**Present Status of Renal Replacement Therapy in Asian Countries**

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**Key Words**
Renal replacement therapy · Hemodialysis · Continuous ambulatory peritoneal dialysis · Asian countries

**Abstract**

**Background:** Asia is a huge and populous continent with diverse economies where the status of renal replacement therapy varies among different countries. **Summary:** The penetration of dialysis is poor among low income countries like India and China. A lack of trained nephrologists and limited numbers of dialysis facilities plague South Asian countries. Most of the hemodialysis centers are in the private sector; the few centers that are government-run or run by charitable organizations cannot meet growing needs. China has shown that twice-a-week hemodialysis can be feasible in female patients with small build. Peritoneal dialysis (PD) has less penetration among the developing countries than the developed countries in Asia. Novel schemes in India including the ‘once-in-a-lifetime payment’ scheme and an insurance scheme for peritonitis are attracting more patients to PD. New biocompatible PD solutions and home care facilities have brought down the peritonitis rates. The PD-first policy in Thailand alongside the domestic manufacture of PD fluids has decreased the cost of PD there. Iran has shown drastic changes in its PD policy (from 0 to 1,150 recruitments in 5 years) in spite of its high transplantation rate. Home hemodialysis is practiced in mostly affluent countries like Japan, where again it accounts for only 0.1% of all hemodialysis.

**Key Messages:** Developing countries should have more budgetary allocation for chronic ailments such as chronic kidney disease that can be utilized for training programs and establishing dialysis units, and thus meet the growing demands for renal replacement therapy. PD should be encouraged and adopted as first modality of renal replacement therapy considering its ease and economy.

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**Introduction**

Asia is not a homogenous entity. When the different Asian countries are compared economically, politically, and culturally, differences in diverse healthcare systems, with consequent differences in models for the delivery of dialysis, should be considered. Thus, any review of Asian dialysis practices has to take into account the continent’s huge economic contrasts. Asia contains high income countries such as Japan, Taiwan, Hong Kong, Singapore and countries in the Middle East, middle income coun-
tries like Malaysia and Thailand, and low-middle income and low income countries like China, India, Pakistan, Bangladesh, and Sri Lanka.

Dialysis in Asia

Internationally, it has long been recognized that there is an association between a country’s gross domestic product (GDP) (fig. 1) and its dialysis treatment rate [1]. Along with the United States, Japan and Taiwan make up the top three countries in the world in terms of end-stage renal disease (ESRD) treatment rates. The countries with the next biggest populations of patients receiving dialysis are Malaysia, and Thailand, with between 4,000 and 10,000 patients each. In contrast, treatment rates in India are extremely low, but the enormous population of the country means that even a very low treatment rate results in a significant dialysis patient population.

**Fig. 1.** The economies of Asian countries.
Two of the most interesting countries in Asia are the city-states of Hong Kong and Singapore. While each of these has only about 4,000 patients on dialysis, the delivery systems involved are unique, highly developed, and have a profile and influence disproportionate to their size. Looking across the region at renal replacement therapy (RRT) in general, a number of striking features can be identified. One is the high survival rate reported by many of the wealthier Asian countries compared to those in the wealthier Western countries. A second is the particularly low transplant rates in Asia, which are the consequence of a variety of cultural and structural factors. A third striking feature is the intensely cost-effective approach to dialysis delivery in the city-states of Hong Kong and Singapore and the potential for these approaches to act as models from which other countries may learn.

Per capita GDP alone cannot explain all the differences in treatment rates across the region. One explanation as to why Japan and Taiwan have disproportionately higher rates than Singapore and Hong Kong is that healthcare expenditure, as a proportion of GDP, in the former two countries is markedly higher than in the latter two. Singapore and Hong Kong, in particular, have continually tried to constrain spending on health care, whereas Japan and Taiwan have evolved more expensive social insurance-based models comparable to many in continental Europe. Thus, the proportion of the GDP devoted to health care in Singapore and Hong Kong is under 3% [2], while in Japan and Taiwan the figure is in the region of 5%–7%. An additional point is that both Japan and Taiwan make wide use of private providers in dialysis delivery. In contrast, Hong Kong has a predominantly publicly provided system, and Singapore has a unique model in which the main provider is a philanthropic charity. It has frequently been noted that, internationally, private provision of dialysis is almost invariably associated with higher treatment rates than is public provision [3, 4].

### Hemodialysis

**India, Pakistan, and South Asia**

Table 1 shows the economic and developmental indicators of major South Asian countries. In India, the first hemodialysis facility was established in 1961 at the CMC Vellore [5]. Over the last five decades, many more dialysis facilities have been established in the government sector, in institutions run as charitable trusts, and by private nephrologists.

