

# Aquaboss®

## Dialysis water purification

**Lauer**  
Medical Water Purification  
a B. Braun company



Avitum

**B | BRAUN**  
SHARING EXPERTISE

# Quality of Life

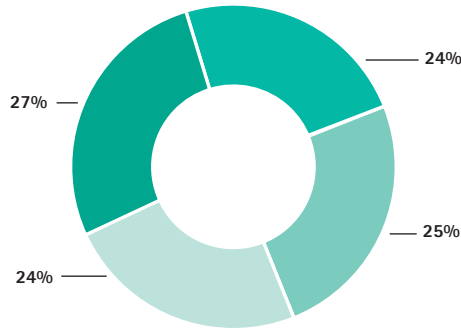
During hemodialysis treatment patients are exposed to large quantities of dialysis fluid, which is comprised of more than 99,3% of water, only separated from the patient's blood by a non-selective dialyzer membrane. Clinical data show that contaminants in dialysis water are contributory factors for acute 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.



\*Cannata-Andia, JB, Fernández-Martin, JL. The clinical impact of aluminium overload in renal failure. *Nephrol Dial Transplant* 17 [Suppl 2]: 9-12, 2002 | Usuda, K, Kono, K, Yoshida, Y. The effect of hemodialysis upon serum levels of fluoride. *Nephron* 75:175-178, 1997 | Calderaro, RV, Heller, L. Outbreak of hemolytic reactions associated with chlorine and chloramine residuals in hemodialysis water. *Rev Saude Publica* 35:481-486, 2001 | Yamagami, S, Adachi, T, Sugimura, T, Wada, S, Kishimoto, T, Maekawa, M, Yoshimura, R, Niwa, M, Terano, Y, Shaldon, S. Detection of endotoxin antibody in long-term dialysis patients. *Int J Artif Organs* 13:205-210, 1990

# Cost effectiveness

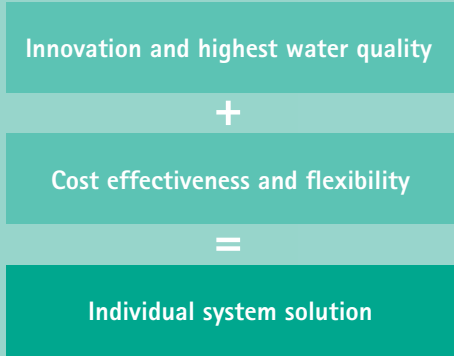
In addition to striving to achieve the best possible treatment outcome, healthcare systems face financial strain all over the world. Depending on the system configuration, pure investment costs for water treatment systems only comprise approximately one quarter of the total life cycle costs. Due to this, 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.



## Total Costs of Ownership

- Capital costs RO and hot disinfection system
- Water costs
- Energy costs
- Service and maintenance

**Assumptions:**  
76 patients and 12,000 treatments per year, 210 liters permeate per dialysis treatment, 15 years operating life, Water costs: € 2/m<sup>3</sup>



Lauer has been a company completely focused on dialysis water purification for almost 20 years. The Aquaboss® portfolio differentiates itself from its competition through superior technology and many patented features.

Today, Lauer is a B. Braun company. Both companies have enjoyed a strong partnership in the dialysis market for a number of years. The acquisition marks B. Braun's

response to increasing demands for dialysis products and services from a single source. 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

Reverse Osmosis Systems

## ■ Aquaboss® Reverse Osmosis Systems

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

|            | I<br>Single Stage    | Stations<br>(with 500 ml/min) | II<br>Double Stage    | Stations<br>(with 500 ml/min) |
|------------|----------------------|-------------------------------|-----------------------|-------------------------------|
| RO Dia LCC | 210-900 l/h at 6 °C  | 6-25                          |                       |                               |
| RO Dia C   | 500-3000 l/h at 6 °C | 14-90                         | 500-1600 l/h at 6 °C  | 14-45                         |
| RO Dia     |                      |                               | 1800-3600 l/h at 6 °C | 50-120                        |

RO Dia LCC



RO Dia / RO Dia C



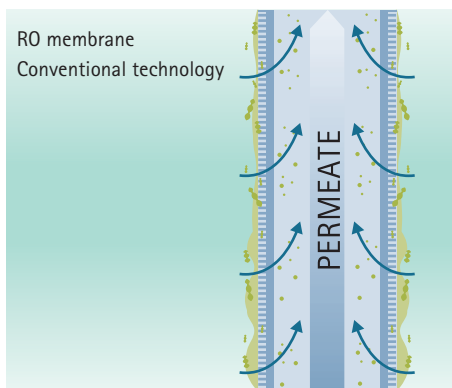
Generally Aquaboss® reverse osmosis systems are characterized by an efficient water consumption. Innovative water saving technology enable best use of freshwater resource. In addition to this, the RO Dia / RO Dia C series are available as complete heat disinfectable reverse osmosis systems. This allows a chemical free disinfection for high patient safety and environmental compatibility.





