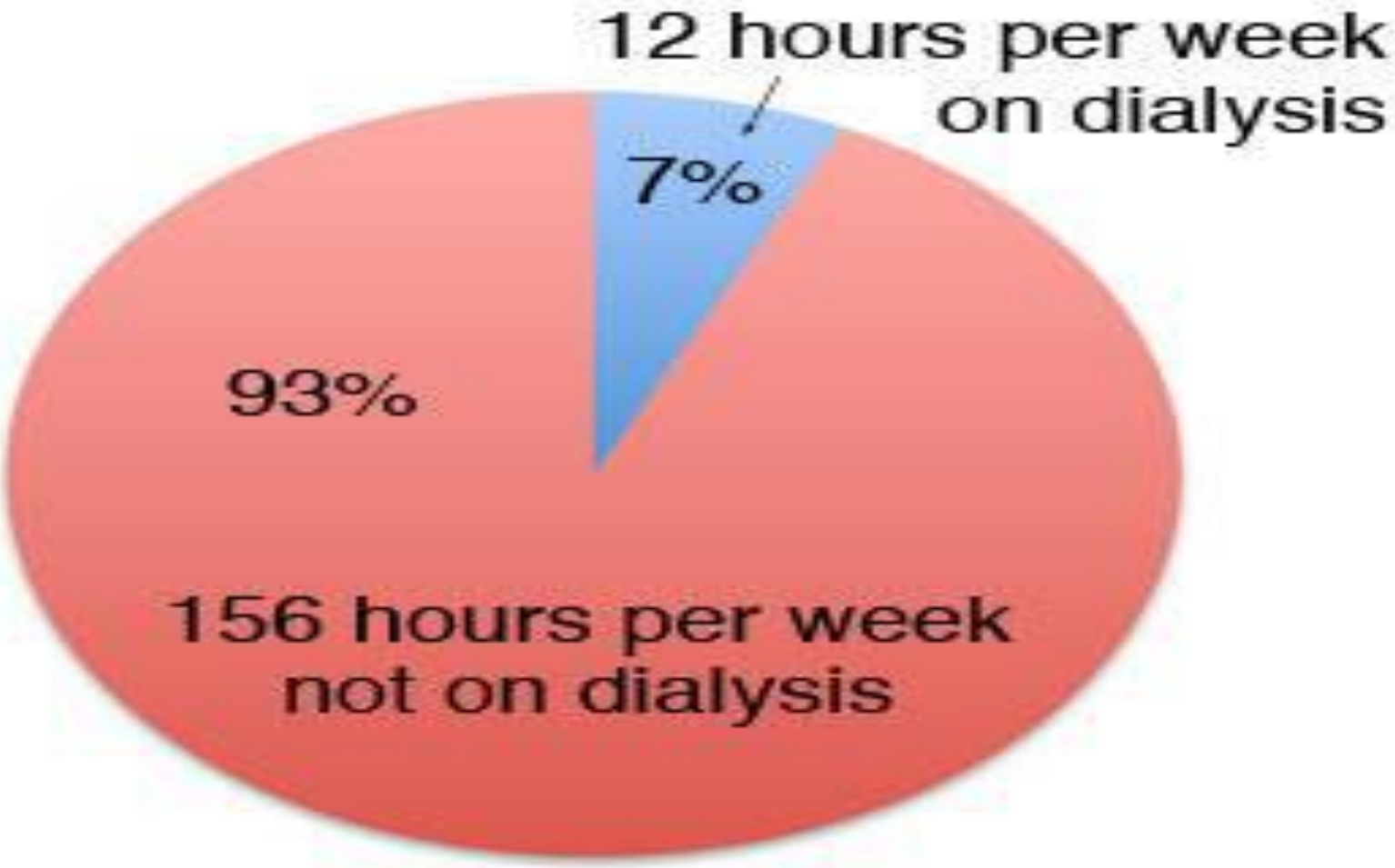
IN THE NAME OF GOD

ADEQUACY OF HEMODIALYSIS
AND
OCM

ADEQUACY OF HEMODIALYSIS AND OCM



Total hours in a week: 168

DIALYSIS ADEQUACY

Adequacy is a measure of how well the dialysis is working

DIALYSIS ADEQUACY

- Hemodialysis is the common kidney replacement therapy. Doing an adequate and effective dialysis can improve patients' quality of life and reduce kidney failure complications.

- Additionally, dialysis quality is an important factor in reducing mortality in patients with chronic kidney failure

DIALYSIS ADEQUACY

- Adequacy of dialysis refers to how well we remove toxins and waste products from the patient's blood, and has a major impact on their well-being

DIALYSIS ADEQUACY

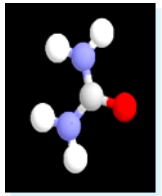
Two methods are generally used to assess dialysis adequacy:

- URR
- Kt/V

Urea as marker substance!

- The clearance of urea has been selected as the basis for all the calculations of dialysis adequacy

Urea MW: 60 D



WHY UREA ?

- The natural kidney excretes urea in large amounts.
- Urea is the end product of protein metabolism. The kinetics of protein metabolism can be used to assess the intake of protein (nutrition!), the formation of urea in the body and the secretion of urea through dialysis.
- The concentration of urea is used to measure the degree of uremia in uremic. (This does not mean that the urea itself is toxic!)

WHY UREA ?

- Moving relatively quickly, urea spreads across all fluid compartments of the body.
- Urea can be transported rapidly through the membrane of red blood cells.
- In clinical laboratories, urea is a routine parameter which can be determined quickly and cost-effectively.

What is the URR?

- URR stands for urea reduction ratio.
- The URR is one measure of how effectively a dialysis treatment removed waste products from the body
- expressed as a percentage.
- Blood is sampled at the start of dialysis and at the end. The levels of urea in the two blood samples are then compared.

URR : Urea Reduction Ratio

- $$\frac{\text{(Pre dialysis urea – post dialysis urea)}}{\text{Pre dialysis urea}} \times 100$$

What is the Kt/V?

Kt/V is another way of measuring dialysis adequacy.

- K: stands for the dialyzer clearance, the rate at which blood passes through the dialyzer, expressed in milliliters per minute (mL/min)
- T : stands for time
- Kt : is clearance multiplied by time, representing the volume of fluid completely cleared of urea during a single treatment
- V : is the volume of water a patient's body contains

