Hemodialysis Prescription & Adequacy

Hemodialysis University
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Disclosure Statement

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I have no involvement with industry (i.e. grants or research support, employee, consultant, expert witness, major stockholder, member of speaker's bureau or advisory boards, etc.) that might give a perception of bias in my presentation.
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Workgroup disclosure:
All members of the Work Group are required to complete, sign, and submit a disclosure and attestation form showing all such relationships that might be perceived as or actual conflicts of interest. This document is updated annually and information is adjusted accordingly.

Strength of the recommendation

Level 1
“We recommend”
Most patients should receive the recommended course of action

Level 2
“We suggest”
Different choices will be appropriate for different patients. Each patient needs help to arrive at a management decision consistent with her or his values and preferences.

Grade of the evidence

Grade A: High quality of evidence. We are confident that the true effect is close to that of the estimate of the effect.

Grade B: Moderate quality of evidence. The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Grade C: Low quality of evidence. The true effect may be substantially different from the estimate of the effect.

Grade D: Very low quality of evidence. The estimate of effect is very uncertain and often will be far from the truth.

Not graded: Typically included to provide guidance based on common sense, where adequate evidence is lacking.


Guideline Categories

1. Timing of Hemodialysis Initiation
2. Frequent and Long Duration Hemodialysis
4. Volume and Blood Pressure Control: Treatment Time and Ultrafiltration Rate
5. New Hemodialysis Membranes
Guideline 1: Timing of Hemodialysis Initiation

1.1 Patients who reach CKD stage 4 (GFR < 30 mL/min/1.73 m²), including those who have imminent need for maintenance dialysis at the time of initial assessment, should receive education about kidney failure and options for its treatment, including kidney transplantation, PD, HD in the home or in-center, and conservative treatment. Patients' family members and caregivers also should be educated about treatment choices for kidney failure. (Not graded)

1.2 The decision to initiate maintenance dialysis in patients who choose to do so should be based primarily upon an assessment of signs and/or symptoms associated with uremia, evidence of protein-energy wasting, and the ability to safely manage metabolic abnormalities and/or volume overload with medical therapy rather than on a specific level of kidney function in the absence of such signs and symptoms. (Not graded)
Guideline 1

IDEAL Study: Time to Start of Dialysis

- Early-start group
- Late-start group

828 patients
32 centers in Aus & NZ

Hazard ratio, 2.09 (95% CI, 1.81–2.41)
P < 0.001

No. at Risk
- Early start: 404, 35, 12, 8, 2, 1
- Late start: 424, 118, 45, 21, 9, 3

Cooper BA, et al. NEJM 363(7):609-12, 2010

Guideline 1

IDEAL Study: Time to Death

- Early-start group
- Late-start group

Hazard ratio, 1.04 (95% CI, 0.83–1.30)
P = 0.75

No. at Risk
- Early start: 404, 358, 305, 249, 177, 99, 59, 32
- Late start: 424, 385, 333, 254, 187, 115, 60, 32

Cooper BA, et al. NEJM 363(7):609-12, 2010
IDEAL Study, subgroup analysis

Subgroup analysis showed no survival benefit of early versus late initiation of hemodialysis (p values 0.26 to 0.74).

- Age
- Sex
- Diabetes
- Body mass index
- History of cardiovascular disease
- Serum albumin level

IDEAL Study, secondary outcomes

No statistically significant secondary benefits were observed.

- Cardiovascular events
  - Cardiovascular death
  - Nonfatal MI
  - Nonfatal stroke
  - Transient ischemic attack
  - New-onset angina
- Infection events
- Complications of dialysis
- Economic evaluation
- Nutritional status
- Echocardiographic findings
- Quality of life
Guideline 2. **Frequent and Long Duration HD**

**In-center Frequent Hemodialysis**

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)

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**Guideline 2**

**Treatment Effect on LV Mass (g) by Level of Baseline LV Mass**

Comparison of 6x/Week vs. 3x/Week

-0.50 -0.10 0 0.50

Baseline LV Mass (g)

Chan CT et al. Circ Cardiovas Imaging 2012
Guideline 2. **Frequent and Long Duration HD**

**Home Long Hemodialysis**

2.3 Consider home long hemodialysis (6-8 hours, 3 to 6 nights per week) for patients with end-stage kidney disease who prefer this therapy for *lifestyle considerations*. *(Not graded)*

2.4 We recommend that patients considering home long frequent hemodialysis be informed about the *risks of this therapy*, including possible increase in *vascular access complications*, potential for increased *caregiver burden*, and possible accelerated *decline in residual kidney function*. *(1C)*

2.5 During pregnancy, women with end-stage kidney disease should receive frequent long hemodialysis either in-center or at home, depending on convenience. *(Not graded)*
Guideline 2

