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ASSOCIATION OF TOXIC MICROBIAL AND CHEMICAL WATER QUALITY OF HEMODIALYSIS INSTRUMENTS DURING 2016

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ABSTRACT

Various contaminants in the water which are used for dialysis may be harmful to patients, therefore, the standard compliance is vital for dialysis water. The aim of this study was the analysis of the effect of hemodialysis system in pollutants removal from Razi hospital hemodialysis instruments. This cross-sectional descriptive research studied the microbial water quality of hemodialysis instruments in Razi hospital of Ahwaz, Iran. Experiments were done according to the book of standard methods from hemodialysis instruments during 2016. Finally, the relationship between results at different months and stations was done, using SPSS and descriptive statistics. Results shown that the average of microbial parameters and chemical quality in water influent hemodialysis instruments were pH =7.595, SO_4=3.5 mg/l, Na=70 mg/l, C=22.95 mg/l, Mg=51.05 mg/l and HPC=1 Cfu/ml. Also, total coliform and fecal coliform in water influent indicated that the reverse osmosis process was good. Razi hospital hemodialysis system effluent was mitted Iran environmental standards.

KEYWORDS:
Hemodialysis System, Microbial Quality, Chemical Quality, water treatment, Iran

INTRODUCTION

Distribution network usually is compliance with drinking water standards in terms of quality, but because of some elements, without supplementary treatment, it is not suitable for dialysis procedures and can be dangerous for such patients. So, dialysis centers should be noted to use complementary treatment of water [1, 2]. Microbial contamination of water among dialysis patients can cause infection and production of endotoxin with mild, moderate and fatal fever-causing reactions [1, 3, 4]. Chemical contamination of water including the common ionic compounds present in municipal water (chlorine, iron, nitrate, manganese, copper, zinc and iodine), trace elements in water (arsenic, silver, selenium, chromium, lead, cadmium, cyanide, barium, tin), physiology elements (calcium, potassium and sodium) and chemical additives to water in municipal water treatment plants (aluminum, fluoride and chloramines) can have the greatest effects on dialysis patients [5-14]. For example, nitrates may cause methemoglobinemia disease. Manganese and iron have toxicity property and accumulation of fluoride in bones which can lead to Osteomalacia. Aluminum accumulation is related to dementia syndrome and anemia among dialysis patients [15]. Devices reverse osmosis process is the most commonly used method of water treatment for hemodialysis [3, 16]. A reverse osmosis process by means of a semi-permeable membranes to separate the amounts of ion from water and take to treated water quality at the level of quality is necessary for hemodialysis devices [3, 16]. This method is used for hemodialysis to membrane permeability semi-artificial instead of kidney glomeruli [17-19]. In fact, the semi-permeable membrane synthetic acted as a filter and blood purification instead kidney defective [17-19]. Dialysis fluid is mixing the concentrate soluble (concentration of solution containing electrolytes) and drink-

ing water in a ratio of 1 to 34 that provided by hemodialysis machine, automatically [20-22]. Kidney failure is a condition that occurs as a result of decreased kidney function and urine in the body increases toxic metabolism and waste. Hemodialysis treatment procedure is used in order to correct the imbalance of water, electrolytes and blood chemical substances on patients suffering from chronic kidney failure and end-stage kidney disease [23, 21, 24]. Kawanishi et al in 2009 in Japan were studied the new standards in water entering the hemodialysis devices. According to the obtained results, treatment of aluminum, fluoride and chloramines should be considered [25]. Based on a study conducted in Egypt about the input hemodialysis devices showed that the microbial quality is up to standard, pH neutral and some elements in the range had been exceeded the standard range [26]. Razi hospital dialysis department is one of the best equipped centers that provide services to dialysis patients with 20 beds hemodialysis machines. This hospital water will be provided through water supply network. This study was done in order to analyze the effect of hemodialysis system in pollutants removal from Razi hospital hemodialysis instruments, with respect to water supply safety, and its role in health and extend the life of dialysis patients.

EXPERIMENTAL SECTION

Method. This cross-sectional descriptive research studied the microbial water quality of hemodialysis instruments in Razi hospital of Ahvaz (located in south-western Iran) during 2016. Razi educational health treatment center with 220 active beds is one of the largest specialized hospitals in South and South-West of Iran that has 20 equipped hemodialysis machines. pH, SO_4, Na, Ca, Mg, HPC values were determined according to the standard methods.

Table 1 shows the general properties process of Razi Hospital hemodialysis instruments including treatment system, active beds and water supply system (Table 1).

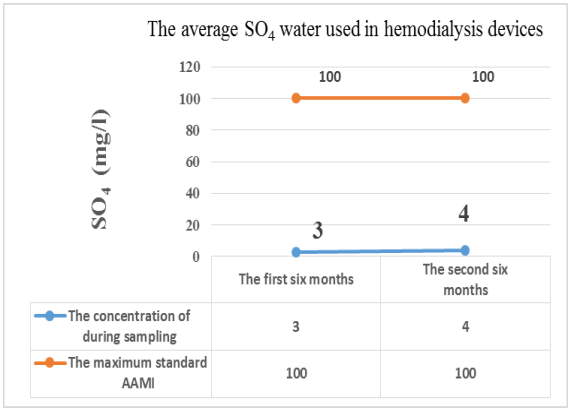
TABLE 1
General properties process Razi hospital hemodialysis instruments.

