Renal Replacement Therapy Practices in India: A Nationwide Survey

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ABSTRACT

Introduction: Renal replacement therapy (RRT) is utilized for patients admitted with acute kidney injury and is becoming indispensable for the treatment of critically ill patients. In low middle income and developing country like India, the epidemiological date about the practices of RRT in various hospitals setups in India are lacking. Renal replacement therapy although is being widely practiced in India, however, is not uniform or standardized. Moreover, the use of RRT beyond traditional indications has not only increased but has shifted from the ambit of the nephrologist and has come under the charge of intensivists.

Aims and objectives: The goal of the study was to record perceptions and current practices in RRT management among intensivists across Indian intensive care units (ICUs).

Materials and methods: A questionnaire including questions about hospital and ICU settings, availability of RRT, manpower availability, and RRT management in critically ill patients was formed by an expert panel of ICU physicians. The questionnaire was circulated online to Indian Society of Critical Care Medicine (ISCCM) members in October 2019.

Results: The facilities in government setups are scarce and undersupplied as compared to private or corporate setups in terms of ICU bed strength and availability of RRT. High cost of continuous renal replacement therapy (CRRT) makes their use restricted.

Conclusion: Resources of RRT in our country are limited, more in government setup. Improvement of the existing resources, training of personnel, and making RRT affordable are the challenges that need to be overcome to judiciously utilize these services to benefit critically ill patients.

Keywords: Acute kidney injury, Continuous renal replacement therapy, Renal replacement therapy.

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INTRODUCTION

Acute kidney injury (AKI) in intensive care units (ICUs) is associated with a high mortality of up to 50–60% and almost 5–20% of the patients remain long-term dialysis dependent.[1] Thirty-two percent of patients with sepsis developed AKI who are admitted to ICU of developed countries.[2] Almost 20% of patients admitted in ICUs undergo renal replacement therapy (RRT) for various reasons.[3]

Renal replacement therapy modalities include intermittent hemodialysis (IHD), continuous renal replacement therapy (CRRT), and other hybrid techniques like slow low efficiency dialysis (SLED). Continuous renal replacement therapy is more readily available in corporate or private setup in comparison to a government setup and is utilized in ICU for hemodynamically unstable patients; its use is mainly constrained by high cost.[4] The epidemiological data from developing countries, such as India, about the use of various modalities of RRT in AKI are lacking. The main reason is that there is a considerable variation in the presentation and management of these patients which depends on the resource availability, socioeconomic standing of patients, and the type of hospital setup.[5]

The present survey was undertaken to study and assess the current RRT practices and resources available in ICUs of various institutions across India. The survey also attempted to study the factors influencing the indication, initial RRT modality preference and whether any difference existed with respect to setup of the treating hospitals. For patients initially treated with CRRT, data related to indications, time of initiation, and anticoagulation used were collected.

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MATERIALS AND METHODS

To broadly assess the knowledge about the current practices of RRT among intensivists in Indian ICUs, an online survey was devised by intensivists and nephrologists from different institutions across the country including questions on types of ICUs and the practices of RRT and the modalities used. The online form was distributed from October 11 to 20, 2019. The survey was sent to around 8,000 members of the Indian Society of Critical Care Medicine (ISCCM) through the ISCCM portal in India. The ICUs included were medical surgical ICUs. Specialty-specific and pediatric ICUs were excluded. The definitions of various hospitals are as follows:

- Government hospitals are defined as institutions owned by the state.
- Private hospitals are defined as hospitals owned by individual or a group of individuals which provide medical services.[6]
- Corporate hospitals are defined as hospitals which are public limited companies formed under the companies acts that run on commercial lines.[7]

    A teaching hospital is one which is running a course in critical care medicine (IDCCM/IFCCM/FNB/DNB/DM/PDCC). All others were considered as non-teaching hospitals.