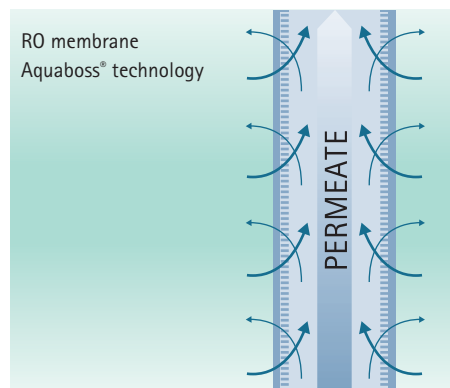
**Conventional technology:**

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.



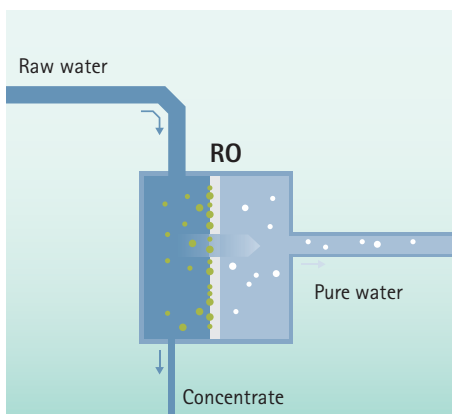
■ **Impulse Backwashing (Lauer Patent\*)**

Raw water contains dissolved and undissolved substances. Over time, those 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.

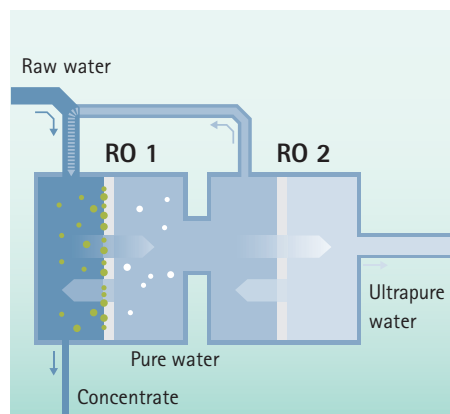
**Single Stage RO:**

Single Stage RO with high water conversion.



**Double Stage RO System:**

Redundant RO System that increases chemical and microbiological permeate quality and delivers additional water savings.



■ **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. The Aquaboss® double stage systems provides a 100% redundancy the same as that delivered by two independent single stage systems. Due to this Aquaboss® double stage systems reduce a breakdown and interruption of dialysis treatment to a minimum.

\* 93 912 821.1-2113 and other patents or patent applications

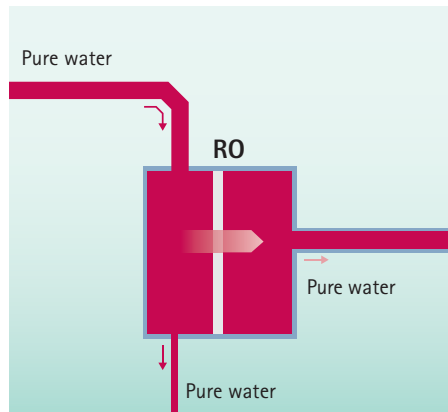
# Innovation and highest water quality

Reverse Osmosis Systems

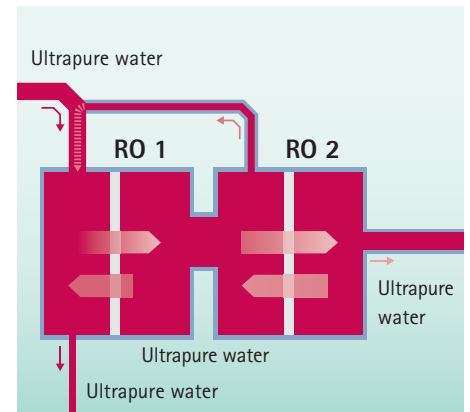
## Hot Total (HT)

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.

