

Patients and Machines

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Caroline Helm

Caroline Helm was the first home patient in the United States.

She was a patient of Dr. Belding Scribner at the University of Washington in Seattle Washington.

Caroline was 16 years old when she started on home dialysis in August of 1964. She was assisted by her mother.

She lasted 4 years on dialysis completing high school and 3 years of college.



One of the 1st Home Dialysis Patients

(The picture is from the 1965 Milton Roy Co. Annual Report)

Carlos Clar and his wife dialyze at home in Seattle, WA. The large box on top of the Kill dialyzer is a heparin syringe pump. No blood pump was needed.

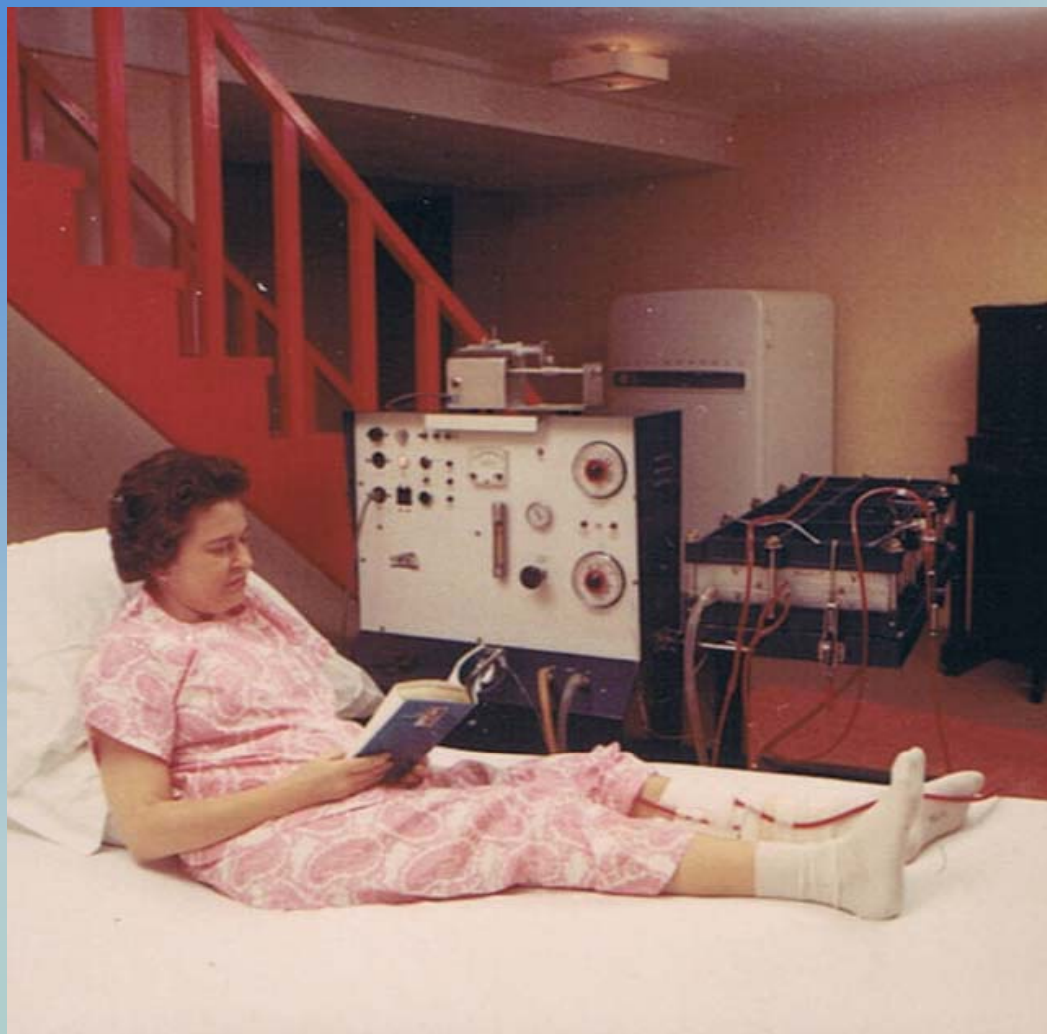
Milton Roy was the 1st company to mass produce dialysis machines. This one was called the Model A.



Patient dialyzing on a Model B

The Model B was the second generation of machines from the Milton Roy Company.

This patient has the machine controls within her reach. Notice the venous drip chamber mounted on the side of the Kill Dialyzer. The heparin pump has been reduced in size.



Patient dialyzing on a Model B

One of the requirements for home dialysis was the need to have plenty of storage space. This patient is dialyzing in her basement.



