Cost-effectiveness of Advice and Activation, and a Rehabilitation Program, Compared to the Ontario Legislated Standard of Care for Acute Whiplash Injury.


UOIT-CMCC Joint Research Day
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Motivation

• Whiplash affects 83% of persons involved in collisions.
• Health care resources used to manage traffic injuries in the auto insurance system exceed those in other systems for similar injuries.
• Despite increasing health care use, health outcomes declining.
• To test an evidence-based recommendation, and a cost-saving intervention, in a real-world setting.
• No economic evaluations of whiplash interventions, yet major policy changes in Ontario about to occur.
Design

- Economic evaluation alongside the University Health Network Whiplash Intervention Trial (UHN WIT).
- The **UHN WIT** compared the **effectiveness** of three interventions for patients with acute grade I-II whiplash-associated disorder:
  - Financial Services Commission of Ontario’s Pre-approved Framework (**PAF**).
  - Multi-disciplinary rehabilitation (**Premiere**)
  - Physician-based activation and motivation (**MD**) and
Design

- Economic evaluation alongside the University Health Network Whiplash Intervention Trial (UHN WIT).
- The economic evaluation compared the cost-effectiveness of three interventions for patients with acute grade I-II whiplash-associated disorder:
  - Financial Services Commission of Ontario’s Pre-approved Framework (PAF).
  - Multi-disciplinary rehabilitation (Premiere)
  - Physician-based activation and motivation (MD) and

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Design Elements of the Economic Evaluation

- Design: Cost-effectiveness (utility) analysis.
- Time horizon: 1 year.
- Perspective: Payer.
- Costs: Canadian dollars (standardized to 2012).
- Primary outcome: QALYs (QoL weight = EQ VAS).
- Willingness-to-pay (cost-effectiveness) threshold:
  - $50K per additional QALY gained, and
  - $100K per additional QALY gained.
Analysis

- Mean cost (health care use) per person.
- Mean QALYs per person.
- Incremental cost-effectiveness ratio (ICER).
- Incremental net benefit (INB).
- Cost-effectiveness acceptability curves.
- Sensitivity analyses.
Table 1. Baseline characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All ( n = 340 )</th>
<th>PAF ( n = 115 )</th>
<th>Premiere ( n = 113 )</th>
<th>MD ( n = 112 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD), y</td>
<td>40.5 (13.2)</td>
<td>38.9 (11.7)</td>
<td>39.5 (12.1)</td>
<td>43.2 (15.2)</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>229 (67)</td>
<td>81 (70)</td>
<td>70 (62)</td>
<td>78 (70)</td>
</tr>
<tr>
<td>WAD grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td>101 (30)</td>
<td>41 (36)</td>
<td>34 (30)</td>
<td>26 (23)</td>
</tr>
<tr>
<td>Grade 2</td>
<td>239 (70)</td>
<td>74 (64)</td>
<td>79 (70)</td>
<td>86 (77)</td>
</tr>
<tr>
<td>Mean pain intensity in past 24 hrs, (SD)</td>
<td>5.7 (2.1)</td>
<td>5.6 (2.1)</td>
<td>5.7 (2.0)</td>
<td>5.9 (2.1)</td>
</tr>
<tr>
<td>Mean VPMI scores, (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active coping score</td>
<td>15.0 (3.7)</td>
<td>15.7 (3.5)</td>
<td>15.2 (3.2)</td>
<td>14.2 (4.3)</td>
</tr>
<tr>
<td>Passive coping score</td>
<td>14.9 (4.1)</td>
<td>14.3 (3.9)</td>
<td>15.2 (3.9)</td>
<td>15.1 (4.5)</td>
</tr>
<tr>
<td>Mean functional status, (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 physical component score</td>
<td>38.4 (9.4)</td>
<td>40.2 (9.0)</td>
<td>38.2 (9.4)</td>
<td>36.8 (9.4)</td>
</tr>
<tr>
<td>SF-36 mental component score</td>
<td>45.4 (13.4)</td>
<td>45.9 (12.7)</td>
<td>45.2 (14.6)</td>
<td>45.1 (13.1)</td>
</tr>
<tr>
<td>Expected recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Get better soon</td>
<td>165 (48)</td>
<td>69 (60)</td>
<td>43 (38)</td>
<td>53 (47)</td>
</tr>
<tr>
<td>Get better slowly</td>
<td>101 (30)</td>
<td>25 (22)</td>
<td>45 (40)</td>
<td>31 (28)</td>
</tr>
<tr>
<td>Never get better/don't know</td>
<td>74 (22)</td>
<td>21 (18)</td>
<td>25 (22)</td>
<td>28 (25)</td>
</tr>
</tbody>
</table>