Statistical Analysis

The data analysis was performed using statistical software SPSS (Version 20.0). Descriptive statistics were used for the analysis. The data for continuous variables were summarized as mean and were summarized as frequency and percentage. Statistical tests were two tailed, and $p < 0.05$ was considered to show a statistical difference. Chi-square test for association was performed between different treatments modalities used.

RESULTS (SURVEY QUESTIONNAIRE AS APPENDIX I)

To broadly assess the knowledge and practices of RRT among intensivists in Indian ICUs, an online survey was conducted through the ISCCM portal. The survey included basic questions on types of ICUs and specific questions (Appendix I) related to the practices of RRT. A total of 320 intensivists responded to the survey through an online portal. The reasons for few responses could be non-availability of the full-time practicing intensivist, unfamiliarity with survey and how to fill them, and a short time window of the survey.

Intensive Care Unit Settings

Majority of the respondents who responded to survey were practicing in a corporate (50%) or private (41%) setup as against 9% who were from a government setup. Overall critical care medicine teaching courses were being run in 65.9% of the total institutes which participated in the survey. While 68.75% and 57% of corporate and private setup, respectively, were teaching hospitals, almost 89.6% of the government hospital setup had a teaching program. In terms of capacity of ICU beds in different sectors, there was a statistically significant difference observed ($p = 0.000$), with 65.6% of government hospitals having <20 ICU beds (Table 1). In comparison, nearly 60% of the private and corporate hospitals had ICU bed strength of >30 beds. Out of all the ICUs that participated, only 20% were closed ICUs. Among the open types of ICUs, while 82.8% of corporate and private hospitals were being managed by a full-time intensivist, in government setups, it was the case in 34.5%.

Table 1: Basic information about participating intensive care units

Parameter	Types	n (%)
Institution	Teaching	211 (65.9)
	Non-teaching	109 (34.1)
Setup	Corporate	160 (50)
	Private	131 (40.9)
	Government	29 (9.1)
ICU beds	0–10	44 (13.8)
	11–20	72 (22.5)
	21–50	136 (42.5)
	>50	53 (16.6)
	>100	13 (4.1)
	>200	2 (0.6)
Type of ICU	Closed ICU	64 (20)
	Open ICU without full-time intensivist	44 (13.8)
	Open ICU with full-time intensivist	212 (66.3)
Bedside RRT	Yes	300 (93.8)
	No	20 (6.3)
Dialysis technician	Full time	257 (80.3)
	On call	40 (12.5)
	Part time	23 (7.2)
CRRT managed by	Nephrologist	160 (50)
	Dialysis technician	89 (27.8)
	Intensivist	65 (20.3)
	ICU nursing staff	6 (1.9)
Number of dialysis machines	<2	32 (10)
	2–10	220 (68.75)
	>10	68 (21.2)
Availability of CRRT	Yes	232 (72.5)
	No	88 (27.5)

Renal Replacement Therapy Facilities in Intensive Care Units

The survey aimed to find out the facilities available for RRT in ICUs in various setups. Basic RRT practices as reported from various respondents are shown in Table 2. It was reported that overall the accessibility of bedside RRT facility and CRRT in ICUs across the country was 93.8 and 72.5%, respectively. However, only 72.5% of the government hospitals had bedside RRT available as compared to 91.6% of private and 99.4% corporate hospitals ($p = 0.00$). Continuous renal replacement therapy was found to be available in 79.4, 65.6, and 65.5% of corporate, private, and government setup, respectively. In addition, only 34% of the government hospitals had a full-time dialysis technician available as compared to 91.3 and 71% of corporate and private hospitals, respectively.

    There was a significant difference in availability of RRT facilities between teaching and non-teaching hospitals as shown in Table 3. Bedside RRT facilities were available in 95.6% and 90.9% of teaching and non-teaching institutes respectively ($p = 0.041$). Similarly CRRT was performed in 82% and 55.1% of teaching and non-teaching institutes, respectively ($p = 0.000$). Full-time dialysis technician were more readily available in teaching hospitals (84.4%) as compared to non-teaching hospitals (72.5%) ($p = 0.034$).

