WATER TREATMENT

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INTRODUCTION

Water is an essential element of life and an important component of dialysis therapy, where it is used in the preparation of dialysis fluid and when dialyzers are reused. The water used for these applications originates as **drinking water**, that is, water which safe to drink, contains no harmful contaminants or pathogenic organisms, and is aesthetically pleasing in regard to taste, odor, and appearance.

The Implications of Water Quality in HemodialysisRENAL RESEARCH INSTITUTE SYMPOSIUMSeminars in Dialysis—Vol 16, No 6 (November–December)
2003 pp. 492–497

INTRODUCTION

<u>However, all sources of drinking water contain contaminants;</u> these may be present **naturally** or as a consequence of **human activity**. To ensure that water is safe to drink, within the United States the **Environmental Protection Agency (EPA)** administers the **National Primary Drinking Water Regulations** (NPDWRs or primary standards), legally enforceable **standards** that **apply to public water systems**.

The standards define the maximum contaminant levels or the highest permitted contaminant level for more than 80contaminants (1).

INTRODUCTION

Patients with renal failure are **not only exposed to higher volumes of water in their lifetime than the general population**, but the **barrier between blood and dialysis fluid is generally in the form of a nonselective semi-permeable membrane, providing a direct route for any contaminants into the bloodstream.**

Consequently many of the permitted levels of contaminants in drinking water have the potential to cause problems in dialysis patients.

The Implications of Water Quality in HemodialysisRENAL RESEARCH INSTITUTE SYMPOSIUM, Seminars in Dialysis—Vol 16, No 6 (November–December) 2003 pp. 492–497

INTRODUCTION

Historically water used in dialysis was softened to minimize the occurrence of *hard water syndrome*. **Awareness of clinical problems** led to the introduction of additional treatment such as deionization, reverse osmosis, and carbon filtration, as well as the development of ***national and international standards for water contaminant levels in water used for the preparation of dialysis fluid (Association for the Advancement of Medical Instrumentation [AAMI] standard for the United States, European Pharmacopoeia in Europe, and ISO13959).***

INTRODUCTION

The **rationale** used in the development of these standards is similar, and there is **general agreement** in the maximum permitted contaminant levels.

TABLE 1. Common symptoms during dialysis and water contaminants capable of causing them

Symptom	Water contaminant
Anemia	Aluminum, chloramine, nitrate, lead, copper, zinc, silicon
Bone disease	Aluminum, fluoride, silicon
Hypertension	Calcium, magnesium, sodium
Hypotension	Bacteria, Endotoxin, Nitrate
Acidosis	Low pH, sulfate
Muscle weakness	Calcium, magnesium
Nausea/vomiting	Bacteria, endotoxin, chloramine, low pH, nitrate, sulfate, calcium, magnesium, copper, zinc
Neurologic disturbances	Aluminum, lead, calcium, magnesium

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TABLE 2. Influence of water treatment upgrade on patient biochemical and hematologic parameters

Parameter	Before upgrade	After upgrade	*p*
Monthly erythropoietin dosage[a] (U)	85,800 (70,000)	82,500 (731,500)	NS
Monthly intravenous iron dosage[a] (mg)	100 (350)	125 (400)	NS
Hemoglobin[b] (g/dl)	10.9 ± 1.4	11.3 ± 1.2	<0.0001*
Erythropoietin/hematocrit ratio[a]	8134 (6929)	7095 (7407)	0.07
Albumin[b] (g/dl)	3.9 ± 0.37	3.94 ± 0.36	0.0002*
Ferritin[a] (ng/ml)	251 (389)	355 (429)	<0.0001*
Transferrin saturation[a] (%)	26.0 (14.5)	30.5 (17.3)	<0.0001*
Creatinine[b] (mg/dl)	10.6 ± 3.3	10.1 ± 3.1	<0.0001
White blood cell count[b] ($\times 10^3/\mu l$)	6.5 ± 2.1	6.5 ± 1.9	NS
CRP[a]	14.3 (21.0)	12.2 (19.6)	<0.0001*

[a] Nonnormally distributed variable: median (interquartile range) shown along with *p*-value based on signed rank test.

[b] Normally distributed variable: mean ± SD shown along with *p*-value based on paired *t*-test.

* Statistical significance based on Bonferroni adjusted α of 0.0045.

INTRODUCTION

Water purity for dialysis is of critical importance for patient health and outcome, and in this regard there are three major points to consider:

Hemodialysis International 2005; 9: 127–134

Introduction

1) **Hemodialysis (HD) patients** are exposed to more than **400** L of water per week. Contrast this with a person with normal kidney drinking only less than **15** L of water per week.
2) The **stomach acid** and **intestinal barrier** protect from the ills of contaminated water more effectively than the barrier imposed by the dialyzer membrane.
3) **The functioning kidney** can **further protect** the normal individual from the contaminants of water by eliminating these, **this protection being absent for the HD patient.**

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INTRODUCTION

Thus the regulations governing the purity of drinking water are further modified by the above considerations:

<u>**exposure of only 10 to 15 L per week and the efficacy of gut and kidney to protect the individual**</u>. **Whereas the dialysis water is regulated by more strict purity guidelines, failure in observing any of these guidelines has had disastrous consequences**. The use of modern **more permeable dialyzer membranes** has **increased the risk of water contamination**, and **more stringent purity standards must be** strictly followed to avoid harm to the patient.

WATER CONTAMINANTS

The contaminants can be divided into three major categories:

1) **particulate matter**,
2) **chemicals**
3) **microorganisms and endotoxins.**

1- **Particulate matter** (Figure 1, P):

These cause turbidity and include clay, iron, sand, chalk, silica, etc.

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WATER CONTAMINANTS

2- **Chemicals**: These include **dissolved inorganic ions and salts** (Figure 1, I) such as **Na, Cl, Al, Ca, Mg, and Fl**. **Organic matter includes** (Figure 1, O) **industrial and agricultural toxins such as fertilizers, pesticides, and oils.**

3- **Microorganisms** (Figure 1, M) and **endotoxins** (Figure 1,E):

These include predominantly bacteria and occasionally fungi, viruses, protozoa, spores, and endotoxins produced by the organisms.