Long frequent versus standard dialysis during pregnancy: Canadian Study

<table>
<thead>
<tr>
<th>Source</th>
<th>N</th>
<th>Td (hrs)</th>
<th>Pd (wks)</th>
<th>birth rate</th>
<th>birth wt (gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian</td>
<td>22</td>
<td>43 ± 6</td>
<td>36</td>
<td>86.4%</td>
<td>2118 ± 857</td>
</tr>
<tr>
<td>US Registry</td>
<td>70</td>
<td>17 ± 5</td>
<td>27</td>
<td>61.4%</td>
<td>1748 ± 949</td>
</tr>
</tbody>
</table>

Td: hours of dialysis/week
Pd: duration of pregnancy in weeks


Guideline 3

Measurement of HD: Urea Kinetics

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

3.2 In patients with significant residual native kidney function (Kr), the dose of hemodialysis may be reduced provided Kr is measured periodically. (Not graded)

3.3 For hemodialysis schedules other than thrice weekly, a target standard Kt/V of 2.3 volumes per week with a minimum delivered dose of 2.1 using a method of calculation that includes the contributions of ultrafiltration and residual kidney function. (Not graded)
**Guideline 3**

**How to calculate standard Kt/V**

\[ eKt/V = spKt/V \left( \frac{t}{t + 30} \right) \]  
(Tattersall)

\[ \frac{10080 \left( 1 - e^{-eKt/V} \right)}{t} \left( \frac{1 - e^{-eKt/V}}{eKt/V} + \frac{10080}{Nt} \right) - 1 \]  
(Gotch, Leypoldt)

\[ \text{stdKt/V} = \frac{S}{1 - 0.74 F + 10080 V} \]  
(Daugirdas)  
NDT 28: 2156–60, 2013

**Surface area normalized stdKt/V**

\[ SA_{stdKt/V} = \frac{\text{stdKt/V}}{20} \cdot \frac{V_w}{BSA} \]  
(Daugirdas, NDT 28: 2156–60, 2013)

\( V_w \) is Watson estimate of total body water  
BSA is body surface area

**Hemodialysis Adequacy Update 2015**
Guideline 3

**Effect of Surface Area Normalization**

Daugirdas, et al, CJASN 2010

**Guideline 4**

**Volume & BP Control: Treatment Time**

4.1 We recommend that patients with low residual kidney function (< 2 ml/min) undergoing thrice weekly hemodialysis be prescribed a bare minimum of three hours per session. (*ID*)

4.1.1 Consider additional hemodialysis sessions or longer hemodialysis treatment times for patients with large weight gains, high ultrafiltration rates, poorly controlled blood pressure, difficulty achieving dry weight, or poor metabolic control (such as hyperphosphatemia, metabolic acidosis, and/or hyperkalemia). (*Not graded*)
Volume & BP Control: Ultrafiltration Rate

4.2 We recommend both reducing dietary sodium intake as well as adequate sodium/water removal with hemodialysis to manage hypertension, hypervolemia, and left ventricular hypertrophy. (1B)

4.2.1 Prescribe an ultrafiltration rate for each hemodialysis session that allows for an optimal balance among achieving euvoolemia, adequate blood pressure control and solute clearance, while minimizing hemodynamic instability and intradialytic symptoms. (Not graded)

Volume & BP Control

• Strong recommendation to minimize dietary sodium (and water) intake is reaffirmed.

• Not enough evidence to raise minimum of 3 hours of dialysis across the board.
  3 hours is a bare minimum.

• Exceptions……
  Ongoing TIME trial may shed more light on this.

• No evidence of harm from extending time.

• Studies advocating limits to ultrafiltration rate are based on observational data only.

• No recommendation with regard to dialysate sodium concentration.
Hemodialysis Membranes

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

High flux membranes: no survival benefit

Three large randomized trials:


One meta-analysis:

High versus low flux membranes

- One secondary outcome analysis (HEMO) and a meta-analysis showed reduced cardiovascular mortality.
- Some showed reduced all-cause mortality in subgroups:
  - For pre-specified subgroups:
    - Low serum albumin (<4 g/dL) [MPO]
    - High vintage (> 3.7 years on dialysis) [HEMO]
  - For post-hoc subgroups:
    - Diabetes mellitus [MPO, Ege]
    - AV fistulas [Ege]
- None showed harm.
- Cost may be a consideration in some venues.
Summary: what’s different?

- GRADE: strength of recommend (1 & 2) and grade (A-D) of the evidence
- Individualized prescriptions: include patient expectations and preferences
- More prescription flexibility: initiation, frequency, duration, Uf rate
- Less emphasis on absolute minimum or maximum cut-offs
- Recommendations regarding high frequency hemodialysis:
  - No compelling evidence that frequent dialysis is best for everyone
  - Consider for patients with special needs:
    - Left ventricular hypertrophy and/or congestive heart failure
    - Uncontrolled hypertension, fluid overload
    - Metabolic derangements (hyperphosphatemia, hyperkalemia)
    - Sleep apnea
    - Pregnancy (strong recommendation)
  - Acknowledges the risks of frequent hemodialysis
- Consider stdKt/V to measure frequent HD; adjust for Kru, Uf, BSA
- More emphasis on volume and BP control