During hemodialysis treatment patients are exposed to large quantities of dialysis fluid, which is comprised of more than 99.3% of water, only separated from the patient's blood by a non-selective dialyzer membrane. Clinical data show that contaminants in dialysis water are contributory factors for acute and chronic problems as well as severe injuries to hemodialysis patients.\(^*\) It is estimated that many more incidences go unreported because chronic symptoms and side-effects are often related to problems secondary to ESRD patients. Due to this, water quality is an essential key factor in modern dialysis.

In addition to striving to achieve the best possible treatment outcome, healthcare systems face financial strain all over the world. Depending on the system configuration, pure investment costs for water treatment systems only comprise approximately one quarter of the total life cycle costs. Due to this, it is an important aim to strive for innovative and flexible solutions to reduce the total life cycle costs and to ensure a cost effective dialysis.

Lauer is an independent company that has been completely focused on dialysis water purification for almost 20 years. Lauer differentiates itself from its competition through superior technology and many patented features with the brand Aquaboss®. Today, Aquaboss® water purification systems are installed in more than 35 countries and are the first choice in many key opinion leading hospitals. B. Braun Avitum is the exclusive sales partner and distributor for Lauer systems in many countries all over the world. B. Braun Avitum is a knowledgeable and intimate partner, offering a full line of dialysis products and services. Together with the Aquaboss® portfolio, B. Braun Avitum strives to offer the best possible system solution, by always focusing on the customers’ key drivers: Increase patients’ quality of life and reduce the total cost of ownership.
Innovation and highest water quality

**Aquaboss® Reverse Osmosis Systems**

- Stainless steel quality
- Dead space free design
- Modular system
- Compact device
- Water saving technology

<table>
<thead>
<tr>
<th>Component</th>
<th>Single Stage</th>
<th>Double Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RO Dia 70</td>
<td>70 l/h at 10°C</td>
<td>1 RO station</td>
</tr>
<tr>
<td>RO Dia LCC</td>
<td>210-700 l/h at 6°C</td>
<td>6-25 RO stations</td>
</tr>
<tr>
<td>RO Dia C</td>
<td>700-3000 l/h at 6°C</td>
<td>20-90 RO stations</td>
</tr>
<tr>
<td>RO Dia</td>
<td>700-3600 l/h at 6°C</td>
<td>20-120 RO stations</td>
</tr>
</tbody>
</table>

Conventional technology: Reverse osmosis with standard one way flow.

Advanced flow technology: Aquaboss® impulse backwashing function minimizes deposits on the membrane for higher permeate quality and reduced water consumption.

Impulse Backwashing (Lauer Patent*)

Raw water contains dissolved and undisolved substances. Over time, these substances will manifest on the RO membrane, bearing the risk that bacteria will grow through the membrane to release endotoxins. Furthermore, the membrane will become blocked and therefore reduce the permeate capacity. The impulse backwashing (Lauer Patent) is an option for all Aquaboss® RO devices. An innovative flow technology significantly reduces deposits on the RO membrane. This actually leads to two advantages: a high permeate quality as well as a stable permeate production capacity.

All Aquaboss® RO devices equipped with the impulse back-washing function are labelled as Eco versions, e.g. Eco RO Dia C.

### Double Stage RO for all Center Sizes

Single Stage RO Systems are a reliable solution for all standard treatment applications. However, Single Stage RO Systems are often not able to reduce specific ions such as nitrate or aluminum under the limited value. A second RO Stage further reduces those substances and thus results in higher permeate quality and an excellent solution to perform HDF or High-Flux therapies. In addition to this, the concentrate of the second RO Stage is recirculated to the first stage resulting in no water loss and thereby lower running costs.

* BS 101 A-9113 and other patents or patent applications
Innovation and highest water quality

**Hot Total (HT)**

Today, hot disinfection is often seen as an integral part of modern dialysis systems. However, hot disinfection should cover the whole water treatment system, including the distribution system to the dialysis machine and the RO device. Single Stage and Double Stage Aquaboss® RO devices go in line with the technology to also perform hot disinfection on the RO device, including all elements and parts of the system, from the break tank up to the point of use.

**Dead Space Free Secondary Ring Piping (Lauer Patent)**

To ensure a high permeate quality it is crucial to have a complete and continuous flow in the whole water treatment system. In this case, stub hose connections from the primary ring piping to the dialysis machine are a weak point of the system, as these are dead spaces. Stagnant permeate triggers the proliferation of a biofilm, resulting in a retrograde contamination of the primary ring. The dead space free Aquaboss® secondary ring piping (Lauer Patent) always ensures a constant permeate flow up to the dialysis machine.

**Flow Through Heater**

An increasing demand of hot disinfection goes in line with different system solutions. One approach was the Aquaboss® Hot Rinse Smart 300/500, which is a hot tank disinfection system. All tank systems have stagnant permeate and dead spaces. Consequently, the Aquaboss® Hot Rinse flow through heater was successfully launched to ensure a dead space free system.

**Steam Sterilization / AutoClav**

By definition, disinfection is the elimination of pathogenic bacteria. Even though hot disinfection is a good solution for inactivating bacteria, it is a matter of fact that 90°C hot water cannot inactivate all dangerous pathogens. The Aquaboss® AutoClav Solution provides 150°C steam sterilization and currently is the world’s only safe solution for eliminating all microorganisms (bacteria, viruses, fungi) and prions in the field of dialysis. Aquaboss® AutoClav offers a sterile system from the time of installation. An autoclaving is performed once a year as a safety measure as part of an extended maintenance agreement, which results in lower follow-up costs compared to a conventional system.