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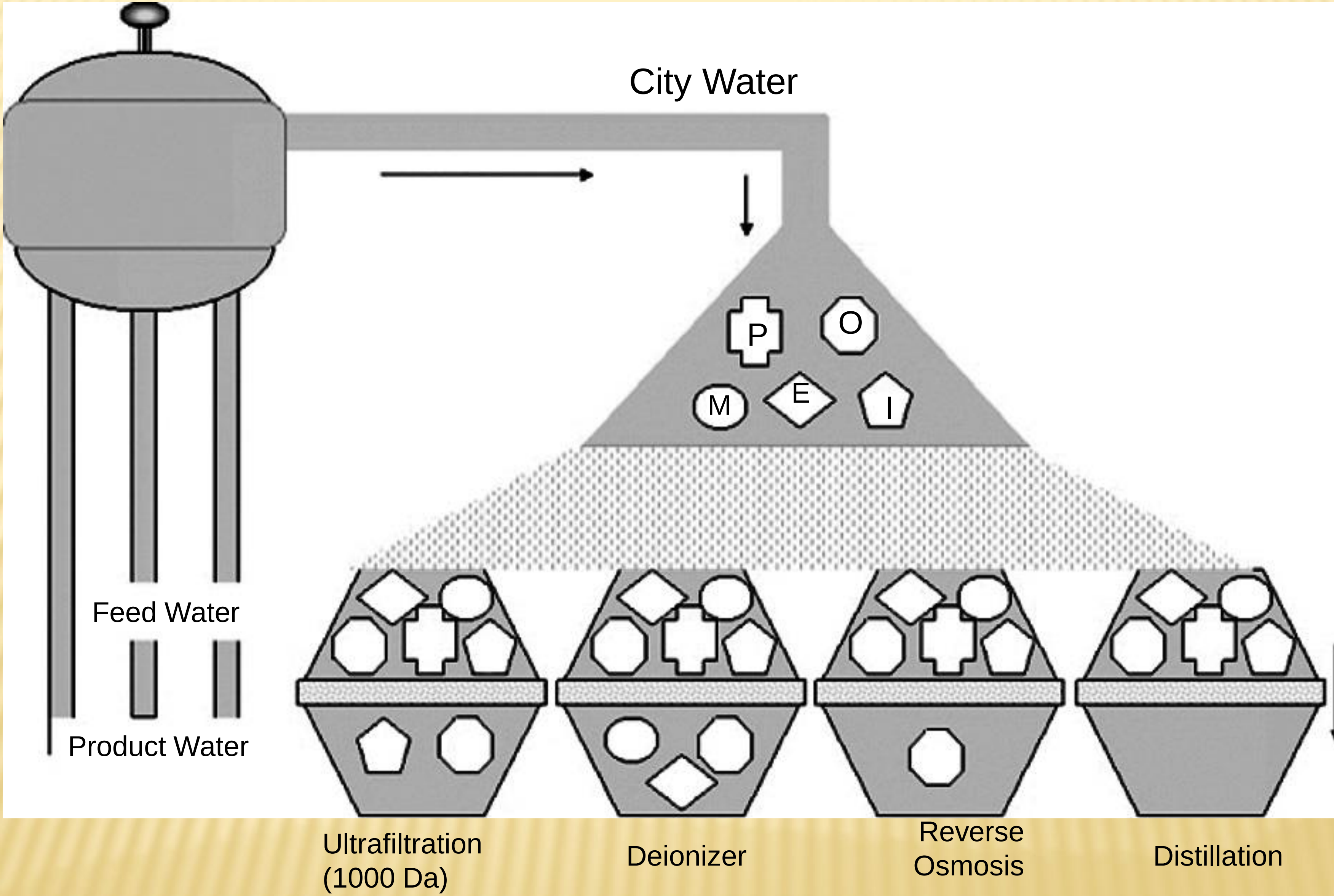
DEVICES TO CLEAN WATER

Figure 1 shows various methods of cleaning water and the quality of product water from these devices. The most effective method, distillation, is not used for dialysis water for two major reasons: it requires large amounts of energy and the yield is relatively small compared to the rate of required water consumption.

DEVICES TO CLEAN WATER

Table 1 summarizes the advantages and disadvantages of all the purification methods. It is clear that not any single method purifies water completely, and a combination of several devices is needed to produce water that can be used for dialysis.


City Water
P
O
M
E
I
Feed Water
Product Water
Ultrafiltration
(1000 Da)
Deionizer
Reverse
Osmosis
Distillation

TYPICAL WATER TREATMENT SYSTEM

The design of a water treatment system is dependent on the quality of feed water and local requirements of the purity standards. One typical scheme commonly used is shown in Figure 2; this system will be first discussed and then common variations would be further elaborated.

BACKFLOW-PREVENTING DEVICE (BFD)

The feed in water first comes in the unit and goes through a backflow-preventing device; this is essentially a valve that prevents the dialysis unit water flowing back into the city/building supply water. Often this device is supported by an additional booster pump that helps maintain the necessary minimum pressure despite fluctuating pressure and flow from the feed line.

TEMPERATURE-BLENDING VALVE (TBV)

The reverse osmosis (RO) unit works most efficiently if feed water temperature is 77F. A heater and blending valve assures a constant desired temperature by blending heated water with cold water. This unit is sometimes placed right at the beginning of the water system and sometimes more distally.

FILTERS

A series of increasingly tighter filters (with smaller pores) are placed in the water line. In Figure 2, these are *shown* as F-1 through F-4 with the filter size listed in micrometers.
The very first, F-1, is basically to remove large particulate matter from the feed water and often this includes mud with large silica and clay particles.

