

Assessing a Whiplash Management Model: A Population-Based Non-Randomized Intervention Study

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ABSTRACT. Objective. To evaluate the effectiveness of a multidisciplinary clinical management approach for whiplash-associated disorders (WAD) following a motor vehicle injury in Quebec.

Methods. A clinical management model was implemented in 5 geographic regions of the Province of Quebec, Canada, in 7 hospitals and 19 clinics. A 2-group population-based parallel design was used to assess its effectiveness. All patients with a new whiplash injury seen in these 26 centers between March and September, 2001 were entered into the Whiplash Management Model (experimental group). A reference group included all subjects who had a whiplash injury during this same period but were not seen in these 26 intervention centers. All subjects were followed for up to a year. The outcome variables were time on compensation, time to file closure, and total direct costs.

Results. A total of 288 patients with WAD were identified in the experimental group and 1,875 patients in the reference group. The rate of ending of compensation was significantly higher in patients who received the experimental treatment model than those receiving the reference treatment approach (rate ratio, RR: 3.2; 95% confidence interval, CI: 2.8-3.6). The rate of file closure was also significantly higher with the experimental treatment (RR: 1.5; 95% CI: 1.2-1.8). The average cost per patient was significantly reduced with the experimental intervention.

Conclusion. A coordinated whiplash management approach can lead to earlier return to work and lower costs for patients who have sustained a whiplash injury. (J Rheumatol 2006;33:581-7)

Key Indexing Terms:

MOTOR VEHICLE CRASH PROGNOSIS SOFT TISSUE INJURY TRAUMA

Whiplash, a common injury arising from motor vehicle crashes, was originally named to describe the result of a rapid hyper-extension and flexion of the muscles of the neck¹. Its yearly incidence varies between 70 per 100,000 in Quebec^{2,3}, 100 per 100,000 in Sweden⁴, and 106 per 100,000 in Australia⁵. In the US in 2000, the rate of neck sprain treated in hospital emergency departments was estimated to be 328 per 100,000 population⁶. Its cost to the health care system is high, with an estimated \$2,500 (1987 CAD) in indirect costs per subject³. Managing patients with a whiplash injury is complex because the high variability

and low predictability of its prognosis⁷. Studies on the duration of this condition produced highly variable results, such as 27% still affected at 6 months⁸, 26% at one year⁹, 44% at 2 years, and 7% still unable to return to work at 2 years¹⁰. Nevertheless, population-based studies indicate that most patients recover from these injuries within 8 weeks². One in 4 people, however, will experience a more complex and slower rate of healing, which may extend for some beyond 1 to 2 years after the injury. The situation seriously challenges the current manner in which patients are cared for and the coordination of services available to them. The Quebec Whiplash-Associated Disorders Task Force, in view of the disparate and often unproven approaches to treatment, recommended that research should be undertaken on clinical management models with different configurations of health professionals with contrasting arrangement of access, referral, and team function, accompanied by formal evaluation of their impact, particularly among patients with WAD in a chronic phase². Such research has become more urgent lately in view of increasing health care costs and lack of consistency in clinical practices.

The Société de l'assurance automobile du Québec (SAAQ) is a government body that provides a no-fault public automobile insurance plan that covers all 7 million residents of the Province of Québec for injuries sustained as a result of a motor vehicle collision. It incorporates accident prevention, promotion of road safety, compensation of peo-

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ple injured in motor vehicle collisions, and protects and insures all Quebec residents. Faced with these challenges, the SAAQ decided to implement a clinical management model, focused on structuring and coordinating patient care to enable a whiplash-injured person to return to his or her previous activities faster and to prevent complications. The SAAQ identified a model program of caring for patients injured in the workplace that emphasizes the timely care of each patient and adapted the program to people involved in automobile crashes who sustained soft tissue injuries. The program involved shorter waiting periods and, if necessary, immediate access to a specialized interdisciplinary team to intervene quickly on related factors that may interfere with the healing of an injury¹¹. The SAAQ funded and implemented a study to evaluate the effectiveness of this program.