Dialysis Frequency Effect on Standard Kt/V (Patient Parameters)

- No residual renal function
- End of treatment patient weight = 85 kg
- Patient height = 178 cm
- Patient age – 60 years
- Weight loss per week = 4.0 kg
- Weight loss per treatment = $4.0 \text{ kg} \div \text{Tx per week}$
- Single pool Kt/V for the week = 3.9
- Individual treatment Kt/V = $3.9 \div \text{Tx per week}$
- 3 Standard Kt/V (stdKt/V) calculations:
 - Leypoldt Fixed-volume Standard Kt/V
 - FHN UF-corrected Standard Kt/V
 - SAN (surface-area-normalized) Standard Kt/V

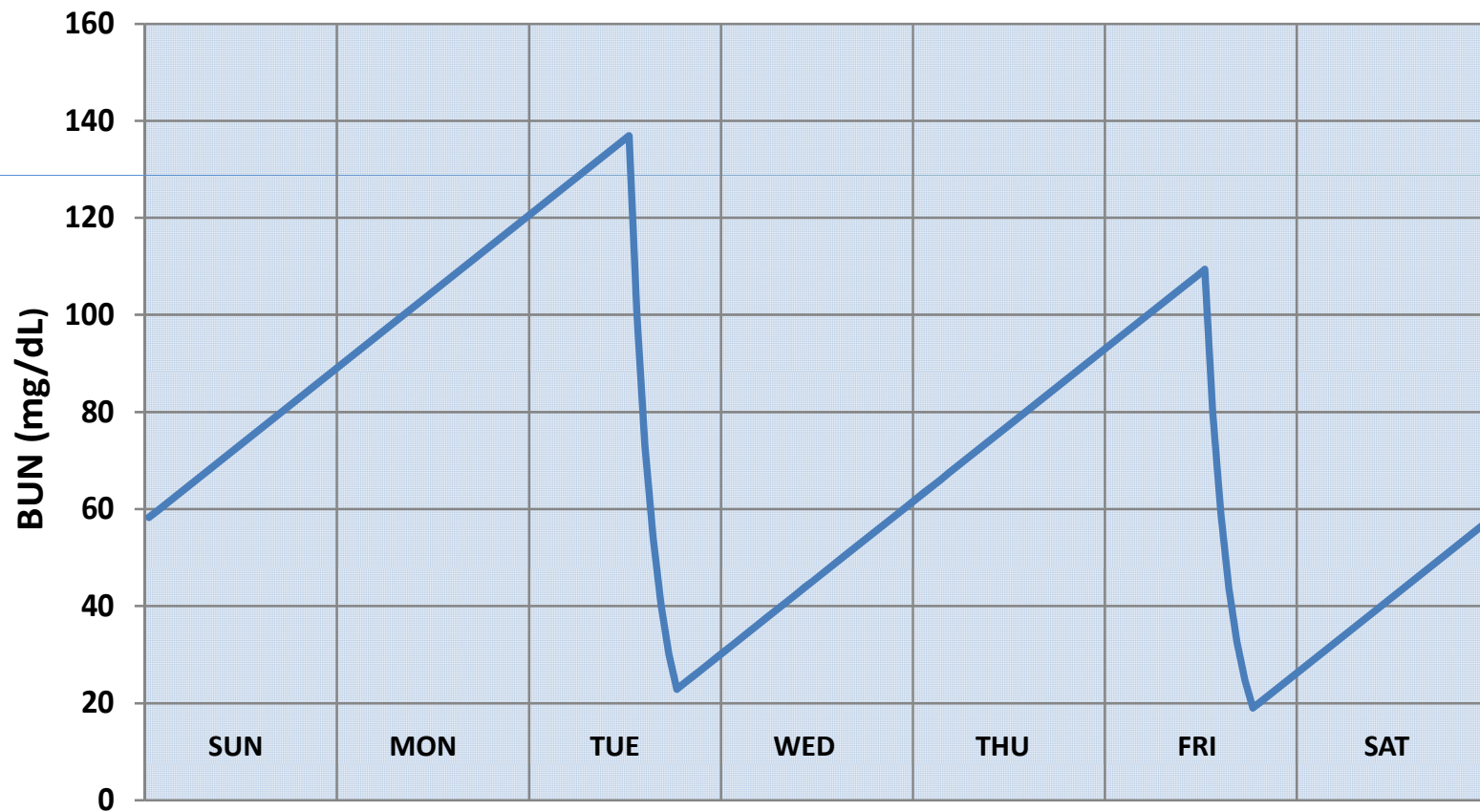
www.hdcn.com/calcf/ley.htm

Kt/V vs. Standard Kt/V (stdKt/V)

