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Preparation and quality management of fluids for haemodialysis and related therapies~~—~~ —

Part 2: Water treatment equipment for haemodialysis applications and related therapies

Préparation et management de la qualité des liquides d'hémodialyse et de thérapies annexes~~— Partie 2: Équipement de traitement de l'eau pour des applications en hémodialyse et aux~~ —

~~Second edition~~

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Partie 2: Équipement de traitement de l'eau pour des applications en hémodialyse et thérapies apparentées

FDIS stage

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO ~~documents~~document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT~~)~~), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 150, *Implants for surgery*, Subcommittee SC 2, *Cardiovascular implants and extracorporeal systems,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 205, *Non-active medical devices,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 23500-2:2019), which has been technically revised. The main changes are as follows:

— ~~—~~alternative water treatment technologies (e.g. reverse osmosis pre-treatment with ultrafiltration) have been added;

— ~~—~~alternatives to classic microbial analytical methods [endotoxin testing using involving recombinant Factor C (rFC ~~(tp)~~)] have been added.

A list of all parts of the ISO 23500 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document reflects the conscientious efforts of concerned physicians, clinical engineers, nurses, dialysis technicians and dialysis patients, in consultation with device manufacturers and regulatory authority representatives, to develop an International Standard for performance levels that can be reasonably achieved at the time of its publication. The term "consensus," as applied to the development of voluntary medical device documents, does not imply unanimity of opinion, but rather reflects the compromise necessary in some instances when a variety of interests should be merged.

This document applies to individual water treatment devices and to water treatment systems assembled from one or more of these devices. In the first instance, this document is directed at the individual or company that specifies the complete water treatment system and, second, at the supplier who assembles and installs the system. Since systems can be assembled from a number of individual water treatment devices, the provisions of this document are also directed at the manufacturers of these devices, provided that the manufacturer indicates that the device is intended for use in haemodialysis applications. This document is written principally to address water treatment systems for dialysis facilities treating multiple patients. However, many of its provisions apply equally to water treatment systems used in applications where a single patient is treated, such as in a home dialysis or acute hospital dialysis setting. Specifically, requirements for the chemical and microbiological quality of water are considered to apply in all settings, regardless of whether a single patient or many patients are being treated.

Increasingly, self-contained, integrated systems designed and validated to produce water and dialysis fluid are becoming available and used clinically. The provisions included in this document apply to systems assembled from individual components. Consequently, some of the provisions in ISO 23500-1 and ISO 23500-2 ~~might~~do not apply to integrated systems, however such systems are required to comply with ISO 23500-3~~:~~, ISO 23500-4[47]~~:~~ and ISO 23500-5[48]~~:~~.

This document helps protect haemodialysis patients from adverse effects arising from known chemical and microbial contaminants found in water supplies. However, dialysis and patient safety is ultimately dependent on the quality of the dialysis fluid. Since the manufacturer or supplier of water treatment equipment does not have control over the dialysis fluid, any reference to dialysis fluid in this document is for clarification only and not a requirement of the manufacturer. The responsibility for assuring that the dialysis fluid is not contaminated, mismatched~~,~~ or otherwise damaging to the patient rests with the clinical professionals caring for the patient under the supervision of the medical director. Requirements and recommendations on the preparation and handling of water and dialysis fluid in a dialysis facility are provided in ISO 23500-3~~:~~ and ISO 23500-5[48]~~:~~ respectively. The rationale for the development of this document is given in Annex A~~Annex A~~.

Since the chemical and microbiological content of the water produced need to meet the requirements of ISO 23500-3~~:~~, the maximum allowable levels of contaminants are listed in Tables B.1~~Annex B (Tables B.1~~ and B.2~~B.2)~~. The values shown include the anticipated uncertainty associated with the analytical methodologies listed in Table B.3~~Table B.3~~.

Preparation and quality management of fluids for haemodialysis and related therapies — —

Part 2:
Water treatment equipment for haemodialysis applications and related therapies

1 Scope

This document gives guidance onspecifies requirements and recommendations for individual water treatment devices and water treatment systems assembled from one or more of such devices. ItThis document is directed at the individual or company that specifies the complete water treatment system and, the supplier who assembles and installs the system. Since systems can be assembled from a number of individual water treatment devices, the provisions of this document are also directed at the manufacturers of these devices, provided that the manufacturer indicates that the device is intended for use in the provision ofto be used to supply water for haemodialysis and related therapies.

This document is applicable to -

- —all devices, piping, and fittings between the point at which water is delivered to the water purification system and the point of use of the purified water. Such components include but are not necessarily limited to water purification devices, online water quality monitors (such as conductivity monitors),) and piping systems for the distribution of purified water.

This document does not apply to

— —equipment used in the preparation of concentrates from powder or other highly concentrated media at a dialysis facility either for a single patient or multiple patients.

