Sengkang General Hospital
SingHealth

Nurse Led Adequacy Workshop

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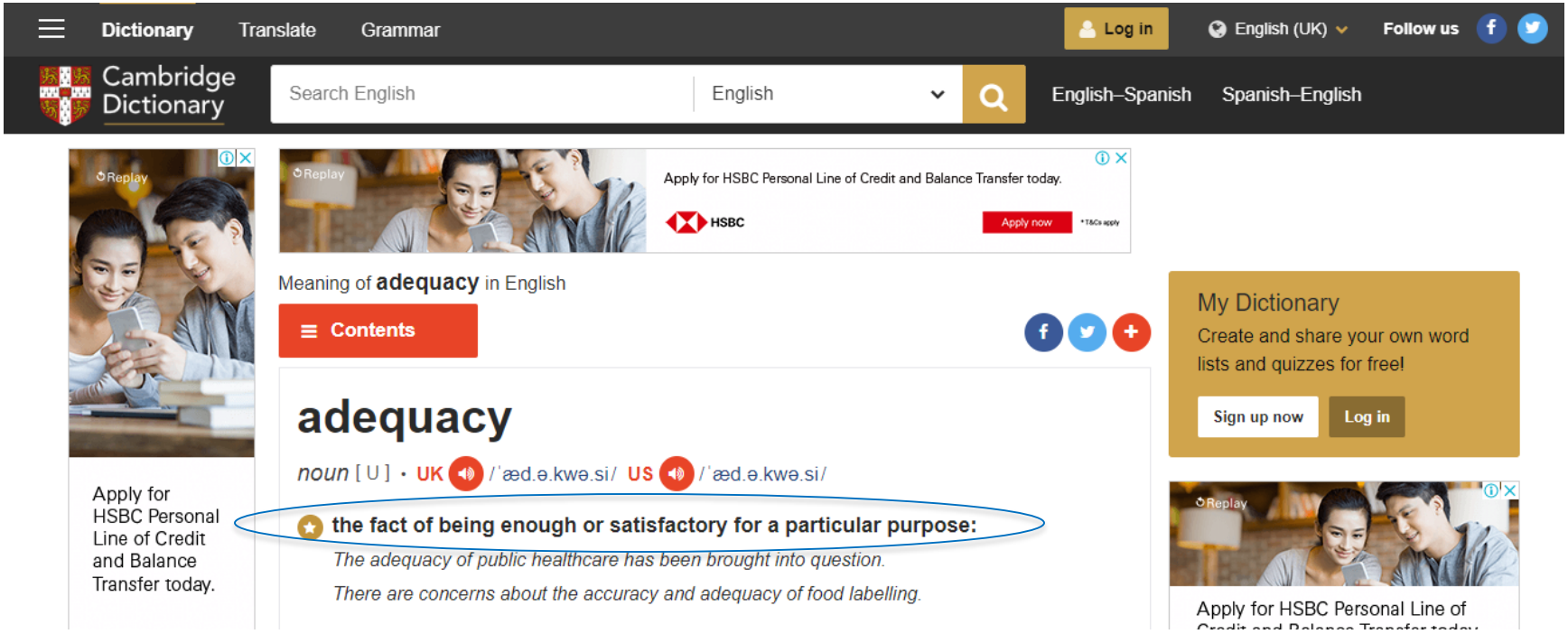
19/7/19

For SOTANC 2019

Better Health Together

What is Adequacy?



