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# Cost Analysis of Methylprednisolone Treatment of Multiple Sclerosis Patients

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**ABSTRACT:** *Background:* Intravenous methylprednisolone (IVMP) is the treatment of choice for multiple sclerosis (MS) patients undergoing acute exacerbation of disease symptoms and yet its cost has not been accurately determined. Determination of this cost in different settings is also pertinent to consideration of cost-saving alternatives to in-patient treatment. *Methods:* Cost analysis from the point of view of the health care system of IVMP treatment of MS patients receiving treatment in association with a selected Toronto teaching hospital in fiscal year 1994/95 was carried out. Costs of any concurrent treatments were excluded. *Results:* Total cost for 92 patients, based on a 4 dose regime, was estimated to be \$78,527. The the cost per patient was \$1,1181.84 for in-patients (IP), \$714.64 for out-patients of the MS Clinic (OP) and \$774.21 for patients whose treatment was initiated in the Clinic, but completed in the home (HC). Sensitivity analyses indicated: 1) IP treatment was in all cases more expensive than that of OP or HC; 2) the cost savings of OP vs. HC was sensitive to assumptions made regarding Clinic overhead, Clinic nursing costs and Home Care Program overhead. *Conclusion:* Alternatives to in-patient care must be considered carefully. In this study, both out-patient and in-home treatment were cost-saving alternatives to in-patient treatment, but large differences in the cost of hospital out-patient vs. in-home care could not be demonstrated.

**RÉSUMÉ:** *Analyse du coût du traitement par la méthylprednisolone chez des patients atteints de sclérose en plaques. Introduction:* Bien que l'administration de méthylprednisolone intraveineuse (MPIV) soit le traitement de choix pour les patients atteints de sclérose en plaques (SEP) qui présentent une exacerbation aiguë de leurs symptômes, le coût de ce traitement n'a par été déterminé de façon précise. La détermination de ce coût dans différents contextes est également pertinente à la considération des alternatives moins coûteuses que le traitement hospitalier. *Méthodes:* Nous avons effectué une analyse du coût imputable au système de santé pour le traitement par la MPIV chez les patients atteints de SEP qui ont reçu ce traitement dans un certain hôpital d'enseignement de la région de Toronto pendant l'année fiscale 1994/95. Les coûts de tout autre traitement concomitant ont été exclus. *Résultats:* Le coût total pour 92 patients, basé sur un protocole de 4 doses, était estimé à \$78,527. Le coût par patient était de \$1,1181.84 pour les patients hospitalisés (PH), \$714.64 pour les patients de la clinique de SEP traités en externe (PE) et de \$774.21 pour les patients dont le traitement était commencé à la clinique et complété à domicile (PD). Des analyses de sensibilité ont indiqué que: 1) le traitement des PH était plus coûteux dans tous les cas que celui des PE ou des PD; 2) l'épargne du coût des PE vs. les PD était sensible aux coûts présumés d'opération de la clinique, du personnel infirmier de la clinique et d'opération du programme de soins à domicile. *Conclusion:* Les alternatives aux soins hospitaliers doivent être considérées avec soin. Dans cette étude, le traitement hospitalier en externe et le traitement à domicile étaient des alternatives moins coûteuses que le traitement du patient hospitalisé. Cependant, nous n'avons pas pu démontrer de différences importantes dans le coût du traitement en externe vs. à domicile.

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The total social cost of multiple sclerosis (MS) in Canada was estimated to have been \$502 million in 1994, equivalent to 0.07% of the GDP.<sup>1</sup> The contribution of hospital costs to this total was \$134 million, an unknown part of which would have been due to treatments for acute exacerbations of relapsing-remitting MS.

The current treatment of choice for such episodes is intravenously administered methylprednisolone (IVMP) given in

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daily high doses over 3 to 5 days.<sup>2,3</sup> The same regime has also been recommended for optic neuritis attacks, an early manifestation of MS.<sup>4,5</sup> The effectiveness of IVMP treatment in reducing the duration and severity of MS relapses has been demonstrated in comparisons with low dose oral prednisone or placebo treatments,<sup>6-8</sup> although large, well-designed studies are still lacking.<sup>9</sup> In spite of the common use of IVMP treatment, its cost has not been reported.