An Indian population-based study determined the crude and age–adjusted ESRD incidence rates as 151 and 232 per million population, respectively [6, 7]. If these rates hold for other parts of this region, it would mean that about 220,000–275,000 new patients need RRT every year in this part of the world. It is estimated that there are about 55,000 patients on dialysis in India, and the dialysis population is growing at the rate of 10%–20% annually.

The current expenditure on health care by union and state governments in India is less than 1.5% of the total gross national product. Most funding goes toward maintaining the national programs, family planning and nutrition, staff salaries, and basic hospital infrastructure. Patients themselves have to pay for medications and disposables. The insufficient number of major hospitals results in overcrowding and long wait-times for dialysis and kidney transplantation. Overburdened public sector facilities prefer to dialyze patients who are transplant candidates. The inability of the states to provide adequate health care has led to the emergence of a large, but expensive, private sector. A few hospitals are run by charitable organizations, whose charges are lower than those at private hospitals, and some provide free treatment.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>India</th>
<th>Pakistan</th>
<th>Bangladesh</th>
<th>Sri Lanka</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population, billions</td>
<td>1.13</td>
<td>0.16</td>
<td>0.15</td>
<td>0.021</td>
</tr>
<tr>
<td>Birth rate, per 1,000</td>
<td>22.7</td>
<td>27.5</td>
<td>29.4</td>
<td>17</td>
</tr>
<tr>
<td>Growth rate</td>
<td>1.6</td>
<td>1.8</td>
<td>2.1</td>
<td>1</td>
</tr>
<tr>
<td>Life expectancy at birth, years</td>
<td>68.6</td>
<td>63.7</td>
<td>62.8</td>
<td>74.8</td>
</tr>
<tr>
<td>Percentage living below national poverty line</td>
<td>29</td>
<td>33</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>Health expenditure per capita, (public), % of GDP</td>
<td>1.2</td>
<td>0.7</td>
<td>1.1</td>
<td>1.6</td>
</tr>
</tbody>
</table>

From the United Nations Development Program [9].
Lack of Trained Manpower Hampers Healthcare Delivery

India has only 900 qualified nephrologists for a country of 1.2 billion people, whereas Pakistan has 250 for about 150 million. Over 90% of nephrologists work in the private sector. The number of nephrology training centers is increasing, but a number of nephrologists leave to seek work in affluent Western countries. There are about 5,500 dialysis centers in India, over 90% in the private sector. Pakistan had 175 dialysis centers as of 2009 spread over 53 cities, with about 30% government funded and 45% under private management [8–10]. The rest are run by community support organizations or charitable agencies. About 10%–15%, however, are non-functional [8]. In both countries, a large number of dialysis units are small facilities that offer minimal care and are owned and looked after by non-nephrologists or even technicians.

The cost of each hemodialysis (HD) session in India varies from INR 150 in government hospitals to INR 2,000 in some corporate hospitals. The monthly cost of HD in most private hospitals averages INR 12,000 and the yearly cost of dialysis INR 140,000 (about USD 3,000). The cost of hemodialysis is lower when the nephrologist-owned units are set up and when charitable trusts run the units. In some parts of South India, government-run health insurance schemes pay for dialysis provided in private hospitals [11, 12].

China

The prevalence of chronic kidney disease (CKD) in China approaches that in the United States. Data from the recently launched Chinese Renal Data System and data available from city registries show that a significant proportion of patients are on two-times weekly HD [13–16]. Twenty-eight percent of patients registered in Beijing were undergoing two-times weekly HD in 2002, according to the Beijing Hemodialysis Quality Control and Improvement Center [14–17]. The 2005 Shanghai Dialysis Registry reported patients were receiving dialysis an average of 2.6 times per week. One Chinese study, limited to Shanghai, has previously characterized the population of patients undergoing two-times weekly HD. Lin et al. [39] followed about 2,500 patients in Shanghai for a period of 2 years. In their cohort, patients on two-times-weekly HD (versus three-times-weekly HD) were younger and had lower body surface area, shorter HD vintage, and higher serum albumin concentrations. Women were more likely to be prescribed this frequency of HD, and we hypothesize that this may be due to their smaller body size. Patients without national insurance were more likely to be on two-times weekly HD.

In developed Asian countries, particularly Japan, Taiwan, and Korea, the proportion of patients receiving dialysis has reached 0.1%–0.2% of the population [20]. In Cambodia, there were only 10 dialysis facilities as of 2011 [20, 21]. In each country, the most frequent cause of renal failure resulting in the initiation of dialysis is diabetes mellitus. Online hemodiafiltration (HDF) has been spreading, not only in developed but also developing countries. The exact number of patients receiving online HDF in Japan is unknown because no survey focusing specifically on online HDF has been carried out.