SD = standard deviation; SF-36 = acute 30-item short-form survey; VPMI = Vanderbilt Pain Management Inventory; WAD = Québec Classification of Whiplash-associated Disorders.
### Results: Total Costs

**Table 2. Total costs per aggregate health care cost category and mean costs. (n=340)**

<table>
<thead>
<tr>
<th>Cost category</th>
<th>All (n=340)</th>
<th>PAF (n=115)</th>
<th>Premiere (n=113)</th>
<th>MD (n=112)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessments</td>
<td>902,194.7 (37.5)</td>
<td>237,413.6 (35.0)</td>
<td>365,746.5 (39.5)</td>
<td>299,034.6 (37.3)</td>
</tr>
<tr>
<td>Treatment visits</td>
<td>614,616 (25.5)</td>
<td>197,760.8 (29.2)</td>
<td>244,319.5 (26.4)</td>
<td>172,536.2 (21.5)</td>
</tr>
<tr>
<td>Benefits</td>
<td>575,412.7 (23.9)</td>
<td>138,310.1 (20.4)</td>
<td>195,086.1 (21.1)</td>
<td>242,016.5 (30.1)</td>
</tr>
<tr>
<td>Documentation</td>
<td>65,789.1 (2.7)</td>
<td>24,515.6 (3.6)</td>
<td>22,980.9 (2.5)</td>
<td>18,292.6 (2.3)</td>
</tr>
<tr>
<td>Other costs</td>
<td>249,472.2 (10.4)</td>
<td>80,409.9 (11.9)</td>
<td>98,164.7 (106)</td>
<td>70,897.6 (8.8)</td>
</tr>
<tr>
<td><strong>Sum of costs</strong></td>
<td><strong>2,407,485</strong> (100.0)</td>
<td><strong>678,411.3</strong> (100.0)</td>
<td><strong>926,297.7</strong> (100.0)</td>
<td><strong>802,777.4</strong> (100.0)</td>
</tr>
</tbody>
</table>

Costs reported in 2012 CAD
Results: MD compared to PAF

Table 3a. Cost-effectiveness: MD vs PAF (cost per additional QALY gained)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Costs, $ (95% CI)</th>
<th>Incremental Costs, $ (95% CI)*</th>
<th>Mean QALYs (95% CI)</th>
<th>Incremental QALYs (95% CI)</th>
<th>ICER (95% CI)</th>
<th>Incremental Net Benefit, $ (95% CI)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAF (n=101)</td>
<td>5,347 (3,757; 6,936)</td>
<td>$458 (0.753; 0.796)</td>
<td>0.775</td>
<td>-0.021</td>
<td>PAF dominant</td>
<td>-1,486 (-$5,128; 2,156)</td>
</tr>
<tr>
<td>MD (n=92)</td>
<td>6,602 (-2,137; 3,053)</td>
<td>0.750 (-0.061; 0.020)</td>
<td>(0.731; 0.769)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Costs are in 2012 Canadian dollars.

*Differences in costs and effectiveness were adjusted for baseline Expected Recovery and SF-36 Physical Component Scale scores.

**Calculated using willingness-to-pay (λ) = $50,000 per additional QALY gain.

CI = confidence intervals; ICER = incremental cost-effectiveness ratio.
Results: Premiere compared to PAF

Table 3b. Cost-effectiveness of Premiere vs PAF (cost per additional QALY gained)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Costs, $ (95% CI)</th>
<th>Incremental Costs, $ (95% CI)*</th>
<th>Mean QALYs (95% CI)</th>
<th>Incremental QALYs (95% CI)</th>
<th>ICER (95% CI)</th>
<th>Incremental Net Benefit, $ (95% CI)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAF (n=101)</td>
<td>5,347 (3,757; 6,936)</td>
<td>1,585 (0.753; 0.796)</td>
<td>0.775</td>
<td>-0.003</td>
<td>PAF dominant</td>
<td>-1,755 (-5,270; 1,761)</td>
</tr>
<tr>
<td>Premiere (n=102)</td>
<td>7,626 (-783; 3,952)</td>
<td>-1,585 (-0.046; 0.039)</td>
<td>0.752</td>
<td>0.003</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Costs are in 2012 Canadian dollars.
*Differences in costs and effectiveness were adjusted for baseline Expected Recovery and SF-36 Physical Component Scale scores.
**Calculated using willingness-to-pay (λ) = $50,000 per additional QALY gain.
CI=confidence intervals; ICER = incremental cost-effectiveness ratio.
Figure 1. Cost-effectiveness acceptability curves (QALYs).
Results: Sensitivity Analyses

- Secondary outcomes:
  - Cost per additional claim closed.
  - Cost per additional day in recovery.