Prescribed KT/V

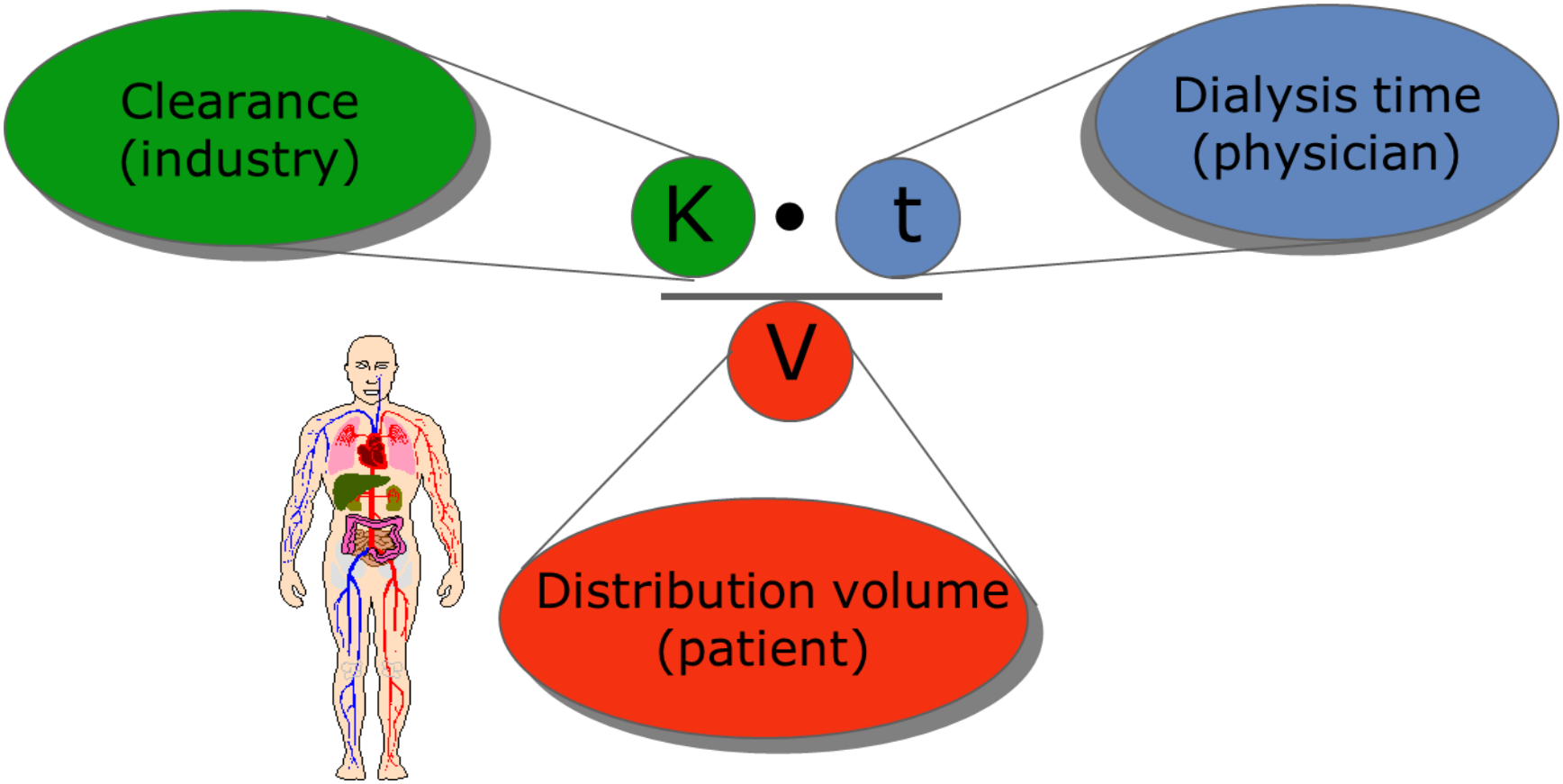
CLEARANCE
In ml/min

Distribution
Volume of urea
In ml

K T / V

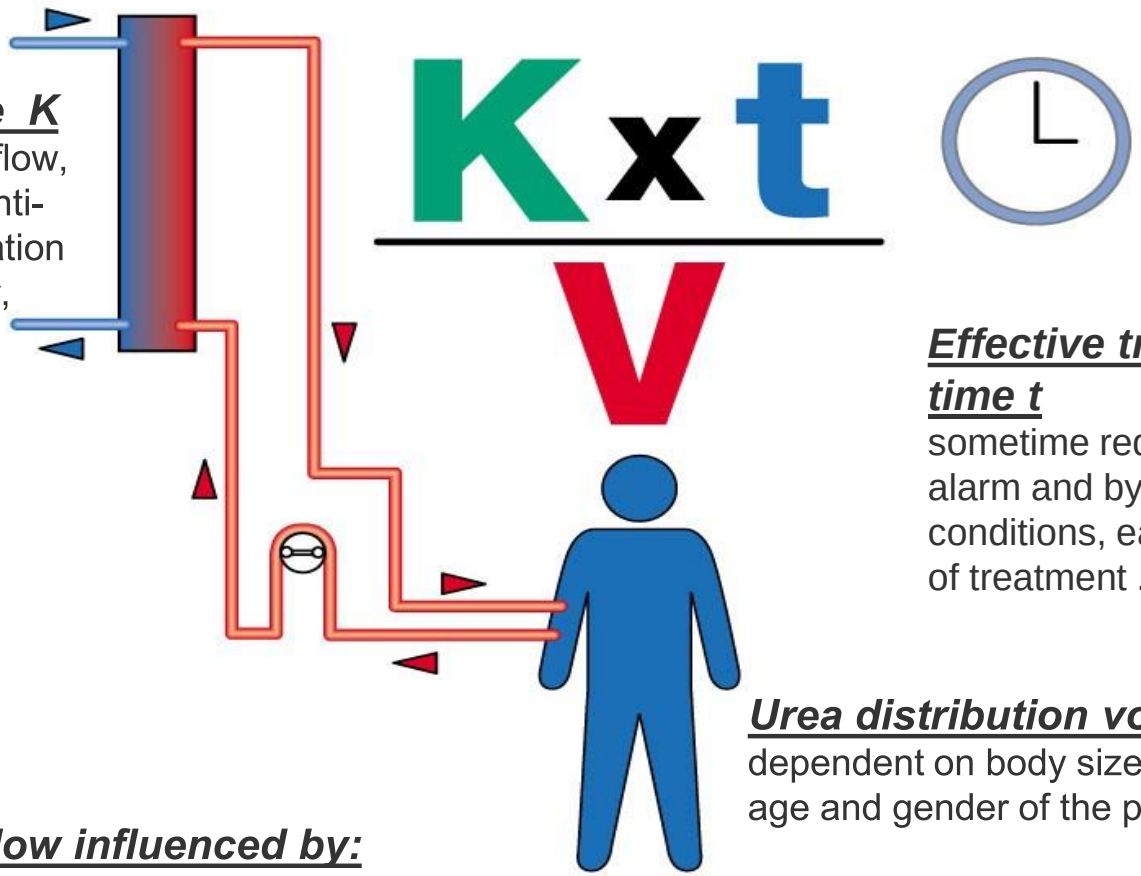
Time of
Dialysis
In minutes

Kt/V – an indicator of dialysis efficiency



Parameters determining Kt/V

In-vivo Clearance K
influenced by: blood flow, blood composition, anti-coagulation, ultrafiltration recirculation, dialyser, dialysate flow ...



Effective treatment time t
sometime reduced due to alarm and bypass conditions, early termination of treatment ...

Urea distribution volume V
dependent on body size, weight, age and gender of the patient

Effective blood flow influenced by:
tolerances in pump segment diameter, arterial pressure, fistula recirculation ...

Optimisation of Dialysis Efficiency

- moderate increase in blood flow rate (Qb) by 50 mL/min – from 250 mL/min to 300 mL/min – under standard conditions of dialysis leads to an increase in the urea clearance of approximately 15 %.

Optimisation of Dialysis Efficiency

- A sufficiently long effective dialysis time(t)is an important factor to ensure administration of an adequate dialysis dose.

Optimisation of Dialysis Efficiency

- Use of a dialyser with the highest possible urea clearance is reasonable to optimise the dose of dialysis.

- The dialysate flow rate(Qd)should be adjusted to the prescribed effective blood flow Qb.

How much Dialysis is adequate ?

- The determination of the Dialysis dose lies on the judgement of the physician.

$$\uparrow \frac{K * t}{V} \uparrow \quad \geqq 1.2 \ \ldots \ 1.8$$

K: effective Urea-Clearance (is not a manufacture instruction; it must be measured!)

t: effective Dialysis time (Alarm, Flow-off and Bypass time are considered!)