This study reports on an analysis of the cost and treatment utilization associated with the 1994/95 fiscal year cohort of MS patients receiving IVMP treatment at St. Michael's Hospital (SMH), a 389 bed acute care teaching hospital situated in inner-city Toronto. Some patients received this treatment as in-patients (IP setting), whereas others received it as out-patients in the SMH Multiple Sclerosis Clinic (OP setting). A third group received their initial IVMP dose(s) in the MS Clinic and subsequent ones through the Home Care Program (HCP) funded by the Ontario Ministry of Health (HC setting). In choosing the approach of cost analysis there was an underlying assumption of equal effectiveness of IVMP treatment in all three health care settings. This assumption was based on the fact that in all three settings, the same type of prescribing pattern, health care professional (registered nurse), drug and supplies were employed for treatment administration.

With the trend toward treatment in delivery settings yielding similar outcomes but lower costs, a thorough assessment of the cost of IVMP treatment in the three settings is pertinent to both the particular case under examination – IVMP treatment for MS patients – as well as to the more general consideration of cost variation among health care settings. According to a rigorous review of the literature,<sup>10</sup> the cost of home intravenous (IV) therapy of various types (antibiotic, pain management, parenteral nutrition, rehydration therapy), has been compared with in-patient therapy, but not to out-patient therapy. Thus, the present study is also unique in providing a cost analysis of intravenous treatment, in this case IVMP treatment, in both home and out-patient, as well as in-patient settings.

## METHODOLOGY

Costs were determined from the point of view of the health care system using standard costing methodology.<sup>11-13</sup> Distinguished below are direct costs (i.e., costs directly attributable to treatment) and indirect costs (i.e., overhead costs incurred through the provision of treatment). A summary of the costs determined are shown in Table 1.

### In-patient Chart Review

Health Records personnel identified 48 hospital episodes with a 1994/95 admission date and multiple sclerosis (ICD-9 340) as the most responsible diagnosis. From these, 22 separate episodes of IVMP treatment were identified.

### In-patient Unit: Unit Level Direct and Indirect Costs

Estimates of the unit level direct and indirect costs of receiving IVMP as an in-patient were assessed using budget expenditure data of the Medicine/Neurology In-patient Unit under the assumption that all patients received the standard treatment of 4 doses (21/22 patients were in fact prescribed this). As well, for the purposes of estimating *only* the cost of IVMP treatment, we

**Table 1:** Costs included in Cost Analysis of Methylprednisolone Treatment.

#### Direct Costs

##### Unit Level Direct Costs

- Methylprednisolone (MP; including pharmacy dispensing cost)
- Other Medical Supplies
- Professional Fees
  - Nurse
  - Physician

#### Indirect Costs (Overhead)

##### Unit Level Overhead

- Nurse Manager/Co-ordinator
- Secretary
- Administrative Supplies
- Laundry

##### Patient Support Services

- Patient Transport
- Health Records
- In-patient Registration
- Out-patient Registration
- Food Services
- Pastoral Services
- Homemaker\*

##### Institutional Level Overhead (ILO)

- Administration & Finance
- Plant Operations
- Systems Support
- Housekeeping
- Communications
- Material Management
- Bioengineering
- Personnel
- In-house Education
- Volunteer Services
- Nursing Administration
- Depreciation on Debt
- Opportunity Cost on Land
- Opportunity Cost on Equipment

\* Included in High Scenario only.

included the costs for only a 3 day stay, and excluded services additional to the IVMP treatment itself. Also excluded were any additional cost for cases which entered the hospital through the Emergency department. The minimum costs of methylprednisolone (MP) and IV supplies were based on unit prices and estimated usage. The costs of all expenditure items of general use among unit in-patients, including wages and benefits for nursing and administrative personnel, were apportioned to IVMP patients on the basis of the ratio of bed-days for these patients to the total bed-days for the In-patient Unit (66/12,470).

### MS Clinic: Unit Level Direct and Indirect Costs

Unit level direct and indirect costs of MS Clinic patients receiving IVMP treatment were estimated using data from the Clinic records. They showed 163 IVMP doses had been given to 70 patients: 112 doses to 28 out-patients (OPs) who received care only in the Clinic (4 doses per OP); 51 doses to 42 home care (HC) patients who received out-patient care initially in the

Clinic (1.2 doses per HC patient) and subsequently received Home Care. These 163 visits for IVMP treatment were a subset of the total 1507 visits to the Clinic for the purposes of seeing a physician for regular medical care (service visits). These service visits and an additional 1075 clinical research visits comprised the 2582 total visits by patients to the Clinic in 1994/95.