Japan

As of the end of 2008, the number of prevalent patients on dialysis in Japan was approximately 283,000 (2,213 per million population [PMP]). The background of dialysis patients is characterized by aging (the average age of prevalent patients is 65.3 years and that of incident patients is 67.2 years), and increasing cases of diabetic nephropathy/nephrosclerosis as the primary disease. Patients with diabetes mellitus and those with nephrosclerosis represent 34% and 7% of all prevalent patients and 43% and 11% of all incident patients, respectively [22].

Korea

The status of RRT in Korea at the end of 2009 was as follows. First, the total number of patients with ESRD was 56,396 (HD, 37,391; peritoneal dialysis [PD], 7,618; functioning kidney transplant, 11,387). The prevalence of ESRD was 1,113.6 PMP. The proportion of patients undergoing RRT was 66.3% with HD, 13.5% with PD, and 20.2% with kidney transplant [23]. Table 2 shows the number of dialysis facilities and machines across the continent.

Table 2. Number of dialysis facilities and patients

<table>
<thead>
<tr>
<th>Country</th>
<th>No. of patients</th>
<th>Percentage of population</th>
<th>No. of facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambodia</td>
<td>200</td>
<td>0.001</td>
<td>10</td>
</tr>
<tr>
<td>Myanmar</td>
<td>600</td>
<td>0.001</td>
<td>28</td>
</tr>
<tr>
<td>Philippines</td>
<td>10,000</td>
<td>0.011</td>
<td>270</td>
</tr>
<tr>
<td>Vietnam</td>
<td>14,000</td>
<td>0.015</td>
<td>130</td>
</tr>
<tr>
<td>Malaysia</td>
<td>23,500</td>
<td>0.083</td>
<td>600</td>
</tr>
<tr>
<td>Thailand</td>
<td>29,500</td>
<td>0.044</td>
<td>500</td>
</tr>
<tr>
<td>Korea</td>
<td>45,009</td>
<td>0.093</td>
<td>614</td>
</tr>
<tr>
<td>Taiwan</td>
<td>63,655</td>
<td>0.275</td>
<td>552</td>
</tr>
<tr>
<td>China</td>
<td>272,000</td>
<td>0.020</td>
<td>3,500</td>
</tr>
<tr>
<td>Japan</td>
<td>297,126</td>
<td>0.232</td>
<td>4,152</td>
</tr>
</tbody>
</table>

Renal Replacement Therapy in Asia
Middle East Asian Countries

The countries of the Middle East cumulatively have a population of 261.1 million and a mean gross national income per capita of USD 9500 according to World Bank data for 2007. The highest income is in the United Arab Emirates (UAE), with a gross national income of USD 26,147; Yemen has the lowest income, at USD 760 (Table 3).

Based on national websites of countries in the region, the total number of patients with ESRD in the Middle East is almost 100,000 and the mean prevalence is 430 PMP, being highest in Lebanon at 818 PMP and lowest in Iraq at 55 PMP [5, 18].

There are 182 dialysis centers in the Kingdom of Saudi Arabia, with 4,755 machines catering to 12,116 patients. The Ministry of Health (MOH) offers the largest percentage of these facilities, with contributions made by the NON-MOH government sector as well as the private sector [18].

About 1,600 patients are undergoing dialysis in the UAE, with 240 being added each year to the list of people suffering from CKD [15].

In Iran, there are currently about 12,500 patients on HD, constituting 48.5% of the population with CKD [18, 19].

Continuous Ambulatory Peritoneal Dialysis

India

There are about 7,000 prevalent patients on chronic peritoneal dialysis in India. Continuous ambulatory peritoneal dialysis (CAPD) for CKD was initiated in India in 1991, with other South Asian countries following the Indian model. Despite relatively few contraindications and the added advantage of it being a simple home therapy, the penetration of CAPD has been only 18%–20% yearly in India. Domestic manufacture of PD fluid and accessories in India, China, Southeast Asia, and Latin American countries has reduced the cost of treatment.

The appropriate use of smaller exchange volumes (6 liters/day) in patients with smaller body size or those with residual renal function can positively impact the daily cost of PD without compromising adequate dialysis. A reduction in complications of PD by implementing better ‘connectology’ techniques that aim at decreasing peritonitis rates may reduce the associated hospitalization and treatment costs.