V: Urea-Distribution volume (normally anthropometric according to Watson oder Hume)

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Determination of the effectiveness in Haemodialysis

- Online Clearance Monitoring -

Product Management Haemodialysis Machines International

The OCM-Logo (Registration is on preparation)

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Radar-Symbol for the continuos „Position`s determination“ of the Dialysis dose

C as Clearance, means measured, detected by the radar

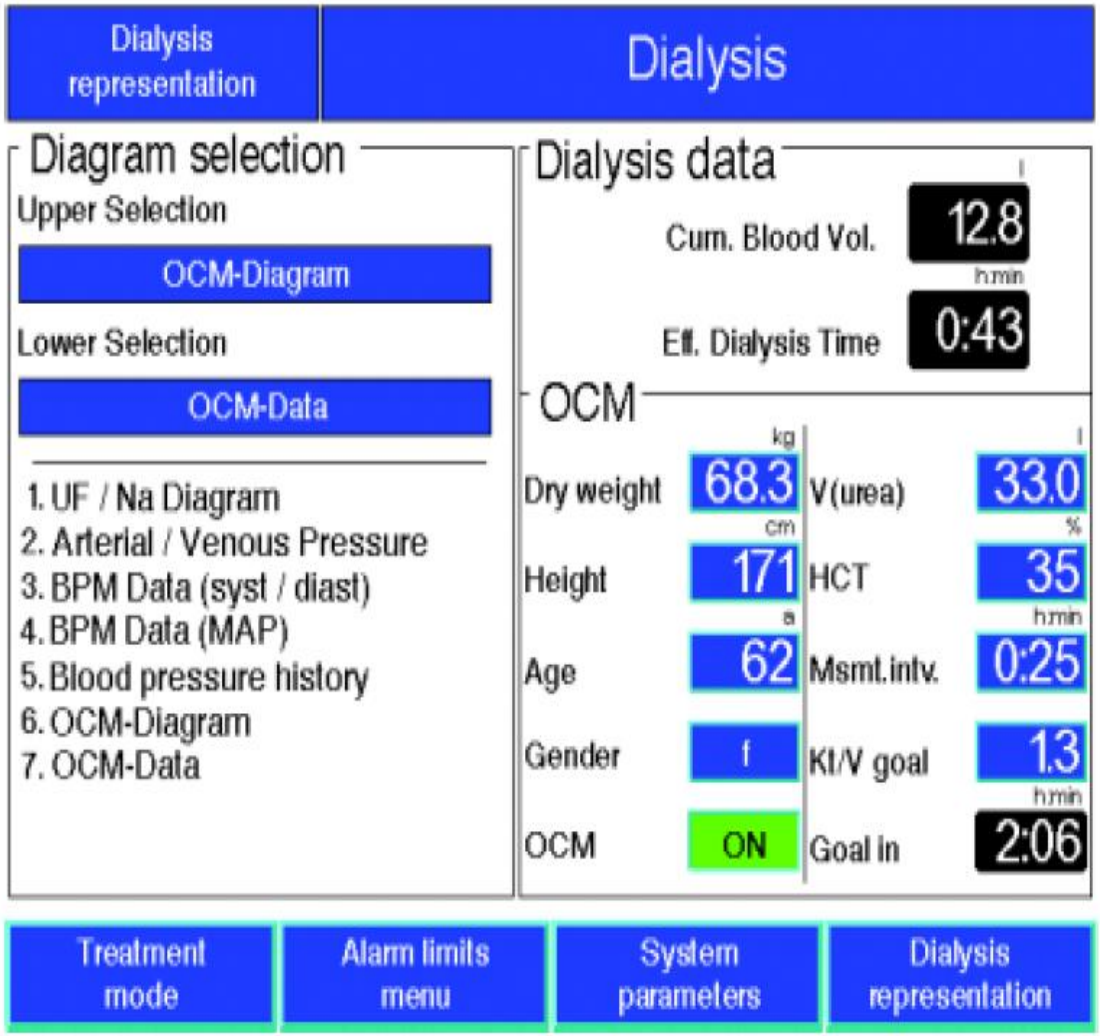
Association to the Dialysis dose Kt/V

Impulses to improve quality of life!

OCM is based on pulses measurement; these impulses are related to innovation

Relation to the quality of Dialysis

OCM


Dialysis representation
Dialysis
Diagram selection
Upper Selection
OCM-Diagram
Lower Selection
OCM-Data
1. UF / Na Diagram
2. Arterial / Venous Pressure
3. BPM Data (syst / diast)
4. BPM Data (MAP)
5. Blood pressure history
6. OCM-Diagram
7. OCM-Data
Dialysis data
l
Curr. Blood Vol.
12.8
h:min
Eff. Dialysis Time
0:43
OCM
kg
Dry weight
68.3
cm
Height
171
a
Age
62
Gender
f
OCM
ON
l
V(urea)
33.0
%
HCT
35
h:min
Msmt.intv.
0:25
Kt/V goal
1.3
h:min
Goal in
2:06
Treatment mode
Alarm limits menu
System parameters
Dialysis representation

The principle of OCM measurement

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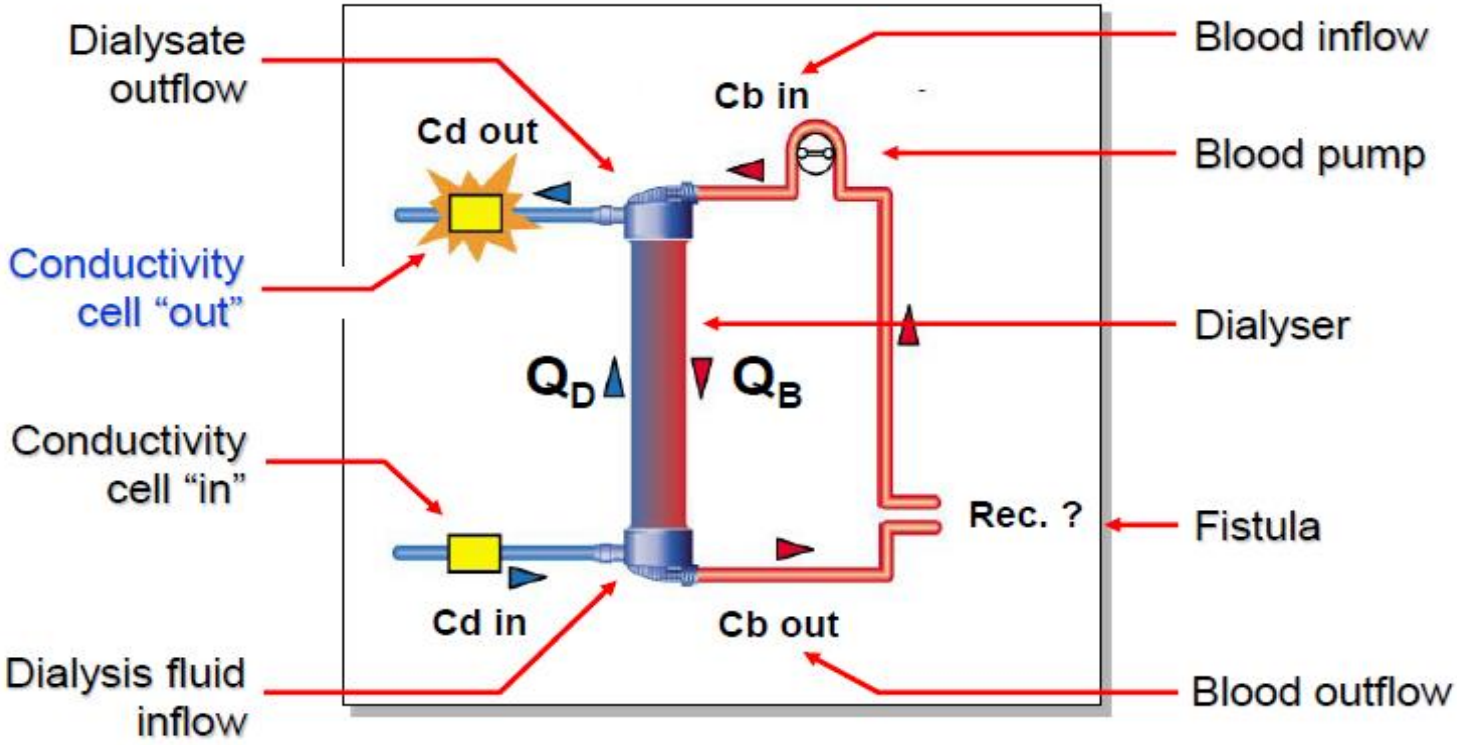