We determined whether this clinical management approach applied to people with WAD following a motor vehicle injury leads to their faster recovery and lower costs related to the injury.

MATERIALS AND METHODS

Study design. A 2-group parallel design was used to evaluate the efficacy of the intervention. The clinical management model was implemented in 5 geographic regions of the Province of Quebec, where 7 hospitals and 19 clinics were identified to carry out the study. All patients with a new whiplash injury seen in these 26 centers between March 1, 2001, and September 30, 2001, were entered into the Whiplash Management Model (WMM). This formed the experimental group. A reference group was formed of all subjects who had a whiplash injury during this same period but either did not live in the 5 target areas or lived in the target areas but were not seen in any of the 26 intervention centers. In all other respects, the experimental and reference groups had identical eligibility criteria. All subjects were followed until February 21, 2002. In order to establish pre-intervention baseline outcomes of whiplash injury in the different regions, all subjects with a new whiplash injury were identified in the 5 target regions and remaining reference regions during the prior year, namely between March 1, 2000, and September 30, 2000, and followed for one year. Ethical approval for this study was received from Laval University and the 7 participating hospitals.

Patient identification. The source population for this study was the entire population of Québec, where all people involved in a motor vehicle crash are covered by the SAAQ and there is virtually complete ascertainment of reported whiplash injuries. Five regions of Québec were targeted for the intervention, namely Québec City, Sherbrooke, Montréal, Lévis, and Joliette. In each region, at least one hospital and several medical clinics were identified as source of patients for the study. Montréal and Québec City each had a greater number of hospitals and medical clinics participate to accommodate the larger population serviced in these areas. A total of 7 hospitals and 19 clinics across the 5 regions participated in the study. All patients involved in a motor vehicle crash who sustained a soft tissue injury to any part of the body and presented at one of the hospital emergency departments or medical clinics were promptly referred to physical therapy clinics identified in the study. A liaison nurse immediately notified the SAAQ of the incident, whereupon a decision regarding the eligibility of a claim was rendered without delay. Pre-existing comorbid conditions and lesions other than the whiplash injury sustained in the motor vehicle crash were identified by the attending physician during the initial assessment and classified according to the ICD-9 coding system.

Physical therapy clinics were selected to implement the intervention on the basis of several criteria. They had to be located within the perimeter of the hospitals selected for the study, since proximity to a hospital facilitates

the use of a clinic. They had to rely on a functional approach that utilizes active treatment and promotes regular activity, and had to take in patients with soft tissue injuries on a regular basis. An assessment center was also identified within each region. Centers selected had physical therapists who use an active sports medicine-type method to treat injuries and placed emphasis on functional exercise directly linked to job-related tasks. Most eligible clinics agreed to participate but a small number refused due to lack of financial remuneration.

Only patients diagnosed by a physician with Grade 1, 2, or 3 WAD according to the Quebec WAD Task Force classification scheme² and aged 18-65 were included in the evaluative component of this study. A classification of grade 1 is made if there is neck pain only, grade 2 if there is neck pain and musculoskeletal signs including neck stiffness or limited range of motion, and grade 3 if there is neck pain accompanied by neurological signs including weakness and sensory deficits. The subjects in this study received their initial WAD diagnosis based upon evaluation by a physician using a combination of personal information provided by the subject, reports of pain, and results of a physical examination. All patients with other soft-tissue injury, around 11% of all subjects, were excluded, as were those with a prior whiplash injury from which they had not recovered or who experienced a second whiplash injury after their entry into the study. In addition, patients whose injury was sufficiently minor to be resolved in less than 8 days were excluded since the management program is initiated one week after the trauma.