- Adequacy is from a Latin adaequare : to equalize
- To cleanse blood and biological fluids to a degree comparable to normal renal function

Adequacy in Hemodialysis

Clinical

- Nutrition
- Control of anemia, acidosis
- Control of bone disease
- BP control
- Relief of uremic symptoms
- Quality of Life

Adequacy in Hemodialysis

REVIEW

The Use of a Multidimensional Measure of Dialysis Adequacy—Moving beyond Small Solute Kinetics

Jeffrey Perl, Laura M. Dember, Joanne M. Bargman, Teri Browne, David M. Charytan, Jennifer LaTonya J. Hickson, Adriana M. Hung, Michel Jadoul, Timmy Chang Lee, Klemens B. Meyer, Ha Isaac Teitelbaum, Leslie P. Wong, and Christopher T. Chan, and on behalf of the American Socie Advisory Group

Abstract

Urea removal has become a key measure of the intensity of dialysis treatment for kidney removal, exemplified by Kt/V_{UREA} has been broadly applied as a means to quantify the do hemodialysis. Yet, the reliance on small solute clearances alone as a measure of dialysis quantify the intended clinical effects of dialysis therapy. This review aims to (1) understa limitations of small solute kinetics as a surrogate marker of dialysis dose, and (2) present comprehensive construct for dialysis dose, one that considers more broadly the goals of ESR quality of life and survival. On behalf of the American Society of Nephrology Dialysis Advis the need to ascertain the validity and utility of a multidimensional measure that moves beyo alone to quantify optimal dialysis derived from both patient-reported and comprehensiv related measures.