The equivalence of electrolyte and urea clearance

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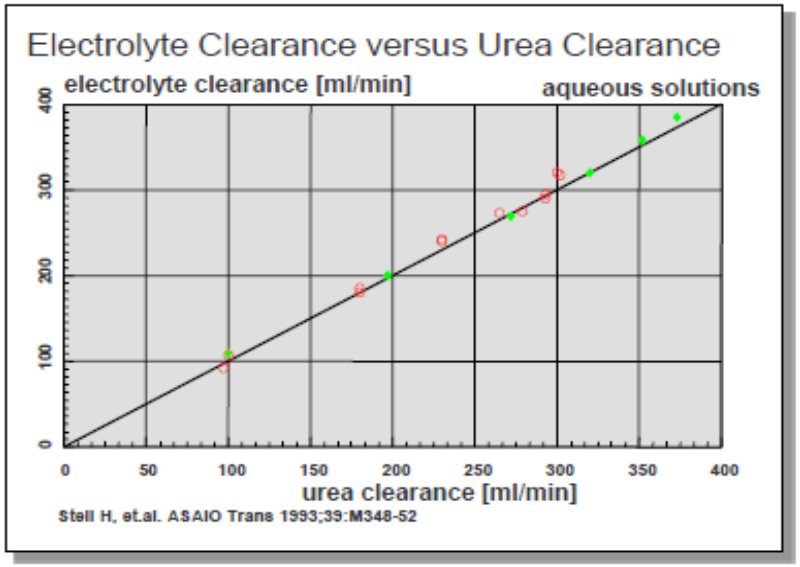
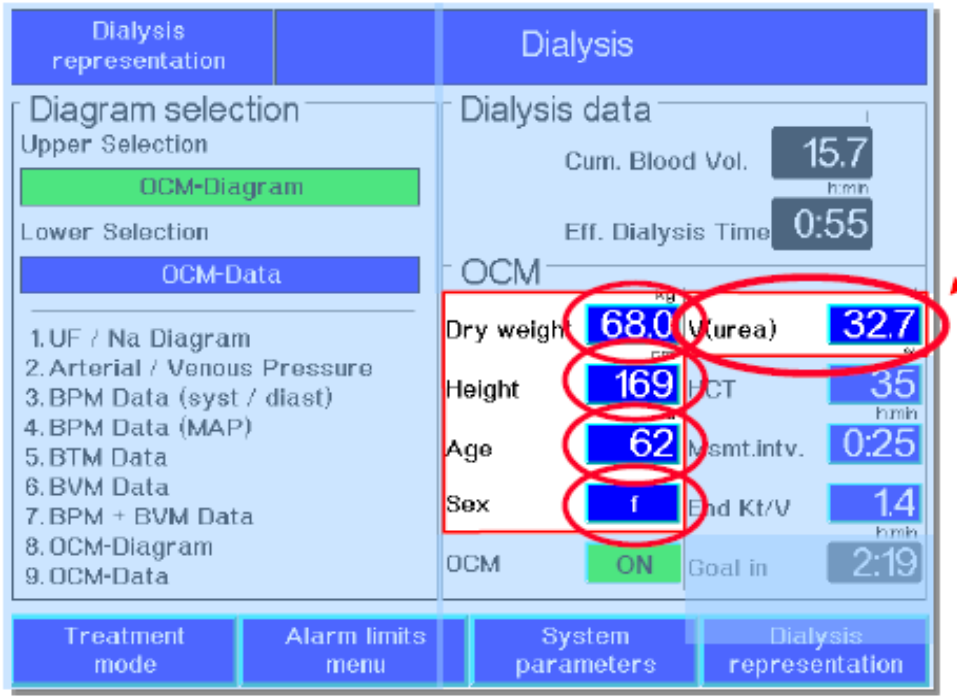
Coefficients of diffusion at 37 ° C [cm^2/s]	
Na^+	Urea
$1,94 \cdot 10^{-5}$	$2,20 \cdot 10^{-5}$

The principle of OCM is based on the equivalence of the diffusive characteristics of the sodium ion and the urea molecule through cell and synthetic membranes.



Babb AL, Maurer CJ, Fry DL, Popovich RP, McKee RE :
The determination of membrane permeabilities and solute diffusivities with applications to hemodialysis
Chem. Eng. Progr. Symp. Ser. 84,64 (1968) 59-68

Calculator for anthropometric V by Watson



Estimated anthropometric V after Watson

- ✓ Dry weight
- ✓ Height
- ✓ Age
- ✓ Sex

Individual deviations from the Watson V are reported:

Kloppenburg et al., Kidney International 59 (2001) 1165-74
Johansson et al, JASN 12 (2001) 568-73
Cooper et al., Kidney International 58 (2000) 408-16

Watson - Formula :

♂ V_{Urea} = 2,447 - 0,09516 x Age + 0,1074 x Height + 0,3362 x Weight

♀ V_{Urea} = - 2,097 + 0,1069 x Height + 0,2466 x Weight

Data input for OCM on FMC 4008 H/S dialysis machines

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Dialysis representation | Dialysis

Diagram selection

Upper Selection

OCM-Diagram

Lower Selection

OCM-Data

1. UF / Na Diagram
2. Arterial / Venous Pressure
3. BPM Data (syst / diast)
4. BPM Data (MAP)
5. BTM Data
6. BVM Data
7. BPM + BVM Data
8. OCM-Diagram
9. OCM-Data

Dialysis data

Cum. Blood Vol. 15.7 l

Eff. Dialysis Time 0:55 h:min

OCM

Dry weight	68.0 kg	V(urea)	32.7 l
Height	169 cm	HCT	35 %
Age	62 a	Msmt.intv.	0:25 h:min
Sex	f	End Kt/V	1.4
OCM	ON	Goal in	2:19 h:min

Treatment mode | Alarm limits menu | System parameters | Dialysis representation

Hematocrit (pre-set at 35%)

Measurement interval (pre-set to 50 min.)

Set Target-Kt/V

Estimated Time to target Kt/V

Measurement can be started manually or automatically!

Distribution Volume of Urea V_{Urea}

Body mass 30-35%

Water 60-65% V=liters

Distribution volume (V)

WATSON:

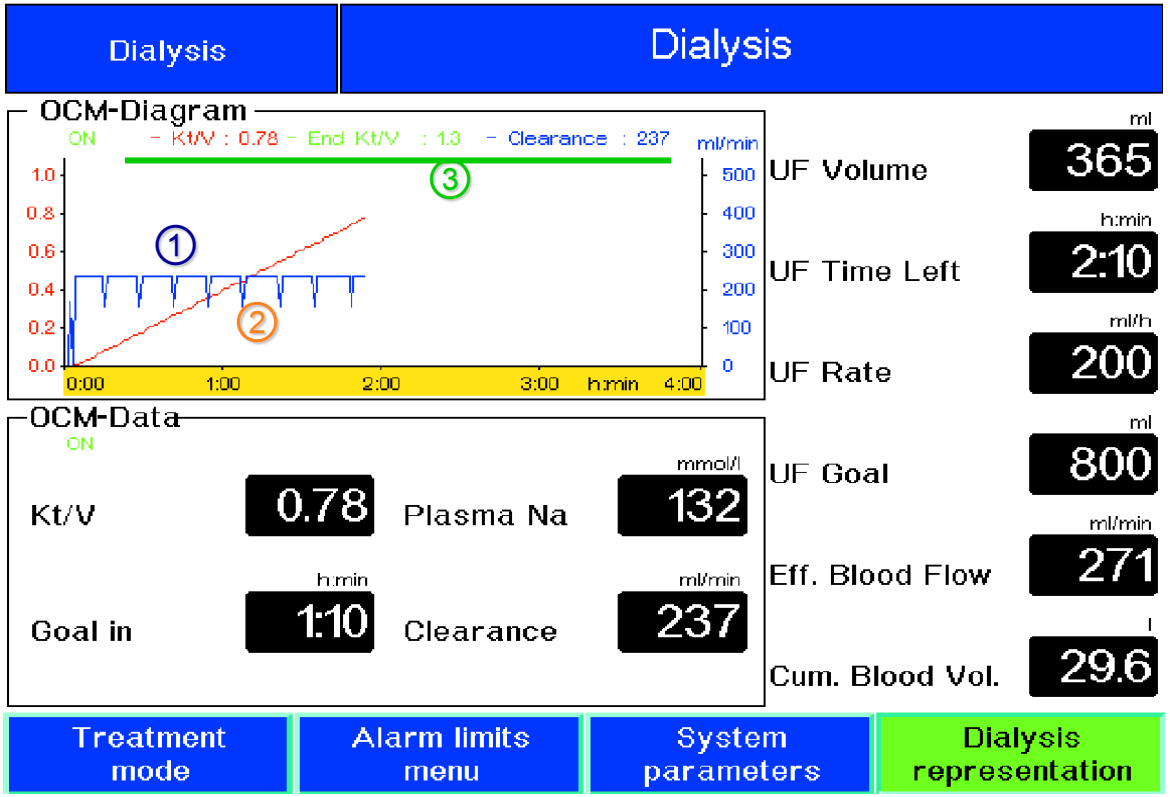
- Male Vurea = 2.447 – 0.09516 x age + 0.1074 x height (cm) + 0.3362 x weight (kg)
- Female Vurea = – 2.097 + 0.1069 x height (cm) + 0.2466 x weight (kg)