Whiplash management model. The Whiplash Management Model (WMM) was based on adapting a model developed for people injured in the workplace¹² to people involved in motor vehicle crashes who sustained soft tissue injuries. Each patient identified for the study was referred to the physical therapy clinic with the physician's prescription in hand and signed a consent form to take part in the study. A small number refused to participate, most often because the intervention clinic was too distant from their home. In this situation, treatment was provided through a reference clinic closer to their home. The patient received a maximum of 9 active physical therapy sessions over 3 weeks that were complemented by a home exercise program (Figure 1), after which time the patient was reassessed. If the patient's condition had progressed positively and if the prognosis of a return to work was favorable, a maximum of 20 additional physical therapy sessions over a 4-week period were scheduled to recover the abilities required to return to work. Patients could also receive an assessment of their functional abilities with or without a medical examination, if necessary. The patient could also be seen only by a physician. He or she was then referred to an assessment center. During the entire process, the attending physician was consulted and the proposed treatment for the patient was discussed with the physician.

If following treatment the patient had not sufficiently recovered within the allotted period, an occupational or physical therapist assessed the individual's functional abilities. Assessment was used to determine the individual's functional abilities and to ensure that he or she could take part in the interdisciplinary program. A physician and psychologist would also assess the patient to ensure that the diagnosis was accurate, to assess obstacles to healing, to determine the degree of residual pain, and to propose possible treatment options. Based on the assessment recommendations, an interdis-

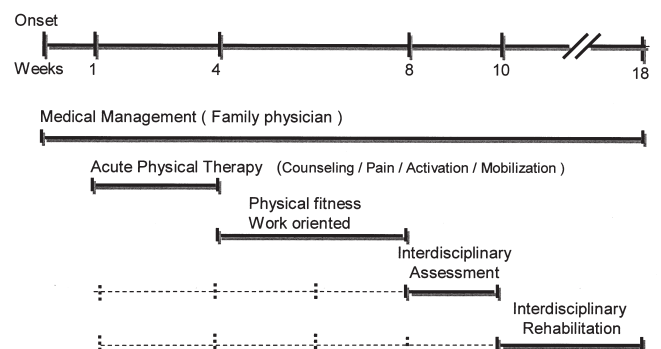


Figure 1. The whiplash management model.

disciplinary team of health care specialists including a physician, physical therapist, occupational therapist, and psychologist took over the cases of patients for whom physical therapy had not produced results, for a maximum 7-week period. The interdisciplinary program was provided by the assessment centers and identified the individual abilities and needs of the patient including their current functional abilities, levels of residual pain, and obstacles to recovery. Treatment objectives and options were discussed among team members to custom tailor the program to the client with the primary goal of returning to work.

Data analysis. Three outcome variables were used to evaluate the impact of the WMM. The first was the length of time the subject received compensation for their whiplash injury. This outcome corresponded to the amount of time taken off work by the whiplash subject, if the subject was employed, or the length of time during which the whiplash subject could not carry out his or her usual activities, if the subject was a student, homemaker, retiree, or unemployed. The second outcome was the time to closure of the subject's file by the SAAQ. This administrative measure was used to complement time on compensation and account for additional treatment time for subjects who return to work early, while continuing treatment. It has been shown that this proxy measure is associated with clinically important outcomes of neck pain and physical functioning¹³. Cessation of compensation and file closure was handled by adjusters who followed a standardized procedure for all claims. The direct costs compensated by the SAAQ and measured in Canadian dollars formed the third outcome measure. These costs include the replacement of regular income, medical costs, costs of assistance, and permanent disability, as well as others. The medical costs do not include those already covered by Québec's universal health insurance plan or other private insurance plans. They do include however, rehabilitation expenses involving other professional services used in the development of a rehabilitation plan, as well as additional hospital, medical, and para-medical care expenses not covered by provincial or other health insurance plans. Other costs include those for permanent disability, drugs, clothes, modifications made to vehicles, residences, or workplaces, job training, transportation for medical appointments, prostheses, wheel chairs, etc.

