Initial Patterns of Clinical Care and Recovery From Whiplash Injuries

A Population-Based Cohort Study

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Background: Little is known about the most effective pattern of clinical care for acute whiplash. We designed a cohort study to determine whether patterns of early clinical care (involving visits to general practitioners, chiropractors, or specialists) were associated with different rates of recovery.

Methods: We studied 2486 Saskatchewan adults with whiplash injuries. We defined 8 initial patterns of care that integrated type of provider and number of visits. We used multivariable Cox models to estimate the association between patterns of care and time to recovery while controlling for injury severity and other confounders.

Results: There was an independent association between the type and intensity of initial clinical care and time to recovery. We found that patients in the low-utilization general practitioner group had the fastest recovery, even after controlling for injury severity and other confounders. Compared with this group, the high-utilization general practitioner group experienced a 1-year rate of recovery that was 27% slower (adjusted hazard rate ratio [HRR], 0.73; 95% confidence interval [CI], 0.61-0.87); for the high-utilization chiropractic group it was 39% slower (HRR, 0.61; 95% CI, 0.46-0.81); for the high-utilization general practitioner plus chiropractic combined group it was 28% slower (HRR, 0.72; 95% CI, 0.57-0.91); and for those who consulted general practitioners and specialists, it was 31% slower (HRR, 0.69; 95% CI, 0.55-0.87).

Conclusions: The type and intensity of clinical care initiated within the first month after the injury is associated with the rate of recovery from whiplash injuries. Our study does not support the hypothesis that early aggressive care promotes faster recovery.

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Saskatchewan Government Insurance covers the uninsured portion of chiropractic services related to injuries, except that insured chiropractic visits are covered. Similar coverage applies to medical services. There are no limits to the annual number of medical or chiropractic services. Access to chiropractors does not require a medical referral. Reimbursement of chiropractic services includes an insured (paid by the health care system) and uninsured (paid by the patient) portion. Chiropractic fees are fully covered for individuals who receive supplementary benefits. There are no limits to the annual number of medical or insured chiropractic visits. Similar coverage applies to medical and chiropractic services related to injuries, except that Saskatchewan Government Insurance covers the uninsured portion of chiropractic services.

**SOURCE POPULATION**

Saskatchewan residents 18 years or older who sustained whiplash injury between January 1 and December 31, 1995, and who reported it to Saskatchewan’s no-fault government insurance agency were eligible for inclusion. Individuals who filed a workers’ compensation claim, did not speak English, made multiple claims during the study period, sustained severe injuries (more than 2 days of hospitalization), or who had other conditions (eg, Alzheimer disease) were not eligible.

**INCLUSION AND EXCLUSION CRITERIA**

We included claimants who reported their injury within 30 days of the traffic collision. To be included, claimants had to answer “yes” to 2 questions: (1) “Did the accident cause neck/shoulder pain?” and (2) “Have you felt neck/shoulder pain or reduced or painful neck movement since the accident?”

We excluded claimants with neck fractures or dislocations, skull fractures, or spinal cord injury and those with patterns of care that did not fit into 1 of the 8 predefined patterns. Finally, we excluded claimants whose claim was closed and then reopened. Saskatchewan Government Insurance overwrites the first closure date with the second one when a claim is reopened. We excluded this group of claimants to ensure that our outcome did not capture time between benefit periods.

**DATA SOURCES**

We used insurance data from Saskatchewan Government Insurance to collect potential confounders and the information necessary to measure our outcome. The insurance data were linked to administrative health services data by Saskatchewan Health. Administrative health services data from Saskatchewan Health were used to collect potential confounders along with the information necessary to measure initial patterns of care among whiplash patients. These data included information on all health care visits to medical doctors and chiropractors for a period of 1 year before and 1 year after injury. Diagnoses (International Classification of Diseases, Ninth Revision [ICD-9] codes), number of services, service dates, provider types, and date of death were extracted from the medical services, hospital services, and registration files. Saskatchewan Health compiled the data using the Health Services Number, a unique identifier assigned to each registered beneficiary. To protect confidentiality, Saskatchewan Health removed all identifiers from the study files. The University of Saskatchewan’s Advisory Committee on Ethics in Human Experimentation approved the study.

