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Access

Percutaneous balloon dilatation in central venous stenosis of hemodialysis patients

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Background/Objective: To evaluate the efficacy of percutaneous balloon dilatation in hemodialysis patients with central venous stenosis. ***Methods:*** Central venous stenosis is a rare but serious complication in hemodialysis patients. It is more common especially in patients with central venous catheter. First we used clinical examination to identify which patient has the diagnosis of central venous stenosis. The main clinical manifestations were different degrees of head or facial swelling, swelling of upper limb or superficial varicose veins of upper chest. Then we gave those patients to undergo central venography, which can be used to confirm stenosis in innominate vein or superior vena cava. Further balloon dilatation was performed. The clinical manifestations were observed and CTA or MRA examinations were performed after 6 months. ***Results:*** 41 patients were diagnosed central venous stenosis through clinical examination. Of which 25 patients underwent central venous angiography. 100% had innominate vein or superior vena cava stenosis, and there was a history of indwelling catheter through central venous catheter. There were 16 males and 9 females. The age was 56 ± 11 years, and the dialysis age was 11.2 ± 6.2 months. All of the patients were treated with balloon dilatation, of which 21 patients were treated with 8 mm balloon, and 4 patients underwent 10 mm balloon. Immediately after angiography, the stenosis disappeared, and the primary patency rate was 100%. 1 patients had retraction of the central vein, and stenosis was about 50%. Stent was implanted into the vein and the stenosis disappeared. The swelling of upper limb and the superficial varicose veins of upper extremities disappeared in all patients, but only 4 patients were found the swelling of the head and face disappeared. After 6 months follow-up, CTA or MRA was taken and the central vein was not found restenosis. The patency rate was 100% at 6 months, and the swelling of upper limb, the swelling of the head or face and the superficial varicose veins of the upper chest were all disappeared. ***Conclusions:*** Percutaneous balloon dilation is the first choice for the treatment of hemodialysis patients with central venous stenosis. It is safe, reliable and high primary patency can be maintained after treatment. If central vein gets retraction or restenosis after balloon dilatation, stent may be implanted. However, the long-term patency rate and the presence of restenosis in the stent remain to be further investigated.

Needle cannulation using dual axis echography of the hemodialysis fistula

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Background: Arteriovenous fistula failure is a common complication in hemodialysis. The technical failure, obstruction, bleeding and infection play a major role in the arteriovenous failure. To avoid these failure, adequate insertion is required at every session. However, there is some risk in staff with less experience. Although echo-guided cannulation is preferred, there is also a pitfall because conventional echo could only image one axis and go through the vessel wall. Therefore, we have determined the efficacy of dual axis echography which demonstrates long and short axis together in one image. ***Subjects and methods:*** End-stage renal disease patients who underwent hemodialysis in our hospital were subjected to the study. Hemodialysis needle was cannulated to the arteriovenous fistula using dual axis echography. The technical failure and bleeding was compared to those without echo-guided or conventional echo-guided cannulation. ***Results:*** Dual axis echography demonstrated clear image of arteriovenous fistula with both long and short axis, which allowed us to cannulate easily and avoid the needle to go through the posterior vessel wall. This had advantage to the cannulation without echo-guided or echo-guided cannulation with conventional single axis echography. ***Discussion:*** Echo-guided cannulation to the arteriovenous fistula is preferred. However, conventional echo-guided cannulation could cause vertical insertion and penetrate either lateral or posterior vessel wall. The dual axis echography could insert the tip of the needle straight forward to the vessel cavity. It is also beneficial if the fistula is curve bended. ***Conclusions:*** Echo-guided cannulation with dual axis echography is safer and avoid fistula complications, which could improve the quality of hemodialysis.

How do stents in the central vein affect AV fistula?

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Background: Recently, we see many cases where AVF does not work well due to failure of the central vein. We do PTA to the central vein frequently, but it does not work for long and we see cases of occlusion. ***Purpose:*** We evaluated how the central vein changed with stent implantation. Also, we evaluated the improvement of the AVF function. ***Subjects:*** We evaluated

8 stent implantations in the central vein with IVUS. Also, we evaluated the function of AVF. ***Methods*:** We used IVUS to assess the vessel diameter and the vascular lumen of the stenosed lesions. We used angiography to evaluate the central venous stenoses. We measured them before and after implantation and treatment. ***Results*:** We found that the vessel diameter improved after the stent implantation. Concerning the AVF function, brachial arterial blood flow greatly increased after treatment. (pre 286.4 ± 160.8 ml/min post 606.9 ± 186.4 ml/min: t = 0.0025) ***Conclusion*:** The vascular lumen of the central vein was established and the AVF function improved with stent implantation.

Application of a novel intermittent pneumatic compression device assists in dilation of radiocephalic fistulas

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Aims: Arteriovenous fistulas (AVF) are the preferred type of vascular access for hemodialysis patients. AVF have the lowest complication rate and highest long-term survival rate compared to other types of vascular access. Among AVF, radiocephalic fistulas (RCF) are considered first choice due to their advantageous location at the wrist, allowing for lower flow rates and lower rates of complications. However, this low flow rate makes RCF maturation difficult, and it has historically been inferior to that of brachiocephalic fistulas (BCF). Previous research indicates that increased distention pressure and intermittent wall shear stress as a result of intermittent compression of upper arm veins may aid in forearm vein dilation. The aim of the present study is to determine if the use of a novel intermittent compression device assists long-term clinical dilation of RCF. ***Methods*:** This was an IRB approved study conducted at the MS Ramaiah Medical College in Bangalore, India. After AVF creation, a novel, intermittent pneumatic compression device enabling 60 mmHg of cyclic compression was worn 15 cm proximal to AVF intermittently for 6 hours daily for 3 months. Patients in the treatment group (n = 41) wore the device. Of these patients, twenty-four (n = 24) had BCF, while seventeen (n = 17) had RCF. Controls (n = 12) used a sham device. Vein size was measured and recorded at baseline and after 3 months by duplex measurement. Clinical Results (percentage increase) were recorded and tested for significance. ***Results*:** After three months, the mean percentage increase in vein diameter in the RCF treatment group was significantly larger than those in the BCF treatment group at proximal distances of 5 cm, 10 cm, and 15 cm from the anastomosis (p = 0.000, P = 0.000, P = 0.017, respectively). Patients in the RCF treatment group also had significantly larger mean percentage increases in vein diameter as compared to controls at proximal locations of 5 cm and 10 cm (P = 0.008, P = 0.006, respectively). All fistulas treated with FA are still functional with no reported thrombosis, extravasations or other adverse effects. ***Conclusions*:** Application of this novel intermittent pneumatic compression device is safe and may be more effective at assisting long-term RCF maturation (3 months) as compared to BCF. RCF are associated with lower risks of infection, distal ischemia, and steal syndrome. Thus, efficiently maturing RCF is extremely important because this may decrease costs associated with vascular access, reduce complications, and preserve upper arm veins for future use in vascular access.

Calcium, Phosphorus, Bone

Bone mineral management in hemodialysis patients – Is 6 weekly monitoring of calcium and phosphate sufficient?

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Background: KDIGO recommends monitoring of Calcium (Ca) and Phosphorus (PO4) in hemodialysis (HD) pts. every 1 to 3 months, but there is little evidence to support this practice. Our centre changed bloodwork for mineral metabolism from monthly to every 6 weeks in March, 2014. The objective of this quality improvement report is to examine the volume of Ca and PO4 tests, costs, and proportion of pts. with Ca and PO4 on target before and after the change in bloodwork frequency. ***Methods*:** This is a retrospective study of prevalent HD pts. in South-Eastern Ontario. We compared the number of Ca and PO4 tests performed (obtained from EMR) during the 252 days before and 252 days after Mar. 24, 2014 and the associated costs (CDN $2.59/Ca and CDN $2.59/PO4 Provincial Schedule). The 252 day equal periods represent exactly 8 complete monthly cycles and 6 complete 6-week cycles before and after the change. The proportion of pts. with Ca and PO4 on target (2.2–2.5 mmol/L, and 0.8–1.5 mmol/L respectively) was assessed for a longer period of 2 yrs. before and after the change to assess long term outcomes. ***Results***: The profile of HD pts is 435 total, 46% in-centre, 43% satellite, 11% home HD, mean age 66, 44% female, 46% DM, and 45% with CVC. The tests dropped from 3262 Ca and 3227 PO4 before to 2979 Ca and 2788 PO4 after the change for a total cost savings of $CND 1,870.00. The proportion of pts. with Ca and PO4 on target 2 years before and after the change in bloodwork frequency was similar (49.5% and 52% for Ca and 46% and 46% for PO4). ***Conclusions***: The results of this study suggest that compared to monthly, 6-weekly monitoring of Ca and PO4 in HD pts. is sufficient to meet recommended targets with reduced costs. Larger studies including hard clinical outcomes for reduced frequency of bloodwork are needed, in alignment with "Choosing Wisely Canada", the National campaign to help clinicians and patients reduce unnecessary tests and treatments, and make smart and effective care choices.

Serum phosphorus and phosphate binder pill per day in home hemodialysis patients prescribed sucroferric oxyhydroxide

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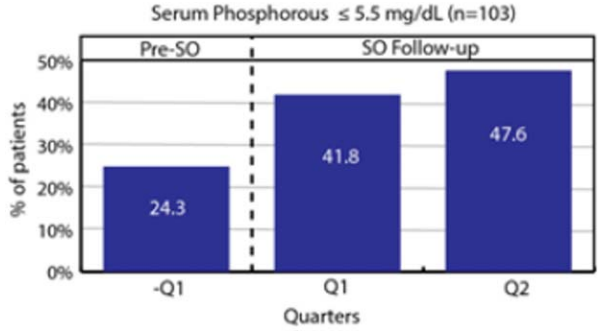
Background: A retrospective database analysis was conducted to assess serum phosphorus (sP) and phosphate binder (PB) pill burden changes in home hemodialysis (HHD) patients switched to sucroferric oxyhydroxide (SO) as part of routine clinical practice. ***Methods*:** De-identified data was extracted for all adult, HHD patients with first SO prescription (Rx) between 4/14- 8/16 and SO Rx for 6 months (n = 103). Repeated-measures data were analyzed using linear mixed-effects regression with mean measures summarized using least-squared means and compared between 6 months of baseline and SO Rx. ***Results*:** At baseline, patients were, on average, 51.5 years old with 4.4 HHD treatments/week for 3.2 hours/treatment and 86% were on PB. PB pills/day were reduced from 8.9 to 4.3 pills during baseline and SO, along with improvements in sP from 6.3 to 5.9 mg/dl. Patients achieving sP≤5.5 mg/dl increased by 96% from 24.3% pre-SO to 47.6% after 6 months on SO (Figure). ***Conclusion*:** A 96% increase in patients achieving sP≤5.5 mg/dl was observed in 103 HHD patients switched to SO as part of routine care. This was accomplished despite a >50% decrease in PB pills per day after patients switched to SO.



Who is real culprit? Acidosis or Hyperparathyroidesim. Bilateral Achillis tendon spontaneous rupture in hemodialysis patient. First case from Qatar.

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Background*:** Cases of simultaneous Achilles tendon rupture in patients on regular hemodialysis have been describedin the literature[1–2]. They are rare however, simultaneous, spontaneous, bilateral ruptures mostly occur in the weight bearing tendons. Only a few cases of spontaneous bilateral Achillis tendon ruptures have been reported in literature to date[3]. Tendon rupture may be attributed to degenerative changes in tendons or at their attachments to bone. Some authors advocate duration of dialysis with subsequent malnutrition, insufficient dialysis and β2-amiloidosis as the main etiologic factor[4] while other considered accumulation of uremic toxins as the causative factor of tendon weakness and rupture[5]. ***Case Report*:** This is a55 Year old male patient known case of End stage renal disease on hemodialysis since 2007. He is hepatitis B and C positive. For last one year he developed tertiary hyperparathyroidism with excessive secretion of parathyroid hormone (PTH) at level of 1900 pg/mL resistance to medical treatment,and his parathyroid scan showed parathyroid adenoma. He presented to us with a sudden onset of painful disability in the left posterior ankle developed while he was climbing the stairs,ultrasonography revealed a complete disruption of Achilles tendon. He was admitted for Tendon repair. Four months back he presented once again to us with sudden pain and swelling in Right posterior ankle,developed with force full dorsiflextion of right foot. Ultrasonography revealed a partial disruption of Achilles tendon. He was treated in emergency department by Right leg cast. Parallel to surgical repair and physiotherapy we started to manage his tertiary hyperparathyroidism with referral to surgeon for parathyroidectomy. Other important finding in this patient was persistently low bicarbonate level (16 mmol/L)despite he was dialyzing with high bicarb level (40 meq/L). So patient was started on sodium bicarbonate oral Tablets. ***Discussion: Tendinopathy is prominent in hemodialysis patients [10], but the presentation with tendon rupture is rare. Secondary hyperparathyroidism plays a major role in rupture of tendons in dialysis patient beside other predisposing factors include being on long-term hemodialysis, β-2 microglobulin associated amyloidosis, fluoroquinolone use, corticosteroid use, malnutrition/chronic inflammation syndrome, and chronic acidosis. Chronic acidosis with the consequent degenerative changes [13] contribute to development of tendon rupture in chronic renal failure patients. It is unclear whether hepatitis C infection increase the risk for spontaneous tendon rupture or is merely coincident finding. ***Conclusion*:** Tendon ruptures are uncommon injuries in hemodialysis patients that require early surgical intervention, physiotherapy, with management of predisposing factors in order to maximize functional outcomes for the patient. Patients with hyperparathyroidism are at increased risk for development of spontaneous tendon ruptures.

The effectiveness of fracture risk assessment using FRAX with or without BMD in hemodialysis patients

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Background: The Fracture Risk Assessment Tool (FRAX) is a computerized algorithm that determines fracture probability in individuals by integrating important individual clinical risk factors for fracture and mortality, with or without the addition of femoral neck bone mineral density (BMD). This FRAX is used to predict and assess the risk of fracture in various patient groups. This study aimed to evaluate the risk of fracture in hemodialysis patients using FRAX with or without BMD. ***Methods*:** Total 79 hemodialysis patients, 40 men and 39 women, aged 40 years or older were included in the study. The mean age was 62.0 ± 11.8 years and the vintage of hemodialysis was 1894.7 ± 1938.1 days. We calculated the 10-year probabilities of fracture (%) using the FRAX model with or without femoral neck BMD. BMD was measured by dual-energy X-ray absorptiometry. We then performed comparative analyses 10-year probabilities of major osteoporotic fracture (MOF) and hip fracture depending on BMD values. ***Results*:** The 10-year probabilities of MOF and hip fractures using the FRAX without BMD were 6.3 ± 5.2% and 2.5 ± 3.2%. When the BMD value was assigned to the FRAX, the 10-year probabilities of fracture were 5.7 ± 3.9% and 2.0 ± 2.1%. There was no statistical significance in observing MOF and hip fracture when BMD was tested together or FRAX alone (95% confidence intervals; $P = 0.69$ and $P = 0.96$). ***Conclusions*:** FRAX may predict the risk of 10-year bone fracture in hemodialysis patients with a single test without BMD.

Association between the number of medical doctors and full-time dietitians in dialysis units and regional differences in achieving CKD-MBD guideline targets for chronic dialysis patients

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***Background*:** Regional differences in the outcomes for chronic dialysis patients and the causes of such differences have not been clarified. We investigated the relationship between the number of dialysis staff and regional differences in achieving the targets of the chronic kidney disease-mineral and bone disorder (CKD-MBD) guideline among patients on chronic dialysis. ***Methods*:** The database included 199,858 mineral bone data sets for Japanese patients on chronic dialysis at the end of 2009. We investigated the patient-based number of dialysis staff and the rate of achieving the Japanese guidelines for management of CKD-MBD (target predialysis levels: Ca 8.4–10.0 mg/dL, P 3.5–6.0 mg/dL, and intact PTH 60–180 pg/mL) with adjustment for the age, gender, diabetes mellitus, and duration of dialysis. Then we investigated the relationship between achieving these targets and the number of full-time and/or part-time dialysis staff in each prefecture of Japan. ***Results*:** Only 30.6% of the patients completely achieved the CKD-MBD targets (max: 37.0%, min 21.4%). The adjusted average number of dialysis staff per 100 dialysis patients was 4.8 medical doctors, 14.9 nurses, 5.0 technicians, 2.0 dietitians, and 0.9 caseworkers. There was a significant positive correlation between the regional rate of achieving CKD-MBD targets and the patient-based number of medical doctors ($p = 0.038$, $R = 0.261$) and full-time dietitians ($p = 0.028$, $R = 0.280$) among the dialysis staff. ***Conclusions*:** There are marked regional differences in the achievement of CKD-MBD targets. The number of medical doctors and full-time dietitians in dialysis units should be increased to improve achievement of targets in the CKD-MBD guideline.

Clinical Experiences

'How much can I drink, Doc?' A formula to advise individualized interdialytic fluid management for hemodialysis users

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Background: Attention has recently and correctly focused on the *rate* of fluid removal, the ultrafiltration rate (UFR), during hemodialysis rather than the *volume* of fluid to remove through its surrogate, the interdialytic weight (IDWG) But, as the UFR is dependent on dialysis duration, the time allowed for volume removal *must* be extended when, if faced with a large IDWG, the UFR is to be kept within a safe maximum (UFR_{max}). But, an optimum safe UFR_{max}—is it <13, <10, or <6–7 ml/kg/h?—is still under debate, and the question "How much can I drink, Doc?" has also not yet been satisfactorily answered. A response is still often avoided, or prompts a recommendation like "500 ml + urine output", an odd instruction that pays no heed to patient size, age, gender, nutritional status or dialysis prescription. However, all the necessary parameters to predict and advise a safe, individualized limit to IDWG are known, or can be regularly measured. It is thus possible to devise a simple formula that individually advises fluid restriction, treatment by treatment. ***Methods***: As intra-dialytic weight gain (IDWG) = [Fluid restriction (FR, in ml) – urine output (UO, in ml)] x dialysis interval (DI, in days), and as in addition, IDWG = UFR x dialysis sessional duration (SD, in hours) x target post-dialysis weight (TW, in kg), then FR = (UFR x SD x TW) ÷ DI + UO. ***Results*:** While the FR = (UFR x SD x TW) ÷ DI + UO formula is yet to be validated or tested against large populations, a requisite step to gain wide acceptance, individual services are encouraged to assess its value in local patient populations- especially as an aide to patient fluid compliance and engagement. ***Discussion***: Only two options ensure the preferred UFR_{max} for any given IDWG is not exceeded in any one treatment: (1) the extension of SD to restrict the UFR to less than UFR_{max}, or (2) the limitation of

IDWG. As variable extensions of SD are logistically complex, a simple formula that individualizes the fluid intake limit for each and every interdialytic period is preferable. ***Conclusion:*** This simple calculator answers the age-old dialysis patient question "How much can I drink, Doc"? If IDWG can be better advised, excessive UFR can be more frequently prevented.

Re-using dialysis plastic waste as an incorporative into concrete

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Background: Global hemodialysis post-dialysis plastic waste (pdPW) generation is now likely >900,000 tonnes/year. Considered as infectious waste, pdPW is chemically disinfected for landfill or incinerated, at financial and environmental cost. SteriMed 700, a novel waste management system, sterilizes and shreds medical waste, creating a potential re-use end product. We have explored incorporating pdPW into concrete. ***Method***: All p-dPW [lines, dialyzers, saline bags, syringes: all inclusive] were sterilized and shredded, then added as a polypropylene plastic fiber "shreddate" (PPfs) to concrete slurries in 0.5% and 1% concentrations by concrete weight. Pre-separated hard, soft, and mixed PPfs separately tested in 1% concentrations. All mixes were assessed for compressive strength (CS), tensile strength (TS), and water absorption (WA). ***Results:*** Adding mixed PPfs led to a minor increase in TS (0.5% mix = 0.8% increase, and 1% mix = 8% increase). 1% PPfs modestly decreased CS (hard = 9.9%; soft = 16.9%; mixed = 11.5% respectively). While adding PPfs left the 1° rate of WA unchanged, the 2° rate of WA decreased by a mean 30% across all three PPfs-concrete mixes. ***Discussion***: Both the % of PPfs waste, and the shape/size of the fibers significantly influenced final concrete characteristics. While the small loss in CS is unlikely to significantly impact the behavior of the incorporative product, the increase in TS and the 30% reduction in WA is significant and may in particular improve resistance to water penetration and corrosion. ***Conclusion***: Sequestering p-dPW in concrete may help solve the financial and environmental costs of p-dPW disposal, while also significantly improving some specific concrete characteristics. Better long-term concrete quality, flexibility, water resistance, and durability may result, especially if used in buildings in coastal areas, or in marine structures like retaining walls in contact with seawater. As this research potentially has far-reaching implications, further testing is underway.

Intradialytic meditation: A feasibility pilot study

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Background: Meditation has been shown to improve stress, anxiety and depression in chronic disease. The Purpose of this study was to evaluate the feasibility of a meditation program and evaluate its effect on anxiety, depression, pain and patient reported outcome measures (PROMs). ***Methods:*** Seventeen dialysis patients in a single dialysis center experienced twelve 10-minute Smartphone Application (App) meditation sessions at the commencement of every dialysis over a three-week period during the cannulation process. The primary outcome was adherence to the meditation program. Secondary outcomes were: (1) change in anxiety and depression as measured by the Patient Health Quality (PHQ-4) scale; (2) pain as measured by Wong Baker Pain Scale (WBPS); and (3) PROMs (well-being, pain, washed out, sleep, shortness of breath (SOB), appetite) as measured by the London Evaluation of Illness (LEVIL) scale. Paired t-tests were applied. ***Results:*** 12 out of 17 patients (71%) completed all twelve sessions. PHQ-4 total scores improved significantly by 52% after meditation (p = 0.01). There were decreases in anxiety and feelings of depression, and no change in worrying and lack of interest. No change in pain scale scores was noted. There was a significant improvement in patients' washed out feelings and a slight improvement in well-being per LEVIL PROMs.

	Increase/ Decrease	95% Cls	P value (*p<0.05)
PHQ-4 (↓ = improved)			
Anxiety	−0.92	−1.55,0.28	0.01*
Worrying	−0.75	−1.61,0.11	0.08
Lack of Interest	−0.25	−0.73,0.23	0.27
Feelings of Depression	−0.50	−1.01,0.01	0.05*
LEVIL(↑ = improved)			
Well-being	8.0	−7.61, 23.61	0.28
Pain	−7.2	−30.23,15.90	0.51
Washed Out	21.1	1.38,40.79	0.04*
Sleep	5.4	−14.39,25.22	0.56
SOB	−2.8	−16.06,10.39	0.65
Appetite	−0.3	−14.45,13.95	0.97

Discussion and Conclusion: Meditation during HD does not improve pain during cannulation. However, overall PHQ-4 scores improved significantly due to decreased anxiety and feelings of depression. PROMs suggest an improvement with washed out feelings after meditation.

Renal replacement therapy in patients with autosomal dominant polycystic kidney disease: A National cohort study based on the Canadian Organ Replacement Registry

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Background: Polycystic kidney disease (PKD) is the most common hereditary kidney disease, with afflicted patients often progressing to end-stage kidney disease (ESKD) requiring renal replacement therapy (RRT). As the timelines to ESKD are predictable over decades, it follows that PKD patients should be optimized regarding kidney transplantation, home dialysis therapies and vascular access. We set out to examine the association of kidney transplantation, dialysis modalities, and vascular access in PKD patients compared to a matched, non-PKD cohort. ***Methods*:** All incident RRT patients (>18 years) included in CORR from 2001 to 2015 were included. PKD was defined by the treating physician. PKD and non-PKD patients were propensity score (PS) matched (1:4) using demographics, comorbidities, and lab values. Conditional logistic regression and Con proportional hazards models were used to examine associations with kidney transplantation (pre-emptive or any), dialysis modality (peritoneal, short-daily, home or in centre hemodialysis) vascular access (AVF, permanent or temporary CVC), and dialysis survival. ***Results*:** We matched 2120 PKD (99.9%) with 8283 non-PKD patients, with no significant imbalances between the groups. PKD was significantly associated with pre-emptive kidney transplantation (OR 7.13 95%CI 5.74–8.87), any kidney transplant (OR 2.37 95%CI 2.14–2.63) and initial therapy of nocturnal daily hemodialysis (OR 2.74 95%CI 1.38–5.44) whereas in centre intermittent hemodialysis was significantly less likely in the PKD population (OR 0.59 95%CI 0.54–0.65). There was no difference in peritoneal dialysis as initial RRT but lower use of any PD among the PKD group (OR 0.85 95%CI 0.77–0.95). PKD patients were significantly more likely to have an AVF (OR 3.25 95%CI 2.79–3.79) and less likely to have either a permanent (OR 0.68) or temporary (OR 0.49) CVC as compared to the non-PKD cohort. Survival on either in-centre HD or PD was better for PKD patients (HD: HR 0.48 95%CI 0.44–0.53, PD: HR 0.73 95%CI 0.60–0.88). ***Conclusions*:** PKD patients are more likely to receive a kidney transplant, use home hemodialysis, dialyze with an AVF and have better survival relative to non-PKD patients. Conversely they were less likely to receive peritoneal dialysis either as initial therapy of anytime during ESKD. This may be attributed to clinical decision making processes susceptible to education and intervention.