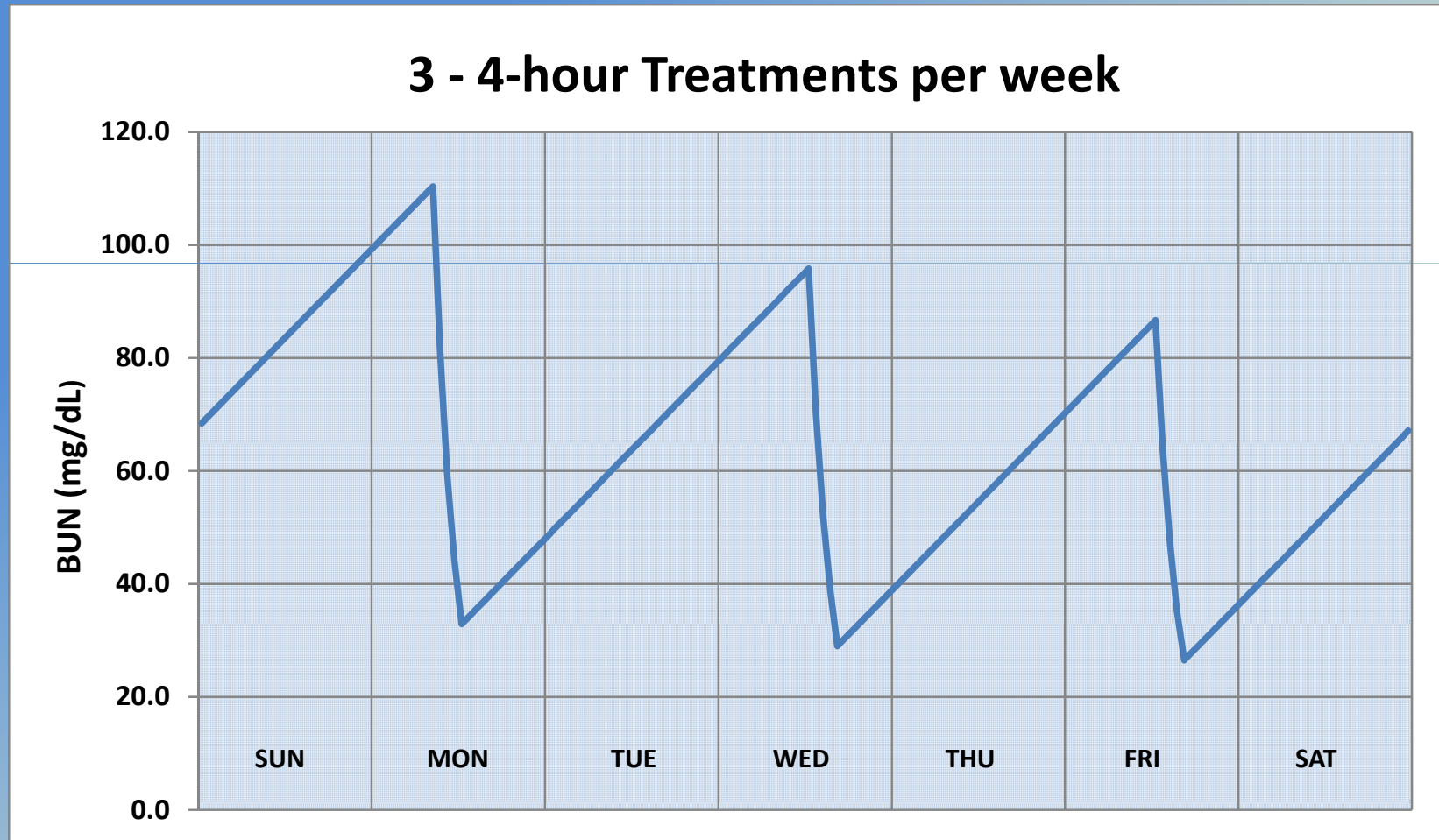
- Kt/V used to model a single treatment to estimate a urea reduction ratio
- spKt/V is referred to as “single pool” Kt/V which assumes all patient fluids are readily available for dialysis
- Standard Kt/V is used to model urea over multiple treatments for an entire week.
- Standard Kt/V can be used to compare different dialysis therapies