**PATTERNS OF CARE**

We defined 8 patterns of care that include visits made to general practitioners, chiropractors, and specialists during the first month after the injury. We used consensus of the clinician investigators to determine the number of visits used to categorize patterns of care into low- vs high-utilization groups. Specialists include all specialties except radiology.

We used the following ICD-9 codes to identify visits for whiplash injuries: 721 (spondylosis and allied disorders), 722 (intervertebral disc disorders), 723 (other disorders of the cervical region), 724 (other and unspecified disorders of the back), 729 (other disorders of soft tissues), 784 (symptoms involving head and neck), 840 (sprains and strains of shoulder and upper arm), and 847 (sprains and strains of other unspecified parts of the back). Saskatchewan chiropractors do not use ICD-9 codes. Because most chiropractic visits are for neck pain, back pain, and other musculoskeletal conditions, we assumed that chiropractic visits made during the first month after the collision were for whiplash-related injuries.

**OUTCOME**

We measured time to recovery as the number of days between the date of injury and the date corresponding to the closure of the insurance claim. The decision to close a claim results from a negotiation between the insurer, health care providers, and the claimant. It corresponds to the end of treatment, the attainment of maximal medical improvement, or the termination of income replacement benefits. Saskatchewan Government Insurance provided us with the claim-closure dates.

We validated claim closure as a marker of health recovery in our population by studying its relationship to clinically im-
important levels of improvement in neck pain intensity, physical functioning, and depressive symptoms. Our analysis clearly demonstrated that claimants who close their claims have significantly lower levels of neck pain, better physical functioning, and no depression compared with claimants who have not closed their claims. This finding supports the use of claim duration as a valid marker of health recovery.

POTENTIAL CONFOUNDERS

We evaluated the confounding effect of 87 variables that were measured within the first 30 days after the collision. Confounders were selected after systematically reviewing the literature and based on their clinical relevance.

Injury Severity

We obtained 6 separate measures of pain intensity using 100-mm visual analogue scales. These measures included current and usual intensity of neck pain, headache, and other pains. We controlled for multiple injuries by computing the percentage of the body in pain and by measuring symptoms that started within 4 days of the collision (headache, dizziness, nausea, vomiting, vision problems, memory problems, concentration problems, ringing in the ears, difficulty swallowing, reduced and/or painful jaw movement, low back pain, numbness and/or pain in the arm(s), numbness and/or pain in the leg(s), and loss of consciousness). We controlled for work disability by asking claimants whether they missed work because of the injury.

We also controlled for postcollision medical diagnoses. We classified the diagnoses (ICD-9 codes) made during the first 30 days after the collision into 4 broad categories: (1) Diseases were defined according to ICD-9 codes indicating a diagnosis of malignant neoplasm, benign neoplasm, endocrine disorder, mental disorder, disease of the nervous system, disease of the circulatory system, chronic obstructive pulmonary disease, digestive disorders, genitourinary disorders, and migraine. (2) Arthritis and rheumatism diagnoses included arthropathies and related disorders, polyarthritis rheumatica, osteopathies, chondropathies, and acquired musculoskeletal disorders. (3) We defined severe injuries as fractures, dislocations, internal injuries, open wounds of the head and neck, and nerve injury. Finally, (4) we classified superficial injuries as those referred to ICD-9 codes indicating superficial injuries and contusions with intact skin.

Comorbidities

We used administrative health services data to measure comorbidities. We classified all diagnoses (ICD-9 codes) made during the year prior to the collision into broad categories: neoplasms; mental disorders; endocrine system disorders; nervous system disorders; circulatory system disorders; digestive system disorders; genitourinary system disorders; chronic bronchitis; emphysema or asthma; migraines; arthritides and rheumatism; dorsiopathies; acquired deformities; symptoms of the head and neck; fractures; sprains, and strains; and chiropractic diagnoses.

Health Prior to the Collision

Subjects rated their general health (excellent to poor) during the month prior to the collision and reported whether they had experienced any of the following symptoms: neck pain, headache, jaw pain, low-back pain, anger, depression, anxiety, fearfulness, tiredness, frustration, concentration problems, memory problems, body discomfort, and/or sleeping problems. Subjects were asked whether they had previously injured their neck in a motor vehicle collision. Finally, self-reported height and weight was used to compute body mass index (calculated as weight in kilograms divided by the square of height in meters).