— —dialysis fluid supply systems that proportion water and concentrates to produce dialysis fluid,

— —sorbent dialysis fluid regeneration systems that regenerate and recirculate small volumes of the dialysis fluid,

— —dialysis concentrates.

— —haemodiafiltration or haemofiltration systems.

— —systems that process dialysers for multiple uses, and

— —peritoneal dialysis systems.

Requirements for the ongoing monitoring of thewater purity of water in terms of chemical and microbiological quality are given in ISO23500ISO 23500-3.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10993-1,*Biological evaluation of medical devices — Part 1: Evaluation and testing within a risk management process*

~~ISO 13485, *Quality management for medical devices*~~

~~ISO 14971,*Medical devices — Application of risk management to medical devices*~~

ISO 23500-1, *Preparation and quality management of fluids for haemodialysis and related therapies — Part 1: General requirements*

ISO 23500-3, *Preparation and quality management of fluids for haemodialysis and related therapies — Part 3: Water for haemodialysis and related therapies*

~~ISO 23500-4, *Preparation and quality management of fluids for haemodialysis and related therapies — Part 4: Concentrates for haemodialysis and related therapies*~~

~~ISO 23500-5, *Preparation and quality management of fluids for haemodialysis and related therapies — Part 5: Quality of dialysis fluid for haemodialysis and related therapies*~~

~~IEC 60601-1 *Medical Electrical Equipment*~~

~~*IEC*~~ IEC 60601-1-11, *Medical electrical equipment — Part 1-11: General requirements for basic safety and essential performance — Collateral standard: Requirements for medical electrical equipment and medical electrical systems used in the home healthcare environment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23500-1 ~~also~~and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ~~—~~ISO Online browsing platform: available at https://www.iso.org/obp

— ~~—~~IEC Electropedia: available at https://www.electropedia.org/

3.1
microfilter
filter designed to remove particles down to 0,1 µm in size

Note 1 to entry: Microfilters have an absolute size cut-off and are available in both dead-end and cross-flow configurations. Some microfilters can reduce the concentration of endotoxins by adsorption.

4 Requirements

4.1 Dialysis water quality requirements

4.1.1 General

The requirements contained in this document apply to the dialysis water as it enters the equipment used to prepare concentrates from powder or other concentrated media at a dialysis facility, to prepare dialysis fluid, or to reprocess dialysers. As such, these requirements apply to the water treatment system as a whole including the distribution network and not only to each of the individual devices that make up the system.

4.1.2 Chemical contaminant requirements

Dialysis water used to prepare dialysis fluid or concentrates from powder at a dialysis facility, or to reprocess dialysers for multiple uses, shall not contain chemical contaminants at concentrations in excess of those in ISO 23500-1:2024, Tables 1 and 2 (reproduced as Tables B.1~~Tables B.1~~ and B.2~~B.2~~).). The manufacturer or

supplier of a complete water treatment system shall recommend a system capable of meeting the requirements of Clause 4~~this clause~~ based on the analysis of the feed water. The system design should reflect possible seasonal variations in feed water quality. The manufacturer or supplier of a complete water treatment and distribution system shall demonstrate that the complete water treatment, storage~~,~~ and distribution system is capable of meeting the requirements of this document at the time of installation.

For disposable water treatment and distribution systems that have been validated to produce dialysis water meeting the quality requirements of this document for a specified time, ~~surveillance of the~~ incoming water ~~is required~~shall be surveyed to ensure that the input to the treatment system is in the range for which the system has been validated. The manufacturer's recommendation for ~~surveilling~~surveying the final dialysis water can be followed when the system is operated according to the manufacturer's instructions. Alternatively, the quality of the dialysis water can be closely observed as outlined for non-validated systems.

NOTE 1 If the manufacturer or supplier does not install the water storage and distribution system, then the responsibility of the manufacturer or supplier is limited to demonstrating that the water treatment system, excluding the water storage and distribution system, meets the requirements of this document. If individual devices of the water treatment system are provided by different manufacturers or suppliers, the person or organization specifying the devices is responsible for demonstrating that the complete system meets the requirements of this document at the time of installation.

NOTE 2 Following the installation of a water treatment, storage~~,~~ and distribution system, the user is responsible for continued surveillance of the levels of chemical contaminants in the water and for complying with the requirements of this document.

4.1.3 Organic carbon, pesticides and other chemicals

The impact of organic compounds, such as pesticides, polycyclic aromatic hydrocarbons and other chemicals such as pharmaceutical products and endocrine disruptors in respect of haemodialysis patients are difficult to specify. Consequences of exposure are probably of a long-term nature and it is technically difficult and costly to measure these substances on a routine basis. Furthermore, there is an absence of evidence of their widespread presence in water although it is recognized that inadvertent discharges are possible. In view of this, it is not possible to currently specify limits for their presence in water used in the preparation of dialysis fluid.

