Management of Renal Replacement Therapy in Acute Kidney Injury: A Survey of Practitioner Prescribing Practices

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Background: Data on current practices for management of renal replacement therapy (RRT) in acute kidney injury (AKI) are limited, particularly with regard to the dosing of therapy.

Design, setting, participants, and measurements: A survey was conducted of practitioners at the 27 study sites that participate in the Veterans Affairs/National Institutes of Health Acute Renal Trial Network (ATN) Study before initiation of patient enrollment for ascertainment of the local prevailing practices for management of RRT in critically ill patients with AKI. Surveys were returned from 130 practitioners at 26 of 27 study sites; the remaining study site provided aggregate data.

Results: Intermittent hemodialysis and continuous RRT were the most commonly used modalities of RRT, with sustained low-efficiency dialysis and other "hybrid" treatments used in fewer than 10% of patients. Intermittent hemodialysis was most commonly provided on a thrice-weekly or every-other-day schedule, with only infrequent assessment of the delivered dosage of therapy. Most practitioners reported that they did not dose continuous RRT on the basis of patient weight. The average prescribed dosage of therapy corresponded to a weight-based dosage of no more than 20 to 25 ml/kg per h.

Conclusions: These results provide insight into clinical management of RRT and provide normative data for evaluation of the design of ongoing clinical trials.

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Data on current practices for management of renal replacement therapy (RRT) in acute kidney injury (AKI) are limited, particularly with regard to the dosing of therapy. Surveys of nephrologists that were conducted in the United States in 1995 (1) and in Canada in 1999 (2) focused primarily on modality of RRT used and did not address the prescribed or delivered dosage of therapy. Similarly, observational studies, such as the Program to Improve Care in Acute Renal Disease (PICARD) study, provide data related to treatment modality but not treatment dosage (3). A survey that was conducted in 2004 at an international course on critical care nephrology evaluated dosing practices for RRT but only in patients with sepsis-associated AKI (4). Thus, although several recent clinical trials have suggested that more intensive regimens for the management of intermittent hemodialysis (IHD) (5) and continuous RRT (CRRT) (6) are associated with improved survival, the impact of these studies on clinical practice is unclear.

The Veterans Affairs (VA)/National Institutes of Health Acute Renal Failure Trial Network (ATN) Study is a multicenter, randomized, controlled trial to compare an intensive management strategy for RRT in critically ill patients with AKI with a less intensive ("conventional") dosing strategy (7). However, in the absence of robust data regarding clinical practice patterns, the relationship between the study's protocol-driven treatment arms and usual care is uncertain. For this reason, a survey of practitioners at the 27 medical centers and university-affiliated VA hospitals that participated as ATN Study sites was conducted before initiation of patient enrollment to ascertain the local prevailing practices for management of RRT in critically ill patients with AKI.

Materials and Methods

Survey Methods

The survey was sent from the Study chairman's office to the site investigators at the 27 original sites that are participating in the ATN Study (Ann Arbor VA, Buffalo VA, Dallas VA, Houston VA, Indianapolis VA, Little Rock VA, West Los Angeles VA, Miami VA, Nashville VA, New Orleans VA, Pittsburgh VA, Portland VA, Richmond VA, San Diego VA, San Francisco VA, San Juan VA, Seattle VA, West Haven VA, Cleveland Clinic Foundation, Johns Hopkins University, Massachusetts General Hospital, University of Miami, University of California at San Francisco, University of Pittsburgh, University of Texas at Houston, Wake Forest University, and Washington University at St. Louis) in October 2003, before initiation of study enrollment in November 2003. The site investigators at the 27 study sites were asked to distribute the survey to all practitioners who were responsible for prescribing RRT at their site. Site investigators returned surveys to the ATN Study chairman's office at the VA Pittsburgh Healthcare System, where the data were analyzed.

The survey was approved by the institutional review board (IRB) at

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the VA Pittsburgh Healthcare System as a review preparatory to research. As data were collected with no information regarding the identity of individual practitioners other than specialty (nephrologist or intensivist) and study site; the analysis and reporting of data were approved by the IRB at the VA Pittsburgh Healthcare System as exempt research.

