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ORIGINAL ARTICLE

Primary Therapist Model for Patients Referred for Rheumatoid Arthritis Rehabilitation: A Cost-Effectiveness Analysis

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Objective. **To estimate the incremental cost-effectiveness (ICE) of services from a primary therapist compared with traditional physical therapists and/or occupational therapists for managing rheumatoid arthritis (RA), from the societal perspective.**

Methods. **Patients with RA were randomly assigned to the primary therapist model (PTM) or traditional treatment model (TTM) for ~6 weeks of rehabilitation treatment. Health outcomes were expressed in terms of quality-adjusted life years (QALYs), measured with the EuroQol instrument at baseline, 6 weeks, and 6 months. Direct and indirect costs, including visits to health professionals, use of investigative tests, hospital visits, use of medications, purchases of adaptive aids, and productivity losses incurred by patients and their caregivers, were collected monthly.**

Results. **Of 144 consenting patients, 111 remained in the study after the baseline assessment: 63 PTM (87.3% women, mean age 54.2 years, disease duration 10.6 years) and 48 TTM (79.2% women, mean age 56.8 years, disease duration 13.2 years). From a societal perspective, PTM generated higher QALYs (mean ± SD 0.068 ± 0.22) and resulted in a higher mean cost ($6,848 Canadian, interquartile range [IQR] $1,984–$9,320) compared with TTM (mean ± SD QALY −0.017 ± 0.24; mean costs $6,266, IQR $1,938–$10,194) in 6 months, although differences were not statistically significant. The estimated ICE ratio was $13,700 per QALY gained (95% nonparametric confidence interval −$73,500, $230,000).**

Conclusion. **The PTM has potential to be an alternative to traditional physical/occupational therapy, although it is premature to recommend widespread use of this model in other regions. Further research should focus on strategies to reduce costs of the model and assess the long-term economic consequences in managing RA and other rheumatologic conditions.**

KEY WORDS. Rheumatoid arthritis; Rehabilitation; Primary therapist model; Cost-effectiveness analysis.

INTRODUCTION

Physical therapy (PT) and occupational therapy (OT) are well-accepted adjunct treatments for patients with rheumatoid arthritis (RA) (1,2), 26.5% of whom are referred for PT and/or OT after seeing a rheumatologist (3). In Canada, most rehabilitation facilities (publicly funded or private clinics) are using the traditional PT/OT model, in which generalist rehabilitation professionals provide discipline-

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specific arthritis care in rehabilitation clinics or at the patient's home. To improve rehabilitation services for patients with arthritis, The Arthritis Society instituted the primary therapist model (PTM) in the province of Ontario in 1994. Under the PTM, physical therapists and occupational therapists function as case managers and multiskilled rehabilitation professionals (4,5). Primary therapists may consult their respective PT or OT colleague, rather than transferring the patient for completion of the treatment. Services are provided at the patient's home or in clinics that are set up in partnership with local rheumatologists and primary care physicians. Disease-specific, cross-disciplinary training (6) is continuously being offered by The Arthritis Society to all PTM therapists.

Results from our recent randomized controlled trial (RCT) demonstrate that the PTM can offer better patient outcomes as compared with the traditional therapy model (TTM) (7). However, the cost of treatment provided by a primary therapist is also higher. In the late 1990s, the cost per visit provided by a primary therapist with a PT background ranged from $81 Canadian (~$67 US) for a clinic visit to $90 Canadian (~$75 US) for a home visit. This was substantially higher than the cost of services provided in community clinics, which were reimbursed at $12.20 Canadian (~$10 US) per visit by the Ontario Health Insurance Plan (OHIP) (8). To determine whether the PTM is an economically viable option to provide RA rehabilitation, we conducted a cost-effectiveness analysis of the PTM against the TTM within the context of a 6-month RCT (7). The evaluation adopted a societal perspective, so that all costs regardless of payer were considered.

PATIENTS AND METHODS

Full details of the RCT are described elsewhere (7). Briefly, between November 1999 and May 2002, 173 patients with RA were referred by 25 rheumatologists in the province of Ontario. Eligible participants were patients who were candidates for PT and/or OT interventions, including exercise, prescription of aids or assistive devices, home assessment, education, and/or referral to community resources. Patients were excluded if they received PT or OT for RA in the previous 2 years, received joint replacement surgery in the last 3 months, or were scheduled to receive surgery in the next 3 months. Consenting patients (n = 144) were randomly assigned to the PTM group or the TTM group and were followed for 6 months. Patients were stratified according to American College of Rheumatology (ACR) functional classification criteria (9) prior to the randomization. Patients assigned to the PTM group received treatment from an Arthritis Society primary therapist. Those in the TTM group received traditional discipline-specific interventions from a PT and/or OT generalist in hospital outpatient departments (PT and OT), publicly funded clinics (mostly PT), or home care agencies (PT and OT). We assigned the treatment location for both groups using a triage algorithm developed by The Arthritis Society. The length of intervention was set at 6 weeks (10–12). We allowed therapists to decide the number of visits depending on the patient's needs. All participants continued to receive medical care from their rheumatologists.