OCM - graphical display

① Clearance curve

② Kt/V curve

③ Goal Kt/V

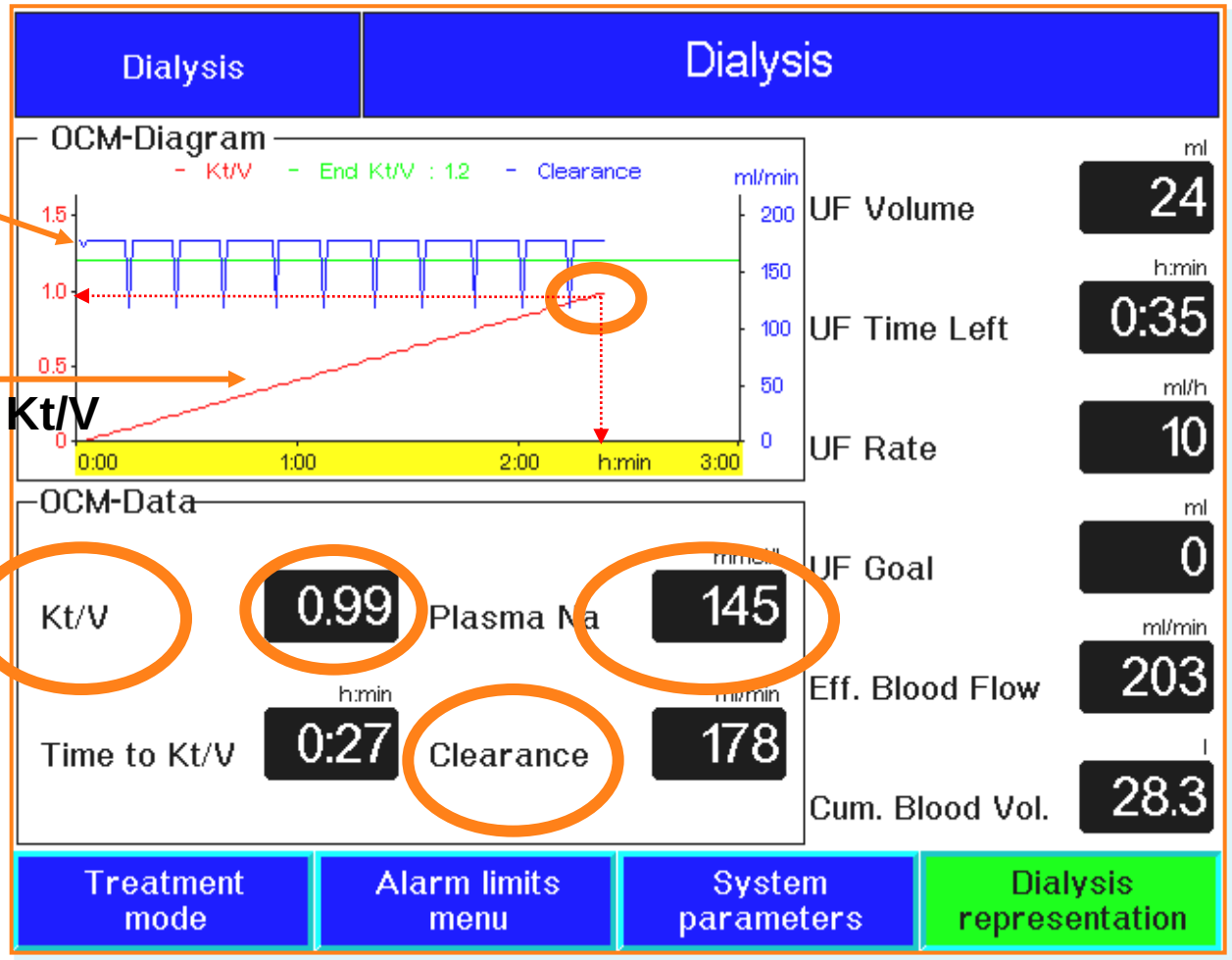


Parameters displayed by OCM®

Effective *in-vivo* clearance

Cumulating Kt/V

Plasma Sodium concentration (corrected to flame photometer)



Parameters displayed by OCM

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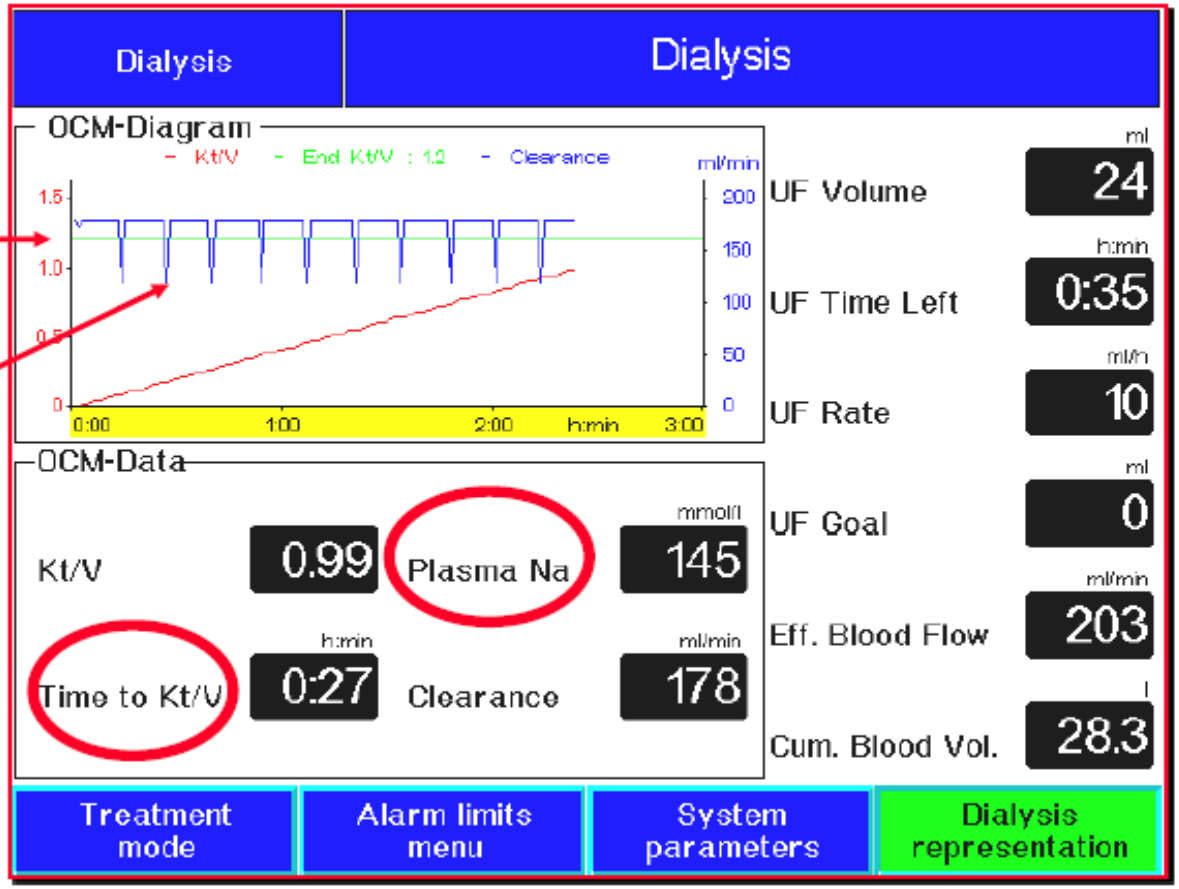
Target Kt/V

