

G7 Haemodialysis water sampling: current procedures in Scottish renal units

Introduction

All haemodialysis units need to ensure that the water they use for dialysis has safe levels of chemical and microbiological contaminants. The United Kingdom Renal Association (UKRA) Guidelines (4th edition)¹ list the maximum concentrations that can be tolerated. This includes guidance on the testing frequency of supply and reverse osmosis water, but there is no advice about the methods to be used for testing or the action that should be taken when the recommended levels are exceeded.

The limits for chemical contaminants in haemodialysis water were originally derived from the Association for the Advancement of Medical Instrumentation (AAMI) American National Standard for Dialysate for Haemodialysis². Some chemical contaminants, such as aluminium, fluoride and nitrates have been reported to be associated with specific illnesses and accordingly strict limits have been set. In the absence of evidence, other chemical contaminants are simply limited in the AAMI standard to a tenth of the Environmental Protection Agency's limit for drinking water.

The Scottish Trace Element and Micronutrient Reference Laboratory, based at Glasgow Royal Infirmary, analyses haemodialysis water for trace element and chemical contaminants for all NHS renal units in Scotland. In 2006-2007 1717 samples were analysed (15453 tests). The laboratory measures aluminium, calcium, copper, lead, magnesium, potassium, silver, sodium and zinc in haemodialysis water samples. The UKRA guidance is that these should be measured at least every three months with the exception of lead and silver, which need only be measured if there is contamination of the water supply. The guidelines also recommend monitoring some contaminants which are not measured at the Scottish Trace Element and Micronutrient Reference Laboratory including three monthly measurements of fluoride, weekly chlorine measurement, and monthly checks for endotoxins and total viable bacterial count (TVC). Renal units do not all use the same sampling regimens.

Aim

The study aimed to determine the protocols for frequency of sampling haemodialysis water for chemical contaminants, endotoxins, bacterial count and chlorines and to determine how each renal unit responded to chemical contaminant results that were above the accepted limits.

Methods

All 28 renal units operating in March 2007 participated. There were 10 parent adult units, 17 satellite adult units and one paediatric unit. The person responsible for haemodialysis water sampling was contacted and they all completed and returned a questionnaire which was sent by post in March 2007. The questionnaire asked about the unit's current protocols for frequency of sampling of chemical contaminants, endotoxins, bacterial count and chlorines. Renal units were also asked how they responded to chemical contaminant results that were above the accepted limits.

This survey coincided with the publication of the 4th edition of the UKRA's Clinical Practice Guidelines.

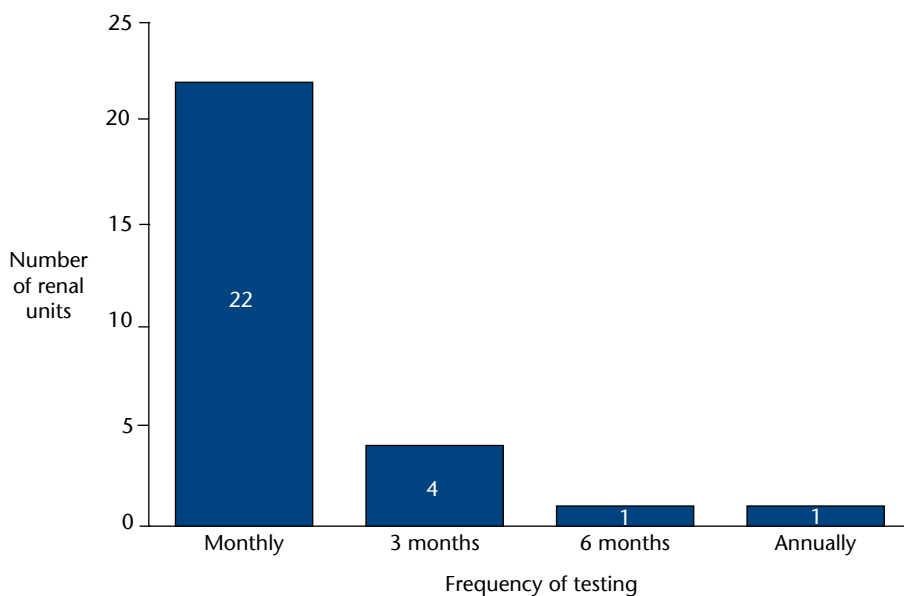
The questionnaire is available on the SRR website at:

<http://www.srr.scot.nhs.uk/About/Questionnaire.doc>

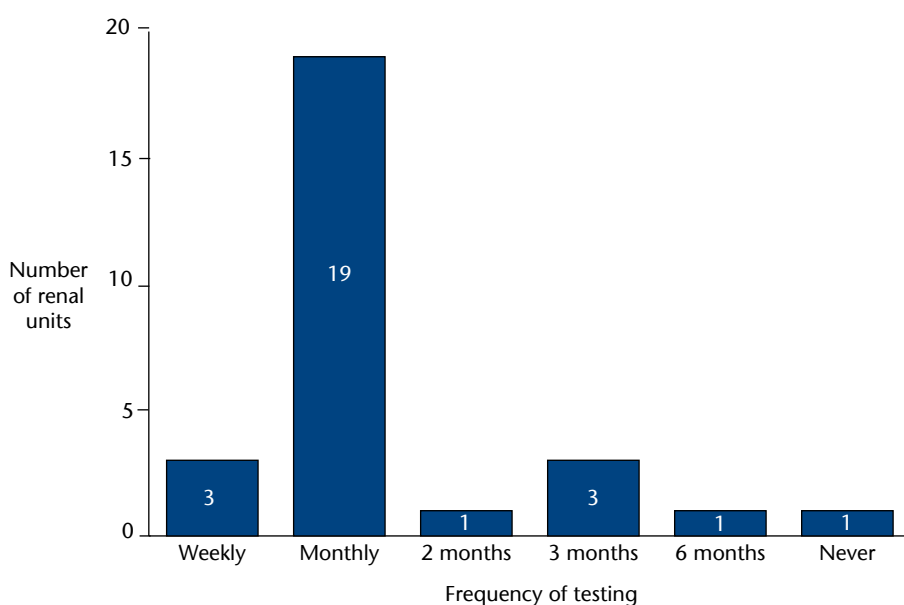
Results

All 28 questionnaires were returned. 24 of the 28 units that responded had a centralised reverse osmosis plant for haemodialysis water purification.

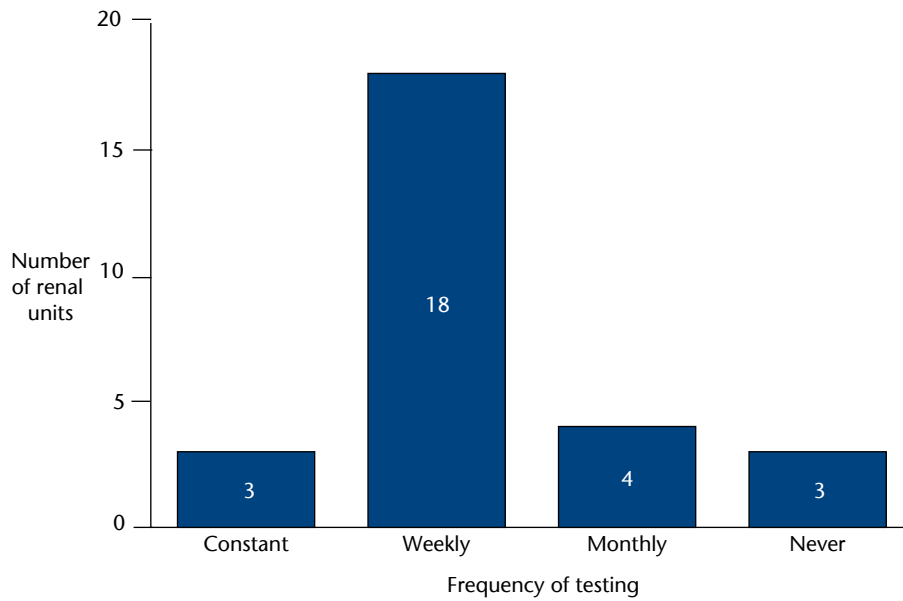
G7.1 Frequency of sampling of haemodialysis water for chemical contaminants