Various methods were used to apportion shared budget expenditure items to patients receiving IVMP treatment. The minimum cost of the major IVMP treatment-specific supplies were calculated using unit prices applied to 163 doses. The costs of some shared overhead supplies/services were calculated on the basis of estimated usage when possible; others were based on the IVMP visit/total Clinic visit ratio (163/2582).

Costs of the unit co-ordinator, nursing and secretarial services pertaining to IVMP treatments were estimated in two ways and the resulting estimates averaged to provide a base scenario estimate. The low scenario estimates for the cost of nursing and secretarial activities were based on the time used in treatment-related activities, a portion of the time (163/2582) spent responding to phone calls and on paid breaks, the hourly rate including benefits, and a gross-up factor of 5% to allow for miscellaneous general activities. The low scenario estimate for the co-ordinator was based on a proportion of the co-ordinator's total salary and benefits in accordance with the ratio of IVMP cases to total service cases (70/1414), with the denominator of 1414 derived by counting each non-IVMP service visit to the Clinic as a case and adding the 70 IVMP cases. The high scenario estimates for salary and benefit costs of the nurses, secretaries and co-ordinator were based on appropriate proportions of total salary and benefits (163/1507 for nurses and the co-ordinator, 70/1414 for the secretaries). The assumption inherent whenever using the case ratio (70/1414) in the above, was that costs were incurred primarily in the "setting-up" of the IVMP case.

### Hospital Overhead Allocation

The opportunity cost on the land and buildings (which is estimated by the potential earnings from investment which is foregone by owning land and buildings) for St. Michael's Hospital (SMH) was calculated to be \$1,042,984 by applying a local commercial rental rate to the hospital square footage and a standard 5.0% discount rate<sup>12</sup> to this value. The same discount rate, applied to the net book value of major hospital equipment, yielded an opportunity cost on equipment of \$727,701.

Total hospital costs, incorporating depreciation on capital equipment and new construction and interest on a loan were reported in the Hospital Ledger as \$165,161,121; by adding the above opportunity costs, total hospital costs were adjusted to \$166,931,806. Opportunity, depreciation and interest (DOI) costs were allocated to all cost centres, using total cost centre expenditure as the basis.

Cost centres pertinent to the study were identified in the SMH Hospital Budget Ledger using the Ontario Guide to Case Costing.<sup>13</sup> Institutional Level Overhead (ILO) was fully allocated to the Patient Support Services and the patient care departments using the step down allocation method.<sup>12</sup> Wherever possible, revenues and the costs of education and research were excluded from the cost allocation process.

The portion of the total ILO, including DOI, that was allocated to the in-patient unit was \$648,886 and for the Clinic \$57,718. By dividing these values, respectively, by total Unit patient days

and MS Clinic visits, a basis for allocating costs by length of stay for IPs (\$52.04 per patient day) and by number of visits for Clinic patients (\$22.35 per MS Clinic visit) was obtained.

### Physician Fees

Although physicians do not administer IVMP treatment, they are compensated for overseeing it. Thus, for each visit corresponding to administration of the second, third and fourth dose in the 4-dose regime, we assigned a cost corresponding to reimbursement for a minor assessment in the Ontario Ministry of Health Schedule of Benefits<sup>14</sup> (\$23.10 OP, \$17.10 IP). We also assigned this cost for the first visit as well – in order to assign only the cost of overseeing treatment – even though in practice, the physician reimbursement is sometimes greater because the first visit also involves review of the case and the decision to treat with IVMP.

### Home Care: Direct and Indirect Costs

According to MS Clinic records, the Clinic initiated IVMP treatment with 1 or more doses of IVMP (average of 1.2 doses per patient) to 42 patients who were subsequently referred to the Home Care Program (HCP) for treatment completion. Estimation of direct costs for all 42 patients were based on specially prepared data sets provided by the Metropolitan Toronto Home Care (MTHCP) program (including one specific to SMH patients receiving IVMP treatment) and MTHCP Annual Report data, although 18 of the 42 patients were actually served by home care programs outside of Metro Toronto. The MTHCP data confirmed that, at least for the Metro Toronto patients, the average patient received 2.8 doses of IVMP from the Home Care Program (HCP), which was the rate anticipated from the Clinic records.