Palliative care utilization in patients discontinuing hemodialysis

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Background: End stage renal disease (ESRD) patients have a high symptom and treatment burden, multiple medical comorbidities, frequent hospitalizations, and shortened life expectancy. Hence, there is an increased focus on conservative management and end-of-life care that involves the expertise of a palliative care team. Our goal was to identify factors associated with palliative care consultations in patients who go on to withdraw from hemodialysis (HD). ***Methods*:** Adult incident dialysis patients initiating maintenance HD between January 2001 and September 2013, who discontinued HD through November 2015 (n = 262) were assessed by chart review for the presence of palliative care consultation within 6 months of death. ***Results*:** Of 262 adult patients who discontinued HD, 172 patients (66%) received palliative care consultation within 6 months of death. 61 (36%) of these patients' initial consultations occurred in the inpatient setting. The most common reasons for palliative care consultation were to facilitate decision making regarding discontinuation of HD (54%) and to discuss end-of-life care options/hospice enrollment (19%) in patients who have already decided to discontinue HD. The median number of palliative care visits from the time of consultation was 3 (IQR 1, 23). In univariate analysis, palliative care consultation within 6 months of death was associated with a longer HD duration (1068 days vs. 551 days, $P < 0.001$), inpatient death (43% vs. 29%, $P = 0.016$) and at least one hospitalization within 30 days of death (91% vs. 64%, $P < 0.001$). In multivariable analysis, a longer HD duration (OR 1.25; 95% CI 1.11–1.41; $P < 0.001$) and hospitalization within 30 days of death (OR 7.41; 95% CI 3.06–18.0; $P < 0.001$) remained significant, but not inpatient death (OR 1.06; 95% CI 0.55–2.05; $P = 0.87$). ***Conclusions and Relevance*:** The majority of patients who discontinued HD prior to death are done so with the aid of palliative care teams, mostly in the hospital setting. Longer HD duration and a recent hospitalization prior to death were associated with palliative care assistance. Further studies are warranted to examine the optimal timing of palliative care consultation to not only optimize these important decisions at the most appropriate time, but also to improve quality of remaining life in those with ESRD.

Severe respiratory alkalosis, severe metabolic alkalosis, and severe metabolic acidosis in a maintenance hemodialysis patient

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***Introduction*:** Maintenance hemodialysis is the treatment for metabolic acidosis of end stage renal disease. Bicarbonate baths are often adjusted based on serum bicarbonate levels. With acute and chronic illnesses, acid base status may instantly change requiring adjustments to the dialysis prescription. ***Case Description*:** A 52 year old male with past medical history of end stage renal disease on hemodialysis, type 2 diabetes, hypertension, CAD, cirrhosis secondary to hepatitis C presented to the emergency room with dizziness, profound weakness, malaise, left shoulder pain, and a twenty pound weight loss after three weeks of vomiting. His last dialysis was three days prior to admission. On admission, blood pressure was 141/100 mmHg, heart rate 88 bpm, respiratory rate 18 bpm, temperature 36.6 degrees C, and saturation 99% on room air. Chest x-ray showed no acute disease. Patient appeared ill with epigastric tenderness and then became tachypneic and diaphoretic. Serum sodium 138, potassium 5.3, chloride 95, and CO2 22 mEq/L, with a BUN 45 and creatinine 9.6 mg/dl, calcium 10.6 mg/dl, anion gap 21 mEq/L, glucose 116 mg/dL. WBC 13.4 x 10^3/microliter, hemoglobin 12 g/dL platelet 235 x 10^3/microliter. Initial arterial blood pH >7.72, P_{CO2} <20 mmHg, P_{O2} 130 mmHg. He then had pulseless polymorphic ventricular tachycardia with Q_{tc} prolongation requiring 200J of biphasic defibrillation. He was given IV fluids and IV magnesium. CT showed no aortic dissection, aneurysm, or pulmonary embolism. Subsequent arterial blood pH 7.55, P_{CO2} 25, and P_{O2} 350. Tropinin I trended up from 0.14 to 32.92 to 87.33 micrograms/liter. He was started on heparin drip then dialyzed with a low bicarbonate bath. Patient underwent cardiac catherization which showed blockages of 95% OM II, 70% LAD, and 80% RCA. He had a stent of OMII with subsequent PCI to the RCA and LAD. He continued his regular dialysis sessions during this time. ***Discussion*:** This patient had a severe respiratory alkalosis with severe metabolic alkalosis and severe metabolic acidosis that was life threatening and survived. Thus, the astute clinician must make changes to the dialysis prescription according to the needs of the patient.

Intradialytic laughter therapy: A feasibility study

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Background: The patient experience of maintenance hemodialysis is frequently described as stressful, depressing, and boring. Ways to improve the patient experience through laughter therapy programs have not formally been put into practice. The purpose of this study was to explore the feasibility, safety, acceptance, and patient experience of laughter therapy in two hemodialysis centers in California from September 2016 to April 2017. ***Methods*:** Laughter therapy sessions were implemented weekly for 30 minutes per session. Laughter therapy consisted of breathing and stretching exercises; facilitated intentional laughter exercises; and finished with laughter meditation. Evaluation consisted of surveying and interviewing patients (n = 58) and staff (n = 25). ***Results*:** Seventy percent of surveyed staff and patients agreed that the laughter therapy program had a positive impact on their mood and would recommend it for future centers. 20% of patients did not agree it had a positive impact on themselves with 10% being neutral. ***Discussion*:** Intradialytic laughter therapy is a safe and feasible therapy that can improve perceptions of mood in dialysis patients and dialysis staff and has implications for patient stress, anxiety and adherence to treatment and staff satisfaction. The majority of patients in the 2 centers participated in the 3 month laughter programs and reported positive responses.

Incidence of acute kidney injury in the patients undergoing percutaneous coronary intervention (PCI)

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***Background and Purpose of study*:** Acute kidney injury (AKI) frequently occurs in patients after PCI. Possible causes are administration of contrast media, older age and hemodynamic instability. We studied the incidence, predictive factors and prognosis of AKI following PCI. ***Methods*:** We prospectively studied 150 consecutive patients who underwent PCI in our department. AKI was defined according to KDIGO criteria. ***Results*:** AKI was identified in 30 patients (20%) and 9 (6%) patients required renal replacement therapy. The median contrast dose was 130 mL in the AKI patients and 125 mL in the patients without AKI, a difference that was not statistically significant. The unadjusted 30-days mortality rate was 2.66% (4 patients) in those patients with AKI and zero mortality in those without AKI ($P < 0.0005$). Univariate analysis identified preoperative serum creatinine more than 134 mmol/L, hemoglobin level less than 106 g/L, age 70 years or older,and blood transfusion as risk factors to be associated with AKI. Compared with non-diabetics, those with insulin-treated diabetes had 2-fold greater odds of AKI. By multivariate analysis preprocedural serum creatinine level remained as the only independent predictor of AKI. ***Conclusions*:** In this study, AKI occurred in one-fifth of the patients after PCI and was associated with risk of in-hospital mortality. Preprocedural serum creatinine level was identified as the only predictor of AKI.

P-cresyl sulfate is associated with long-term prognosis of hemodialysis patients

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Background: P-cresyl sulfate was demonstrated to relating to the progression of chronic kidney disease and endothelial injury. Our study aims at investigating the association between p-cresyl sulfate and long-term prognosis, especially cardiovascular events, in hemodialysis patients. ***Methods*:** Enrollment criteria included: 1) Hemodialysis patients; 2) Hemodialysis time over 6 month; 3) Age>18. Exclusion criteria included: 1) newly developed cardiovascular events (including angina pectoris, myocardial infarction, arrhythmia, heart failure, etc) in recent 3 month; 2) newly developed cerebrovascular events (including cerebral infarction and hemorrhage) in recent 3 month; 3) patients planning to proceed kidney transplantation; 4) patients with expected survival time less than 1 year; 5) patients unwilling to participate. Basic clinic data was collected, and biochemical parameters were tested. Blood serum was obtained and was stored at −80 centigrade degree. Serum P-cresyl sulfate level was determined by HPLC-ESI-MS/MS method. The primary end point included: 1) death; 2) newly developed cardiovascular events (including angina pectoris, myocardial infarction, arrhythmia, heart failure, etc); 3) newly developed cerebrovascular events (including cerebral infarction and hemorrhage). Secondary end point included: 1) kidney transplantation; 2) transferred to other dialysis center. Patients were divided into two groups according to p-cresyl sulfate level. Kaplan–Meyer actuarial method was used to estimate primary end point. Proportional hazards model was built to further explore the association between p-cresyl sulfate and long-term prognosis. ***Results*:** 255 patients were enrolled (143 male and 112 female, age 57.0 ± 14.7, median dialysis time 43 month). The median p-cresyl sulfate concentration is 20.1 μg/mL. During the follow-up period (84 months), 100 patients died, among which were 31 cardiovascular death and 15 cerebrovascular death; 15 patients accepted kidney transplantation, and 15 patients were transferred to other dialysis center. Kaplan–Meyer analysis showed that the mortality of high p-cresyl sulfate group is significantly higher than which of low p-cresyl sulfate group (*Log-Rank* P = 0.034). High serum p-cresyl sulfate increased the risk of cardiovascular mortality after adjustment of other risk factors (HR = 1.24, 95%CI [1.02–1.43], P = 0.02). P-cresyl sulfate is not significantly associated with all-cause mortality and other end point events. ***Conclusions*:** Protein-bind uremic toxin p-cresyl sulfate level is associated with cardiovascular mortality in hemodialysis patients. The mechanism needs further investigation. Reduction of p-cresyl sulfate level may become a new target to improve long-term prognosis of hemodialysis patients.

Intradialytic blood pressure fall can predict long-term mortality in MHD patients

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Background/Objective: To assess the association between different time point of intradialytic blood pressure and the prognosis of MHD patients. ***Methods*:** We recruited patients who underwent hemodialysis during Mar. 2009 to May. 2009. Intradialytic blood pressure was monitored during a 3-month period. Dialysis-related information was collected such as complications, prognosis and etc. Cox regression analysis were performed to examine the association between different time point of intradialytic blood pressure and clinical events, using a follow-up through 31 Dec 2014. ***Results*:** 1. A total of 200 patients were recruited. Male 67%, with an age range 25∼85. The primary diseases for end-stage renal disease were glomerulonephritis 66.5%, hypertensive nephropathy 23%, diabetic nephropathy 10.5%, and etc. 2. During the 5-year follow-up, 76 patients died, with a cumulative mortality rate 41.8%. 18 patients were censored during the 5-year observation period. 76 deaths during the follow-up included 18 cardiovascular events, 14 cerebrovascular events, 10 infectious events, 8 tumor events and 9 events for sudden death, and etc. 3. The multivariate Cox regression model indicated that the adjusted hazard ratio for death was 2.049 (95% CI 1.314–3.196) when the decline in intradialytic SBP was analyzed in increments of 20 mmHg, and was 1.912 (95% CI 1.218–3.001) when the decline in intradialytic DBP was analyzed in increments of 10 mmHg. ***Conclusions*:** Fall in blood pressure during hemodialysis can lead to poor outcome among MHD patients.

The decline in intradialytic blood pressure can predict long-term prognosis of MHD patients.

Implementation of advance care planning in renal setting: Our experience

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Advance care planning (ACP) has been actively promoted at Auckland District Health Board (ADHB) since 2012 by a range of clinical groups and leaders across the primary, secondary, NGO and aged residential care sectors. For specialised clinical functions such as the Renal team, embedding ACP as standard clinical practice has required the development of a range of novel solutions that are consumer-focussed and enable clinicians to easily engage in conversations that result in written planning

for future care. Solutions include offering a mix of formalised, accredited ACP training and training tailored to and developed in concert with specific clinical teams; Development of clinically-specific Renal ACP resources, standardised documentation and automated data capture and reporting mechanisms; Incorporation of ACP as a key element of daily service, unit and ward-based Management Operating System team meetings; Empowering clinical leadership from all staff within the Renal team; and Working with consumers to understand their needs and use this insight to develop strategies to normalise initial ACP conversations from a focus on end-of-life care to a message of control and empowerment that better resonates with consumers and puts them at the centre of planning for their future care. This approach has resulted in high levels of participation in ACP by Renal team staff, strong consumer understanding of the benefits of planning for future care and uptake of this service and a high level of staff and consumer satisfaction.

Effect of intra venous ascorbic acid on hepatic iron overload in prevalent hemodialysis patients with hepatitis C

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***Background/Aim*:** Iron overload is not uncommon among prevalent HCV +ve HD patients. We studied the effect of IV ascorbic acid on hepatic iron overload in HD patients with HCV. ***Methods*:** 50 prevalent stable HD patients (25 HCV +ve, 25 HCV -ve), were investigated by hepatic magnetic resonance imaging MRI R2 to assess the liver iron content (LIC). CBC, retics, iron biomarkers & CRP titer were done after stoppage of any iron therapy 3 months prior to study. Patients with increased LIC ($\geq$ 2 mg/g) were selected to receive ascorbic acid treatment for 3 months; 300 mg of ascorbic acid infused over 30 minutes 3 times/week after each dialysis session. Hepatic MRI, iron biomarkers, CBC & Retics were reassessed after 3 months of treatment. Delta change (Δ = Post treatment value – pretreatment value) was calculated. ***Results*:** 44% of patients had hepatic iron over load by hepatic MRI, LIC mean was 5.73 ± 6.37 mg/g, [15 HCV + ve patients (m LIC = 12.60 ± 6.41 mg/g) & 7 HCV −ve patients (m LIC = 8.50 ± 4.33 mg/g)]. Iron overload was: mild in 14%, moderate in 16%, severe 14%. Hepatic iron overload was significantly higher in HD patients with HCV than patients without HCV (P = 0.023). There was statistically significant reduction in the LIC after receiving ascorbic acid for 3 months, in the group of HD patients with HCV Δ was (−1.04 ± 0.58 mg/g) & among group of HD patients without HCV Δ was (−0.68 ± 0.39 mg/g). A statistically significant reduction in the serum ferritin & iron in HCV group Δ was (−220.40 ± 284.25 ng/mL, −45.40 ± 53.66 ug/dl) ($P < 0.01$), respectively. LIC was significantly correlated with ferritin, serum iron, & TSAT. ***Conclusions*:** Short term treatment with IV ascorbic acid significantly reduces liver iron content and serum iron biomarkers among prevalent hemodialysis patients with seropositive chronic HCV infection.

Readmissions following a hospitalization for cardiovascular events in dialysis patients

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***Background*:** Hospitalization for cardiovascular disease (CVD) is common in patients receiving dialysis, but patterns of readmissions following CVD events are underexplored. ***Method*:** In this retrospective analysis of prevalent, Medicare-eligible patients receiving dialysis in 2012 to 2013, all live-discharge hospitalizations attributed to CVD were ascertained. Rates of all-cause, CVD-related, and non-CVD-related admissions, and of death, in the ensuing 10 and 30 days, were calculated.
***Results*:**

Hospitalizations, n = 142.210	All-Cause Readmission	CVD Readmission	Death	ED visit/ Obs Stay
30-day outcomes, %				
All CVD hospitalizations	34.2	14.7	4.5	24.6
Acute coronary syndrome	37.0	16.8	6.4	24.4
Arrhythmia	31.2	13.3	4.8	22.9
CHF	34.6	16.1	4.6	23.7
Stroke	29.1	9.8	6.3	23.0
Other CVD	34.5	14.0	3.6	26.1
10-day outcomes, %				
All CVD hospitalizations	15.6	6.6	1.5	11.6
Acute coronary syndrome	19.0	8.7	2.3	12.0
Arrhythmia	15.1	6.6	1.5	10.8
CHF	15.1	6.9	1.5	10.6
Stroke	14.5	4.8	2.4	11.4
Other CVD	15.5	6.2	1.2	12.5

***Conclusion*:** Fully 15.6% and 34.2% of CVD hospitalizations resulted in readmission within 10 and 30 days, respectively; less than half of which were CVD-related. Nearly 1 in 20 patients died within a month. These findings demonstrate the high morbidity and mortality associated with CVD events in patients receiving dialysis.

COMPare-HDF: Comparing the effect of mixed and post dilution hemodiafiltration (HDF) on transmembrane pressure and hemodialysis circuit clotting

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Background: Post dilution HDF is highly efficient in solute clearance. However, it may increase the risk of dialysis circuit clotting from hemoconcentration. In mixed dilution HDF, the ratio of fluid reinfused before and after the dialyzer is automatically regulated by the transmembrane pressure (TMP) and ultrafiltration feedback. An internal feedback mechanism, maintains the TMP between 240 and 320 mmHg to maximise convection volume, while taking into account the internal pressure of the dialyzer. If the TMP exceeds its maximum tolerated value, a fraction of infused dialysate is diverted from post- to pre-dilution, which decreases hemoconcentration and lowers the risk of membrane pore occlusion. This study was conducted to ascertain the comparative effect of mixed and post dilution HDF on TMP and hemodialysis circuit clotting, particularly in the dialyzer and venous chamber. ***Method*:** A prospective, open label, randomised, cross-over study was performed at two Australian dialysis centres. Following a 2 week post HDF wash in period, patients were randomized to either the experimental (mixed HDF) or control (post HDF) arm for 4 weeks, with crossover to the alternative treatment after a 2 week washout period. Maximum TMP and degree of circuit clotting were recorded at each dialysis session. ***Result*:** 22 patients were included in this study. Median age was 62.5 years, with 14 male and 8 diabetic patients. Dialyzer clotting showed a possible benefit in week 1 using the experimental intervention ($P = 0.01$); however this trend was not sustained. ***Discussion*:** Analysis of TMP was constrained by the delivered treatment mode, as TMP values in mixed HDF did not fall below 240 mmHg and post HDF did not exceed 320 mmHg. Moreover, assessment of circuit clotting was performed by visual inspection and therefore was at risk of observer bias. ***Conclusion*:** Mixed dilution HDF was associated with effective control of TMP, however circuit clotting was not significantly improved when compared to post dilution HDF in this short-term cross-over study.

Frequency and significance of elevated reverse T3 in prevalent hemodialysis patients

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***Background*:** Sick euthyroid syndrome is frequently detected in many chronic diseases and it may be associated with higher mortality particularly in prevalent hemodialysis (HD) patients). Diagnosis depends on finding of low free T3/normal TSH with increased Reverse T3. However, many reports did not detect elevated reverse T3 levels in cases of sick euthyroid syndrome in HD patients and diagnosis depends on low free T3/normal TSH only. The aim of this studyis is to investigate the frequency and clinical significance of elevated Reverse T3 levels in HD patients. ***Methods*:** Forty stable HD patients randomly selected from our unit were studied by history and detailed clinical examination in addition to CBC, routine chemistry, free T3, free T4,TSH, Inorganic iodine level, Reverse T3 level in addition to thyroid ultrasound. Exclusion criteria included those with known thyroid diseases or with other diseases that may affect thyroid functions e.g. diabetes or on drugs that may affect thyroid functions. ***Results*:** We detected low FT3/normal TSH in 27(67.5%) of HD patients while increased Reverse T3 in only 14 (35%) of patients. Combined low FT3/low TSH and high reverse T3 were detected in 9(22.5%) cases. We did not detect significant differences nor significant correlations between cases with low FT3 and normal FT3 in all studied clinical, other biochemical nor thyroid ultrasono-graphic parameters. However, we detected significantly higher frequency of thyroid nodules in cases with high reverse T3 levels. ***Conclusion*:** It may be concluded that contrary to many previous reports elevated reverse T3 may be frequently detected in stable HD patients and may be associated with higher frequency of thyroid nodules.

Relation of carotid Doppler intima/media thickness and astherosclerotic index to cognitive function impairment in prevalent hemodialysis patients and astherosclerosis

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***Background and Aim*:** Cognitive impairment is a common problem in prevalent hemodialysis (HD) patients. Whether accelerated athero-sclerosis or metabolic abnormalities or both are the major contributor to such changes is not yet settled. ***Methods*:** The aim of this study is to assess the possible relation between atherosclerotic common carotid doppler score and cognitive functions in stable non elderly HD patients. Thirty stable non elderly HD adequately dialyzed (using RO bicarbonate dialysis) patients(including 12 females) were randomly selected from our unit and were studied by CBC, routine chemistry including fasting lipogram and PTH(Intact). Common carotid Doppler was done for assess-ment of Intima Media thickness and Atherosclerotic score including peak velocity, degree of stenosis, calcification and plaque type and site in addition to battery of cognitive function tests including Mini Mental State Examination (MMSE),Benton Visual Retention Test, Trail Making Test A&B, Wechsler Memory Scale Test. Exclusion criteria included diabetics, smokers, uncontrolled. ***Results*:** We detected increased atherosclerotic score in 12(40%) cases

(mild-moderate)., MMST showed impairment in 6 cases (20%), Trail Make Test(A) impaired in 14(47%) cases, Trail Make Test (B) impaired in 6(20%) cases, Benton Visual Retention test impaired in 22 cases(73%), Verbal paired association1 test impaired in14(47%) cases, Verbal paired association 2 test impaired in 12(40%) cases. However, we did not detect any significant correlation between atherosclerotic index and all the studied cognitive function tests except Benton Visual Retention test. ***Conclusion*:** It may be concluded that atherosclerosis in nonelderly HD patients may not contribute significantly to cognitive function impairment except Visual memory

Primary appraisal of intradialytic events and stress towards hemodialysis

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Background: Intradialytic events (IDEs) complicate >20% of all hemodialysis (HD) treatments. Yet, no studies were found that evaluated how patients' cognitively appraise these events. This is important because stress associated with IDEs may decrease adherence to prescribed HD treatment plans leading to poor patient outcomes. The purposes of this study were to: a) describe patients' perceived IDEs and their associations to stress and b) examine the primary cognitive appraisal of IDEs on stress related to HD treatments. ***Methods*:** A cross sectional correlational design was used. A convenience sample of 73 persons on HD were consented and completed the Hemodialysis Demographic Form, Dialysis Symptom Index (DSI), Cognitive Appraisal of Health Scale (CAHS), and Hemodialysis Stress Visual Analog Scale. ***Results*:** The majority of the sample was African American (94.5%) and male (52.1%). Participants' mean age was 57 ($SD = 11.98$) years and averaged 41 ($SD = 31.55$) months on HD. Most (60%) had a high school diploma or less education. The average number of perceived IDEs reported by participants was 11 (SD = 6.79; range 1–28). The most frequently reported were lack of energy (70%), followed by dry skin (64%), itching (54%), and cramping (53%). Harm/loss ($M = 23.40$, $SD = 7.74$) and challenge ($M = 21.19$, $SD = 4.15$) appraisals were the highest on the CAHS. Threat appraisal ($r = .243$, $P = .038$) and harm/loss appraisal ($r = .341$, $P = .003$) significantly correlated with stress. When controlling for age, sex, and time on dialysis, primary cognitive appraisal significantly predicted stress ($R^2 = .22$; ($F(7, 65) = 2.58$; $P = .021$). None of the variables uniquely influenced stress. ***Discussion***: The majority of participants indicated stress toward HD related to IDEs. While primary appraisal explained a small amount of the variance in stress during HD, we do not know other factors that may explain this stress. ***Conclusion*:** Persons reported multiple symptoms as IDEs and the primary cognitive appraisal influenced stress during HD. A better understanding of HD stress would strengthen the interdisciplinary team's ability to tailor the treatment plan to minimize stress and improve patient experiences. More studies are needed to understand how IDEs affect persons on HD, especially if these events are repetitive or increase in severity with HD treatments.