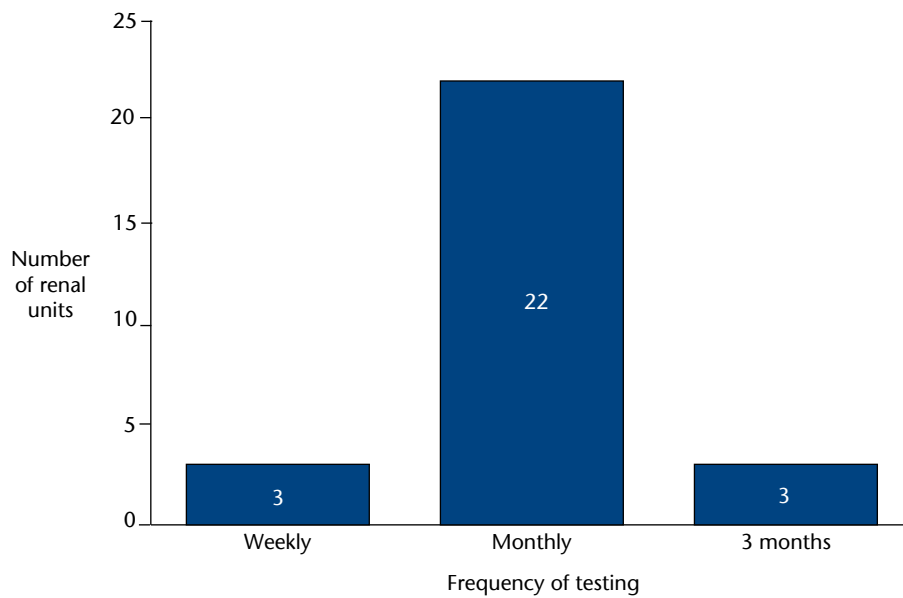
G7.2 Frequency of sampling of haemodialysis water for endotoxins



G7.3 Frequency of sampling of haemodialysis water for bacteria



G7.4 Frequency of sampling of haemodialysis water for chlorines



G7.5 Frequency of sampling of haemodialysis water

Renal unit	Frequency of haemodialysis water samples			
	Chemical contaminants	Endotoxins	Bacterial Count	Chlorines
Aberdeen Royal Infirmary + 6 satellites	1/12	1/12	1/12	1/52
Crosshouse Hospital	1/12	1/12	1/12	1/52
Dumfries and Galloway Royal Infirmary + 1 satellite	1/12	1/12	1/12	1/52
Glasgow Royal Infirmary	1/12	3/12	1/12	Never
Stobhill Hospital	1/12	1/12	1/12	1/12
Falkirk and District Royal Infirmary	1/12	2/12	1/12	1/52
Monklands Hospital	3/12	1/52	1/52	1/52
Ninewells Hospital	1/12	1/12	1/12	Never
Queen Margaret Hospital + 1 satellite	1/12	1/12	1/12	1/52
Raigmore Hospital + 2 satellites	3/12	3/12	3/12	Constant
Royal Hospital for Sick Children, Glasgow	Annually	Never	1/12	Never
Royal Infirmary of Edinburgh + 3 satellites	1/12	1/12	1/12	1/52
Western Infirmary, Glasgow	6/12	6/12	1/12	1/12
Inverclyde	1/12	1/52	1/52	1/12
Vale of Leven	1/12	1/52	1/52	1/12

1/52= weekly; 1/12= monthly; 2/12= every second month; 3/12= every third month; 6/12= every 6 months.

While most of the renal units in Scotland met the recommendations, some did not. There is wide variation in testing frequencies especially for endotoxins with differences noted even between a parent and their satellite units.