Single Stage RO



Double Stage RO System

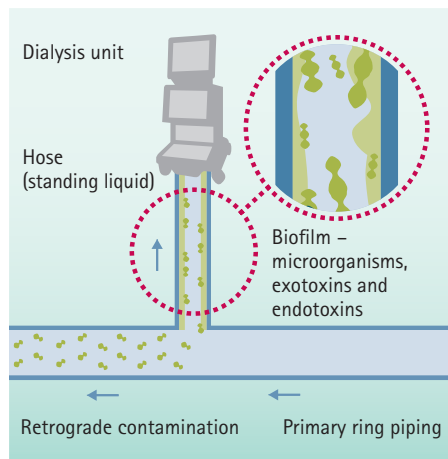


Distribution Systems

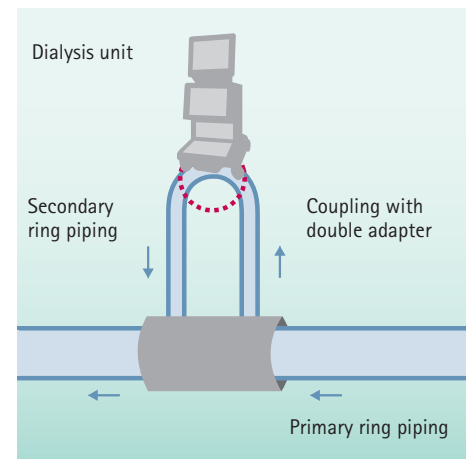
## Dead Space Free Secondary Ring Piping (Lauer Patent\*)

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.

Conventional technique



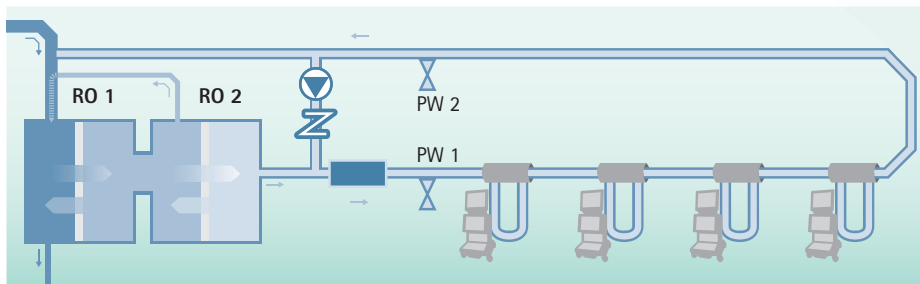
Advanced Aquaboss® technique



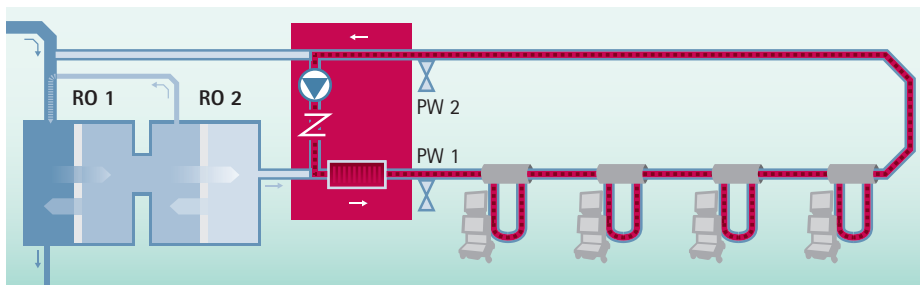
\* P 43 41 456.7-09 and other patents or patent applications



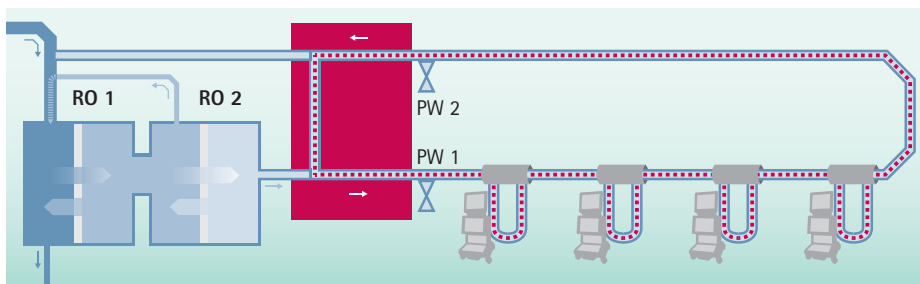
## Dialysis time / dialysis free time



## Hot disinfection 90°C



## Hot disinfection 150°C



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

## 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.

Walter Steuer, F. Schubert Hrsg, Leitfaden der Desinfektion, Sterilisation und Entwesung (8. Auflage. Behr's Verlag Hamburg) | Helmut Hahn, Stefan H. E. Kaufmann, Thomas F. Schulz, Medizinische Mikrobiologie und Infektiologie (6. Auflage 2009. Springer Medizinverlag Verlag Heidelberg)