Treatment System	Active beds	Water supply system
Reverse osmosis (RO) process	220	**Ahvaz city water supply**

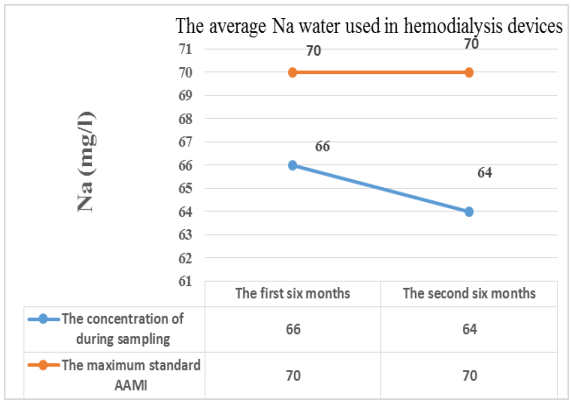
TABLE 2
The average chemical and biological characteristics of water quality in Razi hospital hemodialysis instruments

Average months of sampling / Raw water quality parameters	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	AAMI standard	Annual average (mean and standard deviation)
Total coliforms (MPN/ 100 ml L)	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	-	**<1.1± 0**
Fecal coliform (MPN/ 100 ml L)	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	-	<1.1± 0
HPC (Cfu/ml)	4	2	0	0	3	0	0	0	2	1	0	0	<200	**16 ±54**
Turb (NTU)				4.37						4.12			-	**16 ±54**
PH				7.69						7.5			-	**7.46 ± 0.7**
PO_4 (mg/l)				0.24						0.21			-	
Na (mg/l)				66						64			70	
Mg (mg/l)				53.4						48.7			4	
So_4 (mg/l)				3						4			100	
Ca (mg/l)				24						21.9			2	
NH_3 (mg/l)				0.972						0.723			2	
EC(µS/cm)				127						121			-	**29.57 ± 4.8**

AAMI: Association for the Advancement of Medical Instrumentation
EC: Electrical Conductivity
TDS: Tot al Dissolved Solids
HPC: Heterotrophic plate count



(a)



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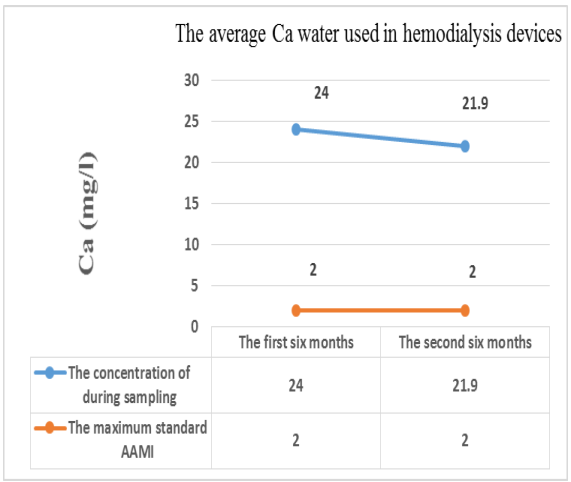

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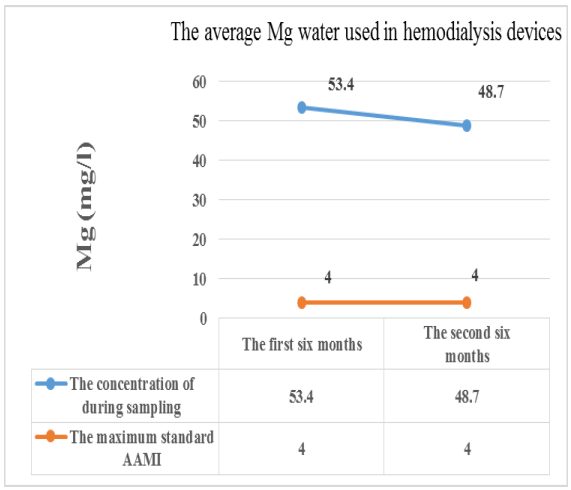