Assessment of costs. To estimate societal costs (base-case analysis) during the 6-month period, patients were asked to complete a monthly Health Resource Utilization (HRU) questionnaire. The HRU questionnaire was developed for the Community Hypertension and Arthritis Project for both self and interviewer administration (13). It consisted of a series of open-ended questions about patients' visits to health professionals, use of investigative tests, hospital visits, use of medications, purchases of adaptive aids, and estimable productivity loss incurred by patients and their caregivers due to the patient's health. All costs are reported in 2002 Canadian dollars.

Costs were estimated in accordance with guidelines recommended by the Washington Panel for cost-effectiveness analyses (14). Costs of visits to physicians, procedures performed, and investigative tests undertaken were obtained from the Schedule of Benefits for Physicians and Laboratory Services, Ontario Ministry of Health (15). Primary therapist treatment costs were previously reported following a comprehensive costing methodology, which accounted for direct patient care (i.e., assessment and treatment time) and indirect time (i.e., record keeping, travel time for providing home visits) (8). We applied the OHIP reimbursement schedule to all publicly funded PT/OT visits at an outpatient clinic. For home care services, including PT, OT, nursing, and personal care services, we obtained a costing template for patients with RA from the Toronto Community Care Access Centres in February 2000. Costs of other health professionals, such as chiropractors and massage therapists, were obtained from their respective professional organizations.

For patients receiving disease-modifying antirheumatic drugs (DMARDs), the cost assignment for routine monitoring was obtained by costing all laboratory tests that are required when following monitoring directions issued under precautions for each drug in the Canadian Compendium of Pharmaceuticals and Specialties (16). Costs were averaged for the following DMARDs: methotrexate, gold, leflunomide, sulfasalazine, hydroxychloroquine, cyclosporine, and combination therapies.

Costs of hospitalization and day surgery were obtained from the Ontario Case Costing Initiative (OCCI; available at http://www.occp.com/) based on the International Classification of Diseases, Ninth Revision, Clinical Modification code for the respective diagnosis and procedure performed. OCCI used the step-down allocation approach to attribute direct and indirect costs to each hospitalization in accordance with the Management Information Systems Guidelines (17). This method accounted not only for the direct costs of care, but also the shared costs of support departments and overhead items (18). Costs of emergency room visits were assigned according to information in the 1999 Alberta Ambulatory Care Costing Survey (19).

The wholesale price of prescription and over-the-counter drugs was obtained from the 1999 catalog of a major wholesale supplier to Ontario pharmacies and hospitals (20). A 10% profit markup was applied to the costs. Costs per unit were calculated by dividing the cost per package by the number of units the package contained. The overall cost of each medication per patient was calcu-

lated by multiplying the unit cost by the number of administrations.

Costs of community services and assistive devices were obtained from 2 sources. Out-of-pocket costs were obtained directly from patients. For equipment that was partially funded by the provincial Assistive Device Program, the rates were obtained from the Wheelchair, Positioning and Ambulation Aids Manual (21).

Productivity losses incurred by patients while attending treatment sessions and by their caregivers due to the patients' illness were estimated according to the patient's age and sex. Provincial data on age- and sex-matched mean earnings were obtained from Statistics Canada (available at www.statcan.ca). Time costs incurred through a patient's inability to do chores were obtained by multiplying the number of hours lost by a professional housekeeper's hourly wage of $10 Canadian (~$8 US). Furthermore, patients were asked to report any additional out-of-pocket costs incurred for household chores.

Assessment of quality-adjusted life year. Health outcomes were expressed in terms of quality-adjusted life years (QALYs). Patients were asked at baseline, discharge (6 weeks), and 6 months to complete the EuroQol Instrument (EQ-5D), a generic utility measure that comprises 5 dimensions of health (mobility, self care, usual activities, pain, and anxiety/depression), each with a 1 (no problem) to 3 (major problems) rating. The 5 dimensions (i.e., the health state profile) are then converted into a weighted health state index between 0 and 1, with 1 indicating perfect health and 0 indicating death (22,23). The questionnaire appears to be valid in patients with RA (24,25), with mean scores varying from 0.73 for patients in ACR functional class I (n = 60) to 0.02 for patients in functional class IV (n = 50) (24). As has previously been done, British conversion tariffs were used for transforming health state profiles into utility scores (26,27) because the North American tariffs were at the development stage (28). This decision was supported by studies from Norway (29) and Sweden (30), which demonstrated that the tariffs associated with various health state profiles were similar across countries.