Survey Design

The survey consisted of 26 questions. (A copy of the survey is available online as supplementary material.) Demographic questions asked the practitioner to identify his or her study site, specialty (nephrologists or intensivist), and the estimated number of critically ill patients with AKI whom the practitioner treats with RRT each month. Seven questions related to the prescription of IHD, including estimation of his or her relative frequency of use of IHD as the modality of RRT in critically ill patients with AKI and the frequency of his or her use of treatment schedules ranging from twice weekly to daily; specification of his or her usual prescribed blood flow rate, duration of treatment, and target dosage of therapy (urea reduction ratio or Kt/V_{urea}); and whether and how frequently he or she assessed delivery of hemodialysis dose. A similar set of questions was asked about the use of sustained low-efficiency dialysis (SLED) and other forms of extended-duration hemodialysis. Nine questions focused on the prescription of CRRT, including estimation of his or her relative frequency of use of CRRT as the modality of RRT in critically ill patients with AKI; specification of the modalities of CRRT that he or she used (vascular access: arteriovenous or venovenous; modality: hemofiltration, hemodialysis, or hemodiafiltration); specification of his or her usual prescribed blood flow rate; characterization of whether he or she prescribed CRRT on the basis of patient weight and what his or her usual prescribed effluent flow rate (sum of dialysate flow rate and ultrafiltration rate) was (as ml/h or ml/kg per h); and specification of the composition of fluids that he or she used as replacement fluid and dialysate.

Statistical Analyses

Aggregated data are summarized using descriptive statistics. All data were analyzed at the practitioner level unless otherwise noted. The relative frequency of use of each modality of RRT at the patient level and the frequency with which different treatment schedules were used in the management of IHD and SLED was calculated from the total number of patients treated per month and the percentage use of each modality of RRT as reported by each practitioner. Data are presented as means ± SD, median and interquartile range (IQR), or the percentage of patients treated, as appropriate.

Results

Survey Response Rate

Completed surveys were returned from all 27 study sites. One site provided aggregate data for all providers at that site; 130 surveys were returned from the remaining 26 sites. Eighty-four surveys were completed by providers at the 18 participating Department of Veterans Affairs (VA) medical centers and 66 surveys by providers at the nine non-VA university study sites. Twenty practitioners provided care at both VA and university sites. There were a median of five respondents per site (IQR 3 to 7) with a median of four respondents (IQR: 3 to 5.8) at the VA sites and 7.5 respondents (IQR 5.8 to 11.2) at the university sites. Respondents reported treating a median of 7.5 critically ill patients with AKI each month (IQR 3.5 to 20) with a median of five patients per month (IQR 2 to 9) at the VA sites and 15 patients per month (IQR 5 to 25) at the university sites. The 20 practitioners who provided care at both VA and university sites reported treating a median of 10 patients per month (IQR 4.2 to 20). Only one respondent identified himself as an intensivist, two did not specify a specialty, and all of the remaining respondents identified themselves as nephrologists (Table 1).

Modality of RRT Used

All but two providers responded that they used IHD in the management of RRT for critically ill patients with AKI. A total of 112 (86.2%) providers responded that they used some form of CRRT in the treatment of critically ill patients with AKI, whereas 32 (24.6%) providers reported using SLED. Eleven (8.5%) providers reported using only IHD, one (0.8%) reported using only CRRT, and 25 (19.2%) reported using all three modalities of renal support. Whereas only one respondent at a non-VA site did not use CRRT, 17 respondents at seven VA sites indicated that they did not use these modalities. Adjusting for the number of patients that each provider reported treating, the relative frequency of use of each of the modalities of RRT was 57% for IHD, 35.7% for CRRT, and 7.3% for SLED (Table 1).

