

Cost Effectiveness Evaluation of the Ministry of Health Malaysia Dialysis Programme

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Summary

We determine the cost effectiveness of centre and home haemodialysis (HD), continuous ambulatory peritoneal dialysis (CAPD) and intermittent peritoneal dialysis (IPD) treatment in the Ministry of Health (MOH) programme. The viewpoint taken for this evaluation is that of MOH. Cost categories identified were capital cost, dialysis operational cost, medical cost and general hospital cost. Cost estimates were mostly based on actual resource utilisation. Life years saved were estimated based on Dialysis Registry data on 2480 HD and 732 CAPD patients. Overall, the cost-effectiveness ratio (CER) of centre HD was RM21620/life year saved. Those of home HD, CAPD and IPD were RM23375, RM30469 and RM36016 respectively. Sensitivity analyses did not change the ranking of the CER. We conclude the MOH dialysis programme was cost-effective, and among the various dialysis modalities centre HD was the most cost-effective.

Key Words: Economic evaluation, Cost-effectiveness, Dialysis, Haemodialysis, Continuous ambulatory peritoneal dialysis

Introduction

Public healthcare programme evaluation includes determining the programme effectiveness (outcome assessment), efficiency (economic evaluation), accessibility (reachability of services) and equity (equal provision for equal needs)^{1,2}. All agree that rigorous programme evaluation should be an integral component of programme operation, this however is rarely performed in practice.

Economic evaluation refers to the comparative analysis of alternative courses of action in terms of both their costs and outcomes³. It provides the necessary

information for an objective assessment of the relative value for money of competing health care interventions. Thus, it can assist informed and rational decision making on alternative uses of scarce health care resources. Health care consumes a significant proportion of a country resources, it has increasingly been subjected to scrutiny by economists.

Publicly funded or subsidised dialysis treatment provision rate in Malaysia has steadily increased in recent years to reached 28 per million population (pmp) in 1996⁴ (Table I). This is still inadequate; as the estimated incidence of end-stage renal failure in

Table I
Publicly Funded or Subsidised Dialysis Acceptance Rate Per Million
Population (pmp), Malaysia 1990-1996

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|------------|------|------|------|------|------|------|------|
| Rate (pmp) | 11 | 12 | 15 | 14 | 20 | 24 | 28 |

Malaysia is at least 100pmp¹¹ and as compared to the US treatment rate of 160pmp in 1990⁵. In other words, we continue to deny life saving treatment to many patients with end-stage renal failure (ESRF). An obvious reason for this is the government simply cannot afford treatment rate as high as 160pmp; however treatment rates between 50 to 100pmp should be affordable. Hence, another reason for under-provision may be that dialysis treatment is perceived as non-cost effective vis a vis other health care interventions like say treatment for cancer and coronary artery disease. However, to our knowledge, hard objective data on the cost effectiveness of any health care intervention is not available in this country. Though such data are increasingly available from developed countries⁶⁻⁸, results of economic evaluation have very limited generalisability across border. We therefore perform an economic evaluation of the Ministry of Health Malaysia (MOH) dialysis treatment programme. We used cost effectiveness analysis where outcomes are measured in life years saved.

Materials and Methods

Viewpoint

The viewpoint taken is that of MOH. This is justified by that the MOH is the ultimate decision maker on the funding of its own dialysis programme as well as subsidies for dialysis provision by Non-Governmental Organisations. The objective of economic evaluation is to assist the decision-making process.

Dialysis Treatment Alternatives

The dialysis modalities available from the MOH programme are centre haemodialysis (HD), home HD and continuous ambulatory peritoneal dialysis (CAPD). In addition, since dialysis treatment provision remains inadequate in this country (Table I)⁴, many patients with newly diagnosed ESRF are put on

holding intermittent peritoneal dialysis (IPD) treatment at initial presentation. Most of these patients would not be accepted for long term definitive dialysis treatment either in a government, NGO or private centre. They would be on IPD fortnightly or so as palliative treatment to relieve uraemic symptoms. They died typically within a year. These are the interventions compared in this evaluation. Renal transplant is arguably the 'best' treatment for ESRF, however it is excluded from consideration because its availability is limited by organ donation than by economics. HD and CAPD are not perfect substitutes for one another. A more realistic analysis should take into account patient movements between the two modalities. However, such flows are insignificant in MOH practice; in 1996 only 0.006% of HD patients transferred to CAPD and 6% vice versa⁴. We therefore ignore patient movements in this evaluation. In other words, results pertain only to patients who stay on the same modality of treatment till death.