Clin J Am Soc Nephrol 12: 839–847, 2017. doi: https://doi.org/

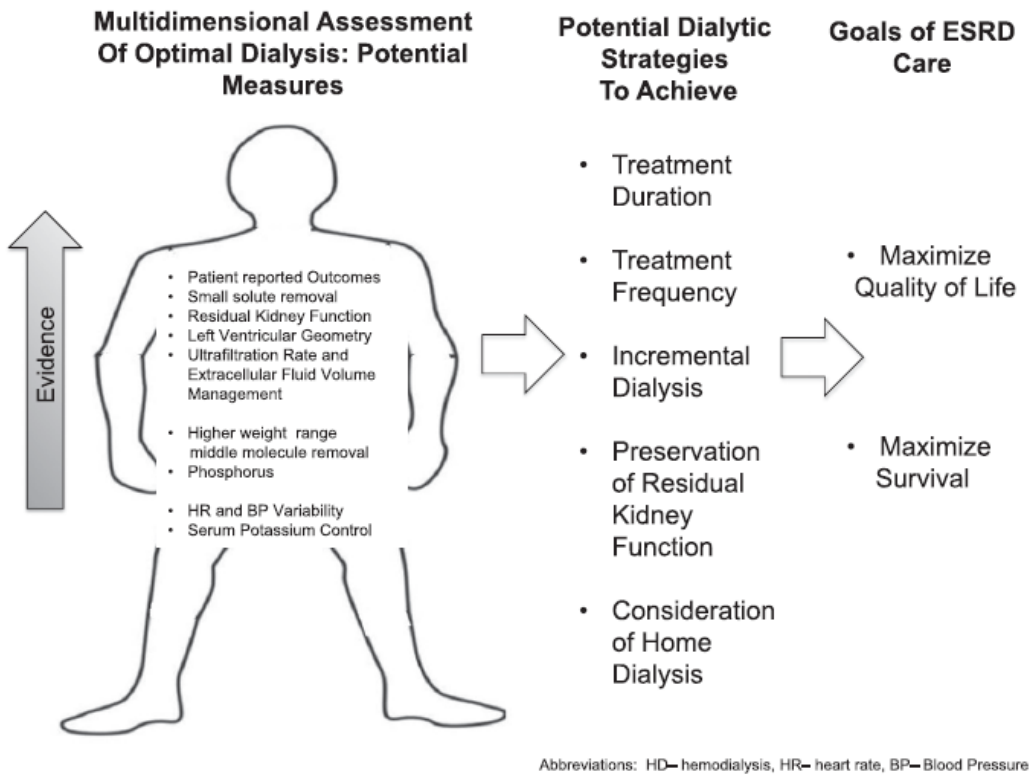
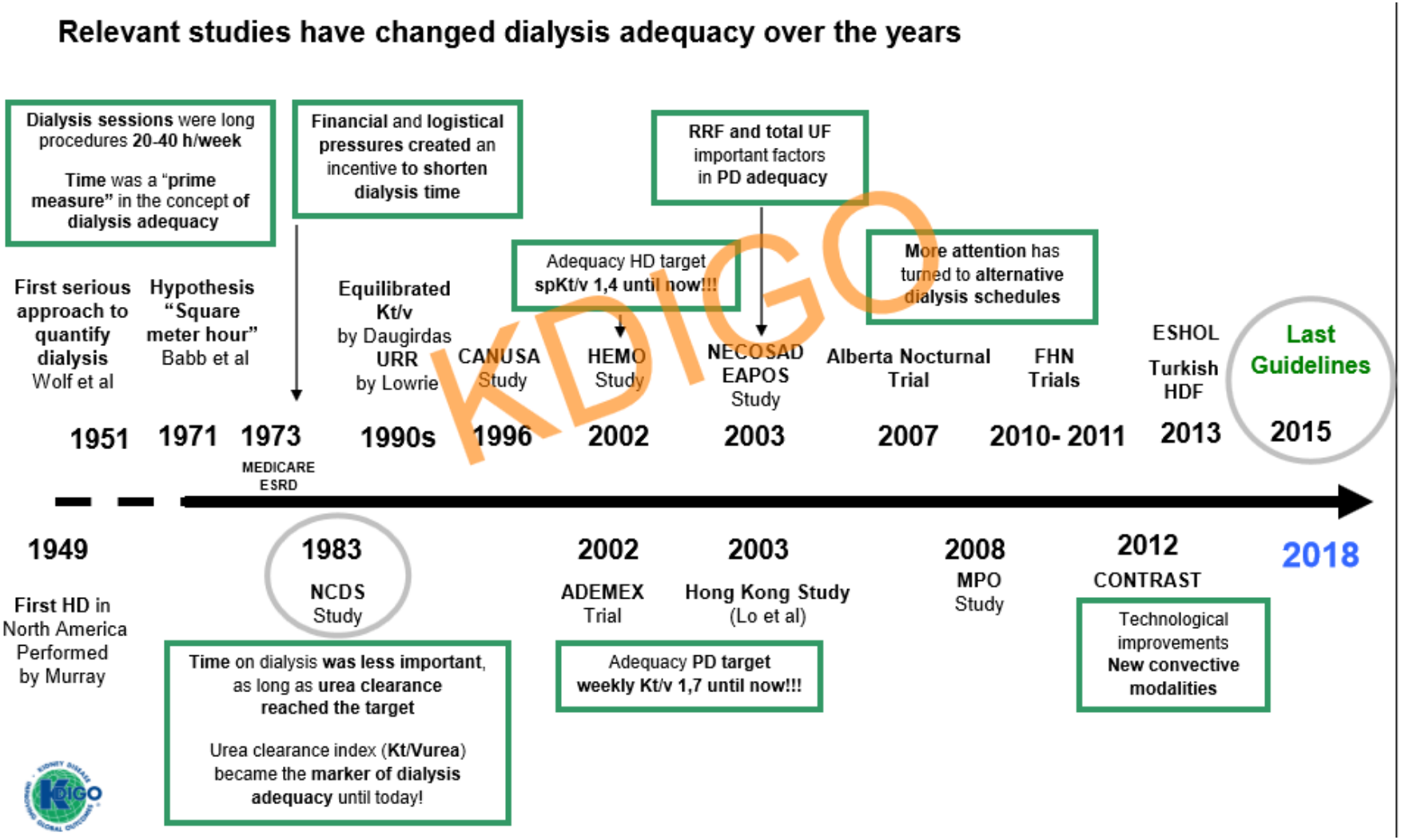


Figure 1. | Multidimensional Measure of Dialysis. HR, heart rate.