Indication of cyclic pressure holding tests

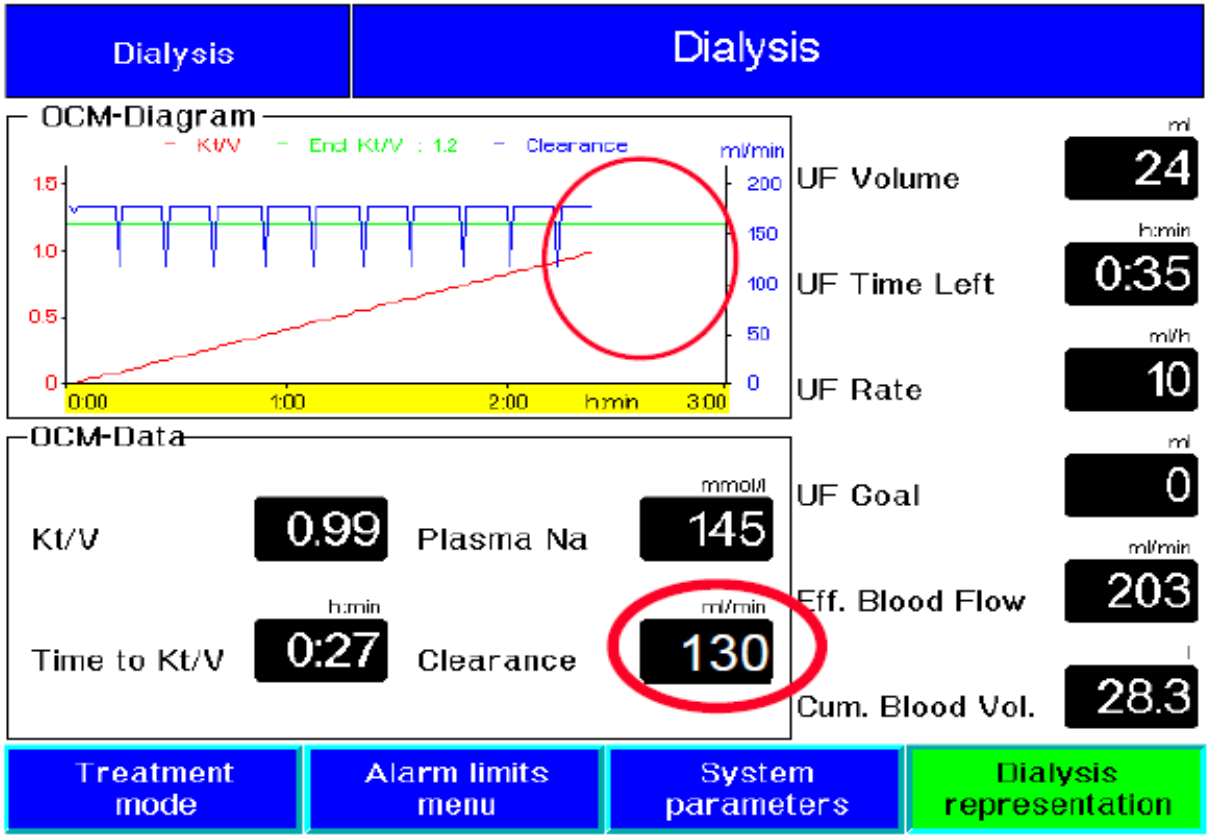
Plasma sodium concentration

Time left to reach pre-set target Kt/V



Reduced clearance and the effect on Kt/V

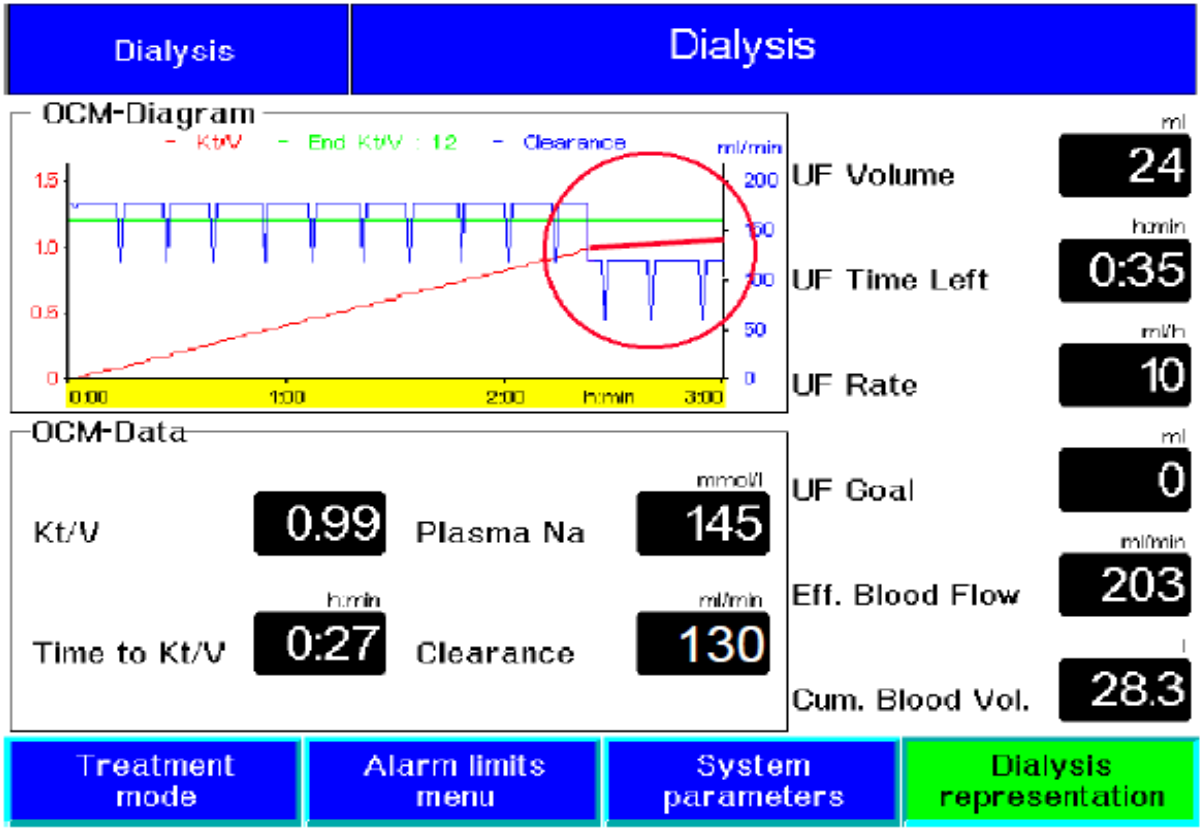
An intradialytic reduction in clearance leads to a visualised decrease in delivered dialysis dose Kt/V which would remain undetected without OCM.



Reduced clearance and the effect on Kt/V

An intradialytic reduction in clearance leads to a visualised decrease in delivered dialysis dose Kt/V which would remain undetected without OCM.

OCM allows intradialytic counteraction, i.e. an increase in blood flow where possible!



