DIALYSIS
EQUIPMENTS
(DIALYSIS MACHINE & R.O)

Nursing Conference on Dialysis
Tehran
DIALYSIS MACHINES

The standard dialysis machines are designed for performing chronic and acute hemodialysis.

They can be used in home dialysis, limited care centers and clinical hemodialysis.
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All of standard dialysis machines should have the following conditions:

1) Ability to perform dialysis with acetate, bicarbonate fluid and bicarbonate powder.
2) Dialysis fluid flow range
3) Dialysis fluid temperature
4) Dialysis fluid conductivity
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5) Bicarbonate concentration dialysis fluid
6) Ultrafiltration controller
7) Blood leak detector
8) Disinfection
9) Hot disinfection
10) Heparin pump
11) Air bubble detector
12) Arterial blood pump
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13) Arterial blood monitoring
14) Venous pressure monitoring
15) Transmembrane monitoring
16) Battery backup
17) Ability to perform dialysis with high flux membrane
18) Self test
19) Isolated ultrafiltration
SORBENT DIALYSIS

Diagram of a sorbent dialysis system with labeled components:
- Electricity Source
- 6 Liter Reservoir
- Dialysate
- Cartridge
- Infusate Pump
- Infusate
- Blood Leak Detector
- UF Meter
- Used Dialysate
- Fresh Dialysate
- Heater
- Flow Meter
- Conductivity Meter
- Temperature Meter
- UF Control

Date: 28-Feb-10
Reza Sabagh
DIALYSIS MACHINES

New features:

*Blood Volume Monitoring (BVM)*

Hypotensive episodes occur in up to 30% of dialysis treatments, involving symptoms like nausea, cramps and cardiac arrhythmias. Their occurrence is associated with a decrease in blood volume which is faster than the refilling rate from interstitium, resulting in a drop of blood pressure.
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An ultrasonic BVM with a high accuracy in measuring relative blood volume. It also allows feedback control with adjustment of ultrafiltration rates.

Clinical trials have demonstrated the benefits of this method for achieving the desirable fluid removal with less blood volume reduction and without drops of arterial blood pressure in hypotention prone patients.
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BVM permits the exact online acquisition of the:
1. Relative changes in the blood volume (RBV)
2. Haematocrit value (Hct)
3. Haemoglobin value (Hb)

with the clinically evaluated algorithms of this option, symptomatic hypotension due to excessive fluid removal can now be prevent, without the need of an additional sodium load for the patient.
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**Blood Temperature Monitor (BTM)**

It is based on the observation that a patient gains heat when he is dialysed against a dialysate of 37°C which results in peripheral vasodilation, impairment of venous tone and ultimately a decrease in blood pressure.

BTM allows control of the thermal energy balance.

BTM allows the control of vascular access function.
Access recirculation can lead to significant discrepancies between the prescribed and the delivered clearance, resulting in inefficient dialysis.

Whenever the test is performed, the machine sends a temperature signal through the venous line. If this signal is detected in the arterial line afterwards, the blood has not left the fistula. The machine computes and displays the percentage of recirculation.
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FINESSE

FINESSE is a dialysis data acquisition and management system for continuous quality assurance and process analysis providing the basis for an effective and efficient organisation of the dialysis practice:

1. Automated pre-setting of our dialysis machines via download
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**Blood Pressure Monitoring (BPM)**

The BPM is a fully automated and non-invasive blood pressure monitor.

It is also possible to perform measurements in preselected intervals:

1. Interval modes of 5 – 15 – 30 – 60 minutes
2. Quick mode for individual measurements approx.
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the following obtained values will be recorded:

1. Systolic blood pressure
2. Diastolic blood pressure
3. Mean arterial pressure (MAP)
4. Pulse
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ONLINE CLEARANCE MONITORING (OCM)

The online clearance monitoring enables the continuous monitoring of:

1. The effective *in-vivo* urea clearance (K)
2. The accumulated cleared plasma (KT)
3. The current dialysis dose administered (KT/V)
4. The plasma sodium concentration during treatment
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The user can specify prescribed therapy goal and detect immediately possible deviations during the course of the treatment and perform the necessary corrections.

The measuring technique is:

1. Non-invasive
2. Runs completely automatically
3. Causes no additional treatment costs
4. Requires no additional disposable, laboratory or staff effort.
Ultrafiltration and sodium profiles

Profiles counteract actively against intra and post-dialytic complications by targeted influence in the fluid and electrolyte balance.

Sodium profiles can achieve:
1. A temporary increase in the plasma sodium concentration
2. A support in the intradialytic refilling
3. Stabilisation of the circulation
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The UF profiles adapt the fluid removal to the intradialytic change in the UF tolerance of the patients and are designed in such a way that an adequate refilling can take place in the intravascular space.

Sodium and UF profiles can be combined, however, they can also be used individually.
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*DIASAFE PLUS* – *DIALYSIS FLUID FILTER*

Due to its high retention properties for microbiological contaminants the dialysis fluid filter DIASAFE prevents the passage of microbial substances and assures ultrapure dialysis fluid, independent from the type of dialyser and treatment modality selected:
Reverse Osmosis Device

Water treatment systems used in dialysis are a critical factor in the overall care received by dialysis patients; they also provide one of the greatest hazards to the patients if they are not functioning properly.
Reverse Osmosis Device

All of standard Reverse Osmosis Device should have the following conditions:

1. Water softener
2. Carbon tank
3. Reverse osmosis device
4. De – Ionization system
5. Chemical contaminant monitoring
6. Microbiological monitoring
7. Flow rates
8. Drain system
9. Monitoring disinfectants
Reverse Osmosis Device

**water softener:**

Water softeners are an important part of most water treatment systems. Their use, however, is primarily in protecting and prolonging the life of the RO membrane.