Evaluation of the efficacy of the model was based on a comparison of patients treated by the WMM in the target areas with patients treated in the reference areas by the usual approach. Data on patients treated in these areas during the baseline period were used to verify similarity of outcomes in these regions. Time on compensation and time to file closure were analyzed using methods for survival data. Cumulative end of compensation and closure curves were estimated by the Kaplan-Meier method. The Cox proportional hazards model was used to estimate rate ratios (RR) of end of compensation and closure from whiplash. This model was used to control for confounding bias by adjusting for various prognostic covariates, including age, sex, marital status, the number of lesions related to the crash, unrelated co-morbidity, as well as the grade of the lesions according to the Quebec WAD Task Force classification. Multiple linear regression was used to compare costs with adjustment for the same factors.

To assess selection bias from the clinics chosen to provide the experimental whiplash management model, we repeated the analyses by restricting the reference group to patients not receiving the experimental treatment but treated in the conventional way at those same clinics.

RESULTS

In 2001, a total of 288 patients with a whiplash injury were identified and treated according to the WMM in the 5 target regions. During this intervention period, 1,875 patients were treated in the reference regions, including 23 who were treated in the target clinics but who did not receive the experimental management model. During the baseline pre-intervention period, 769 patients were treated for whiplash in the target regions and 1,745 patients in the reference regions. The characteristics of these patients are presented in

Table 1. The major differences between the groups are with respect to marital status, co-morbidity unrelated to the whiplash injury, and grade of the injury. Patients who received the experimental treatment model were more likely to have grade 1 WAD and less likely to have grade 2 or 3 WAD than the patients treated in the reference regions.

Figure 2A displays the cumulative proportion of patients who reached the end of compensation for the experimental and reference regions during the baseline period. It shows that the 2 regions are similar in this respect and that by one year roughly 50% of patients were still receiving compensation. Figure 2B displays the corresponding curves during the intervention period and shows patients treated by the WMM had less time on compensation than patients treated in the reference regions. At one year, 40% of patients treated by the WMM were receiving compensation compared with over 50% of patients treated in the reference regions. The difference is visible early and persists for the first 2 months after the crash. Figure 3A displays the cumulative proportion of patients who had their files closed. Again the curves are similar for the 2 regions during the baseline period. Figure 3B shows that during the intervention period, patients receiving the experimental model had shorter times to file closure than reference treated patients.

Table 2 shows the RR of end of compensation and closure corresponding to Figures 2 and 3. The rate of end of compensation is equivalent in experimental and reference regions during the baseline period (RR 1.0). In the intervention period, the rate of end of compensation is significantly higher in patients who received the experimental treatment model than those receiving the reference treatment approach (RR: 3.2; 95% confidence interval, CI: 2.8-3.6). The rate of closure, while similar during the baseline period, is significantly higher with the experimental treatment (RR: 1.5; 95% CI: 1.2-1.8). Restricting reference subjects to those treated in target clinics but who did not receive the experimental management model, the RR for end of compensation and closure were almost identical.

Table 3 presents costs associated with the injury. The mean total cost to a patient from the reference treatment was \$5,660 CAD. After adjustment for covariates this average cost was significantly reduced by \$876 CAD (95% CI: \$215-1536) with the experimental approach. This reduction was due primarily to a reduction in the costs due to salary replacement (\$1015 CAD) and physiotherapy (\$269 CAD). Other costs were increased in patients receiving the experimental treatment, but this increase was defrayed by the decrease in other costs. Analysis that restricts reference subjects to those treated in target clinics but who did not receive the experimental management model produced similar findings, albeit with wider confidence limits.

DISCUSSION

Using a population-based intervention study across Quebec,

Table 1. Description of the experimentally treated and reference patients during the baseline and intervention periods. Severity of whiplash injury was defined using the Quebec WAD Task Force classification.