Statistical analysis. *Cost-effectiveness analysis (base-case analysis).* We grouped costs under 7 headings: health professional visits, investigative tests, hospitalization, drugs, community services, adaptive aids and devices, and indirect costs. All costs were considered in the base-case analysis. Incremental 6-month costs were extrapolated to an annual estimate. QALYs are commonly estimated by summing the products of the utility score and the period it measures (31). Due to a significant imbalance in baseline utility scores between groups, we calculated individuals' QALYs based on the change from baseline values (i.e., the area bounded by the baseline value and values from assessments at 6 weeks and 6 months). We extrapolated the utility score to 12 months by assuming that the utility score remained constant between 6 and 12 months. The last observation carried forward method was used to replace the missing values (32). No discounting was used, given that the time horizon of the analysis was less than a year.

Stochastic cost-effectiveness estimation was used, as both cost and effectiveness data were collected from the same patient sample (18). The incremental cost-effectiveness ratio (ICER) was estimated using the following equation:

$$\text{ICER} = (\mu_{\text{C\_PTM}} - \mu_{\text{C\_TTM}})/(\mu_{\text{E\_PTM}} - \mu_{\text{E\_TTM}})$$

where μ_C and μ_E represent the mean cost and mean health effect, respectively, of the treatment. The 95% confidence intervals for incremental costs and QALYs were derived using nonparametric bootstrap method, with 1,000 samples of incremental costs and incremental QALYs (33).

Further, incremental net monetary benefit (INMB) was estimated using the following equation:

$$\text{INMB} = \lambda(\mu_{\text{E\_PTM}} - \mu_{\text{E\_TTM}}) - (\mu_{\text{C\_PTM}} - \mu_{\text{C\_TTM}})$$

where E and C are the observed QALYs and costs, respectively, and λ represents the price a person is willing to pay for a unit of QALY (34,35). It is difficult to judge how much society is willing to pay for a QALY, although a price of less than $20,000 (Canadian) per QALY, suggested by the literature, offered strong evidence for adopting a new treatment, and a price between $20,000 and $100,000 (Canadian) per QALY offered moderate evidence (36,37). In this analysis, we used λ values between $0 and $150,000 (Canadian) to reflect a wide range of willingness to pay. A cost-effectiveness acceptability curve was constructed by plotting the probability of the results favoring the PTM against λ.

Sensitivity analyses. Sensitivity analysis was conducted by varying the valuation approach for lost productivity. First, age- and sex-matched hourly wages of a typical patient/caregiver were used. In this study, a typical patient was a 55.3-year-old woman (average hourly wage $16.74 Canadian; www.statcan.ca), and a typical caregiver was a 47.1-year-old man (average hourly wage $22.32 Canadian). Second, the wage rate of a professional housekeeper ($10 Canadian per hour) was used for estimating productivity lost. In addition, we conducted a regression-based analysis for QALYs by adjusting for baseline measures where there was a statistically significant difference (e.g., the baseline utility) or a trend of difference. Because the PTM group appeared to be slightly younger, have more women, and have shorter disease duration than the TTM group, we used age, sex, disease duration, and baseline utility as covariates in this analysis.

RESULTS

Of the 144 consenting patients, 111 (77.1%) completed the baseline assessment plus at least 1 posttreatment assessment and were included in the analysis (PTM group = 63, TTM group = 48) (Table 1). Among those included in the economic evaluation, 1 (1.6%) PTM patient and 21 (43.8%) TTM patients did not initiate the assigned treatment after randomization. We were unable to determine the actual cause for failing to initiate treatment; however, 25.6% of these patients reported problems accessing publicly