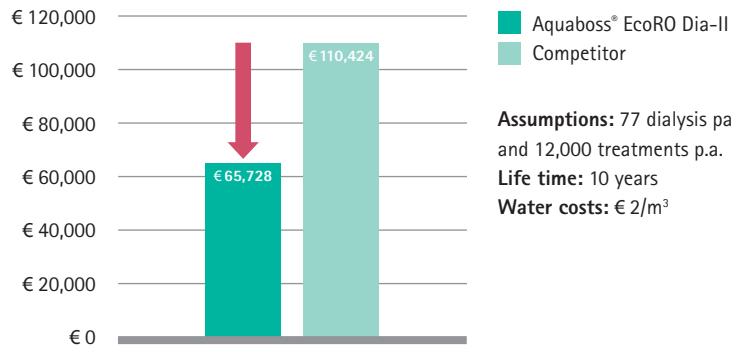
# Cost effectiveness

Reverse Osmosis Systems

- **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.

## Water cost savings



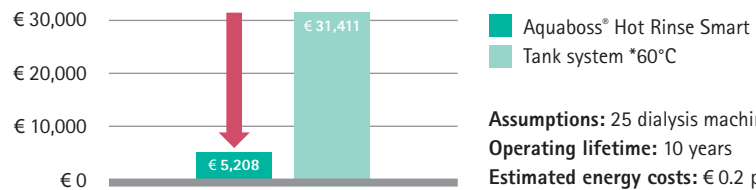
**Assumptions:** 77 dialysis patients and 12,000 treatments p.a.  
**Life time:** 10 years  
**Water costs:** € 2/m<sup>3</sup>

Disinfection Systems

- **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%.

## Energy cost savings

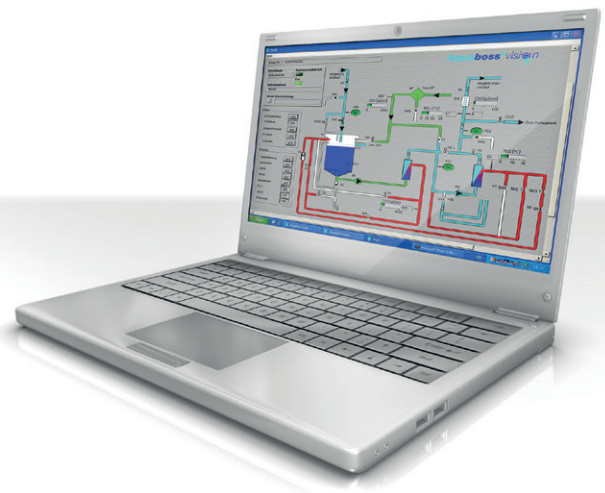


**Assumptions:** 25 dialysis machines  
**Operating lifetime:** 10 years  
**Estimated energy costs:** € 0.2 per kWh

Process Visualization

- **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.





# Flexibility

| I<br>Single Stage                            | Eco<br>(including impulse<br>back washing) | II<br>Double Stage     | Hot Total |
|--|--|------------------------|-----------|
| <b>Single Patient Unit</b><br>70 l/h at 10°C | ✓  |                        |           |
| <b>RO Dia LCC</b><br>210–700 l/h at 6°C      | ✓  |                        |           |
| <b>RO Dia C</b><br>700–3600 l/h at 6°C       | ✓  | 700–1600 l/h<br>at 6°C | ✓         |
| <b>RO Dia</b><br>700–3600 l/h at 6°C         | ✓  | 700–3600 l/h<br>at 6°C | ✓         |

**Upgradability**

## ■ Modular System

The Aquaboss® RO portfolio not only enables the user to easily expand the system but also ensures 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 meets tomorrow’s demands today.