	Baseline Period 1 Mar 2000–30 Sept 2000		Intervention Period 1 Mar 2001–30 Sept 2001	
	Experimental ^a	Reference ^b	Experimental ^c	Reference ^d
No. of New whiplash cases	769	1745	288	1875
Age \pm SD	34 \pm 12	40 \pm 14	34 \pm 12	37 \pm 15
Sex, % male	32.5	29.6	31.9	30.5
Marital status, %				
Married, cohabitating	39.5	48.2	31.6	45.7
Divorced, separated	14.6	13.6	5.9	14.1
Single, widow, other	45.9	38.2	62.5	40.2
Number of lesions related to crash, %				
1	29.5	22.9	30.2	27.3
2	26.5	28.3	29.9	29.1
3	18.9	20.1	20.1	20.1
4 or more	25.1	28.8	19.8	23.5
Unrelated co-morbidity, %				
1. Cervical pain only	62.3	54.8	51.0	35.0
2. With musculoskeletal signs	35.4	41.6	46.5	61.6
3. With neurological signs	2.3	3.6	2.4	3.5

^a Baseline experimental subjects are those who experienced a whiplash injury between March 1, 2000 and September 30, 2000, received standard treatment, and resided in 1 of the 5 target regions in Quebec. ^b Baseline reference subjects are those who experienced a whiplash injury between March 1, 2000 and September 30, 2000, received standard treatment, and resided in Quebec outside of the 5 target regions. ^c Intervention experimental subjects are those who experienced a whiplash injury between March 1, 2001 and September 30, 2001, and received treatment using the experimental management model in 1 of the 5 target regions. ^d Intervention reference subjects are those who experienced a whiplash injury between March 1, 2001 and September 30, 2001, received standard treatment, and resided in 1 of the 5 target regions in Quebec or resided in Quebec outside of the 5 target regions.

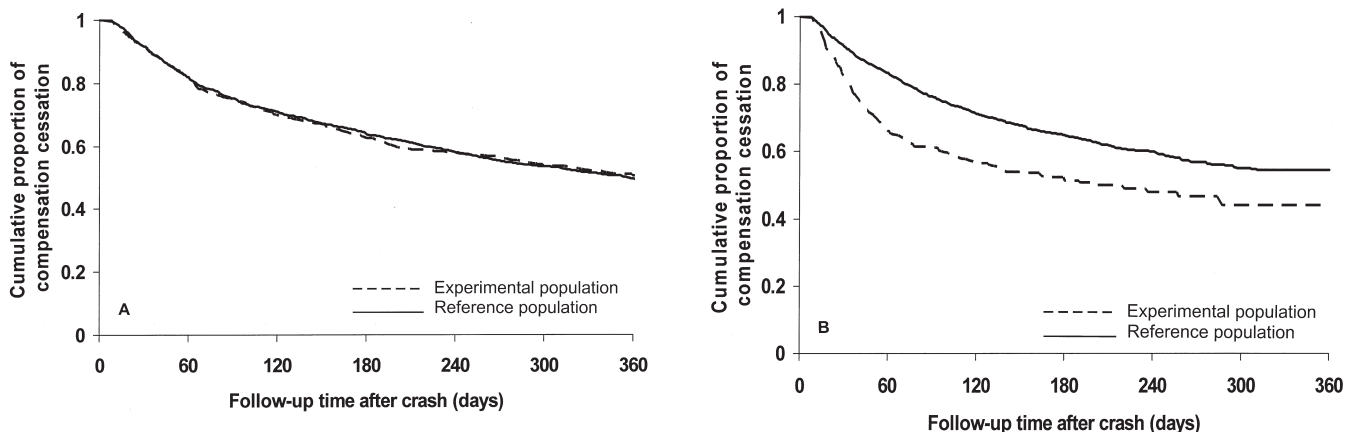


Figure 2. Cumulative proportion of subjects who stop receiving compensation over the first year of followup after the crash for the experimental (broken line) and reference populations (solid line), during (A) the baseline period and (B) the intervention period. Recovery is defined as patients who stopped receiving compensation.

we found that a coordinated WMM decreased time on compensation leading to earlier return to work and lower costs for patients who have sustained a whiplash injury. The median time on compensation was about 1 year prior to the intervention. With the experimental treatment, it was reduced to less than 6 months and the cost per patient was reduced by almost \$1000 CAD per patient.