G7.6 Place of analysis of haemodialysis water for contaminants

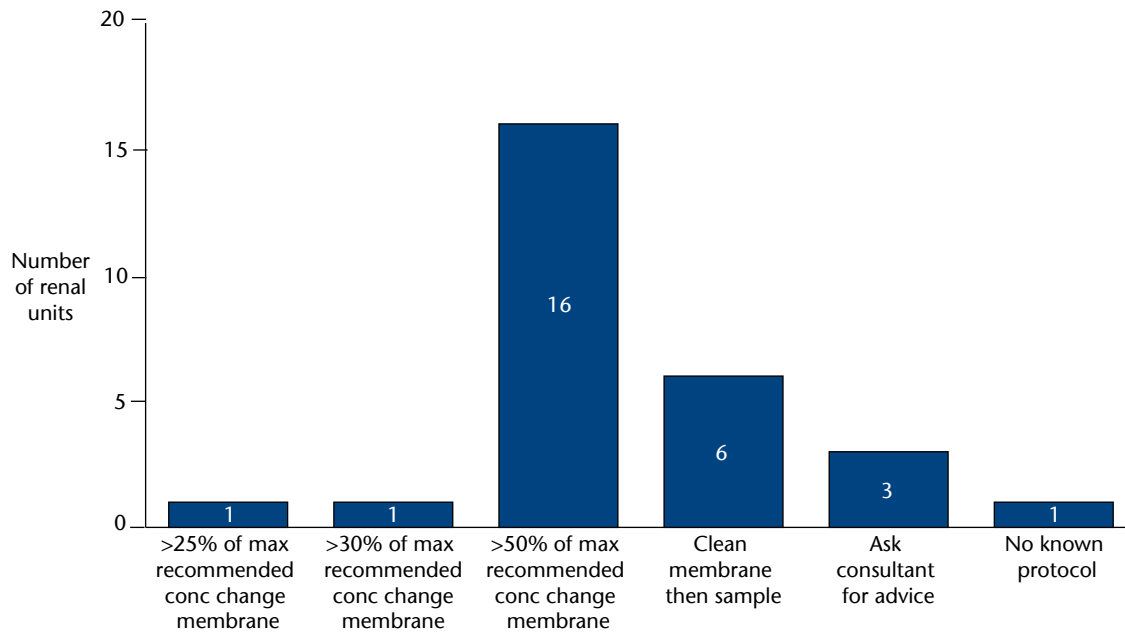
	No of units
Endotoxins	
External laboratory	17
In renal unit -Testing Kit - Endosate	7
In renal unit -Testing Kit - Pyrosate	3
Never	1
Bacterial count (TVC)	
External laboratory	4
Local Microbiology Lab	24
Chlorines	
In renal unit - Palintest Photometer	3
In renal unit- Hach Pocket Colorimeter	7
In renal unit - Stericheck Reagent Strips	3
In renal unit - Lovibond photometer	7
Constant	3
Unknown	2
Never	3

G7.7 Location and method of analysis of haemodialysis water samples

	Location and method of sampling and analysing haemodialysis water		
	Endotoxins	Bacterial count	Chlorines
Aberdeen Royal Infirmary + 6 satellites	Testing kit - Endosate	Local Microbiology	Testing kit - Lovibond
Crosshouse Hospital	External Laboratory	External Laboratory	Testing kit - Palintest
Dumfries and Galloway Royal Infirmary + 1 satellite	External Laboratory	External Laboratory	Testing kit - Stericheck
Glasgow Royal Infirmary	Testing kit - Pyrosate	Local Microbiology	Never
Stobhill Hospital	Testing kit - Pyrosate	Local Microbiology	Testing kit - Hach
Falkirk and District Royal Infirmary	External Laboratory	External Laboratory	Testing kit - Palintest
Monklands Hospital	External Laboratory	Local Microbiology	Unknown
Ninewells Hospital	External Laboratory	Local Microbiology	Never
Queen Margaret Hospital + 1 satellite	External Laboratory	Local Microbiology	Testing kit - Hach
Raigmore Hospital + 2 satellites	External Laboratory	Local Microbiology	Constant
Royal Hospital for Sick Children Glasgow	Never	Local Microbiology	Never
Royal Infirmary of Edinburgh + 3 satellites	External Laboratory	Local Microbiology	Testing kit - Hach
Western Infirmary Glasgow	Testing kit - Pyrosate	Local Microbiology	Testing kit - Stericheck
Inverclyde	External Laboratory	Local Microbiology	Unknown
Vale of Leven	External Laboratory	Local Microbiology	Testing kit - Palintest

There is no current guidance as to where or by whom the samples should be analysed. The term "External laboratory" refers to a laboratory undertaking analysis outwith the NHS and charging the NHS for the service. Ten units (36%) use point of care testing kits for endotoxins and all units that measure chlorines, except two with in-line constant chlorine meters, measure chlorines by point of care testing kit. 17 (61%) units send their endotoxin measurements to an external laboratory. However, 24 (86%) units use their local microbiology laboratory for measuring total viable bacterial count.