Precollision Health Care Utilization

Past health care utilization is a strong predictor of future utilization and health care-seeking behavior; thus, it was important to control for it in the present analysis. We used administrative data to compute the number of visits made to general practitioners, specialists, and chiropractors and the number of hospitalizations during the year prior to the collision.

Demographic and Socioeconomic Characteristics

We controlled for the following variables: age, sex, marital status, education, annual family income, number of dependents, employment status, and main work activity.

Legal Factors

Subjects reported whether a lawyer was involved in the claim process. Data from Saskatchewan Government Insurance were used to determine whether the subject was at fault for the collision.

Collision Characteristics

Because the characteristics and severity of the collision may be related to injury severity, we considered the following variables as potential confounders: direction of impact, seating position, seat belt use, headrest use, head position at impact, whether the head was hit during impact, vehicle stopped or in motion, vehicle rolled over, vehicle drivable after the collision, collision time, road type, and road surface.

STATISTICAL ANALYSIS

We computed median time to recovery and 95% confidence intervals (CIs) through the Kaplan-Meier method. We used multivariable Cox models to measure the associations between patterns of care and time to recovery. In these models, the low-utilization general practitioner group served as the reference category. Hazard rate ratios (HRRs) and 95% CIs described the strength and direction of association, with ratios lower than 1 suggesting slower recovery.

Exploratory analyses demonstrated that the hazards of the various patterns of care were nonproportional. Therefore, our Cox models included interaction terms between the patterns of care and the logarithm of time. We conducted sensitivity analyses to assess the impact of excluding reopened claims by repeating our analyses on all claims, including the reopened ones.

The purpose of our multivariable model was to test the independence of the association between patterns of care and time to recovery. To determine whether confounding was present, we tested the impact of each potential confounder individually. Similarly, we tested the aggregate effect of confounders belonging to a domain of variables. A variable or group of variables was considered a confounder if adding it to the crude Cox model (containing the patterns of care as the only independent variable) changed any of the pattern of care crude HRR by at least 5%. All analyses were conducted using SAS software, version 6 (SAS Institute Inc, Cary, NC).
Patients in the low-utilization general practitioner group had the fastest recovery (Table 3). High-utilization groups had the slowest recovery. Overall, patients in the high-utilization chiropractic group (median time to recovery, 362 days [95% CI, 297-468 days]) and those in the high-utilization general practitioner plus chiropractic group (median time to recovery, 368 days [95% CI, 252-440 days]) took more than twice as long to recover as patients in the low-utilization general practitioner group (median time to recovery, 164 days [95% CI, 153-175 days]).

Our bivariate and multivariable regression analyses confirmed that patients in the low-utilization general practitioner group had the fastest recovery (Table 4 and Table 5). A comparison of the crude and adjusted results demonstrates that the association remained strong even after controlling for injury severity and other confounders. Compared with the low-utilization general practitioner group, the high-utilization general practitioner group was 27% less likely to have recovered 1 year after the collision (HRR, 0.73 [95% CI, 0.61-0.87]) (Table 5). The largest delays in recovery occurred in the high-utilization chiropractic and the high-utilization general practitioner plus chiropractic groups. Compared with patients in the low-utilization general practitioner group, 1 year after the collision those in the high-utilization chiropractic group had a 39% slower rate of recovery (HRR, 0.61 [95% CI, 0.46-0.81]), and those in the high-utilization general practitioner plus chiropractic groups had a 28% slower rate of recovery (HRR, 0.72 [95% CI, 0.57-0.91]).

The association between the general practitioner plus specialist group and time to recovery remained constant during the follow-up period (Table 5). One year after the collision, patients who saw a general practitioner and a specialist had a 31% slower rate of recovery (HRR, 0.69 [95% CI, 0.55-0.87]) than the reference category. Patients in the general medical group had significantly slower recovery rates during the second year of follow-up than patients in the reference category. Results

Figure. Classification chart for subjects in the study.

### STUDY POPULATION

A total of 3679 acute whiplash injuries were reported to Saskatchewan Government Insurance during the study period (Figure). We excluded 1193 claimants because of reopened claims, neck or skull fractures, spinal cord injuries, or because their pattern of care did not correspond to 1 of the 8 predefined patterns. Claimants who re-opened a claim were similar to those who did not reopen a claim. Our cohort included 2486 patients (67.6% of all claimants). None was lost to follow-up: we acquired outcome information on all subjects.