The Quebec WAD Task Force recommended that research should be undertaken on the implementation and evaluation of such clinical management models². This clin-

ical approach to management of patients with a whiplash injury involves coordination of services from several disciplines into a network of trauma care providers responsible for health care continuum. Such a system did not previously exist; patients used to be treated in a haphazard way by health care providers dispersed throughout the province in different hospitals and rehabilitation centers. Patients were cared for and managed by professionals with different knowledge, experience, practices, and response techniques. In all, each link in the clinical management chain was con-

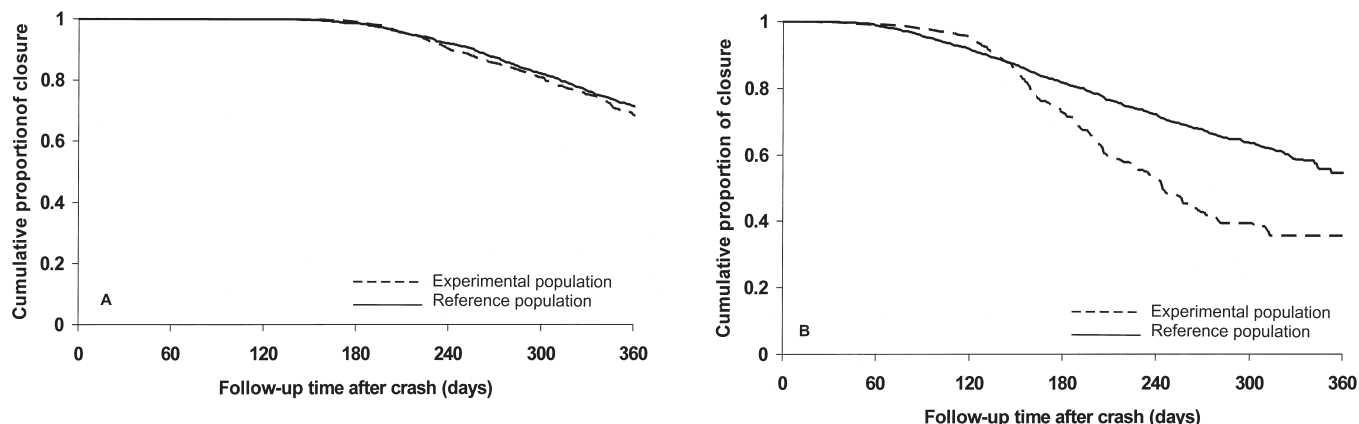


Figure 3. Cumulative proportion of subjects with file closure recover over the first year of followup after the crash for the experimental (broken line) and reference populations (solid line), during (A) the baseline period and (B) the intervention period. Recovery is defined as patients who stopped receiving compensation.

Table 2. Rate ratios (RR) of end of compensation and closure for the experimentally treated and reference patients during the baseline and intervention periods.

	Rate Ratio	
	Crude	Adjusted (95% CI)*
End of compensation		
Baseline period (Experimental ^a vs reference ^b subjects)	1.1	1.0 (0.9–1.1)
Intervention period (Experimental ^c vs reference ^d subjects)	3.1	3.2 (2.8–3.6)
Intervention period in target clinics only (Experimental ^c vs reference ^e subjects)	3.3	3.3 (2.3–4.6)
File Closure		
Baseline period (Experimental ^a vs reference ^b subjects)	1.2	1.1 (1.0–1.2)
Intervention period (Experimental ^c vs reference ^d subjects)	1.7	1.5 (1.2–1.8)
Intervention period in target clinics only (Experimental ^c vs reference ^e subjects)	1.9	1.4 (0.8–2.4)