Costs

Costs are given in 1996 Ringgit Malaysia (RM). Since the viewpoint taken is that of MOH, only direct treatment costs borne by the MOH are included. Costs borne by patients include direct non-treatment costs (e.g. transport to HD facility), indirect costs (e.g. lost work time) and intangible costs (e.g. pain and anxiety); these are excluded in this analysis.

Unless otherwise indicated, cost data were obtained from a recent detailed costing study undertaken by the Finance Department of MOH in 1996 as part of the requirement for the proposed privatisation of MOH dialysis services⁹. Since hardly any data on IPD were available, costing estimates were based on actual resource utilization of a random sample of 31 patients receiving 407 IPD treatments among them in 1996. The cost categories identified and measured are:

1. Capital costs which include land, building and capital equipment. Building and equipment costs are amortised over their useful life to obtain the 'equivalent annual cost'¹⁰. Land cost however is not depreciated³. Capital costs for home HD includes only equipment and structural modifications of home or office. That for IPD includes only peritoneal dialysis cyclor machine and allocated to individual patient by actual usage.
2. Dialysis operational costs which include staff salaries, consumables (e.g., dialyser reuse 3 times, blood lines, CAPD system and dialysate), equipment maintenance, utilities and telephone.
3. Associated medical costs which include laboratory tests and X ray (4 times per year), vascular/peritoneal access surgery, pharmaceuticals (excluding Epoietin), and hospitalisation. In 1996, the mean hospitalisation rate of dialysis (HD and CAPD) patients was 7 days per patient per year. However, as data on hospitalisation cost based on actual resource utilisation is not available, we have to use per diem hospitalisation cost estimated at RM270 (personal communication, Dr Shahidah bt Abdul Manaff, Pengarah Bahagian Perancangan dan Pembangunan, Kementerian Kesihatan Malaysia).
4. General hospital costs allocated to patient care departments include administration and supportive services like laundry, cleaning, building maintenance etc. This is based on ad hoc estimate as such data are not available. Our estimate is RM360 per patient per year.

Cost profiles of the various dialysis modalities are shown in Appendix 1. Detailed data are available from us or from the Finance Department, MOH⁹.

Health outcomes

This was measured in life years saved. Estimates were based on the Malaysian Dialysis and Transplant Registry data⁴. Only data of MOH patients commencing dialysis between 1980 and 1996 were used to compute survival rates. This is because death rates on dialysis has been stable since 1980 (i.e. absent of secular trend) to allow the patient cohorts from 1980 onwards to be regarded as a single homogenous group in respect of calendar time⁴. This patient group comprised 2480 HD and 732 CAPD

patients. Life expectancy was computed using the method described by Hakama and Hakulinen¹²; which is more accurate than the approximate methods commonly used in the literature¹³⁻¹⁴. Briefly, observed survival rates in the patient group were related to the expected survival rates in a group of the general population similar with respect to age, sex, and calendar time to obtain the annual relative survival ratio. Expected survival rates are available from official publication¹⁵. The relative survival ratio was used to estimate the constant persistent excess risk due to ESRF on dialysis. This constant can then be used to estimate life expectancy even though patient follow up information was inevitably incomplete (censored at closing date for analysis; in this case 31/12/96). We assumed life expectancy on holding IPD without definitive therapy is 1 year. This is both conservative and reasonable as IPD is a palliative treatment to relieve uraemic symptoms for patients awaiting premature death as a result of being denied definitive long-term renal replacement therapy like centre/home HD, CAPD or renal transplant.

Discounting Costs and Health Outcomes

Future costs were discounted at 5%; which is a common rate used in the literature. Discounting health outcomes is controversial¹⁶⁻¹⁷. Discounting outcomes at the same rate as costs penalised treatment with benefits that accrue over long time horizon¹⁷. A lower discount rate is justifiable if societal willingness to pay for life saving care increases with time; evidence to support this is available for dialysis treatment in Malaysia (Table D)⁴. We therefore discounted health outcomes arbitrarily at 2.5%, which is half the discount rate for cost.

Sensitivity Analysis

A range of values for uncertain cost estimates and outcome discount rates were tested to determine robustness of results.