Patient Toxin Fluctuations over one Week

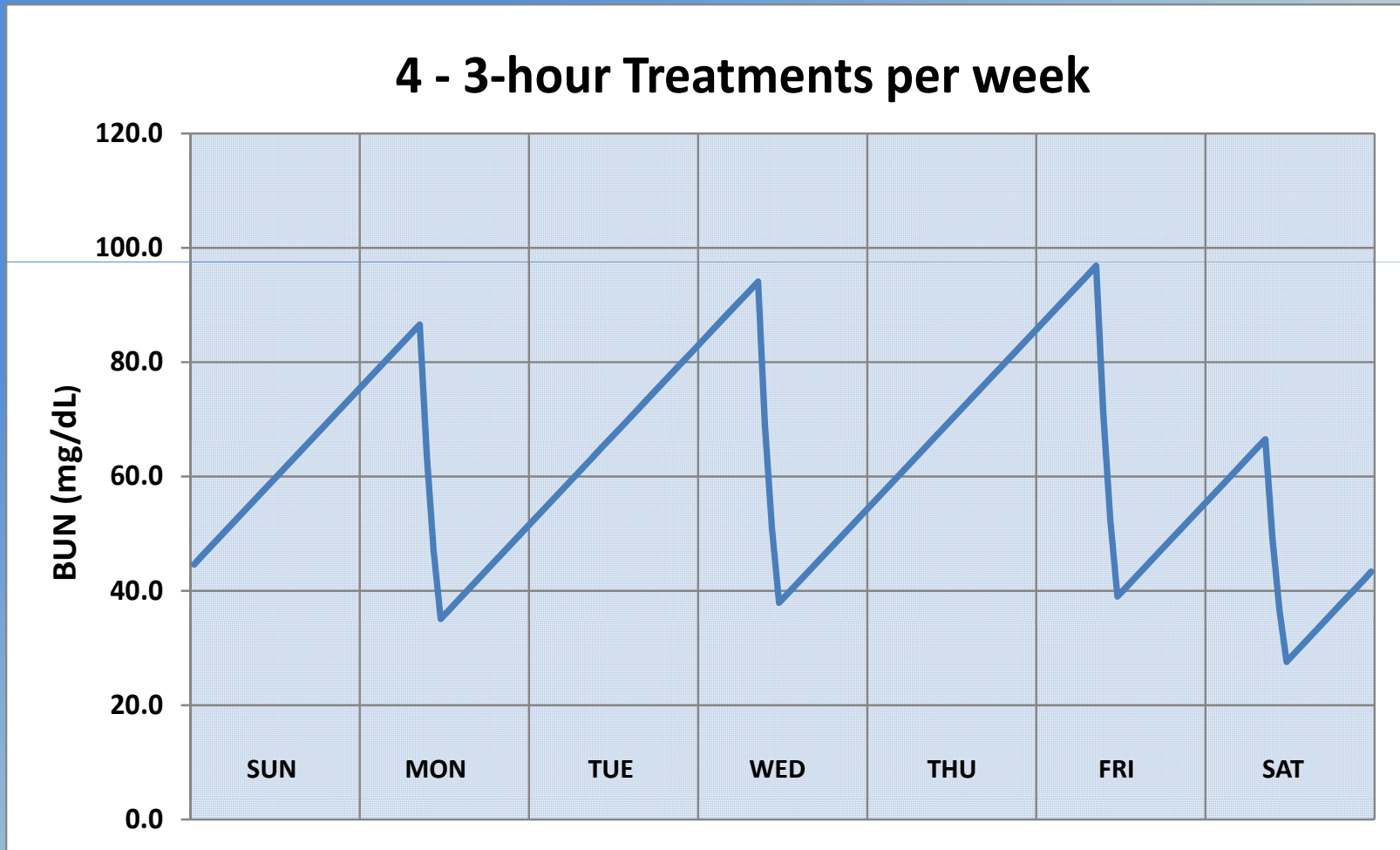
2 - 6-hour Treatments per week



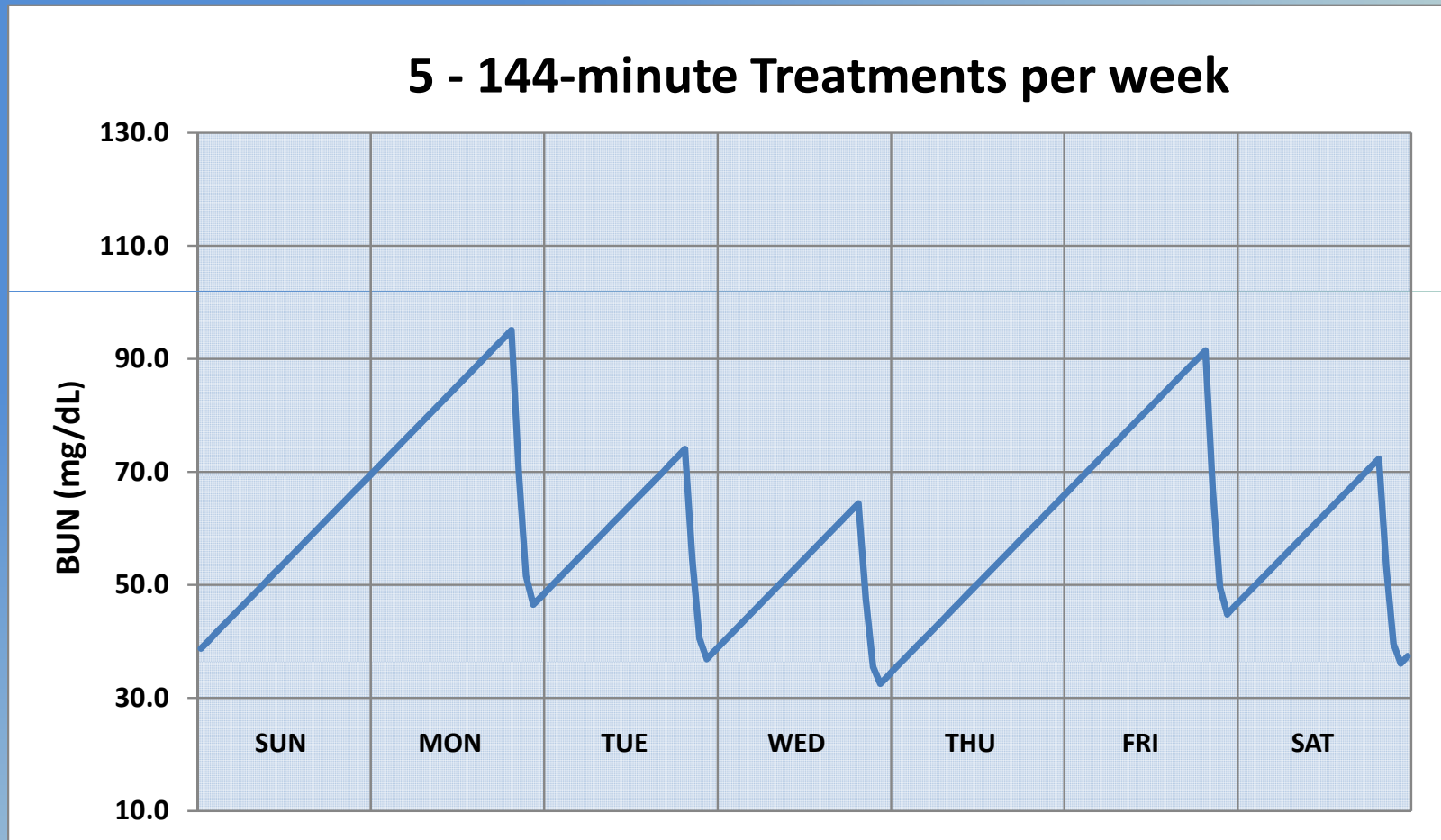
Patient Toxin Fluctuations over one Week



