Hyodo *et al. Renal Replacement Therapy* (2017) 3:11
DOI 10.1186/s41100-016-0082-7

Renal Replacement Therapy

POSITION STATEMENT

Open Access

Present status of renal replacement therapy at 2015 in Asian countries (Myanmar, Vietnam, Thailand, China, and Japan)

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Abstract

Currently, the Asian region is showing marked population growth and economic progress. In developing countries in Asia, rapid demands for dialysis therapy which have the same standard as those delivered in developed countries have arisen. The end stage renal disease (ESRD) patients have been increasing in these countries, but every country has its own barriers to promote better dialysis due to several reasons as the financial, educational, historical matters and so on. However, they have overcome these problems step by step.

The Japanese Society for Dialysis Therapy (JSDT) has started to make efforts to promote exchanges in the region, and increase the standard of dialysis therapy in each country. Based on the information obtained in this symposium, the committee is planning to prepare effective programs for young physicians and paramedics in developing countries. This report is the Review Article by the Committee of International Communication for Academic Research of JSDT. The presentation associated this article was opened at the 61st Annual Meeting of the Japanese Society for Dialysis Therapy held on June 26, 2015 (FRI), Yokohama City, Japan.

Keywords: The Committee of International Communication for Academic Research of the Japanese Society for Dialysis Therapy, Asian developing countries, Dialysis therapy, Hemodialysis, Continuous ambulatory peritoneal dialysis, Renal transplantation, Myanmar, ESRD, HD, CAPD, Vietnam, CAPD, Peritoneal dialysis first policy, Hemodialysis, Thailand, Hemodialysis, Staff education, Labor intensity, Beijing, Purification of dialysis fluid, Developing country, ET, Bacteria, Clinical engineer, Dietitian, Kidney disease, Nutritional management, Qualifications, Dialysis, Initiative, Educational program, Support program, Textbook

Background

Preface: Perspective of the committee of international communication for academic research of the Japanese society for dialysis therapy for Asian developing countries

Toru Hyodo, Nobuhito Hirawa, Matsuhiko Hayashi, Japan

Currently, the Asian region is showing marked population growth and economic progress. In developing countries in Asia, with such economic development, rapid demands for healthcare services which have the same standard as those delivered in developed countries have arisen, particularly for dialysis therapy. We must make efforts to promote exchanges in the region, and increase the standard of dialysis therapy in each country.

With the aim of broadly contributing to the development of dialysis therapy in developing countries in Asia, JSDT launched a “The Committee of JSDT to Support Dialysis Staffs in the Asian Developing Countries” in 2015. This symposium was designed with the aims of: exploring the types of dialysis therapy provided, current issues, and individual needs in developing countries in Asia as well as in those that have shown recent, rapid development, such as Thailand, and sharing information to achieve more effective cooperation among such countries. Based on the information obtained in this symposium, the committee is planning to prepare effective programs for young physicians and paramedics in developing countries.

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A clinical engineer is a profession that has uniquely developed in Japan, referring to a person who practices the maintenance and management of medical devices and uses them to provide patients with treatment. Since the clinical engineers are currently in demand in other Asian countries, we stressed to introduce this profession from Japan in this symposium.

Present status of renal replacement therapy in Myanmar

Khin Maung Maung Than, Myanmar

Renal replacement therapy (RRT) in Myanmar started in 1970 at a government hospital with one hemodialysis (HD) machine. Private HD started in 1996, and there are a small percentage of patients overlapping among government and private centres. Home HD is very rare. Hemodiafiltration (HDF) machines were introduced recently, but true on-line HDF is not available yet. Continuous renal replacement therapy (CRRT) was also introduced a few years ago but was not successful.

Regarding HD status in Myanmar, although the number of HD centres in districts is greater than in Yangon (machines numbers are similar), the majority of patients (925/1284 [72%]) are in Yangon (Table 1).

Continuous ambulatory peritoneal dialysis (CAPD) started several years ago, but the programme was delayed because of a lack of training and resources. The programme has been re-initiated recently. Live, related-donor kidney transplant started successfully in 1995 with five patients at a military hospital by a joint team. Doctors in Myanmar independently performed transplants successfully in 1997 at Yangon General Hospital (YGH), and a total of 215 procedures have done in Myanmar up to May 2015 (Table 2).

Training is usually done internally by experienced trainers, but there is no regular training programme. Occasional training workshops had been done successfully at government centres within the last few years. Doctors and nursing staff were sent abroad at times for proper training or to attend meetings or conferences.

There are a number of issues for RRT in Myanmar. The costs of RRT are the biggest issue, because it is usually by self payment (sometimes partly by the government or non-governmental organisations [NGOs]). Lack of options and choices for patients are also present (HD is still the predominant form of RRT available). Availability of resources (funding, equipment, and disposables) is still insufficient, and there is great disparity between Yangon and other districts. Awareness of chronic kidney disease (CKD)/ESRD in general and its treatment options are poor among the public. Quality assurance of the centres and staff is also an important issue that needs to be solved.

Table 1 The number of HD centres in districts is greater than in Yangon (machines numbers are similar), the majority of patients (925/1284 [72%]) are in Yangon

	Yangon			Districts		
	Government	Private	Total	Government	Private	Total
Centres	4	13	(17)	15	16	(31)
HD machines	35	101	(136)	49	60	(109)
Patients	183	742	(925)	179	180	(359)

Table 2 The kidney transplant started successfully in 1995 by a joint team. Doctors in Myanmar independently performed transplants successfully in 1997, and a total of 215 procedures have done in Myanmar up to May 2015

	Joint cases	Independent cases	Total cases
Government hospitals	24	161	(185)
Private hospital	-	30	(30)
Total	24	191	(215)

The average cost of an HD session in Myanmar is about US$ 40, and to bring down the cost further is not straightforward. A reimbursement system is required and medical insurance urgently needed. The role of NGOs may be important in this matter. As for other options in RRT, the CAPD programme needs further development and encouragement. Renal transplant cases need to be increased in both the government and private sectors (expanding donor pools and starting cadaveric programmes will be helpful). HDF/CRRT should be for selected cases only. Government spending on the healthcare budget has increased significantly in the last few years, and equipment is becoming more easily available with reduced costs owing to competition among distributors. However, more centres and machines are needed in the districts to reduce the extra costs and burdens for patients.

Increasing public awareness of CKD/ESRD and RRT is essential and health education to be given whenever possible. (World Kidney Day events have been done in Yangon and Mandalay since 2006, and these should be expanded to other big cities in the future). For quality assurance in the centres, regular training programmes are needed, together with regular audits of the centres as well as staff.

Overall, the outlook for the future of RRT in Myanmar seems to be promising!