- Methods:
  - Approach for dealing with missing data.
    - Last observation carried forward,
    - Best case scenario,
    - Worse case scenario, and
    - Complete case analysis.
Limitations

• Potential health care use outside of the auto insurance system (OHIP) was not measured.
Conclusion

An evidence-based minimal care treatment and a rehabilitation programme designed to reduce administrative burden and costs are not cost-effective compared to the legislated standard of care for adults with acute grade I-II whiplash-associated disorder in Ontario.
Hypotheses, Future Research

- Interventions that are evidence-based and designed to be more efficient are not likely to be adequately tested or to be cost-effective in the real world, unless:
  - The legislative issues are also addressed,
  - Beliefs about acute whiplash treatments held by the general population and health care providers are updated to the current evidence, and
  - Potential provider-induced or lawyer-induced overtreatment is addressed.

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## Results: Mean Health Effect

### Table 2. Unadjusted quality-of-life weights (EQ-VAS scores) and QALYs

<table>
<thead>
<tr>
<th></th>
<th>PAF</th>
<th>Premiere</th>
<th>MD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean quality-of-life weights ± SD (n)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>0.71±0.15 (102)</td>
<td>0.69±0.17 (108)</td>
<td>0.67±0.20 (103)</td>
</tr>
<tr>
<td>6 weeks</td>
<td>0.76±0.17 (84)</td>
<td>0.74±0.18 (77)</td>
<td>0.71±0.19 (71)</td>
</tr>
<tr>
<td>3 months</td>
<td>0.78±0.15 (76)</td>
<td>0.76±0.16 (70)</td>
<td>0.75±0.16 (64)</td>
</tr>
<tr>
<td>6 months</td>
<td>0.78±0.20 (60)</td>
<td>0.74±0.18 (65)</td>
<td>0.75±0.19 (63)</td>
</tr>
<tr>
<td>9 months</td>
<td>0.76±0.18 (69)</td>
<td>0.80±0.13 (45)</td>
<td>0.78±0.15 (49)</td>
</tr>
<tr>
<td>12 months</td>
<td>0.81±0.18 (61)</td>
<td>0.77±0.17 (55)</td>
<td>0.76±0.16 (46)</td>
</tr>
<tr>
<td><strong>QALYs</strong>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (95% CI)</td>
<td>0.77(0.75; 0.80)</td>
<td>0.75 (0.73; 0.77)</td>
<td>0.75 (0.73; 0.77)</td>
</tr>
<tr>
<td>n</td>
<td>n=101</td>
<td>n=102</td>
<td>n=92</td>
</tr>
</tbody>
</table>

*Calculated after applying inverse probability weighting to account for censoring and using all observations with at least one follow-up

CI = Confidence intervals; QALY = quality-adjusted life year; SD = standard deviation

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1. Concepts and terms

The quality-adjusted life year (QALY) is a measure of effectiveness that:
- Includes morbidity and mortality,
- It is generally understood how much a payer is willing to pay for a unit of this health effect*.

*Willingness-to-pay (WTP) threshold or cost-effectiveness threshold
1. Concepts and terms

A quality-of-life weight is based on a patient preference score (e.g., EQ VAS, EQ-5D, SF-6D, Standard Gamble, etc.)

A preference score represents the desirability of a health outcome or state.
1. Concepts and terms

A quality-of-life weight is based on a patient preference score (e.g., EQ VAS, EQ-5D, SF-6D, Standard Gamble, etc.)

A preference score represents the desirability of a health outcome or state.
1. Concepts and terms

Willingness-to-pay (WTP) is:
- The amount a payer is willing to pay for an additional unit of health measure.
- *a.k.a.* cost-effectiveness threshold.
- The criterion / threshold by which cost-effectiveness is established.
2. Statistics

Incremental Cost-Effectiveness Ratio (ICER)

\[
\text{ICER} = \frac{\Delta C}{\Delta E}
\]

Where: \(\Delta C\) = incremental mean costs, and \(\Delta E\) = incremental mean effects.

ICERs represent the cost per additional health effect gained.

E.g., cost per additional QALY gained.
2. Statistics

Incremental Net Benefit (INB)

\[(\Delta E \times \lambda) - \Delta C\]

Where: \(\lambda\) = willingness-to-pay threshold.

INB computes the net benefit of a health technology in dollars, by valuing additional health effect (\(\Delta E\)) in dollars, then subtracting associated additional cost (\(\Delta C\)).

If \(INB > 0\), cost-effective
If \(INB < 0\), not cost-effective