Dialysis Studies



Dialysis Studies

- National Cooperative Dialysis Study (NCDS) in 1981 compared post dialysis urea level (low vs high) and duration of dialysis (3 vs 4.5 hours)
- Sargent & Gotach then established that urea kinetic modelling as the accepted method of measuring solute clearance after
- They suggested a minimal dose of dialysis is required and concluded that patient morbidity and treatment failure are related to dialysis dose

Dialysis Dose Monitoring

NKF KDOQI GUIDELINES

Clinical Practice Guidelines and Clinical Practice Recommendations
2006 Updates
Hemodialysis Adequacy
Peritoneal Dialysis Adequacy
Vascular Access

I. CLINICAL PRACTICE GUIDELINES FOR HEMODIALYSIS ADEQUACY

GUIDELINE 2. METHODS FOR MEASURING AND EXPRESSING THE HEMODIALYSIS DOSE

Quantifying HD is the first step toward assessment of its adequacy. Fortunately, the intermittent rapid decrease in urea concentration during HD allows a relatively easy measurement of the dose.

2.1 The delivered dose of HD should be measured at regular intervals no less than monthly. (A)

2.2 The frequency of treatments should be included in the expression of dose. (A)

2.3 The dose of HD should be expressed as $(K_{urea} \times T_d)/V_{urea}$ (abbreviated as Kt/V), where K_{urea} is the effective (delivered) dialyzer urea clearance in milliliters per minute integrated over the entire dialysis, T_d is the time in minutes measured from beginning to end of dialysis, and V_{urea} is the patient's volume of urea distribution in milliliters. (B)

- Numerous outcome studies have shown a correlation between delivered dose of HD and patient mortality and morbidity
- To ensure that patients receive adequate treatments, delivered dose of dialysis must be measured
- Clinical signs and symptoms alone are not reliable indicators of dialysis adequacy

Dialysis Dose Monitoring

- Urea is commonly used as the marker of small molecules
- Recommended biochemical indices of dialysis includes
  1. KT/V
  2. Urea Reduction Ratio (URR)

Urea Reduction Ratio (URR)

Mr Lim's pre dialysis urea is 60 mg/dL and his post dialysis urea is 18 mg/dL.

Calculate Mr Lim's Urea Reduction Ratio (URR)

- Pre Dialysis Urea – Post Dialysis Urea divided by Pre Dialysis Urea multiply by 100

$$URR = \frac{U_{pre} - U_{post}}{U_{pre}} \times 100\%$$

➢ Hence(60 − 18)/60 = 42/60 X100 = 70%

Urea Reduction Ratio (URR)

- URR stands for urea reduction ratio, meaning the reduction in urea as a result of dialysis
- The URR is one measure of how effectively a dialysis treatment removes waste products from the body and is commonly expressed as a percentage

Urea Reduction Ratio (URR)

- KDOQI HD Adequacy Guideline:2006
  - ➢Incorporate URR into the guideline
  - ➢spKt/V 1.2=URR 65%/ spKt/V 1.4=URR 70%
- Limitation
  - ➢Does not account for the contribution of UF to dialysis dose

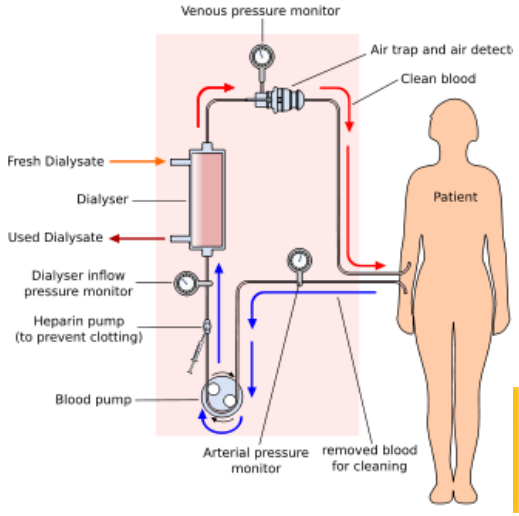
Blood Urea Sampling Methods

- Blood urea sampling methods
  1. Slow Flow Method
  2. Stop Dialysis Flow Method
- Pre & Post HD (during the same session)
- Before a mid-week HD session
- Once every 1-3 months