HCP overhead costs for the HC patients, including institutional level overhead and case management level costs, were estimated to be \$104.29 per case load unit (CLU), using summary information on the HC acute care program (Stephen Roche, VP Administrative Services, MTHC). CLUs, a measure developed by the MTHCP for administrative purposes, reflect the time required for case management by case managers. Upon admission to the HCP, cases are assigned a weight of 1 CLU; the additional weight of 1 CLU is added to the case if it is still active at the time of reassessment at the first of each month. An average CLU of 1.17 was therefore assumed for IVMP treatments, accounting for a day of admission, a treatment period of 3 days, a day of discharge, and the possibility of the period of treatment overlapping two months. Thus, the majority of overhead cost in the HCP was incurred during the "setting-up" of the case. Consistent with the in-patient scenario, additional days of care due to comorbidities were not included.

### Sensitivity Analysis

In addition to the base scenario estimates for all treatment cost components, wherever appropriate, low and high scenario estimates were also made by modifying the assumptions in the manner detailed in Appendix.

## RESULTS

### Overview of MS Patient Cohort Receiving IVMP Treatment

The review of SMH in-patient and MS Clinic records found

**Table 2:** Cost of IVMP Treatment for SMH Cohort of MS Patients in 1994/95.

Treatment Setting	Treatment Description	Number of Patients	Cost per Patient	Cost for Group of Patients
In-patient (IP)	4 doses in IP Unit	22	\$1,181.84	\$26,001
Out-patient (OP)	4 doses in Clinic	28	\$ 714.64	\$20,010
Home Care (HC)	1.2 doses in Clinic; 2.8 doses in home	42	\$ 774.21	\$32,517
		92		\$78,527

that 92 SMH patients received IVMP treatment in fiscal year 1994/95. These were distributed across the IP, OP and HC settings in a ratio of 22:28:42. The records showed that treatment was prescribed in 4 doses (with only one exception, who received 5 doses), thereby requiring as a minimum, a 3 day stay in the IP setting and 4 Clinic and/or home visits in the OP and HC settings. The total marginal cost of providing IVMP to the 92 patients, from the point of view of the health care system, was estimated to be \$78,527 (Table 2).

#### In-patients: Service Utilization and IVMP Treatment Cost

Although three of the 22 in-patients stayed only the minimum length of stay of 3 days required for treatment, most stayed longer, averaging 9.3 days and ranging from 1 to 28 days. The additional days were required for the following reasons: additional procedures and consultations for MS related problems; time needed to re-establish independence in activities of daily living (ADL); time required for diagnosing new cases. The most common reason for admission were: a requirement for multiple services (11 patients); an inability to perform ADL (9 patients); diagnostic investigation (5 patients); limited access to other treatment settings (3 patients); inadequate social support (2 patients); need for observation due to a history of psychotic reactions to other intravenous steroid therapy (1 patient). For some patients there was more than one reason.

For the purpose of estimating the cost of *only* the IVMP treatment given in the IP setting, we considered only the cost of a minimal length of stay of 3 days and excluded the cost of any additional procedures. As shown in Table 3, a cost of \$1181.84

was estimated for IVMP treatment as an IP. Nursing care (\$484.38) and overhead (\$428.81) were by far the largest components of the cost, followed by methylprednisolone (MP; \$179.55) and physician fees (\$68.40). The total cost for the 22 patients, based on a 3 day stay, was estimated to be \$26,001.

#### MS Clinic Out-patients: Service Utilization and IVMP Treatment Cost

Only the 28 patients who received all four IVMP treatments in the Clinic were considered in the out-patient (OP) group (112 treatments in total). Costs per case were \$714.64 (Table 3) and differed from IP treatment in the relative contributions of major costs: overhead (\$232.28); MP (\$213.30); nursing (\$158.28) and physician fees (\$92.40). Total for the cohort of 28 patients was \$20,010.

#### Home Care Patients: Service Utilization and IVMP Treatment Cost

Costs were incurred by HC patients for both initial treatment in the MS Clinic (\$242.13 per patient) and follow-up treatment in the Home Care Program (\$532.08 per patient), for a total of \$774.21. Major costs, in decreasing order of importance were estimated to be MP (\$221.79), overhead (\$217.93) and nursing (\$197.80). The cost of medical supplies in this setting (\$108.65) was notably higher than in the others (\$20.70 for IP and \$18.38 for OP). The total cost for the HC group of 42 patients was therefore \$32,517, with \$10,170 of the cost attributable to the Clinic portion of treatment and \$22,347 to the home portion.