* Adjusted for age, sex, marital status, number of lesions related to the crash, unrelated co-morbidity, and grade of whiplash injury according to the Quebec WAD Task Force classification. ^a Baseline experimental subjects are those who experienced a whiplash injury between March 1, 2000 and September 30, 2000, received standard treatment, and resided in 1 of the 5 target regions in Quebec. ^b Baseline reference subjects are those who experienced a whiplash injury between March 1, 2000 and September 30, 2000, received standard treatment, and resided in Quebec outside of the 5 target regions. ^c Intervention experimental subjects are those who experienced a whiplash injury between March 1, 2001 and September 30, 2001, and received treatment using the experimental management model in 1 of the 5 target regions. ^d Intervention reference subjects are those who experienced a whiplash injury between March 1, 2001 and September 30, 2001, received standard treatment, and resided in 1 of the 5 target regions in Quebec or resided in Quebec outside of the 5 target regions. ^e Reference subjects in target clinics are subjects who experienced a whiplash injury between March 1, 2001 and September 30, 2001 and who received standard treatment in a target clinic.

sidered a distinct unit, exclusive and independent of all others. The current WMM facilitates accessibility and allows careful monitoring of continuity of services with clinical assessments. We have shown that this model appears to work in experimental conditions. It remains to be seen whether, when implemented province-wide, it will also show the same efficacy.

Studies of interdisciplinary rehabilitation programs for patients with chronic pain conditions show that such an approach appears to be effective^{14–17}. A study conducted in the Netherlands indicates these programs may also be useful for people with chronic symptoms after whiplash injury¹⁸.

All patients in the study had whiplash symptoms for at least 6 months that were consistent with grade 1 or 2 WAD as defined by the Quebec Task Force. After taking part in a 4-week interdisciplinary program, patients had statistically significant reductions in disability, depression, and cognitive complaints. Furthermore, 24 of 26 participants returned to at least part-time work within 6 months of completing the program. However, evaluation of another interdisciplinary rehabilitation program for persons with chronic whiplash associated disorder had more mixed results¹⁹. Researchers found participants had a better ability to cope with and control pain, and neck and back pain was significantly

Table 3. Mean costs with crude and adjusted cost differences (in CAD) associated with the WMM.

	Mean Cost		Mean Cost Difference	
	Experimental	Reference	Crude	Adjusted* (95% CI)
All patients, n	288	1875		
Total cost (CAD)	3813	5660	-1847	-876 (-1536 to -215)
Salary compensation	1932	3503	-1571	-1015 (-1490 to -540)
Physiotherapy	586	941	-355	-269 (-360 to -178)
Other costs**	1312	1216	95	410 (88 to 734)
Patients in target clinics, n	288	56		
Total cost (CAD)	3813	8016	-4203	-2799 (-4198 to -1401)
Salary compensation	1932	4505	-2573	-1979 (-2856 to -1102)
Physiotherapy	586	1201	-617	-517 (-657 to -377)
Other costs**	1312	2310	-988	-299 (-1094 to 496)

* Adjusted for age, sex, marital status, the number of lesions related to the crash, unrelated co-morbidity, as well as the grade of the lesions according to the Quebec WAD Task Force classification². ** Other costs include medical costs other than physiotherapy, rehabilitation expenses, additional hospital, medical and para-medical care expenses not covered by the provincial or other health insurance plans, costs for permanent disability, drugs, clothes, modifications made to the vehicles, residences, or workplaces, job training, transportation for medical appointments, prostheses, wheel chairs, etc.

decreased 6 months post-intervention, but no significant differences were found for functional abilities.

In our study, the compensation curve indicates that the major impact of the intervention occurs in the first 13 weeks after the crash. A prior cohort study conducted in 1987 in this population showed that only 25% of patients were still receiving compensation for their whiplash injury after 13 weeks³. However, unlike the present study, that cohort included patients whose pain resolved within the first 7 days after the crash and who comprised roughly 30% of the study population. Despite this, the 1987 cohort implies that among those whose pain persisted longer than 7 days, about 35% were still receiving compensation after 13 weeks. This is much lower than the present study based on data from 2000-2001 that show that the proportion of patients still receiving compensation at 13 weeks dropped from 75% in the reference program to 60% in the experimental program. This apparently important increase in time on compensation between 1987 and 2001 needs to be investigated.