Nanofiltration and reverse osmosis are capable of significant rejection of many such compounds. Granular activated carbon (GAC) is also highly effective at removing majority of such compounds. However, as granular activated carbon is widely used in the removal of chlorine/chloramine, their use in the removal of organic carbons, pesticides and other chemicals will be dependent upon the size of the carbon filters and/or beds and users shall be aware of appropriate dimensioning since the majority of carbon valences can be already occupied and not available for further removal activity.

4.1.4 Microbiology of dialysis water

Dialysis water used to prepare dialysis fluid or concentrates from powder at a dialysis facility, or to reprocess dialysers for multiple uses, shall comply with the requirements specified in ISO 23500~~–~~3.

The manufacturer or supplier of a complete water treatment and distribution system shall demonstrate that the complete water treatment, storage, and distribution system meets the requirements of this document, including those related to action levels at the time of installation.

For disposable water treatment systems validated by the manufacturer to produce dialysis water meeting the quality requirements of this document for a specified time, ~~surveillance of the~~ incoming feed water ~~is required~~shall be surveyed to ensure that the input to the treatment system is in the range for which the system has been validated. The manufacturer's recommendations for ~~surveilling~~surveying the dialysis water can be followed when the system is operated according to the manufacturer's instructions. Alternatively, the quality of the dialysis water can be observed as outlined for non-validated systems.

NOTE 1 If the manufacturer or supplier does not install the water storage and distribution system, then the responsibility of the manufacturer or supplier is limited to demonstrating that the water treatment system, excluding the

water storage and distribution system, meets the requirements of this document. If individual devices of the water treatment system are provided by different manufacturers or suppliers, the person or organization specifying the devices is responsible for demonstrating that the complete system meets the requirements of this document at the time of installation.

NOTE 2 Following installation of a water treatment, storage, and distribution system, the user is responsible for continued surveillance of the water bacteriology of the system and for complying with the requirements of this document, including those requirements related to action levels.

4.2 Water treatment equipment requirements

4.2.1 General

4.2.1.1 Water treatment system

The supplier of the feed water or the supplier of the water treatment system or a laboratory specified by the user shall perform chemical analyses on feed water to determine the compatibility of the system with the feed water and the suitability of the system for providing dialysis water meeting the requirements of 4.1.2~~4.1.2~~. The result of the chemical analyses shall be available to the user in charge of dialysis. In the case of an individual device, the person incorporating the device into the water treatment system is responsible for ensuring that incorporation of the device does not compromise the ability of the overall system to deliver dialysis water capable of meeting the requirements of 4.1.2~~4.1.2~~ and 4.1.4~~4.1.4~~.

The water treatment and distribution system should include appropriate pressure gauges, flow meters, sample ports, and other ancillary equipment necessary to allow surveillance of the performance of individual system devices and the system as a whole.

Valves can be included in the water treatment system to allow individual devices to be bypassed when there is device failure or to facilitate replacement of a device. Bypass valves should have a physical lockout installed and be labelled with a warning notifying the user of the result of its removal.

If it is possible to bypass a device of the water treatment system, then the manufacturer or installer of that component shall inform the user of the risks associated with bypassing that device and the need for clearly defining the responsibility for operating the bypass. Where such valves are installed, however, a means should be included to minimize the likelihood that the device will be inadvertently bypassed during normal operation of the system.

Bypass valves should not be used to bypass deionization tanks, carbons and other critical components e.g ~~R.O.~~ reverse osmosis (RO) systems. They should not be used on ultra filters used in conjunction with deionization tanks for patient treatment.

Operating controls shall be positioned so as to minimize inadvertent resetting.

Electrical circuits shall be separate from hydraulic circuits and adequately protected from fluid leaks.

4.2.1.2 Materials compatibility

Materials that are in contact with dialysis water (including materials used in piping, storage~~,~~ and distribution systems) shall not interact chemically or physically with that water so as to adversely affect its purity or quality. Water-contacting surfaces shall be fabricated from non-reactive materials (e.g. plastics) or appropriate stainless steel. The use of materials known to cause toxicity in haemodialysis, such as copper, brass, galvanized metal~~,~~ or aluminium, are specifically prohibited at any point beyond the water treatment device used to remove contaminating metal ions, most commonly a reverse osmosis system or a deionizer.

The materials of any water treatment devices (including piping, storage, and distribution systems) shall be compatible with the means used to disinfect those devices. Chemicals infused into the water in the pre-treatment section, such as chlorine, acid, flocculants~~,~~ and complexing agents, shall be adequately removed from dialysis water before they reach any point of use. Monitors or specific test procedures to verify removal of additives shall be provided.