G7.8 Renal unit protocols for response to chemical contaminants



G7.9 Response from renal units to an abnormal haemodialysis water analysis result	
Renal unit	Response to abnormal results
Aberdeen Royal Infirmary Balfour Hospital, Orkney Gilbert Bain Hospital, Lerwick Dr Gray's Hospital Elgin Inverurie Dialysis Unit Peterhead Community Hospital Campbell Hospital, Portsoy	>50% of maximum recommended concentration change membrane
Crosshouse Hospital	>50% of maximum recommended concentration change membrane
Dumfries and Galloway Royal Infirmary Galloway Community Hospital Stranraer	Clean membrane then resample
Glasgow Royal Infirmary Stobhill Hospital Falkirk and District Royal Infirmary	>50% of maximum recommended concentration change membrane Clean membrane then resample Clean membrane then resample
Monklands Hospital	Clean membrane then resample
Ninewells Hospital Perth Royal Infirmary	No known protocol
Queen Margaret Hospital Victoria Hospital Kirkcaldy	>50% of maximum recommended concentration change membrane
Raigmore Hospital Belford Hospital, Fort William Caithness General Hospital Western Isles Hospital, Stornoway	Ask consultant
Royal Hospital for Sick Children, Glasgow	Clean membrane then resample
Royal Infirmary of Edinburgh Borders General Hospital, Melrose St John's Hospital, Livingston Western General Hospital, Edinburgh	>50% of maximum recommended concentration
Western Infirmary, Glasgow Inverclyde Royal Hospital, Greenock Vale of Leven	>30% of maximum recommended concentration change membrane >50% of maximum recommended concentration change membrane >25% of maximum recommended concentration change membrane

Units were asked what action they take when a chemical contaminant is detected in the haemodialysis water. Maximum recommended concentrations are given in the 4th UK Renal Association Guidelines, but there is no guidance from the UK Renal Association as to how these results should be acted upon. There is a very wide variation in practice across Scottish renal units, including between parent and satellite units, though the majority (59%) would change the purification membrane if a chemical contaminant result was greater than 50% of the maximum recommended concentration.

Discussion

This questionnaire has shown large differences in testing regimens between Scottish renal units despite guidance from the UK Renal Association. There is also a wide variation as to where and how tests are performed and what action is taken when abnormal results are reported.

A large percentage of the haemodialysis water sample analysis is being performed in the renal units themselves (point of care testing) or by sending to external laboratories. No specific guidance is given by the UKRA concerning the quality assurance requirements for haemodialysis water sample analysis. However, in all other clinical settings it is mandatory that there is evidence that the laboratory performing the test has adequate quality procedures in place. Point of care testing can be very difficult and the testing kits should be validated for medical use, the operators should be trained in its use and there should be regular calibration, internal quality control and ideally participation in external quality assurance schemes. The Royal College of Pathologists have published guidelines on the use of point of care testing³.

There is little consensus in Scotland as to how results should be acted upon, with a wide variation in practice when receiving a raised chemical contaminated result. Some units were unsure as to how they would act on receiving an abnormal result. It is good practice to have a protocol in place for the response to results for any routinely requested test.

References

1. Clinical Practice Guidelines for Haemodialysis. United Kingdom Renal Association 4th Edition, 2007.
2. American National Standard for Dialysate for Haemodialysis. Association for the Advancement of Medical Instrumentation, 2004.
3. Guidelines on Point of Care Testing. Royal College of Pathologists, 2004.
<http://www.rcpath.org/resources/pdf/Point-of-CareTesting-updatedOct04.pdf>