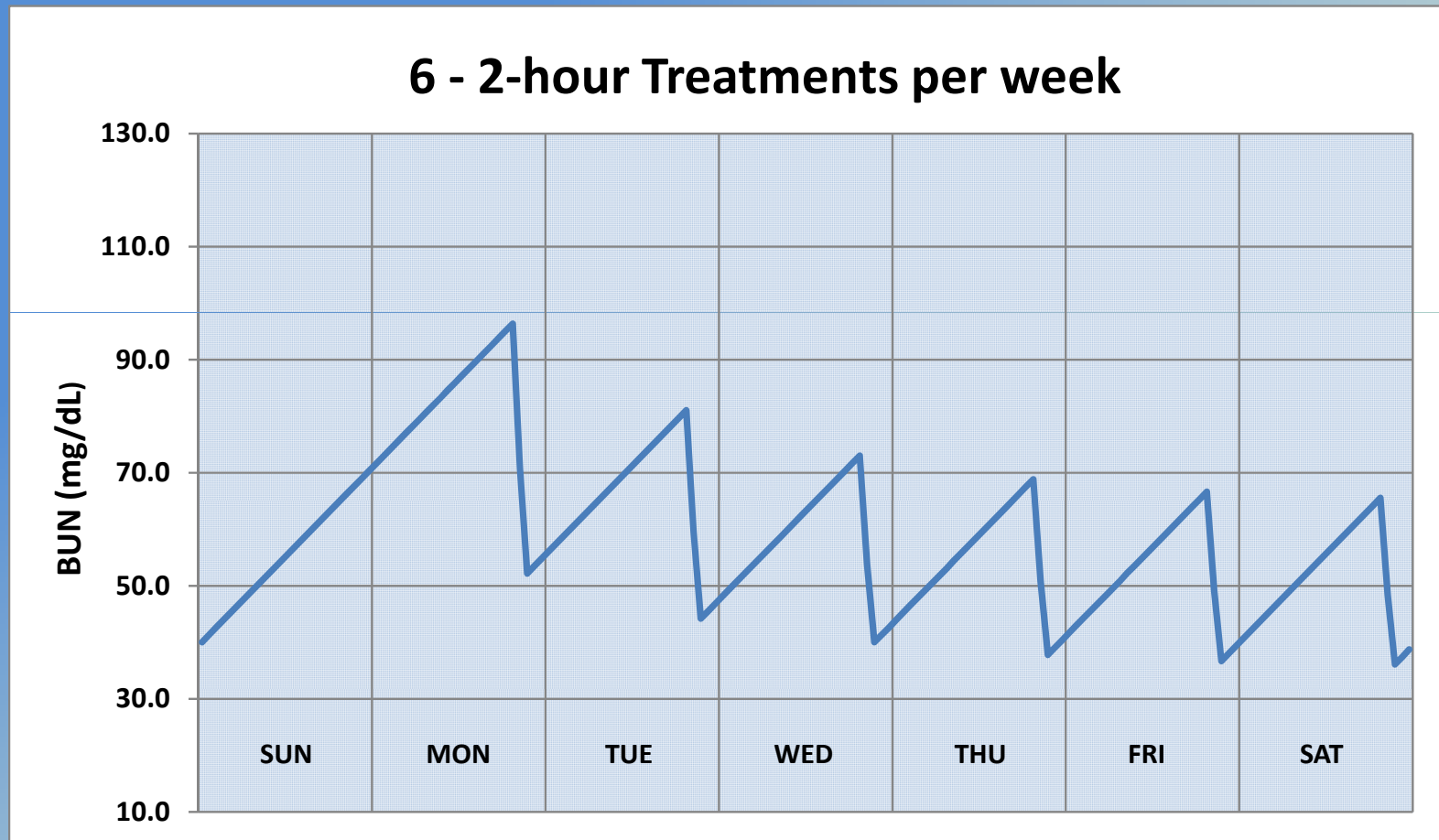
Patient Toxin Fluctuations over one Week