ACTIVATED CARBON FILTERS (TANK/ COLUMN

Granules of activated carbon are packed in a cartridge and water is allowed to flow around these granules. The microporous structure of the carbon permits adsorption of organic matter and chlorine and chloramines over its large surface area relative to weight. Activated carbon columns are not effective filters. The carbon columns tend to release "fines," which are abrasive particles

ACTIVATED CARBON FILTERS (TANK/ COLUMN

A series of microfilters (F-2, F-3) are inserted after the carbon column to remove these fines. Often there are two activated carbon tanks in series: the first is called the primary and second the polisher carbon tank (not shown in Figure 2). Two very important issues related to carbon filters are the exhaustion of the carbon and the growth of microbial organisms. The exhaustion of the adsorptive capacity leads to increased concentrations of chlorine, chloramines, and organic matter in the postcarbon water.

ACTIVATED CARBON FILTERS (TANK/ COLUMN

To prevent this, the post carbon water should be monitored for chlorine and chloramines, and its presence in concentrations beyond the acceptable range (Table 2) should lead to the change of carbon filter. The carbon columns are a major source of bacterial and endotoxin contamination because the porous surface, the presence of organic matter, and the removal of chlorine all favor microbial growth. Monitoring of the carbon filter and periodic flushing with chlorine keeps the microorganism growth under control.

WATER SOFTENER

To protect the downstream water treatment device of choice, reverse osmosis (RO) or deionizer (DI), large concentrations of divalent cations must be removed from the water. The high concentrations of Ca and Mg in the city water cause hardness and limit the life of DI or RO devices.

WATER SOFTENER

Water softeners use resin beads fixed with Na. As water is allowed to pass around these fixed-bead cations in water (Ca, Mg, iron and manganese) are exchanged with Na, thus making the product water softer with <1 parts per million (ppm) total hardness (Figure 3). The softener needs constant monitoring of the quality of softness/hardness and periodic regenerating by flushing with brine. The water softener also is a major site for microorganism growth and potential for downstream seeding. To prevent this periodic back-flushing and use of sodium hypochlorite solution is employed

FINAL WATER PURIFICATION DEVICE

After the above-discussed pretreatment devices, the final purification of water is achieved by the use of either RO or mixed-bed DI. The advantages and disadvantages of these two devices are listed in the Table 1. Some units use both devices, either in a series, less commonly, or more commonly, a DI as a back up for the reverse osmosis.

RO SYSTEM

RO is the most cost-effective method for water purification from both organic and inorganic solutes, including organisms and endotoxins. This is a filtration process of water across a very tight membrane with ionic rejection of 90% to 99%. When water is filtered across this tight membrane, the filtered water is called “permeate” or “RO water” and water containing rejected solutes and other substances is called “rejection,” “concentrate,” or “brine.”

RO SYSTEM

The osmolarity of brine (containing solutes) is a lot higher than the osmolarity of permeate; normally the water would move from permeate to brine because of higher osmotic pressure. Enough mechanical force (hydraulic pressure) with a pump, however, is applied on the brine side; water is thus forced (filtered) against the osmolar force across the membrane. <u>RO membranes are like dialyzer membranes except the pores are so small that they do not even allow any solute including Na or other ions and any organic matter (Figure 4).</u>

RO SYSTEM

Three different types of membranes, cellulosic, synthetic, and thin composite membranes, similar to dialyzers, are fitted in different designs, parallel plates, hollow fibers, or spiral wounds.

RO SYSTEM

Chlorine, chloramines, the pH of water, disinfectants, and bacteria all potentially destroy the membrane. Chemicals are more harmful to synthetic membranes and bacteria to cellulosic membranes, and generally composite membranes are more resistant.

The performance of the RO membrane must be monitored by measuring the resistivity of the RO water.

RO SYSTEM

Pure water is highly resistant to an electrical current; this electrical conductivity increases if more ions are present. The acceptable production to rejection ratio is >0.85; a value below 0.80 means that the membrane must be changed. The rejection ratio is calculated from conductivity in the feed water and the product (RO) water, by using the formula, 1 – (RO water conductivity/feed water conductivity)100.

RO SYSTEM

Conductivity is dependent on total dissolved solutes in parts per million (ppm).
If after 6 months the feed water conductivity is unchanged but the RO water conductivity increases to 20, this means that the rejection ratio is only 80% and it is time to change the membrane.

DI

This process removes inorganic ions dissolved in the water by an ion-exchange process using cationic and anionic resins. When water is passed through the DI first, the cationic resin exchanges dissolved cations (Na, Ca, Al, Mg, etc.) with H ions (Figure 5).
Water containing H ions and very little other cations then percolates around the anionic resin where the dissolved anions are exchanged with OH– ions, and H and OH– ions combine to form pure water, free of all cations and anions. This product water has high resistivity (> 1 MOhm/cm); monitoring of resistivity alerts if
resin beds are exhausted because the presence of inorganic ions would decrease the resistivity of the water.

DI

The resins are regenerated by using HCl and NaOH or bleach. **DI are very effective in removing inorganic ions but are ineffective in removing organic and other contaminants.** **In fact, DI may become a site for bacterial growth and may lead to downstream contamination**. The DI described above is a mixed-bed solid-phase DI.

The continuous electric deionizer (CDI) is the other type of DI recently being used that utilizes electric current and ionexchange membranes and resins to remove ions from water. **CDI produces very high quality water with resistivity as high as 20MOhm/cm. This type of DI also has less bacterial growth because of continuous water flux.**

ULTRAVIOLET (UV) TREATMENT

UV radiation is an effective way to kill all types of bacteria in all states. Its efficacy, however, depends on the depth of penetration and water flow rates. Germicidal UV lamps are commercially available but have a limited life span. UV is effective but increases lipopolysaccharides and fragments by bacterial killing. UV alone is not an effective water treatment device and is normally used in conjunctionwith DI and should be followed by ultrafiltration to remove bacterial fragments.