Table 1. Patient characteristics*

Variable	PTM group		TTM group		Dropout	
	No. missing	Total group (n = 63)	No. missing	Total group (n = 48)	No. missing	Total dropout (n = 32)
Age, mean ± SD	0	54.19 ± 14.35	1	56.77 ± 13.18	12	58.75 ± 16.08
Disease duration, mean ± SD years	1	10.60 ± 11.46	1	13.17 ± 12.07	11	14.41 ± 11.80
Sex	0		0		0	
Female		55 (87.30)		38 (79.17)		30 (93.75)
Male		8 (12.70)		10 (20.83)		2 (6.25)
ACR functional class	0		0		0	
I		10 (15.87)		8 (16.67)		6 (18.75)
II		25 (39.68)		19 (39.58)		10 (31.25)
III		23 (36.51)		17 (35.42)		12 (37.50)
IV		5 (7.94)		4 (8.33)		4 (12.50)
>2 comorbid conditions	0	30 (47.62)	0	18 (37.50)	10	6 (27.27)
Education level	0		1		10	
≤High school		31 (49.21)		21 (44.68)		6 (27.27)
University/college		24 (38.10)		18 (38.30)		14 (63.64)
Postgraduate studies		8 (12.70)		8 (17.02)		2 (9.09)
Marital status	0		1		10	
Married/common law		46 (73.01)		32 (68.09)		15 (68.18)
Separated/divorced		8 (12.70)		7 (14.89)		1 (4.55)
Widowed		8 (12.70)		4 (8.51)		4 (18.18)
Never married		1 (1.59)		4 (8.51)		2 (9.09)
Employment status	0		1		10	
Full time		16 (25.40)		16 (34.04)		8 (36.36)
Part time		5 (7.94)		2 (4.26)		3 (13.64)
Homemaker		10 (15.87)		7 (14.89)		2 (9.09)
Retired		19 (30.16)		17 (36.17)		7 (31.82)
Unemployed		5 (7.94)		1 (2.13)		1 (4.54)
On leave		8 (12.70)		4 (8.51)		1 (4.54)
Average household income	0		1		12	
≤$20,000		13 (20.63)		7 (14.89)		4 (20.00)
$20,000–$60,000		26 (41.27)		22 (46.81)		4 (20.00)
>$60,000		15 (23.81)		14 (29.79)		7 (35.00)
Refuse		9 (14.27)		4 (8.51)		5 (25.00)
Living arrangement	0		1		10	
Living with family		49 (77.78)		35 (74.47)		5 (22.73)
Living alone		12 (19.05)		12 (25.53)		17 (77.27)
Living in a nursing home		2 (3.17)		0		0
Received treatment at an outpatient clinic during intervention period	1	46 (74.2)	0	43 (89.6)		NA

* Values are the number (percentage) unless otherwise indicated. PTM = primary therapist model; TTM = traditional treatment model; ACR = American College of Rheumatology; NA = not applicable.

funded facilities (e.g., location, wait time). Details regarding participant noncompliance are described elsewhere (7).

Cost data. Health care resources and indirect costs led to a total amount of $6,848 (interquartile range [IQR] $1,984–$9,320) for PTM and $6,266 (IQR $1,938–$10,194) for TTM over the 6-month period from a societal perspective (Table 2). The incremental annual societal costs were $1,163 (i.e., PTM was more expensive). Average direct costs over the 6-month period were $4,040 for the PTM and $3,669 for the TTM. The mean length of rehabilitation treatment in the PTM group was 3.4 visits, as compared with 5.3 visits reported by the TTM group. However, because the unit cost for visiting a primary therapist was substantially more expensive, the mean treatment costs were significantly higher in the PTM group ($P < 0.01$). Despite the costs, the average number of rehabilitation visits was considerably lower in the PTM group. This was due to the fact that some patients in the TTM group received treatment from both a physical therapist and an occupational therapist. The actual number of visits in the TTM group could be greater, considering 43.8% of patients did not initiate the assigned treatment. No patient was re-referred for further treatment after the intervention period. We found no statistically significant difference in other health resource items.

Drug costs accounted for more than half of the direct costs (PTM = 58.1%, TTM = 51.9%), with biologic agents being the major contributor. The high cost of biologic agents (e.g., infliximab: $16,400/year, etanercept: $18,000/year [20]) had a significant impact on the mean drug costs, even though they were only used by 25.4% of patients in

Table 2. Estimated health resource utilization costs from the societal perspective (base case)*