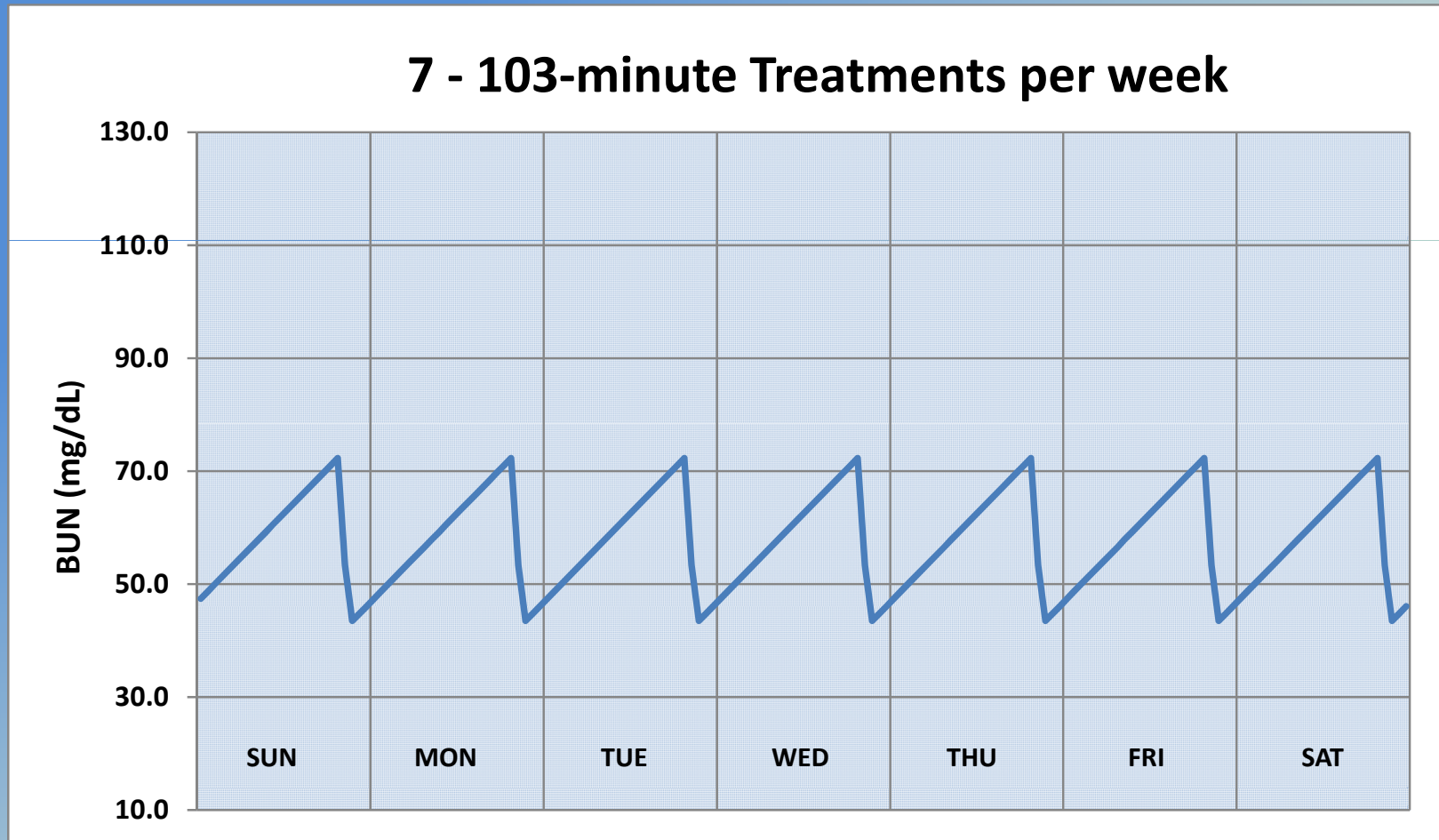
Patient Toxin Fluctuations over one Week



Patient Toxin Fluctuations over one Week



Patient Toxin Fluctuations over one Week



Statistics by Treatments per Week

(All values in mg/dL)

	2X	3X	4X	5X	6X	7X
TIME AVERAGE UREA CONCENTRATION	71.8	63.6	61.3	60.1	59.2	57.7
STANDARD DEVIATION	31.4	21.2	17.1	15.0	13.5	8.5
HIGHEST VALUE	136.9	110.34	96.85	95.05	96.36	72.29
LOWEST VALUE	19	26.5	27.6	32.5	36.1	43.47
RANGE	117.9	83.84	69.25	62.55	60.26	28.82

Your next home dialysis machine?