WATER DELIVERY LOOP

Purified water is run through the dialysis unit in a loop as shown in Figure 2, the terminal end of the loop ending in the pipe feeding water into the RO or DI unit. Dialysis machines are connected to this loop in parallel withdrawing water for proportioning with dialysate concentrate.

The second arrangement is shown in Figure 6 where the purified water is delivered into a holding tank from which the water is pumped into the distribution loop that returns water back into the tank.

MATERIAL FOR PIPE AND FITTINGS

Substances for water pipes and surfaces exposed to water can leach in the water and have been known to cause toxicity in dialysis patients. For example, copper intoxication from copper pipes and the accumulation of aluminum dissolved in water has happened. It is therefore required, that all the water pipes in dialysis units should be free of metals and are constructed of polyvinylchloride. Similarly, all the surfaces exposed to water such as storage tank or casings of the devices should be constructed of materials that do not readily leach in the water

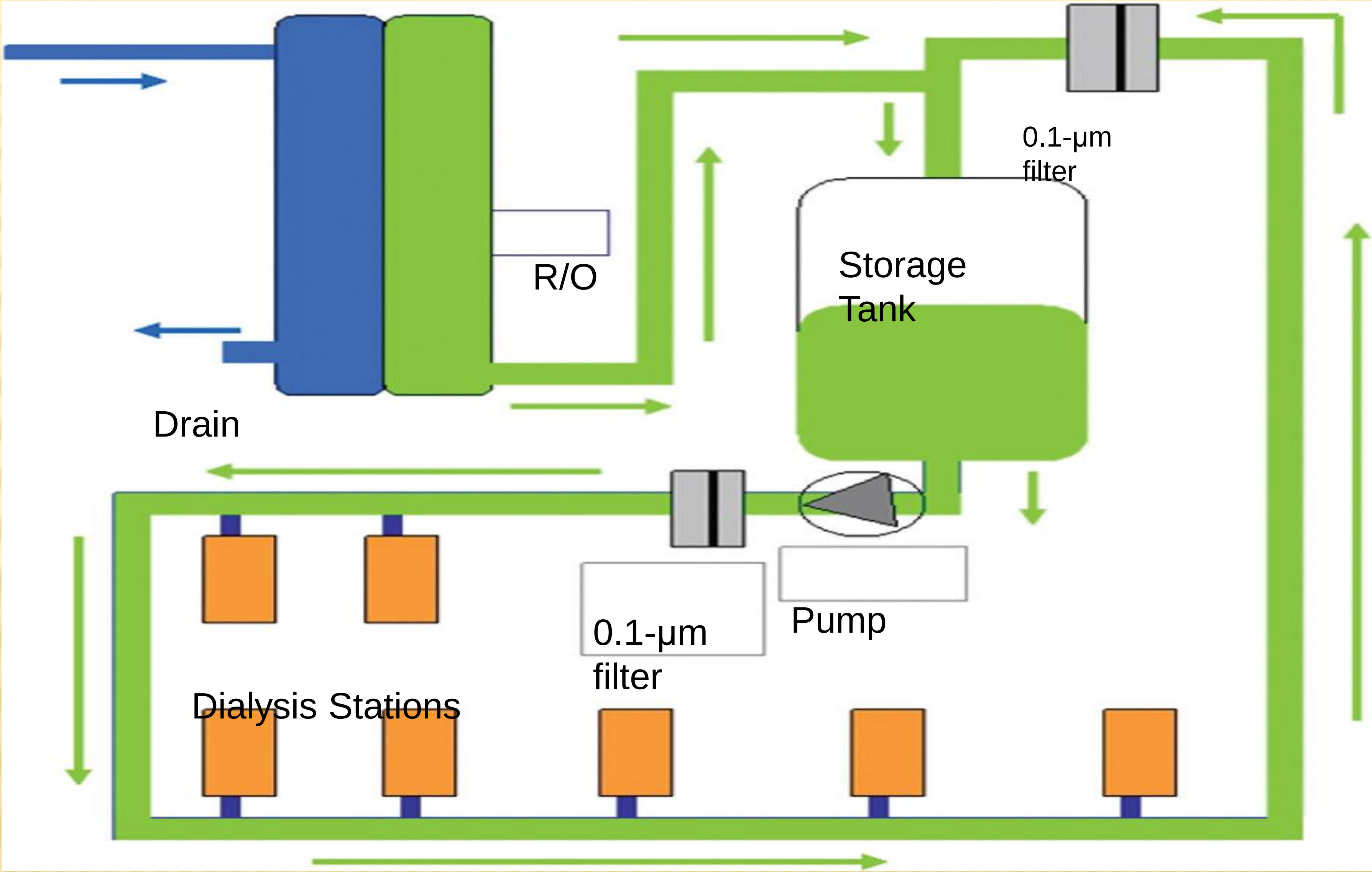


Figure 6 Water loop connected to a storage tank.

WATER QUALITY STANDARDS

Even in the early days of dialysis it was known that soft water should be used to avoid problems with excess Ca and Mg, the “hard water syndrome.” With time, the clinical syndromes associated with accumulations of various ions coming from the water gradually forced tighter purity standards. Most dramatic and damaging was the aluminum intoxications causing severe morbidity and even mortality. As we learn more about the harmful effects of less pure water, particularly with the use of very permeable dialyzers, the purity standards are becoming more stringent.

At present, the water purity standards can be divided in three broad categories:

1 Standards for inorganic solutes;

2 Standards for microorganisms and other organics; and

3 Standards for lipopolysaccharide and endotoxins.

STANDARDS FOR INORGANIC SOLUTES

Table 2 describes the clinical effects of accumulation of various inorganic substances and the acceptable maximum concentrations in dialysis water (as recommended by Advancement of Medical Instrumentation [AAMI]).

Evolution of knowledge about water-related clinical problems is quite interesting and often based on anecdotal experiences. Some of the important clinical issues would be discussed in the following examples.