Paget's disease of bone: An unusual presentation of hypercalcemia in a hemodialysis patient

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***Background*:** Secondary hyperparathyroidism develops in chronic kidney disease patients often before dialysis begins. The clinical course of secondary hyperparathyroidism is often progressive and can be difficult to manage in some patients. ***Case Report*:** The index case is a 68 year old lady with end stage renal disease secondary to type 2 diabetes mellitus with multiple comorbid conditions including hypertension, anemia secondary to ESRD, secondary hyperparathyroidism, obesity, hypoalbuminemia, dyslipidemia, progressive hearing loss, osteoarthritis and stage I breast cancer. She underwent hemodialysis for 4 hours on a three times a week schedule without complications. She required activated vitamin D therapy in addition to cinacalcet for management of secondary hyperparathyroidism. Over the course of therapy she developed hypercalcemia despite discontinuation of active vitamin D therapy and continuation of cinacalcet. She was re-evaluated by her surgical oncologist and medical oncologist and had no evidence of recurrence. After consultation with endocrinology, she was found to have Paget's disease of bone and underwent therapy with pamidronate. She has had a good response during this initial follow-up period, with subsequent resumption of active vitamin D therapy for continue treatment of secondary hyperparathyroidism without the development of hypercalcemia. ***Discussion*:** Paget's disease of bone is characterized by focal areas of increased bone resorption in the presence of increased bone formation. Consequentially, bone formed in Paget's disease patients is disorganized structurally, weaker and may be prone to fractures and complications. These patients experience bone pain, skeletal deformities, osteoarthritis, increased fracture risk and fractures, hearing loss and mobility difficulty. Evaluation typically includes measurement of calcium, 25 hydroxyvitamin D, 1,25 dihydroxyvitamin D, alkaline phosphatase, phosphorus, parathyroid hormone, thyroid function studies and, radiographs of skull and affected bones. Treatment includes bisphosphonate therapy, analgesics and often physical therapy.

Paget's disease in dialysis patients has been reported sporadically and there is no clinical practice guideline for the

management of these complex patients. In the management of dialysis patients with secondary hyperparathyroidism who develop hypercalcemia, it is important to consider other causes of hypercalcemia, in addition to the usual treatment related consequence of active vitamin D therapy. Other bone diseases may be present in dialysis patients and treatment of the constellation of bone diseases occurring in these patients may require complex regimen and a multidisciplinary approach.

The effects of a pre-dialytic exercise program on the health of hemodialysis patients

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Background: The number of Canadians being treated for kidney failure has more than tripled over the past twenty years. A recent report by the Canadian Institute for Health Information detailed that dialysis, the most common treatment for kidney failure, costs Canada an estimated $1.9 billion each year, approximately 1.1% of the total yearly health expenditures. In addition to the substantial financial burden on the Canadian health care system, hemodialysis (HD) patients personally experience significant physical and psychological burdens. HD patients have poor health outcomes compared to healthy populations, low functional status and physical functioning, high mortality rates, lower quality of life, and an increased likelihood of experiencing symptoms of depression. While previous studies have found that a structured exercise program can improve the mental and physical health outcomes of HD patients, little is known about the feasibility and potential effects of an exercise program delivered prior to the start of a dialysis session while patients are waiting at the unit. ***Aim***: This research study will specifically evaluate a pre-dialytic exercise program that uses the limited space and resources available in the HD waiting rooms, that can maximize health benefits by involving whole-body functional exercises at a level of intensity suitable for HD patients, that is designed to avoid interfering with the HD treatment process by occurring during a time period when the HD patients are not receiving treatment and that should increase adherence by taking place at a patient's regular HD treatment facility prior to a scheduled appointment. ***Objectives***: The objectives of this study are to 1. determine the effects of a pre-dialytic exercise program on the physical performance (Short Physical Performance Battery), mental and emotional well-being (Centre for Epidemiologic Studies Depression Scale Revised), and quality of life (EQ-5D-5L) of HD patients, 2. To explore patient and staff experiences with the pre-dialytic exercise program. ***Methods:*** HD patients will be recruited from 5 outpatient community dialysis units within Fraser Health Authority in British Columbia, Canada. Subjects in the intervention group will participate in an exercise program 3 days a week for 3 months prior to their HD treatment appointments. Both the control and the intervention group will undergo pre- and post-testing to determine the effects of the intervention. ***Results/Discussion/Conclusions:*** A feasibility portion of this study was completed with 27 participants in 2016 and showed positive benefits and acceptance by the HD staff and patients. The full study will begin in January 2018. A basic pre-dialytic exercise program is a novel intervention that should be easy to implement and easily transferrable to other units since it does not interfere with the HD treatment process (as compared to an intra-dialytic exercise program) and has minimal equipment and space requirements.

An atypical acute renal failure in an adult

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Background: Several reported cases of typical hemolytic uremic syndrome (HUS) secondary to Shiga-toxin producing E. coli have been reported in children. However, very few reported cases of typical HUS have been reported in the literature for adults. ***Case Presentation:*** A 61-year-old man presented initially with acute kidney injury (AKI), thrombocytopenia, and encephalopathy. Work up showed thrombotic microangiopathy on renal biopsy and Shiga-toxin producing E. coli is confirmed by positive Shiga-toxin suggesting typical HUS in an adult. Thrombocytopenia resolved with 7-day course of plasmapharesis and steroids. The patient returned gradually to baseline mental status, and renal function slowly improved with scheduled hemodialysis. ***Conclusion:*** We report a case of typical HUS in an adult secondary to Shiga-toxin producing E. coli

Crescentic glomerulonephritis occurring with renal amyloidosis caused by rheumatoid arthritis: A case report

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Background: Patients with rheumatoid arthritis (RA) have many risks of renal dysfunction. Amyloid A (AA) amyloidosis is a serious complication of RA, and causes renal dysfunction. Patients with renal amyloidosis may develop crescentic glomerulonephritis (CrGN), and may present with rapidly progressive glomerulonephritis (RPGN). Several case reports have shown that tocilizumab (TCZ), an anti-human interleukin-6 (IL-6) receptor monoclonal antibody, has the ability to suppress serum AA (SAA) levels and improve the clinical symptoms of AA amyloidosis. ***Case presentation:*** A 67-year-old female with RA presented with general malaise, watery diarrhea, and renal failure over several weeks. Renal biopsy showed renal amyloidosis, and found cellular or fibrocellular crescents. We used TCZ after steroid pulse therapy. TCZ suppressed SAA levels and improved diarrhea, proteinuria, and recovered renal function. However, we had to discontinue TCZ therapy because of Cytomegalovirus

(CMV) infection and *Clostridium difficile* infection. ***Conclusion***: The patient developed end-stage renal disease after treatment interruption, and began maintenance hemodialysis. The effects of renal dysfunction dominate the course of AA amyloidosis, which is associated with SAA concentrations that remain in the low-normal range. If we could have continued TCZ therapy, her renal function might have been preserved.

Benefit of hybrid therapy with hemodialysis and peritoneal dialysis as an initiation step for chronic hemodialysis therapy

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Background*:** Hybrid therapy with hemodialysis and peritoneal dialysis is a treatment option for patients undergoing peritoneal dialysis to introduce hemodialysis in Japan. Peritoneal dialysis is a home-based therapy, but there is a limitation in the efficacy of mid-to-large molecules in patients with reduced residual renal function. In contrast, hemodialysis has higher efficacy, however there are many patients who do not accept hemodialysis because of the acute change in their life style. We therefore accessed the beneficial role of the hybrid hemodialysis and peritoneal dialysis for introduction of chronic hemodialysis therapy. ***Methods: Five end stage renal disease patients did not accept hemodialysis. These patients underwent peritoneal dialysis during maintained residual renal function and peritoneal dialysis efficacy, indicated by lowered mid to large molecules such as β2 microglobulin. Hybrid hemodialysis and peritoneal dialysis therapy was applied when patients have serum β2 microglobulin level above 30 mg/L. ***Results***: Initially, all five patients did not accept conventional hemodialysis therapy because of work, long distance to dialysis facility, or unacceptable to three sessions per week. They however accept hybrid therapy after the introduction. They started hemodialysis once a week and peritoneal dialysis. One patients required hemodialysis twice a week to maintain volume control and serum levels of β2 microglobulin. All patients quit peritoneal dialysis on the day of hemodialysis and some patients even next day when volume control and β2 microglobulin were controlled well. Finally, four patients accepted hemodialysis for their future therapy and one patient decided to receive renal transplantation. ***Discussion***: Since conventional institutional hemodialysis normally requires three sessions per week, it may reduce patients' quality of life and acceptability. Although peritoneal dialysis can minimize the disruption of patient's daily activity and these patients can work or travel more easily, long term peritoneal dialysis Results in less filtering of waste products and increases a risk of concomitant diseases. Stepwise induction is one option to increase better understanding for hemodialysis in patients undergoing peritoneal dialysis. ***Conclusions*:** Hybrid therapy with hemodialysis and peritoneal dialysis could increase patient tolerance for conventional hemodialysis therapy and may have advantage in quality of life and better efficacy of renal replacing therapy.

Changes in the indications of tunneled cuffed catheter use in hemodialysis patients: A single-center experience

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***Background*:** In Japan, tunneled cuffed catheters (TCC) are recently widely being used during hemodialysis (HD) due to the increasing number of elderly patients with lack of suitable vessels for arteriovenous fistulas (AVF). However, TCC is also used as a bridge access until maturation of AVFs. This study aimed to clarify the changes over time in the indications of TCC at our hospital. ***Methods*:** This single-center, retrospective study included all patients at our hospital in whom a TCC was placed between July 2005 and July 2017. We compared the patients'demographic data and clinical information by dividing the observation period into two groups (early phase and late phase) relative to the median (6.5 years). ***Results*:** A total of 147 TCCs were placed in 97 patients (median age 75 years, 48.9% males, 40.8% with diabetes mellitus, mean duration of dialysis 42.8 months). Of these, 58 TCCs were placed in the early phase (from July 2005 to December 2011), and 89 TCCs were placed in the late phase (from January 2012 to July 2017). Although late phase patients were older than early phase patients (78 vs. 70 years, $P = 0.002$), there were no significant differences in the duration of dialysis between the two groups (38.1 vs. 50.4 months, $P = 0.231$). Late phase patients tended to have superficialization of the brachialartery (29.3% vs. 44.9%, $P = 0.057$). There was no difference in the prevalence of CVD between the two groups. In early phase patients, the main indications for TCC were lackof suitable vessels for AVF (86.2%) and severe cardiac dysfunction (6.9%). In contrast, the main indications for TCC in late phase patients were lack of suitable vessels for AVF (53.9%), severe cardiac dysfunction (21.3%), and bridge access until maturation of AVF (13.5%). ***Conclusion*:** This study seems to indicate a change in the indications for TCC use for hemodialysis to include older patients with severe cardiac dysfunction and as bridging use until maturation of the AVF.

The utility of intravenous decongestive diuresis in type 1 acute cardiorenal syndrome: Accelerated rising pro B naturetic peptide at presentation is a prognosticator for good renal outcomes

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***Background*:** Forward heart failure with low cardiac output does not fully define renal dysfunction in cardiorenal syndrome (CRS). "Congestive renal failure" was coined (Ross, 2012) to depict the role of renal venous hypertension (RVH) in CRS. If so, aggressive decongestive therapy via mechanical ultrafiltration (dialysis machines) or pharmacologic ultrafiltration (Decongestive Diuresis - DD) should improve cardio-renal outcomes. Yet, a 2012 review concluded that a RVH-directed approach using diuretics was yet to be fully investigated. ***Case Description*:** We describe significant renal salvage with combination IV Furosemide infusion plus 8-hourly IV Chlorothiazide in three consecutive patients with type 1 CRS seen in our Mayo Clinic Health System Renal Unit, March-May, 2017. Incidentally, all three revealed acutely rising Pro B Naturetic Peptide (BNP) levels at presentation. ***Conclusions*:** We hypothesized that type 1 CRS patients presenting with acutely rising Pro-BNP levels represent a group of such patients who would demonstrate good cardio- and renal outcomes following DD. This easily affordable therapeutic option (DD) should be of the highest utility in resource-poor countries where mechanical ultrafiltration is often unavailable. More studies are warranted.

The effect of synbiotic on serum indoxyl sulfate in maintenance hemodialysis patients

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Background: Indoxyl sulfate (IS) is a major uraemic toxin contributing to major cardiovascular morbidity and mortality. The aim of our study was to evaluate whether synbiotic (pre- and probiotic) therapy alters the gut microbiota and reduces serum concentrations of IS in hemodialysis patients. ***Methodology***: 80 ESRD patients undergoing regular hemodialysis recruited (between January 2017 and March 2017) to a randomized, single-blind, placebo-controlled trial of synbiotic therapy over 6 weeks. The primary outcome was serum IS. Secondary outcomes included serum Creatinine, Blood Urea Nitrogen (BUN), Sodium, Potassium, Calcium, Phoshorus and C-reactive protein (CRP). Synbiotic (prebiotic 15 gm lactulose/day) + (the probiotics include 5 bacterial strains; Lactobacillus rhamnosus, Lactobacillus acidophilus, Lactobacillus casai, Bifidobacterium brevis, Bifidobacterium longum in a dose of 10 billion CFU/10 gm prepared by Dairy and Food Microbiology Department of National Research Center). ***Result*:** Synbiotic therapy significantly reduced serum IS (13.55 ± 9.31 in intervention group Vs 3.18 ± 14.56 in the control group, $P < 0.001$). Synbiotic therapy significantly reduced the levels of Creatinine, BUN, Phosphorus ($P < 0.001$) and CRP (P 0.011). ***Conclusion*:** In hemodialysis patient, synbiotics significantly reduced serum IS, besides a marked reduction in serum Phosphorus and CRP without recorded adverse effects.

Effect of probiotics on serum indoxyl sulphate in hemodialysis patients

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Background*:** Indoxyl sulfate (IS) is a major uraemic toxin contributing to major cardiovascular morbidity and mortality. The aim of our study was to evaluate weather probiotic therapy alters the gut microbiota and reduces serum concentrations of IS in hemodialysis patients. ***Methodology*:** 92 ESRD patients on regular HD from January 2017 to March 2017 was recruited to randomized, single-blind, placebo-controlled trial of probiotic therapy over 6 weeks. The primary outcome was serum Indoxyl Sulfate (IS). Secondary outcomes included serum Creatinine, Blood Urea Nitrogen (BUN), Sodium, Potassium, Calcium, Phoshorus and C-reactive protein (CRP). The probiotics include 5 bacterial strains; Lactobacillus rhamnosus, Lactobacillus acidophilus, Lactobacillus casai, Bifidobacterium brevis, Bifidobacterium longum in a dose of 10 billion CFU/10 gm for each strain prepared by Dairy and Food Microbiology Department of National Research Center). ***Results show reduction of IS (14 ± 22.71 μg/mL vs 3.6 ± 14.33 μg/mL, P value 0.02) in intervention group vs control group respectively, probiotic therapy also significantly reduced the levels of Phosphorus (P values <0.001) and CRP ($P < 0.001$) and lipid profile (cholesterol, Triglyceride, LDL with $P = 0.008$, 0.004,0.02 respectively). ***Conclusion*:** In Hemodialysis patient, probiotic significantly reduced serum IS, besides a marked reduction in serum Phosphorus, CRP, and lipid profile without recorded adverse effects.

Bullous pemphigoid after immunosuppressant withdrawal in failed renal transplant on hemodialysis

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Background: The occurrence of the autoimmune blistering disease, bullous pemphigoid (BP), in patients with failed renal allograft is rare. Here we report the case of a patient presenting with bullous lesions soon after the complete discontinuation of immunosuppressant therapy (IS) following renal allograft failure. Administration of systemic corticosteroid controlled the occurrence of BP lesions in our patient. Increased clinical suspicion is warranted in patients with failed renal transplant, since withdrawal of the immunosuppressant therapy could unmask underlying autoimmune diseases. ***Case Report*:** 45 year old African American female presents to clinic with blistering lesions mainly

on extremities, ten months after failed kidney transplant. She was on mycophenolate mofetil (MMF), tacrolimus and prednisone before rejection. MMF was stopped immediately after transplant rejection, prednisone tapered and stopped 1 month before presentation. Skin biopsy performed confirmed the diagnosis of Bullous Pemphigoid. Systemic steroids were restarted immediately and patient improved clinically. Glucocorticoids were weaned off and the patient initiated on azathioprine after which no recurrence has been seen. ***Conclusion***: IS therapy regimens utilized for renal transplant recipients have been known to be active against BP. Since BP is an autoimmune disease, it could be masked in patients on immunosuppressant therapy. Bullous pemphigoid might not always present as an isolated autoimmune entity. There are various possibilities associated with the situation. The renal transplant rejection by itself can cause formation of autoantibodies that react with the epidermal basement membrane. Similarly, the cessation of IS treatment post failed renal transplant may unmask an underlying autoimmune disorder, such as the bullous pemphigoid.

High burden of hospitalization and related medicare expenditures in incident dialysis patients in nursing homes

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Background: A subset of incident end-stage renal disease (ESRD) patients initiate dialysis in nursing homes. The size of this subset is uncertain, as are patient characteristics and hospitalization patterns in the subset. We aimed to use data from the United States Renal Data System (USRDS) to describe the burden of hospitalization and related Medicare expenditures in such patients. ***Methods:*** We identified adult patients who initiated dialysis between January 1, 2006, and December 31, 2013; who carried Medicare as primary payer on the first day of dialysis; and whose primary dialysis setting was a skilled nursing or long-term care facility, according to the ESRD Medical Evidence Report (form CMS-2728, item 22). We assessed age, race, sex, and primary cause of ESRD in such patients. We also estimated rates of hospital admissions and Medicare Part A payments to inpatient care facilities, both in aggregate and by category of principal discharge diagnosis (cardiovascular disease, infection, other morbidity). ***Results:*** We identified 63,412 patients who initiated dialysis in nursing homes, or slightly more than 7900 patients per calendar year. Mean age was 71.6 years, although 27.8% of patients were non-elderly (*i.e.*, age <65 years). Prevalence of white race and female sex were 70% and 51%, respectively, and 77% of patients had either diabetes or hypertension as primary cause of ESRD. Core-based statistical areas with highest counts of patients were New York ($n = 4131$), Los Angeles ($n = 2909$), Chicago ($n = 2792$), Pittsburgh ($n = 1125$), and Detroit ($n = 946$); there were 29 areas with an average of 50 or more patients per year. The hospital admission rate was 2.8 admissions per patient-year, with cause-specific rates of 0.6, 1.0, and 1.2 admissions per patient-year for cardiovascular disease, infection, and other morbidity, respectively. The hospital day rate was 44.0 days per patient-year, with cause-specific rates of 8.5, 15.3, and 20.2 days per patient-year for cardiovascular disease, infection, and other morbidity, respectively. The Medicare Part A expenditure rate for inpatient care was $38,305 per patient-year. By race, expenditure rates were $35,851, $43,460, and $51,561 per patient-year for white, black, and Asian patients, respectively. ***Conclusions:*** Almost 8000 patients per year initiated dialysis in nursing homes. This patient population is predominantly elderly and white, but it is not uniformly so. The burden of hospitalization and related Medicare expenditures is very high, as patients spend more than 12% of their days in hospitals. Interventions are urgently needed to reduce the need for acute care in this patient population.

Dialysis Systems and Equipment

Real world in-center urea clearance experience with a novel self-care hemodialysis system

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Background: Patients receiving hemodialysis have expressed a desire for greater control of their dialysis treatments. Tablo™, is a novel hemodialysis system which enables patient-empowered care at a dialysate flow rate of 300 mL/min. Kinetic modeling data and bench top testing predict that the majority of US patients can achieve adequate urea clearances in under 4-hour treatment times on thrice weekly hemodialysis treatment schedule with Tablo™. Herein we present a real-world experience of urea kinetics for patients undergoing self-care in-center hemodialysis with Tablo™. ***Methods***: 15 patients at a single in-center hemodialysis unit were approached regarding doing self-care hemodialysis by the dialysis unit staff. 9 of 15 patients approached agreed to a trial of self-care in-center hemodialysis. All treatments were conducted under a physician's supervision and prescription. Patients were instructed on the use of the device and did all treatments. Fistula cannulation was performed by the patient or by a patient care technician while initiation, operation and termination of dialysis was performed by the patient him or herself. Laboratory testing was done per the attending physician's discretion and were collected as part of post-market safety monitoring activities. Laboratory tests were collected by facility staff in accordance with routine practice. Urea samples were collected after first decreasing blood pump speed to 100 mL/min and allowing one minute to elapse before the post-urea sample was collected. Single pool Kt/V were calculated using the second general Daugirdas equation. De-identified data on weight, blood pump speed, and ultrafiltration volume are automatically collected by Tablo™ and transmitted to a HIPPA-compliant cloud-based server. ***Results***: The table below

Patient	Pre-HD Weight (kg)	SKt/ V_{urea}	URR	Ultrafiltration (kg)	Treatment Time (min)	N
1	74.3	1.72	78	1.86	195	14
2	124.5	1.39	70	2.23	210	12
3	63.6	1.72	76	2.32	180	9
4	74.1	1.23	65	2.13	210	3
5	86.9	1.46	71	2.48	225	4
6	96.9	1.41	68	3.95	240	8
7	93.9	1.34	68	2.97	210	7
8	118.5	1.28	67	4.13	210	9
9	94.3	1.48	71	3.10	210	4
Avg.	91.9	1.45	70	2.80	210	7.8

demonstrates pre-dialysis weights, measured urea reduction ratios, modeled single pool Kt/V_{urea} values, and average ultrafiltration rates. The number of independent measurements made over a 3-month period are denoted by N. From instrument collected data, blood pump speeds ranged from 350 to 400 mL/min. Over the 3-month observation period there were no changes in prescribed treatment time from the initial dialysis prescription on Tablo™. Dialyzers utilized during the course of the observation period ranged in surface area from 1.6 to 1.8 M^2. ***Conclusions***: These observational data in an unselected patient population support previously reported urea kinetic modeling data. CMS mandated urea clearance targets can be routinely achieved with a thrice weekly schedule in a patient population with a wide range of weights using Tablo™ and a dialysate flow rate of 300 mL/min

Estimation of the plasma refilling rate during hemodialysis based on real-time hematocrit monitoring

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Background: During a typical hemodialysis (HD) session, excessive water removal sometimes induces a rapid drop of blood pressure. In order to prevent dialysis-related hypotension, it seems necessary to ensure adequate water removal from the patient based on the change of the blood volume. In this paper, we describe a method for estimation of the plasma refilling rate (Q_{PR}) using data obtained from real-time hematocrit monitoring. ***Methods***: A real-time hematocrit (Ht) monitor, Critline®, has been widely used during HD sessions, and is useful for estimation of the blood volume (BV) change during hemodialysis. The Q_{PR} (t) value can be estimated using the following equation; Q_{PR} (t) = Q_{UF} + ΔV_B (t)/Δ t, where Q_{UF} denotes the constant ultrafiltration rate for excessive water removal and ΔV_B (t) denotes the BV change during the time interval (Δ t). On the other hand, ΔV_B (t) can be calculated as ΔV_B (t) = V_B (t) x (Ht (t)/Ht (t + Δ t)-1), because of the constant volume of the formed elements; Ht (t) and Ht (t + Δ t) denote the hematocrit values at t and t + Δ t, respectively. Combining the above equations, the Q_{PR} (t) value can be estimated as follows,

$$Q_{PR}(t) = Q_{UF} + (V_B(t)/\Delta t) \times (Ht(t)/Ht(t+\Delta t)-1)$$

Results and Discussion: We assumed the initial BV [L] value as the body weight [kg] before the HD session divided by 13 and set the Δ t at 10 minutes. The Ht (t) and Ht (t + Δ t) values can be determined as the moving average values for 4 minutes of data obtained from the Ht monitor around t and t + Δ t, respectively. ***Conclusion***: The time-course of changes of the Q_{PR} and V_B values at Δ t (= 10 minutes) later after time (t) can be determined using the above-mentioned method. Application of this method to prescribe appropriate water removal may allow rapid drop of the Q_{PR} and V_B values during HD treatment to be avoided.