### BASELINE CHARACTERISTICS

Most patients (53.7%) visited general practitioners only (low or high utilization); 9.1% consulted chiropractors only (low or high utilization); and 19% consulted multiple providers (Figure). A significant proportion of patients (18.1%) saw medical doctors who submitted diagnoses other than whiplash (general medical group).

Table 2 lists the baseline characteristics by pattern of care. The mean age of patients ranged from 36 years in the low-utilization general practitioner group to 40.1 years in the general medical group. Compared with patients in the low-utilization general practitioner group, those in the low-utilization chiropractic group reported less severe injuries. These chiropractic patients reported less intense neck pain and headaches; fewer had numbness or pain in the arms; and fewer reported missing work because of their injury. Patients in the high-utilization general practitioner group and those in the high-utilization general practitioner plus chiropractic group had more severe injuries than those in the low-utilization general practitioner group. These patients had more intense neck pain and headaches; a higher proportion had numbness or pain in the arms; and more patients reported missing work because of their injury.
from our sensitivity analyses were similar to those of our primary analysis, suggesting that the exclusion of re-opened claims did not bias our findings.

We found that increasing the intensity of care beyond 2 visits to general practitioners, beyond 6 visits to chiropractors, or adding chiropractic to medical care was associated with slower recovery from whiplash injuries even after controlling for initial injury severity. Clinicians who promote frequent visits may inadvertently encourage patients to cope passively with their pain. Similarly, patients who cope passively with their pain may demand more clinical care. Relying on repetitive clinical care likely

<table>
<thead>
<tr>
<th>Pattern of Care</th>
<th>Median Time to Recovery (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP (1-2 visits)</td>
<td>164 (153-175)</td>
</tr>
<tr>
<td>GP (≥ 2 visits)</td>
<td>251 (214-296)</td>
</tr>
<tr>
<td>DC (1-6 visits)</td>
<td>206 (166-261)</td>
</tr>
<tr>
<td>DC (≥ 6 visits)</td>
<td>362 (297-468)</td>
</tr>
<tr>
<td>GP and specialist</td>
<td>205 (165-269)</td>
</tr>
<tr>
<td>GP and DC (1-6 visits)</td>
<td>213 (186-284)</td>
</tr>
<tr>
<td>GP and DC (≥ 6 visits)</td>
<td>368 (252-440)</td>
</tr>
<tr>
<td>General medical group</td>
<td>139 (131-149)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; DC, chiropractic; GP, general practitioner.
reinforces some patients’ belief that whiplash is a serious disorder with a long, disabling course. As with low-back pain, aggressively treating patients with acute whiplash injuries likely promotes illness behaviors and disability rather than return to normal activities.23,24

Our study has several strengths. First, the complete ascertainment of eligible cases reduced selection bias and allowed us to conduct sensitivity analyses. Second, using Saskatchewan Health data limited the misclassification of patterns of care. Third, we validated our outcome and demonstrated that time to claim closure is a valid marker of health recovery.14 Fourth, there was no loss to follow-up in our study. Fifth, we obtained complete pattern of care and outcome data on all patients. Finally, we extensively controlled for important confounders including several measures of initial injury severity, precollision comorbidities, and precollision health care utilization.

The main limitations of our study include residual confounding and confounding by indication. Residual confounding related to unmeasured variables or measurement error cannot be ruled out. However, we are confident that our analysis limited these biases by controlling for known prognostic factors of delayed recovery.13 As evidenced by comparing the crude and adjusted results, our effect sizes were robust to confounding and remained strong after controlling for initial injury severity and comorbidities. Also, it is possible that selection bias threatened the validity of our results because our sample included patients who did not reopen their claims. We investigated this possibility through sensitivity analysis and found similar results when the entire sample population of eligible claimants (reopened and not reopened claims) was analyzed. The results of our sensitivity analysis indicate that the exclusion of reopened claims did not bias our results.

