrow) | High | 3 |
| Vasopressors AND Mechanical Ventilation | Very High | 5 |

x

| Injury Score | | |
|---|---|---|
| Δ in Creatinine | or Fluid Overload % | Score |
| < 0 | < 0-4.99 % | 1 |
| 1.0-1.49x | 5-9.99 % | 2 |
| 1.5-1.99x | 10-14.99 % | 4 |
| > 2x | >15 % | 8 |

The RAI is automatically calculated 12 hours after ICU admission and an NGAL order is reflexively placed for any scores resulting in 8 or greater.

Continuous kidney replacement therapy (CKRT) trends and outcomes were analyzed between the eras before and after the implementation of this algorithm to assess for any associations.

## Methods

The CKRT quality improvement database started housing data on patients starting in 2013. Data collection for this project ended September 2021. This totaled 106 and 168 patients in the pre- and TF2 cohorts, respectively.

PRISM III scores were analyzed to assess the acuity of the patient population between the groups. Scores for 82 and 141 patients were available in the pre- and TF2 cohorts, respectively.

The other variables analyzed include the time between ICU admission and CKRT start, CKRT duration, survival to CKRT discharge, survival to ICU discharge and ICU length of stay (LOS). All 106 and 168 pre- and TF2 patients were analyzed for these five variables.

Mann Whitney U tests were used for all non-normally distributed continuous data; Pearson chi-squared tests were used for all categorical data, with p-values of <0.05 considered significant.

A multivariable (MV) logistic regression model was developed to include variables associated with outcomes on bivariate analysis with p-value <0.20. This assessed for incremental associations between the variables and the outcomes.

## Results: Patient Demographics

| | Pre-TF2 | TF2 | p-value |
|---|---|---|---|
| Age | 11.3 [3.1,17.5] | 11.0 [2.0,17.1] | 0.61 |
| Weight | 29.5 [14.8,53.5] | 33.2 [12.6,59.9] | 0.73 |
| PRISM III | 12.5 [9,18] | 10 [6,15] | 0.014 |

Neither age nor weight differed between the two groups.

PRISM III scores were higher in the pre-TF2 cohort, suggesting greater illness severity at PICU admission.

Percentage of fluid overload data at CKRT start was added to all patients starting in March 2015. 70 patients' worth of data was available for FO analysis in the pre-TF2 cohort.
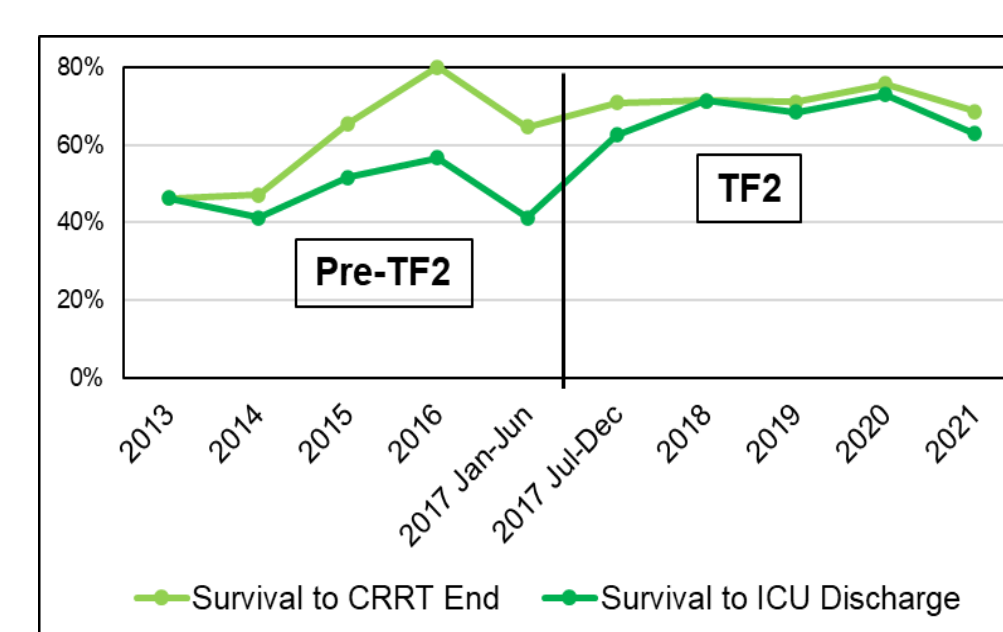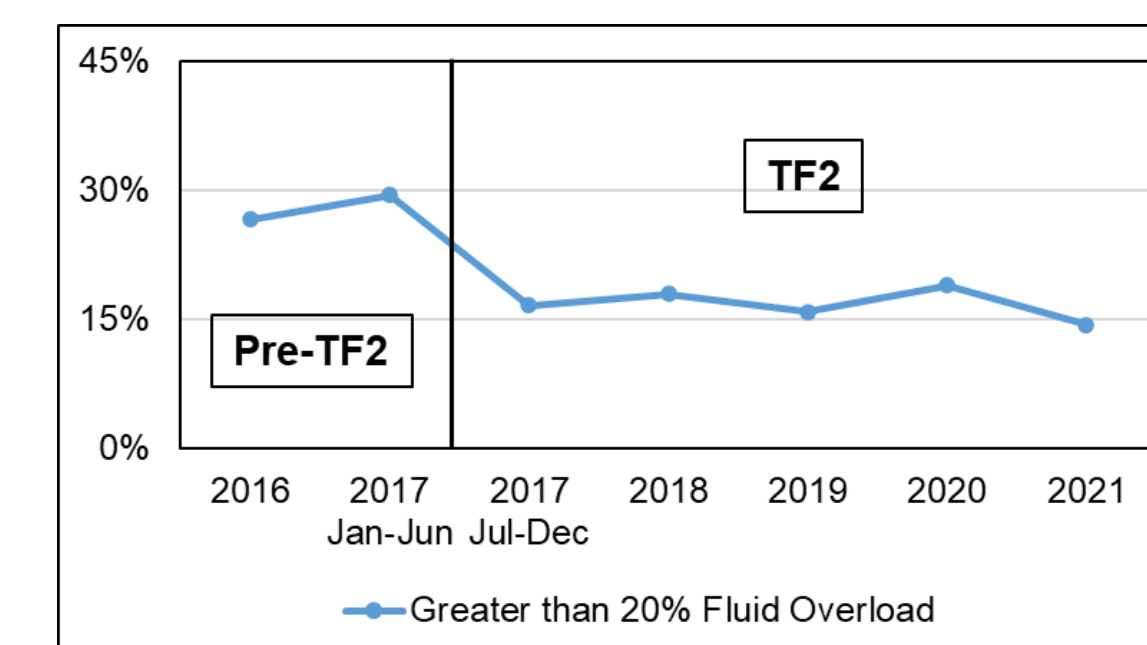