Blood Urea Sampling Methods

Slow Flow Method

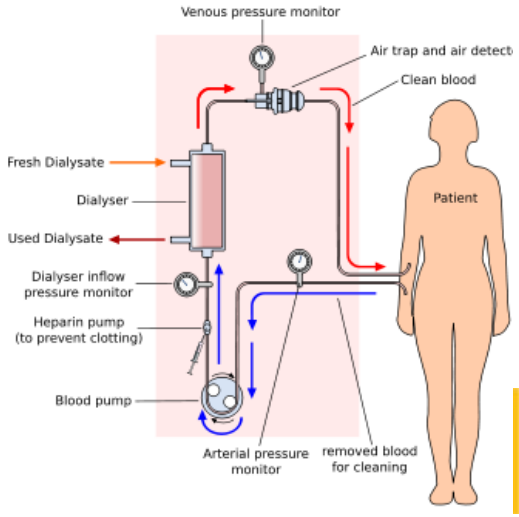
- Set UF Rate to 0
- At the end of the dialysis time turn the blood pump speed down to 100 ml per min
- Override alarms to keep blood pump operating.
- Wait 15–30 seconds and take samples from the “arterial” line sampling port



Blood Urea Sampling Methods

Stop Dialysis Flow Method

- At the end of the dialysis time stop dialysate flow but keep the blood pump running
- After 5 minutes with no dialysate flow take a blood sample from anywhere in the blood circuit



Kt/V

- In 1985, Sargent & Gotach proposed a mathematical model called Kt/V to quantify dialysis dose and dialytic removal of urea
- It's a measurement of solute removal during dialysis
- What does these alphabets represent?

Kt/V

Where

- K = dialyzer urea clearance (L/h or ml/min)
- t = time (h or min)
- V = distribution volume of urea (L or ml)

Volume of plasma cleared of urea

Total body water

Kt/V

- Small-solute clearance is currently considered the best measure of adequacy
- Kt/V is the fractional urea clearance
- A dimensionless ratio (no units)
- The most precise and tested measure of the dialyzer effect on patient survival
- Most frequently applied measure of the delivered dialysis dose

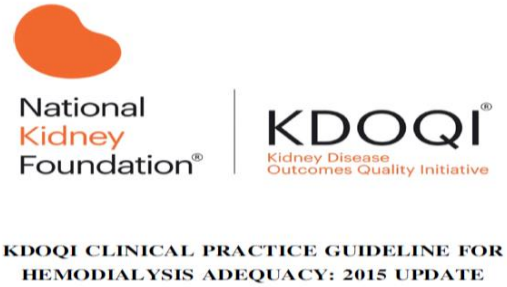
Kt/V

Newer methods of Kt/V monitoring

- Online Clearance Methods (OCM)
- Using conductivity variations
- Hemodialysis machines are equipped with monitoring KT/V
- Without the need of additional laboratory test
- Not been validated in large scale studies
- Useful for monitoring and guiding initial prescription but will still require calculated KT/V or URR

Kt/V Targets

KDOQI HD Adequacy Guidelines 2015



Guideline 3: Measurement of Dialysis: Urea Kinetics

3.1 We recommend a target single pool Kt/V (spKt/V) of 1.4 per hemodialysis session for patients treated thrice weekly, with a minimum delivered spKt/V of 1.2. (1B)

Kt/V Targets

National Cooperative Dialysis Study (NCDS)

- Established that patients dialysed to a low average weekly blood urea level fared better than those whose dialysis was less intense and whose average urea levels were higher

Gotch and Sargent

- Introduced the concept of Kt/V
- Based on the NCDS study they found that a Kt/V of less than 1.0 is associated with increased mortality in dialysis patients
- Did not demonstrate any benefit from increasing the Kt/V beyond
- If we accept a Kt/V of 1.0 (URR 60%) as a minimum standard, we should target a Kt/V of 1.2 (URR 65%) to ensure that this minimum is achieved