The positive effect of increased blood flow on effective in-vivo clearance and Kt/V

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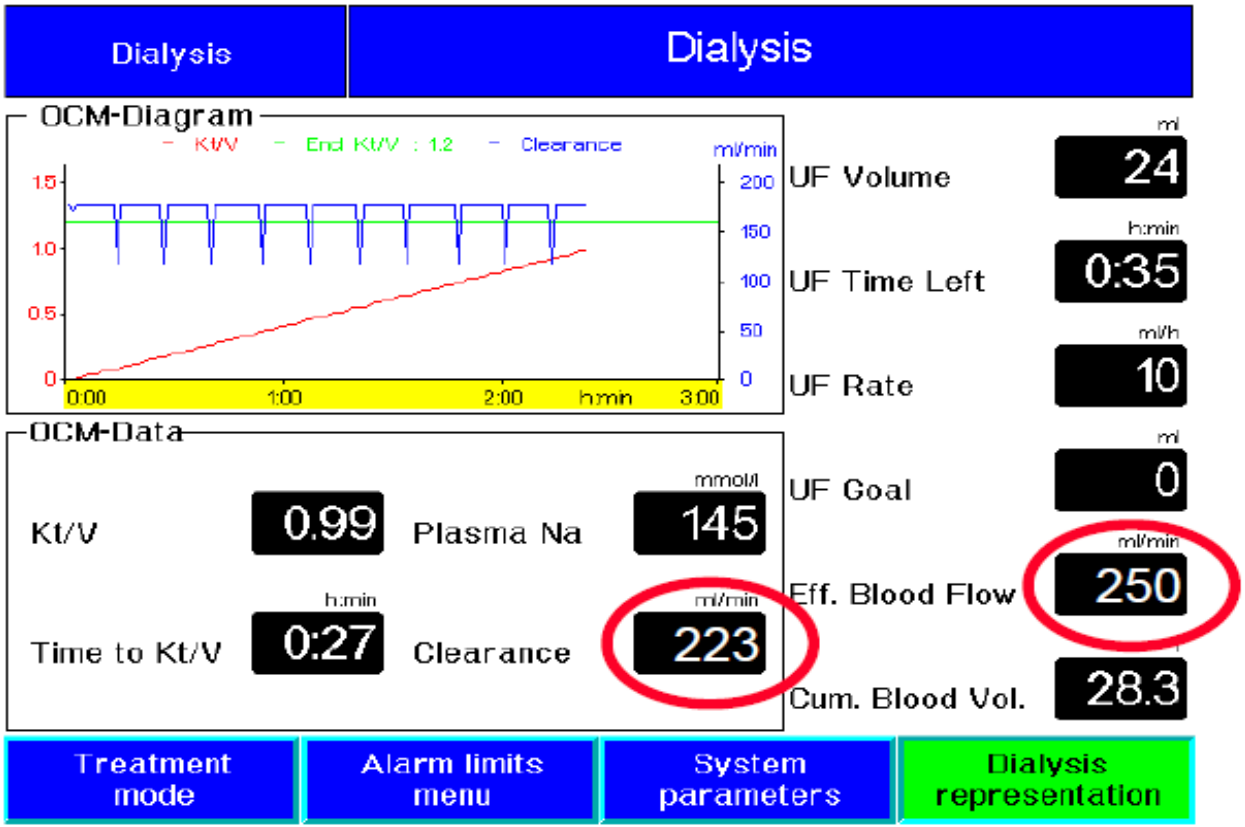
An increase in effective blood flow from 203 to 250 ml/min ...

... results in an increase in clearance e.g. from 178 to 223 ml/min.