	PTM group (n = 63)†		TTM group (n = 48)†		
	Value	Mean costs (95% CI)	Value	Mean costs (95% CI)	*P*‡
Direct costs		4,040 (3,059, 5,016)		3,669 (2,525, 4,812)	0.62
Average health professional visits (median, range)		655 (563, 748)		428 (354, 502)	< 0.01
Family physician	3.1 (2, 0–10)	75 (60, 90)	3.5 (3, 0–14)	77 (58, 96)	0.83
Rheumatologist	3.5 (3, 3–20)	146 (115, 176)	3.0 (3, 0–10)	126 (99, 153)	0.35
Other nonsurgeon specialists	1.4 (0, 0–12)	97 (48, 146)	1.5 (1, 0–8)	98 (59, 136)	0.99
Surgeon	0.1 (0, 0–2)	5 (1, 10)	0.4 (0, 0–6)	21 (5, 38)	0.07
Physical/occupational therapist	3.4 (3, 0–15)	289 (231, 347)	5.3 (1, 0–50)	88 (49, 127)	< 0.01
Other allied health professional	0.9 (0, 0–11)	29 (10, 48)	0.5 (0, 0–6)	16 (4, 29)	0.29
Complementary/alternative medicine practitioner	0.4 (0, 0–5)	15 (2, 28)	0.1 (0, 0–2)	2 (−2, 6)	0.06
Average investigative tests, (median, range)	–	270 (214, 326)	–	275 (227, 323)	0.89
Blood tests	4.5 (4, 0–21)	161 (127, 194)	4.7 (5, 0–10)	166 (143, 188)	0.81
Other investigative tests	1.8 (1, 0–20)	110 (64, 155)	2.3 (2, 0–9)	109 (72, 147)	1.00
Drugs, %	–	2,345 (1,566, 3,124)	–	1,903 (1,050, 2,757)	0.45
DMARD	82.5	310 (159, 460)	79.2	253 (125, 382)	0.58
NSAID (excluding COX-2 inhibitors)	39.7	48 (18, 77)	22.9	24 (6, 42)	0.17
COX-2 inhibitors	50.8	223 (102, 345)	35.4	116 (54, 177)	0.15
Corticosteroid	38.1	5 (1, 10)	43.8	12 (1, 23)	0.24
Narcotic drugs	7.9	22 (−7, 51)	2.1	1 (−1, 2)	0.15
Analgesic drugs	31.7	2 (1, 3)	37.5	12 (3, 22)	0.04
Narcotics/analgesics combined	25.4	16 (−6, 37)	29.2	2 (0, 4)	0.28
Biologics	25.4	1,379 (677, 2,082)	16.7	1,036 (270, 1,801)	0.51
GI protective agents	25.4	97 (40, 154)	31.3	152 (71, 234)	0.27
Osteoporosis drugs	61.9	54 (24, 84)	60.4	47 (14, 79)	0.75
Other drugs	74.6	189 (116, 263)	66.7	249 (18, 481)	0.58
Hospital visits, %	–	453 (67, 839)	–	900 (207, 1,594)	0.26
Hospitalization	4.8	300 (−64, 664)	10.4	766 (77, 1,455)	0.23
Day surgery/procedure	4.8	36 (−6, 78)	12.5	68 (10, 127)	0.36
Ambulatory care	4.8	70 (−35, 175)	4.2	53 (−50, 157)	0.83
Emergency room visits	11.1	47 (0.3, 94)	8.3	13 (−3, 29)	0.17
Aids and devices, %	–	232 (72, 392)	–	140 (−27, 307)	0.43
Hand splints	41.3	29 (17, 41)	14.6	9 (2, 16)	0.01
Foot orthotics, knee/ankle support, and proper footwear	14.3	9 (−2, 20)	4.2	20 (−8, 48)	0.45
Mobility aids	19.0	149 (−2, 300)	8.3	92 (−70, 254)	0.61
Bathroom equipment	17.5	29 (7, 51)	16.7	18 (2, 34)	0.44
Other	25.4	16 (1, 33)	12.5	2 (1, 4.3)	0.08
Community resources, %	–	85 (−35, 204)	–	21 (1, 42)	0.36
Indirect costs, %	–	2,807 (1,616, 3,999)	–	2,597 (1,665, 3,530)	0.79
Patient time loss	27.0	787 (125, 1,448)	25.0	735 (87, 1,384)	0.91
Lost time doing chores	71.4	1,437 (910, 1,963)	70.8	1,301 (882, 1,721)	0.70
Caregiver time loss	27.0	321 (−115, 758)	16.7	295 (−40, 629)	0.93
Paid help	30.2	263 (63, 462)	35.4	266 (52, 480)	0.98

* Costs are in Canadian dollars. The mean differential annual costs, calculated by (PTM_{c_6mth} − TTM_{c_6mth}) * 2, were $1,163 (median $1,123; nonparametric 95% CI −$3,606, $6,139). Nonparametric 95% CI based on 1,000 bootstrap replications: lower band = 2.5 percentile; upper band = 97.5 percentile. PTM = primary therapist model; TTM = traditional treatment model; 95% CI = 95% confidence interval; DMARD = disease-modifying antirheumatic drug; NSAID = nonsteroidal antiinflammatory drug; COX-2 = cyclooxygenase 2; GI = gastrointestinal.
† Mean societal costs (6-month study period) for the PTM and TTM groups were $6,848 (median $4,745; interquartile range $1,984–$9,320) and $6,266 (median $4,107; interquartile range $1,938–$10,194), respectively; $P = 0.64$.
‡ Student's *t*-test for costs between PTM and TTM group.

the PTM group and 16.7% in the TTM group. Hospital visits were needed for 4.8% and 10.4% of patients in the PTM and TTM groups, respectively, doubling hospitalization costs for TTM patients.