The present status of renal replacement therapy, quality of water and dialysate, and staff education in Vietnam

Do Gia Tuyen, Vietnam

Introduction

Chronic renal failure is a devastating medical, social, and economic problem for patients and their families in Vietnam. Reliable data on the true incidence and prevalence of ESRD in Vietnam are lacking because no national registries exist. Because a national registry of

ESRD has not been developed for Vietnam, we can present only limited data in this report.

Overview of Vietnam

The population of Vietnam in 2013 was 90 million, with 25% of people living in urban areas and 75% in rural. The area of the country is 332,000 km^2, divided into 63 provinces. The population growth rate is 1.5% per a year, and 54 million people are of working age. Gross domestic product (GDP) per capita is US$ 1900. Insurance covers 65% of population, and the health premium for a monthly salary is 4.5% at minimum. There are 6.5 doctors and 8.0 nurses per 10,000 inhabitants.

Structure of diseases

Economic growth, an aging population, and lifestyle changes are leading to an increasing burden of non-communicable diseases. As for cancer, Vietnam reports about 75,000 new cases of cancer per a year. The case–fatality rate is high, and cancer accounts for around 12% of total deaths annually in Vietnam. Vascular heart diseases are also common, and myocardial infarction is now one of leading causes of mortality.

ESRD in Vietnam

In Vietnam, 6 million (6.73%) of the general population have been estimated to be diagnosed with chronic kidney disease. Of these 6 million patients, 80,000 (1.3%) patients have already reached ESRD. Annually, 8000 patients are newly diagnosed, of whom 104 (1.3%) will also go on to require HD services. The number of ESRD patients on HD was estimated as 10,338. ESRD and treatment methods consist of 87% receive HD, 8.7% receive CAPD, and 4.3% receive renal transplantation.

Hemodialysis in Vietnam

HD costs US$ 5000 per patient per year and CAPD is UD$ 6000. There are 130 dialysis centres in Vietnam, and 31 centres among these can perform CAPD. There are 70 centres in the northern part of Vietnam, 25 in the central part, and 35 in the southern part. In total, 56 centres are located in the provinces and 64 in cities. Of the provincial centres, 31, 11, and 14 centres are in the northern, central, and southern parts of Vietnam, respectively. The total number of HD patients is 10,338, of whom 4781, 1232, and 4325 patients are in the northern, central, and southern parts of Vietnam, respectively. The causes of renal disease for patients on HD consist of 74% due to diabetic nephropathy, 9% chronic glomerular nephritis, 8% kidney stone, 3% hypertension, 3% polycystic kidney disease, and 2% other causes. The peak ages of HD patients are 46–55 years old [Fig. 1]. The number of HD machines in Vietnam is 1807, with 916, 207, and 684 machines are in the northern, central, and southern parts of Vietnam, respectively. The most common utilization rate of HD machine is 3 sessions per a day and the other is 4 sessions. In total, 74.6% machines were rented, 18.0% were bought by the state budget, and 7.4% were donated.

All HD facilities had RO (reverse osmosis) systems and used a bicarbonate dialysate. Low-flux dialyzers accounted for 70% and were reused six times, middle-flux dialyzers accounted for 20% and reused six times, and the high-flux dialyzers for 10% and reused 10–12 times. The dialyzers were sterilized using formalin/Hemoclin. The blood circuit lines were disposable or reusable. The arterio-venous fistula needles were disposable.

The standard HD conditions in Vietnam were as follows. The frequency was 4 h × 3 sessions/week, blood flow 250–300 mL/min, dialysate flow 500 mL/min, and the ultrafiltration rate 0.5–1.0 L/hour. KT/V was 1.2–1.3

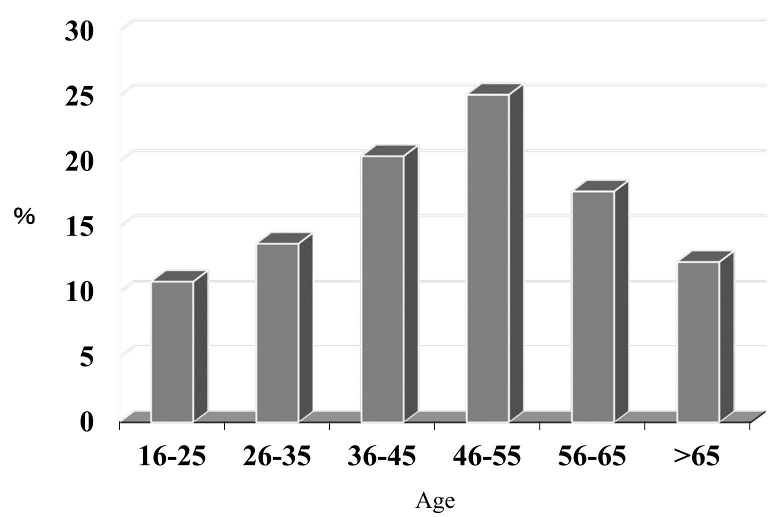

Fig. 1 The distribution of dialysis population. The peak ages of HD patients in Vietnam is 46–55 years old

and urea reduction rate (URR) is 60–70%. Heparin or low molecular weight heparin was used for anticoagulation. Dialysate was bicarbonate and the ultrafiltration coefficient (Kuf) of the dialyzer 5.0–50 mL/mmHg/h. The reuse of dialyzer was indicated for 98% of patients.

Medications prescribed in HD

The medications that are paid for by health insurance are as follows: anticoagulation medications: heparins (mostly), which are imported from Europe and India; Erythopoietin (Eprex, Neo-recomon, Epokin and etc.) 16,000–18,000 units/month; Intravenous iron therapy (Venofer, Cosmofer, and etc.); and Nephosteril (supply of amino acids).

Other dialysis modalities

Online hemodiafiltration (HDF) treatment has been performed Vietnam since 2011. At present (2015), online HDF is used in many hospitals in Vietnam, and health insurance partly covers online HDF.

Quality of dialysis: current situation

The quality of each HD session is questionable. In general, it was not qualified, and KT/V ~1.0 (URR 50–60%) was common. "Dry weight" management was not good. The causes were as follows. The time length of HD was not enough, mostly 3.5 hours/session and even rarely 3.0 h/session in some centers. Overall, 70% of dialysis centers used low-flux membranes with Kuf = 5.6–6.5. In addition, the system to clean the dialyzer was not modern enough, which caused difficulty in managing the quality of reusable dialyzers. The HD reimbursement from insurance in each session was too low (US$ 23), and equipment costs have increased to 10% every year. The dialysis centers were forced to reduce the hours of HD, reduce dialysate, use cheaper and more frequently reused dialyzers.