Patients by %FO
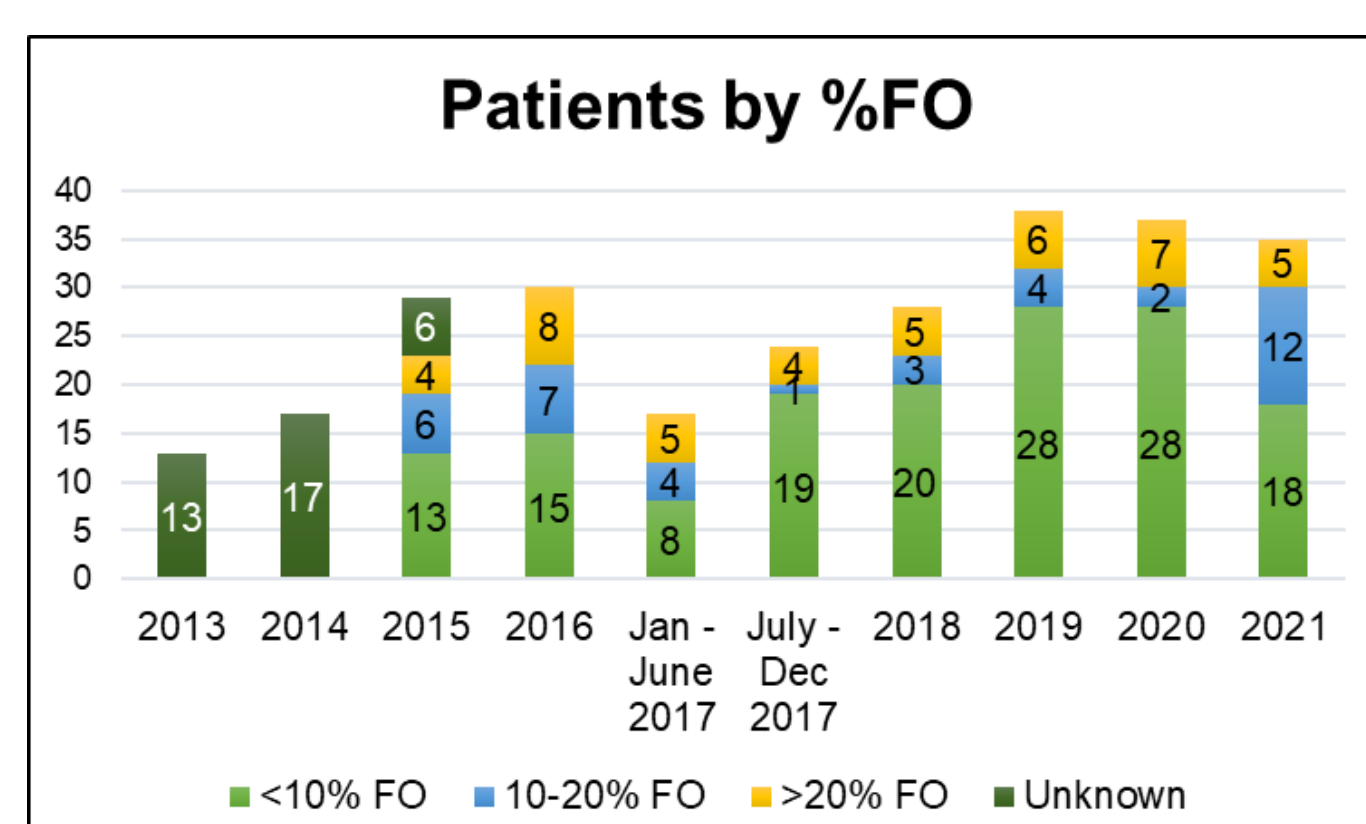
## Outcomes and Trends
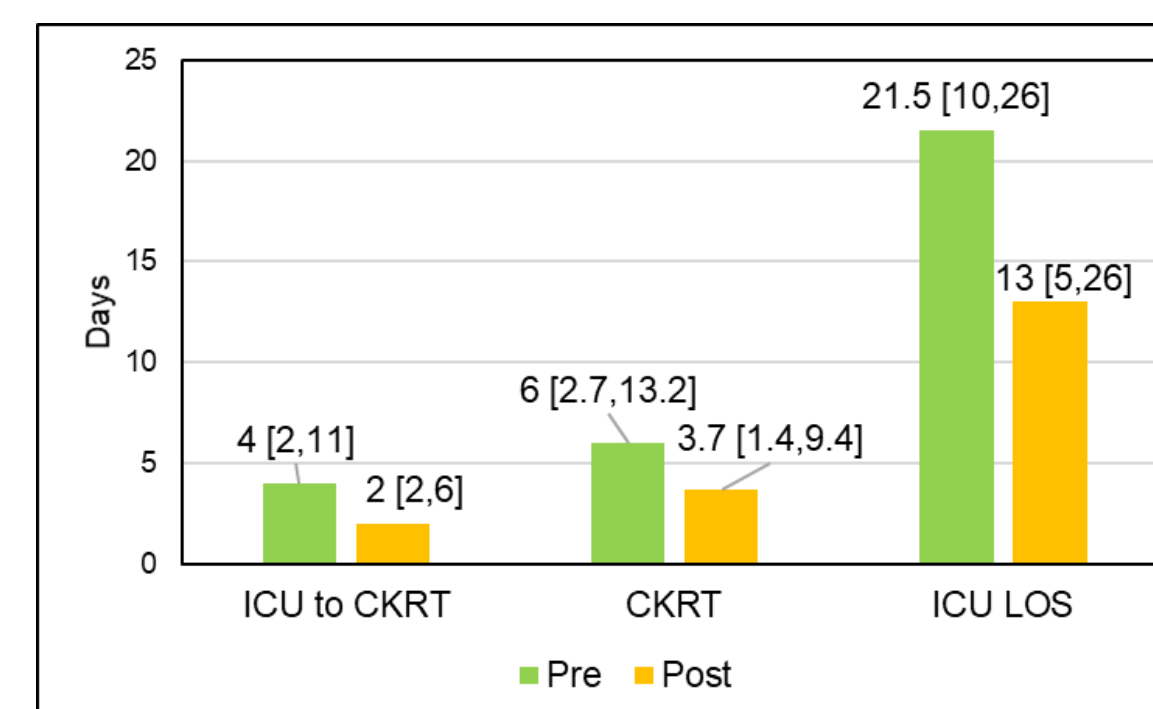