Indirect costs accounted for 41% of societal costs in both groups. More than 25% of patients reported time lost from paid employment due to the treatment, and 71% reported time lost from doing chores due to health problems. Paid help was used by 30.2% of patients in the PTM group and 35.4% in the TTM group.

Effectiveness data. We observed a statistically significant difference in mean ± SD baseline EQ-5D scores between groups (PTM: 0.46 ± 0.30, TTM: 0.57 ± 0.21; $P =$

Table 3. Estimates of mean quality adjusted life years (QALYs) of the primary therapist model (PTM) compared with the traditional treatment model (TTM)*

	PTM group (n = 63)	TTM group (n = 48)	*P*†
EQ-5D utility values			
Baseline	0.46 ± 0.30	0.57 ± 0.21	0.03
Discharge	0.53 ± 0.32	0.56 ± 0.26	0.53
6 months	0.56 ± 0.32	0.53 ± 0.30	0.64
QALYs (using changes from baseline)‡	0.068 ± 0.22	−0.017 ± 0.24	0.06
Adjusted QALYs (controlling for baseline EQ-5D, age, sex, and disease duration), mean ± SEM§	0.545 ± 0.03	0.533 ± 0.03	–

* Values are the mean ± SD unless otherwise indicated. EQ-5D = EuroQol Instrument.
† Student's *t*-test between PTM and TTM groups.
‡ Incremental QALYs (PTM minus TTM) = 0.085 (nonparametric 95% confidence interval [95% CI] <−0.01, 0.17). Nonparametric 95% CI based on 1,000 bootstrap replications: lower band = 2.5 percentile; upper band = 97.5 percentile.
§ Incremental adjusted QALYs = 0.012 (nonparametric 95% CI −0.08, 0.051). Nonparametric 95% CI based on 1,000 bootstrap replications: lower band = 2.5 percentile; upper band = 97.5 percentile.

0.03) (Table 3). For the PTM group, the mean utility score was 0.53 at discharge and 0.56 at 6 months. In contrast, a slight decline was found in the TTM group (discharge: 0.56, 6 months: 0.53). We assumed that the utility score remained stable between 6 and 12 months for the QALY calculation. The mean ± SD QALY gains from baseline were 0.068 ± 0.22 for PTM and −0.017 ± 0.24 for TTM. The incremental mean QALY gain from baseline between the 2 groups was 0.085 (nonparametric 95% confidence interval [95% CI] <−0.01, 0.17). However, the difference dropped to 0.012 (nonparametric 95% CI −0.08, 0.051) when QALYs were adjusted for baseline utility, age, sex, and disease duration.

Cost-effectiveness analysis. From a societal perspective, PTM generated higher mean QALYs and resulted in a higher cost compared with TTM, although differences in both measures were not statistically significant. This yielded an estimated ICER of $13,700 per QALY gained (nonparametric 95% CI −$73,500, $230,000) (Figure 1). However, further analysis using the adjusted QALY found a substantial increase in the ICER to $96,900 per QALY gained (nonparametric 95% CI −$846,300, $1,296,000).

The full range of INMBs is presented in Figure 2. A positive INMB value indicates that the monetary value on the incremental benefits is greater than that of the incremental costs (i.e., PTM should be adopted). We constructed acceptability curves (baseline and sensitivity analyses based on productivity lost) to show the relation between the willingness to pay for 1 QALY and the probability for ICERs to fall below certain thresholds (Figure 3). For example, given the uncertainty in the incremental benefits and costs among treatment groups, 50% of ICERs would fall below a willingness-to-pay threshold of $13,700 per QALY, whereas >91.2% of ICERs would fall below the $100,000 per QALY threshold. From a societal perspective, cost-effectiveness ratios asymptotically approach the

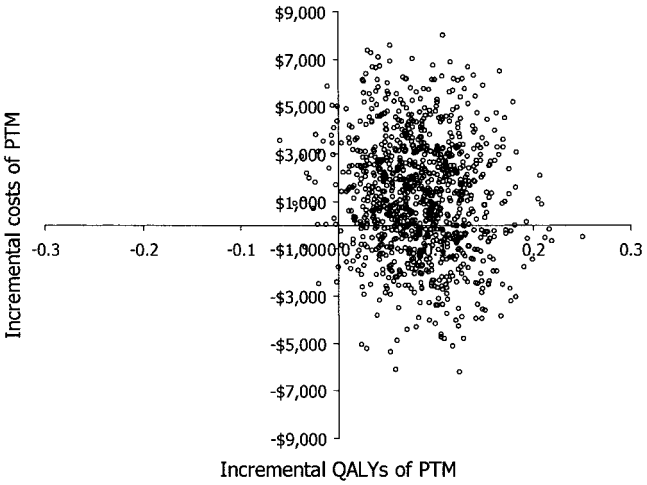

Figure 1. Base-case cost-effectiveness analysis of the primary therapist model (PTM) and the 95% confidence intervals using the nonparametric bootstrap method (1,000 simulations). QALYs = quality-adjusted life years.