ALUMINUM INTOXICATION

Outbreaks of unexplained, progressive dementia often leading to death occurred in areas with significant aluminum contamination of local water supply. Also noted was the higher prevalence in units not using adequate water purification systems. **One of the most interesting incidences occurred in Portugal in 1993, when city water authorities decided to add aluminum sulfate as flocculent to remove particulate matters from the water**.

CHLORAMINE EXPOSURE

In 1987, several dozen patients in Philadelphia suffered from nausea, low blood pressure, dyspnea, and anemia.
Eventually the cause was attributed to chloramine exposure. Since then, several centers in this country and abroad have experienced problems with chloramines. Chloramine (combination of chlorine and ammonia) provides growth control at a lower cost. Often water authorities add chloramines instead of chlorine to control bacterial growth in the city water. Unfortunately it is not removed by either RO or DI.

An activated charcoal column effectively removes it; however, if water flow is very rapid or if the charcoal is exhausted the removal of chloramines is ineffective, leading to the exposure of patients. Several states have mandated that chloramine levels must be checked in the product water frequently (every day to every shift of dialysis).

Taken orally chloramine does not cause any clinical problems; however, in the blood it leads to oxidation of hemoglobin and destruction of red cells by spleen resulting in Heinz body anemia. Acute intravascular hemolysis can be recognized by noting dark blood in the blood lines, shortness of breath, palpitation, headache, vomiting, and severe anemia. Laboratory evidence of hemolysis, Heinz body anemia, is suggestive and the presence of chloramines in water or dialysate is confirmatory. Other causes of hemolytic anemia in this population are exposure to copper and nitrate (Table 2).

Fluoride exposure

Fluoride is added to city water and if not removed can cause toxicity. Normally the RO and DI remove fluoride. In contrast, if anion resin in the mixed-bed DI, which normally exchanges fluoride with OH ions, gets exhausted the anion resin then can release large quantities of bound fluoride in exchange for chloride, sulfate, and nitrate. This water with very high quantities of fluoride can cause severe intoxication or death. This happened in Chicago and within 24 hr, three patients died with arrhythmias. The problem was with the monitor light which was the same color for safe as for unsafe.

In the body, fluoride binds to calcium disrupting cell membrane leading to the leakage of potassium and hyperkalemia. The latter causes cardiac arrhythmia and death.

This hyperkalemia is refractory to the usual management including kayexelate, and the only effective treatment is zero potassium dialysis. The other earlier toxic effects of fluoride include itching, pain, gastrointestinal problems, syncope,

tetany (from hypocalcemia), and neurologic symptoms.

The standards recommended by AAMI for various inorganic solutes in the water and the potential toxic effects are listed in Table 2. It is important that close vigilance to these standards are constantly maintained to prevent major catastrophes as exemplified above.

STANDARDS FOR MICROORGANISMS AND OTHER ORGANICS

Water and dialysate do not have to be completely free of microorganisms because the dialyzer membrane provides an effective barrier to infectious agents. The AAMI recommends the maximum acceptable level of bacteria to be 200 colony forming units (CFU) per milliliter of water. The recommendation by the European Pharmacopoeia is 100 CFU/mL.

In 1996, more than 60 dialysis patients died from liver failure caused by the overgrowth of blue/green alga Microcystis aeroginosa in the water supply in Brazil. This alga produced a cyanotoxin which is potent hepatic toxin. It is clear that the water for the dialysis should be clean, pure, and free of organic contaminants.

STANDARDS FOR LIPOPOLYSACCHARIDE AND ENDOTOXINS

Endotoxin levels in water should be frequently monitored from different sites to prevent patients getting exposed to it. This leads to febrile reactions and may contribute to ongoing inflammation. The endotoxin ismonitored by a LAL test, and the acceptable level is less than 0.1 EU/mL. Recently, short DNA fragments have been found in the dialysate, capable of inducing interleukin-6 and may be responsible for chronic inflammation.1 Unfortunately, these can pass through the diayzer membrane and are undetectable by the LAL test. These oligosaccharides are the fragments of bacteria and more attention may have to be paid to these in future

MONITORING OF WATER SYSTEM

A well-planned monitoring program is the only way to prevent water-related catastrophes in the dialysis unit. The following is a very brief summary of some of the major areas of monitoring. Each unit must develop a well organized program which is specific for its situation.

MAJOR AREAS TO MONITOR ARE:

1) Water softener:

a. Total hardness in the product water: The total water hardness should not exceed 1 ppm. This should be checked once a day, preferably at the end of the day.

b. Pressure drop: If pressure drop changes more than 10 PSI between presoftener and postsoftener sites, the softener may need back-flushing. Most units have an automated setup to back-flush periodically.

c. Brine tank salt level: Next to the softener sits a brine tank that regenerates the softener periodically. It is important to make sure that the salt level is maintained in the brine tank. A timer should be installed that regenerates the tank while unit is not operating.

2) Carbon tanks:
a. Chlorine and chloramine levels after the last carbon tank, preferably each shift.
b. Pressure drop change of more than 10 PSI leading to back-flush when unit is not operating.
3) RO
a. Water pressure and flow rates through the unit to ensure optimum efficiency and life of membrane. A drop in water flow rate may mean that membrane is plugging up.
b. Resistivity and rejection ratio: As discussed above under the description of RO system.

4) DI

a. Water pressure before and after the unit: a change of more than 10 PSI may mean that tanks may be getting plugged up.