Once-in-a-Lifetime Payment Scheme for Chronic Peritoneal Dialysis: A Novel Initiative

The ‘once-in-a-lifetime payment’ scheme for patients, paid to the manufacturing industry for PD supplies, has enabled the expansion of the PD program in India from 2003 [24]. With a legal agreement between the patient and the dialysis industry, supplies consisting of a double bag transfer set, mini caps, etc. are provided so long as the patient continues CAPD. The lifetime scheme currently costs INR 700,000 (USD 15,500) for 3 exchanges per day, including all supplies delivered to the place of residence, as either a single upfront payment or 3 installment payments over a period of 3 years. Under certain circumstances, such as a switch to HD, renal transplantation or death, the remaining credit amount is refunded to the patient or family after deducting a nonrefundable amount of USD 1,100. This has the added advantage of there being no cost escalation until the patient dies or switches mode of therapy. The total number of patients enrolled is about 3,600 patients by different dialysis providers in India. The current expenses for those under the umbrella of this lifetime scheme are about USD 375–500 per month for 3 to 4 exchanges per day. Similar schemes are also available for automated PD at a higher cost. All ESRD patients anywhere in India can access the scheme. A multicenter retrospective study from South India showed that of the patients who survived on PD for 3 years, 46% belonged to the once-in-a-lifetime payment scheme and 21% were fully reimbursed by their employers [24, 25].

PD Suraksha Insurance for Peritonitis

A novel initiative was introduced in 2010 by a medical insurance company. This initiative involves a payment of USD 58 per year to ensure coverage for peritonitis treat-
ment, including hospitalization and antibiotics, for PD patients in India. All hospitalization expenses are insured up to a sum of USD 1,063 each year with an annual premium of only USD 58. If the patient requires catheter removal, the cost of the new catheter, implantation surgery, and hospitalization is included in the coverage. This scheme also provides care for the cost of HD during the interim period when the catheter has to be removed due to infection.

Novel Biocompatible Solutions

Due to local manufacturing and innovation in India, a biocompatible triple-chambered bag (TriChoice) is available in India, costing the patient about USD 850 per month for 3 exchanges per day.

Inexpensive PD Solutions

Local manufacturing has also helped produce PD solution bags (mNob) costing about USD 200 per month for 3 exchanges per day. This may be very well suited for use in developing economies.

Renal Home Care

Another unique initiative in India is the establishment of a ‘renal home care’ program recently initiated by the dialysis industry. This works like a call center that patients can call toll free and receive advice on CAPD or services that range from booking a doctor’s appointment to instructions on catheter care to when to consult their doctor regarding complications. Each patient is given a unique patient ID number to facilitate this process. Program workers provide training and conduct pre- and post-training evaluation to assess the effectiveness of the training provided. Reinforcement to patients to increase adherence to the protocols after training and reminders for appointments ensure adequate patient compliance. This service is provided in English and in eight local languages.

China

The proportion of individuals with end-stage kidney disease who are treated with dialysis in China is only about 20%. For the rest, RRT is not presently available. PD has been developed and used for more than 30 years in China to treat patients with end-stage kidney disease. Several national PD centers of first-rate scale and quality have sprung up, but the adoption of PD varies widely among geographic regions across China. The Chinese government has dedicated itself to continually increasing the coverage and level of medical service for patients with end-stage kidney disease. Under the guidance of the government and because of promotion by kidney care professionals, presently there are more than 40,000 prevalent PD patients in China, representing approximately 20% of the total dialysis population. Recently, the National Dialysis Unit Training Program for countrywide hospitals has been initiated [26].

Table 4. Number of patients on HD, online HD, and CAPD in South East Asian Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>HD</th>
<th>Online HD</th>
<th>CAPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambodia</td>
<td>200</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Myanmar</td>
<td>600</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Philippines</td>
<td>9,300</td>
<td>Unknown</td>
<td>700</td>
</tr>
<tr>
<td>Vietnam</td>
<td>10,000</td>
<td>5–10</td>
<td>2,000</td>
</tr>
<tr>
<td>Malaysia</td>
<td>21,700</td>
<td>Unknown</td>
<td>1,800</td>
</tr>
<tr>
<td>Thailand</td>
<td>26,500</td>
<td>1,400</td>
<td>1,500</td>
</tr>
<tr>
<td>Korea</td>
<td>37,391</td>
<td>4,000</td>
<td>7,618</td>
</tr>
<tr>
<td>Taiwan</td>
<td>55,825</td>
<td>2,200</td>
<td>6,110</td>
</tr>
<tr>
<td>China</td>
<td>260,000</td>
<td>Unknown</td>
<td>12,000</td>
</tr>
<tr>
<td>Japan</td>
<td>297,126</td>
<td>Unknown</td>
<td>9,128</td>
</tr>
</tbody>
</table>

Table 4 shows the number of patients on HD, online HD, and CAPD in Southeast Asian countries.