Factors that affect recovery from WAD have been investigated in the literature with age, sex, initial symptoms, and severity of the whiplash injury being the most consistently associated with prognosis²⁰. We assessed severity of the initial whiplash injury using the Québec WAD Task Force Classification². The Québec WAD Task Force Classification has been shown to be a significant prognostic factor for WAD, with a longer recovery and poorer prognosis associated with an increasing higher WAD grade²¹. The 1987 cohort study found that several sociodemographic and crash-related factors, as well as several specific musculoskeletal and neurological signs and symptoms that whiplash patients present at the time of the trauma, are predictive of a longer recovery period, and can vary the median recovery time from 17 to 123 days²¹⁻²³. Additional studies are needed to identify, for recent cohorts, sociodemo-

graphic and clinical factors measured both at the time of the crash and over the first 13 weeks, to evaluate their impact on recovery. In addition, it will be necessary to review the literature and identify possible effective strategies for such patients to include in the continuum of treatment.

Several aspects of our study could have affected the validity of the results. First, patients were not randomized to the experimental management approach. The 26 centers involved in applying the WMM could have been different in their usual approach to these patients. To address this, we used 2 additional analyses in this study. First, we compared patients seen in these centers with those of other regions during the year prior to the intervention and found them to be almost identical with respect to recovery rates and costs. Second, we also identified 56 patients in the reference group who were treated in experimental clinics but who did not receive the management model, and found that reductions in time on compensation and costs were similar to those observed using all patients in the reference group. A second issue that could have affected the validity of our results is that while the experimental treatment approach was similar regardless of the clinic attended, the treatment approaches provided in reference group clinics were not specifically assessed other than that they followed current standards of care. It is possible that some reference clinics may have provided a treatment approach similar to the experimental group. This would make the groups more similar and attenuate any differences between them. However, differences were still found between treatment groups and it is likely that the beneficial effect of the experimental approach is actually greater than observed. Third, misclassification of the covariates “number of lesions” and “co-morbidity” is possible, but is unlikely to be different between participants in the experimental and reference treatment groups, resulting in, at worst, a bias towards the null hypothesis. Finally,

while data entry and completeness of SAAQ computerized databases have been shown to be reliable, one outcome measure, namely time on compensation, is potentially subject to different sources of misclassification. It is possible that some subjects were malingerers who continued to be compensated even though they were sufficiently recovered from their whiplash injury to resume their usual daily activities. For such measurement error to cause bias, however, patients treated with the experimental approach would have to be systematically different from patients treated with the reference approach, something that cannot be assessed.

Time on compensation and time to file closure closely approximate return to daily functional activities after a whiplash injury, but are not ideal indicators of full recovery. It is possible that some whiplash patients continue to live with pain or discomfort for some time after their injury or have periodic recurrent episodes of neck pain. In future studies, recovery from whiplash could be directly measured by contacting subjects and having them complete a validated quality-of-life survey, such as the 36 item short-form (SF-36), or by eliciting feedback from subjects regarding their perceptions of recovery from whiplash injury.

Figure 3B displays rates of file closure between the experimental and reference groups and indicates that these rates are not proportional over time. The rates are roughly equal between the groups in the first 6 months but subsequently diverge. However, given the RR is an average of the rate over time, including the first 6 months in our analysis, makes the overall experimental and reference group rates more similar and underestimates the true effect of the WMM treatment program after the initial 6 months.

In conclusion, this population-based study shows that a coordinated whiplash management program that takes early charge of patients, only one week after the injury, and directs them through a unified continuum of care with periodic clinical assessments reduces their time on compensation and related costs. Given the considerable benefit of the experimental approach in shortening time on compensation from WAD, the fact that the experimental approach is adapted from a well established current program, and that the primary difference between the experimental and reference groups is communication between disciplines and coordination of services, rather than actual treatment techniques, this tailor-made management program for sprains and muscle injuries from whiplash will be introduced at the province-wide level in Quebec. It now remains to be seen and evaluated whether the impact observed in this study under experimental conditions can be replicated in the natural setting.

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