IHD

The frequency with which different treatment schedules are used in the management of IHD was calculated on the basis of the reported number of patients treated per month, frequency of use of IHD, and reported frequency of use of dialysis treatment schedules ranging from twice weekly to daily dialysis (Figure 1). Fewer than 1% of patients were prescribed hemodialysis less frequently than three times per week. Overall, approximately 52% of patients were treated on a thrice-weekly or every-other-day schedule, 32% of patients received IHD four times per week, and approximately 7% of patients received IHD six or more times per week. There was substantial variation in the frequency of use of different treatment schedules between sites (Figure 1); however, practitioners at only one site reported prescription of IHD six or more times per week for >20% of patients. There was no significant difference in the frequency of IHD treatments at VA as compared with non-VA sites (Table 2).

The median reported blood flow rate used for IHD was 350 ml/min (IQR 300 to 360 ml/min), and the median reported duration for the IHD treatments was 4.0 h (IQR 3.5 to 4.0 h). Practitioners were asked to identify their target dosage of prescribed hemodialysis. Seven percent indicated that they prescribed IHD with a goal of delivering a Kt/V_{urea} of at least 1.2 per treatment, and 31% reported a target urea reduction ratio of at least 0.65. A total of 56% of practitioners responded that they had no particular target dosage of hemodialysis for critically ill patients with AKI. A total of 78.9% of practitioners reported that they did not routinely assess the delivered dosage of hemodialysis; 21.1% of practitioners indicated that they measured the delivered dosage of therapy at least once per week, and 11.7% reported that they assessed the delivered dosage of IHD more than once per week. There was clustering of responses by institution, with >70% of the respondents who

Table 1. Modality of RRT[a]

Site	Practitioners Responding (*n*)	Patients per Month with AKI (Median [IQR])	Modality of RRT					
			% of Practitioners Who Use			% of Patients Treated with		
			IHD	CRRT	SLED	IHD	CRRT	SLED
VA sites								
A	5	3.5	100.0	100.0	—	31.8	68.2	—
B	2	2.8	100.0	100.0	—	25.0	75.0	—
C	3	10.0	100.0	100.0	—	48.2	51.8	—
D	1	5.0	100.0	—	—	100.0	—	—
E	4	5.0	100.0	100.0	—	67.2	37.8	—
F	7	17.5	100.0	43.0	100.0	73.0	2.4	24.6
G	3	3.5	100.0	—	—	100.0	—	—
H	8	4.5	87.5	100.0	37.5	39.3	56.2	4.5
I	4	4.0	100.0	100.0	—	65.4	34.6	—
J	1	2.0	100.0	—	100.0	70.0	—	30.0
K	6	5.5	100.0	100.0	16.7	56.8	38.3	4.9
L	3	7.5	100.0	100.0	—	80.2	19.7	—
M	4	4.5	100.0	75.0	—	79.5	20.5	—
N	5	1.0	100.0	20.0	60.0	85.5	1.7	12.8
O	3	4.0	100.0	—	—	100.0	—	—
P	5	2.0	100.0	100.0	—	93.9	6.1	—
all VA	64	5.0 (2.0 to 9.0)	98.4	73.4	23.4	63.7	28.5	7.8
Non-VA sites								
Q	[b]	30.0	100.0	100.0	—	40.0	60.0	—
R	4	35.0	100.0	100.0	—	36.4	63.6	—
S	6	2.8	100.0	83.3	—	18.3	81.7	—
T	7	10.0	100.0	100.0	28.6	32.9	65.8	1.4
U	13	25.0	100.0	100.0	100.0	60.0	20.0	20.0
V	5	5.0	100.0	100.0	—	46.5	53.5	—
W	11	12.0	100.0	100.0	—	74.1	25.8	—
all non-VA	46	15.0 (5.0 to 25.0)	100.0	97.8	15.2	54.0	36.8	9.1
Combined VA/non-VA sites								
X	8	10.0	87.5	100.0	12.5	40.7	59.2	0.1
Y	12	8.8	100.0	100.0	8.3	65.0	34.0	1.0
all combined	20	10.0 (4.2 to 20.0)	95.0	100.0	10.0	56.0	43.3	0.6
All sites	130	7.5 (3.5 to 20.0)	98.5	86.2	24.6	57.0	35.7	7.3

[a]AKI, acute kidney injury; CRRT, continuous renal replacement therapy; IHD, intermittent hemodialysis; IQR, interquartile range; RRT, renal replacement therapy; SLED, sustained low-efficiency dialysis and other forms of hybrid therapy; VA sites, Department of Veterans Affairs medical centers; non-VA sites, university-affiliated non-VA medical centers.
[b]Site provided aggregate data for all practitioners.

indicated that they routinely assessed the delivered dosage of IHD practicing at only three of the 26 institutions that provided individual responses.