#### Comparison of Treatment Settings and Sensitivity Analysis

The base scenario estimate showed that treatment in the OP and HC settings (\$714.64 and \$774.21, respectively), was considerably less costly than treatment in the IP setting (\$1,181.84; Table 3). Furthermore, treatment in the OP setting relative to treatment in the HC setting offered cost savings of \$59.58.

In addition to the base scenario presented above, alternative low and high cost scenarios were considered for all three settings (Tables 4a & 4b). The cost of IP treatment exceeded that of OP or HC treatment in all three scenarios; even the lowest estimate for IP treatment (\$1,066.62) exceeded the highest estimates for OP and HC treatments (\$846.81 and \$882.90). On the other hand, the cost savings of the OP and HC settings, relative to one another, could not be so clearly demonstrated. Although costs for OP treatment were less than that for HC treatment under all three scenarios, the difference was not very large,

**Table 3:** Base Scenario Comparison of per Case Costs of IVMP Treatment in Three Settings.

Cost Component	In-patient	Out-patient	Home Care		Total	All Cases
			Clinic	Home		
Methylprednisolone (MP)	179.55	213.30	64.75	157.07	221.79	
Other Medical Supplies	20.70	18.38	5.58	103.07	108.65	
Nursing	484.38	158.28	48.05	149.75	197.80	
Physician Fees	68.40	92.40	28.05	n.a.	28.05	
Overhead	428.81	232.28	95.70	122.23	217.93	
<b>Total per case</b>	<b>1,818.84</b>	<b>714.64</b>	<b>242.13</b>	<b>532.08</b>	<b>774.21</b>	
<b>Total all cases</b>	<b>26,001</b>	<b>20,010</b>	<b>10,170</b>	<b>22,347</b>	<b>32,517</b>	<b>78,527</b>

**Table 4a:** Low Scenario Comparison of per Case Costs of IVMP Treatment in Three Settings.

Cost Component	In-patient	Out-patient	Home Care		Total	All Cases
			Clinic	Home		
Methylprednisolone (MP)	175.17	208.10	63.17	141.33	204.50	
Other Medical Supplies	19.27	17.96	5.45	92.76	98.21	
Nursing	387.51	123.31	37.43	142.26	179.69	
Physician Fees	68.40	92.40	28.05	n.a.	28.05	
Overhead	416.27	140.88	67.74	97.78	165.52	
<b>Total per case</b>	<b>1,066.62</b>	<b>582.64</b>	<b>201.84</b>	<b>474.14</b>	<b>675.98</b>	
<b>Total all cases</b>	<b>23,466</b>	<b>16,314</b>	<b>8,477</b>	<b>19,914</b>	<b>28,391</b>	<b>68,171</b>

**Table 4b:** High Scenario Comparison of per Case Costs of IVMP Treatment in Three Settings.

Cost Component	In-patient	Out-patient	Home Care		Total	All Cases
			Clinic	Home		
Methylprednisolone (MP)	183.93	218.50	66.33	172.74	239.07	
Other Medical Supplies	22.13	18.80	5.71	113.38	119.08	
Nursing	581.26	193.25	58.67	157.23	215.90	
Physician Fees	68.40	92.40	28.05	n.a.	28.05	
Overhead	445.78	323.86	123.70	157.09	280.79	
<b>Total per case</b>	<b>1,301.50</b>	<b>846.81</b>	<b>282.45</b>	<b>600.44</b>	<b>882.90</b>	
<b>Total all cases</b>	<b>28,633</b>	<b>23,711</b>	<b>11,863</b>	<b>25,219</b>	<b>37,082</b>	<b>89,425</b>

ranging from a difference of \$36.09 in the all-high scenario (Table 4b), to \$59.58 in the base scenario to \$93.34 in the all-low scenario (Table 4a). Thus, the following results concentrate on the sensitivity to costing assumptions of the cost savings estimate of \$59.58 for the OP treatment relative to the HC treatment (Table 5).