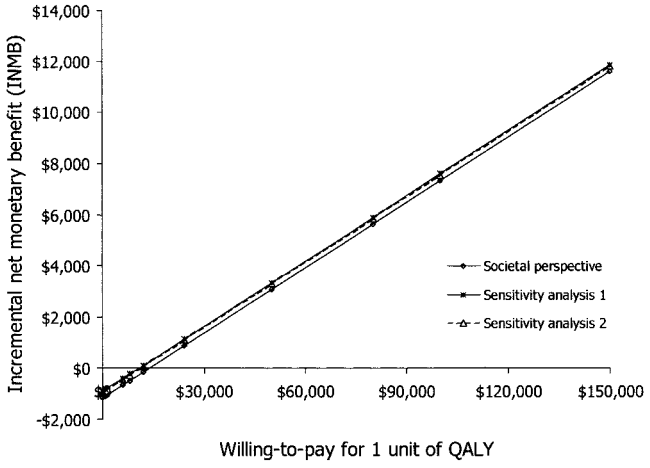

Figure 2. Incremental net monetary benefit (INMB) analysis (base-case and sensitivity analyses). Sensitivity analysis 1: wages of a typical patient/caregiver were used as replacement costs for productivity lost. Sensitivity analysis 2: the wage of a professional homemaker was used as replacement costs for productivity lost. QALY = quality-adjusted life year.

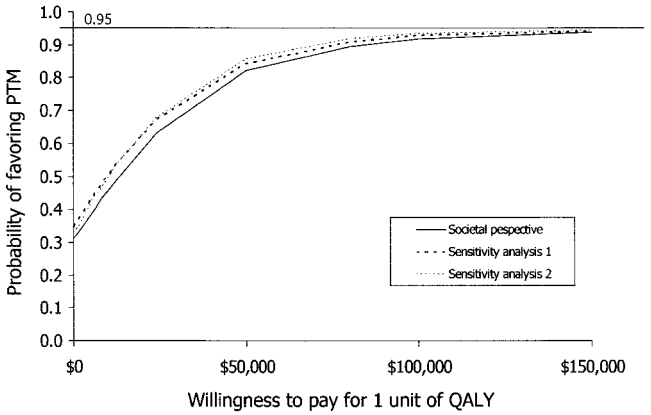

Figure 3. Cost-effectiveness acceptability curve (base-case and sensitivity analyses). Sensitivity analysis 1: wages of a typical patient/caregiver were used as replacement costs for productivity lost. Sensitivity analysis 2: the wage of a professional homemaker was used as replacement costs for productivity lost. PTM = primary therapy model; QALY = quality-adjusted life year.

95% limit beyond thresholds of $100,000 per QALY. A similar pattern of acceptability curves was observed in sensitivity analyses using different valuation approaches for productivity lost.

DISCUSSION

This study investigated the economic consequences of referring patients with RA to receive treatment from a primary therapist versus a traditional physical therapist and/or occupational therapist. From a societal perspective, the results suggest that the PTM initiated by The Arthritis Society (Ontario Division) has the potential to be a management option for patients with RA, although there was no statistically significant difference in QALYs. We also observed a substantial variation in the ICER in the sensitivity analysis using an alternate method to calculate QALYs. It is, therefore, premature to recommend a widespread use of this model in other regions. However, it should be noted that the PTM offers a promising model for RA rehabilitation as demonstrated in our RCT (7). Further research should focus on strategies to reduce costs of the model and to explore the roles of primary therapists in early RA management.

There was a 7-fold increase in our estimated ICER when QALYs were calculated with regression-based adjustment as compared with the "changes from baseline" method. The latter has been widely used in studies with baseline utility imbalance; however, this method fails to address the phenomenon of regression to the mean, which may lead to over- or underestimation of QALYs. Manca et al (38) argue that the regression-based approach provides more appropriate estimates because it adjusts for the baseline differences. In a recent simulation study, the researchers demonstrated major disparities in results using the 2 methods, regardless of whether the baseline utility was statistically significantly different. Although the regression-based adjustment appears to be a more appropriate approach, we recommend the use of both methods in future studies to allow for comparisons with previous economic evaluations that use only one of the methods.