SLED

Only 24.6% of respondents, at nine institutions, reported use of SLED in the treatment of critically ill patients with AKI. A total of 72.6% of patients who received SLED received treatments on a daily basis. The median reported blood flow rate was 150 ml/min (IQR 150 to 200 ml/min), the median dialysate flow rate was 100 ml/min (IQR 100 to 200 ml/min), and the median duration of therapy was 19 h (IQR 10 to 24 h; Table 3).

CRRT

A total of 107 (95.5%) of the 112 providers who reported use of CRRT indicated that they used venovenous modalities of therapy; five (4.5%) providers reported using both venovenous and arteriovenous modalities, and four (3.6%) providers reported use of only arteriovenous CRRT. Forty-three (38.4%) of the 112 providers reported use of continuous hemofiltration, 78 (69.6%) reported use of continuous hemodialysis, and 67 (59.8%) reported use of hemodiafiltration. The median reported blood flow during venovenous therapy was 150 ml/min (IQR 125 to 170 ml/min). Only 20 (17.9%) practitioners reported dosing CRRT on the basis of patient weight, with 16 (80%) of

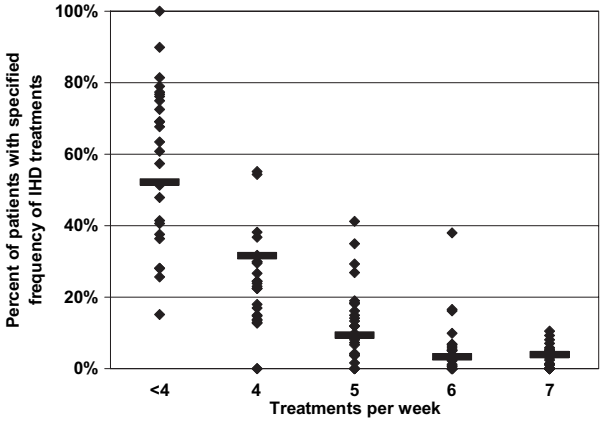

Figure 1. Percentage of patients with specified frequency of intermittent hemodialysis (IHD) treatment. Horizontal lines represent pooled data from all sites; symbols represent data for individual sites. Data for treatment schedules that were less frequent than four times per week (two times per week, three times per week, and alternate-day treatment schedules) are pooled.

the 20 practitioners prescribing an effluent flow rate of at least 35 ml/kg per h. Of the practitioners who did not report use of weight-based prescription of CRRT, the median reported effluent flow rate was 1825 ml/h (IQR 1200 to 2400 ml/h; Table 4).

There was wide variation in the composition of dialysate and replacement fluids. Of the 99 practitioners who described dialysate composition, 30.3% indicated that they used bicarbonate-buffered dialysate, 26.2% that they used lactate-buffered dialysate; 14.1% that they used both bicarbonate- and lactate-buffered dialysate, and 14.1% that they used citrate-buffered dialysate, 2% that they used acetate-buffered dialysate; 13.1% did not specify a buffer. Of the 98 respondents who described the composition of replacement fluids, 35.7% indicated that they used bicarbonate-buffered fluids, 17.3% that they used normal saline, 5.1% that they used citrate-buffered fluids, and 4.1% that they used lactate-buffered fluids; 37.8% used selected buffer composition on a case-by-case basis or did not specify buffer composition.

Discussion

Clinical practice patterns for the management of RRT in patients with AKI are poorly characterized. Our survey was conducted at 27 academic university-affiliated and VA medical centers before the initiation of a multicenter, randomized, controlled trial to compare two strategies of intensity of RRT in critically ill patients with AKI at those sites (7). The survey demonstrated that there was wide variability in the management of RRT. There was less use of CRRT at VA sites, but, otherwise, there were no differences in prescribing practices by facility type.