Table 2: Difference in hospital setups

		Corporate, n (%)	Government, n (%)	Private, n (%)	p value
ICU beds	<10	8 (5)	8 (27.6)	28 (21.4)	0.000
	11–20.0	33 (20.6)	11 (37.9)	28 (21.4)	
	21–30	31 (19.4)	5 (17.2)	28 (21.4)	
	31–40	23 (14.4)	3 (10.3)	15 (11.5)	
	>40	65 (40.6)	2 (6.9)	32 (24.4)	
Type of ICU	Teaching	110 (34)	26 (8)	75 (23)	0.002
	Non-teaching	50 (16)	3 (1)	56 (18)	
Bedside RRT facility	No	1 (0.6)	8 (27.6)	11 (8.4)	0.000
	Yes	159 (99.4)	21 (72.4)	120 (91.6)	
Dialysis technician	Full time	146 (91.3)	10 (34.5)	101 (71)	0.000
	On call	11 (6.9)	10 (34.5)	19 (14.5)	
	Part time	3 (1.9)	9 (31)	11 (8.4)	
CRRT managed by	Dialysis technician	29 (18.1)	7 (24.1)	29 (22.1)	0.111
	ICU nursing staff	1 (0.6)	2 (6.9)	3 (2.3)	
	Intensivist	42 (26.3)	11 (37.9)	36 (27.5)	
	Nephrologist	88 (55)	9 (31)	63 (48.1)	
No. of dialysis machines	<2	4 (2.5)	9 (31)	19 (14.5)	0.000
	2–10.0	114 (71.3)	18 (62.1)	88 (67.2)	
	>10	42 (26.3)	2 (6.9)	24 (18.3)	
CRRT	No	33 (20.6)	10 (34.5)	45 (34.4)	0.023
	Yes	127 (79.4)	19 (65.5)	86 (65.6)	
Preferred dialysis access	Femoral cannulation	22 (7)	12 (4)	30 (9)	0.000
	Internal jugular cannulation	129 (40)	10 (3)	93 (29)	
	No specific preference	9 (3)	7 (2)	8 (2)	
RRT for dialyzable toxins	No	96 (60)	22 (75.9)	101 (77.1)	0.005
	Yes	64 (40)	7 (24.1)	30 (22.9)	

Table 3: Comparison of teaching vs non-teaching institutes

		Institution (teaching/non-teaching)		
		Non-teaching, n (%)	Teaching, n (%)	p value
Type of setup	Corporate	50 (45.9)	110 (52.1)	0.002
	Government	3 (2.8)	26 (12.3)	
	Private	56 (51.4)	75 (35.5)	
ICU beds	<10	21 (19.3)	23	0.000
	11–20.0	33 (30.3)	39	
	21–30	32 (29.4)	32	
	31–40	9 (8.3)	32	
	>40	14 (12.8)	85	
Type of ICU	Closed ICU	12 (11)	52 (24.6)	0.011
	Open ICU	19 (17.4)	25 (11.8)	
	Open with full-time intensivist	78 (71.6)	134 (63.5)	
Bedside RRT facility in ICU available	No	11 (10.1)	9 (4.3)	0.041
	Yes	98 (89.9)	202 (95.7)	
CRRT	No	50 (45.9)	38 (18)	0.000
	Yes	59 (54.1)	173 (82)	
CRRT therapy managed by	Dialysis technician	25 (22.9)	40 (19)	0.650
	ICU nursing staff	1 (0.9)	5 (2.4)	
	Intensivist	28 (25.7)	61 (28.9)	
	Nephrologist	55 (50.5)	105 (49.8)	
	Sometimes	19 (17.4)	31 (14.7)	
	Yes	77 (70.6)	158 (74.9)	