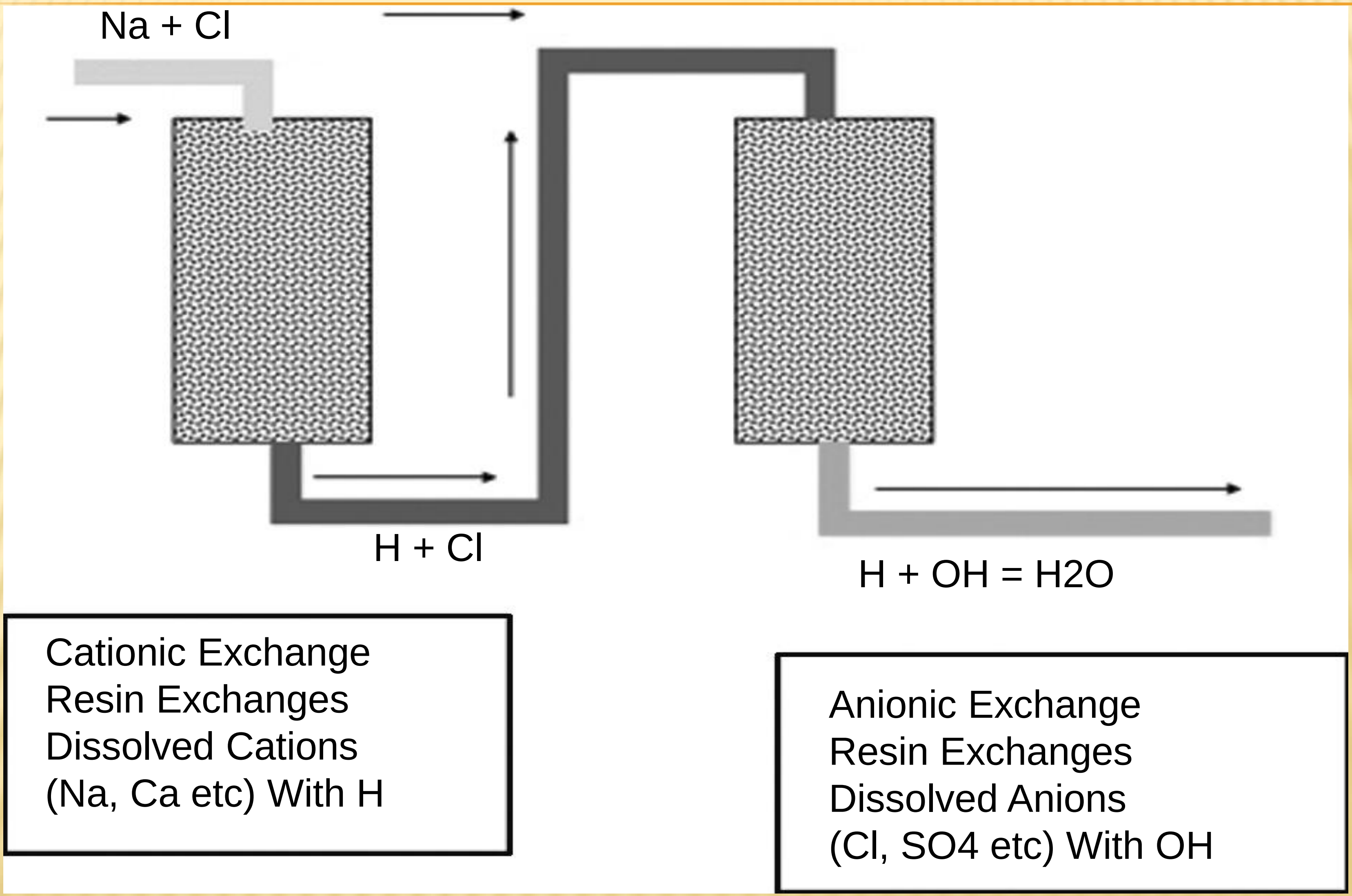
b. Resistivity and conductivity: See above under the description of DI.

5) Filters: All the filters should be regularly monitored for pressure drop across the device.

6) Ancillary devices: temperature-blending valve, backflow prevention device, booster pump, and acid feed pump should also be regularly monitored and maintained.

In light of our current knowledge it is clear that highly purified water close to the pharmaceutical grade is needed for use in dialysis. For higher-grade water, the term ‘‘ultrapure water’’ has been coined; for chemical purity, the water resistivity should be greater than 5 MOhm/cm rather than the current standard of 1 MOhm/cm. More importantly the bacterial and organic

standards would be more stringent. The bacterial count of <100 CFU and undetectable endotoxin and lipopolysaccharides (oligosaccharide) would be the goal. All this can be achieved with currently available technology.


Na + Cl
H + Cl
H + OH = H2O
Cationic Exchange
Resin Exchanges
Dissolved Cations
(Na, Ca etc) With H
Anionic Exchange
Resin Exchanges
Dissolved Anions
(Cl, SO4 etc) With OH