IHD was the most widely used modality of renal support, used by virtually all practitioners and accounting for more than half of all patient treatments. The majority of patients who were treated with IHD received treatments on a thrice-weekly or every-other-day schedule, with only 7% of patients receiving treatments six or more times per week. More than half of practitioners did not specify a target delivered dosage of IHD in this population, and more than three quarters of practitioners indicated that they did not routinely monitor the delivered dosage of therapy. These results are notable in light of the fact that the survey was conducted more than 18 mo after publication of a study that demonstrated improved survival with daily IHD as compared with alternate-day therapy in patients with AKI (5). In addition, although studies to evaluate the optimal delivered dosage per treatment in AKI have not been conducted, expert consensus has recommended a minimum Kt/V_{urea} of at least 1.2 delivered three times per week in this population (8). The absence of assessment of the actual delivered dosage of therapy is also notable in light of studies that documented large discrepancies between the prescribed and the delivered dosage of dialysis in this population (5,9,10).

The survey provides only limited data on the use of SLED and other forms of "hybrid" therapy. These modalities of treatment were reported as used at only one third of the institutions. Although approximately one quarter of respondents reported using these modalities, the majority also used CRRT in hemodynamically unstable patients. On the basis of the survey data, fewer than 10% of patients were treated with SLED. When SLED is used, the vast majority of patients are treated on a daily basis. No providers reported routine monitoring of the delivered dosage of therapy during SLED.

More than 95% of providers reported use of CRRT. Nine percent reported use of arteriovenous therapies, either as their exclusive modality of CRRT or in addition to use of venovenous therapy, despite the widespread availability of equipment for venovenous CRRT and the markedly lower rate of vascular complications with venovenous therapy (11). There was substantial variation in the reported modalities of CRRT used, with greater use of diffusive as compared with convective therapies. Fewer than 20% of practitioners reported using weight-based dosing of CRRT, with the majority of these prescribing an effluent flow at least equal to the intermediate dosage arm (35 ml/kg per h) in the study by Ronco *et al.* (6). The median effluent flow rate of 1800 ml/h that was reported to be prescribed by practitioners who did not use weight-based dosing represents a flow rate of 20 to 25 ml/kg per h, assuming an average patient weight of 80 kg. This is a dosage that corresponds to the low-dosage arm in the study by Ronco *et al.* (6), which was published 3 yr before the survey and demonstrated improved survival with higher dosages of continuous venovenous hemofiltration.

The results of this survey suggest an absence of a consistent standard for the prescription and monitoring of RRT in the setting of AKI. This is in stark contrast to the management of dialysis in the long-term setting, where there are well-established clinical practice guidelines and performance measures. Although much of the variability in treatment in the acute setting can be attributed to the absence of a robust evidence base to support treatment standards, the absence of monitoring of delivered treatment dosage is surprising.

The results of this survey are also of relevance to the design and ethical conduct of clinical trials of RRT in AKI in general and specifically to the conduct of the ATN Study (7). The relationship

Table 2. Management of IHD[a]