Anemia management in HD patients

Erythropoietin 2000 IU was injected subcutaneously after a HD session. Iron of 100 mg (Venefer) per month was also injected intravenously after the session. The target Hb level was 11.0–12.0 g/dL. Blood infusion is restricted if possible. However, it is estimated that only 60–70% of patients achieved the target outcomes. Therapeutic doses of erythropoietin depended on the ceiling of insurance. There were many patients with insufficient medication (only 16,000 IU/month). Combined medications were not effective because of limitations in laboratory tests. The poor quality of HD negatively impacted on the effectiveness of dialysis therapy. The quality of erythropoietin was not equal because too many kinds of products were in use.

Other problems

There were a number of limitations in nutrition for dialysis patients. Nutritional consultation was the most common method. A diet menu for dialysis patients has not been issued, and most patients did not comply nutritional regimens. Malnutrition and excessive water intake were common in dialysis patients. In addition, the management co-morbid diseases caused substantial difficulties.

Hypertension management was poor, because anti-hypertensive medications were not paid for by health insurance. The lack of specialist doctors is another big problem. Diabetes management is very difficult and diabetic medications are not paid for by health insurance.

The calcium–phosphorus – PTH (parathyroid hormone) level management is not considered adequate in most of dialysis centres.

Water quality

In Vietnam, 100% of dialysis centers have RO systems. However, the quality of water in RO systems was poor because the regeneration time for RO membranes was infrequent. In addition, the recommended frequency of maintenance was not implemented. Water quality, in terms of the chemical and microbial indicators, was not assessed periodically. Most dialysis centers did not have technicians or clinical engineers undertaking RO system maintenance.

The endotoxin (ET) levels in RO water were acceptable at only two among four facilities in the survey with Japanese team. ET levels in dialysis fluids were assessed in standard dialysis. The ET levels in standard dialysates were satisfactory at only one location. The bacterial counts in RO water were acceptable only one other location. The bacterial counts in dialysates were not acceptable at any of the locations investigated. In RO water and standard dialysate, the ET level should be <50 EU/L and the bacterial count <100 colony-forming units (CFU)/mL. In ultrapure dialysate injected directly into the human body (e.g., for online HDF), the ET level should be <1 EU/L (less than the detectable limit) and the bacterial count <0.1 CFU/mL.

Solutions for improving patient's quality of life in Vietnam

To improve outcomes during HD sessions in Vietnam, it seems the following changes are needed: the use high-flux membranes and avoidance of reusing low-flux membranes; HD frequency needs three sessions per week, with 4–5 h per session, KT/V of 1.2, and the URR of 60–70%; and improvement of the quality of water sources and dialysate, and the quality of HD machines combined with other modalities such as online HDF.

CAPD: current situation

The prevalence of CAPD accounted for 15.4% of RRT patients. CAPD costs were UD$ 6000 per patient per year, and CAPD equipment is imported from BAXTER Company. The most common CAPD complications include infection around the catheter site or peritonitis.

Kidney transplantation

A total of 1011 kidney transplantation took place. Of these, living donors accounted for 95% and only 5% from brain-dead donors. Most donors were related to the patient and less than 60 years old. The graft survival rate for more than 1 year was 95%, and for more than 5 years was 70%. The longest graft survival was 22 years. The main causes of graft loss were infection and chronic rejection. The medications are covered by health insurance.

Staff education of renal replacement therapy

None of the hospitals in the provinces had a Nephrology department. Of centers with a working Nephrology department, the medical doctors who work there were not always nephrologists or trained in nephrology, and the nurses were not educated systemically in nephrology. Most dialysis centers were located in hospitals, and the dialysis facilities were developed before the nephrology department was established. Most physicians in HD centers were general doctors with a short duration of training in dialysis but not in nephrology generally. Most HD centers did not have clinical engineers.

An update on renal replacement therapy in Thailand

Korntip Pattanasittangkur, Thailand

PD first policy era

RRT in Thailand has been increasingly widespread since National Health Security Office (NHSO) launched the Peritoneal Dialysis (PD) First Policy under Universal Healthcare Coverage Scheme (UCS) in 2008. CAPD has been chosen as the first choice of dialysis because it is potential cost-saving, simplier, more feasible, and require less infrastructure. Comparing data between CAPD and HD in UCS, the number of CAPD patients is growing rapidly and nearly equal to the number of HD patients. Problems resulting from rapid increase in CAPD patient numbers are a lack of PD trained staffs, an insufficient number of CAPD centers, and CAPD-related complication. Outcome data have been collected on technical value and patient survival. Currently, there is no data on cost-effectiveness. Moreover, HD units expand continuously for new ESRD patients and for patients who are not suitable for CAPD program.

Quality of water for hemodialysis and dialysate

Water for HD remains a huge problem for quality control because the water supply is quite different across Thailand such as bypass water from sideway due to shortage of rainwater, seasonal high tides of seawater in the central part of the country and using groundwater supply in some northeastern areas. Monitoring of RO water and dialysate quality for trace elements, bacteria contamination and endotoxins is necessary, but there are variations in monitoring frequency and testing techniques especially in HD units that are far away from laboratory centers.

Present and future challenge

Although universal RRT penetration and dialysis techniques have improved, unplanned dialysis is still a major problem because of patient denial. The challenge is to communicate the benefits of PD therapy to healthcare workers, patients and their families. The Ministry of Public Health has acknowledged this issue and implemented CKD clinic to cover prevention along with promoting renal transplantation as the most cost-effective therapy. RRT in Thailand is now in developing as a strategy to improve prevention and treatment for the entire Thai population.

Status of hemodialysis in Beijing and impact of staff continuous medical education and labor intensity

Liu Wen Hu, China

Present status of RRT in China

The number of patients with CKD has been increasing worldwide. Similar to other developed countries, CKD patients have already reached 10.8% of the total population in China. However, with a huge population of more than 1.3 billion, this equates to 130 million CKD patients. In the coming decades, there will be more than 1 million patients with ESRD, which will impose a huge burden on government healthcare budgets. Even so, there are still many counties across China without HD centers. The causes of this situation include economic, traffic, medical support, and educational reasons, among others. The central government has launched a major project to reach such patients, especially in rural or remote areas. The number of patients receiving maintenance HD has increased rapidly due to government support. The number of HD patients was 234632 in 2011, 248016 in 2012, 283581 in 2013, and 339227 in 2014. However, there are still differences in prevalence among provinces in China.