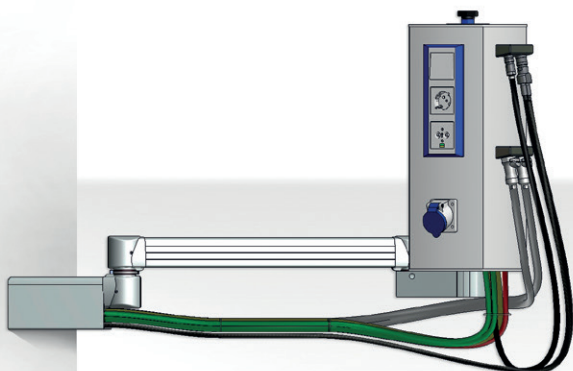
|  | PVCU | PEX | Stainless Steel |
|--|------|-----|-----------------|
| <b>Stub connection</b>                       | ✓    | ✓   | ✓               |
| <b>Dead Space Free Secondary Ring Piping</b> | ✓    | ✓   | ✓               |

## ■ 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.

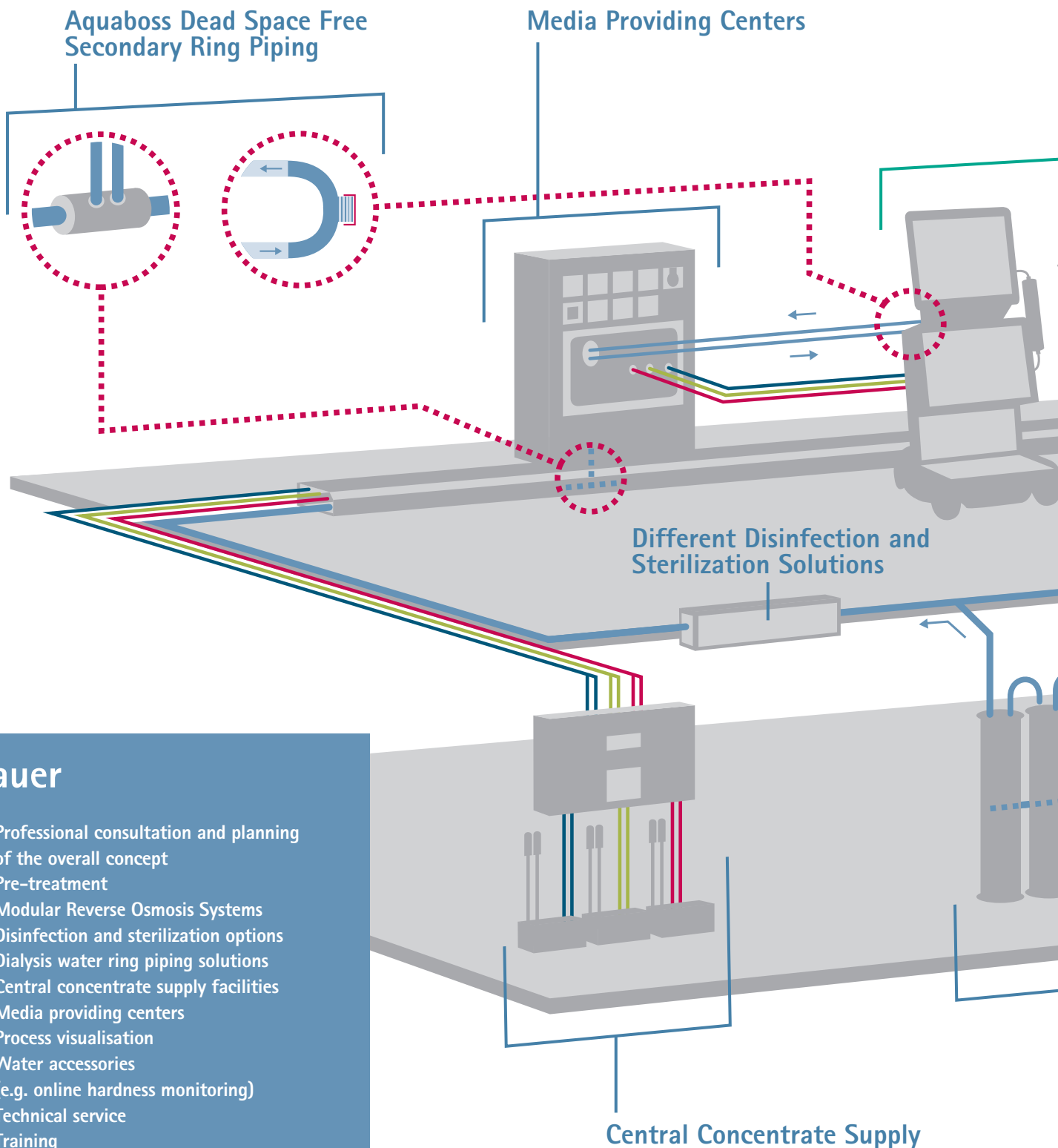


Reverse Osmosis Systems

Ring Loop