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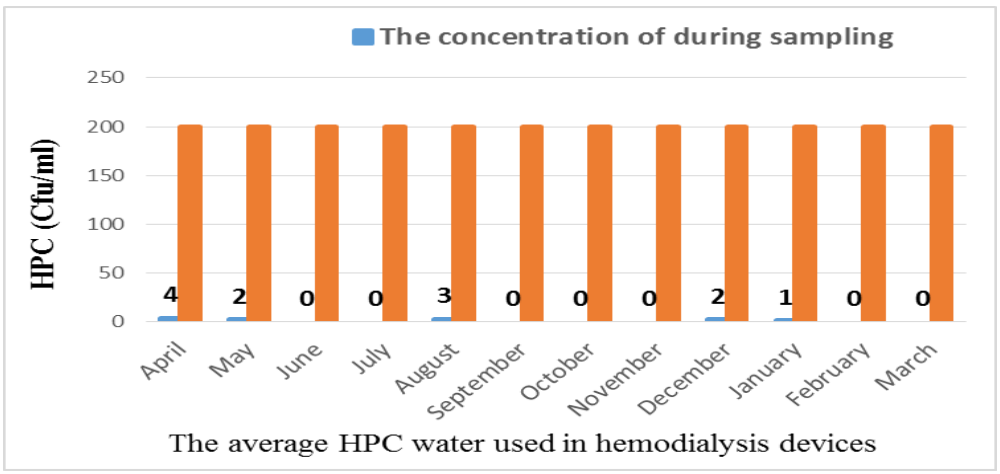

(e)

FIGURE 1
Compare to parameters of water used in Razi hospital hemodialysis instruments with standard AAMI (a) the average SO4 water used in hemodialysis devices, (b) the average Na water used in hemodialysis devices, (c) the average Ca water used in hemodialysis devices, (d) the average Mg water used in hemodialysis devices (e) the average HPC water used in hemodialysis devices

Sampling. Samples of input hemodialysis devices were collected from Razi hospital dialysis department and transferred to the laboratory. Temperature and pH parameters were measured in situ. In this study, 12 samples were collected with two glass bottles in 250 ml volume. In this study, we were seen some indexes such as the total coliform, fecal coliform and heterotrophic bacteria counts in terms of

HPC (CFU; Colony Forming Unit), residual chlorine, sodium (flame photo meter), magnesium, calcium (titration), sulfate (spectrophotometry method) and PH (PH meter device) on the efficiency of removal [26-28]. Finally, the relationship between results at different months and stations was done, using SPSS and descriptive statistics.

RESULTS AND DISCUSSION

In this study, we evaluated the chemical and biological quality of water entering to hemodialysis devices of Razi educational hospital in a period of one year in 2016.

Table 2 and Figure 1 are shown chemical and biological parameters of water quality during sampling compared to the standards of the Iranian Environmental Protection Agency (Iranian EPA). Table 2 presents the results of chemical and biological characteristics of water quality for information and comparison of it with AAMI standard (Association for the Advancement of Medical Instrumentation).

The average of SO_4 water which is used in hemodialysis devices based on the maximum of AAMI standard is 100 mg/l. Figure 1 shows that the amount of SO_4 in our study was 3.5 mg/l that was acceptable and lower than AAMI standard. Based on figure 1, the average of Na in water which is used in hemodialysis devices was 65 mg/l that in compare to AAMI standard (70 mg/l) was lower.

According to the results of present study, the effectiveness and performance of Razi hospital hemodialysis machines were in optimal efficiency. Results of this study demonstrated that all evaluated parameters in water which were used in hemodialysis devices of Razi hospital of Ahvaz were pH, SO_4, Na, Ca, Mg, with 7.595, 3.5, 70, 22.95 and 51.05 mg/l, respectively. Also, total and fecal coliforms and HPC were in accordance to AAMI standards that indicate good performance reverse osmosis process. Baseri et al have been investigated the hemodialysis instruments of Kashan Akhavan hospital. They showed that none of the samples had signs of bacterial contamination [29]. Asadi et al, compared heavy metals of the influent water of dialysis machines of Qom province hospitals with AAMI standards during 2012 [30]. They reported that concentrations of NH_3, SO_4 and Na were quite within the standard range [30], which is in consistent with our results and the reason of this can be probably attributed to the same water source and purification process. In a similar study by Vorbeck-Meister, bacterial and chemical parameters of hemodialysis water were evaluated. Based on the result, the microbial quality of water which is used for hemodialysis, residual chlorine and PH were less than the standard amount [31]. In another study conducted by Marjani et al in Gorgan, Iran, water devices for hemodialysis on average are lower than standard, chemically [32]. Result showed that chemical and biological quality which were measured, with the exception of calcium and magnesium, were less than the standard.

The most important potential barriers to improve system are inexperienced operators; they didn't enough budget for maintenance and operation of treatment systems; also, a manager's viewpoint.

CONCLUSION

In this study, detailed analyzed data were carried out to find the efficiency of hemodialysis instruments of Razi educational hospital of Ahvaz (located in south-western Iran) during 2016. In recent years, the effectiveness of the hemodialysis devices considering the large number of hospitals admission from different cities of Khuzestan province of Iran, the neighboring provinces in Razi educational hospital, various specialized and ultra-specialized services in these medical centers, changes in the quantity and quality of water in Ahvaz and hot weather of this province is very important in order to provide, maintain and increase the level of public health. Therefore, it is suggested that in order to have combination of fixed and standards all the times use the outflow of water purification systems.

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