If all Home Care Program (HCP) costs were adjusted to their low scenario estimates, while those of the Clinic were maintained as base scenario estimates, the cost of OP treatment remained lower than that of HC, but only by \$1.64. On the other hand, if all Clinic costs were adjusted to their highest estimate (affecting costs of both OP treatment and the Clinic portion of HC treatment), while those of the HCP were maintained as base scenario estimates, the HC option became *less expensive*, with a cost savings of \$32.27 conferred to HC treatment (relative to OP treatment).

Sensitivity of the cost savings of \$59.58 seen in the base scenario (OP vs. HC) was further tested by determining the effect of individual alterations of each of the 5 main cost components for each of the Clinic and the Home Care Program; i.e., the individual effect of  $2 \times 5 = 10$  variations was tested. In the case of the Clinic costs, adjustment was from the base to the high scenario estimates; in the case of the HCP costs, adjustment was from the base to the low. Only one of these alterations on its own, that of adjusting the Clinic overhead from the base estimate to the high estimate, had the effect of making the HC option *less expensive*, with a cost savings of \$4.00. However, by making two alterations (Clinic overhead and HCP overhead), one could effect a cost savings of HC treatment (vs. OP treatment) of as much as \$28.45; with three alterations (Clinic overhead, HCP overhead and Clinic nursing), a savings of HC (vs.

OP treatments) of as much as \$52.81. Clearly then, the number of changes in assumptions for the Clinic and/or Home Care Program need not be large before the cost advantage of the OP setting found in the base scenario, switches to there being a cost advantage in the HC setting.

## DISCUSSION

### Potential Cost Savings for the Health Care System

IVMP treatment of 92 SMH MS patients suffering relapses in fiscal 1994/95 cost the health care system \$78,527. During this period, only 24% of cases were IP cases. If IVMP treatment had continued to be delivered on an IP basis only, which had been the case until May 1989, the cost of IVMP treatment would have been \$108,729 for the 92 patients, based on our estimate of \$1,181.84 for a 4-dose 3-day IP treatment exclusive of any additional treatment. Thus, it follows that adoption of OP and HC delivery of IVMP treatment at SMH either reduced the cost to the health care system by up to 28% and/or permitted more patients to be treated with this therapy. This suggests that further savings to the health care system might be found in hospitals still using IP treatment delivery only, through the adoption of HC and/or OP delivery instead of IP delivery.

In-patient charts were examined to identify cases which might have been readily treatable in OP or HC settings instead of the IP setting. Conservative criteria were adopted in the review: 1) cases receiving no treatments or consultations, except those related to IVMP treatment; and 2) evidence of sufficient resources to cope with any loss of patient ADL. Only one such case out of the twenty-two IP cases was identified. If treatment had been provided to this patient in the OP or HC settings

**Table 5:** Sensitivity Analysis – Comparison of Costs of IVMP Treatment in Out-patient and Home Care Settings.

Scenario used in Clinic Cost Estimation	Scenario used in Home Care Program Cost Estimation	Cost Savings of OP vs. HC Setting
Base	Base	\$59.58
Base	Low	\$1.63
High	Base	-\$32.27**
Overhead High	Base	-\$4.00
Overhead High	Overhead High	-\$28.45
Overhead High, Nursing High	Overhead High	-\$52.81
No research in Clinic	No research in Clinic	\$13.02

\* Where the cost component is specified, it was changed to the indicated scenario estimate, with all other cost components remaining as in the base scenario.

\*\* Negative values indicates the HC setting offered cost savings compared with OP setting.

instead of the IP setting, savings to the health care system would have been \$503.70 and \$444.13, respectively.

If one reviewed the IP charts using less conservative criteria, additional cases could be identified which would have been *potentially* treatable outside of the hospital. However, an alternative treatment setting could only have been considered for these patients if their other needs had been accommodated in addition to their need for IVMP treatment. Such additional needs included access to diagnostic equipment, consultations with other specialists (e.g., urologist, social worker) and assistance with ADL.

At SMH, HC patients first visit the MS Clinic and receive at least their first dose there, before receiving the remaining doses in their home. As a result, such cases incur costs of overhead in both the hospital (\$95.70) and in the Home Care Program (HCP, \$122.23). Part of the overhead cost in each setting is incurred on a per treatment basis, whereas another part is incurred on a per case basis, arising primarily during the “setting-up” of the case. Thus, if one of these “set-up” costs could be eliminated, the total cost of the HC option would be less. The hospital “set-up” cost could be eliminated if all four doses were administered in the home instead of the Clinic. Alternatively, the HCP “set-up” cost might be reduced or eliminated by increasing the degree to which the HCP is administered from the hospital.