Present status of RRT in Beijing

More than 90% of RRT occurs in conventional HD centers. The mean quantity of blood flow (QB) was 265 ml/min, and the quantity of dialysate (QD) was 500 ml/min. In total, 92% of patients had an arterio-venous fistula. More than 86% of all dialyzers used polysulfone membrane with an area of 1.3–1.6 m^2, and more than 50% was high-flux membrane. Endotoxin levels of the dialysate were less than 0.25 EU/ml. A central dialysate delivery system is not widely used. The number of HD centers in Beijing was 110 in 2011, 109 in 2012, 110 in 2013, and 110 in 2014, although military hospitals were not included in these numbers. The total number of HD centers in China was 4047, with 2.7% of all HD centers located in Beijing. The number of HD patients in Beijing was 12,696 in 2011, 9362 in 2012, 8914 in 2013, and 10,029 in 2014, but patients attending military hospitals were not included. The total number of HD patients in China was 339,227 in 2014, and 2.9% of all HD patients lived in Beijing. The leading causes of new ESRD patients in 2014 were chronic glomerulonephritis (43.62%), diabetes mellitus (DM) (21.15%), and hypertension (8.77%), of which DM was the second leading cause. The leading causes of total mortality of patients receiving maintenance HD (MHD) in Beijing in 2014 were cardiovascular events (41.47%), cerebral events (22.39%), and infection (8.59%). Rates of hepatitis B virus (HBV) infection in new HD patients in Beijing in 2014 was 7.19%, hepatitis C virus (HCV) infection 1.30%, syphilis 1.43%, and human immunodeficiency virus (HIV) infection 0.15%. The prevalence of HBV and HCV infections has been stable at around 7 and 4%, respectively, among total MHD patients for the last 4 years.

A survey about the impact of hospital employees on clinical outcomes of MHD patients in Beijing

Aim of the survey There are three kinds of medical hospitals in China. Hospital group A comprises community public health stations without beds, hospital group B belongs to the district government each with hundreds of beds, and hospital group C belongs to the university or city hall or ministry of health each with thousands of beds. The aim of this study was to determine whether there is any difference in clinical outcomes or quality of HD among the three hospitals groups in Beijing. If there were any differences, the reasons were elucidated from the point of view of medical staff.

Materials and methods

Fifteen hospitals were randomly selected from 110 HD units in Beijing. A questionnaire survey was employed and clinical parameters were collected from the renal registry system in Beijing (Table 3). Whether blood tests for each element were performed and the rates (%) of fulfillment for the target test frequency were investigated (Table 4). Additionally, the rates (%) of fulfillment for the target hemoglobin, serum ferritin, calcium, phosphorous, iPTH, and albumin, Kt/V for urea, and urea reduction rate were checked (Table 5). The difference in labor intensity and academic education levels of dialysis staffs among the three hospitals groups was also investigated. The labor intensity was defined as the number of doctors per 100 HD patients. The academic education levels of dialysis staffs were defined with the best score of 100 points and the worst of 0 (Table 6).

Table 3 The blood tests performance rate (%) per a year for each element among three hospital level groups

	Hospital A	Hospital B	Hospital C
Hb	70.69	88.19	79.00
Ferritin	14.40	70.75	59.80
Ca	69.15	85.68	78.02
Phosphorus	68.89	85.13	77.80
iPTH	57.84	78.90	71.40
Alb	43.70	60.79	60.47
Kt/V	43.70	60.79	60.47
Urea reduction rate	53.98	74.39	56.98

Results

Whether the blood tests for each element were performed were best in hospital group B, second in hospital group C, and worst in hospital group A (Table 3). The rates of fulfillment for the target test frequency varied among the three kinds of hospital (Table 4). The rates of fulfillment for the target level of each blood test were best in hospital group B, second in hospital group C, and worst in hospital group A (Table 5). The labor intensity for hospital group A was 4.3, B was 6.25, and C was 1.39. The hospital group C was under the toughest condition. The continuous medical education (CME) level of dialysis staffs in the hospital group A was 60 points, B was 90, and C was 93. The CME level of the staffs in the hospital group C was best (Table 6).

Discussion

The management of the major clinical parameters examined was better in hospital group B than in hospital group C. Hospital group C was the poorest in the management of the major clinical parameters among the three hospital groups. Community medical stations

Table 4 The rates (%) of fulfillment for the target test frequency per a year

	Hospital A	Hospital B	Hospital C
Hb (6 times/year)	39.85	44.92	32.73
Ferritin (3 times/year)	0.77	33.45	33.91
Ca (6 times/year)	36.25	35.41	27.35
Phosphorus (6 times/year)	35.99	35.39	26.85
iPTH (4 times/year)	18.51	24.84	25.28
Alb (4 times/year)	24.16	25.97	22.14
Kt/V (4 times/y)	24.16	25.97	22.14
Urea reduction rate (4 times/year)	28.53	34.86	19.82

Table 5 The rates (%) of fulfillment for the target level for each test

	Hospital A	Hospital B	Hospital C
Traget level			
Hb (100–130 g/L)	54.24	66.00	59.51
Ferritin (100–500 ng/dL)	6.66	39.69	34.64
Ca (2.1–2.5 mmol/L)	37.53	55.72	51.33
Phosphorus (1.13–1.78 mmol/L)	28.02	38.95	36.93
iPTH (150–300 ng/mL)	16.20	23.07	21.56
Alb (>35 g/L)	30.08	35.53	35.17
Kt/V (>1.3)	30.08	35.53	35.17
Urea reduction rate (>67.5%)	29.82	38.66	31.10

(hospital group A) had the second lowest labor intensity and the poorest education level among the hospital groups in Beijing. Hospital group C had the highest CME level and the lowest labor intensity but with poorer clinical parameters than hospital group B.

Our survey suggested that the CME levels of staff members have an impact on major clinical parameters for patients receiving MHD. The labor intensity might impose a stronger impact than CME level for the major clinical parameters in patients receiving MHD. Therefore, in order to improve the quality of life of patients receiving MHD, we should employ sufficient numbers of staff and offer proper CME programs for medical professionals.

Quality of water for renal replacement therapy and education for clinical engineering technologists

Tomotaka Naramura, Japan

Background

The numbers of patients requiring dialysis and dialysis facilities in developing Southeast Asian countries (e.g., Cambodia, Myanmar, and Vietnam) has increased annually and are expected to increase in the future [1]. The public insurance system has not been introduced in Cambodia, and has been partially in Myanmar. And it has been established in Vietnam. According to the maturation of the insurance system, the dialysis patients and facilities have been increasing. The low-flux dialyzers are common in these countries. The HDF therapy has been partially introduced only in Vietnam. To prevent dialysis-related complications while performing HDF therapy or when using high-flux dialyzers, or even when using low-flux dialyzers, it is critical to use purified dialysis fluid [2, 3].