Site	Respondents Using IHD	Treatment Frequency (%)							Median Treatment Duration (hr)	Median BFR (ml/min)	Monitoring of Delivered Dosage (No. of Practitioners)
		2/wk	3/wk	Every Other Day	4/wk	5/wk	6/wk	7/wk			
VA sites											
A	5	—	47.8	—	38.1	14.1	—	—	4.0	400	5/5
B	2	—	15.9	25.5	31.8	26.8	—	—	4.0	350	—
C	3	—	75.7	0.5	23.8	—	—	—	4.0	300	—
D	1	—	75.0	—	13.0	12.0	—	—	3.5	300	—
E	4	—	69.1	—	12.7	18.2	—	—	4.0	310	1/4
F	7	1.9	65.4	0.3	29.9	1.6	0.9	—	4.0	400	1/7
G	3	3.1	60.6	—	24.4	11.9	—	—	4.0	300	—
H	7	—	45.9	5.4	22.5	16.2	6.9	3.0	4.0	300	1/7
I	4	—	40.6	—	29.5	18.9	6.0	5.0	4.0	350	—
J	1	—	69.0	—	15.0	10.0	5.0	1.0	4.0	350	—
K	6	—	13.3	14.8	26.7	29.2	16.1	—	3.25	300	2/6
L	3	—	49.5	7.8	24.5	7.3	5.5	5.4	3.0	350	—
M	4	—	39.4	38.0	16.9	—	—	10.6	3.5	360	—
N	5	—	18.2	18.1	36.8	13.3	6.6	7.1	4.0	300	—
O	3	—	37.5	—	22.5	35.0	38.0	1.2	3.5	325	—
P	5	—	90.0	—	—	—	10.0	—	4.0	350	—
all VA	63	0.7	51.4	5.7	25.7	10.9	3.7	2.0	4.0	350	10/63
Non-VA sites											
Q	—[b]	—	88.9	11.1	—	—	—	—	4.0	350	—[b]
R	4	—	56.9	15.7	13.7	6.7	1.2	5.9	3.0	325	—
S	6	—	73.8	2.9	23.1	18.4	—	—	4.0	350	5/6
T	7	—	23.1	2.5	54.4	15.0	2.5	2.5	3.5	350	—
U	13	—	16.5	11.6	55.2	8.0	0.7	8.0	4.0	350	—
V	5	—	81.5	—	14.8	3.7	—	—	4.0	300	1/5
W	11	—	77.2	1.8	13.5	3.9	2.2	1.4	3.5	375	10/11
all non-VA	46	—	41.8	8.3	36.7	6.8	1.2	5.2	4.0	350	16/46
Combined VA/non-VA sites											
X	7	—	12.9	2.2	17.9	41.2	16.6	9.2	3.5	400	—
Y	12	1.2	57.8	1.8	29.9	4.2	5.1	—	4.0	350	1/12
all combined	19	0.9	45.5	1.9	26.6	14.3	8.2	2.5	4.0	350	1/19
All sites	128	0.4	45.4	6.4	31.6	9.3	3.2	3.8	4.0	350	27/128

[a]BFR, blood flow rate; IHD, intermittent hemodialysis.
[b]Site provided aggregate data for all practitioners.

between clinical trial interventions and concurrent clinical practice has been the subject of intense controversy (12–17). Two years after publication of the results of the Acute Respiratory Distress Syndrome Network's (ARDSNet) ARMA Trial (Prospective, Randomized, Multi-Center Trial of 12 ml/kg *versus* 6 ml/kg Tidal Volume Pressure Ventilation for Treatment of Acute Lung Injury and Acute Respiratory Distress Syndrome), which evaluated the efficacy of lower tidal volume ventilation in acute respiratory distress syndrome (18), the design of the study was challenged as ethically unsound on the basis of the contention that it compared groups that reflected extremes of practice rather than intermediate tidal volumes that were putatively more commonly used (17,19). The critics argued that both protocol-driven treatment arms constituted experimental interventions and that a non–protocol-driven arm ("wild-type therapy") was ethically required as a control group for assessment of both safety and efficacy. Although the Office for Human Research Protections (OHRP) of the United States Department of Health and Human Services ultimately did not find fault with the ARDSNet study design, OHRP faulted the IRB that were responsible for oversight of the ARDSNet studies for failing to obtain sufficient information required to assess the risks to patients (20). Specifically, OHRP opined that the IRB should have been provided "a clear detailed description of concurrent routine clinical practice at the ARDS Network trial sites with respect to management of tidal volume in patients with ALI and ARDS" and "a detailed comparison of the tidal volume management strategies that were to be used in the two experimental groups relative to concurrent routine clinical practice" (20).