COMPare-HDF: Comparing the impact of mixed and post hemodiafiltration (HDF) on convection volume, small and middle molecule clearance, and post dialysis recovery time

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Background: Mixed dilution HDF is a widely available therapeutic modality, however it is yet to be determined if it increases convection volume when compared to post HDF, and whether this is associated with improved small and middle molecule clearance, and reduced post dialysis recovery time. ***Method***: In this prospective, open label, cross-over study, patients were randomized to receive either experimental (mixed HDF) or control (post HDF) therapy as their first treatment. A two-week wash-in period (post HDF) was followed by two treatment phases (mixed HDF-post HDF or post-HDF-mixed HDF) separated by a two-week washout period. Laboratory tests and post dialysis recovery time were measured at baseline and at the commencement and completion of each treatment phase. ***Result***: The study recruited 25 prevalent hemodialysis patients from two Australian dialysis centres with 22 patients completing the study. Total convection volume was significantly increased during the mixed-HDF phase by approximately 17 L/treatment ($P < 0.001$). There was a significant difference in post dialysis creatinine during the post-HDF therapy (223.10 ± 83.9) vs. the mixed-HDF therapy (244.59 ± 98.1, $P = 0.01$), with no statistically significant change in other biochemical parameters. Approximately 30% of patients exhibited immediate post-dialysis recovery, with no significant difference between the two treatments.

***Discussion*:** In this short crossover study, a significant increase in total convention volume was observed with mixed HDF therapy compared with post HDF therapy. Although recent literature has shown higher convection volumes confer better health outcomes, there were no significant differences in small or middle molecule clearance or in dialysis recovery time. No safety issues were identified. ***Conclusion*:** Longer studies will be required to determine whether the higher convention volume results in clinically significant improvements in patient-level outcomes.

Comparison of biocompatibility in polysulfone dialysis membranes with different sterilization

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***Background and Purpose of study*:** Polysulfone (PSf) membrane has been widely and most commonly used for hemodialysis because of its higher permeability than that of other materials. A few studies have been reported that method of sterilization may affect biocompatibility, even in cases where the same basic membrane material is used. In this study, the comparison was made between two PSf membranes in order to evaluate the effect of sterilization from the biocompatibility point of view. ***Methods*:** We investigated the biocompatibility of the following two dialyzers, i.e., APS-11SA (Asahi Kasei medical Co., Tokyo, Japan), sterilized by gamma-ray irradiation, and RENAK PS-1.0 (Kawasumi laboratories, Tokyo, Japan), sterilized by autoclave. Heparin of 40 units/mL was put in a syringe, and test blood was collected from healthy volunteers. Then, the dialyzer and blood circuit were filled with the test blood. Subsequently, the blood was circulated by a roller pump at the rate of 200 mL/min. We measured the platelet counts, platelet factor 4 (PF4), β-thromboglobulin (β-TG) and CD41 and CD42b platelet surface markers at 30, 120 and 240 minutes. ***Results*:** The platelet counts at 30, 120, and 240 minutes decreased significantly from the initiation of blood circulation in both dialyzers. The average PF4 and β-TG increased from X1 and Y1 to 571.3 ± 231.7 ng/mL and 816.6 ± 444.1 ng/mL with APS-11SA and from X2 and Y2 to 404.6 ± 231.7 ng/mL and 525.3 ± 152.8 ng/mL with RENAK PS-1.0, respectively. The average expression of CD41 and CD42b decreased to $94.4 \pm 1.3\%$ and $90.9 \pm 2.3\%$ with APS-11SA and $92.8 \pm 3.1\%$ and $91.0 \pm 4.0\%$ with RENAK PS-1.0, respectively. ***Discussion*:** There are some reports that the gamma-ray irradiation changes the membrane structure of the PSf membrane, cross-linking the polyvinylpyrrolidone (PVP), a hydrophilic agent, on to the membrane. On the other hand, excess amount of PVP may have been eluted during the rinsing procedure in RENAK because it was sterilized with autoclave. Because both these factors influenced on our Results, we could not find the significant difference in blood compatibility between these membranes. ***Conclusions*:** APS-11SA and RENAK PS-1.0 dialyzers showed an excellent blood compatibility and differences in terms of PF4, β-TG, CD41 and CD42b were not significant.

Determination of technical specifications of dialyzers for CRRT

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***Background and Aim*:** We made prototype dialyzers of different housing with the same membrane permeability, surface area and the packing density using the polyester polymer alloy (PEPA) membrane that is known to have strong adsorption characteristics. We have already reported that higher clearances were obtained with larger inner diameter of the hollow fiber and a longer housing design for small and middle molecules in aqueous solution system. In this study, we measured albumin (Alb) transport together with pressure changes in bovine blood using the same 9 prototype dialyzers. ***Materials and Methods*:** Total of 9 prototype dialyzers were prepared by changing the L/D ratios (L: effective length, D: diameter of the housing), i.e., 9.3 (long & slim: LS), 5.1 (normal: N) and 2.9 (short and thick: ST) and the inner diameter of the hollow fiber (ID), i.e., 170, 210 and 245 μm. They have the same surface area of 0.8 m^2. The test solution was prepared with Alb dissolved in PBS or bovine whole blood whose hematocrit was adjusted to 30%. Ultrafiltration experiments were performed at 310 K under the flow rate of the test solution (blood) 100 mL/min, and that of ultrafiltration 1000 mL/h. We measured the time course of Alb concentration and pressures at the inlet and outlet of the dialyzer and at the filtrate. ***Results and Discussion*:** In the aqueous solution, lager Alb leakage was found in the shorter-thicker housing design as well as larger ID. Same results were found with bovine whole blood with a little larger deviation due to the individual specificities of the blood. Therefore, the amount of Alb leakage may be controlled by changing the ID and housing design. Pressure in the filtrate was higher in the module ST, followed by N, and LS. It was also higher with larger ID. Results found in bovine blood system were not significantly different from those in aqueous solution system. Solute transport performances of dialyzers for CRRT under blood system may be predicted from those under aqueous solution system by choosing appropriate experimental conditions. ***Conclusion*:** Technical specifications of dialyzers for CRRT may be determined by choosing appropriate experimental conditions.

Quantification of heterogeneity of dialysis membrane using forward and backward ultrafiltration

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***Background and Objective*:** Solute removal performance of the dialyzer is closely related to physicochemical structures of the membrane. The objective of this study is to devise a new *in vitro* evaluation technique to directly quantify the physicochemical structures of the membrane. ***Materials and Method*:** Three commercial dialyzers with cellulose triacetate (CTA), asymmetric CTA (termed ATA), and polyether sulfone (PES) membranes (Nipro, Osaka, Japan) were employed for investigation. Forward ultrafiltration experiments were performed with aqueous vitamin B_{12} (MW 1355), chymotrypsin (MW 25,000), and albumin (MW 66,000) test solutions. Backward ultrafiltration experiments were devised introducing the test solution outside the hollow fiber (HF) and the filtrate inside the HF, respectively. Experiments with dextran solution in the wide range of MW were also performed separately. Sieving coefficients (*s.c.*) for those solutes were measured under $Q_B = 200$ mL/min and $Q_F = 10$ mL/min at 310 K. The ratio of *s.c.* in the backward ultrafiltration to that in the forward ultrafiltration, $R_{B/F}$, was defined for evaluation. ***Results and Discussion*:** According to the classic mass transfer theory, *s.c.* in the forward ultrafiltration and that in the backward ultrafiltration are expected to be identical, and $R_{B/F}$ values were indeed unity for vitamin B_{12}, and chymotripsin in all 3 dialyzers. Unlike these solutes, $R_{B/F}$ values for albumin were 1.0 in CTA, 1.9 in ATA, and 3.9 in PES membranes, respectively, which corresponded well with the fact that CTA is homogeneous, whereas ATA and PES are heterogeneous in structure, found by FE-SEM system. Moreover, the heterogeneity of ATA and PES may be different by two folds (= 3.9/1.9). Above fact was also verified in the continuous manner by employing dextran as a test solute. This must be based on the fact that the physicochemical structures of the heterogeneous membrane had a wedge-like pore size distribution in the radial direction. ***Conclusions*:** A wedge-like pore size distribution in the radial direction in heterogeneous membrane was semi-quantitatively evaluated by introducing a backward ultrafiltration technique.

Education

Patient to patient peer mentoring in one hemodialysis center: A pilot program

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Background and Objective: Patients new to hemodialysis (HD) are primarily provided education by the care team to support their adjustment to HD. However, most clinicians, no matter how empathic, are limited in their ability to fully relate to the patient experience starting the journey of dialysis. Peer mentor programs have been shown to be feasible in HD, and can increase patient engagement, improve quality of life and mental health measures. The purpose of this study was to pilot an adapted patient peer to peer mentoring program, published by Network 5, in one dialysis center in Northern California. ***Methods*:** A mentor/mentee program is being implemented consisting of mentor identification, training, support, mentor and mentee matching, and 5 mentor/mentee meetings every 2 weeks for a 2-month period. The patient mentor training consists of two 4-hour workshops covering active listening, reframing, encouragement, providing self-care tips, maintaining confidentiality and seeking assistance. Primary study outcomes will be: change in self-efficacy as measured by 6-Item Self-Efficacy for Managing Chronic Disease Scale. Secondary outcomes will be change in anxiety and depression as measured by the 4 item Patient Health Questionnaire Scale (PHQ-4). Mentee and mentor evaluations through semi-structured interviews will be performed. ***Results*:** Seven mentor/mentee dyads were identified in the center where 110 patients are currently dialyzed. Preliminary data indicates positive acceptance of the mentor/mentee program by center staff and patients. A high level of engagement from key dialysis center champions including the social worker and renal dietitian played a key role in the success of starting the mentor/mentee program. ***Discussion and Conclusion*:** A structured mentor/mentee program supported by clinicians is explored in an attempt to provide patients with additional resources for coping with the demands and burden of ESRD. Commitment from dialysis provider and staff is vital to ensure success and sustainability of mentor/mentee program.

Novel approach to pre-dialysis modality options education leads to informed decision-making and improved admission to home dialysis

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Background: Home hemodialysis and peritoneal dialysis result in better clinical outcomes, lower hospitalization rates, and improved quality of life compared to conventional in-center hemodialysis. It is estimated that 20%-50% of dialysis patients would be classified as good home dialysis candidates, but less than 10% of dialysis patients choose a home modality. About 70% of patients report not receiving sufficient education on modality options. A pilot program was established to introduce the "options navigator" role that provides modality options education to potential dialysis patients and prepares them for admission. This study aims to determine the effectiveness of the pilot program in increasing the prevalence of home dialysis modalities. ***Methods*:** The on-going pilot that started in January 2017 includes 7 home dialysis centers and 6 options navigators. 582

patients have been referred to the navigators through September 2017. Outcome measures include home admissions before vs. after the pilot program started and the proportion of patients who have been contacted, educated, awaiting admission, and admitted. ***Results*:** Since the pilot started, monthly new home patient admissions have increased by 13%. Navigators have successfully contacted 90% of the patients referred to them. Among patients who have been successfully contacted, 84% have received modality options education. Of those who have received modality options education, 88% of them were educated within 1 month after referral. Thus far, 20% of the patients educated have been admitted for home dialysis modalities. 51% of the educated patients are considered eligible for home therapies.

Discussion/*Conclusions*: One potential reason for low home dialysis admission is insufficient modality options education. To address this unmet need, this pilot program established a role that provides modality options education to potential dialysis patients and prepares them for admission. Preliminary results are promising in improving home dialysis admission by empowering patients to make an informed decision to choose the most suitable dialysis modality.

Advance care planning: Empowering nurses in hemodialysis

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Background and Aim: Despite high mortality rates, patients undergoing dialysis typically do not view themselves as terminally ill and falsely assume they can be kept alive indefinitely on dialysis. Care of these patients therefore requires skill in advance care planning (ACP) to lay out a set of values and processes for approaching end of life decisions and identify preferences for future goals of care. The process may involve discussion, knowledge sharing, and informed decision making about future and potential end of life treatment options and preferences. Individuals who engage in ACP are more likely to have their end of life wishes known and followed hence decreasing family members stress and rates of intensive care admissions. ACP allows patients to have fewer life sustaining procedures and therefore less costly care in the last weeks of life. Further, the Ontario Renal Network (ORN), has made it a mandate for ACP and goals of care discussion to be part of the care ESRD patients receive. Comprehensive care of patients with ESRD requires comfort and expertise in ACP, however, there are no standards of care regarding when to initiate or how to facilitate ACP. Method: The aim of this initiative was to built the nurses capacity through education to enable them to initiate conversations on ACP with ESRD patients in incentre hemodialys (HD). A needs assessment through a survey was sent out to more than 100 nurses in incentre HD. From the survey, barriers including lack of knowledge, resources, and decreased comfort levels were identified. An ACP working group was initiated in the unit to assist and empower HD nurse's through bi-weekly educational sessions and provision of resources and supports including current material. Further, liason building was fostered between the HD unit and ethics department, as well as, the hospital's palliative care team. Partnership between the home dialysis program and incentre HD program further enabled collaboration on common goal setting with outlined timelines. ***Results***: From the inception of the initiative, incentre HD nurses have increased their ACP knowledge through education and collaboration within nephrology and hospital programs. More than 80% of the nurses have attained ACP education which has allowed an increase in the nurses comfort level with initiating ACP discussions in incentre HD unit. ***Conclusion*:** Empowering nurses through education and ongoing support on ACP can lead to capacity building in incentre HD nurses. This increases patient engagement hence improving quality care provided to HD patients. Ongoing education and standardization of ACP process in the unit, as well as, nephrologist involvement is required for sustainability of this initiative. This will prevent future unnecessary hospital admissions of HD patients including heroic measures at the end of life stage.

Optimal transitions: An innovative approach to improve home dialysis modality penetrance

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Background: Home hemodialysis (HHD) and peritoneal dialysis (PD) result in better clinical outcomes, lower hospitalization rates, and improved quality of life compared to conventional in-center hemodialysis (CHD). Less than 10% of incident patients choose home dialysis, and 70% of patients report not receiving sufficient education on modality options. The Optimal Transitions (OT) program, a transitional dialysis care unit concept, was established to provide clinical stabilization and optimization through the delivery of short-daily hemodialysis. Moreover, we are able to provide in-depth education in all dialysis modalities and self-care management over a flexible time period to allow for more patient engagement and empowerment. This study aims to determine the effectiveness of the OT program in increasing the penetrance of home dialysis modalities. ***Methods*:** This study evaluates patients enrolled in the OT program from Oct 2016 to Aug 2017. Each patient completes 6 courses over about 4 to 6 weeks. The OT program consists of 4 stations using a home hemodialysis cycler within a CHD center staffed with a dedicated nurse and technician. Admission criteria include incident, in-center hemodialysis, peritoneal, and transplant patients who are deemed eligible for the program based on a clinical and psychosocial assessment. Upon the completion of the administered courses, i.e. graduation, patients were administered a survey to evaluate their level of engagement and preparedness upon transition to their desired modality. Outcome measures include

the proportion of patients transitioning to home dialysis and the proportion who felt prepared to transition to chosen modality upon graduation. ***Results*:** Of the 23 patients referred to the OT program, 74% (17) were admitted and 26% (6) were rejected due to lack of readiness to join the program. To date, 88% (15) graduated, one patient (6%) is currently enrolled, and one patient (6%) died. Of the 15 patients who completed the program, 47% (7) chose HHD, 27% (4) chose PD, and 27% (4) in-center HD. The majority of patients experiencing OT (53% (8)) were admitted directly from the hospital. 10 patients who filled out the evaluation survey answered "agree" or "strongly agree" when asked if they felt prepared to transition into their chosen modality. ***Discussion*:** Preliminary results are encouraging for the opportunity to increase the adoption of home/self-care dialysis options. ***Conclusion*:** These preliminary results indicate that more patients choose a home/self-care dialysis option when admitted to the OT program. Psychosocial challenges, suboptimal dialysis delivery, modality education, premature decision-making, and fear are addressed with the OT program by establishing a life plan and providing in-depth, ongoing education.

Pre-ESRD care, self-dialysis, and maintenance of employment among incident dialysis patients, 2006–2015

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***Background*:** In 1972 Congress extended Medicare to people with kidney failure with the belief that many patients would work. This study sought to examine the employment status at initiation of dialysis, among those employed 6 months prior, and predictors of maintained employment during the critical transition period to dialysis. ***Methods*:** Data on 156,377 incident dialysis patients ages 21 to 65 who were working (full or part-time) 6 months prior to dialysis initiation in the United States Renal Data System (USRDS) using data available in the Medical Evidence Report (CMS 2728) were analyzed. Subjects who were institutionalized, non-ambulatory or needing assistance were excluded. Initial modalities included in-center hemodialysis (HD), in-center self HD (ICSHD), home HD (HHD), CAPD, and CCPD. The odds of sustained employment during the critical 6-month transition period (defined as employed at 6 months prior, as well as at dialysis initiation) were calculated using multivariable logistic regression, accounting for patient demographics, comorbidities, pre-ESRD care (yes/no), and insurance status. ***Result*:** Patients electing self-care modalities had a higher prevalence of being employed 6 months prior to dialysis initiation (51%, 43%, 48%, and 53%, respectively for ICSHD, HHD, CAPD, and CCPD vs. 28% for HD patients). Self-care patients also had a higher prevalence of pre-ESRD nephrology care (~80% vs. 56% for HD). Electing self-dialysis was significantly associated with maintained employment status (AOR's ranged from 1.37 to 1.96, all $P < 0.0001$) compared to HD. Pre-ESRD care was associated with 42% higher odds of maintained employment (AOR-1.42, 95% CI: 1.39–1.45). Other characteristics associated with maintained employment included: younger age, White race, non-Hispanic ethnicity, few comorbidities, and private health insurance ($P < 0.0001$). Receiving pre-dialysis nephrology care and initiating home dialysis or self-care HD were associated with maintained employment during the last 6 months prior to dialysis. Optimal pre-dialysis care may have involved encouraging patients to continue working up to and including dialysis initiation and toward choosing home and self-care dialysis modalities. These findings should be confirmed by prospective studies.

Home Hemodialysis

The impact of learning styles on adverse events in home hemodialysis patients

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Background and Aims: Better clinical outcomes in Home Hemodialysis (HHD) have led to a significant growth seen over the last two decades. However, the need for hemodialysis training, its technical complexity and adverse events risk still pose significant challenges for wider adoption. ***Method***: We compared adverse events and bacteremia rates among prevalent HHD patients with different learning preferences. We used multiple logistic regression analysis to determine unadjusted and adjusted odds ratios for adverse events. ***Results*:** Sixty-one HHD patients were enrolled with 10 unimodal, 13 bimodal and 38 multimodal individuals identified after completing the VARK questionnaire. Adverse event rate for all groups was 0.08 events per-patient year. Unimodal and bimodal groups had 0.052 and 0.075 events per-patient year on HHD respectively compared to the multimodal group with 0.095 events per patient year. Patients with auditory learning preferences were more likely to have an adverse event compared to those who were not (Unadjusted Odds Ration [UOR] = 3.19, 95% CI 1.07- 9.52, $P = 0.038$). After adjusting for vascular access, diabetes, duration of training, dialysis vintage, level of education and sensory impairment, auditory learners were four times more likely to have an adverse event compared to non-auditory learners (Adjusted Odds Ratio [AOR] = 4.37, 95% CI 1.22 - 15.64, $P = 0.023$). Trends for lower bacteremia rates was seen in visual and reading-writing learners. ***Conclusions*:** Different learning styles in HHD patients exist and may be associated with an increased risk of adverse events. Further efforts to individualize training to reduce adverse events is warranted.

Low incidence of intradialytic hypotension on more frequent home hemodialysis

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Background: Intradialytic hypotension (IDH) is a frequent complication of hemodialysis and is associated with many adverse patient outcomes, including longer post-treatment recovery time. Flythe *et al* (J Am Soc Nephrol, 26(3):724–734) estimated the incidence of IDH, according to multiple definitions of blood pressure variation, among patients on thrice-weekly in-center hemodialysis (IHD) in a large dialysis organization. We compared these estimates of incidence to corresponding estimates in a cohort of home hemodialysis (HHD) patients, the vast majority of whom are prescribed $\geq$4 sessions per week. ***Methods*:** We analyzed blood pressure variation in HHD patients who used the Nx2me Connected Health telehealth platform. Patients recorded blood pressure before, during, and after each hemodialysis session; patients typically recorded multiple measurements during each session. We considered two definitions of IDH: (1) nadir intradialytic systolic blood pressure (SBP) less than 90 mmHg ("nadir-based IDH"), and (2) minimum intradialytic SBP at least 20 mmHg less than pre-dialysis SBP ("fall-based IDH"). We classified each patient as having experienced IDH if $\geq$30% of hemodialysis sessions within a 30-day interval satisfied the specified definition of IDH. We estimated the proportion of HHD patients meeting each definition of IDH and compared the proportion to the corresponding estimate in Flythe *et al*. We further stratified the analysis by pre-dialysis SBP. ***Results*:** We identified 439 HHD patients. The incidence of nadir-based IDH was similar in HHD and IHD patients (9.8% on HHD vs. 10.1% on IHD, $P = 0.81$), whereas the incidence of fall-based IDH was significantly less in HHD patients than in IHD patients (31.7% on HHD vs. 89.5% on IHD, $P < 0.001$). Additionally, higher pre-dialysis SBP was associated with lower incidence of nadir-based IDH and higher incidence of fall-based IDH among both HHD and IHD patients. Finally, a larger proportion of HHD patients had pre-dialysis SBP <130 mmHg (49.7% on HHD vs. 13.5% on IHD, $P < 0.001$). ***Conclusions*:** The risk of IDH, as defined by minimum intradialytic SBP <90 mmHg, was similar on home and in-center hemodialysis. However, the risk of IDH, as defined by intradialytic decline in SBP $\geq$20 mmHg, was far lower on home hemodialysis. Increased treatment frequency, which is typical in the home setting, may result in more stable blood pressure, as evinced by lower risk of a large decline in blood pressure during treatment. Further studies should assess whether more stable blood pressure is associated with lower risk of cardiovascular mortality and morbidity.

Growth and retention in home hemodialysis

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***Background*:** Growth and retention of patients in home hemodialysis programs require interdisciplinary teams to have a paradigm shift in the patient "selection" process. The following case studies show patients and caregivers with challenges can become trained and proficient in home hemodialysis when the training program is individualized.

***Case Description*:** Patient **A** is 67 years old with the challenge of being legally blind in one eye.

Individualized interventions include:

> Techniques to assist with adequate visualization of connections and self-cannulation. Identification of visual field angels was crucial for success.

Marking the fistula and placing foam tubing over the fistula to practice cannulation.

Patient **B** is 51 years old, diabetic, hypertensive and color blind. He has impaired fine motor skills, with difficulty grasping objects between the thumb and fingers.

Individualized educational interventions included:

> Attention to the size of the arial/venous clamps and connections.
>
> Reading light to make it brighter for his connections
>
> Taught him dialysate will be in his left hand and the Saline will be in his right hand

Used needle nose pliers to help secure connections and break cones when using hanging bags

Patient **A** has been on HHD for 9 months, decreased antihypertensive medications by 2 meds; has improved quality of life and increased physical activities of walking and playing golf. He lowered his BMI and is now qualified for transplant. Patient **B** has been on HHD for 7 months and no longer requires antihypertensive medications.

***Conclusion*:** Individualized training is essential to successful HHD programs. In 12 months I have trained 14 patients and care partners with extenuating circumstances such as color blindness, age, learning disability and severe anxiety. After identification of the potential barriers I developed individualized plans. Average training time was 6 weeks, current HHD patients is 10, lost 2 for transplant and 2 from care partner burnout.