Table 6 The number of doctors per 100 patients (Labor intensity) and the staff academic education level (Maximum Points: 100)

	Hospital Group A	Hospital Group B	Hospital Group C
Labor intensity (Dr/Pts)	4.30	6.25	1.39
Staff academic education	60	88	90

The non-governmental organization (NGO) Ubiquitous Blood Purification International (UBPI) has supported to purify the dialysis fluid and taught how to do it in these countries. The NGO UBPI surveyed the dialysis fluid quality and studied how to keep its quality in these countries under their own facilities' conditions. Here, we report its activity and the results of the study.

Subjects and methods

Dialysis fluid and RO water samples were collected from dialysis facilities in Myanmar, Cambodia, and Vietnam. The ET level was determined by means of an ET-specific limulus reagent (kinetic nephelometry method; Toxinometer ET-Mini and Limulus ES-II plus CS Single Test Wako; Wako Pure Chemical Industries, Ltd., Tokyo, Japan). Bacterial number was determined using a conventional plate-counting technique on Reasoner's 2A (R2A) agar (Nippon Becton Dickinson Company, Ltd., Tokyo, Japan). Each sample was spread on an R2A agar plate and incubated at room temperature (approximately 25–30 °C) for 7 days. For samples that had not undergone the conventional plate-counting technique, bacterial number was determined using the membrane method, in which 100 mL of sample was filtered through a cellulose membrane filter (37-mm quality monitor; diameter, 37 mm; pore size, 0.45 μm; Nihon Pall Co., Ltd., Tokyo, Japan). The sample was cultured by pouring it into tryptone glucose extract broth and incubating at room temperature (approximately 25–30 °C) for 7 days.

All necessary equipment was imported from Japan, including syringes, measuring devices, and culture medium because of the difficulty in obtaining materials locally.

Results and discussion

At all facilities, the RO water and dialysis fluid demonstrated high levels of ET and bacterial contamination. For example, the ET level in dialysis fluid was 0.65 EU/mL and the bacterial number was >300 cfu/mL at dialysis facility A in Cambodia. Therefore, we initiated a dialysis fluid purification project with the NGO UBPI. Furthermore, we have supported the purification of dialysis fluid in these countries (Fig. 2).

First, for simple contamination control, an ET-retentive filter (ETRF; CF-609; Nipro Co., Ltd., Osaka, Japan) was installed in all dialysis consoles. At the same time, flushing solenoid valves were installed to prevent clogging of the ETRF. Furthermore, the silicon tube from the ETRF to the coupler was replaced. After ETRF installation, the ET level and bacterial number in the dialysis fluid were measured.

The ET levels and bacterial numbers immediately before/after and approximately 1 year after ETRF installation are shown in Table 7. The contamination levels of

Fig. 2 Purification support of dialysis fluid by the NGO UBPI. **a** ET and bacteria measurement. **b** Installation of ETRF with a flushing solenoid valve and replacement of the silicon tube. **c** Dialysis machine after ETRF installation. **d** Confirmation of dialysis machine operation

the dialysis fluid at the post-ETRF installation and even at the re-examination after 1 year fulfilled the water quality criteria of JSDT (Table 8) [4].

ETRF is very useful to purify dialysis fluid even under difficult conditions in developing countries. However, because dialysis fluid demonstrated high levels of ET and bacterial contamination before filtration, smaller ET and fine bacterial components as DNA size levels can pass through the ETRF. Moreover, methods to filter and purify dialysis fluid and maintain dialysis-related equipment have not been properly performed. Therefore, the quality management of dialysis fluid must be standardized in the future. Appropriate maintenance of dialysis equipment and implementation of contamination controls are essential.

Table 7 Endotoxin levels and bacterial numbers immediately before, after, and approximately 1 year after ETRF installation in Cambodia

	Endotoxin (EU/mL)	Bacterial colony (CFU/mL)
Before ETRF installation		
RO water	0.120	180
Dialysis fluid	0.650	>300
After ETRF installation		
Dialysis fluid	<0.001	<0.1
Approximately 1 year after ETRF installation		
RO water	0.733	>300
Dialysis fluid	<0.001	<0.1

To do this, local medical staff should be educated regarding quality management of dialysis fluid.

Accordingly, we established the Japanese Assistance Council of Establishing Dialysis Specialist System (JAC-DSC) in Cambodia to assist in educating Cambodian physicians and medical staff (Fig. 3). JAC-DSC provides training and education regarding dialysis, chronic kidney disease, renal transplantation, diet therapy for patients with diabetes mellitus, and clinical engineering.

In Japan, the Clinical Engineers Act was established approximately 30 years ago to enable clinical engineers to specialize in medical equipment training. In Japan, the main work of clinical engineers is the operation and maintenance of medical equipment, including life support equipment, such as dialysis machines. In Japan, clinical engineers are indispensable for ensuring safe dialysis treatment, including dialysis fluid purification. Medical instruments have become very sophisticated and complicated in recent years. In the future, developing countries will need to organize staff similar to the clinical engineers in Japan, who have knowledge of medical science and engineering, to ensure appropriate levels of medical care.

Acknowledgements
We would like to thank the Japanese clinical engineers belonging to the NGO UBPI who supported the installation of the ETRFs as volunteers.

Table 8 The water quality criteria for dialysis fluid of JSDT

Attainment level:
▪Standard dialysis fluid
Endotoxin: <0.050 EU/mL
Bacteria: <100 CFU/mL
▪ Ultrapure dialysis fluid
Endotoxin: <0.001 EU/mL (less than the detection limit)
Bacteria: <0.1 CFU/mL

This shows indications for dialysis system based on the quality of dialysis fluids. The standard dialysis fluid is minimum requirement for dialysis therapy. The ultrapure dialysis fluid is the dialysis fluid for the preparation of online substitution fluid

Clinical nutrition education for Japanese dietitians

Kenichi Miyamoto, Japan

Nutrition and kidney disease

Nutritional management of kidney disease, including CKD and dialysis, has become increasingly important [5]. Renal dysfunction has a large effect on nutritional metabolism. In addition, nutritional care is considered essential following a diagnosis of CKD. Compelling evidence indicates that the incidence of CKD is increasing due to the aging population and a higher prevalence of cardiovascular disease, diabetes, and hypertension [5]. CKD leads to complications such as high blood pressure, anemia, bone disease, and declining nutritional status [5]. Nutrition problems associated with kidney disease include energy intake, proper body weight, salt protein, and mineral intake [5]. In the USA, to address these problems, professional programs have been developed to provide nutritionists with a high degree of knowledge and experience with regard to kidney disease. In addition, the American Dietetic Association (ADA) guarantees the qualifications of ADA registered dietitians (RDs) with continuing education requirements [6].