Table 4: Basic renal replacement therapy practices

RRT practice	Response	n (%)
Preferred RRT modality in hemodynamically stable patient	IHD	182 (57)
	CRRT	13 (4)
	No preference	28 (9)
	Mixed responses	27 (9)
Preferred modality in hemodynamically unstable patient	SLED	182 (57)
	CRRT	118 (38)
	IHD	16 (5)
Common indication for starting RRT in ICU	Metabolic acidosis	117 (36.5)
	High creatinine levels	44 (14)
	Hyperkalemia	31 (10)
	Fluid overload	40 (12.5)
	Combination of above	88 (28)
Other triggers for initiating RRT in ICU	Early AKI (KDIGO stage 3 or failure stage as per RIFLE classification)	134 (43)
	Fluid accumulation of >20% of patients body weight	32 (10)
	Septic shock and use of blood purification extracorporeal therapies	97 (31)
	None of the above	6 (16)
Cost in consideration in CRRT	High cost	172 (54)
	Extremely important as advantages but no survival benefit	88 (27)
	Cost no consideration	28 (9)
	No response	32 (10)
Initiation of RRT	Within 8 hours	166 (52)
	Within 24 hours	136 (43)
	Beyond 24 hours	8 (5)
Parameter settings while initiating intermittent RRT	Blood flow rate 100 mL/minute with dialysis flow rate of 300 mL/minute	140 (44)
	Blood flow rate 200 mL/minute with dialysis flow rate of 100 mL/minute	65 (20)
	Do not know, nephrologist decides the RRT settings	107 (33)
	Do not know, dialysis technician/nurse sets up the machines	8 (2.5)
Anticoagulant preference during CRRT	Unfractionated heparin as infusion	139 (43)
	Unfractionated heparin as bolus	107 (33)
	Regional citrate	34 (11)
	Low molecular weight heparin	20 (6)
	No preference	20 (6)
Frequency of CRRT circuit change	Within 24 hours	28 (12)
	Between 24 hours and 72 hours	214 (67)
	Beyond 72 hours	68 (21)
Cause of circuit change	Filter clotting/clogging, rise in TMP	246 (77)
	Protocolized change	56 (17.5)
	Sepsis	7 (2.5)
	Do not know	8 (3)
RRT for toxins	Used	101 (33.6)
	Never used	219 (68)
Strategy for discontinuing RRT	Spontaneous (without diuretics) urine output >500 mL/day with stable serum creatinine <40 mg/dL	91 (28)
	Spontaneous (without diuretics) urine output >500 mL/day irrespective of serum creatinine	87 (27)
	Diuretic induced urine output >500 mL/day with stable serum creatinine <40 mg/dL	36 (11)
	Diuretic induced urine output >500 mL/day irrespective of serum creatinine level	27 (8)
	Clinician opinion irrespective of urine output or serum creatinine levels	79 (25)

Renal Replacement Therapy Practices

Differences noted in overall RRT practices across various setups are shown in Table 2. The differences according to types of setups (corporate, private, and government) and teaching vs non-teaching institutions are shown in Tables 3 and 4, respectively. The nephrologists managed RRT in 50% ICUs in comparison to 28% ICUs in which RRT was being managed by intensivists. Overall, there was uniformity in the indications for initiating RRT in different ICUs,

metabolic acidosis being the most common followed by rising creatinine and hyperkalemia (64, 32, and 30%, respectively) which was seen in patients with early septic shock (43%) and early kidney disease improving global outcome (KDIGO) stage 3 (31%). Only 10% of the respondents used RRT when there was fluid accumulation of more than 10%. Variations in practices across various setups are shown in Table 4. While femoral venous cannulations (41%) were more common as a site of venous access for dialysis catheter in government setup, internal jugular cannulations were preferred in corporate and private sector (81 and 71%, respectively).