Patients in the pre-TF2 era spent more time in the ICU before starting CKRT, more time on CKRT, and more total time in the ICU.

Patients in the pre-TF2 cohort were more FO at CKRT start. On average, pre-TF2 patients were 9.5% FO and TF2 patients were only 3.7% FO.





Survival rates to ICU discharge were higher in the TF2 era.

| | p-value |
|---|---|
| Days Between ICU Admission and CKRT Start | 0.0002 |
| Duration of CKRT | 0.005 |
| ICU Length of Stay | 0.0001 |
| Percent Fluid Overload | 0.0001 |
| Survival to CKRT Discharge | 0.19 |
| Survival to ICU Discharge | 0.001 |

## Multivariable Logistic Regression

A MV logistic regression model included TF2 era, PRISM III scores, days between ICU admission and CKRT start, and %FO to assess for a potential association with ICU mortality.

The only variable that retained association associated with ICU mortality was TF2 era.

| | P Value | Odds Ratio (95% CI) |
|---|---|---|
| Era | 0.000 | 4.38 (2.10-9.12) |
| Days Between ICU Admission and CKRT Start | 0.075 | 0.97 (0.95-1.00) |
| PRISM III Score | 0.660 | 1.01 (0.97-1.05) |
| % FO | 0.356 | 0.99 (0.96-1.01) |

## Conclusion

We observed a greater than four-year persistent association between TF2 implementation and improvement in CKRT outcomes in the PICU, including survival to ICU discharge.

Given the association between TF2 and shorter CKRT duration and ICU LOS, there is suggestion that the TF2 algorithm has the potential to reduce healthcare costs.

## Acknowledgments