Differences in Methods in Dialysis Standards:

AAMI, ISO, CMS
How to Cope

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Centers for Medicare & Medicaid Services

CMS, AAMI, ISO--Who are they?

- CMS-Centers for Medicare & Medicaid Services
- AAMI-Association for the Advancement of Medical Instrumentation
- ISO-International Standards Organization

Background

- AAMI RD 52 due for its 5 year review/update in 2009
- Adopting ISO 23500 serves as a partial revision of RD 52
- ISO 23500 includes references to other ISO documents
  - ISO 13959:2009 (Water Quality),
  - ISO 13958:2009 (Concentrate Quality)
  - ISO 11663:2009 (Dialysate Quality)
  - ISO 26722:2009 (Water Treatment)
- These complete the revision of RD 52

Chronology of Document Development

Document	2004	2006	2008	2009	2010	2011	2014
AAMI RD52	X						
AAMI RD62		X					
CMS Conditions for Coverage ESRD			X				
CMS Interpretive Guidance			X				
CMS Core Survey							X
ISO 23500				X	X	X	X
ISO 23500, 11663, 13958, 13959, 26722				X			X
AAMI/ISO 23500, 11663, 13958, 13959, 26722				X			
AAMI 23500, 11663, 13958, 13959, 26722 (with U.S. deviation)							X

CMS

- Develops Conditions of Participation (CoPs) and Conditions for Coverage (CfCs) that ESRD facilities must meet in order to begin and continue participating in the Medicare and Medicaid programs
- Adopts specific editions of referenced documents as regulation in the U.S.
- There is no “automatic” updating
- There is a formal process that must be followed to implement or update regulations:
  - “Notice of Proposed Rulemaking” (NPRM)
- Core Survey introduced in 2014

Notice of Proposed Rule Making

- CMS must publish a public notice of intent to make new rules in the Federal Register
- There must be a comment period, usually 30-90 days
- CMS then considers the comments in developing the final rule
- Final rule published in the Federal Register with an implementation date

What Does the CMS Conditions for Coverage Interpretive Guidance-ESRD Facilities Cover?

- Coverage more extensive than RD52 & RD62
- V tag based
- Topics included
  - Patient Safety
    - Infection control
    - Water & dialysate quality
    - Dialyzer & bloodline reuse
    - Physical environment
  - Patient Care
    - Patients' rights
    - Patient assessment
    - Patient plan of care
    - Care at home
    - QAPI
    - Special purpose facilities
    - Laboratory services
  - Administration
    - Personnel qualifications
    - Medical director responsibilities
    - Medical records
    - Governance

CMS Core Survey

- Presurvey preparation
- Introductions
- Environmental “Flash” Tour
- Water Tx/Dialysate Prep Area(s)
- Reuse Room
- Home dialysis training area
- Entrance Conference
- Observations of Hemodialysis Care & Infection Control Practices
- Patient Sample Selection
- Water Tx & Dialysate Review
- Dialyzer Reprocessing/Reuse Review
- Dialysis Equipment Maintenance
- Home Dialysis Trainng & Support Review
- Patient Interviews
- Medical Record Review
- Personnel Interviews
- Personnel Record Review
- QAPI Review (Segments I,II,III)
- Decision making
- Exit Conference

AAMI

- Develops consensus standards for the medical device industry
- Renal Disease & Detoxification Committee develops
  - Standards
  - Recommended practices
  - Technical information reports
- Aims to harmonize as much as possible with International Standards

ISO

- A Worldwide Federation of National Standards Bodies
- U.S. is an ISO member
- ISO has subcommittees like AAMI
  - ISO Cardiovascular Implants and Extracorporeal Systems Working Group is the ISO equivalent to the AAMI Renal Disease and Detoxification Committee

Important Terminology Differences

AAMI & ISO Standards

- Shall--Required
- Should—Recommended
  - Not requirement except if by CMS
- May—a permissible way to achieve compliance

CMS

- Shall & Should—Required
- Condition level non-compliance
  - Pervasive deficient practices
  - Serious in nature
  - Potential risk to patient health & safety
- Standard level non-compliance
- V Tag based

Summary

- CMS – Regulation
- AAMI -- U.S. Standards
- ISO — International Standards
- AAMI-ISO – Harmonized Standards