According to the survey, RRT was initiated within 24 hours in 95% of the patients, if any of the said criteria were met, across various setups after the decision to do RRT was taken. However, RRT was initiated earlier (within 8 hours) in 50% patients in a corporate and private setup in comparison to a government setup (27% patients, $p = 0.00$). In the survey, when enquired about the initial IHD settings used, 35% of the respondents were not aware of the initial settings. While the rest 65% mentioned the blood flow rates used by them were between 100 and 200 mL/minute and dialysis flow rates were between 100 and 300 mL/minute.

Overall, 57% of intensivists preferred IHD for hemodynamically stable patients and only 4% used CRRT for such patients. For hemodynamically unstable patients, SLED was the RRT of choice as used by 57% intensivists, while 38% preferred CRRT. More (63%) intensivists from corporate setups preferred CRRT for hemodynamically unstable patients, while 55% of those working in government setup and 40% in private setup used CRRT in such patients. This might be because of limited availability of resources: 80% of corporate setups, 66% of government and private setups had CRRT facility, and this difference was statistically significant ($p = 0.023$). With regard to CRRT, 54% intensivists considered high cost as sole reason for not using it even though a correct indication was present. Only 9% of the intensivists thought that high cost of CRRT should not be used as criteria for not using CRRT when indicated. Twenty-seven percent of intensivists considered CRRT did not translate into survival benefit or improved AKI when compared to other modalities of RRT. Thus, the overall usage of CRRT was found to be low due to high costs associated with it. Unfractionated heparin (UFH) as infusion or bolus remained the most commonly (76%) used anticoagulant for CRRT. The use of regional citrate anticoagulation was low (11%) across all setups and overall 6% intensivist in the survey did not prefer to use any anticoagulant. Forty-eight percent responders reported that circuit was changed within 48 hours. Frequent changes can lead to higher cost incurred. The reasons to change the circuit were due to filter clogging or clotting of blood by 77% respondents followed by a protocolized change of circuit by 17% respondents. Looking at the non-conventional uses of RRT, 44% of responders had never used RRT for removal of poisons or toxins. This indication was used for RRT mostly by intensivist in corporate sector (40%) and less commonly employed by public (24%) or private sector (23%) ($p = 0.005$). One-fourth of intensivists are either not modifying or sometimes modifying drug doses for patients undergoing RRT.

Majority of the respondents in our survey preferred adequate urine output (>500 mL/day) with or without the use diuretics to discontinue RRT. Twenty-five percent of the clinicians discontinued RRT irrespective of the urine output or the serum creatinine values based on clinical judgments.

Discussion

The aim of this survey was to obtain information about the current RRT facilities and practices in India ICUs including dialytic management. Currently, data about the same in Indian ICUs are lacking. Recently, a small survey was performed by Vasudevan et al. about RRT practices as performed by nephrologists in children in 26 centers.[8] Our survey is probably among the first to focus on the current RRT practices as performed by intensivists in different Indian ICU setups in adult patients with AKI. This survey highlighted that the corporate and private hospitals were better equipped as compared to a government setup in terms of higher ICU bed strength, availability of more dialysis machines, CRRT machines, and presence of full-time dialysis technician.

The survey data demonstrated that hemodynamic status determined the choice of modality of RRT. While IHD was preferred in hemodynamically stable patients, intensivist preferred SLED over CRRT in hemodynamically unstable patient.[9] According to our survey, only 38% of intensivists preferred CRRT for hemodynamically unstable patients, while 57% had a preference for SLED and a high cost of CRRT was a deterrent for the intensivist to not use it. In a study performed by Annigeri et al.[10] in Indian ICUs, the use of hybrid techniques for RRT like prolonged IHD decreased the use of CRRT by 37%. This is different from what is practiced in Western countries where 80% of the patients with AKI in ICU undergo CRRT.[11]

The survey data related to RRT initiation were also conflicting in some respects. Most common indications for RRT as per the survey were metabolic acidosis (64%), high creatinine levels (32%), and hyperkalemia (30%). Early septic shock with AKI was the most common trigger for the initiation of RRT (43%). Along with electrolyte/acid–base disturbances, multi-organ failure, early AKI (KDIGO stage 3 or failure stage of RIFLE classification) with sepsis (when no life-threatening complication of AKI existed) were commonly reported as an important initiation criterion in literature.[12] There is enough evidence demonstrating an association between cumulative fluid balance values of >10% with increased mortality and delayed recovery of renal function, at the time of initiation of RRT.[13,14] Nevertheless, only 10% respondents in the survey considered it as a trigger for the initiation of RRT.