**Resistance level**

<table>
<thead>
<tr>
<th>Resistance level</th>
<th>Organism/pathogen</th>
<th>Temperature in °C (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Pathogenic streptococci, listeria, polio viruses</td>
<td>61.5</td>
</tr>
<tr>
<td>II</td>
<td>Most vegetative bacteria, yeasts, mold, all viruses except for Hepatitis B</td>
<td>80</td>
</tr>
<tr>
<td>III</td>
<td>Hepatitis B viruses, most fungal spores</td>
<td>100</td>
</tr>
<tr>
<td>IV</td>
<td>Bacillus anthracis spores</td>
<td>105</td>
</tr>
<tr>
<td>V</td>
<td>Bacillus stearothermophilus spores</td>
<td>121</td>
</tr>
<tr>
<td>VI</td>
<td>Prions</td>
<td>137</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150°C steam sterilization</td>
</tr>
</tbody>
</table>

Cost effectiveness

- Complete Stainless Steel Construction
  Highest durability/longest lifetime!

- Double Stage
  Impulse Backwashing

Aquaboss® RO devices are high quality products and are all manufactured from stainless steel. They are extremely reliable and have an outstanding long life cycle. As water costs comprise approximately one quarter of the total life cycle costs, the water consumption of the device needs to be seen as a crucial factor. Due to its innovative technology, Aquaboss® RO devices reduce the water consumption by approximately 40%, compared to competitor systems. In addition to this, life cycle costs will be reduced by a longer membrane usage (impulse backwashing) and a minimum need of chemical disinfections.

- Flow Through Heater
  Tank systems for hot disinfection have stagnant permeate. Therefore, it is necessary to always maintain the permeate temperature at 90°C to reduce the risk of bacterial growth. In contrast to this, a flow through heater ensures continuous recirculation and only heats up the permeate during hot disinfection. Consequently, the Aquaboss® Hot Rinse Smart reduces the energy costs against a tank system by up to 80%.

- Process Visualization & Optimization
  Aquaboss® Vision is an online monitoring system for all Aquaboss® medical devices. The software provides for the visualization of operating parameters and displays the status and digital readings of all the sensors. The possibility to exchange log files and to track the operation status online leads to quick fault finding and error prevention. Thus Aquaboss® Vision helps to provide cost-effective maintenance as well as an optimized and paperless process for the user.

### Water cost savings

<table>
<thead>
<tr>
<th>Water cost savings</th>
<th>€120,000</th>
<th>€100,000</th>
<th>€80,000</th>
<th>€60,000</th>
<th>€40,000</th>
<th>€20,000</th>
<th>€0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquaboss® EcoRO Dia-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquaboss® Hot Rinse Smart</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Assumptions:**
- 27 dialysis patients
- 12,000 treatments p.a.
- Life time: 10 years
- Water costs: €0.2/m³

### Energy cost savings

<table>
<thead>
<tr>
<th>Energy cost savings</th>
<th>€30,000</th>
<th>€20,000</th>
<th>€10,000</th>
<th>€0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquaboss® Hot Rinse Smart</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Assumptions:**
- 25 dialysis machines
- Operating lifetime: 10 years
- Estimated energy costs: €0.2 per kWh

Flexibility

- Modular System
  The Aquaboss® RO portfolio not only enables the user to easily expand the system but also guarantees the upgradability of the RO device. For this reason, it is feasible to start with a state-of-the-art Single Stage RO and upgrade the system – e.g. in case of raising standards – to the next quality level later. As a result, the Aquaboss® portfolio shows a high grade of flexibility and already meet tomorrow’s demands today.

- Choice of Different Ring Loop Solutions
  Depending on customer needs and requirements, the Aquaboss® portfolio includes all types of materials – from the conventional PVCU and PEX up to the stainless steel gold standard. In addition, the user has a choice of two different ring loop solutions. The first option is a conventional stub connection, whereas the second choice ensures a dead space free and complete permeate recirculation up to the dialysis machine.

- Media Providing Centers
  The Aquaboss® portfolio offers a wide range of different media providing panels. The Aquaboss® Flex represents Lauer’s latest innovation, providing a permeate supply to the dialysis machines without hoses and tubes on the ground. This results in an increased hygiene of the dialysis center. An additional advantage will be a clear separation between permeate and drain. Furthermore, the user can easily choose between different concentrates by using a selection switch.
Lauer – B. Braun’s partner for complete water treatment solutions

- Professional consultation and planning of the overall concept
- Pre-treatment
- Modular Reverse Osmosis Systems
- Disinfection and sterilization options
- Dialysis water ring piping solutions
- Central concentrate supply facilities
- Media providing centers
- Process visualization
- Water accessories (e.g. online hardness monitoring)
- Technical service
- Training

B. Braun
- Professional consultation
- Dialysis machines
- Data Management System
- Dialyzers
- Blood tubing systems
- Dialysis concentrates
- Rinsing solutions
- Complete range of disposables
- Technical service
- Training

Aquaboss Dead Space Free Secondary Ring Piping

Media Providing Centers

Dialysis unit

Process Visualisation

Central Concentrate Supply

Modular Reverse Osmosis

Pre-treatment

Different Disinfection and Sterilization Solutions