Consistent preferences for solo home hemodialysis vs. in-center hemodialysis across hypothetical relative risks of death

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Background: Certain risks associated with hemodialysis (HD) treatment are increased when performing solo home HD (*i.e.*, home HD without a care partner) because no one is present to help the patient respond to health emergencies. We analyzed responses to a patient preference survey to assess the maximum

tolerated risk of death on solo home HD among current home HD patients. ***Methods*:** In an online survey, current home HD patients selected a preference for solo home HD with x% annualized risk of death or in-center HD with 16% annualized risk of death, with $x = 5$, 12, 16, 20, 25, 30, and 35. For each patient, we defined the maximum tolerated risk of death on solo HHD by the highest value of x for which the patient selected solo home HD; if the patient selected solo home HD at 35% annualized risk of death, we set the maximum tolerated risk at 39.9%. We used interval regression with a lognormal distribution to assess the maximum tolerated risk of death on solo HHD as a function of age, sex, race, cardiac disease, diabetes, hypertension, kidney transplant waitlist registration, employment status, travel time to HD clinic, dialysis vintage, home HD vintage, and current use of solo home HD. ***Results*:** There were 142 survey respondents, and 22 (15%) already utilized solo home HD. Mean age was 58.6 years, 70% of respondents were male, and 78% of respondents were white. Mean maximum tolerated risk of death on solo home HD was 29.0% (95% confidence interval, 27.6–30.5%). Among strata defined by the aforementioned patient characteristics, mean maximum tolerated risk of death ranged from 23.9% to 35.1%; the lower bounds of 95% confidence intervals around these means were not less than 18.4%. By interval regression, age from 20 to 44 years (vs. 55 to 64 years), travel time to HD clinic equal to or greater than 15 minutes (vs. less than 15 minutes), and current use of solo home HD were significantly associated ($P < 0.05$) with higher maximum tolerated risk of death on solo home HD, whereas home HD vintage from 1.0 to 1.9 years (vs. 0.0 to 0.9 years) was significantly associated with lower maximum tolerated risk. ***Conclusions*:** Across all analyzed strata of current home HD patients, mean maximum tolerated risk of death on solo home HD is higher than 18% per year. Younger patients, those who live relatively far from HD clinics, and those currently on solo home HD may tolerate even higher risk. New home HD patients also may tolerate higher risk, but ongoing follow-up of those who choose solo home HD is likely needed.

Distribution of cause of death on home hemodialysis

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Background: The distribution of the primary cause of death among patients on home hemodialysis is unknown. We used data from the United States Renal Data System (USRDS) to describe the distribution. ***Methods*:** The USRDS linked home hemodialysis prescription records from NxStage Medical (Lawrence, MA) with registry records, including the ESRD Death Notification (form CMS-2746). We analyzed patients who initiated home hemodialysis with the NxStage System One between January 1, 2006, and December 31, 2012, and we followed patients until the earliest of death, the date that was exactly one month after the last date of home hemodialysis, or December 31, 2013. Among patients who died (in the context of the aforementioned follow-up rule), we queried the ESRD Death Notification to identify the primary cause of death. ***Results*:** We analyzed 12,600 patients and identified 2681 (21.3%) deaths. The leading causes of death were cardiac arrest (percentage of all deaths, 26.3%); unknown cause (17.5%); dialysis withdrawal (9.7%); septicemia (6.2%); acute myocardial infarction (5.6%); cardiac arrhythmia (4.1%); other known cause (4.0%); malignancy without history of immunosuppresive medication (3.0%); cerebrovascular accident (2.4%); cardiomyopathy (2.0%); congestive heart failure (1.9%); cardiac infection (1.8%); pulmonary infection (1.6%); malignancy with history of immunosuppressive medication (1.3%); atherosclerotic heart disease (1.2%); and cachexia (1.0%). ***Conclusions*:** The distribution of the primary cause of death in home hemodialysis patients is qualitatively similar to the corresponding distribution in all dialysis patients. Notably, cardiac arrest and arrhythmia account for approximately 3 in 10 cases and the primary cause of death is unknown in roughly 1 in 6 cases. However, the distribution of the primary cause of death in home hemodialysis patients also has unique features. Deaths due to myocardial infarction and atherosclerotic heart disease are slightly more likely than in all dialysis patients, whereas deaths due to hyperkalemia are markedly less likely. Deaths due to septicemia are only slightly more likely than in all dialysis patients, but deaths due to cardiac infection are much more likely. Finally, deaths due to dialysis withdrawal are less likely than in all dialysis patients. Overall, the distribution of the primary cause of death on home hemodialysis still points toward a need for further reduction of sudden cardiac death risk.

Predictors of home hemodialysis technique failure

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Background: Home hemodialysis (HHD) readily permits increased treatment frequency, which reduces left ventricular mass, blood pressure, and serum phosphorus and improves physical health-related quality of life. However, HHD technique failure (*i.e.*, conversion from HHD to either in-center hemodialysis or peritoneal dialysis) is a common event, particularly during the first year of HHD. There remains relatively little literature about predictors of HHD technique failure. We aimed to use a national database of HHD patients to identify novel predictors. ***Methods*:** We identified patients who initiated HHD training with the NxStage System One between January 1, 2010, and December 31, 2014, and retained those patients who completed training. We followed patients from the first treatment at home until the earliest of technique failure, death, kidney transplant, or December 31, 2015. We used Fine-Gray regression to estimate the cumulative incidence of technique failure as a function of patient and HHD prescription factors. ***Results*:** We identified 15,269 patients who initiated HHD training and 12,756 (84%) who completed training. In patients who completed training,

mean age was 54.0 years (standard deviation, 14.3 years), 65% were male, 81% were previously on in-center hemodialysis, mean body mass index was 30.4 (standard deviation, 7.8), and 69% had an fistula. Regarding HHD prescription factors, 84% used the PureFlow SL system to produce dialysate, mean dialysate volume was 28.6 liters/session (standard deviation, 8.4 liters/session), and <1%, 14%, 55%, and 30% underwent ≤3, 3.5–4.9, 5.0–5.9, and ≥6 sessions/week, respectively. The cumulative incidence of technique failure was 24.3%, 35.0%, 41.1%, and 44.7%, and 47.3% at 1, 2, 3, 4, and 5 years, respectively. Factors significantly associated ($P < 0.05$) with higher incidence of HHD technique failure were age ≥65 years (vs. 55–64 years), black (vs. white) race, in-center hemodialysis (vs. no renal replacement therapy, kidney transplant, or other dialytic modality) as prior renal replacement therapy, higher body mass index, catheter or graft (vs. fistula) as vascular access modality, lower dialysate volume liters/session, and ≥6 (vs. 5.0–5.9) sessions/week. ***Conclusions:*** HHD technique failure is most likely during the first year at home and iteratively less likely during subsequent years. Elderly age, black race, recent history of in-center hemodialysis, and higher body mass index comprise non-modifiable risk factors for HHD technique failure, whereas dialysate volume and treatment frequency comprise modifiable risk factors.

Reduction in home hemodialysis training time with use of Nx2me connected health

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Background: Nx2me Connected Health is an iPad-centered telehealth platform, the use of which is associated with lower risk of home hemodialysis (HHD) technique failure. The introduction of Nx2me during HHD training may accelerate training and ultimately increase the likelihood of training graduation. We assessed whether training metrics have improved in centers that have begun to introduce Nx2me during HHD training. ***Methods:*** Initially, we identified patients who began to use Nx2me during the first 2 weeks of HHD training, as well as their respective centers. Subsequently, we identified patients that began HHD training during the 4-year interval preceding each center's first use of Nx2me in the aforementioned cohort. We retained patients in centers with ≥1 Nx2me user and ≥1 historical control. Between Nx2me users and historical controls, we compared the mean, median, and quartiles of training time (*i.e.*, mean number of calendar days from training initiation to either training graduation or training dropout) and the probability of training graduation. We repeated the analysis in high-volume centers, which were defined by ≥10 Nx2me users and ≥10 historical controls. ***Results:*** We identified 83 Nx2me users and 386 historical controls among 19 centers. In Nx2me users vs. controls, mean (standard deviation) training time was 28.2 (11.6) vs. 30.4 (16.9) days; median training time was 28 vs. 28 days; and the third quartile of training time was 34 vs. 40 days ($P = 0.05$, by Savage test of equal distributions). The probability of training graduation in Nx2me users vs. controls was 96.4% vs. 69.7% ($P < 0.01$). In high-volume centers, we identified 60 Nx2me users and 91 historical controls among 4 centers. In Nx2me users vs. controls, mean (standard deviation) training time was 28.7 (10.6) vs. 33.8 (17.7) days; median training time was 29 vs. 30 days; and the third quartile of training time was 34 vs. 49 days ($P < 0.01$, by Savage test of equal distributions). In all 4 centers, mean training time was between 15% and 19% lower in Nx2me users than in controls. Overall in these 4 centers, the probability of training graduation in Nx2me users vs. controls was 96.7% vs. 65.9% ($P < 0.01$). ***Conclusions:*** Introduction of Nx2me Connected Health during the early part of HHD training was associated with a serial shift in the distribution of training duration and a serial increase in the probability of training graduation. Introduction of Nx2me appears to compress the distribution of calendar days between HHD training initiation and training graduation, thereby improving the regularity of training duration.

Infection

Interferon-λ3 (IFN-λ3) gene (IFNL3) polymorphisms, circulating IFN-λ3, and clinical variables in hemodialysis (HD) patients exposed to hepatitis E virus (HEV)

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Background: Factors associated with HEV infection are sparsely recognized in patients receiving renal replacement therapy (RRT) and are inconsistent among studies. Our aim was to look for determinants of HEV seroprevalence among *IFNL3* SNPs, circulating IFN-λ3, and routine clinical variables of RRT patients, currently treated with maintenance HD in the region hyperendemic for HEV. ***Methods:*** HEV seromarkers (HEV Ag, anti-HEV IgM, anti-HEV IgG) and IFN-λ3 were tested in 90 prevalent HD patients by ELISA assays. *IFNL3* SNPs (rs8099917, rs12979860) were genotyped using HRM curve analysis. Logistic regression analysis was used to show the determinants of anti-HEV IgG positivity. Results were adjusted for possible confounding variables, including gender, age, RRT duration, and history of renal transplantation, as appropriate. Survival analysis was conducted using the Kaplan-Meier method with the log rank test and Cox proportional hazard model. Haplotype frequencies were estimated using the Haploview 4.2 software. ***Results:*** In the study group, there were 37.8% anti-HEV IgG positive subjects, but none was HEV Ag or anti-HEV IgM positive. Age (67.0, 28.4 – 90.5 years), gender (54% men), renal disease (diabetes the most frequent – 26%), living in the rural area (43% subjects), RRT duration (5.5, 0.3 – 30.4 years), anti-HBs titer <10 IU/L (35%

subjects), exposition to HBV (15%)/HCV (14%) infections or renal graft failure (18%) were not explanatory variables for HEV seroprevalence. HD modalities utilizing high-flux dialyzers (adjusted OR 3.586, 95% CI 1.142 – 11.263, P = 0.029) as well as major homozygosity in rs8099917 (adjusted OR 4.933, 95% CI 1.516 – 16.054, P = 0.008) and rs12979860 (adjusted OR 3.537, 95% CI 1.136 – 11.014, P = 0.029), but not circulating IFN-λ3 (85.6, 9 – 232.7 pg/mL), were significant positive determinants of anti-HEV IgG positivity. Liver enzyme activities and C-reactive protein, tested as response variables to HEV infection, did not differ patients stratified by anti-HEV IgG positivity. An association between anti-HEV IgG positivity and survival was not demonstrated (log-rank test P value 0.509). ***Conclusions*:** *IFNL3* polymorphism and treatment with high-flux HD are explanatory variables for anti-HEV IgG positivity among HD patients. Examinations of water supplied for dialysis purposes for HEV contamination should be considered as routine practice in regions hyperendemic for HEV.

Outcomes associated with quadrivalent and high-dose trivalent influenza (flu) vaccines in Dialysis Clinic, Inc. ESRD Seamless Care Organization patients during the 2016–2017 flu season

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Background: During the 2016 to 2017 influenza (flu) season, Dialysis Clinic, Inc. administered quadrivalent (QV) and high-dose trivalent (HDTV) flu vaccines. We investigated flu vaccine impact on patient (pt) hospitalization (HOSP) and death. ***Methods*:** All pts attributed to an ESRD seamless care organization (ESCO) and administered flu vaccine in clinic between Aug-Dec, 2016 were followed thru June 2017. Efficacy measures were HOSP, death or the composite of HOSP or death ≥14 days post dose. Cox models for the entire ESCO population and age subgroups (<65, ≥65 yrs old) were adjusted for age, race, gender, diabetes, albumin, prior HOSP during the past 2 months, catheter use, and dialysis vintage. ***Results*:** Flu vaccine was administered to 800 pts: 454 QV (56.8%) and 346 HDTV (43.2%). Hemodialysis was the main modality (90.5%) and the proportion of pts ≥65 years was 21.2% QV and 78.3% HDTV (P <0.001). The groups did not differ in baseline characteristics except that the HDTV group had fewer black pts (39.2% v. 53.1%; P <0.001). The table uses hazard ratios (95% CI) to compare HDTV to QV vaccine use.

	Hazard Ratio (95% CI)		
Outcome	Overall (346 HDTV, 454 QV)	< 65 yrs old (75 HDTV, 358 QV)	≥ 65 yrs old (271 HDTV, 96 QV)
HOSP	0.85 (0.67, 1.07)	0.84 (0.56, 1.26)	0.69 (0.50, 0.97)*
Death	1.47 (0.88, 2.45)	1.78 (0.62, 5.06)	1.19 (0.58, 2.44)
Composite	0.89 (0.71, 1.11)	0.83 (0.56, 1.23)	0.77 (0.56, 1.06)

* p-value = 0.03

***Conclusions*:** HDTV vaccine was associated with fewer hospitalizations in pts ≥65 years old during the 2016 to 2017 flu season, consistent with the vaccine's indication. HDTV vaccine use trended toward fewer hospitalizations in the overall population and among pts < 65 years old. Mortality rates were not different between QV and HDTV. Further study may investigate use of HDTV in dialysis pts < 65 years old.

Kinetics

Insulin resistance associates with risk factors of cardiovascular diseases among hemodialysis patients

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***Background*:** Insulin resistance (IR) is an independent predictor of cardiovascular morbidity and mortality in end-stage renal disease (ESRD) patients. This study was to investigate the association between IR and cardiovascular disease (CVD) risk factors among ESRD patients undergoing hemodialysis. ***Methods*:** A clinical cross-sectional study was conducted on 384 HD patients aged 20 years and above, from seven dialysis centers. Biochemical parameters were analyzed from the 8-hour pre-prandial and pre-dialysis blood samples by using the automated and standardized methods. Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) was used as an indicator of IR. The CVD risk factors were defined by the Kidney Disease Outcomes Quality Initiative (K/DOQI) Clinical Practice Guidelines. Logistic regression analysis was used. ***Results*:** Patients' age was 60.9 ± 11.8, 58.1% men, and 40.3% overweight or obese. The prevalence of high HOMA-IR was 71.6%. The traditional CVD risk factors included high SBP (82.8%), high DBP (25.5%), high TC (16.7%), high LDL-C (48.4%), low HDL-C (65.9%), high TG (40.6%), and impaired fasting glucose (69.5%). The non-

traditional CVD risks included anemia (58.3%), low calcium (8.3%), high calcium (35.2%), low phosphorus (7.0%), high phosphorus (35.4%), high calcium-phosphorus product (25.5%), high intact parathyroid hormone (42.7%), hyperhomocysteinemia (85.7%), elevated high sensitive C-reactive protein (45.6%), and low serum albumin (12.0%). After controlled for age, gender, hemodialysis vintage, Charlson Comorbidity Index, Physical activity, and body mass index, elevated level of HOMA-IR was significantly associated with higher low HDL-C (OR = 2.23, 95%CI = 1.38 to 3.61, P = .001), high TG (OR = 2.95 [1.71 to 5.10], P < .001), IFG (OR = 7.95 [4.65 to 13.59], P < .001), and hypoalbuminemia (OR = 6.72 [2.01 to 22.44], P = .002). ***Conclusions*:** Hemodialysis patients were with the high prevalence of insulin resistance, and CVD risk factors. Higher HOMA-IR was associated with higher CVD risk factors.

Value of Igf-1 in assessment of malnutrition in different dialysis modalities

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***Background and Aim*:** Malnutrition in CKD adversely affects morbidity, mortality, functional activity & patients' quality of life. This study aimed to assess the nutritional status of dialysis patients using serum (IGF-1) as a laboratory marker on & laboratory markers of adequacy of dialysis & hsCRP as an inflammatory marker on the other side. ***Methods*:** 20 patients PD patients, 20 patients on low-flux hemodialysis (Polypure 16M Allmed) & 20 patients on high-flux hemodialysis (Polypure 16S + Allmed). History taking, anthropometric measures, subjective global assessment and laboratory Investigations were done. ***Results*:** dry weight, BMI and MAC, showed significant difference between HFHD and LFHD group compared to PD group with non-significant difference between HFHD and LFHD group. IGF showed significantly lower levels in PD patients, compared to higher in LFHD patients, and the highest in HFHD patien. IGF was negatively correlated with age, total SGA score and hsCRP, but positively correlated with dry weight and albumin. hsCRP showed significant difference between high flux group compared to PD group and significant difference between low flux group and both of high flux and PD groups. Total SGA score was significantly higher in PD patients compared to both HD groups and in LFHD, compared to HFHD, group. IGF showed a negative significant correlation with age, positive correlation with albumin levels. A significant correlation between high SGA total score and hsCRP levels was found in all studied groups. Furthermore, the obtained results showed a negative correlation between hsCRP and IGF levels. ***Conclusion*:** IGF-1 can be used as additional valuable marker in assessment of nutritional state in dialysis patients along with other nutritional & inflammatory markers.

Intradialytic changes in endothelin-1 level and its relation to with intradialytic hypertension

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***Background*:** Intradialytic hypertension is a major problem encountered in ESRD patients affecting 5% to 15% of maintenance hemodialysis patients. **Endothelin-1** levels rise during dialysis. We evaluated the changes in role of endothelin-1 levels during hemodialysis, and its relation to intradialytic hypertension. ***Methods*:** We divided 48 stable HD patient into 2 groups: **Group I**: (24) HD, with intradialytic hypertension. **Group II** included (24) HD with well controlled blood pressure. Diabetic patients, patients taking ACEI or ARBs, patients who had evidence of severe infection, malignancy, or having decompensated liver cell failure were excluded from this study. For all patients: blood pressure measurement before hemodialysis session and every half an hour throughout the sessions. Endothelin-1 level was measured using ELISA technique as 3 samples (before session, when blood pressure rises during session, at end of session) were taken from Group I patients and one sample before session in Group II patients. ***Results*:** Group I had significantly lower dry weight than group II (59.9 ± 16 vs.71.5 ± 11 kg) but a significantly higher UF volume (2 vs. 1.5 L). There was significant positive correlation between basal Endothelin-1 and DBP after dialysis ($r = 0.51$, P value <0.05). In this study basalEndothelin-1 level had a significant moderate diagnostic performance in prediction of intradialysis HTN (P value < 0.001). Basal Endothelin-1 $\geq$100 (pg/mL) had 100% specificity, 75% sensitivity and 87.5% diagnostic accuracy in prediction of intradialysis HTN, leading to suggestion that Endothelin-1 was a significant risk factor for having intradialysis HTN (P value <0.05). ***Conclusion*:** high Endothelin-1 is a significant risk factor for having intradialytic hypertension and basal Endothelin-1 level had a significant moderate diagnostic performance in prediction of intradialytic HTN.

Long term renal rehabilitation induce a significant shift in serum antioxidative profile

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***Background*:** Though the benefits of exercise programs for patients with chronic kidney disease (CKD) are become recognized, there still remains systemic risks which include

cardiovascular events. To evaluate the risks brought by the intradialysis exercise renal rehabilitation program, we investigated its effects on antioxidative profiles and inflammation markers.

***Methods*:** The renal rehabilitation program consisted in aerobic training using the lower limb ergo-meter twice a week during HD with a work time of 15 to 60 minutes and a Borg scale of 11 to 13. Forty-three stable hemodialysis (HD) patients from multiple dialysis centers were examined. Thirteen of them were investigated over the long term (6 to 9 mos). Antioxidative profiles were evaluated measuring serum scavenging activities against multiple reactive oxygen species. Also measured were inflammatory cytokines including TNF-α, IL-6 and adiponectin.

***Result*:** The patients receiving renal rehabilitation showed significant increases in daily activity, exercise tolerance and muscle strength. The hydroxyl radical scavenging activity of the patients significantly enhanced by the long-term exercise program but not by that of short-term (less than 3 mos). Together with this, the alkylperoxyl radical was significantly improved within the first 3mos. period, and continued until 9 mos. Contrary, a decrease of the superoxide scavenging activity and an increase of TNF- α were increased during the first 3 mos period. No severe unfavorable effects were observed during the program.

***Conclusion*:** These results indicate that the effect of renal rehabilitation is mostly favorable although decreases of superoxide scavenging activity accompanied by an increase in TNF- α should be a matter of concern. The oxidative stress related response of HD patients is different from that of healthy subjects.

Quality Improvement

Heparin-free dialysis for patients on oral anticoagulants

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***Background*:** Intradialytic unfractionated heparin is used as an anticoagulant in hemodialysis (HD) to prevent dialysis circuit clotting. There is little data on the safety or efficacy of heparin in patients already treated with oral anticoagulants (OACs) for other indications. We examined the feasibility of heparin-free HD in 8 patients treated with intradialytic heparin and OACs. ***Methods*:** In a descriptive crossover-study design, patients treated with intradialytic heparin and OACs including warfarin or apixaban underwent 2 weeks of standard HD with heparin followed by 2 weeks of heparin-free HD. We assessed dialyzer clotting, circuit loss, time to access hemostasis post-HD, and hemoglobin. Baseline data were collected for 2 weeks followed by the 2-weeks of heparin-free dialysis. Study participants resumed intradialytic heparin after study completion. ***Results*:** Eight patients with ESRD, 4 men and 4 women with a median age of 71 years (range 58–80) provided informed consent. Six patients were on warfarin and 2 patients were on apixaban for the following indications: atrial fibrillation (75%), stroke (12.5%), and venous thromboembolism (12.5%). During the baseline period, dialyzer clotting or circuit loss did not occur in any of the 41 HD sessions. During the heparin-free period, 2 of 47 HD sessions were complicated by either dialyzer clotting or circuit loss. 2 of 6 patients on warfarin experienced either an episode of dialyzer or circuit clotting, while neither of the 2 patients on apixaban experienced any clotting. INR results were not available for the 2 patients on warfarin in the 2 weeks prior to the dialyzer clotting. The post-HD access hemostasis times (9.51 minutes vs 9.91 minutes) and hemoglobin (10.5 g/dl vs 10.3 g/dl) during the two study phases were similar. ***Discussion*:** HD patients treated with oral anticoagulants often receive additional heparin to prevent clotting during HD. In 47 HD sessions, only 2 events of clotting occurred when heparin free dialysis was performed indicating a low risk for adverse events. Until larger studies provide evidence-based approaches, an individualized approach per physician orders is recommended.

Patient care technicians, valuable partners in the daily demands of dialysis care, welcome opportunities to be their best!

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***Background*:** The majority of the workforce providing in-center HD care in the US is comprised of patient care technicians (PCTs). Certification has been mandated since April 2010, thus enabling standardized testing and competence. With the increasing demands to provide comprehensive high-quality care, competent and integrated functioning of the Certified Clinical Hemodialysis Technician (CCHT) in dialysis centers is becoming more critical. We report three strategies employed to leverage CCHTs to provide a concerted care team approach. ***Approach*:** The following 3 strategies were implemented across one medium-sized non-profit dialysis provider in the US: (1) structured career path implementation for CCHTs with the opportunity to become an Advanced or Master PCT; (2) CCHT targeted quarterly web-based education offerings aligned with the organization's clinical strategies and initiatives and appropriate to certification expectation and clinical understanding of CCHTs, and (3) encouragement for CCHTs to be accountable co-owners for in-center programs. ***Results*:** Current evidence suggests an increasing involvement of PCTs in the team-based care approach. Of the 596 PCTs associated with the organization, currently 109 (18.3%) have become Advanced PCTs and 49 (7.9%) have achieved Master PCT status. Recently implemented quarterly web-based education meetings have shown 81% CCHT participation. Several programs have been delegated to CCHTs, including "CVC last – programs" and fluid management and transplantation communication with patients and family. ***Conclusion*:** CCHTs comprise the majority of caretakers in US

in-center HD programs. The increasing demands for comprehensive care require a collaborative care team approach including CCHTs. Investing in opportunities for career advancement and education yields mutual benefits. CCHTs are the frontline caretaker of HD patients, often spending the most time with them and knowing them well. Our experience suggests that encouraging and helping "CCHTs to be their very best" benefits all – patients and the workflow in HD centers.