Results

Table II shows the cost of each treatment modality and Appendix I shows their cost profiles. Surprisingly, centre HD had the lowest cost. Home HD was more costly than centre HD largely because of the high capital cost associated with limiting HD machine to a single user at

Table II
Comparison of the Cost of Centre HD, Home HD, CAPD and IPD

| | Cost 1996 Ringgit Malaysia (RM) |
|-----------------------------|--|
| Centre HD | |
| * Annual cost | RM 24,803 |
| Home HD | |
| * Year 1 cost | RM 27,872 |
| * Year 2 on annual cost | RM 25,191 |
| CAPD | |
| * Year 1 cost | RM 32,894 |
| * Year 2 on annual cost | RM 31,166 |
| IPD | |
| - cost for 1 year treatment | RM 35,138 |

Table III
Comparison of Life Years Saved on Centre HD, Home HD and CAPD by Age Group (Figures are Life Years Saved(SE))

| | Centre HD N=1558 | Home HD N=922 | CAPD N=732 |
|--------------|-----------------------------|--------------------------|-----------------------|
| AGE GROUP | | | |
| < 40 | 20.0 (1.7) | 15.2 (2.3) | 18.6 (3.6) |
| 40 - 54 | 11.5 (1.4) | 9.0 (1.1) | 6.5 (1.6) |
| >= 55 | 6.8 (1.1) | 6.1 (0.7) | 3.8 (2.8) |
| All patients | 15.5 (1.2) | 10.8 (1.1) | 6.4 (1.3) |

Table IV
Comparison of the Cost-Effectiveness of Centre HD, Home HD, CAPD and IPD

| | Centre HD | Home HD | CAPD | IPD |
|---|------------------|----------------|-------------|------------|
| Present value of cost in 1996 RM: (at 5% discount rate) | | | | |
| Age < 40 | 324559 | 277233 | 397213 | - |
| 40 - 54 | 230830 | 190690 | 191083 | - |
| >= 55 | 150697 | 136938 | 117767 | - |
| All patients | 282253 | 222394 | 167827 | 35138 |
| Present value of life years saved: (at 2.5% discount rate) | | | | |
| Age < 40 | 15.6 | 12.4 | 15.0 | - |
| 40 - 54 | 10.3 | 8.0 | 6.3 | - |
| >= 55 | 6.3 | 5.5 | 3.8 | - |
| All patients | 13.1 | 9.5 | 5.5 | 0.98 |
| Cost per life year saved in 1996 RM: | | | | |
| Age < 40 | 20820 | 22391 | 26518 | - |
| 40 - 54 | 22503 | 23923 | 30095 | - |
| >= 55 | 23734 | 24861 | 31304 | - |
| All patients | 21620 | 23375 | 30469 | 36016 |

Table V
Sensitivity Analyses
(Figures are Costs Per Life Year Saved for All Patients in 1996 RM)

| | Centre HD | Home HD | CAPD | IPD |
|---|-----------|---------|-------|-------|
| Per diem hospitalisation cost : | | | | |
| Decreased 50% | 20797 | 22541 | 28286 | 21266 |
| Increased 100% | 23268 | 25041 | 34834 | 65517 |
| Allocated general hospital cost : | | | | |
| Decreased 50% | 21463 | 23216 | 30294 | 36016 |
| Increased 100% | 21934 | 23692 | 30817 | 36016 |
| Outcome discount rate : | | | | |
| 0 % | 17640 | 20218 | 27971 | 35138 |
| 5 % | 26043 | 26773 | 33064 | 36894 |
| Home HD: | | | | |
| Consumables purchase at bulk order price. | - | 20721 | - | - |
| 5 patients sharing one HD machine | - | 17238 | - | - |

home, in contrast a single machine in centre HD can support 5 patients on average. Further centre HD enjoyed marked discount on consumables through bulk purchase. CAPD was costly due to the high cost of consumables (dialysate and disposables). Its capital cost was extremely low however, which is expected for a home based treatment with minimal equipment requirement. IPD was the costliest modality. It is a hospital based treatment; on average a patient on IPD spent 107 days per year in hospital which is extremely costly. Both home HD and CAPD had high first year costs because of the intensive period of training required to enable patients to perform the treatment procedure at home.

Table III shows the life expectation for each modality. Centre HD had the best outcome. This is not necessary due to selection bias, as the age specific life expectations were similarly superior for centre HD.

Table IV shows the cost effectiveness ratio (CER) of each dialysis treatment modality. Overall, centre HD was the most cost effective, followed by home HD, CAPD and IPD the least cost effective.

Table V shows the results of 5 sensitivity analyses. Not surprisingly, IPD, a hospital based treatment was

extremely sensitive to variation in hospitalisation cost. However even at the unrealistically low RM135 per diem hospitalisation cost, CER of IPD, at RM21,266/life year saved was still inferior to centre HD. Variation of allocated general hospital cost had no impact on CER results. As health outcome discounting is controversial, it is useful to know its effect on CER results. As shown in Table V, not discounting health outcome at all (0% discount rate) or discounting at the same rate as cost (5% discount rate) did not change the rankings of the different dialysis modalities. Finally CER of home HD was slightly better than centre HD if patients could purchase consumables at bulk purchase price. And if 5 patients could share the use of a HD machine, home HD would be the most cost effective.