- Sophisticated technology benefiting the quality of treatment
- Treatment adjustments very easy and clear on computer display
- Short preparation time (15 min) before treatment
- Short, simple “finishing up” time after treatment
- Blood tubing and dialyzer can be reused 30x
- Very little room needed for supplies
- Minimal waste

Aksys PHD

The first of the “new age” home dialysis machines.

The design centered on simplifying the overall performance of the treatment by the operator.

Reuse of the bloodlines and dialyzer was automated.

The instrument cost was higher than an in-center machine.

In the end, the sophistication of the machine resulted in a low mean time between failures.

Aksys Inc. shut down in January of 2007



Another home dialysis machine

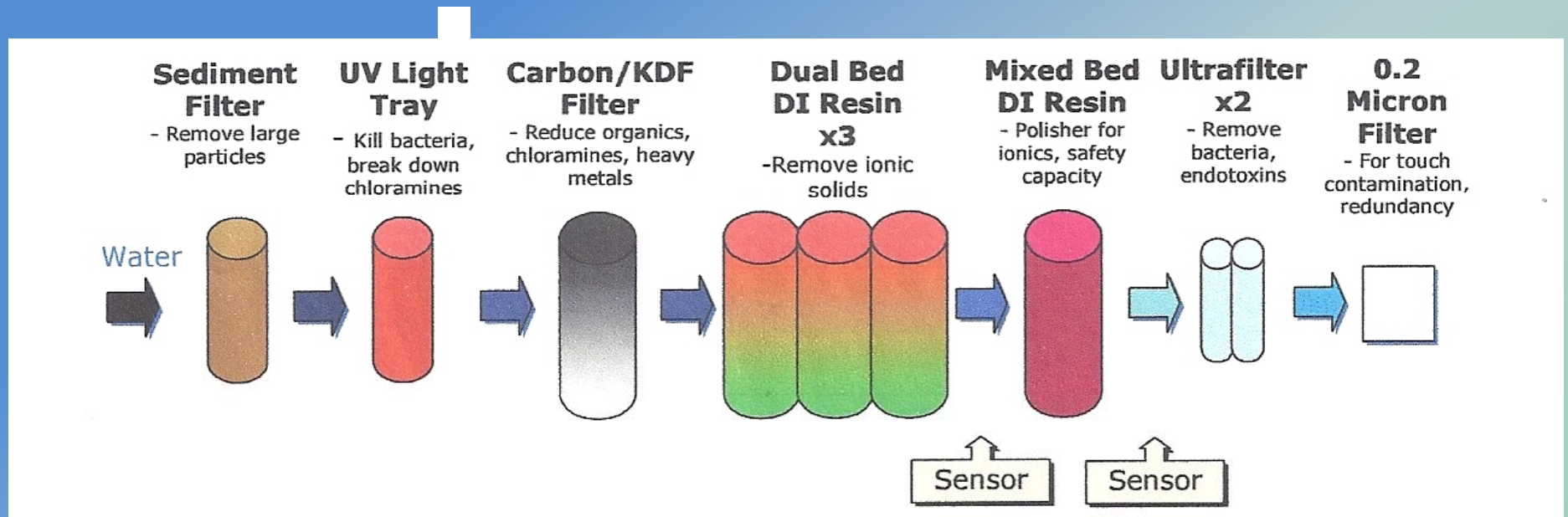
- Easy to use
- Small and portable (75 lbs)
- No special electrical connections
- No special plumbing modifications
- Disposables are single use
- Sterile dialysate available in prepackaged bags
- 100% of source water used for dialysate

NxStage[®] System One with PureFlow[™] SL



http://www.nxstage.com/chronic_renal_care/products/index.cfm

NxStage® PureFlow™ SL Process



Dialysate Preparation Primer – Chronic Hemodialysis with the NxStage® PureFlow™ SL

Addressing Hyperphosphatemia using NHD and SDHD

- Phosphate in the body
 - Normal person intake = 1000 to 2000 mg/day
 - ESRD person intake = 550-1100 mg/day
 - Normal person's absorption = 60%
 - ESRD person's absorption = 50%
 - 80% in the presence of Vitamin D
 - 40 % in the presence of phosphate binders
 - Removal by dialysis needs to be about 1925 – 3850 mg/week
 - Phosphate location:
 - Bones + teeth = 19,000 mmol (85%)
 - Soft tissues = 3,200 mmol (14%)
 - Interstitial fluid = 10 mmol (0.05%)
 - Blood plasma = 3.5 mmol (0.02%)

Koolenga L., *Phosphorus Balance with Daily Dialysis*, Seminars in Dialysis, Vol 20, no. 4, July/August 2007, pp. 342-345