The response regarding the initial settings in IHD in the survey reflected that around 35% respondents were not aware of the settings and the other 65% who responded also showed the initial settings were inadequate as both the blood and dialysate flow rates set at a lower limit as compared to what is recommended to achieve a Kt/V index >3.9/week. This requires three sessions per week of IHD of at least 4 hours with a blood flow >200 mL/minute and a dialysate flow >500 mL/minute.[15] Suboptimal flow rates lead to inadequate dialysis dose and may result in ineffective therapy.

In our survey, the right internal jugular vein (IJV) was the most favored vascular access for RRT as the delivery of RRT is better as compared to other vascular accesses.[16] Subclavian veins remains the least preferred site as it is associated with high rate of stenosis when used for a longer duration.[17] This is in accordance with preference given by KIDGO guidelines.[12]

Hemodynamic instability during RRT is a common phenomenon which is seen in all modalities of RRT used. The incidence of hemodynamic instability as reported in various studies is very variable and complicates around 10–70% of IHD sessions,[18] 40–60% of SLED,[19] and 50% of CRRT sessions.[20] The commonly used interventions to tackle hemodynamic instability during RRT include use of higher dialysate sodium or sodium modeling, lower dialysate temperature, and slower blood flow rate.[20] Similarly, in the survey adapting a combination of different approaches were used to resolve hemodynamic instability during RRT which included conservative ultrafiltrate goals and dialysate flow, circuit priming

with saline, sodium bicarbonate buffer use, and sodium remodeling. The responses in the survey matched with the interventions reported in literature.[21]

Renal replacement for blood purification therapy as a part of treatment of sepsis was used by 31% of the respondents. The survey also provides insight that only 56% respondents knew that RRT is a modality to remove toxins and drugs. Around 10% knew specifically that overdose with anticonvulsants could be treated with RRT. Other toxins that are commonly removed by RRT include alcohol poisoning, salicylate toxicity, lithium overdose, dabigatran, and sodium valproate poisoning.[22]

The utilization of regional citrate anticoagulation is less as compared to heparin during CRRT and this is distinct from what is practiced in the developed world.[23] Regional citrate anticoagulation was practiced by only 11% of the intensivists as reported in our survey. Unfractionated heparin was the most common anticoagulant used in our survey. This, however, matches the result of a multicenter epidemiological survey conducted by Uchino et al.[24] in which UFH was used preferentially in 42.9% of patients. The low use of regional citrate anticoagulation according to our survey could be due to lack of availability of commercial reagents or physician preference, but this is not evident from the survey. A rise in the transmembrane pressure (TMP) during CRRT signifies filter clotting or clogging. Clogging is due to deposition of proteins or red cells in the membrane that leads to decreased permeability of the membrane.[25] Seventy-seven percent of filter changes in this survey were due to filter clogging/clotting leading to a high TMP alarm. Lack of trained personnel and a lower use of citrate anticoagulation which prolongs filter life[26] could be probable causes for filter changes. Non-anticoagulation measures to prolong membrane life aimed to optimize vascular catheter, partial pre-dilution of the circuit, and training of staffs should be employed.

Numerous studies performed have attempted to resolve the debate regarding the optimal timing of initiation of RRT, current evidence eludes us, and guidelines remain weak in this regard.[27] In the survey, majority of patients underwent RRT within 24 hours which may be considered as a part of "early therapy" (95%). Whether early therapy accorded any benefit to the patients was not assessed as a part of this survey.