Discussion

The results of this evaluation should be interpreted cautiously. The main weaknesses are the costing estimates. The allocation of general hospital costs to patient care department was highly uncertain. Fortunately the results were insensitive to this. More serious was the use of per diem hospitalisation cost. This had no impact at all on the relative CER of centre HD,

Table VI
Interstudy Comparison of Dialysis Cost/Life Year Saved*

| | MOH, M'sia (this study) | NZ ⁶ | US ⁷ | CANADA ⁸ |
|-----------|----------------------------|-----------------|-----------------|---------------------|
| Centre HD | 21,620 | 77,231 | 135,255 | 182,428 |
| Home HD | 23,375 | 61,695 | 139,478 | - |
| CAPD | 30,469 | 56,691 | - | 125,115 |

* All costs in 1996 RM. Costs were first converted to RM using exchange rate in the year of study, and then inflated to 1996 using 4% CPI

home HD and CAPD, the 3 definitive dialysis modalities. CER of IPD was very sensitive to variation in per diem cost, however IPD is not a serious alternative to the other 3 dialysis modalities. The 2 home based treatment, home HD and CAPD, are likely to incur greater patient costs which were excluded in this evaluation since the perspective taken was that of MOH. We had excluded costs incurred for treatment of comorbidities like diabetes, or of subsequent illnesses that patients may develop having had their lives extended by dialysis treatment, for example coronary heart disease or cancer. These costs are probably substantial and relevant; diabetes is the commonest cause of ESRF and cardiovascular disease the commonest cause of death among dialysis patients⁴. We have only presented the average CER results and completely ignored cost and effect at the margin for 2 reasons. Firstly variable costs, consumable costs in particular, predominates in dialysis treatment. Thus increase in number of patients will have little effect on average cost. Secondly, dialysis treatment is an extremely scarce resource in Malaysia. Marginal capacity is practically non-existent in publicly funded dialysis programme. We have used life years saved as the sole measure of health outcome in this evaluation. Quality of life outcome on dialysis is obviously relevant and important as dialysis treatment has considerable impact on patients' lifestyle. Instrument like QALYs (Quality adjusted life years saved) which combines information on both quality and quantity of life is available for purpose of economic evaluation³. We had however encountered methodological difficulties in estimating utility values which is required for obtaining QALYs. No doubt more work in this area is required.

Returning to our research question, how cost effective is the MOH dialysis programme? An absolute CER value, like RM21,260/life year saved on centre HD, is hard to interpret on its own in the absence of any benchmark that defines cost effectiveness. It would ease interpretation if local CER data on other life saving treatment like for cancer or coronary heart disease were available for comparison. Alternatively one could compare the results with those obtained by studies from other countries, preferably other developing countries though we have not seen one yet. International inter study comparisons are of course fraught with difficulties given methodological differences between studies and more seriously differences in purchasing power. Nevertheless, as shown in Table VI, CER of the MOH dialysis programme is extremely low; 8 times lower than Canada, 6 times lower than US and 3 times lower than New Zealand. Dialysis treatment is labour intensive, as are other clinical services. Hence professional staff costs predominate in studies from developed countries, while in the MOH consumables was the most costly component. This also explains the reversal in ranking between centre HD (more cost effective in MOH) and home based treatment like home HD or CAPD (more cost effective in developed countries) where patients themselves can substitute partially for expensive professional staff. Thus it does appear that the MOH programme is cost effective. In other words, health care resource allocation decision ought to favour publicly funded dialysis, at least until it could be demonstrated that treatment for other diseases or privately funded dialysis treatment are as cost effective.

Among the 3 definitive dialysis modalities, centre HD would appear the best bet. Home HD could be more cost effective if patients could share HD machine and consumables could be purchased at bulk order price. This is essentially what is implemented in so called "office" HD where HD treatment facility is installed in an office or work place rather than in patient's home. However this would completely negate the advantages of home treatment like flexible treatment schedule (dialyse at anytime you fancy), treatment under familiar and comfortable home environment, avoidance of frequent transport to a dialysis facility etc. "Office" HD loses all the advantages of home HD and yet is without the advantages of centre HD like closer professional supervision, higher standard of care, equipment, facility maintenance and better health outcome. "Office" HD is effectively poor man's centre HD. Its practice is rapidly declining in the MOH programme⁴.