Registered dietitians in the USA

RDs or registered dietitian nutritionists (RDNs) in the USA receive a high level of education and they are certified by the ADA [6]. To become an RD or RDN in the USA, it is necessary to obtain at least a Bachelor's degree. RDs and RDNs must also meet current minimum academic requirements as approved by the Accreditation Council for Education in Nutrition and Dietetics (ACEND) of the Academy of Nutrition and Dietetics. They must complete a supervised practical program accredited by ACEND, with a minimum of 900–1200 clinical hours. They must also successfully complete the Registration Examination for Dietitians, and approximately 50% of RDs have advanced qualifications. In addition, five specialist certifications are available to professional nutritionists [7]: Kidney nutrition Certified Specialist (Certified Specialist in Renal Nutrition: CSR), Child nutrition Certified Specialist (Certified Specialist in Pediatric Nutrition: CSP), Sports nutrition Certified Specialist (Certified Specialist in Sports Dietetics: CSSD), Elderly nutrition Certified Specialist (Certified Specialist in Gerentological Nutrition: CSG), and Tumor nutrition Certified Specialist (Certified Specialist in Oncology Nutrition: CSO).

Kidney nutrition certified specialists have at least 2 years' experience as an RD and at least 2000 hours experience in the past 5 years with nutritional management of patients with kidney disease. Once these qualifications are met, the RD or RDN must pass specialized tests of the ADA Commission on Dietetic Registration. Questions on the exam range from nephrology to basic knowledge and practical nutritional management of patients with CKD. In the USA, dietitians are ranked (Generalist, Specialist, Advanced Practitioner), and the skills, education, and qualification levels required for each stage have been determined [8].

Registered dietitians in Japan

In Japan, there are two types of dietitians: dieticians and RDs. RDs are responsible for more complicated tasks than dietitians. Although Japan has a long history of a formal dietitian system, the education of dietitians is based on home economics or agricultural science, and not medicine. Therefore, they have less medical knowledge and less clinical experience. In the general course to obtain an RD license in Japan, clinical training for nutritional management in a university requires only ~160 h. International standards, however, are at least 500 h. As described above, in the USA, clinical training is at least 900–1200 h. The clinical training education in Japan is far lower than the international standard.

Based on the historical background, clinical nutrition education in Japan is insufficient, particularly clinical training in hospitals. To improve this situation, the Japan Dietetic Association and the Japan Society of Metabolism and Clinical Nutrition have launched a program for RDs to specialize in renal nutrition. A RD specialist that provides clinical nutritional management is important for long-term patient care.

Much attention has been paid recently to the nutritional management of disease. Several Asian countries currently do not have dietitian education programs. Nutritional management of patients with CKD requires early disease recognition, appropriate interpretation of the markers and stage of CKD, and collaboration with other healthcare practitioners [8–11]. Since 2006, a number of new international guidelines have been published or revised using an agreed-upon grading system, and together with current literature, should be applied in dietetic practice, specifically nutritional interventions or prescriptions administered by clinical dietitians [8–11].

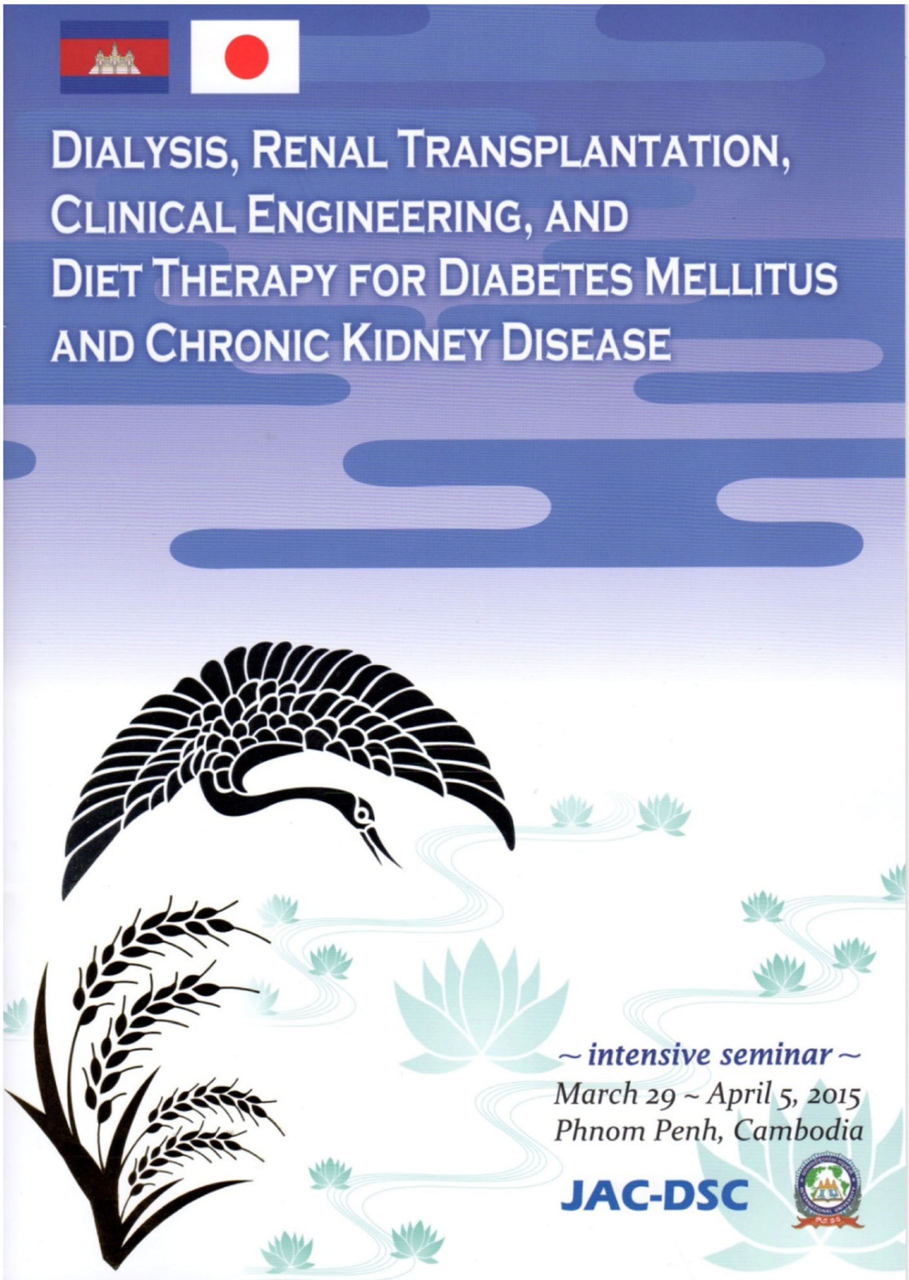

Fig. 3 Booklet from JAC-DSC intensive seminar

Introduction of support program of Japanese society for dialysis therapy to the developing countries of dialysis

Akihiro C. Yamashita, Japan

Introduction

The outcome of Japanese dialysis therapy for ESRD patients is known to be one of the best in the world. Japan, however, has not yet contributed much even to neighboring countries as a leader of dialysis therapy. JSDT established an internal committee to support dialysis therapy in so-called developing countries of this treatment. In this article, introduced is what this committee is planning to do for those who need any support in dialysis treatment.