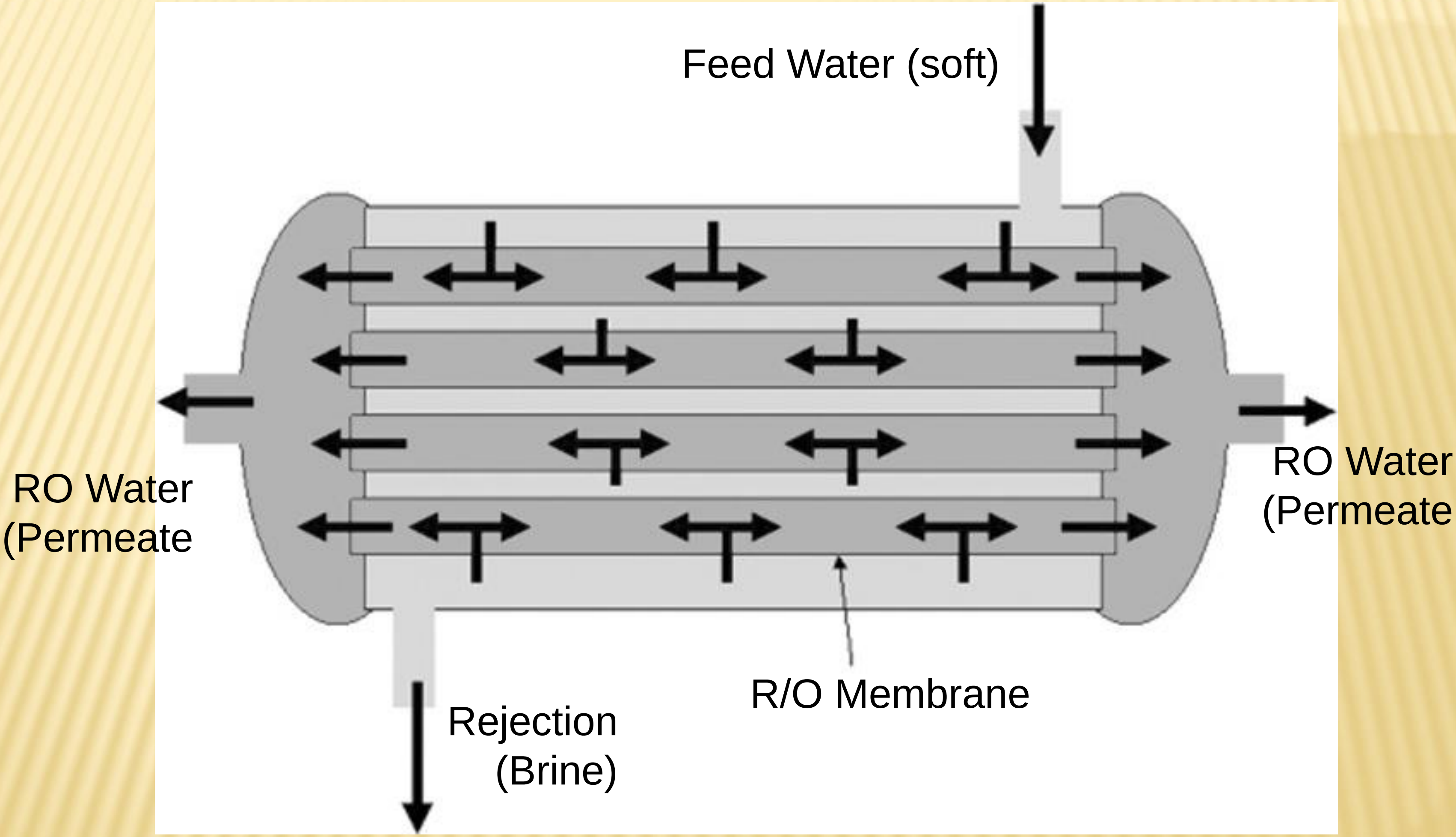

Feed Water (soft)
RO Water
(Permeate
RO Water
(Permeate
Rejection
(Brine)
R/O Membrane

Table 1 Comparison of advantages and disadvantages of various water purification devices

Benefits	Limitations
1. Softeners	
• Effectively removes Ca, Mg (hardness)	• Ineffective at removing other contaminants
• Inexpensive	• Difficult to sanitize
• Easy to regenerate	• Needs frequent regeneration
	• Resin exhaustion leads to hard water
	• Promotes bacterial growth
2. Activated carbon	
• Effective at removing organic contaminants, chlorine, and chloramine	• Exhaustable adsorptive capacity, risk of spillover
• Inexpensive	• Promotes bacterial growth
	• Difficult to sanitize
	• Releases "fines" (abrasive particles)
3. DI	
• Effective at removing ions	• Ineffective at removing organics and microorganism
• Low maintenance cost	• Facilitates bacterial growth
• Easy to regenerate	• Release of particles
	• Risk of spillover with exhaustion of resins
4. RO	
• Removes almost all dissolved ions	• Needs pretreatment
• Removes almost all organisms and fragments	• Uses large quantities of water
• Life of membrane depends on quality of water	