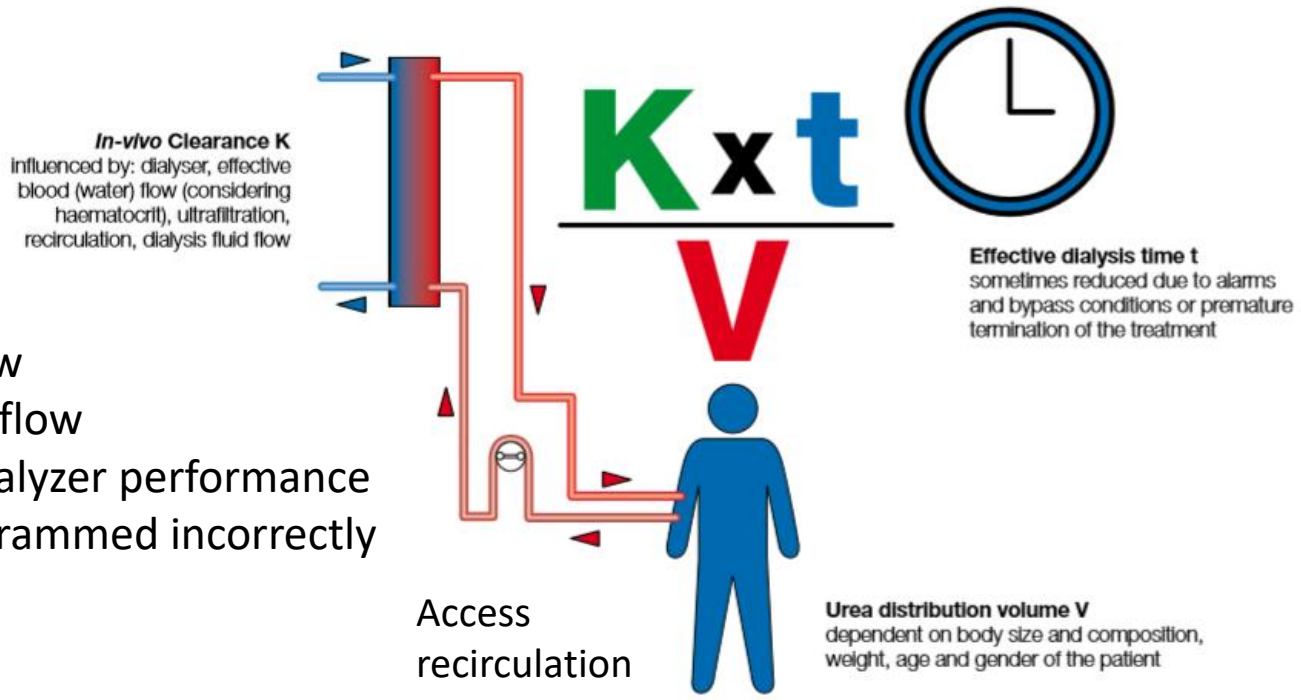
Kt/V Targets

HEMO study (2002)

- Conducted in the US, examined whether increasing the dialysis dose improved mortality as well as examining the difference in mortality of low- and high-flux membranes
- They found that neither an increased dose beyond spKt/V of 1.32 nor the use of high flux membrane substantially improve survival

Kt/V

- Possible Causes of low Kt/V



- Low blood flow
- Low dialysate flow
- Inadequate dialyzer performance
- Machine programmed incorrectly

FMC, Online Clearance Monitoring Assuring the Desired Dose of Dialysis

Kt/V

Ways to improve Kt/V:

Address the prescription

- Increase blood flow rates
- Increase dialysate flow rates
- Better dialyzer clearance
- Increase dialysis time
- Increase dialysis frequency
- Increase needle size
- Ensuring adequate anticoagulation