Educational and training programs

HD is the most popular treatment modality for ESRD patients and is an application of membrane separation at which the solute of interest in blood goes across to the other side of the membrane where dialysis fluid flows in accordance with the concentration gradient between these two fluids. Therefore, the base of this treatment includes not only "medicine" but also physics, chemistry and even mathematics. Medical staffs of this treatment are usually being well trained hands-on and preferably be familiar with above basic principles.

The committee is established for supporting education of medical staffs, including young doctors, nurses, clinical engineers (CE), dietitians and other medical staffs with licenses, in the developing countries of this treatment. The mission of this committee includes the following four things.

Editing study materials of introduction of dialysis

Starting with the basic principles of dialysis and various initiatives, we are currently editing several PowerPoint files of learning material based on the guidelines published by JSDT. Each file contains one specific topic and one slide is designed for a couple of minute-long explanation. Followings are the titles of eleven chapters, showing a model time (= # of slides × 2 min) for a lecture.

I. Introduction of patients to dialysis (1 h)
II. Dialysis prescription (3 h)
III. Peritoneal dialysis (2 h)
IV. Anemia (1 h)
V. Mineral bone disorder (1 h)
VI. Vascular access (1 h)
VII. Water treatment (1h)
VIII. Dialysis fluid (1 h)
IX. Dialysis fluid delivery systems (2 h)
X. Dialyzers (2 h)
XI. Acute kidney injury (2 h)

Hands-on training program in Japanese dialysis centers

We will invite medical staffs to dialysis centers in Japan authorized by JSDT to provide a week-long hands-on training with partial financial aid of \100,000/person by JSDT. Feasibility study of this program has already been done by sending and collecting questionnaires to 454 authorized hospitals out of total of approximately 4300 dialysis units, resulting 44 units with affirmative answers to this project. Curriculum depends on the choice of each trainee and the venue is assigned where the curriculum is available. We are expecting 20 trainees to come to Japan each year. For more information, JSDT's homepage is available in 2015 or ask the local academic society of nephrology.

Lectures in dialysis units

Tutors from Japanese hospitals are going to be delegated to dialysis units to make lectures on dialysis. The topic of the lectures is determined upon request. This program, however, is currently joined and performed together with the project shown below.

Supporting other individual dialysis support programs

There are several individual programs with similar support concept of dialysis therapy. Since most of them are driven with dialysis related companies and/or with dialysis hospitals, they usually have financially abundant supply. For example, one of these projects is currently trying to help establishing a local academic society of nephrology/dialysis. We are supporting these support programs by endorsing the name of JSDT.

Engineering support program and license

As mentioned previously, it is important to understand the basic principles of dialysis for further success of the modality, including physico-chemical structures of the dialysis membrane, removal mechanism of the treatment (Fig. 4, from Chapter X of the textbook), disinfection

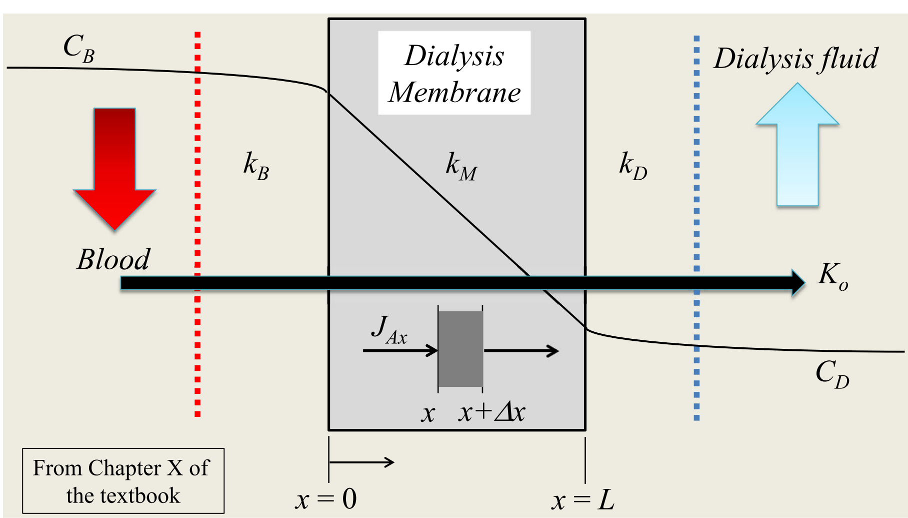

Fig. 4 Diffusion across a piece of membrane assuming an existence of boundary films adjacent to either side of the membrane. *Symbols* are conservatively assigned

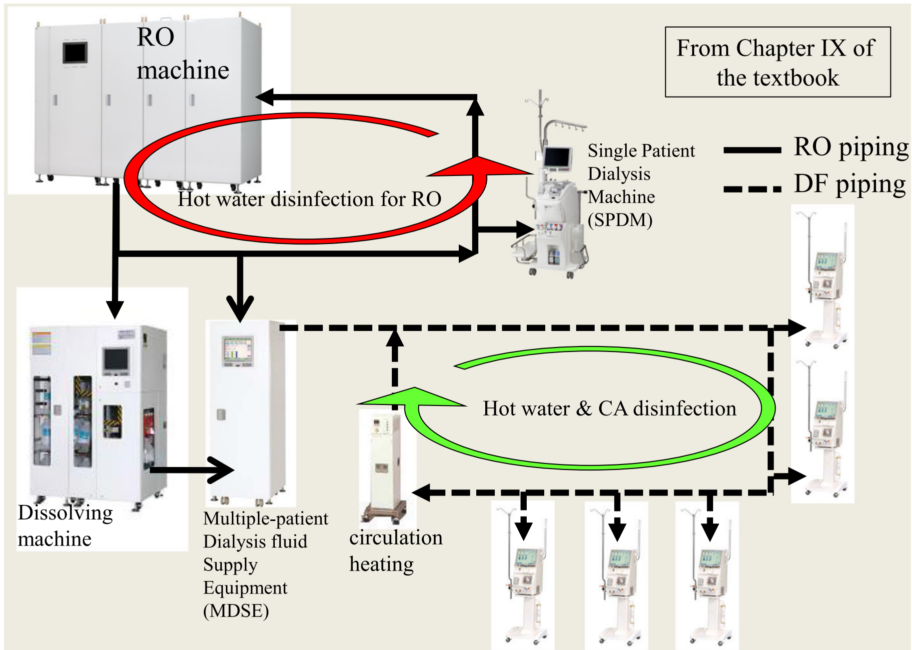

Fig. 5 CDDS, the best economical way to treat many patients at the same time

procedure of the dialysis water supply, including central dialysis fluid delivery system (CDDS) that is the best economical way to treat many patients at the same time with much less troubles in combination use of "automatic" dialysis consoles (Fig. 5, from Chapter IX of the textbook). The textbook under edition includes these materials in addition to the conventional clinical procedures of the treatment. Understanding and daily maintenance of the