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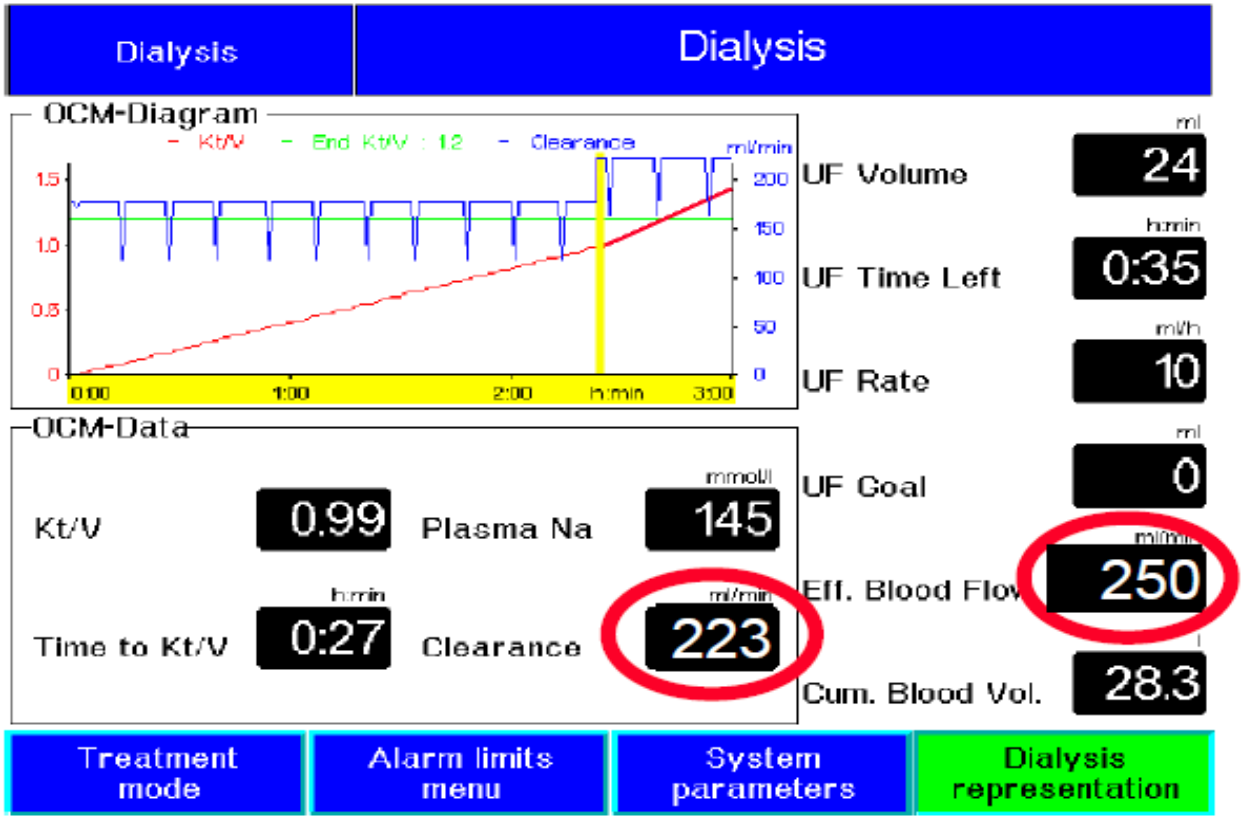
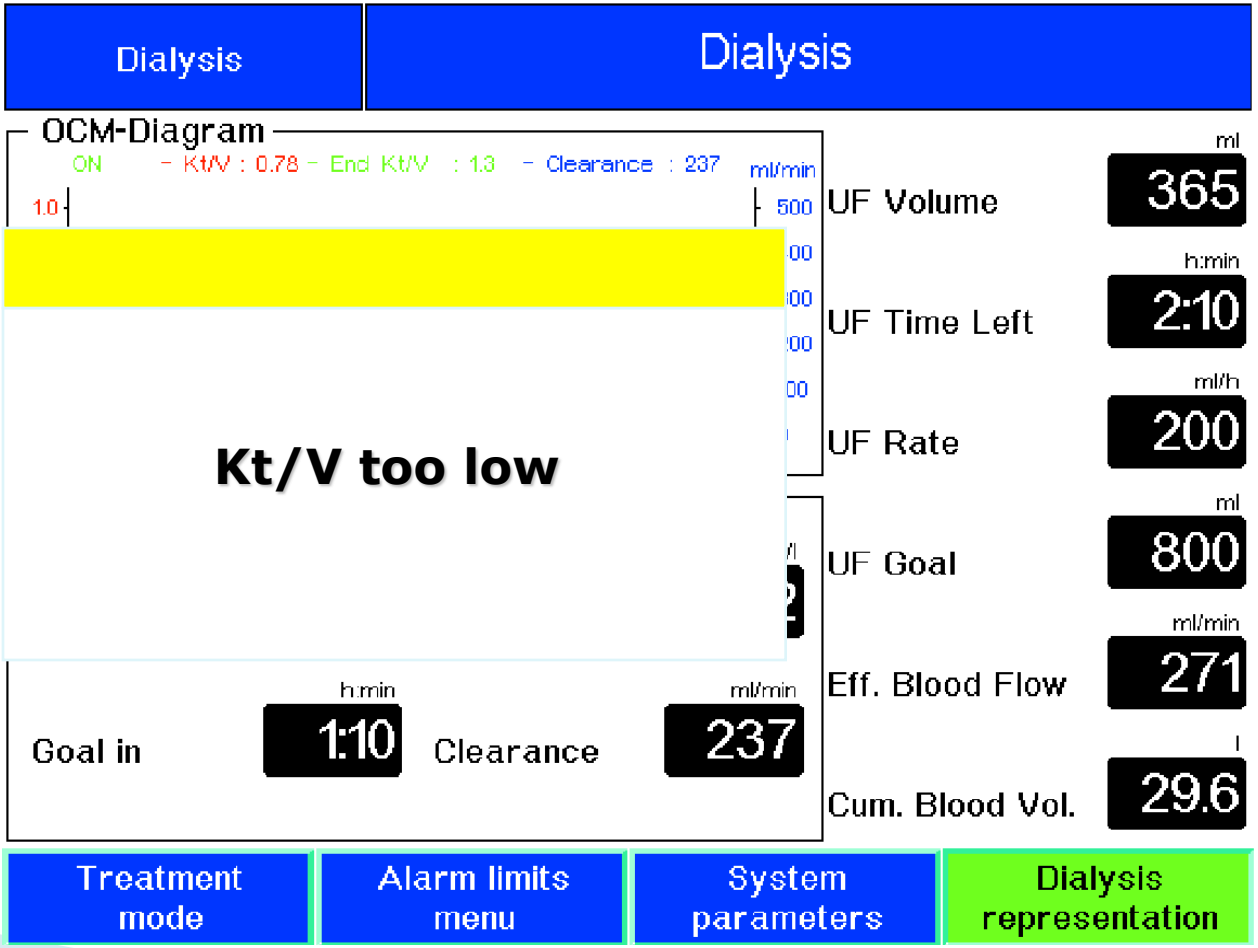
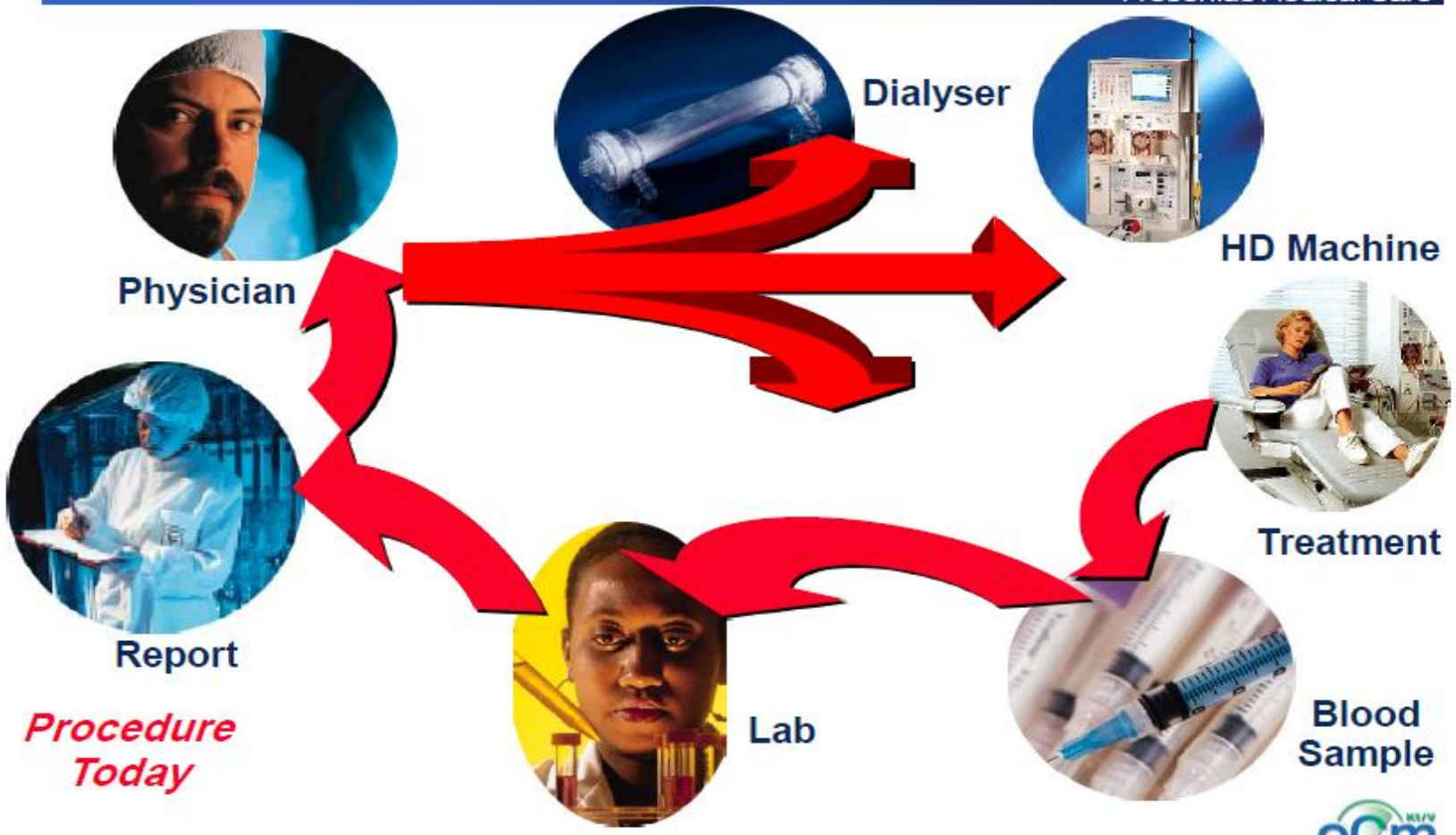


OCM - warnings / messages



Dose assessment today!



Dose assessment now with OCM!

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Physician

Dialyser

HD Machine

Treatment

Now with oCm

Report

Lab

Blood Sample

oCm

The clear advantages of OCM !

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The conventional procedure today	Aspects	With OCM option
Blood samples (expensive)	Kt/V ≥ 1.2 ...1.8	Dialysate; K and t, (no additional costs)
Monthly / quarterly	Frequency	In every session
Retrospective	Quality Control	Continuous, online
Staff, syringes, lab time cost and energy	Effort	None
6-8%	Accuracy of K	5%
Inconvenient	Handling	Automatic
Impractical and uncommon	Quality assurance	Standard!

oCm Kt/V at one glance!

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1. It exits an indisputable **correlation** between the **Dialysis dose** expressed in Kt/V_{Urea} and the relative **mortality rate** by Haemodialysis patients
2. The comparison between **prescribed** and **real** administered **dose**, based on theoretical parameter, shows **significant differences** in routine operation.
3. The continuos check of the dose by the Laboratory analysis is retrospective, uncomfortable and related partly to additional high costs.
4. Measure method for the continuos monitoring of the real prescribed Dialysis dose and with it, is really necessary the assurance of the dialysis quality in the routine operation.
5. **Online Clearance Monitoring** informs the user continuously about the **effective clearance** and the **current dialysis dose** by **minimal work effort and costs!**

Online Clearance Monitoring OCM

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Give you and your patients the confidence of having a good dialysis!

Thank you

گردآورنده مطالب : سمیه حاجتی
کارشناس پرستاری