This evaluation has also revealed "irrationalities" in the operation of the MOH dialysis programme. Firstly, IPD is clearly dominated (its cost effectiveness is unjustifiable) and yet it is the most widely practiced form of dialysis treatment in Malaysia, since less than half of ESRF patients could access definitive dialysis treatment every year (dialysis acceptance rate was 28 pmp in 1996 and ESRF incidence is between 100 - 200 pmp). There are several reasons for this. Its cost is "hidden" within a hospital total operating cost unlike the explicit budget for HD and CAPD. It is needed on

humanitarian ground to relieve the discomfort of untreated uraemia. Nobody could deny palliation to the dying ESRF patients who have been denied access to HD or CAPD. Under such circumstances cost effectiveness may be irrelevant. Secondly, CAPD is clearly dominated by centre HD and yet it is the most rapidly expanding dialysis modality in the MOH programme. Between 1992 and 1996, the number of patients on CAPD had increased by 168% while that for HD was only 47%⁴. The obvious reason is the low capital cost required to start a patient on CAPD (RM 182 for CAPD versus RM1690 for centre HD). CAPD is clearly "cheaper" in absolute term in the first year of operation and therefore it is easier to secure the more modest budget to start a patient on CAPD than on HD. In the longer term, centre HD is undoubtedly less costly and yet more effective.

In conclusion, dialysis provided by the MOH is a cost-effective treatment. Among the various dialysis modalities, centre HD is the most cost-effective. Economic evaluation is a useful tool in the planning and operation of health care programme, particularly in the public sector.

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Appendix 1

Cost Profile of Treatment

All costs given in 1996 RM

1. Centre HD:

| | | |
|----|---|--------|
| 1. | Equivalent annual capital costs/patient: • Building = 405 • Equipment = 1116 • Land = 168 | 1690 |
| 2. | Annual dialysis operational costs/patient: • Staff = 6864 • Consumables = 10034 • Maintenance = 468 • Utilities & phone = 1485 | 18851 |
| 3. | Annual associated medical costs/patient: • Lab. & X-ray = 1250 • Pharmaceuticals = 532 • Access surgery = 231 • Hospitalisation x 1 week = 1890 | 3903 |
| 4. | Annual general hospital costs allocated to patient care department/patient : (administration, supportive services) | 360 |
| | TOTAL: | 24,804 |

2. Home HD:

Year 1 cost:

| | | |
|----|------------------------------------|--------|
| 1. | 4 months training and HD in-centre | 11,078 |
| 2. | 8 months home HD | 16,795 |
| | TOTAL: | 27,873 |

Year 2 on cost:

| | | |
|----|---|--------|
| 1. | Equivalent annual capital costs/patient: • Start-up package including HD machine, water treatment, plumbing and structural modifications to home = 5267 • Other equipment = 82 | 5349 |
| 2. | Annual dialysis operational costs/patient: • Staff = 821 • Consumables = 13044 • Maintenance = 468 • Utilities & phone = 1248 | 15581 |
| 3. | Annual associated medical costs/patient: as centre HD above | 3903 |
| 4. | Annual general hospital costs allocated to patient care department/patient : as centre HD above | 360 |
| | TOTAL: | 25,193 |

3. CAPD:**Year 1 cost:**

| | | |
|----|---------------------------------------|--------|
| 1. | 8 days training in-hospital | 1,728 |
| 2. | CAPD at home for the rest of the year | 31,166 |
| | TOTAL: | 32,894 |

Year 2 on cost:

| | | |
|----|---|--------|
| 1. | Equivalent annual capital costs/patient: • Building = 13 • Equipment = 15 • Start up package = 153 | 182 |
| 2. | Annual dialysis operational costs/patient: • Staff = 810 • Consumables = 22,193 • Utilities & phone = 1000 | 24,003 |
| 3. | Annual associated medical costs/patient: • Lab. & X-ray = 1250 • Pharmaceuticals = 532 • Access surgery = 491 • Hospitalisation x 1 week = 1890 • Treatment for peritonitis = 2458 | 6,621 |
| 4. | Annual general hospital costs allocated to patient care department/patient : (administration, supportive services) | 360 |
| | TOTAL: | 31,166 |

4. IPD:

Year 1 cost:

| | | |
|----|--|--------|
| 1. | Equivalent annual capital costs/patient for 1 year: • Equipment = 1487 | 1487 |
| 2. | Intermittent PD annual operational costs/patient for 1 year: • Consumables = 4838 • Hospitalisation = 28,782 • Treatment for peritonitis = 31 | 33,651 |
| | TOTAL: | 35,138 |

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