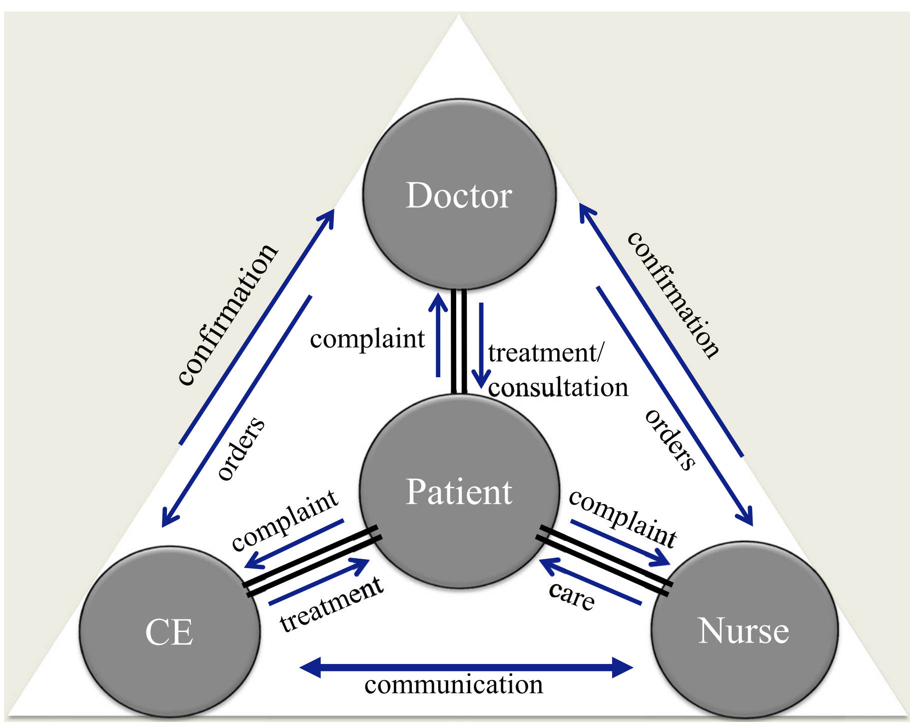

Fig. 6 Medical team care

water purifying and supplying system is especially important for the safe treatment. For this purpose, these tasks are assigned to nationally licensed CE in Japan.

Medical team care is important for offering high quality or more effective medical treatment on the background of recent medical advancements (Fig. 6). To achieve this purpose, CE is nationally licensed in Japan in 1988, following the establishment of “Clinical Engineering Technicians Act” by Ministry of Health, Labor and Welfare of Japan in the previous year. CE’s are expected to perform not only blood purification treatment but also all other medical device-related affairs. Following list covers the roles of CE’s. They sometimes move between departments in the occasion of the regular internal transfer like nurses.

i. Maintenance and management of medical devices
   A) Check/adjustment/exchange/repair/and operation of the medical devices and safety education to medical staffs, giving information of medical devices.
   B) Technological assistance and consultation of the purchase of medical devices.
ii. Operation of the life-support devices
   A) Supporting respiratory therapy, blood purification therapies including HD.
   B) Assisting circulation with heart-lung machine, cardiac catheterization etc.

Conclusions

JSDT will provide educational and training programs for those who need help especially in Asian countries. Japanese dialysis treatment has been developed in a different way to the USA and European counterparts. For example, CDDS has been believed to be a classic system in the USA and European countries. It is, however, employed in most dialysis units in Japan and is one of the keys of good clinical outcomes. CE’s, who have been well-educated in vocational schools or universities, have significant roles for maintaining the quality of Japanese dialysis treatment.

Abbreviations

ACEND: Accreditation Council for Education in Nutrition and Dietetics; ADA: The American Dietetic Association; CAPD: Continuous ambulatory peritoneal dialysis; CDDS: Central dialysis fluid delivery system; CE: Clinical engineers; CFU: Colony-forming units; CKD: Chronic kidney disease; CME: Continuous medical education; CRRT: Continuous renal replacement therapy; CSG: Certified specialist in gerentological nutrition; CSO: Certified specialist in oncology nutrition; CSP: Certified specialist in pediatric nutrition; CSR: Certified specialist in renal nutrition; DM: Diabetes mellitus; ESRD: End stage renal disease; ET: Endotoxin; ETRF: ET-retentive filter; GDP: Gross domestic product; HBV: Hepatitis B virus; HCV: Hepatitis C virus; HD: Hemodialysis; HDF: Hemodiafiltration; HIV: Human immunodeficiency virus; JAC-DSC: The Japanese Assistance Council of Establishing Dialysis Specialist System; JSDT: The Japanese Society for Dialysis Therapy; Kuf: The ultrafiltration coefficient; MHD: Maintenance HD; NGO: Non-governmental organisation; NHSO: National Health Security Office; PD: Peritoneal dialysis; PTH: Parathyroid hormone; QB: Quantity of blood flow; QD: Quantity of dialysate; RD: Registered dietitian; RDN: Registered dietitian nutritionist; RO: Reverse osmosis; RRT: Renal replacement therapy; UBPI: Ubiquitous Blood Purification International; UCS: Universal Healthcare Coverage Scheme; URR: Urea reduction rate; YGH: Yangon General Hospital

Acknowledgements

Not applicable.

Funding

Not applicable.

Availability of data and material

Not applicable.

Authors’ contributions

This report is the Review Article by the Committee of International Communication for Academic Research of JSDT. TH, NH and MH are the planners of this report and the committee members. Other authors wrote their own reports. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Our manuscript does not contain any individual persons data. This section is not applicable to our submission.

Ethics approval and consent to participate

Our manuscript dose not report on or involve the use of any animal or human data or tissue. This section is not applicable to our submission.

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Received: 1 May 2016 Accepted: 8 December 2016
Published online: 27 January 2017

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