Phosphate removal by Dialysis

- Standard thrice-weekly 4 hr Tx = 1800-3600 mg/week
- Most of the phosphate is removed during the first hour
- SDHD and NHD provide more time for removal
- Study: 17 patients on CHD switch to SDHD

	Phosphorus Intake (mg/day)	Serum Phosphorus (mg/dL)	Phosphate Binder use (g/week)
CHD	1085 ± 326	6.16 ± 1.64	40.1 ± 37.0
SDHD	1267 ± 351	5.94 ± 1.51	24.9 ± 21.9

Galland R., Treger J.; *Short daily hemodialysis and nutritional status in patients with chronic renal failure*; Seminars in Dialysis Vol 17: pp. 104-108, 2004

Study: 8 CHD patients vs. 8 NHD patients

- Phosphate removal
 - NHD = 4,985 ± 1827 mg/week
 - CHD = 2,347 ± 697 mg/week
- Serum Phosphorus
 - NHD = 4.0 mg/dL
 - CHD = 6.5 mg/dL
- NHD patients increased their phosphate intake from 775 mg/day up to 1,400 mg/day
- At 4 months, all NHD patients had stopped taking phosphate binders (CHD average = 2.4 g/day)
- The NHD patients when on CHD had averaged 2.4 g/day

Mucsi I, et al.; *Control of serum phosphate without any phosphate binders in patients treated with nocturnal hemodialysis*; *Kidney International* 53: pp. 1399-1404, 1998

Patient Study: 51 CHD patients vs. 26 SDHD

- SDHD = 3 hour sessions, 6 times per week
- Serum Phosphate results (SDHD)
 - Baseline = 6.26 ± 2.57 mg/dL
 - At 6 months = 4.58 ± 1.06 mg/dL
 - At 12 months = 4.20 ± 1.16 mg/dL
- Serum Phosphate results (CHD)
 - Baseline = 4.98 ± 1.49 mg/dL
 - At 12 months = 5.02 ± 1.15 mg/dL
- Study found improved phosphorus level was an independent predictor of reduction in left ventricular mass index

Ayus JC, et al.; Effects of short daily versus conventional hemodialysis on left ventricular hypertrophy and inflammatory markers: A prospective controlled study; J AM Soc Nephrol 16: pp. 2778-2788; 2005

Addressing Venous Needle Dislodgement

- Redsence Medical Inc.
- Received FDA clearance for it's device for home/self use for HHD in the US
- Consists of a sensor patch and an alarm unit
- Infrared light used with fiber optic cable to detect bleeding
- When blood leak occurs, blood blocks the infrared light creating an alarm

www.redsencemedical.com



Promoting Successful Home Dialysis

- Offer hope
 - There are a variety of treatment options
 - Think about dialyzing at home
 - Talk about successful patients
- Learn Patient Priorities
 - What's most important to them?
- Discuss lifestyle advantages of HHD
 - Think freedom, convenience, effectiveness, simplicity
- Find patient mentors
- Support Care Partners
 - Have the patient do as much as possible for themselves

Schatell D., *Five Practical Steps YOU Can Take to Promote Successful Home Dialysis*, Dialysis & Transplantation, Vol 39, No 8, August 2010 pp. 326-327

Christopher Blagg on treatment choices

(in increasing order of benefit)

- In-center thrice-weekly four hour treatments
- Peritoneal Dialysis
- Thrice-weekly overnight HD in a facility
- Thrice-weekly HD at home, preferably overnight
- Alternate night overnight HD at home (6-8 hours)
- 5/6 times per week short HD at home (2-3 hours)
- 5/6 times per week overnight HD at home

“It is certainly significant that when asked what treatment they would prefer for themselves if they had kidney failure (and a transplant was not feasible) most nephrologists would opt for home HD five or six nights a week”

Why I like Nocturnal Dialysis

David Lockwood

- Previously doing in-center HD (3x/wk., 3.5 hr, QB = 500 mL/min)
- Switch to in-center NHD (3x/wk., 8 hr, QB = 350-400 mL/min)
- Noted improvements
 - Recovery time was 1.5-2 hr; now almost nil
 - Sense of well being as high as its been in many years
 - Potassium and Phosphorous was 5.0-5.5 mg/dL; now 3.0-4.0 mg/dL
 - Eating better – Albumin up from 4.2-4.5 g/dL to 4.7-5.2 g/dL
 - Better time management – has his own business
- Disadvantages
 - Gaining too much fluid (knows he will dialyze 8 hr without complications)
 - Sleeping on dialysis

Patient Quotations

Patient doing in-center nocturnal HD 3x per week after starting with conventional in-center 4 hour HD

“ I have been given that chance for normalcy again. For this I am thankful. I have returned to the workplace during these 8 years, and I appreciate every day that is given to me.”

“ Life has not ended for me; it has just begun. It’s wonderful to be living in a time when we have the opportunity to choose from several options for the treatment of CKD.”

Diana Headlee Bell