AAMI RD 52 ⟶ CMS Regulation

- AAMI RD 52 was adopted as part of the 2008 ESRD regulation
- Because AAMI RD 52 is now CMS regulation, it “must” be followed in dialysis units certified under the ESRD regulations
- Verbs like shall, should, may in RD52= MUST in CMS ESRD regulation
- RD62 adopted by CMS by reference

Comparing CMS Regs & ISO Standards

- International Standards which functions as a recommended practice
- Adopted by AAMI to replace RD 52 (along with the adoption of other ISO documents)
- NOT REGULATION
- Has not been adopted by CMS
- Remember, CMS has to follow that formal process; if it started tomorrow, it would take 18-24 months at a minimum to change current regulation and adopt all or part of the ISO standards.

Why Bother With ISO Standards?

- AAMI sets the Standards for our industry; has adopted ISO 23500 to replace RD 52
- RD 52 is now “obsolete;” not available from AAMI
- ISO quality standards are more stringent
- You may choose to adopt the more stringent quality standards to increase patient safety/enhance patient outcomes;
- Can still be in compliance with CMS requirements

Applicability of ISO Standards

- Out patient in-center hemodialysis
- Home hemodialysis
- Acute hemodialysis

ISO 23500 is:

- Not required but may be implemented
- Would be required if adopted by policy or inferred by statements of intent to follow the “standard of practice.”

Major Areas of Difference CMS Regs & ISO Standards

- More stringent microbial limits for water & dialysis fluid
- Focus on Validation
- Emphasis on prevention & process control for consistent delivery of quality dialysis fluid not just periodic disinfection
- New strategies to ensure microbiological control
- New methods for culturing viable bacteria from water & dialysis fluid
- Use of Annexes for information & guidance
- Sections on Equipment moved to Annex B

Dialysis Water

Contaminant	ISO Max Limit*	ISO Action Level*	CMS Max Limit	CMS Action Level
Total Viable Bacteria Count (TVC)	<100 CFU/mL	50 CFU/mL	<200 CFU/mL	50 CFU/mL
Endotoxin	<0.25 EU/mL	0.125 EU/mL	<2 EU/mL	1 EU/mL

**Adapted from ISO 13959:2009*

Dialysis Fluid

Contaminant	ISO Max Limit*	ISO Action Level*	CMS Max Level	RD 52 Action
Total viable count (TVC)	<100 CFU/mL	50 CFU/mL	<200 CFU/mL	50 CFU/mL
Endotoxin	<0.5 EU/mL	0.25 EU/mL	<2 EU/mL	1 EU/mL

**Adapted from ISO 11663:2009*

What Is Different? Water ≠ Dialysis Fluid

Fluid	ISO Max Endotoxin Limit	ISO Action Endotoxin Level
Water	0.25 EU/mL	0.125 EU/mL
Dialysis fluid	<0.5 EU/mL	0.25 EU/mL

Note: Allowable endotoxin levels for dialysis fluid are higher than for water because the concentrates can contribute to the dialysis fluid endotoxin load.

Ultrapure Dialysis Fluid

Contaminant	ISO Max Limit*	ISO Action Level*	CMS Max Limit	CMS Action Level
Total viable count (TVC)	<0.1 CFU/mL	Typically 50% of Max Level	<0.1 CFU/mL	Not established
Endotoxin	<0.03 EU/mL	Typically 50% of Max Level	<0.03 EU/mL	Not established

**Adapted from ISO 11663:2009*

ISO Microbial Culture Conditions

Table 5 — Cultivation techniques

Cultivation medium	Incubation temperature	Incubation time
Tryptone Glucose Extract Agar (TGEA)	17 °C to 23 °C	7 days
Reasoner's Agar No. 2 (R2A)	17 °C to 23 °C	7 days

Excerpted from ISO 23500:2014, 8.3.3.3

Preferred Culture Methods & Sample Volumes

- Standard dialysis fluid
  - Spread plate
    - 0.1mL-0.3mL
  - Pour plate
    - 0.1mL-1mL
- Ultrapure dialysis fluid
  - Membrane filtration
    - 10mL-1,000mL
- Substitution fluid
  - Not sampled or cultured