Medications accounted for 58% and 51% of direct costs of the PTM and TTM, respectively. The figures were higher than the 48% recently reported by Maetzel et al (13). This might be due to the fact that ~25% of patients in the PTM group and 17% in the TTM group received biologic agents. The usage rates were higher compared with the general population, in which only ~2–15% of patients with RA required biologic agents (39). Therefore, the pattern of medication use in the present sample should be interpreted with caution.

The difference in direct costs was partly attributable to the disparity in the costs per visit provided by The Arthritis Society versus OHIP clinics. It should be noted that starting April 2005, the Ontario government passed legislation to limit outpatient OHIP-funded PT to only children, senior citizens, and persons receiving social assistance. This means that many individuals with RA can only seek treatment at private PT clinics if The Arthritis Society service is not available. Although there is no standardized fee schedule for private clinics, the cost per visit is close to that of The Arthritis Society. Therefore, the cost difference between the PTM and TTM would be smaller if the analysis was conducted in the current scenario.

In the present analysis, indirect costs accounted for ~41% of the total costs. Similar findings were reported by Clarke et al (36.4%) (40) and by Maetzel et al (44.9%) (13) on the cost of illness of RA. However, the current value was substantially lower than that estimated by Coyte et al (63.9%) (41). The difference in the findings might be due to 2 reasons. First, Coyte et al's estimates of indirect costs were obtained from the 1990 Ontario Health Survey, in which participants were asked whether their activities were restricted by either short-term or long-term disability in the past year. In contrast, all cost information was obtained prospectively in the current study, and patients were asked to report the amount of time lost in work and household activities on a monthly basis.

Second, to avoid double counting in the cost-effectiveness ratio, the current analysis only included the following items as indirect costs: losses in production as a result of patients' participation in treatment, time costs incurred by caregivers, and additional paid help. According to the recommendation of the Washington Panel on cost-effectiveness analysis, losses in work and leisure time incurred by a patient due to ill health should be reflected in the effectiveness measure in terms of QALYs (14). In contrast, Coyte et al included all costs related to disability and premature mortality due to arthritis and rheumatism in the estimation of indirect costs, which might have led to a relatively higher contribution of indirect costs to the total costs.

Findings from this study suggest that patients who were treated under the PTM used more health-related resources as compared with their traditional PT/OT counterparts. This was not surprising because education on disease management and community resources was an integral component of the PTM. Consequently, patients in the PTM group might be more aware of the treatment options and resources available to them. However, it is difficult to

determine, from the present study, whether patients were over- or underutilizing health-related treatments, such as adaptive aids/devices. To optimize the use of health care resources, further investigations should be directed to examining the process of care received by patients with RA.

There are several limitations to this study. The first issue concerns the use of the EQ-5D for assessing health state. This measure takes into account mobility, self care, usual activities, pain/discomfort, and anxiety/depression. However, besides these general attributes, there are other issues that are also pertinent in the valuation of rheumatology care, such as improving self efficacy and the ability to cope with the illness. Unfortunately, none of the existing utility measures have incorporated these specific domains. Despite the shortcoming, the EQ-5D was selected because it has demonstrated reliability, validity, and responsiveness in the RA population (24,25). Second, little is known about the measurement properties of the HRU questionnaire, although the feasibility of using this questionnaire in patients with RA has been previously demonstrated (13). Further research is required to assess the reliability and validity of this instrument.

The third limitation is related to the short followup period. In this study, costs and benefits were estimated based on a 6-month period. Because some patients might require additional rehabilitation treatment for RA, a longer followup time would have been useful for examining these events. Fourth, bias might present as a result of missing data. In this analysis, only patients who completed the baseline assessment plus at least 1 postintervention assessment were included in the analysis. As a result, 33 patients (22.9%) were excluded. Because no posttreatment information was obtained from these patients, any approach for replacing the missing information would be less than satisfactory. However, the exclusion of these patients might have introduced bias to the results. Finally, our study did not provide a clean comparison between the treatment models because more than half of the TTM group did not initiate the assigned treatment. This might, however, reflect the real world, where a considerable proportion of patients did not start with the recommended treatment. Unfortunately, we were unable to determine the actual reason because the study was not designed to collect detailed information about access to treatment. Further research will be required to provide insight into the challenges experienced by patients and strategies to optimize the process of care.

In conclusion, findings from this study suggest that the PTM has the potential to be an alternative to traditional PT/OT, and that its integration into rheumatology care comes at reasonable societal costs. Further investigations will be required to assess the long-term economic consequences in managing RA and other rheumatologic conditions and the feasibility of implementing this model in other communities.

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