Japan

There were 9,514 PD patients in Japan at the end of 2012 (3.1%). Including an additional 522 CAPD patients, there were 10,036 (522 + 9,514) patients, including 7,323 (80.4%) on only PD and 1,788 (19.6%) on both PD and HD. Of these 9,111 PD patients, 1,428 (15.7%) underwent HD one time per week, 219 patients (2.4%) did so two times per week, and 55 patients (0.6%) did so three times per week. The PD+HD patients (1,788) accounted for 19.6% of all PD patients [27].

ESRD data are considered for four Asian countries: Hong Kong (488.5 PMP), Taiwan (216.0 PMP), South Korea (162.5 PMP), and Singapore (158.3 PMP). There was, however, a huge variation in the proportion of patients who received PD as opposed to HD. In Hong Kong, this proportion was as high as 79.4%, while it was 19.0% in South Korea [28–32].

Middle East Countries

The mean PD prevalence is 32 PMP in the Middle East (range: 0–81 PMP). The dialysis rate in the region, 312 PMP, is somewhat more than half the European rate of 581 PMP, but PD penetration is almost the same: 10.2% in the Middle East and 10.3% in Europe [33].

The number of active PD patients has risen dramatically since the end of the 1990s to 5,750 (from 1,030) in Turkey, 772 (from 132) in Saudi Arabia, and 1,150 (from
0) in Iran. Two patterns of RRT are observed: one with less practice of kidney transplantation, such as the situation in Turkey (9.8%), and the other with a high incidence of transplantation, such as in Iran (48.8%) [33].

Iran is the only country worldwide that has eliminated the waiting list for kidney transplantation. This accomplishment, which occurred in 1999, is the result of a mature, well-experienced, scientific, largely ethical, nationwide LURD (live, unrelated renal donor) transplantation program [34]. Almost 82% of donor sources come from the LURD program [35].

The Iranian PD Program
In 2001, a multidisciplinary approach to the expansion of CAPD in Iran was implemented. Care was called ‘Plus & Plus’ instead of the ‘Plus & Minus’ integrated approach [36]. In a Plus & Minus system, establishment of CKD clinics is the ‘Plus’ and restriction of pre-emptive transplantation is the ‘Minus’. The new Plus & Plus approach is to get as much use of the native kidneys as possible. It also emphasizes the weaknesses of pre-emptive transplantation. These weaknesses include the following:

- A high rate of recurrence of the primary renal disease
- A high rate of rejection in highly sensitized patients
- A short period of time for re-evaluation of donor and recipient (stressful for patients and caregivers)
- A high rate of confusion and mix-up of superimposed acute renal failure on chronic renal failure (CRF)
- The reversibility of some forms of CRF, such as CRF in malignant hypertension and scleroderma crises
- Most importantly, the wasting of the most valuable resource: remnant native kidney function

Therefore, an appropriate period of PD before transplantation is strongly recommended in the Plus & Plus program.

Home Hemodialysis

Home hemodialysis (HHD) was initially introduced to overcome the difficulty experienced by renal failure patients in transportation to and from dialysis units, which had been thinly distributed among communities during the first stage of chronic HD treatment in the 1960s and 1970s. HHD also provides other advantages, including the self-scheduling of treatment, maintenance of privacy, provision of more time with family members and reduced risk of infection from a dialysis unit. However, it also poses the disadvantages of requiring the services of a helper for self-care dialysis, increasing risk due to self-cannula-

### Table 5. Home hemodialysis in Asian countries

<table>
<thead>
<tr>
<th>S. No.</th>
<th>County</th>
<th>Prevalence</th>
<th>Registry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bangladesh</td>
<td>0.3</td>
<td>USRDS 2010</td>
</tr>
<tr>
<td>2</td>
<td>Hong Kong</td>
<td>0.41</td>
<td>USRDS 2010</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>0.1</td>
<td>JSDT 2010</td>
</tr>
<tr>
<td>4</td>
<td>The Philippines</td>
<td>0</td>
<td>USRDS 2010</td>
</tr>
<tr>
<td>5</td>
<td>Thailand</td>
<td>0</td>
<td>USRDS 2010</td>
</tr>
<tr>
<td>6</td>
<td>Taiwan</td>
<td>0</td>
<td>USRDS 2010</td>
</tr>
</tbody>
</table>

USRDS = United States Renal Data System; JSDT = Japanese Society for Dialysis Therapy.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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