Hepatitis B vaccination initiative in acute care setting

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***Background*:** The introduction of routine vaccination against the hepatitis B virus (HBV) has proven to reduce the number of cases among children and adolescents in the United States. However, chronic hepatitis B still remains a major health problem. An estimated 800,000 to 1.4 million people are chronically infected with HBV in the United States.

***Methods*:** Dialysis patients are at a higher risk than the general population to contract HBV due to their immunocompromised state and nosocomial transmission. The Center for Disease Control and Prevention has recommended hepatitis B vaccination of hemodialysis patients.

Hepatitis B vaccination of hemodialysis patients is performed all over the world. The World Health Organization (WHO) recommends vaccinating patients with chronic kidney disease (CKD) prior to dialysis commencement. ***Results*:** However, studies reflect that the implementation of a hepatitis B vaccination program for this population is not common.

The following data was obtained from Q3 2016 - Q2 2017. The following is a breakdown of those results:

- 44.4% Hbs Ab positive
- 52.3% Hbs Ab negative
- 3.3% Hbs Ab borderline positive

***Conclusion*:** The data reveals that we are identifying Hbs Ab negative patients in 100% of the dialysis patients that we treat. However, overall we are not initiating the vaccination process. Therefore, our next step is to ensure a complete vaccination record in the electronic medical record (EMR) at the time of the initial treatment by completing the following:

- Obtain a comprehensive vaccination history
- Collaborate with the nephrology and primary medical teams to educate and hardwire the process of initiating the Hepatitis B immunization process
- Patient to receive vaccination prior to discharge
- Communicate with the patients home dialysis unit and/or primary care provider advising them of the immunizations received during the hospitalization
- Provide the patient with a standardized vaccination card

Interventions to improve patient adherence to hemodialysis treatment: A quality improvement study

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***Background*:** Shortened and missed hemodialysis (HD) treatments are associated with increased mortality and morbidity. The purpose of this study was to examine the effect of patient and staff adherence education, in addition to patient-suggested interventions, on adherence with HD therapy in non-adherent patients. ***Methods*:** An 11 item survey was distributed to all patients in one single HD center to ascertain patient suggested interventions. The Intervention was a pre/post non-control design. Adherence interventions were

Table 1 Shortened Treatments for the Full Center Sample (n=G8)

Time Period	Mean Number of Shortened Treatments	IQR	Change in Number of Shortened Treatments	*P*
Month 1 (Pre Intervention)	3.7	(−0.61, 8.08)	N/A	N/A
Month 2 (Intervention)	3.3	(−0.49, 7.05)	−0.4	0.09
Month 3 (Intervention)	3.8	(−0.26. 7.87)	+0.1	0.65

Table 2 Shortened Treatments for 20 Non-adherent Patient Sample (n=20)

Time Period	Mean Number of Shortened Treatments	IQR	Change in Number of Shortened Treatments	P
Month 1 (Pre Intervention)	9.6	(6.52, 12.58)	N/A	N/A
Month 2 (Intervention)	7.8	(4.01. 11.60)	−1.8	0.01*
Month 3 (Intervention)	8.6	(4.56. 12.70)	−1.0	0.13

nephrologist led patient and staff education, iPads for patients, movie scheduling, puzzle books, and pillows. Twelve weeks (3 months) of patient adherence data (shortened treatments by ≥ 10 minutes and total missed treatments) were measured: Month 1 (M1: 1 - 4 weeks prior to interventions), Month 2 (M2: weeks 1 to 4 of interventions) and Month 3 (M3: weeks 5 to 8 of interventions). ***Results*:** There was no difference in the mean number of shortened treatments (Table 1.) or missed treatments during the intervention time period across the whole center. In the 20 most non-adherent patients as measured by total minutes missed in M1, the mean number of shortened treatments decreased from 9.6 in M1 to 7.8 in M2, however, increased back to 8.6 in M3 (Table 2). There was no change in missed treatments from M1, M2, and M3 in the top 20 most non-adherent patients.

Discussion and Conclusion: A combination of education and entertainment interventions resulted in less shortened HD treatments per months in the most non-adherent patients in the first month of interventions. However, this was not sustained through to the second month of interventions.

Getting to the heart of the matter: Nursing management of patients with left ventricular assist devices (LVADs) on intermittent hemodialysis

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***Background*:** LVADs are surgically implanted mechanical circulatory support devices that help an ailing heart pump blood. Over the years, implantable Left Ventricular Assist Devices (LVADs) have become an acceptable alternative to support patients with advanced heart failure, either as a bridge to transplantation or as destination therapy for patients who are not candidates for heart transplantation. As the number of patients with LVADs increase, more patients requiring intermittent hemodialysis (IHD) will be seen. This is due to the common simultaneous occurrence of chronic kidney disease (CKD) in patients with heart failure, but more frequently due to irreversible acute kidney injury.

Hemodialysis nurses are therefore faced with managing and monitoring complex hemodynamic and volume needs of patients with LVAD's as they are transitioned from critical care units to the inpatient floors and incenter hemodialysis units.

The purpose of this quality project is to review the guidelines developed for nursing care and monitoring of LVAD patients receiving hemodialysis. ***Methods*:** Nursing care guidelines include assessing and monitoring patient signs and symptoms, volume status, anticoagulant therapy, LVAD flows, LVAD driveline, dialysis blood and dialysate flow rates and ultrafiltration rates. Guidelines include care of the LVAD patient during a cardiac arrest (since performing cardiac compressions may result in dislodgment of the LVAD cannula), meticulous infection control and reporting of blood transfusions if patient is on transplant list. In addition, since LVAD patients have a diminished or absent pulse, nurses are trained to monitor Mean Arterial Pressure (MAP) by Doppler instead of using automatic Blood Pressure (BP) monitors which will be inaccurate.

***Conclusion*:** Dialysis centers adopt a cautious approach when it comes to performing IHD on patients with LVADs because of the potential for volume flux-related complications and absence of pulsatile BP for monitoring. Many patients have to remain hospitalized for longer periods because of the inability of some dialysis centers to accept them for outpatient dialysis. (Quader et al, 2014). Finally, good communication between the cardiology team, trained LVAD patients and the hemodialysis team is imperative to safely manage these patients on hemodialysis after discharge from critical care units.

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Patient-centred factors associated with poor glycaemic and blood pressure control in co-morbid diabetes and chronic kidney disease

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***Background and aims*:** The extent to which patient-centred factors affect treatment target attainment in co-morbid diabetes and chronic kidney disease (CKD) is uncharacterised. Here, we explore the association between patient-reported barriers to health care, patient activation, quality of life (QOL), and diabetes self-care, with attainment of glycaemic and blood pressure (BP) targets. ***Materials and Methods*:** This cross-sectional multi-centre study recruited adults with diabetes and CKD (eGFR between 20 and 60 mL/min/1.73 m^2). All completed a questionnaire exploring patient-reported barriers to care (elicited from focus groups), the Patient Activation Measure (PAM), 12-Item Short Form Survey (SF-12), the Summary of Diabetes Self-Care Activity (SDSCA) surveys, and had demographic and clinical data collected. Poor glycaemic and BP control were defined as an HbA1c $\geq 8\%$ and systolic BP ≥ 140 mmHg respectively. Multivariable logistic regression was used to identify the most parsimonious models inclusive of age, gender and diabetes duration for poor control and dose response between the number of patient-reported barriers and poor control was analysed, using STATA v13.1. ***Results*:** 199 patients, mean age 68.7 (SD 9.6) were studied. Most were male (70.4%) and had type 2 diabetes (90.0%). There were no

differences in the proportion of patients with poor glycaemic and BP control across age groups, gender, smoking status, eGFR, diabetes duration and activation levels. Poor glycaemic control was associated with an increased odds of "poor family support" (OR 4.90; 95% CI 1.80 to 13.32, $P \leq 0.002$). Poor BP control was associated with an increased odds of "not having a good GP" (OR 6.01; 2.42 to 14.95, $P < 0.001$). Poor glycaemic or BP control was not associated with lower PAM, SDSCA and SF-12 scores (all $P > 0.05$). The total number of patient-reported barriers was not associated with an increased odds of poor control. ***Conclusions*:** Particular patient-reported barriers rather than the total number of barriers, patient activation, diabetes self-care and QOL are associated with poor glycaemic and blood pressure control. Lack of patient perceived family and GP support were associated with increased odds of poor glycemic and blood pressure control. Models of care addressing these issues may improve patient outcomes in co-morbid diabetes and CKD.

Patient reported barriers associated with poor physical and mental well-being in patients with co-morbid diabetes and chronic kidney disease: A cross sectional study

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***Background and aims*:** Health related quality of life (HRQOL) is an important component of health, and therefore should be considered in health care improvement. In this study, we explored which patient-reported barriers to health care were most associated with poor HRQOL in patients with co-morbid diabetes and chronic kidney disease (CKD). ***Materials and Methods*:** This was a cross-sectional study of adults with diabetes and CKD (eGFR <60 ml/min/1.73 m^2) in four large tertiary centres in Australia. All subjects completed a questionnaire exploring patient-identified barriers to care (elicited from previous focus groups), and a 12-Item Short Form Survey (SF-12). Low physical and mental health status were defined as mean <50 (general population $\mu = 50$ and $SD = 10$). Adjusted odds ratios for potential independent predictors of low physical and mental health status were estimated using logistic regression models. ***Results*:** 308 subjects, mean age 67 (± 11) years and 70% male participated. The majority had type 2 diabetes (88.0%) with equal distribution across CKD stages 3a, 3b, 4 and 5 (23.4%, 25.7%, 24.6% and 26.3%) respectively. Older age (OR 1.04; 95% CI 1.02 to 1.06), lack of support from friends (OR 2.07; 95% CI 1.14 to 3.78), feeling unwell (OR 4.23; 95% CI 1.45 to 12.3) and having stressors (OR 2.59; 95% CI 1.20 to 5.61) increased the odds of low physical health status. Feeling unwell (OR 2.92; 95% CI 1.07 to 8.01), low mood (OR 2.82; 95% CI 1.64 to 4.87) and difficulty getting home help (OR 1.91; 95% CI 1.57 to 2.33) increased the odds of low mental health status. An increased number of patient reported barriers was associated with increased odds of low mental health status but not physical health status. ***Conclusions*:** Perceived lack of support from friends, feeling unwell and having other stressors increased the likelihood of low physical health status while feeling unwell, low mood and difficulty getting home help increased the odds of low mental health status. Health care delivery interventions addressing these barriers may improve HRQOL and the health-status of patients with diabetes and CKD.

Pediatrics

A proposed model to reduce peripherally inserted central catheters (PICC) placement in a single-center, pediatric CKD/ESRD population

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***Background and Aims*:** Peripherally inserted catheters (PICCs) are contraindicated in CKD/ESRD pts as they are associated with thrombosis &/or stenosis complications, making vessels unsuitable for future dialysis access. Our hospital is implementing a standardized algorithm that promotes appropriate vascular access device selection [peripheral IV (PIV), midline catheters, PICCs, non-tunneled & tunneled central venous catheters (CVCs), and ports] in all hospitalized pediatric pts. We have created a renal-specific vascular access device algorithm as part of global efforts to preserve current & future vascular options in pediatric CKD/ESRD pts. ***Methods*:** We identified stakeholders (MDs, APNs, & RNs from gen surgery, urology, the vascular access team, & nephrology), key drivers, & 4 main interventions that support our global aim: developing a renal-specific vascular access device algorithm, revising the surgical referral form (SRF) for surgical procedures in colorectal/urology/gynecology pts, trialing port placement in kidney transplant (KTx) recipients to reduce forearm venipuncture trauma, & revising nephrology inpt admission order sets to promote appropriate PIV placement in CKD/ESRD pts. Our work to date has focused on interventions to reduce PICC placement (access algorithm, SRF updates).

Using condition-based EMR registries we are in the process of evaluating baseline data for PICCs placed per inpt days in the pediatric pre-ESRD CKD, KTx, & dialysis populations. Statistical process control (SPC) with the use of control charts will be used to define a change. ***Anticipated Results/Next steps*:** We are working with the hospital-wide improvement team to create & implement the vascular device order sets. The urology team members are focusing on processes to identify CKD/ESRD pts being discussed at weekly combined surgical planning conferences. After the vascular algorithm is implemented, we plan to update admission order sets. We have placed ports in 4 KTx recipients, & in the summer 2018 will study potential associated benefit and risks of this intervention. ***Conclusion*:** We hope to demonstrate reduced PICC placement & implement further interventions that promote vein preservation in pediatric CKD/ESRD pts

Ensuring continuity of hemodialysis catheter care practices in the non-dialysis setting through nurse education

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Background: Lack of continuity of care by staff who provide hemodialysis (HD) catheter care poses a risk for catheter related complications. Though the care of HD catheters is overseen by Pediatric Nephrology and Dialysis Nursing Services, HD catheters are used throughout the organization including ambulatory care areas. During an organizational initiative to transfer patients with HD catheters to the Ambulatory Infusion Center (AIC), nurses were trained according to current policy and procedures for accessing HD lines. The AIC and dialysis teams recognized knowledge gaps remained after training and identified the need to create a standardized, comprehensive training program for non-dialysis nurses. ***Methods***: Interdisciplinary team including HD nurses and AIC Clinical Nurse Specialist (CNS) collaborated to develop a comprehensive, multi-step HD catheter training program. AIC nurses start with a didactic session on basic dialysis and HD catheter concepts, observe HD catheter practices by HD nurse, and hands on training by accessing HD catheter on a mannequin. Next, AIC nurses accesses HD line on a patient with HD nurse observing. HD catheter AIC super-users and CNS were identified to be resources for AIC nurses with dialysis team for support. ***Results*:** Two HD nurses developed the educational tools and teaching. The training was completed within 2 months. HD nurses conducted the standardized instruction in small groups or individually for a total cohort of 11 AIC nurses. An AIC nurse was identified as a HD catheter super-user and received additional training to provide an AIC-based support mechanism. The AIC staff reported an increased level of comfort and competency in caring for HD catheters. ***Future directions*:** An annual review of competency to maintain skills will be conducted. HD complications including infection rates will be monitored and reported.

The effect of immigration on a pediatric dialysis unit in Italy

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***Background*:** Socioeconomical issues can have an important impact on the management of children with end-stage renal disease. ***Methods*:** We retrospectively assessed the following data for each patient < 18 years undergoing chronic dialysis in our unit from 1st January 2008 to 31th December 2016: nationality, renal replacement therapy modality and outcome. ***Results*:** As regards prevalent patients, we observed a reduction of the total number of patients (from 26 at 1st January 2008 to 15 at 31th December 2016), peritoneal (PD, from 17 to 3) and Italian patients (from 21 to 8), with an increase of the percentage of hemodialysis (HD, 34.6 to 80%) and non Italian patients (from 19.2 to 46.8%).

Looking at the incident patients, the number of PD (from 5/year to 1/year) and Italian (from 8 to 4/year) patients decreased, while the number of HD (from 4 to 9/year) and non Italian (from 1 to 6/year) children increased.

The median waiting time for renal transplant and the median duration of HD cycles were not different between Italian and non Italian patients, while that of PD was higher for Italian than for non Italian children.

In the study period the percentage of non Italian people < 18 years living in our region increased from 11.3 to 16.3%. The percentage of non Italian dialyzed children was significantly correlated with the percentage of foreign people living in the region (r^2 0.78, P 0.0015) and with the percentage of children treated with HD (r^2 0.71, P 0.021). ***Conclusions*:** The increase of non Italian children living in our region in the last 9 years was associated with an increase in the percentage of non Italian patients needing dialysis and with an increased use of HD as dialysis modality.

Use of creative writing to illustrate pediatric patient dialysis lived experiences

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Background: Pediatric end-stage renal disease (ESRD) is a relatively rare but devastating medical condition associated with high disease-related burden. Finding ways to better understand patient experiences can lead to improvement in patient care, health-related quality of life (HRQoL), and long-term functioning and health outcomes. Lived experiences have been studied

in adult dialysis patients but little data exists in pediatric patients. This purpose of this study was to examine lived experiences of pediatric dialysis patients through creative writings. ***Methods*:** A retrospective review of a creative writing-based arts project by pediatric patients on dialysis was conducted. Entries were from both males and females, 5 to 25 years of age, and of primarily African-American, Caucasian, and Hispanic ethnicities. A qualitative directed-content analysis was utilized to analyze themes identified in these entries. ***Results*:** Results in this sample yielded similar themes to those in the adult literature. This included *having a physical shackle, mental and emotional distress, relying on a hemodialysis machine, dealing with problems, and feeling different*. ***Conclusion*:** This study highlights the importance of considering the lived experiences of children on dialysis utilizing creative writing. Given that this population of children and young people have voluntarily shared their views and perspectives, there is a unique chance for clinicians to gain a deeper understanding of their lived-experiences, which could help inform treatment and ideally positively impact health outcomes. ***Conclusion*:** Understanding pediatric perspectives and lived-experiences has several potential benefits and is crucial in the context of care and attempting to improve HRQoL and physical well-being. These results offer insights to youth's physical and psychological adjustment to ESRD and have implications for clinical practice and policy formation. On a local level, information from this work can validate patient and family experiences, may illuminate how coping with pediatric ESRD can be associated with personal growth and strength, and inform intervention strategies with the goal of providing the best possible patient-centered care.

Good outcomes for arteriovenous fistulas (AVF) in pediatric (ped) chronic hemodialysis (HD) patients (pts)

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Background: AVF is the preferred access for ped & adult chronic HD pts, but data is limited for outcomes in children & adolescents. ***Aims*:** 1) Determine long term outcomes of AVF HD access, including primary failure within 30 d (PF), revisions, complications & patency, at a single large ped hospital. 2) Assess potential risk factors that might limit AVF patency. ***Methods*:** Medical record retrospective review for all AVF created from Jan 2003-Dec 2015 in ped HD pts ≤25yo & treated with HD>3 mon included demographics, ESRD cause, time on HD, pro-thrombotic condition, self-cannulation, age/wt at AVF creation, details of AVF type/surgery & complications. AVF patency was assessed by Kaplan Meier survival analysis (KM). Potential risk factors influencing AVF patency were assessed by Log Rank test for categorical & Cox proportional hazards for continuous variables. ***Results*:** 79 pts (43M; 42 His/9 non-His white/28 black) had 99 AVF (20 had >1 AVF). ESRD causes were GN/vasculitis (n = 20; 13 FSGS), CAKUT (21), hereditary (4), other (15) & unknown (6). AVF site was forearm cephalic (32), upper arm cephalic (34), upper arm basilic (28), forearm basilic (3) or other (2); 31% (31/99) had stage 2 transposition/revision. 15% (15/99) had PF. Median follow-up for non-PF AVF was 2.3y (1.5–8.8). Median time for maturation was 89d (range 41–343). All AVF were accessed by button holes; 27 pts did total & 18 partial self-cannulation. 19 thrombectomies were needed in 14 AVF. 1&2y patency of non-PF AVF by KM censored for transplant (n = 32) or transfer (n = 20) by wt group were:

All, 16–147 kg: n = 84, age 7–23y,1y 92% (n = 66), 2y 92% (n = 45)
16–30 kg: n = 11, age 7–12y, 1y 81% (8), 2y 81% (7)
31–45 kg: n = 22, age 9–17y, 1y 95% (21), 2y 95% (19)
46–80 kg: n = 39, age 11–23y, 1y 94% (27), 2y 94% (16)
>80 kg: n = 12, age 15–22y, 1y 90% (10), 2y 72% (5)

1&2y patency rates were best for 31 to 45 kg & worse for small 16 to 30 kg & obese >80kg pts. Risk factor analysis showed significantly better outcome for wt group 31 to 45 kg (P = 0.01) & self-cannulation pts (P = 0.02). No risk association was found for age, gender, ethnicity, ESRD cause, time on HD, or pro-thrombotic condition. ***Conclusion*:** AVF created in ped HD pts by experienced vascular/ped surgeons had good outcomes with 15% PF & 92% 1&2y overall patency for all non-PF AVF. Surprisingly patency was best in wt group 31 to 45 kg, then 46 to 80 kg, and in pts who did self-cannulation via button holes.

Vascular access in neonates and small infants: Data from the Carpediem™ retrospective registry

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Background: Renal support therapies in infants and small children are the treatments of choice for a wide spectrum of acute diseases. One of the most important limiting factors in achieving successful RRT in this population is adequate vascular access (CVC). We report data on CVCs and flows utilized on patients enrolled on the Carpediem™ Retrospective-Registry ***Methods*:** We performed a secondary analysis of data from the 26 patients enrolled in the Carpediem™ registry in 6 Italian centers between January 2012 and December 2015. For the current analysis we included patients with a dual lumen CVC. ***Results*:** CVC was placed to twenty patients 77% and served 142 extracorporeal circuits: 7(35%) **4Fr** 5 cm length, except two 8 cm; median bood flow Qb_m was 13 mL/min (interquartile range [IQR] 10–13) and maximum (Qb_{max}) 20 ml/min; was utilized in 59(42%) circuits. 9(45%) **5Fr**: five 5 cm length, two 7 cm and one 8 cm; Qb_m was 10 mL/min (IQR 9.5–18) Qb_{max} 35 mL/min; 48(34%) of circuits. 3(15%) **6.5Fr**: five 10 cm length; Qb_m 20 mL/min (IQR 20–23) Qb_{max} 35 mL/min; 27(19%) circuits. Only one 7 Fr CVC was utilized on a 4 kg patient with Qb_m and Qb_{max} 11 and 12 mL/min respectively. Patients weight(W) were: 3.27 kg (IQR 2.58–3.27) Wminimum (W_m) 1.61 kg for the 4Fr, 3.25 kg (IQR 1.68–3.71), W_{min} 1.68 kg for the 5 Fr and 3.5 (IQR 3.5–3.5), W_{min} 3.35 kg for the 6.5Fr. Most common access site was jugular vein (46%) with 7(77%) 5Fr, 67% 6.5Fr and 4 (57%) 4 Fr, all the others were femoral except for one subclavian. Mean delivered treatment time was 80%, 92% of the prescribed respectively for the 4 and both 5 and 6.5CVCs. Treatment successfully terminated were 64%(4Fr) and 78%(5 and 6.5Fr). Unplanned interruption was primarily due to circuit coagulations followed by catheter malfunctions.17% and 19% were the percentage of malfunctions and circuit coagulation (42% circuits without anticoagulation) for the 4Fr CVC. One CVC lasted longer than 600 hours contributing to the majority of the complications. The 5Fr(6.5Fr) treatments discontinuation were for coagulation 13%(11%) while 2%(0%) for CVC problems (29% of circuits without anticoagulants) ***Discussion and Conclusion*:** To favor catheter insertion and to avoid thrombosis vessel diameter and catheter size should be proportional. 4 and 5Fr CVCs have been effectively utilized in small patients treated with the carpediem machine.