Excerpted from ISO 23500:2014, 8.3.3.2

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V178 **V180**	Bacteriology of Water & Standard Dialysate **<200 CFU/mL** microbial count; **<2EU/mL endotoxin** **Action levels: 50 CFU/mL & 1EU/mL**	**<100 CFU/mL** microbial count; **<0.25 EU/mL endotoxin** **Action levels: 50% of max level**	**13959** **11663**	Yes

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V196	Carbon Adsorption Allows testing for both **Chlorine—Limit 0.5 mg/L** and **Chloramines—Limit 0.1 mg/L**	Allows for testing for **Total Chlorine Only with limit of <0.1 mg/L**	**26722**	**Yes**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V211	Water distribution systems **Prescribes min velocities needed**	Strategies for microbial control (fluid system design): **It has been demonstrated that fluid velocity cannot control microbial growth & biofilm formation in hydraulic systems.**	**23500**	**No** Current data shows fluid velocity does not control microbial growth & biofilm

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V200	RO Requires **alarm audible in patient care area**	RO Recommends **alarm sound level measure; verification of alarm signal after silencing**	**26722**	**Yes**
V201	RO Requires **chemical analysis if rejection rates fall below 90%**	RO Recommends **chemical analysis if rejection rates decrease >10%**	**23500**	**No** If rejection rate was 95% & fell to 89% this would be below 90% but not a drop of 10%

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V209	Water storage tank: **Bladder or surge tanks not addressed**	Storage tanks: **Bladder tanks and pressurized surge tanks** recommended to be used **in the dialysis water distribution system**	**26722**	**Yes**
V225	**Safety requirements for mixing devices not addressed**	**Addresses safety requirements for mixing devices**	**13958**	**Yes**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V213	Water distribution systems: **Bacteria Counts ≤200 CFU/mL; Endotoxin ≤2EU/mL**	Monitoring water distribution system **Bacteria counts ≤100 CFU/mL; Endotoxin ≤0.25 EU/mL**	**23500**	**Yes**
V213	Water distribution systems: **Bacteria & endotoxin testing at least monthly**		**23500**	**Depends on validation data**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/ exceeds CMS ?
V252	Microbial monitoring methods: **Additional testing for evaluation of the disinfection program is not addressed**	Monitoring of H2O distribution systems **Additional testing & troubleshooting strategy** **Need for additional testing based on original validation plan** **Risk analysis of impact of change on system performance**	**23500**	**Yes**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V256	Heterotrophic plate count—Allows **use of dip samplers with conditions**	Does **not** allow use of **dip samplers**	**23500 Annex D** Strategies for microbe control	**Yes**
V256	Heterotrophic plate count — **Incubate 48h, 35°C**	**Incubate 7 days, 17-23°C**	**23500 Annex D** Strategies for microbe control	**AAMI U.S. Deviation**
V257	Heterotrophic plate count--Culture media: **TSA, SMA, PCA**	Culture media: **TGEA, R2A or equivalent**	**23500 Annex D** Strategies for microbe control	**AAMI U.S. Deviation**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA,

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V240	Bicarbonate concentrate distribution systems—UV lamps should provide a radiant energy dose of **30 milliwatt-sec/cm²**	Ultraviolet irradiators—UV lamps in concentrate storage & distribution systems shall provide a radiant energy of **16 milliwatt-sec/cm²** if fitted with calibrated **UV intensity meter**. If not a dose of **30 milliwatt-sec/cm²** required	**13958**	**Yes**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/exceeds CMS ?
V248	Dialysate proportioning—Expected dialysate **pH levels between 6.9 & 7.6**	Expected dialysate **pH levels between 6.9 & 8.0**	**23500 Annex B** Dialysis fluid proportioning	**May follow ISO**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]

V Tag #	CMS Requirement	ISO Recommendation	ISO Document #(s)	ISO meets/ exceeds CMS ?
V253	Microbial monitoring methods—Dialysate Requires **retest of dialysis machine with results above action level**; review compliance procedures; evaluate data trends	Requires retesting of the offending machine **+ additional machines**	**23500 Annex D** Microbial monitoring methods—	**Yes**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]
Annex C Special Considerations Home HD