This OHRP opinion affects the design and the conduct of trials of RRT in AKI. As was the case with the ARDS Network studies, the ATN Study compares two protocol-driven strategies of titrated therapy and does not include a concurrent, non–protocol-directed control arm. We therefore conducted this survey after the release of the OHRP determination in July 2003 to assess the relationship between the treatment arms of the ATN Study and concurrent clinical practice. In the less

Table 3. Management of SLED[a]

Site	Respondents Using SLED	Treatment Frequency						Median Treatment Duration (h)	Median BFR (ml/min)	Median DFR (ml/min)
		3/wk	Every Other Day	4/wk	5/wk	6/wk	7/wk			
VA sites										
F	7	19.7	4.0	42.6	19.0	14.3	0.4	12.0	200	200
H	3	1.4	2.9	7.1	50.0	14.3	24.3	24.0	150	100
J	1	—	—	—	10.0	70.0	20.0	10.0	200	200
K	1	—	—	—	—	—	100.0	NR	NR	NR
N	3	15.8	—	—	14.2	30.5	39.5	8.0	150	100
all VA	15	16.9	3.3	34.3	18.6	15.6	11.2	12.0	200	100
Non-VA sites										
T	2	—	—	—	50.0	50.0	—	6.0	200	500
U	13	—	—	—	—	—	100.0	24.0	150	100
all non-VA	15	—	—	—	0.7	0.7	98.6	24.0	150	100
Combined VA/non-VA sites										
X	1	60.0	—	20.0	20.0	—	—	8.0	250	300
Y	1	—	—	—	20.0	75	5.0	5.5	200	500
all combined	2	3.8	—	1.2	20.0	70.3	4.7	6.75	225	400
All sites	32	5.0	1.0	10.0	6.2	6.1	71.7	19.0	150	100

[a]NR, no response; DFR, dialysate flow rate.

intensive "conventional" treatment arm of the ATN Study, IHD and SLED are provided on a thrice-weekly schedule, with a target delivered Kt/V_{urea} of 1.2 per treatment, and continuous venovenous hemodiafiltration is provided at a prescribed effluent flow rate of 20 ml/kg per h. In the intensive therapy arm, IHD and SLED are provided on a six-times-per-week schedule, with a target delivered Kt/V_{urea} of 1.2 per treatment, and continuous venovenous hemodiafiltration is provided at a prescribed effluent flow rate of 35 ml/kg per h. We believe that the survey results suggest that "wild-type" therapy at the time of initiation of the study was most similar to the ATN Study's less intensive "conventional" treatment arm. IHD was provided with a treatment frequency of between three and four times per week in >80% of patients, with the actual delivered dosage of therapy not being monitored. Similarly, although there was wider variation in the dosing of CRRT, the practitioner responses suggest that the majority of patients are prescribed dosages that are similar to or less than the dosage of therapy specified in the "conventional" treatment arm of the ATN Study. In contrast, the survey indicates that the majority of "wild-type" patients who were treated with SLED received treatment on a daily treatment schedule rather than the thrice-weekly schedule of the conventional treatment arm. Overall, however, there was minimal use of SLED, and the more intensive dosing that was used for this modality has only little impact on the overall intensity of "wild-type" therapy.

There are significant limitations to this survey. The results of this survey may not be generalizable beyond the 27 participating sites. In addition, the reliability of practitioner-reported prescribing practices was not validated by comparison with actual treatment data. Prescribing practices may also change over time, in part influenced by the ongoing clinical trial. For these reasons, observational data on the prescription and delivery of RRT is being collected on patients at participating study sites who meet the eligibility criteria for the interventional study but for whom informed consent could not be obtained. These data will provide a more objective assessment of the relationship between study therapy and concurrent treatment outside the study and will allow assessment of changes in "wild-type" therapy over the duration of the study.

Conclusion

We conducted a survey of practitioners at the 27 sites that are participating in the ATN Study before patient enrollment to assess patterns of clinical practice for the management of RRT in patients with AKI. IHD and CRRT were the most commonly used modalities of therapy, with SLED and other "hybrid" treatments used in fewer than 10% of patients. IHD was most commonly provided on a thrice-weekly or every-other-day schedule, with only infrequent assessment of the delivered dosage of therapy. Most practitioners reported that they did not dose CRRT on the basis of patient weight, and their average prescribed dosage of therapy corresponded to a weight-based dosage of no more than 20 to 25 ml/kg per h. These dosing patterns correspond to the nonintensive treatment arm of the ATN Study. Whereas some practitioners reported using dosing strategies similar to the intensive treatment arm of the ATN Study, very few reported the use of intermediate dosing strategies.