Ultrafiltration rate greater than 13 ml/kg/h is associated with decrease in central venous oxygen saturation levels in pediatric hemodialysis patients

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Background: Limiting ultrafiltration rate (UFR) to 13 ml/kg/h is recommended in adult HD patients to reduce morbidity; however, this has not been studied in pediatric (ped) patients (pts). Central venous O2 saturation ($S_{cV}O_2$) measured from superior vena cava is a good estimate of tissue consumption of O_2

	$S_{cV}O_2$ pre %	$S_{cV}O_2$post %	Hgb	% BV 4 h	UFR (L)
< 13	58.39 ±	**56.07 ±**	11.18 ±	**−8.84 ±**	**1.12 ±**
mL/kg/h	8.18	**7.66***	1.45	**7.39***	**0.93***
> 13	59.23 ±	**54.29 ±**	11.25 ±	**−13.04 ±**	**1.65 ±**
mL/kg/h	6.59	**8.73***	1.66	**8.19***	**0.93***

$P < 0.05$

Methods: HD pts with tunneled catheters (cat) in the IJ & subclavian were included; pts with femoral cat excluded. 4 hour HD performed with linear fluid removal. Morbidity assessed by dialysis associated symptoms (DAM); $S_{cV}O_2$ and % blood volume (BV) change recorded from noninvasive hematocrit monitor (NIHM) pre HD& post HD for 3 mon. ***Results***: 828 treatments (Tx) [22 patients (12 males)] on 3 or 4 times/week HD. $S_{cV}O_2$ fall correlated with fluid removal. $S_{cV}O_2$ lower post HD in Tx which had > 13 mL/kg/h UFR (table). $S_{cV}O_2$ also associated with BV in pts > 20 kg - independent of number Tx/week. Pt < 20 kg on 4 days/week (335 Tx) had higher chance of having > 13 ml/kg/h UFR, but no difference between higher and lower UFR groups observed. DAM symptoms not different between pts categorized by 13 ml/kg/h UFR (X^2, $P = 0.2$).

***Conclusion*:** $S_{cV}O_2$ decreased significantly in ped HD pts > 20 kg when UFR > 13 mL/kg/h signifying possible morbidity in ped pt. Pt symptoms are inadequate and late measures for assessing morbidity. A different UFR standard may be required in smaller children as achieving UFR < 13 mL/kg/h was difficult even in those receiving 4 days/wk HD and there was no difference in $S_{cV}O_2$ between the higher and lower UFR groups.

Comparative epidemiology of end stage renal disease [ESRD] in a pediatric dialysis unit: Single center experience

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Background: Pediatric ESRD in the United States has an approximate annual rate of 18 patients per million. With advancement in renal replacement therapy techniques over the past decade, survival on dialysis is higher, especially in younger children. With prenatal detection of renal disease and successful use of dialysis in neonatal period, the incidence of infants with ESRD is rising. ***Aim***: To assess the differences in epidemiology of our dialysis population over the past decade in order to determine the variations in patient characteristics in regards to medical complexity. ***Methods*:** Retrospective chart review of all children between ages 3 months and 21 years who received dialysis at our institution in calendar years 2010 and 2016 in order to assess the incidence of primary ESRD diagnoses, the distribution of age at initiation, and trends in chronic modality. ***Results*:** 165 patients met inclusion criteria. There was a similar number of children on dialysis at both time points with 80 children with

ESRD in 2010 and 85 children in 2016. The modality distribution (number of children on peritoneal dialysis verses hemodialysis) in both cohorts was not different. The number of children <6 years was higher in the 2016 cohort compared to the 2010 cohort but not statistically significant (P = 0.14, Fisher's exact test). There was however a trend toward a younger hemodialysis population with 5 times more children <6 years in the 2016 cohort compared to the 2010 cohort.

The distribution of etiologies for ESRD across both cohorts was statistically significant (P = 0.02, Chi square test). While CAKUT contributed to majority of ESRD diagnoses in 2010, there was a greater prevalence of genetic disorders such as ARPKD, congenital nephrotic syndrome and nephronophthsis in the 2016 cohort. ***Conclusions*:** Given recent advances in technology, more infants and toddlers are being maintained on chronic dialysis. Surprisingly, the distribution of ESRD diagnoses showed increased prevalence of genetic disorders likely reflecting improvement in diagnostic capabilities over the last decade. Future directions include further characterization of the cohorts to assess medical complexity and thereby justify a need for increased allocation of resources in a pediatric dialysis unit.

A chronic disease self-management program in pediatric dialysis patients: A pilot study

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Background: Chronic disease self-management programs have been extensively studied in adults, but the data in pediatric patients is lacking. The objective of our pilot study of Be Your Own Boss, a peer-led chronic disease self-management program, is to determine if participation in the program can improve mental and physical health parameters in pediatric dialysis patients. ***Methods***: In a prospective crossover design, pediatric hemodialysis (HD) and peritoneal dialysis (PD) patients participated in the study. Participants attended 6 individual sessions on a weekly or monthly basis, which coincided with their HD or PD appointments, respectively. Participants were asked to complete validated questionnaires to evaluate mental and physical health parameters. All participants completed questionnaires at Day 0 and Week 6, following completion of the HD sessions and Month 8, following completion of the PD sessions. ***Results***: A total of 10 dialysis patients, 4 HD and 6 PD, participated. The median age was 15 years (IQR 11.75—17.00). The average attendance at the sessions was 87.5% and 44% for HD and PD patients, respectively. There were no significant differences in self-rated health, adherence, or rates of depression after the intervention or between the dialysis groups. HD patients reported being significantly more confident in their ability to manage physical discomfort (P = 0.026), manage emotional distress (P = 0.004), keep symptoms from interfering with activities (P = 0.002), and manage their disease (0.036) when compared to PD patients across all time points. ***Discussion*:** There were limited statistically significant outcomes due to the sample size. The HD patients, with a greater participation rate, demonstrated greater confidence in some aspects of their health management which may be due to more interaction with the health care system. Qualitatively, the patients enjoyed the opportunity to talk with other patients with kidney disease. Additionally, the investigators were able to explore the process of implementing a pediatric self-management program. Despite participants being the captured audience that is the dialysis patients, attendance was particularly challenging in the PD population. ***Conclusion*:** Larger studies are needed to determine if self-management programs may be a way to improve mental and physical health parameters in pediatric dialysis patients.

Bridging the gap: Dialysis teacher collaborating with local school teachers to support academic achievement for pediatric patients on hemodialysis

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Background: School-aged children on hemodialysis (HD) miss a significant amount of classroom instruction due to in-center dialysis treatments or other health related issues. Missed school contributes to students having difficulty keeping up with lessons, poor school performance, and school avoidance. Dialysis teacher identified issues with students having inadequate supplemental school services, lack of communication between student/parent and school, and inaccurate assessment of student's grade level. ***Aim*:** Dialysis teacher will collaborate with classroom teachers to establish a plan for students to track assignments, make up missed work, and facilitate communication between student/family and local school teacher. ***Method*:** At the start of the school year, dialysis teacher sent an introduction letter to teachers explaining student's medical situation and requesting a partnership to monitor attendance, assignments, and academic progress. To ensure IEP/504 plans were appropriate for patient's skill level, dialysis teacher plans to participate in IEP/504 meetings with families and school. Dialysis teacher checked in with patients weekly to review progress reports and assignments via School Loop, PowerSchool, Edmodo, etc. ***Results*:** Eighty percent (n = 4) of school age patients on HD attend school. Dialysis teacher sent letters to 12 teachers. Dialysis teacher scheduled to participate in 75% of IEP meetings. Dialysis teacher worked with students to check weekly progress to develop self-monitoring skills. Students felt workload was balanced and more manageable which increased motivation to complete assignments. Local teachers and administrators were aware of student needs and felt supported by collaborative approach with the medical team for student's success. ***Conclusion*:** This project highlights the importance of the dialysis teacher's role in working with local school teachers to improve communication, to reinforce material taught at school, and to optimize student performance and achievement.

Vein preservation in children with chronic kidney disease

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Background: Children with chronic kidney disease (CKD) face a lifelong possibility of needing hemodialysis (HD), and vascular access complications are a major cause of morbidity in patients needing HD. Vein preservation in the CKD population has proven to be a challenge in the pediatric inpatient setting. Peripherally inserted central catheters (PICC) are popular for short term vascular access, but there is a high incidence of venous vein thrombosis and/or stenosis associated with PICCs. PICCs are often placed in vessels essential for arteriovenous fistula creation. Though our Nephrology and Interventional Radiology (IR) teams were aware of the vascular needs for CKD patients, we identified a need to standardize workflow for CKD patients who need central venous line (CVL) access and to engage staff who place PICCs to maintain vessel preservation for CKD patients. A quality improvement project was initiated to increase the rate of appropriate location of CVL placements in patients with CKD. ***Aim of the project*:** To increase the rate of appropriate CVL placements in children with CKD (stage 3–5), renal transplant and dialysis patients from 11 to 40 correct CVL placements per 100 patients by June 2018. ***Methods*:** Prior to implementing interventions, key stake holders from nephrology, IR and vascular access (VA) were involved. IR and VA agreed to identify patients with CKD and to place CVL in correct location as defined by published guidelines. VA workflow was standardized to decrease the use of PICCs in CKD patients. Vein preservation education and a formal policy was provided to staff to raise awareness of vascular needs of children with CKD. Vascular Access Quality meetings were initiated with nephrology, IR and VA to review CVL data and address challenges with vein preservation for CKD patients. ***Results*:** Data collected after interventions were initiated revealed the rate of appropriate CVL placement in CKD patients increased from 11 to 70 correct location of CVL placement per 100 patients. ***Conclusion***: Vein preservation for pediatric CKD patients is imperative to protect their future vascular access. By identifying key medical personal, standardizing VA workflow, and instituting a formalized policy for appropriate CVL placement for CKD patients, we were able to increase the rate of correct location of central line placement.

Improvement of anemia rates in pediatric hemodialysis patients

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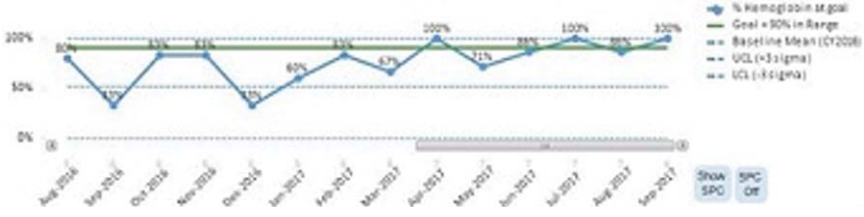
Background: Anemia has been associated with increased morbidity and mortality in hemodialysis patients. The recommended target hemoglobin levels in pediatric dialysis patients as established by both: Kidney Disease Improving Global Outcome and Kidney Disease Outcome Quality Initiative are 11 to 12 g/dL without exceeding a level of 13 g/dL. In our hemodialysis unit, we use a target range of 10 to 13 g/dL. We identified an opportunity to improve anemia rates in hemodialysis patients at our institution. ***Aim*:** To increase the average % of hemodialysis patients with hemoglobin in target range (10–13 g/dL) from 60% to 90% in 6 months. If patient census decreased to less than 10 patients, no more than 1 patient can be out of range. ***Methods*:** Our patient cohort was pediatric hemodialysis patients on chronic dialysis for at least 3 months. Two patients were excluded due to other anemia etiologies (hemoglobinopathy and immunosuppression for liver transplant with history of GI bleeding). Tests of change included the following: minimizing blood loss from catheter access, minimal blood volume from lab draws, and revision of ESA dose adjustment protocol. We reduced the blood discard from the hemodialysis catheter by 3 times. With each treatment we removed only the lumen volume of the catheter for line clearance. On lab days, the discard volume was increased to twice the lumen volume and push pull method for line clearance was added. Updated ESA protocol was based on monthly serum Hgb as well as a trend of pretreatment Hgbs on the CRIT-LINE monitor. Hemoglobin levels and ESA dosing were tracked and recorded through Excel and an electronic database dashboard which pulled real time data from EMR. ***Results*:** We exceeded our goal with 100% of patients with hemoglobin in range (10–13 g/dL) in 3 months. Due to low census, only 7 patients qualified. By minimizing blood loss, on average we saved 49 mls of blood per patient per month. Previous blood loss was on average 84 mls per patient per month. Total ESA dosing was also reduced resulting in no patients requiring maximum ESA dose with Hgb <10 g/dL when previously we had up to 3 patients per month. ***Conclusion*:** We improved



anemia monitoring and lab outcomes. These changes have become our standard of practice. It will be important to continue to monitor and sustain these changes.

Standardizing a clot grading system for dialyzers: Switching modalities from hemodialysis to hemodiafiltration

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Background: Inadequate anticoagulation of the extracorporeal circuit leads to an increased risk of clotting and circuit loss. Clotting in the dialyzer also inhibits the ability to clear blood effectively at the end of a treatment, leading to blood loss. In our center, a standard heparin dosing protocol was followed, with efficacy gauged by monitoring the activated clotting time (ACT) with a target of 160 to 200 seconds. However, clot formation, particularly in the dialyzer was not monitored in a standardized fashion, with significant dialyzer clotting noted despite ACT driven heparin dosing adjustment. With plans to convert patients from Hemodialysis (HD) to Hemodifiltration (HDF), there was concern about increased circuit clotting risk based on the known enhanced heparin removal with HDF. ***Objective*:** It was decided to establish a dialyzer clotting grading system prior to converting from HD to HDF to ascertain the need for changes in anticoagulation. A literature review was completed and various stages of dialyzer clotting were illustrated. A grading score with diagrams and additional criteria was developed to objectively grade the process. ***Method*:** The standard heparin dosing guideline for chronic dialysis patients included an initial heparin bolus of 15 to 20 units/Kg body weight followed by an hourly rate of 15 to 20 units/Kg/h. Heparin was stopped 30 minutes before the end of treatment for patients with central lines and 45 minutes for patients with fistulas. ACTs were performed five minutes after the heparin bolus and hourly rate was started, half way through the treatment and five minutes before treatment termination. The newly developed clotting grading included:

Heparin doses were evaluated when the clot in the dialyzer score 3 or 4 based on dialyzer appearance or machine criteria, and the ACTs were below the current guidelines. ***Results*:** Three treatments were evaluated for patients prior to and after converting to HDF in eight patients. Two patients required an increase in heparin while on HD based on grade 3 and 4 clots in the circuit and did not meet the ACT guidelines. One patient required a decreased dose in heparin for ACTs that were high and scored low on the grading system on 3 consecutive treatments. Two patients required an increase in heparin after switching to HDF. One patient had both low ACT levels and a grade 4 clot in the dialyzer. The second patient met the ACT guidelines but had a grade 4 dialyzer. 6 patients in both the HD and HDF groups had target ACT scores with grade 0 to 2 scores. In the HDF group, one patient had target ACTs but a grade 4 clotting score. Increasing the heparin dose above our dosing guidelines resulted in ACTs in the target range but a reduced clotting score. ***Conclusion*:** The clot grading score was an effective tool in addition to the standard heparin dosing and ACT guidelines. Standardized criteria including diagrams of clotted dialyzers and specific treatment criteria provided a guideline for nursing and medical staff to evaluate the adequacy of heparin dosing. The grading score is still utilized today for all new patients and those transitioning from HD to HDF.

	Clotting in dialyzer	Clotting in venous chamber	Blood flow rate (% prescribed)	# of Arterial and venous alarms	Arterial and venous pressures
Grade 0	None	None	100%	None	$\leq$ 100 mmHg
Grade 1	Small amount of streaking	None	100%	None	$\leq$ 100 mmHg
Grade 2	Moderate amount of streaking	None	100%	None	$\leq$ 100–200 mmHg
Grade 3	Moderate amount of streaking	Small to moderate clot formation	50%–100%	<5 alarms	$\leq$ 100–200 mmHg
Grade 4	Dialyzer completely clotted	Moderate to large amount of clot formation	50%–75%	>5 alarms	$\leq$ 200–300 mmHg

Challenges and rewards of outpatient hemodialysis in a pediatric patient with ROHHAD syndrome

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***Case History*:** ROHHAD (rapid-onset obesity with hypothalamic dysfunction, hypoventilation, and autonomic dysregulation) Syndrome is a rare, life-threatening disorder of the autonomic nervous and endocrine systems that begins in the first decade of life. Clinical manifestations may include rapid weight gain within several months, need for ventilator support, hyper- or hypothermia, and bradycardia resulting in cardiac arrest. ***Patient 1*:** 11-year-old male with ROHHAD Syndrome who subsequently developed ESKD requiring thrice weekly hemodialysis secondary to progressive renal injury from his Type 2 DM,

chronic inflammatory state, and intermittent intravascular contraction. He first showed symptoms of ROHHAD at 3.5 years of age, however was not diagnosed until a prolonged hospitalization lasting 7 months when he was 9 years of age. Complications of ROHHAD Syndrome progressed resulting in Permcath placement for hemodialysis in September 2016. Of note, the patient also had a tracheostomy, ventilator, NG tube feedings, multiple wounds and pressure ulcers, colostomy, and morbid obesity resulting in a non-ambulatory state. Parents wished to continue aggressive medical care, including proceeding with outpatient hemodialysis. Multiple barriers to their wish of outpatient hemodialysis were present; therefore, a clear plan was formulated over many weeks with the help of his interdisciplinary team to achieve the parents' goal of having him home. ***Interventions*:** Multiple meetings were held with the patient's family, physicians, nurses, and home health team to provide a safe plan from hospital discharge to outpatient hemodialysis thrice weekly. His home health nurse accompanied him to his dialysis treatments, along with a parent, to provide full nursing care, and a respiratory therapist was assigned to him during scheduled treatment times to assist with any ventilator complications. In addition, a dialysis nurse provided 1:1 patient care. A specialized wheelchair scale, hoyer lift, and sling were obtained to weight and transfer the patient. Due to the patient's hypotension, he was placed on Midodrine and Prednisolone to achieve blood pressures >90/40 so that he may be dialyzed. In addition, multiple specialty providers were available to see the patient in the hemodialysis unit during his scheduled treatments. ***Summary*:** Despite the challenges and barriers to providing outpatient hemodialysis to an exceptionally complex pediatric patient, we were able to grant this family's wish by giving them more time at home with their terminally ill child.

Securing vascular access in infants and young children on hemodialysis

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***Background*:** Intact dressing and healthy skin around central venous catheters (CVC) are essential in avoiding infections and catheter malfunction in small children on hemodialysis (HD). Nonetheless, multiple challenges exist such as: 1. CVC in close proximity to G-tube and other ostomies; 2. tendency of young children to pull catheters/dressings; 3. Sutures/tape/catheter site is usually irritating to the skin and promote scratching. Here we describe a clinical process improvement to secure CVC in infants and young children on HD. ***Method*:** Using a multi-disciplinary team approach we developed several interventions to secure CVC in young children. Team members included: dialysis nurses, parents/caregivers, surgeons, nephrologist and wound care nurse. Interventions include: 1. Immobilizing CVC using elastic bandages/wraps, wearing onesies, Velcro belts, and/or soft arm restrains; 2. Trying different occlusive dressings that improve adhesiveness; 3. Not using sutures after 3 months of CVC insertion 4. Treating dermatitis when present; 5. Increaseing family accountability by meeting with caregiver and developing a checklist at each HD visit to assure adherence to the recommendations; 5. Involving counselor in school aged children to decrease catheter manipulation. ***Results*:** 7 children on HD with CVC, 1 to 8 years of age underwent these interventions from March 2016 till June 2017. We reported blood stream infection (BSI), exit site infections and CVC change before and after the interventions for each patient. BSI decreased by 80% (from 5 to 1 event), CVC change decreased by 70% (from 10 catheter changes to 3) and exit site infection remained the same (3 before and after). ***Conclusion*:** Multi-disciplinary team approach and team creativity improved CVC site management in infants and young children on HD.

The first-hour refill index: A promising marker of volume overload in children and young adults on chronic hemodialysis

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***Background*:** Volume overload is a risk factor for cardiovascular complications in children on hemodialysis (HD), but a measurable index of volume overload is lacking.

***Method*:** We propose a novel index of pre-HD volume overload based on blood volume (BV) monitoring, the 1st h Refill Index (RI), calculated as the ratio between the ultrafiltration rate indexed for body weight during the first HD hour and the percent BV change at the first hour of the treatment. This parameter was retrospectively calculated in 121 sessions in 11 oligoanuric children and young adults on chronic HD, median age 14.3 years (range 5.4–22.4), and its association with left-ventricular mass index (LVMI), pre-HD blood pressure (BP), number of anti-hypertensive medications evaluated.

***Result*:** The median RI was 2.07 mL/kg/h/%; RI significantly correlated with LVMI (r 0.66, $P = 0.028$). Patients with a median RI >2 had a significantly higher LVMI (53.4 vs 36.6 g/$m^{2.7}$, $P = 0.01$) and a higher number of anti-hypertensive drugs per patient (3 vs 1 per patient; $P = 0.02$) than those with a RI < 2 ml/kg/h/%, while BP was not significantly different between the two groups.

***Conclusion*:** The 1st h Refill Index could be a promising marker of refill capacity and pre-HD volume overload in children and young adults on chronic HD

Risk factors for type IV cardiorenal syndrome (CRS IV) in children on dialysis and their outcome after kidney transplantation (KTx)

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Background: CRS IV, also defined as chronic reno-cardiac disease, is characterized by cardiovascular involvement in patients affected by chronic kidney disease. Few studies have reported on prevalence of CRS IV in children on dialysis, or have evaluated risk factors potentially associated with this disease. In this study we sought to identify a risk profile for children in HD who developed CRS IV. We also evaluated their cardiovascular status after Ktx. ***Methods:*** We retrospectively investigated 7 children with a median age of 11 years (range 5–17) affected by CRS IV and receiving HD, followed at our center between January 2006 and May 2016. Case-series was compared with a matched-control group of 13 children receiving HD in the same period. ***Results:*** Median time on dialysis in children with and without CRS IV was 16 (range 8–24) and 14 months (range 2–22), respectively (n.s.). At time of diagnosis, patients with CRS IV exhibited a significant reduction in ejection fraction (EF) values ($P < 0.001$), urine output ($P < 0.001$), URR% ($P < 0.001$), and Kt/V ($P = 0,01$) as compared with controls. Moreover, higher values of LVMI ($P < 0,01$), interdialytic weight gain ($P = 0,05$), PTH ($P = 0.008$), and n° anti-hypertensive drugs ($P = 0.002$) were observed. Analyzing the full cohort of 20 children on HD, correlations (Pearson) were found between EF and Kt/V ($r = 0.51$, $P = 0.02$), URR% ($r = 0.75$, $P < 0.001$), PTH ($r = -0.6$, $P = 0.006$), interdialytic weight gain ($r = -0.71$, $P = 0.001$), and urine output ($r = 0.61$, $P = 0.005$). Significant but opposite correlations were found with LVMI Z-score. Six months after KTx, children with CRS IV exhibited a dramatic cardiovascular improvement, with reduction in EF ($P < 0.001$), LVMI ($P = 0.,017$), proBNP ($P < 0.0001$) and PTH levels ($P < 0.0001$). ***Conclusions:*** Children receiving HD with anuria, interdialytic weight gain, poor dialytic efficiency, calcium-phospate imbalance, and hypertension are at risk of developing CRS IV. Ktx significantly improves the cardiovascular profile of these patients.

Factors influencing the transfer of pediatric patients to adult care

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Case History: ESRD education and transition preparation was provided in a pediatric dialysis center. Since 2015, seven HD patients were transitioned to adult care. The group was comprised of three males and four females between the ages of 18 to 21.75 years. Five patients earned high school diplomas, none enrolled in higher education. Two patients were referred to Vocational Rehabilitation with one completing the program and one deferring. Two have been employed part-time at some point during pediatric care. All, except one patient, were from single parent families who were either unemployed or worked full-time, part-time or intermittently for low wages. All patients had Medicaid and six received transportation assistance. Four patients were no longer accompanied by caregivers after turning 18. ***Patients:*** **#1** Cognitively disabled non-verbal 21 year male with CVL and G-tube not listed for transplant was in the custody of maternal grandmother and accompanied by cognitively disabled sibling via Medicaid transportation. Biological father with limited involvement wanted to make health care decisions without HCPOA. Family meeting with adult nephrologist resulted in agreement for father to make decisions.

#2 19 year male with AVF, obesity and poor adherence with fluids, diet and binders was not listed for transplant. He did not complete high school or adult education and quit his part-time job. His Medicaid transportation travel time from a neighboring state was >1.5 hours.

#3 18 year female with CVL, non-adherence with fluids, diet and binders was not listed for transplant. She disengaged from center activities and was inconsistent with counseling appointments. She did not meet expectations to transfer to PD. She used Medicaid transportation and was unaccompanied after turning 18.

#4 18 year male with AVF, G-tube and non-adherence with fluids, diet and binders was listed inactive. He refused to attend school, Vocational Rehabilitation or enroll in adult education. His father accompanied him from a neighboring state with a travel time >1.5 hours.