Our study suggests that medical doctors and chiropractors may have the ability to reduce the burden of disability related to whiplash by avoiding overtreatment of patients soon after onset. This finding may have important implications for prevention because it identifies a narrow period for effective intervention. Our results need to be tested in other populations. Future observational studies should focus on determining the most effective intensity of care to be prescribed shortly after an injury. This research should attempt to minimize confounding by collecting a wide range of valid and reliable psychological and physical health data. Moreover, efforts should be made to obtain precollision data to limit differential

### Table 4. Association Between Patterns of Care and Time to Recovery*

<table>
<thead>
<tr>
<th>Pattern of Care</th>
<th>Time Since Collision, mo</th>
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<tbody>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>GP (1-2 visits) (n = 1030)</td>
<td>1.00 (n = 815)</td>
</tr>
<tr>
<td>GP (&gt;2 visits) (n = 306)</td>
<td>0.53 (0.43-0.64) (n = 273)</td>
</tr>
<tr>
<td>DC (1-6 visits) (n = 115)</td>
<td>0.72 (0.54-0.95) (n = 98)</td>
</tr>
<tr>
<td>DC (&gt;6 visits) (n = 112)</td>
<td>0.30 (0.21-0.44) (n = 108)</td>
</tr>
<tr>
<td>GP and DC (1-6 visits) (n = 147)</td>
<td>0.54 (0.41-0.71) (n = 137)</td>
</tr>
<tr>
<td>GP and DC (&gt;6 visits) (n = 147)</td>
<td>0.30 (0.22-0.43) (n = 137)</td>
</tr>
<tr>
<td>GP and specialist (n = 179)</td>
<td>0.68 (0.54-0.86) (n = 153)</td>
</tr>
<tr>
<td>General medical group (n = 450)</td>
<td>1.19 (1.04-1.37) (n = 343)</td>
</tr>
</tbody>
</table>

**Abbreviations:** DC, chiropractic; GP, general practitioner; n, number of patients who have not recovered.

*Data are reported as crude hazard rate ratios (95% confidence intervals).

### Table 5. Association Between Patterns of Care and Time to Recovery, Adjusted Model*

<table>
<thead>
<tr>
<th>Pattern of Care</th>
<th>Time Since Collision, mo</th>
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<tbody>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>GP (1-2 visits) (n = 1030)</td>
<td>1.05 (0.91-1.22) (n = 343)</td>
</tr>
<tr>
<td>GP (&gt;2 visits) (n = 306)</td>
<td>0.56 (0.46-0.69) (n = 273)</td>
</tr>
<tr>
<td>DC (1-6 visits) (n = 115)</td>
<td>0.72 (0.54-0.96) (n = 98)</td>
</tr>
<tr>
<td>DC (&gt;6 visits) (n = 112)</td>
<td>0.38 (0.25-0.57) (n = 108)</td>
</tr>
<tr>
<td>GP and DC (1-6 visits) (n = 147)</td>
<td>0.59 (0.44-0.79) (n = 137)</td>
</tr>
<tr>
<td>GP and DC (&gt;6 visits) (n = 147)</td>
<td>0.36 (0.25-0.51) (n = 137)</td>
</tr>
<tr>
<td>GP and specialist (n = 179)</td>
<td>0.65 (0.51-0.83) (n = 153)</td>
</tr>
<tr>
<td>General medical group (n = 450)</td>
<td>1.05 (0.91-1.22) (n = 343)</td>
</tr>
</tbody>
</table>

**Abbreviations:** DC, chiropractic; GP, general practitioner; n, number of patients who have not recovered.

*Model is adjusted for age, sex, annual family income; neck pain, low-back pain, and memory problems before the injury; body mass index (calculated as weight in kilograms divided by the square of height in meters); chiropractic diagnosis during the year prior to the collision; number of chiropractic visits during the year prior to the collision; sitting position in vehicle; hitting head during collision; headache, dizziness, memory problems, and arm pain and/or numbness experienced during the first 4 days after the collision; current intensity of neck pain; headache and other pain; usual intensity of neck pain; headache and other pain since the collision; percentage of body in pain; superficial injury resulting from the collision; and severe injury resulting from the collision. Data are reported as adjusted hazard rate ratios (95% confidence intervals).
misclassification bias. The information gained in these studies should be used to design population-based randomized trials aimed at testing the effectiveness of various patterns of care.

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Disclaimer: This study is based in part on non-identifiable data provided by the Saskatchewan Department of Health. The interpretations and conclusions contained herein do not necessarily represent those of the government of Saskatchewan or the Saskatchewan Department of Health.

Additional Information: Dr Côté had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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REFERENCES