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Table 4. Management of CRRT[a]

Site	Respondents Using CRRT	CRRT Modalities Used (*n* [%] of Respondents)				Weight-Based Dosing		Non–Weight-Based Dosing	
		AV Modalities	CVVH	CVVHD	CVVHDF	*n* (%)	Median Dosage (ml/kg per h)	*n* (%)	Median Dosage (ml/h)
VA sites									
A	5	—	1 (20.0)	5 (100.0)	—	—	—	5 (100.0)	2000
B	2	—	2 (100.0)	—	—	—	—	2 (100.0)	NR
C	3	—	—	1 (33.3)	3 (100.0)	2 (66.7)	35	1 (3.33)	1850
E	4	—	4 (100.0)	2 (50.0)	2 (50.0)	1 (25.0)	35	3 (75.0)	1000
F	3	2 (66.7)	1 (33.3)	1 (33.3)	1 (33.3)	—	—	3 (100.0)	1000
H	8	1 (12.5)	2 (25.0)	8 (100.0)	—	—	—	8 (100.0)	1000
I	4	—	3 (75.0)	3 (75.0)	4 (100.0)	—	—	4 (100.0)	2500
K	6	—	—	2 (33.3)	4 (66.7)	—	—	6 (100.0)	2000
L	3	—	1 (33.3)	1 (33.3)	2 (66.7)	1 (33.3)	25	2 (66.7)	1800
M	3	—	2 (66.7)	3 (100.0)	3 (100.0)	—	—	3 (100.0)	1100
N	1	—	1 (100.0)	—	—	—	—	1 (100.0)	1500
P	5	—	5 (100.0)	5 (100.0)	4 (80.0)	—	—	4 (100.0)	NR
all VA	47	3 (6.4)	22 (46.8)	31 (66.0)	23 (48.9)	4 (8.5)	35	42 (89.4)	1800
Non-VA sites									
Q	—[b]	—[b]	—[b]	—[b]	—[b]	—	—	—[b]	2000
R	4	—	—	4 (100)	—	—	—	4 (100.0)	1500
S	5	—	4 (80)	1 (20)	—	—	—	5 (100.0)	1600
T	7	2 (28.6)	7 (100.0)	2 (28.6)	7 (100.0)	5 (71.4)	35	2 (28.6)	1000
U	13	—	—	13 (100.0)	13 (100.0)	—	—	13 (100.0)	2400
V	5	—	—	3 (60.0)	3 (60.0)	—	—	5 (100.0)	1000
W	11	2 (18.2)	2 (18.2)	9 (81.8)	4 (36.4)	1 (9.1)	35	10 (90.9)	1500
all non-VA	45	4 (8.9)	13 (28.9)	32 (71.1)	27 (60.0)	6 (13.3)	35	39 (86.7)	1600
Combined VA/non-VA sites									
X	8	2 (25.0)	3 (37.5)	4 (50.0)	6 (75.0)	5 (62.5)	35	3 (37.5)	2250
Y	12	—	5 (41.7)	11 (91.7)	11 (91.7)	5 (41.7)	35	7 (58.3)	2300
all combined	20	2 (10.0)	8 (40.0)	15 (75.0)	17 (85.0)	10 (50.0)	35	10 (50.0)	2400
All sites	112	9 (8.0)	43 (38.4)	78 (69.6)	67 (59.7)	20 (17.9)	35 (IQR 35 to 35)	91 (81.2)	1825 (IQR 1200 to 2400)

[a]CVVH, continuous venovenous hemofiltration; CVVHD, continuous venovenous hemodialysis; CVVHDF, continuous venovenous hemodiafiltration.
[b]Site provided aggregate data for all practitioners.

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Disclosures

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