Water softeners are used primarily to remove calcium and magnesium from the water, which an RO will do easily as well. (softeners remove Ca++ and Mg++ by exchanging these for Na+).
Reverse Osmosis Device

To assure that your softener will perform appropriately, you need to monitor:

1. Pressure drop
2. Salt level in the brine tank
3. Regeneration timer
Reverse Osmosis Device

*Carbon tanks:*

One of the most critical tanks regarding patient safety in the day of a dialysis technician is checking the water treatment system for chlorine and chloramines. Chlorine and its combined form, chloramine, are high-level oxidative chemicals. They are added to municipal water systems to kill bacteria—but they also destroy red blood cells. For this reason they must be removed from water to be used for dialysis.
Reverse Osmosis Device

Carbon tanks are part of the pre-treatment section of a water treatment system and normally are arranged where water will flow first through one tank and then directly into another. This is call a series configuration.

The first tank in the series (primary carbon tank) is referred to as the *worker* tank and second is called the *polisher*.
Reverse Osmosis Device

Your sample should be taken at the point where the water leaves the first tank, a second sample should be taken immediately after the water leaves the second tank.

If there is chlorine leaving the second tank, dialysis should be discontinued in the facility.
Reverse Osmosis Device

- By overcoming the osmotic pressure, a semipermeable membrane can be used to purify water.
Reverse Osmosis Device

De – Ionization system

The primary concerns in monitoring your DI for quality are discussed below in the sections on chemical contamination and microbiological monitoring. However, it is important to monitor the pressures of the DI system to maintain its efficiency.

They do not generate a waste stream like an RO.
<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Maximum Concentration mg/L (Unless otherwise noted)</th>
<th>Test Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>2 (0.1 mEq/L)</td>
<td>EDTA Titrmetric Method, or Atomic Absorption (direct aspiration), or Ion Specific Electrode</td>
</tr>
<tr>
<td>Magnesium</td>
<td>4 (0.3 mEq/L)</td>
<td>Atomic Absorption (direct aspiration)</td>
</tr>
<tr>
<td>Potassium</td>
<td>8 (0.2 mEq/L)</td>
<td>Atomic Absorption (direct aspiration), or Flame Photometric Method, or Ion Specific Electrode</td>
</tr>
<tr>
<td>Sodium</td>
<td>70 (3.0 mEq/L)</td>
<td>Atomic Absorption (direct aspiration), or Flame Photometric Method, or Ion Specific Electrode</td>
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<tr>
<td>Antimony</td>
<td>0.006</td>
<td>Atomic Absorption (platform)</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.005</td>
<td>Atomic Absorption (gaseous hydride)</td>
</tr>
<tr>
<td>Barium</td>
<td>0.10</td>
<td>Atomic Absorption (electrothermal)</td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.0004</td>
<td>Atomic Absorption (platform)</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.001</td>
<td>Atomic Absorption (electrothermal)</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.014</td>
<td>Atomic Absorption (electrothermal)</td>
</tr>
<tr>
<td>Lead</td>
<td>0.005</td>
<td>Atomic Absorption (electrothermal)</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.0002</td>
<td>Flameless Cold Vapor Technique (Atomic Absorption)</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.09</td>
<td>Atomic Absorption (gaseous hydride), or Atomic Absorption (electrothermal)</td>
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<tr>
<td>Silver</td>
<td>0.005</td>
<td>Atomic Absorption (electrothermal)</td>
</tr>
<tr>
<td>Aluminum</td>
<td>0.01</td>
<td>Atomic Absorption (electrothermal)</td>
</tr>
<tr>
<td>Chloramines</td>
<td>0.10</td>
<td>DPD Ferrous Titrmetric Method, or DPD Colorimetric Method</td>
</tr>
<tr>
<td>Total chlorine</td>
<td>0.50</td>
<td>DPD Ferrous Titrmetric Method, or DPD Colorimetric Method</td>
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<tr>
<td>Copper</td>
<td>0.10</td>
<td>Atomic Absorption (direct aspiration), or Neocuproine Method</td>
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<tr>
<td>Fluoride</td>
<td>0.20</td>
<td>Ion Selective Electrode Method, or SPADNS Method</td>
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<tr>
<td>Nitrate (as N)</td>
<td>2.00</td>
<td>Cadmium Reduction Method</td>
</tr>
<tr>
<td>Sulfate</td>
<td>100.00</td>
<td>Turbidimetric Method</td>
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<tr>
<td>Thallium</td>
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<td>Atomic Absorption (platform)</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.10</td>
<td>Atomic Absorption (direct aspiration), or Dithizone Method</td>
</tr>
</tbody>
</table>

NOTE: The physician has the ultimate responsibility for ensuring the quality of
Upper Limits for Bacteria* and Endotoxin† in Water and Dialysate Used for Hemodialysis

<table>
<thead>
<tr>
<th>Guideline Source</th>
<th>Water</th>
<th>Dialysate</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>*CFU/ml</td>
<td>†EU/ml</td>
</tr>
<tr>
<td>AAMI (1981)</td>
<td>200</td>
<td>NS</td>
</tr>
<tr>
<td>AAMI (2001)</td>
<td>200</td>
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<tr>
<td>ERA-EDTA</td>
<td>100</td>
<td>0.25</td>
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<tr>
<td>Ultrapure</td>
<td>0.1</td>
<td>0.03</td>
</tr>
</tbody>
</table>

* implied
Any Question?

Thank you for your attention