The criteria to discontinue RRT are not standardized and little is known about them. According to the KDIGO guidelines,[12] RRT should be discontinued whenever the intrinsic kidney function has recovered. Improvement in creatinine clearance and urine output are taken as predictors to successfully discontinue RRT. In a study by Palevsky et al.[28] RRT was discontinued if the creatinine clearance was >20 mL/min. Uchino et al.[29] in their study found urine output as an important predictor of successfully discontinuing RRT. They found that RRT was successfully discontinued in 80% patients with a urine production of >400 mL/day without diuretics or >2300 mL/day with diuretics. In our survey, most of the respondents considered urine output >500 mL/day as an important indicator to discontinue RRT with or without the use of diuretics.

Our study provides important insights about the current RRT practices in India; its limitations should be mentioned. First, data collected from the survey were relatively qualitative in nature and was performed exclusively among critical care physicians through ISCCM registry. Renal replacement therapy practices among nephrologists may be different and are not reflected in this survey. Second, as pointed in INDICAPS study, the hospitals performing better with more facilities are more enthusiastic in participating in such surveys, which may have been the case in our survey.[30] Nevertheless, specific insights generated by our survey may lead to more quantitative studies in the future. Third, there is considerable variation existing in the RRT facilities available across public and private health sector hospitals in India, differences in RRT prescriptions, we acknowledge the survey data may not reflect Indian clinical practice in all respects. At present, RRT practices in AKI in India may not be standardized yet we believe that our survey provides important data which can be utilized to evolve standardized practices. Currently, dedicated RRT training programs/fellowships and workshops are the way to increase awareness and hence usage of these facilities to benefit critically ill patients and populations at large.

Conclusion

This survey highlights:

- In our country, the resources and availability of RRT to support critically ill patients is limited, more so in government setups.
- Significant number of healthcare providers do have knowledge gap when it comes to prescription and practices regarding RRT. This needs to be bridged so as to improve efficacy of RRT and related outcomes.
- Where available, the use of CRRT is not widespread due to high cost incurred to the patients.
- Trained personnel and making RRT affordable and accessible is the way forward for better utilization and benefitting the critically ill patient.

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APPENDIX I: QUESTIONNAIRE

Name (optional, can put initials)……………………………….
Institution (teaching/non-teaching)………………………….…
Govt/Pvt/corporate setup…………………………….…
No of ICU beds……………………………………….…
Open/open with full-timer intensivist/closed ICU…………………
Bedside RRT facility in ICU available?………
Dialysis Technician: Full time/part time/on call
CRRT therapy managed by: Intensivist/dialysis technician/ICU nursing staff
No. of dialysis machines……………………………

1. Are you having in your institution?
    1) RRT.
    2) ECMO.
    3) Both.
    4) None.

2. Do You have CRRT in your setup?
    1) Yes.
    2) No.

3. Which modality is your preference in hemodynamically stable patient?
    1) IHD.
    2) SLEDD.
    3) CRRT.
    4) Any.

4. Which modality is your preference in hemodynamically unstable patient?
    1) IHD.
    2) SLEDD.
    3) CRRT.
    4) Any.

5. Which is the most common indication for starting RRT in your ICU?
    1) Metabolic acidosis.
    2) High creatinine levels.
    3) Hyperkalemia.
    4) Fluid overload.

6. Do you use any of the following triggers for initiating RRT in your ICU (apart from conventional criteria like severe hyperkalemia; severe pulmonary edema; severe acidosis; urea >40 mg/dL; oligo-anuria >72 hours)
    1) Early (KDIGO stage 3 or failure stage as per RIFLE classification).
    2) Fluid accumulation of >20% of patient's body weight.
    3) Patients with *early-stage septic shock* who have AKI at *failure stage of (RIFLE)* classification or *KIDGO stage 3 but without* any of the life-threatening complications of AKI.
    4) Septic shock with intention to facilitate use of blood purification extracorporeal therapies.