V Tag #	CMS Requirement	ISO Recommendation	ISO Doc #(s)	ISO meets/ exceeds CMS ?
V595	Annex C: Carbon adsorption media: **Does not address use of other means of chloramine removal**	**Addresses the need for adequate flush time if a means other than 2 series connected carbon beds with 10min EBCT is used for chloramine removal**	**23500 Annex F**	**Yes**
V595	Annex C: Home **DI not required to have a means to prevent product H2O reaching point of use if resistivity is 1megohm-cm or less**		**23500 Annex F**	**Yes**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Table of Differences
CMS Regulation & ISO Documents[1]
Special Considerations Home HD

V Tag #	CMS Requirement	ISO Recommendation	ISO Doc #(s)	ISO meets/ exceeds CMS ?
V595	Annex C: Equipment: **Requires alarms to be audible & visible in the patient Tx area**	Equipment: **Does not address visible and audible alarms in patient Tx area**	**23500 Annex F**	**No**
V595	Annex C: Carbon adsorption media: **Allows testing for both chlorine and chloramine**	Carbon media: **Recommends testing only total chlorine when the source water contains chloramine**	**23500 Annex F**	**Yes**

[1] AAMI—Dialysis Water and Dialysate Recommendations: A User Guide. Association for the Advancement of Medical Instrumentation, Arlington, VA, 2014.

Evolution of AAMI & ISO Standards

- AAMI RD52:2004 "Dialysate for Hemodialysis"
- AAMI RD 62:2006 "Water Treatment Equipment for Hemodialysis Applications
- ISO 23500: 2009, 2010, 2011, 2014 "Guidance for the Preparation and Quality Management of Fluids for Haemodialysis and Related Therapies"
- ISO 11663: 2009, 2014 "Quality of Dialysis Fluid for Haemodialysis and Related Therapies"
- ISO 13958: 2009, 2014 "Concentrates for Haemodialysis and Related Therapies"
- ISO 13959: 2009, 2014 "Water for Haemodialysis and Related Therapies
- ISO 26722: 2009, 2014 "Water Treatment Equipment for Haemodialysis"
- AAMI:2009, ISO standards with U.S. deviation

AAMI/ISO Standards

- AAMI-ISO 23500: 2009 “Guidance for the Preparation and Quality Management of Fluids for Haemodialysis and Related Therapies”
- AAMI/ISO 11663: 2009“Quality of Dialysis Fluid for Haemodialysis and Related Therapies”
- AAMI/ISO 13958: 2009 “Concentrates for Haemodialysis and Related Therapies”
- AAMI/ISO 13959: 2009 “Water for Haemodialysis and Related Therapies
- AAMI/ISO 26722: 2009 “Water Treatment Equipment for Haemodialysis”

ISO 2014 Dialysis Standards

- ISO 2014 series of hemodialysis standards allow only for the following culture methods:
  - TGEA or R2A (low nutrient media) or equivalent
  - 7 days (168h) incubation
  - 17-23°C
- Rationale—Lower nutrients, lower temperature and longer incubation yields higher recoveries

Problem with ISO 2014 Approach

- Important for patient safety to know sooner than later if action level has been reached to allow for earlier intervention
- 7 days is a long time to wait for results
- No culture method recovers all bacteria present
- While higher recoveries may be ideal, shorter incubation methods allow for more rapid intervention
- Many of the bacteria harmful to patients (e.g. produce high activity endotoxin) grow at higher temperatures, on higher nutrient medium and in a shorter time
- How to establish equivalency to ISO 2014 recommended methods not defined

U.S. Deviation to AAMI/ISO 2014 Documents

- Deviation is related to acceptable culture method (media and conditions of incubation) for analysis of water and dialysis fluid samples for bacteria
  - Allows for use of
    - TSA (tryptic soy agar),
    - SMA (standard methods agar)
    - PCA (plate count agar)
    - Incubation at 35-37°C, 48h

AAMI 2014 (ISO Standards with U.S. Deviation)

- Deviation Related to Microbial Culture Methods
- ISO Standards
  - TGEA or R2A
  - 17-23°C
  - 7 days
- U.S. Deviation Adds
  - TSA
  - 35-37°C
  - 48 hours