Another source of potential cost savings was suggested by the much higher cost of “Other Medical Supplies” (IV tubing, needles, etc.) in the HC case (\$108.65) than in the other two (\$20.70 and \$18.38). Enquiries to representatives of the Metro Toronto Home Care Program, Caremark (provider of medical supplies to the HCP), the MS Clinic Co-ordinator and one of the nursing service providers to the HCP, provided the following explanations for the large difference in costs (approximately \$90). One is that the HC estimate for “Other Medical Supplies” might have been inflated by the inability to exclude, from the MTHCP data, contributions to the cost of “Other Medical Sup-

plies” for treatment of any comorbidities the patients might have had. This suggested effect of comorbidities can be estimated to have been in the range of \$10 to \$20, because the 25th percentile and median values for “Other Medical Supplies” in the MTHCP data set, corresponding to cases without comorbid conditions, were \$81.53 and \$91.31, respectively, (compared with the mean of \$103.07). It was also pointed out that the MTHCP costs were based on *actual* usage of IV tubing and needles, whereas IP and OP costs were based on *estimated* usage. Although the calculation of IP and OP costs might have underestimated wastage of IV tubing and needles, its effect would have been slight, because of the low cost of these items. Finally, it was noted that in-home treatment required a supply not needed in the hospital – a disposable IV stand. With a current cost of \$36.72, it can be seen that this item represented a large portion of the \$90 difference in cost. In contrast to “Other Medical Supplies”, the costs of MP (including dispensing charges), which is also supplied to HCP by Caremark, were similar in all three programs (IP, \$179.55; OP, \$213.30; HC, \$221.79).

### Sensitivity of OP vs. HC Cost Savings

Base scenario estimates show that OP treatment offered cost savings of \$59.58 in comparison to HC treatment. However, this result was sensitive to assumptions made in the calculation of Clinic and Home Care Program costs. It was most sensitive to assumptions made in estimating the costs of Clinic overhead, followed by Home Care overhead, and then Clinic nursing costs. If the assumptions of these three items were adjusted from the base estimate as to have the greatest effect on the original estimate, a cost savings (of \$52.81) would be found instead for the HC treatment (vs. the OP treatment). Thus, the present data do not allow one to confidently state that the OP treatment setting was less costly than the HC setting.

### Limitations of the Study

Improved precision of the HC and OP treatment estimates requires a narrowing of the difference between low and high estimates for the items shown in the sensitivity analysis to be most influential on the relative cost savings of OP and HC settings – Clinic overhead, HCP overhead and Clinic nursing costs. This is not possible to any great degree using presently available data. For instance, one would need detailed work measure studies of the Clinic’s registered nurse and co-ordinator (since the latter is the major source of uncertainty in the Clinic overhead costs). With respect to the Home Care overhead component, its low/high scenario estimate was in part placed 20% below/above the base estimate to allow for the variation in overhead costs occurring among the various Home Care programs in the GTA, since programs other than MTHCP served 18 of the 42 IPs. It follows that a more detailed investigation of all Home Care programs serving SMH patients could eliminate some uncertainty in this estimate. However, there is also uncertainty in the use of case loading units (CLUs) as a basis for distributing HCP overhead costs, since the measure was created by MTHCP for the administrative purpose of ensuring equitable case loads among case managers. Although CLUs appear to be the measure most appropriate for the allocation of HCP overhead, because a) they reflect requirements of case manager time and b) case management is the primary function of the Home Care Program, CLUs might nevertheless be too crude for case costing purposes. Our

cases are of particular concern because they are short in length compared to the average for the Acute Care Program (30 days) within HCP. Verification of the CLU approach to allocating overhead or the determination of an alternative approach would require work measure studies at the case manager level in the Home Care Program.

Another limitation of this study is its limited scope in determining costs. Costs were considered only from a health care system perspective and not from societal or patient perspectives. With a societal perspective, one would be concerned with the costs of transportation to obtain/deliver treatment and the production foregone by patients and caregivers in all three settings. Also not considered was any difference among the 3 treatment options in terms of patient or caregiver quality of life, and the cost which might be associated with this.