Media Providing Centers

# Lauer – B. Braun's partner for complete water treatment solutions



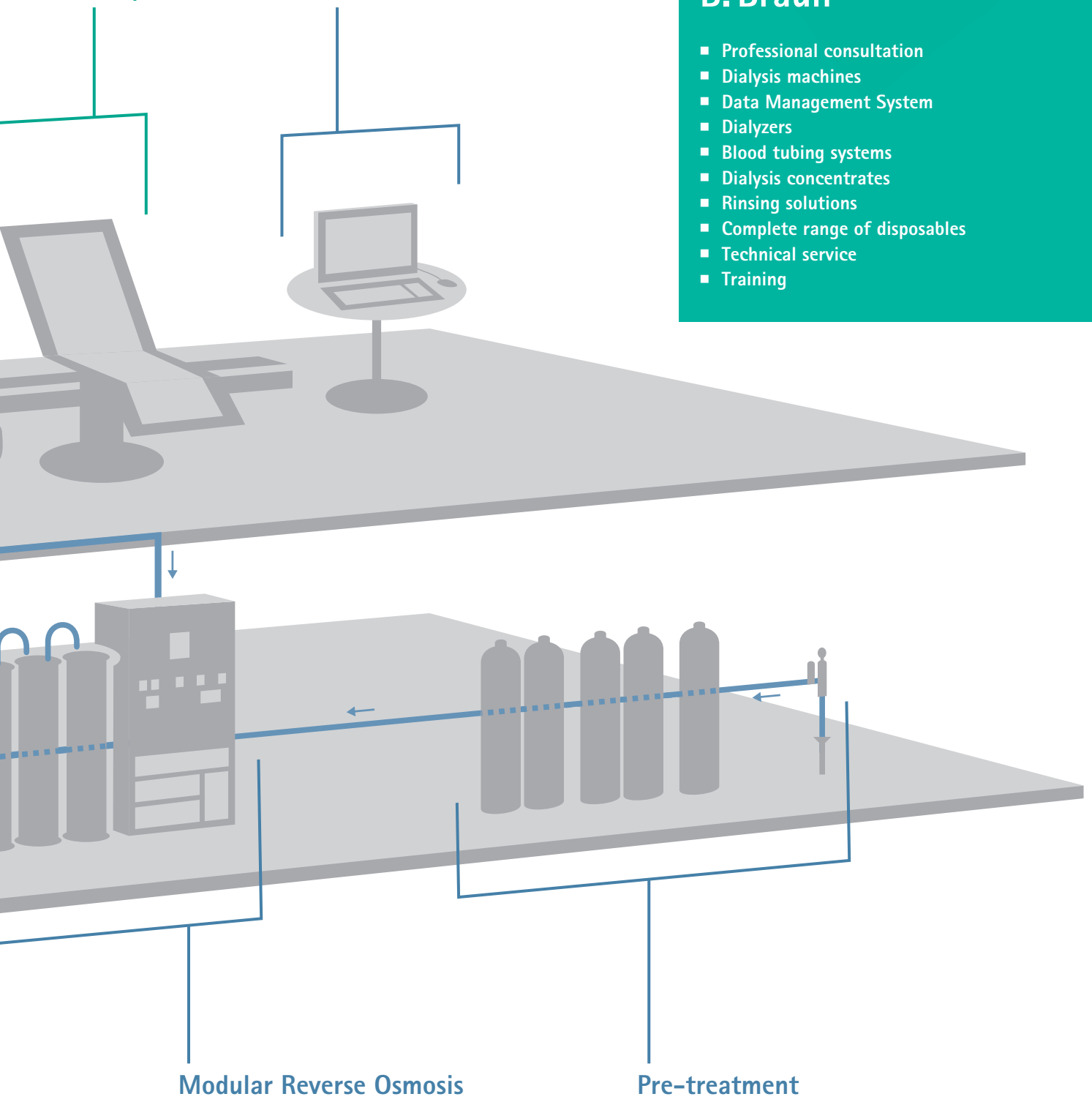
## Lauer

- 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 visualisation
- Water accessories (e.g. online hardness monitoring)
- Technical service
- Training



Dialysis unit

Process Visualisation



## B. Braun

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