7. While making a choice between continuous RRT vs intermittent (e.g., SLED), which of the following influences your decision
    1) Use of anticoagulation can be completely avoided in IRRTs.
    2) Lower blood flow rates helps maintaining hemodynamic stability in CRRT.
    3) In the setting of acute brain injury or fulminant hepatic failure, rapid shifts in blood osmolality often associated with IRRT may contribute to iatrogenic increases in intracranial pressure.
    4) CRRT causes minimal fluctuations of fluid status but higher fluctuations in serum concentrations of renally cleared drugs.
    5) IRRT causes much higher fluctuations of fluid status and serum concentrations of renally cleared drugs.

8. How important is financial consideration while making a decision regarding not choosing CRRT despite its obvious advantage in a large population of critically ill patients
    1) High cost is the sole reason for not considering CRRT in most patients.
    2) Extremely important as most advantages do not translate into survival benefit.
    3) Extremely important as most advantages do not translate into early recovery of AKI.
    4) Somewhat important but can be managed with local customizations.
    5) Cost is never a consideration while choosing RRT modality.

9. Kindly fill your choice of setting regarding following parameters, while initiating intermittent RRT, in a patient with AKI and sepsis with MAP between 60 and 65 mm Hg (without needing vasopressors) for refractory hyperkalemia and metabolic acidosis
    1) Blood flow rate 100 mL/minute with dialysis flow rate of 300 mL/minute.
    2) Blood flow rate 200 mL/minute with dialysis flow rate of 100 mL/minute.
    3) Do not know, nephrologist decides the RRT settings.
    4) Do not know, dialysis technician/nurse sets up the machines and manages alarms.

10. Which of the following strategies are employed in your ICU to improve hemodynamic tolerance while utilizing intermittent RRT in critically ill patients with AKI
    1) Circuit priming with 0.9% saline.
    2) Dialysate flow rate of 50 to 100 mL/minute.
    3) Dialysate [Na+] profiling with progressive increase in dialysate [Na+] to >145 mmol/L.
    4) Preferential use of bicarbonate buffer.
    5) Conservative ultrafiltration with/without extend treatment session to achieve fluid balance goals.

11. How early do you start RRT after deranged metabolic parameters?
    1) Within 8 hours.
    2) Within 24 hours.
    3) Wait for >72 hours.
    4) Wait for 7 days.

12. What is the preferred dialysis access in your patients?
    1) Single-lumen femoral access.
    2) Double-lumen femoral catheter.
    3) Double-lumen jugular catheter.
    4) No specific preference.

13. Which is the preferred site for double lumen dialysis catheter?
    1) Left IJV.
    2) Right IJV.
    3) Left subclavian vein.
    4) Right subclavian vein.

14. Which anticoagulant do you prefer?
    1) Unfractionated heparin as IV infusion.
    2) Unfractionated heparin as bolus and then SOS basis.
    3) LMWH.
    4) Regional citrate.
    5) No anticoagulant.

15. How frequently does your CRRT circuit needs change?
    1) <24 hours.
    2) <48 hours.
    3) <72 hours.
    4) >72 hours.

16. What is the commonest cause of CRRT circuit change?………

17. Are you using RRT for dialyzable toxins, if yes, for which?……

18. Which of the following best defines the strategy for discontinuing RRT in your unit in a patient who does not require it for any more for severe hyperkalemia; severe pulmonary edema, or severe acidosis
    1) Spontaneous (without diuretics) urine output of >500 mL/day with stable serum creatinine level <40 mg/dL.
    2) Spontaneous (without diuretics) urine output of >500 mL/day irrespective of serum creatinine level.
    3) Diuretic induced urine output >500 mL/day with stable serum creatinine level <40 mg/dL.
    4) Diuretic induced urine output >500 mL/day irrespective of serum creatinine level.
    5) Clinician opinion irrespective of urine output or serum creatinine levels.