An examination of treatment effectiveness in all three settings was not carried out in the present study. However, the assumption of equal effectiveness in all three settings, made at the study outset, was not challenged by any evidence uncovered during the course of the study. A full comparison of the treatment settings would have to consider in addition to effectiveness and cost, the following points: 1) Rare but fatal anaphylactic and cardiac complications have resulted from IVMP, as reviewed by Fulcher and Katelaris<sup>15</sup> and White et al.,<sup>16</sup> respectively, and such complications might be better dealt with in an

IP or OP setting. 2) In-patients might receive additional professional services (e.g., physiotherapy) more readily than OP or HC patients, which could have an impact on health outcomes (and costs). 3) In-home treatment might offer quality-of-life and other benefits.<sup>17-19</sup> A fuller analysis could also consider the minority opinion in the research literature which says that high dose oral steroids are equally safe and effective as IVMP and that the use of oral steroids should be favoured for reasons of greater convenience and lower cost.<sup>3</sup>

**Generalizability of the Results**

Although any explicit costs of education and research appearing in the Hospital Ledger were excluded from the cost allocation process, hidden costs or benefits of these teaching hospital activities could have influenced the hospital-associated costs for all patients. Thus, these results are most readily generalizable to other teaching hospitals. However, the robustness of the finding of a cost advantage of IVMP treatment in either the HC or OP settings, compared with the IP setting, suggests that the finding would also be generalizable to other urban areas.

In contrast, the cost advantage of treatment in the OP setting compared to the HC setting was modest (\$59.58) and relatively sensitive to assumptions made regarding Clinic overhead and nursing costs and Home Care Program overhead costs. The generalizable aspects of these findings, at least to other teaching

**Appendix: Alteration of Cost Components in Low, Base and High Scenario Estimates.**

Cost Components	In-patient Costs			Clinic Costs			Home Care Program Costs		
	Low	Base	High	Low	Base	High	Low	Base	High
Methylprednisolone	min.	mean	+5% of min.	min.	mean	+5% of min.	- 10% base	base	+ 10% base
<b>Other Medical Supplies</b>							- 10% base	base	+ 10% base
IV supplies	min.	mean	+5% of min.	min.	mean	+5% of min.			
Other supplies	- 20% base	base	+ 20% base						
Nursing Fees	- 20% base	base	+ 20% base	work measure	mean	serv visit ratio	- 5% base	base	+ 5% base
<b>Physician Fees</b>									
<b>Unit Level Overhead</b>									
Co-ordinator/Manager				serv case ratio	mean	serv visit ratio	inc. in ILO	inc. in ILO	inc. in ILO
Secretary	- 20% base	base	+ 20% base	work measure	mean	serv case ratio			
Admin/Secret Supplies	- 20% base	base	+ 20% base						
stationary				min.	mean	+5% of min.			
equipment									
other									
Laundry	base	base	+ 20% base						
<b>Patient Support Services</b>									
Patient Transport									
Health Records				1 visit	mean	4 visits			
In-patient Registration									
Out-patient Registration				No registrations	mean	Avg reg'n/OP ratio			
Food Services									
Pastoral Services									
Pharmacy Services	min.	mean	+5% of min.	min.	mean	+5% of min.			
Homemaker							not inc.	not inc.	inc.
<b>Institutional Level Overhead</b>	3% disc. rate	5% disc. rate	7% disc. rate	3% disc. rate	5% disc. rate	7% disc. rate	-20% of base	base	+20% of base

Only cost components whose estimates varied among low, base and high scenarios are shown.

Abbreviations used: min., minimum estimate based on useage; serv, service; ILO, institutional level overhead; OP, out-patients; not incl., not included; disc. rate, discount rate used in opportunity cost calculation prior to overhead allocation.

Ratios were used by multiplying them with the indicated cost component. Ratios were as follows: serv case ratio, 70/1414; serv case ratio, 70/1507. See Methodology for explanation.

hospitals and likely to other urban areas, is that 1) a very detailed analysis would be needed to clearly demonstrate a cost advantage of either the out-patient setting or in-home setting for IVMP treatment and 2) such an analysis would be hampered by the limitations of data presently available.

"The Cost-Effectiveness of Home Care" report<sup>10</sup> shows that the relative cost of delivering in-home vs. ambulatory clinic treatment has seldom been examined. The present study therefore suggests that when alternatives to the IP setting are being considered for procedures other than IVMP treatment, the inclusion of both home and ambulatory clinic alternatives in the analysis might usefully inform both the particular decision, as well as health care services research in general.

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