Examining the relationship between theory-driven policies and allowed lost-time back claims in workers’ compensation: a system dynamics model

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Background and Significance

- Workers’ compensation costly, ↑ back claims

- Often studied with piecemeal approach

- Complex role of financial compensation
  - Poorer clinical prognosis
  - Financially-incentivized behaviour

Economic Theory in WC

Legend:
+ Positively related
- Inversely related

Worker’s compensation benefit payment
Incentive for worker to submit claim
Number of claims
Employer’s experience rating costs
Incentive for employer to contest claim

Need for system-wide view on policy impact

Hirsch et al 2010, Gunderson and Hyatt 2004
Specific Aims

1. To **develop a model** of the relationship between theory-driven policies and number of lost-time back claims in WSIB over 30-year timeframe.

*Hypothesis:* An economic theory-driven and policy-based model is sufficiently realistic to reproduce historical claims data.

2. To **determine robustness of model** to establish its utility/flexibility in evaluating proposed policy changes.

*Hypothesis:* Behavior of modeled data will be stable over extended time frame and at extremes of variable input.
Design Architecture

Retrospective, population-based, longitudinal validity study:

Number of Back Claims in Ontario

Policy Changes
**Methods**

**Modeling - System Dynamics (Vensim®):**

<table>
<thead>
<tr>
<th>Year</th>
<th>Policy</th>
</tr>
</thead>
</table>
| Prior to 1985 | Compensation payable - 75% gross  
Temporary benefits payable below MMR  
Experience rating not implemented <1984 |
| After 1985   | Compensation payable - 90% net  
Temporary benefits payable below MMR |
| After 1990   | Compensation payable - 90% net  
Temporary benefits may not be payable <MMR |
| After 1998   | Compensation payable - 85% net  
Temporary benefits reviewed/adjusted each yr |

Sterman 2000; WSIB 2008, 2010
Methods: Model Iteration

Model Conceptualization:
Economic Theory and Related Policies

Model Simulation:
Iterative Process with Historical Data, Expert Input

Statistical Analysis

Is model meaningful?

Sensitivity Analysis:
Model Robustness

Specific Aim 1

Specific Aim 2
Methods: Variables of Interest

- Policies - compensation benefit payments
- Policies - experience rating fees
- # of workers eligible to submit claims
- # of lost-time back claims

Exogenous:
- Policies - health practitioner fees
Outcome Measurement

Predicted number of lost-time back claims

Modeled vs Actual Data (Example)

Actual Data

Example of Modeled Data
Analysis

Aim 1: Is model meaningful?

<table>
<thead>
<tr>
<th>Model Iteration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of determination ($R^2$)</td>
</tr>
<tr>
<td>Theil’s inequality coefficients (U)</td>
</tr>
<tr>
<td>Root mean square error (RMSE)</td>
</tr>
</tbody>
</table>

Aim 2: Sensitivity Analysis

- Output at negative # or $\infty$?

Sterman 2000
Results

Input of policy changes improved RMSE by 13%
# Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Inequality Coefficient (U)</th>
<th>Coefficient of Determination (R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost-time Back Claims (before policy changes)</td>
<td>0.107</td>
<td>0.882</td>
</tr>
<tr>
<td>Lost-time Back Claims (after policy changes)</td>
<td>0.080</td>
<td>0.934</td>
</tr>
</tbody>
</table>

**Sensitive drivers of modeled data:**
Unemployment, multiple back injuries, no lost-time claims
Results of Sensitivity Analysis

Modeled Data at Extreme Variable Input and Timeframe

- Actual
- Model - Extended 100 Years
- Model - 10% Policy Input
- Model - 100% Policy Input
Discussion

• Policies were minor drivers of modeled data
  – Consistent with previous literature

• Sensitive drivers of modeled data:
  – Unemployment, multiple injuries, no lost-time claims

• Study limitations
  – Use of administrative data, model is “useful”

Loesler et al 1995; Brooker et al 1997; Ruseckaite et al 2011, Smith et al 2011, 2012; Box 1987
Summary

• Economic-based policies played minor role

• Other drivers influenced back claims in model

• Developed a robust model that is predictive of historical lost-time back claims

• Innovative model helps guide policy research
Acknowledgements

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Dr. Patrick Loisel
Questions?
Select References

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Methods: 2\textsuperscript{nd} Model Iteration

Is model meaningful?

- Conceptualization: 4 Key Informants, 2 Focus Groups
  - Qualitative Analysis: Themes $\rightarrow$ Variables
    - Model Simulation
      - Statistical Analysis
        - Sensitivity Analysis: Model Robustness
          - SPECIFIC AIM 2

Re-evaluate if NO

YES

YES