#5 21 year female with AVF, failed transplant and high PRA, >7 years listed active. She was unaccompanied since age 16. She resisted transferring due to high comfort level with pediatric staff and fear of the unknown. Her Medicaid transportation travel time was >1 hour.

#6 19 year female with AVF, obesity, anxiety, failed transplant and non-adherence with fluids, diet and binders was listed inactive. She completed high school, never worked and refused Vocational Rehabilitation and counseling. She was unaccompanied to treatments after turning 18. Her travel time with Medicaid transportation was >1 hour.

#7 19 year female with CVL, failed AVF and AFG, morbid obesity and non-adherence with fluids, diet and binders (exacerbated by living in a motel) was not listed for transplant. She completed high school and deferred Vocational Rehabilitation. She used Medicaid transportation. Following a pattern of signing-off treatments early she transferred to adult care. ***Approach:*** Patients were informed that the transition to adult care would be completed before age 22. Transition readiness assessments, depression screenings and health literacy tests were administered to all but the cognitively disabled patient. Identified areas of deficit were addressed through targeted teaching,

skill practice and goal setting. Shared decision-making tools were also utilized. ***Summary*:** The greatest determinant of when patients transferred to adult care was the degree to which they benefited from the pediatric milieu. Patients with favorable adherence to their medical plans and poor social supports were more likely to transfer care later than those whom were resistant to interventions who transferred to adult care before age 20. Except for the cognitively disabled patient, all patients met key competencies of disease awareness, medication management, nutrition knowledge and self-management. Letting go is difficult for both the patient and the medical team. Involving the team in the transition process through targeted discussions during monthly meetings may ease the emotional impact of terminating the relationship.

Pediatric renal nutrition calculator: Prescribing with accuracy and efficiency

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***Background*:** Nutrition plays an integral role in the medical management of infants and children with kidney disease. There is no "one formula fits all" product that meets the nutritional requirements of all pediatric renal patients. Furthermore, the number of formulas that are renal appropriate for pediatric patients is extremely limited. Using commercial formulations currently available, customization is essential to achieve ideal energy, protein, electrolytes, minerals, volumes and concentrations.

In years past, calculating pediatric renal formulations were time-consuming exercises done manually using pen, paper and calculators with a large potential for errors. ***Methods*:** In order to increase accuracy and efficiency, renal dietitians at BC Children's Hospital created an electronic version of the original manual worksheet based on a few of the most consistently used formulas and their respective nutritional compositions. Over time, additional features such as patient weight, concentration and total volumes have been added to the calculator.

***Result*:** Our standardized tool for accurate customization of feeds to meet the unique individual nutrition requirements has significantly improved nutrition prescription in daily clinical practice. The Pediatric Renal Formula Calculator has also become a meaningful communication tool for medical team members about the nutritional content of patients' current feeds. A self-populating formula preparation resource for patients is the most recent update to this clinical tool.

***Conclusion*:** As the range of commercial formulas changes and evolves, this calculator requires regular review and revision to accurately reflect the most current compositions of formulas on the market. By adding and/or substituting regionally available product formulations into the electronic spreadsheet, this clinical tool can be reproduced by pediatric renal dietitians practicing in different jurisdictions internationally.

The pharmacokinetics of ferric pyrophosphate citrate (Triferic®) in pediatric CKD-5HD patients: Implications for dosing

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***Background*:** Triferic (FPC) is a carbohydrate-free complex iron salt with a MW ~1300 Daltons. FPC is approved as a hemoglobin maintenance treatment for adults receiving chronic hemodialysis. FPC rapidly transfers across the dialyzer membrane, donates iron directly to transferrin, rapidly cleared. The current study examined the pharmacokinetics (PK) of Triferic administered via dialysate and intravenously (IV) to pediatric hemodialysis patients. ***Methods*:** This was an open-label, two period single dose study in 22 CKD-5HD patients. The treatments were Triferic 0.07 mg Fe/kg IV into the post-dialyzer blood line (FPC-IV) and Triferic 2 μM (110 μg Fe/L) via HD (FPC-HD). HD was conducted for 3 to 4 hours and FPC-IV was administered during HD. Blood was drawn for serum iron profile at defined times for PK analysis. An estimate of iron delivered at the dialysis session was calculated by using partial AUC based on the IV dose. ***Results*:** 22 subjects, age 1 to 17 years were enrolled. There was greater inter-individual variability and lower peak iron levels in the patients <12 years. FPC-HD showed a similar intradialytic and post-HD iron profile as FPC-IV. Iron administered by FPC-HD was dependent on membrane surface area. The amount of iron administered FPC-HD was 1.0 ± 0.57 mg for age <6; 3.4 ± 0.98 mg for age 6 to 12 and 4.4 ± 2.42 for age 12 to 18. TSAT increased from 26% pre-HD to 61% after FPC-IV and 72% after FPC-HD. FPC iron had a $t^1/_2$ of ~2 hours. FPC was well tolerated with no drug related adverse effects noted. ***Conclusion*:** This study shows that FPC iron can be delivered to pediatric CKD-5HD patients either intravenously when using solid bicarbonate cartridge/bag system or via the dialysate. FPC was well tolerated. The results suggest that IV administration in patients below 50 kg be started at 0.1 mg Fe/kg. For patients >50 kg, the dose should be 6.5 mg IV. Both doses will achieve an estimated peak TSAT of 75 to 80%.

Use of cath dry on hemodialysis and peritoneal catheters for pediatric dialysis patients

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***Background*:** In general, it is not permissible for dialysis patients with any type of catheter to shower or swim because of the risk of infection. However, a recent commercial product (Cath Dry) has made the claim that application of the product over a catheter can prevent the catheter from moisture when it is exposed to water or alert the patient when moisture is present per a color changing ring. ***Aim*:** The objective of this study was to review the experience with Cath Dry in a portion of the children who attended Camp Chimer, a 5 day summer camp for children on peritoneal dialysis, hemodialysis and kidney transplant

recipients. ***Methods*:** Data was collected during the 2017 camp session. In all cases, application and removal of the Cath Dry dressing was carried out by the pediatric dialysis nursing staff from Children's Mercy Kansas City. Data collected included patient gender, patient age, type of access, use during shower, use during swimming, how many times it was changed after noting water contamination, how many catheters remained clean dry and intact after shower or swimming, and what other supplies were used to apply and secure the Cath Dry product. The parents of all patients were aware that their children would shower and swim at camp and that this product would be applied to the catheter site and closely monitored during the exposure to water. ***Results*:** Data was collected from 8 patients: 4 male and 4 female, mean age: 14 (9–18) years. Seven patients had a hemodialysis catheter and one patient had a peritoneal dialysis catheter. All of the patients used the Cath Dry dressing during swimming and they all showered immediately after swimming for a total of 18 exposures to water (HD-16 and PD-2). A total of 28 Cath Dry dressings were applied over the period of observation, with 11 applied to the same child because of repeated evidence of moisture or water contamination of the catheter. Five of the eight children (62%) required a single Cath Dry dressing for each water exposure. Out of the 28 Cath Dry dressings applied, 13 completely prevented water from contacting the catheter after swimming and showering, whereas in one case the catheter area was dry after swimming, but then became wet after showering. All of the dressings were applied with as many as 3 to 6 Tegaderm films over the Cath Dry. The Cath Dry dressing was well tolerated by all the children and there were no reported instances of post-camp catheter related infection. ***Conclusion*:** Our preliminary data reveals that the Cath Dry dressing can prevent water contamination of dialysis catheters while swimming or showering in some pediatric dialysis patients. However, the finding that the Cath Dry dressing failed to prevent water contamination in 38% of children suggests that close monitoring of the integrity of the product is mandatory during water exposure. Further evaluation of the Cath Dry in a larger number of **Subjects** and identification of factors which contribute to water contact with the catheter despite use of the product is mandatory before widespread use of this potential resource can be recommended.

Using high-fidelity simulation to improve code readiness on a pediatric dialysis unit

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Background: Dialysis and apheresis are complex medical treatments with many associated risks. Factors contributing to these risks in the pediatric population include: age, weight, increased central line usage, and multifaceted comorbidities. Due to this increased risk for emergency situations, it is important to ensure dialysis unit staff are prepared to handle scenarios with confidence and have the knowledge to carry out appropriate interventions quickly. High-fidelity mannequins mimic real-life patients in a controlled environment. Our dialysis team set out to improve code readiness by using high-fidelity simulation in realistic, dialysis-related emergency scenarios. ***Methods***: 66 team members (providers, RNs, techs, and unit assistants) participated in two scenarios (compensated hypovolemic shock, and severe anaphylaxis) at least two times, followed by debriefing sessions in small groups. A short didactic presentation about pediatric shock was offered to the team the month prior to the simulation experience. Each participant was asked to complete a pre and post survey about their confidence handling code situations and recognition of deterioration in pediatric patients (Likert scale 1–6), as well as post-simulation knowledge-based questions regarding management of pediatric shock. ***Results***: There was a significant improvement in confidence in code readiness (median scores) from the pre to the post survey on all survey items. No correlation was found between higher confidence on the post survey with good performance on the knowledge-based questions; however, there was a negative correlation with participants with high confidence reported prior to simulation (corr: -0.34, $P = 0.01$). ***Summary*:** Dialysis staff had improved confidence scores after simulation. Anecdotal responses from team members were overwhelmingly positive, with the desire to continue regular simulation experiences. High confidence prior to simulation did not necessarily yield good performance on the knowledge-based questions. Next steps include a process for outcome measurement and application of code readiness in real-life scenarios on the unit. ***Conclusion*:** Improving safety and well-being of the patients is top priority. High-fidelity simulation is a useful tool in educating, improving confidence and maintaining code readiness skills for staff on a pediatric dialysis and apheresis unit.

Intravenous line placement in children with ESRD: Does current practice preserve the non-dominant veins for adulthood?

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***Background*:** An arteriovenous fistula (AVF) in the non-dominant arm is considered the preferred vascular access for hemodialysis patients. Unfortunately, multiple needle sticks in that arm can lead to stenosis and thrombosis of veins, resulting in less success with AVF placement in the future. Whereas preservation of veins in pediatric patients with end-stage renal disease (ESRD) is particularly important due to their diagnosis at a young age and need for life-long medical interventions requiring patent vessels, little information is available regarding upper extremity vein utilization as part of routine clinical practice conducted in pediatric centers. ***Aim*:** To review current practice regarding location (dominant vs. non-dominant arm) of

inpatient peripheral intravenous (PIV) line placement in pediatric dialysis patients and kidney transplant recipients in a single children's hospital. ***Method:*** Retrospective chart review of the inpatient experience of patients ≥ 2 years of age hospitalized from January 1 to June 30, 2017. Data regarding intravenous line location, as well as age and sex were available in the electronic medical record. Information regarding dominant arm was collected by patient or parent interview. SAS was used for statistical analysis. ***Results:*** Overall, 35 patients, mean age: 13 (2–21) years of age, 24 male and 11 female patients accounted for 72 patient admissions. In 38 (52%) instances, the PIV was placed in the non-dominant arm as compared to 34 (47%) in the dominant arm. Patients less than 5 years, were more likely to have the PIV placed in their non- dominant arm (75%) as compared to older patients 5 to 10 years of age (40%) and more than 10 years of age (54%). Of the patients who had PIV placed in their non-dominant arm, 28% of the insertions were in the antecubital vein. There was no statistical difference in the results between patient groups. ***Conclusion:*** Our preliminary data provides evidence that in an inpatient setting, an almost equal number of patient encounters are associated with PIV placement in the dominant and non -dominant arms, respectively in patients with ESRD. These data indicate a need for education and strategies regarding vein preservation in these patients and serve as the baseline data for a quality improvement initiative to be instituted at our institution. The initiative will include education for physicians, nursing staff, IV access staff, parents and patients about strategies to improve vein preservation and the rationale for doing so.

Operant learning improves hyperphosphatemia in children on chronic dialysis

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Background: Hyperphosphatemia in End Stage Renal Disease is associated with vascular calcification, cardiovascular disease, and early death. It poses a management challenge given the ubiquity of dietary phosphorus and the burdensome need to take medication with every meal or snack. To reduce rates of hyperphosphatemia in dialyzed children, we used operant learning to reward adherence to prescribed diet and medication regimens. ***Methods***: The dialysis interdisciplinary team (physicians, nurses, child life specialists) implemented Phocus On Phosphorus (POP), a Quality Improvement initiative augmenting ongoing patient education and counseling with rewards for meeting individualized monthly serum phosphorus goals. Children earned points based on a sliding scale for achieving phosphorus targets. Earned points could be redeemed, initially for prizes determined by dialysis staff, and then for gift cards pre-determined by the children and families to be preferred rewards. The proportion of children meeting phosphorus goals was tracked using statistical process control charts. ***Results***: Prior to POP initiation in March 2014, phosphorus goals were met consistently by only 27% (lower control limit [LCL] to upper control limit [UCL] 1%–53%). For the first 16 months of POP, little change ensued until patients were surveyed as to desired rewards, and gift cards were then offered for meeting targets. Rapid sustained improvement occurred with target levels attained by 36% (LCL to UCL 7%–66%). Further improvement to a mean of 43% (LCL to UCL 16%–69%) followed another modification of rewards prompted by on-going surveying of patients/families. The improvement trend from 27% to 36% to 43% proved highly statistically significant ($P < 0.001$) with each interval step meeting statistical significance (27% to 36%, $P = 0.004$; 36% to 43%, $P = 0.04$). ***Discussion:*** Control of hyperphosphatemia in dialyzed children is suboptimal with usual counseling and education. Strategies leveraging behavioral modification techniques can supplement traditional approaches, leading to improved phosphorus control and potentially improving bone mineral metabolism. Success with operant learning depends on patient-family engagement in the process to identify appropriate rewards that are desired by participants. ***Conclusions:*** A reward program based on achieving individualized monthly serum phosphorus targets can significantly improve outcomes in dialyzed children compared to traditional dietary education and counseling alone. Our experience underscores the importance of choosing appealing rewards with operant learning to maintain ongoing improvements.

Impact of hemodiafiltration on nutritional markers in children receiving chronic renal replacement therapy

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Background:-Malnutrition is a common adverse consequence of Chronic Kidney Disease (CKD), postulated to be caused by a combination of uremic toxin retention, volume overload, and chronic inflammation. For hemodialysis dependent children, there is data from European studies suggesting that hemodiafiltration (HDF) is superior to conventional hemodialysis (HD) in promoting catch up growth. ***Methods***:-Retrospective observational data was collected for three months prior to HDF initiation, for patients on conventional HD, 3 to 6 times per week, for 2.5 to 4 hours (average 12 hours per week). Data was collected prospectively following the switch to HDF. Sixteen patients were consented and four were excluded (three transplanted one month after starting HDF, one did not tolerate HDF). The dose of convective clearance delivered ranged from 185.9 to 412 mL/kg, average 326.9 mL/kg and was delivered post-dilution. Data collected included anthropometric data (height, weight, BMI), normalized protein catabolic rate (nPCR), dietary records and biochemical markers (calcium, phosphate, TCO2, albumin, PTH). Data was analysed using one way repeated measured

anova and paired t tests depending on the number of data points available ***Results***:-Twelve patients were analyzed, 58% female. Median age at HDF initation was 14.25 years (IQR 10.75–16.25). Absolute weights averaged over the 3 month period pre and post, were significantly higher post HDF initiation, p0.02. Heights were also significantly higher P = 0.05. Average Z scores for height and weight showed a trend toward improvement, but did not reach significance, P = 0.2587 and P = 0.965 respectively. nPCR was not significantly increased and there was no significant change in biochemical markers including phosphate, albumin, calcium, difference in pre and post urea, TCO2 or PTH. When comparing nPCR values post HDF, those greater than 1 these were associated with higher convective clearances than nPCR values less than 1, 358.5 mL/kg vs 282.78 mL/kg respectively. Average protein and energy intake were significantly higher post HDF initiation, P = 0.014 and P = 0.011 respectively. Observational data also suggested that patients had more energy. ***Conclusions***: Our data indicates that implementation of HDF has beneficial effects on growth, in part due to improved nutritional intake. Next steps include extending data collection for a longer period post HDF initiation. We also hope to formally analyse patient activity levels.

Interdisciplinary team approach to increase influenza vaccination of parents/caregivers of pediatric dialysis patients

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Background: Severity of vaccine-preventable diseases, such as influenza, is higher in children with altered immune responses, such as in chronic kidney disease. Vaccines may be less effective in these children and the CDC recommends caregivers should also be vaccinated. More than 90% of patients in our dialysis program in 2016 received the flu vaccine, but percent of parents/caregivers vaccinated was unknown. In efforts to optimize protection from the flu, dialysis team created process to track parents/caregivers vaccinated, identify barriers, and raise awareness how vaccination protects them and their child. Goal was to increase percent of parents/caregivers who receive the annual flu vaccine. ***Methods***: During dialysis clinic, staff queried and tracked parents/caregivers' flu vaccination status. Data collected included 1) do they receive annual flu shot, 2) year of last flu shot, 3) do they plan to receive flu shot this year, and 4) if they do not plan to receive flu shot this year, reasons why. For those who did not plan to receive the vaccine, we discussed barriers, importance of vaccine to protect their child, and resources were provided by social worker if needed. ***Results***: Twenty-two parents/caregivers were queried in clinic. Sixty-eight percent of parents/caregivers (n = 15) routinely receive vaccine and plan to do so this season. Thirty-one percent of parents/caregivers (n = 7) gave barriers to vaccination. Of these, 57% (n = 4) did not receive the vaccine because of "side effects", including getting sick from vaccine. Other barriers included one family who did not have insurance and did not know about vaccines, one did not believe in vaccinations, and one did not like shots. ***Discussion***: In addition to dialysis patients receiving annual flu vaccine, we recognized it is equally important for families to be vaccinated. In querying parents/caregivers, the most significant barrier was perceived side effects. In addition to primary providers, we must also provide education in order to better protect patients and families. ***Conclusion***: Education is essential for families, especially around the topic of vaccinations. The responsibility for this usually falls on the primary provider, but our results highlight that vaccination education is important for subspecialists to provide to prevent vaccine-preventable diseases.

Kidney bucks program: Incentivizing compliance in pediatric dialysis patients

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Background/Purpose: Prior to start of Kidney Bucks program, multidisciplinary team of nurses, dieticians, and child life specialists noted that pediatric dialysis patients struggled with compliance in diet and fluid control and record keeping. Child Life proposed incentives, Kidney Bucks, with education to assist in increasing motivation and thus compliance to address these deficiencies. Purpose of this multidisciplinary quality improvement (QI) project was to increase compliance among pediatric hemodialysis (HD) and peritoneal dialysis (PD) patients and their caregivers, focusing on diet and fluid compliance and record keeping. ***Methods***: In February 2015, QI team collaborated with physicians to decide on incentive parameters for phosphorus, potassium, and fluid management. Dialysis dietitian developed and provided ongoing education: one-on-one education, group activities, and teaching skills to appropriately order from a regular diet menu. Data were retrieved through chart audits of labs and clinic visits. ***Results***: Of 38 HD patients, 7 were always compliant with phosphorus; 23 patients experienced 60% improvement. For HD patients, 23 were always compliant with potassium, 7 experienced 18% improvement. In both phosphorous and potassium levels, 8 were not compliant. There was very little behavior change for fluid control in HD patients. Of 19 PD patients, 4 were always compliant with bringing PD fluid/urine, home records and procard; 11 showed 58% improvement. ***Discussion***: Current data demonstrated difficulties dialysis patients have with diet compliance and fluid control. Many did not reach phosphorus goal of 3.5–6, but patients improved. This trend was also true with potassium control. To further educate patients, "Grocery Games" was implemented along with all elements of this QI project. Due to large increase in compliance with record keeping, this focus was removed from project.

Conclusion: The team noted consistent change in behavior when rewards were present.

Comparison of conventional hemodialysis vs. hemodiafiltration on anemia and dose of erythropoietin-stimulating agents in a prospective cohort study

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Background: Anemia is a major clinical problem facing children with chronic kidney disease (CKD). In the 2005 End-Stage Renal Disease (ESRD) Clinical Performance Measures Project, 95% of pediatric patients with ESRD were anemic. The leading causes are erythropoietin and iron deficiency; however, anemia that is hypo-responsive to erythropoiesis-stimulating agents (ESAs) is prevalent in children with CKD and may be, among other factors, related to the high prevalence of inflammation among hemodialysis patients. Recent studies have shown that high-efficiency hemodiafiltration-treated patients have improved renal outcomes, believed to be secondary to the combined use of synthetic biocompatible membranes, ultrapure dialysis fluid, and increased removal of uremic toxins. We hypothesized that hemodiafiltration (HDF) would improve anemia and reduce the dependence on ESAs and iron in our patients on chronic hemodialysis (HD). ***Methods***: In our centre, pediatric patients treated with conventional HD 3 to 6 times per week, lasting 2.5 to 4 hours (average 12 hours per week), were switched to post-dilution HDF. Hemoglobin level, serum iron markers, and dose of darbepoetin and iron were recorded monthly for 3 months while on conventional HD and compared to monthly data collected post-HDF initiation. ***Results***: We included 17 patients in our study: 45% were female and the average age was 12.5 years (range 4–17). The average duration of renal replacement therapy was 9.5 months (range 1–51). Despite a trend toward higher hemoglobin levels with HDF, the results did not meet statistical significance ($P = 0.459$); the same result was noted for serum iron level, transferrin saturation, and iron sucrose intravenous dosing (mg/kg). In addition, the dose of darbepoetin intravenous (mcg/kg/week) was not statistically different ($P = 0.530$). Observational data, however, suggested that patients felt better on HDF. ***Conclusion***: In our single-centre prospective cohort study, changing from conventional HD to HDF did not improve anemia in a statistically significant way; however, there is a trend toward improved outcomes. Future studies are needed with a longer follow up period and larger sample size.

Continuous renal replacement therapy in neonates and small infants: Data from the Carpediem® retrospective registry

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Background: Providing renal support for small infants is challenged by a number of technical issues, including difficulties in achieving an optimal central vascular access and the relatively large extracorporeal blood volume associated with machines developed for adults. We report our experience with continuous renal replacement therapy (CRRT) in neonates and infants using a dialysis machine specifically designed for this age group. ***Methods***: We conducted a retrospective cohort analysis of all patients enrolled within the Carpediem™ registry and treated in 6 Italian centers between January 2012 and December 2015. ***Results***: Twenty-six children received 165 CVVH sessions via a Carpediem™ machine, using a 0.0075 ($n = 10$), 0.15 ($n = 11$) or a 0.25 m^2 ($n = 5$) hemofilter. Median age at CRRT initiation was 1 day (interquartile range [IQR] 1–11), median body weight was 3 kg (IQR 2.1–3.5), and median PRISM II score was 18 (IQR 11–25). Cardiac disease was the most common primary diagnosis (38%) followed by sepsis (15%), inborn errors of metabolism (15%), pulmonary disease (7%), and other. In most patients, CRRT was conducted using a 4 (35%) or a 5 Fr (45%) central vascular access, allowing a median blood flow of 12 ml/min (IQR 9–17) and a median effluent flow rate of 35 ml/kg/h (IQR 28–43). The most common access site was jugular vein (46%) followed by femoral (38%), umbilical (11%), and subclavian (5%) vein. Circuit was primed with normal saline in 58% of patients, while 31% required colloids, and 11% PRBCs. Anticoagulation was obtained with heparin in 72% of treatments, while anticoagulation was not prescribed in the remaining 28% of treatments. Median CRRT duration was 3.5 days (IQR 2–6.8), with a delivered/prescribed time ratio of 91%. The most common causes for "downtime" were clotting (13% of all treatments), vascular access malfunction (7%), and clinical reasons (7%). Twenty-five (96%) patients survived their CRRT course and 13 patients (50%) survived to ICU discharge. Survivors

were more likely to have lower PRISM II 2 scores at ICU admission ($P < 0.05$) and lower percent fluid overload at CRRT initiation ($P = 0.04$). ***Conclusions***: A CRRT machine with low extracorporeal volume and a specifically designed 3 rollers peristaltic pump enables clinicians to provide adequate, safe, and efficient renal support to critically ill neonates and small infants.