ISO Documents 2014 vs Next Revision

ISO 2014	ISO 2018 expected
ISO 23500 Prep & Quality Management of Fluids for HD…	**23500-1** Guidance for prep & quality management for HD…: **General Requirements**
ISO 26722 Water Tx Equipment for HD	**23500-2** Guidance for prep & quality management for HD…:**Water Tx Equipment** for HD
ISO 13959 Water for HD…	**23500-3** Guidance for prep & quality management for HD…: **Water** for HD
ISO 13958 Concentrates for HD…	**23500-4** Guidance for prep & quality management for HD…:**Concentrates** for HD…
ISO 11663 Quality of Dialysis Fluid for HD	**23500-5** Guidance for prep & quality management for HD…:Quality of **Dialysis Fluid** for HD

Proposed Changes to Next Revision of ISO Haemodialysis Series Standards (2018?)

- TSA incubated at 35-37° C, 48h added as an acceptable culture method
  - Applies to Standard Dialysis Water & Dialysis Fluid Heterotrophic Plate Count and Bicarbonate concentrate
  - No supplementation is needed for bicarbonate containing samples
- Residual chlorine detection in rinse water following disinfection of a dialysis system with bleach per manufacturer's instructions can be done by measuring for free chlorine at a limit of ≤0.5mg/L
- Consistency in use of "shall" and "should"

ISO Document Methods: Requirement Level Discrepancies

ISO Doc #	Subject Matter	Media	Requirement Level	Incubation Temp	Requirement Level	Incubation Time	Requirement Level
11663 23500-5	Dialysis Fluid	TGEA, R2A, or =	Shall	17-23°C	Recommended	168h (7days)	Recommended
13959 23500-3	Dialysis Water	TGEA, R2A, or =	Shall	17-23°C or equivalent results	Recommended	168h (7days) or = results	Recommended
23500-1	Dialysis Fluid $NaHCO_3$ Conc	TGEA, R2A TGEA, R2A + 4% $NaHCo_3$	Not specified Should	17-23°C	Not specified	168h (7days)	Not specified
13958 23500-4	$NaHCO_3$ Conc	TGEA or R2A, + 4% $NaHCo_3$, TSA, or = Membrane Filtration	Shall Shall	17-23°C	Shall	168h (7days)	Shall

In Summary

- Differences exist between CMS, AAMI & ISO documents related to dialysis
  - CMS-Must Comply
  - AAMI-Shall or Should
    - Not regulation
    - Often meets or exceeds CMS requirements
    - Sometimes aligned with ISO
      - Goal: Harmonization with ISO
  - ISO-International Standards-Shall or Should
    - Not regulation
    - Recommended practices
- It is possible to incorporate some of AAMI &/or ISO practices and still be in compliance with CMS regulations

Acknowledgements & Resources

AAMI—information excerpted from webinars presented & use of AAMI logo (with AAMI permission) :

- ANSI/AAMI Dialysis Standards: A Detailed Review of ANSI/AAMI RD52: Dialysate for Hemodialysis—An AAMI Webinar, October 5, 2010.
- ANSI/AAMI Dialysis Standards: A Detailed Review of ANSI/AAMI RD62: Water Treatment Systems for Hemodialysis Applications—An AAMI Webinar, October 12, 2010.
- ANSI/AAMI Dialysis Standards: A Detailed Review of ANSI/AAMI RD47: Reprocessing of Hemodialyzers—An AAMI Webinar, October 19, 2010.
- Keeping Patients Safe: Guidance for Preparation and Quality Management of Fluids for Hemodialysis: ANSI/AAMI/ISO 23500, An AAMI Webinar, April 3, 2012
- ANSI/AAMI/ISO 11663 & 23500, Quality Requirements and Monitoring of Water Treatment and Dialysis Fluid for Hemodialysis and Related Therapies, An AAMI Webinar, May 15, 2012.

AAMI publication:

Payne, Glenda, ed**.** *Dialysis Water and Dialysate Recommendations: A User Guide* . AAMI, Arlington, VA, 2014.

Additonal publication:

MALTAIS, J.B., MEYER, K.B., FOSTER, M.C. (2016). Comparison of techniques for culture of dialysis water and fluid. Haemodialysis International: (published on-line, Aug. 2016).

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Thank You

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