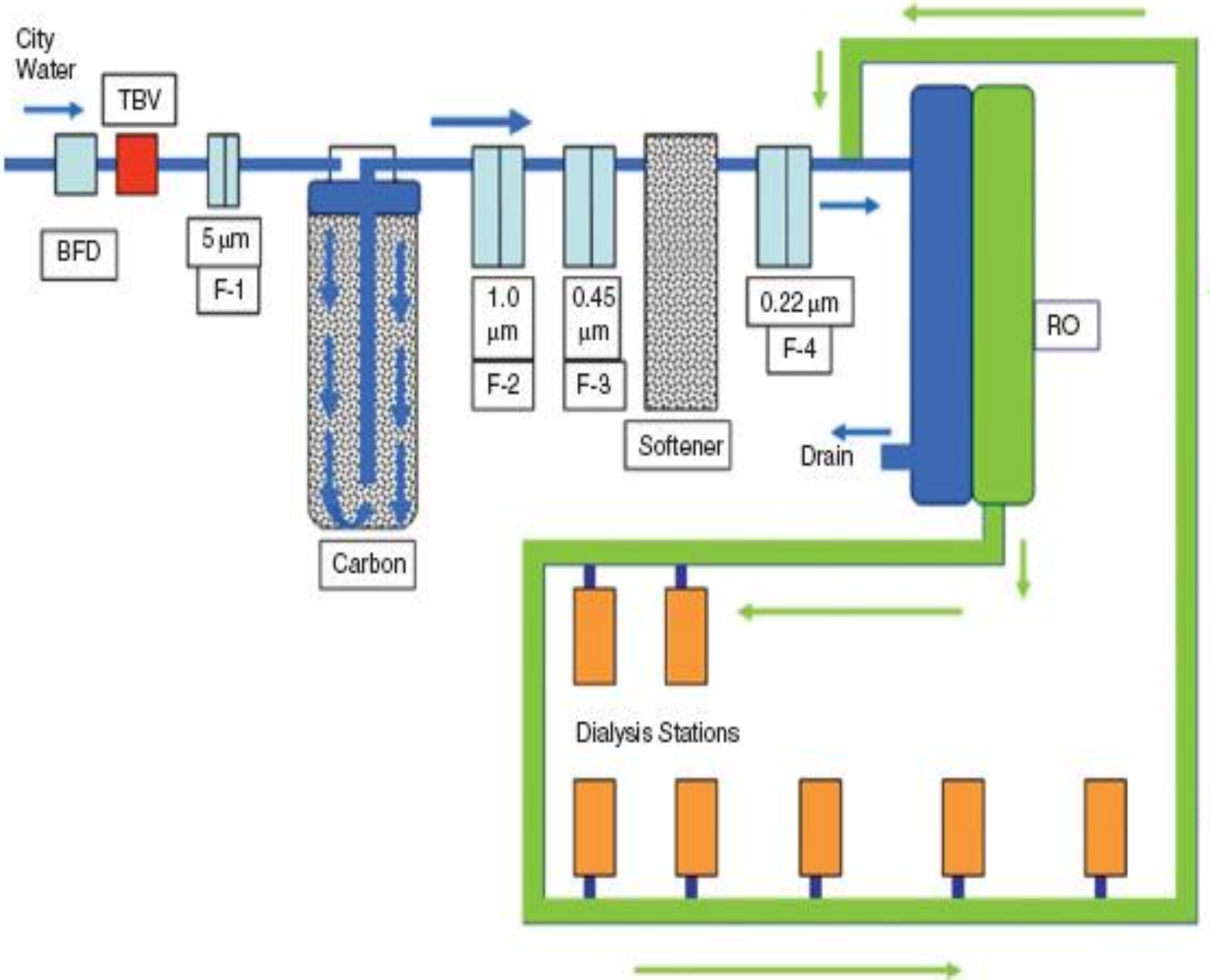


Figure 2 One of the commonly used schemes of water treatment. (For abbreviation, see text.)

گزارش نتیجه آزمون

پارامترهای مورد سنجش	مقدار در آب خام	مقدار در آب تصفیه شده	خصوصیات آب دیالیز طبق دستورالعمل (استاندارد)	مقایسه مقادیر آب تصفیه شده با استاندارد	ملاحظات
Aluminium	0/017	0/004	0/01 mg/lit	passed	
Aresenic	0/00291	0/00130	0/005 mg/lit	passed	
Barium	0/0630	0/0182	0/1 mg/lit	passed	
Cadmium	0/0015	0/0004	0/001 mg/lit	passed	
Calcium	57/63	1/55	(0/1 meq/l) 2 mg/lit	passed	
Chloride	0/49	0/09	0/1 mg/lit	passed	
Chromium	0/0061	0/003	0/014 mg/lit	passed	
Copper	0/031	0/011	0/1 mg/lit	passed	
Fluoride	0/194	0/098	0/2 mg/lit	passed	
Lead	0/0010	0/0001	0/005 mg/lit	passed	
Magnesium	16/34	1/41	4 mg/lit	passed	
Mercury	0/00021	0/00000	0/0002 mg/lit	passed	
Nitrate	5/092	1/08	2 mg/lit	passed	
Potassium	2/118	0/231	(0/2 meq/l) 8 mg/lit	passed	
Selenium	0/0044	0/0000	0/09 mg/lit	passed	
Silver	0/0006	0/0000	0/005 mg/lit	passed	
Sodium	11/294	1/388	70 mg/lit	passed	
Zinc	0/0147	0/0024	0/1 mg/lit	passed	
No. Of Bacteria	<10	<10	تعداد < 200 / ml	passed	

مهر و امضاء آزمایشگاه

مراکز تصفيه آب دياليزدر ايران:

مراكز دياليز خوني داراي سيستم تصفيه اب ميباشند كه بسته به كيفيت اب مشروب ان منطقه تا حدودي باهم متفاوتند.
اب مشروب توسط شبكه اب و فاضلاب بعد از تصفيه و گند زدايي و استاندارد سازي در اختيار مردم قرار ميگيرد ولي اين اب استاندارد كه براي نوشيدن اماد شده, هنوز داراي مقادير زيادي املاح و باكتري و سموم است كه براي بيماران دياليزي در صورت عدم تصفيه و خالص سازي مجدد مشكل ساز ميباشد.دركليهء مراكز دياليز كشورقسمتي بنام تصفيه خانه موجود است كه داراي قسمتهاي زير مي باشد
۱- پيش فيلتر: ابتدا اب مشروب از يك قسمتي بنام پيش فيلتركه داراي چندين فيلتر بزرگ موازي است عبور داده ميشود. در اين فيلتر ها تعداد زيادي از ذرات و اجسام (نظير شن ها پسماند هاي ناشي تركيدگي لوله ها) برداشته ميشوند. بعدا اب عبور داده شده از پيش فيلتر در يك مخزن بزرگ جمع ميگردد. سپس اب از پمپ با شير يك طرفه رد ميگردد(اين قسمت مانع انتقال نوسانات فشار اب شهري به قسمتهاي بعدي ميگردد. در مرحله بعدي اب وارد قسمت سخت گير ميشود. دراين قسمت كاتيون هاي دو ظرفيتي (نظير كلسيم و منيزيوم) توسط رزين در يك محيط اب نمك با سديم مبادله ميگردند. اين قسمت نياز به احياي مكرر دارد كه در بيشتر مراكز بصورت اتوماتيك انجام ميشود. در مرحله بعد اب از فيلتر دغالي عبور داده ميشود تا بعد از تصفيه اوليه وارد دستگاه اصلي يا RO گردد. در اين قسمت خالص سازي بيشتري بر روي اب انجام ميگيرد و كليهء الكتروليتها ميكروبها و سموم رد شده از مراحل قبلي به مقدار بسيار زيادي در اين قسمت تصفيه ميگردند. اب عبور داده شده از سيستم RO سپس از طريق لوله كشي وارد دستگاههاي دياليز ميشود تا با مايع دياليزي غليظ موجود مخلوط گشته و با رقت مناسب به فيلتر دياليزي منتقل گردد.

۱- پیش فیلتر, منبع ذخیره اب و پمپ

۲- سخت گیر و سیستم احیاء ان

۳- فيلتر ذغالي

۴- سيستم RO