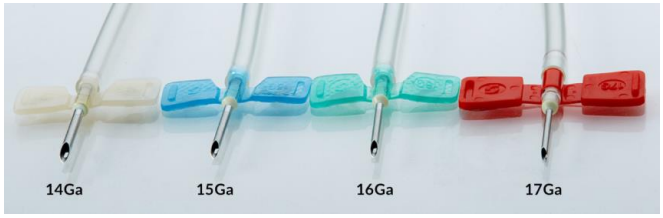
Kt/V

Needle Size & Blood Flow Rates

Table 1. Matching gauge and blood flow rate

Blood flow rate (BFR)	Recommended needle gauge
<300 ml/min	17 gauge
300–350 ml/min	16 gauge
>350–450 ml/min	15 gauge
>450 ml/min	14 gauge

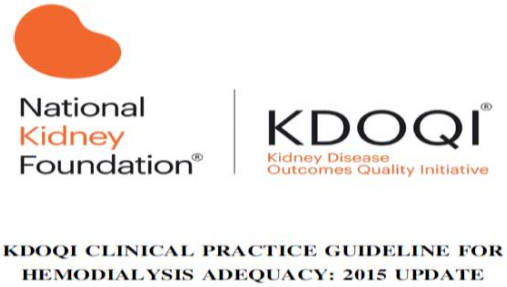
Note: It is important to match needle gauge to blood flow rate. These are minimum recommended gauges for the stated BFR settings. Larger needles, when feasible, will reduce pre-pump arterial pressure and increase delivered blood flow.



Clinical update: Needles and cannulas for arteriovenous fistula access: More options promote better outcomes, National Kidney Foundation, 2016

Dialysers

KDOQI HD Adequacy Guidelines 2015



Guideline 5.1

We recommend the use of biocompatible, either high or low flux hemodialysis membranes for intermittent hemodialysis. (1B)

Frequent In Center Dialysis

National Kidney Foundation® | KDOQI® Kidney Disease Outcomes Quality Initiative

KDOQI CLINICAL PRACTICE GUIDELINE FOR HEMODIALYSIS ADEQUACY: 2015 UPDATE

Guideline 2:

Frequent and Long Duration Hemodialysis In-center

2.1 We suggest that patients with end-stage kidney disease be offered in-center short frequent hemodialysis as an alternative to conventional in-center thrice weekly hemodialysis after considering individual patient preferences, the potential quality of life and physiological benefits, and the risks of these therapies. (2C)

2.2 We recommend that patients considering in-center short frequent hemodialysis be informed about the risks of this therapy, including a possible increase in vascular access procedures (1B) and the potential for hypotension during dialysis. (1C)

Frequent In Center Dialysis

- Statements are based on the FHN trial

Table 7. Summary: Randomized Trials of More Frequent HD

Trial Name	HD Intervention	Frequency (d/wk)	Time (h/session)	Qb (mL/min)	Qd (mL/min)
FHN Daily[9]	Short frequent in-center	5.2 ± 1.1	2.57 ± 0.42	396 ± 42	747 ± 68
	Conventional	2.9 ± 0.4	3.55 ± 0.47	402 ± 41	710 ± 106
FHN Nocturnal[10]	Long frequent at home	5.1 ± 0.8	6.32 ± 1.03	262 ± 61	354 ± 106
	Conventional	2.9 ± 0.2	4.26 ± 1.08	350 ± 49	554 ± 126
Alberta Nocturnal[11]	Long frequent at home	5 to 6	≥6 h prescribed	≤250 prescribed	~300 mL/min prescribed
	Conventional	3	Not reported	Not reported	Not reported

Note: Except for the Alberta Nocturnal trial, values given as mean ± standard deviation.
Abbreviations: FHN, Frequent Hemodialysis Network; HD, hemodialysis; Qb, blood flow rate; Qd, dialysate flow rate.

- Two co-primary outcomes were compared
  1. Composite of death or change in left ventricular mass
  2. Death or health-related quality of life, as well as 9 prespecified secondary surrogate outcomes

Frequent In Center Dialysis

- Frequent hemodialysis, as compared with conventional hemodialysis, was associated with favorable results
- However was found to have more frequent interventions related to vascular access needed

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