Title: Post-Op Home Monitoring after Joint Replacement (POHM): a retrospective outcome study comparing cases with matched historical controls

Short Title: Post-Op Home Monitoring (POHM)

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Abstract:

Background
An retrospective cohort study was conducted in patients undergoing postoperative home monitoring (POHM) following elective primary hip or knee replacements.

Objectives
The objectives were to compare cost per patient, readmissions rate, emergency room (ER) visits and mortality within 30-days to the historical standard of care using a descriptive analysis.

Method
After Research Ethics Board approval, patients who were enrolled and completed a POHM study were individually matched to historical controls by age, American Society of Anesthesiology (ASA) class, & procedure at a ratio 1:2.

Results
A total of 54 patients in the study group and 107 patients in the control were eligible for the analysis. Compared to the historical standard of care, the average cost per case was $5826.32 (SD 1418.89) in the POHM group and $9198.58 (SD 1513.59) for controls. At 30-days, there were 2 ER visits (3.7%), and 0 readmissions in the POHM group, compared to 8 ER visits (7.5%) and 2 readmissions (1.9%) in the control group. There were no mortalities in either group.

Conclusions
The POHM study offers an early hospital discharge pathway for elective hip and knee procedures at a lower cost (38% reduction of the standard of care cost). The multi-disciplinary
transitional POHM team may provide a reliable forum to minimize post-surgical 30-day readmissions and emergency room visits.

Introduction

Post-surgical emergency department (ED) visits and readmissions within 30 days after surgical discharge lead to significant increase in expenditures. In a retrospective database study of 152,783 patients undergoing major joint replacements, 8883 (5.81%) of patients returned to the ED within 30 days, more common than 30-day readmissions of 5229 (3.42%), and pain was the most frequent single diagnosis at 25.75%. Not uncommonly, patients return to a non-index hospital, which is not the hospital where surgery was performed originally. The costs in such cases are higher, as is the mortality. Data from CIHI show that 18.7% of post-surgical patients visited the ED within 30 days of discharge (based on Ontario, Alberta, & Yukon data). An innovative safe clinical pathway to provide a continuity of care or transitional care after surgical discharge would seem ideal both from the patient safety and cost containment perspectives. POHM pathway is feasible and provides the transitional care team to maintain direct communication with their patients after surgery. However, cost associated with this clinical pathway was not studied previously nor the rate of ED visits or readmissions postoperatively.

In this study, we hypothesize that the outcomes of POHM are comparable to historical controls and the costs are lower.
OBJECTIVES

To descriptively compare the rates of 30-day readmissions, ED visits, and total costs between POHM patients and historical controls.

METHODS

Approval from REB was obtained. Data from patients who completed the POHM study were collected and historical controls were selected, matched in 2:1 ratio to POHM cases by age in deciles, American Society of Anesthesiology (ASA) class, and procedure. Potentially matched controls between Jan 2010 and Dec 2012 were identified by Medical Records and the actual control charts were selected by RANDBETWEEN function in Microsoft Excel. Cost analysis was conducted by the hospital Finance Department as per the provincial protocols for case costing.

Outcomes were pre-defined and unchanged during the trial. Rates of post-operative 30-day mortality, readmissions, ED visits, and the total costs were compared between the groups.

Descriptive statistics (mean and standard deviation or frequency and percentage) were used to describe pre-operative and pre-discharge characteristics of participants. Cases and controls were compared using descriptive statistics.

RESULTS

A total of 54 POHM patients (April 17, 2014 and August 31, 2015) and 107 control patients (January 2010 and December 2012) were eligible for the study. Table 1 shows the demographic characteristics and outcomes for the two groups. For one of the cases, an ASA 1, only one control was found. There was no 30-day post-operative mortality in controls or in cases; the 30-day post-operative ED visits were 3.7% (2/54) and 7.5% (8/107) in the POHM group and controls.
respectively. There were two 30-day post-operative readmissions in the controls and none among the POHM cases. Table 2 shows the direct, indirect, and total costs between the cases and controls. Average total costs were $5826.32 (SD 1418.89) for cases and $9198.58 (SD 1513.59) for controls.

Table 1 Case-control demographics and 30-day outcomes, POHM Part 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>POHM (n = 54)</th>
<th>Controls (n = 107)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age - Mean (SD)</td>
<td>61.4 (8.3)</td>
<td>61.9 (8.5)</td>
</tr>
<tr>
<td>BMI - Mean (SD)</td>
<td>27.5 (4.0)</td>
<td>30.7 (6.2)</td>
</tr>
<tr>
<td>HBP</td>
<td>15 (27.8%)</td>
<td>38 (35.5%)</td>
</tr>
<tr>
<td>Type II DM</td>
<td>3 (5.6%)</td>
<td>12 (11.2%)</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>14 (25.9%)</td>
<td>28 (26.2%)</td>
</tr>
<tr>
<td>Pain &gt; 3 months requiring treatment</td>
<td>54 (100%)</td>
<td>96 (89.7%)</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>3 (5.8%)</td>
<td>10 (9.4%)</td>
</tr>
<tr>
<td>Anesthesia Type Spinal GA</td>
<td>50 (92.6%)</td>
<td>91 (85.0%)</td>
</tr>
<tr>
<td>GA</td>
<td>4 (7.4%)</td>
<td>16 (15.0%)</td>
</tr>
<tr>
<td>30-day ER Visit</td>
<td>2 (3.7%)</td>
<td>8 (7.5%)</td>
</tr>
<tr>
<td>30-day Readmissions</td>
<td>0</td>
<td>2 (1.9%)</td>
</tr>
<tr>
<td>30-day mortality</td>
<td>0</td>
<td>0</td>
</tr>
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Table 2 Indirect and Direct Costs in Cases and Controls, POHM Part 2

<table>
<thead>
<tr>
<th></th>
<th>POHM (n = 54) Mean (SD)</th>
<th>Controls (n = 107) Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDL – Variable direct labour</td>
<td>1277.79 (152.78)</td>
<td>2586.62 (601.84)</td>
</tr>
<tr>
<td>VDMGS – Variable Direct Material - General Supplies</td>
<td>563.22 (58.37)</td>
<td>637.26 (120.47)</td>
</tr>
<tr>
<td>VDO – Variable Direct Other</td>
<td>101.90 (26.88)</td>
<td>162.94 (44.19)</td>
</tr>
<tr>
<td>VDMPSS – Variable Direct Material - Patient-Specific Supplies</td>
<td>2373.63 (1368.88)</td>
<td>2724.86 (1170.15)</td>
</tr>
<tr>
<td>FDL – Fixed Direct Labour</td>
<td>192.44 (21.98)</td>
<td>372.46 (117.92)</td>
</tr>
<tr>
<td>FDO – Fixed Direct Other – Sundry</td>
<td>12.02 (0.94)</td>
<td>6.05 (16.95)</td>
</tr>
<tr>
<td>FDBEG – Fixed Direct Building, Equipment, and Grounds</td>
<td>450.05 (30.43)</td>
<td>247.61 (47.11)</td>
</tr>
<tr>
<td>VI – Variable Indirect</td>
<td>626.2 (57.86)</td>
<td>1764.3 (412.77)</td>
</tr>
<tr>
<td>FI – Fixed Indirect</td>
<td>229.07 (23.5)</td>
<td>696.48 (190.96)</td>
</tr>
<tr>
<td>Total cost</td>
<td>5826.32 (1418.89)</td>
<td>9198.58 (1513.59)</td>
</tr>
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DISCUSSION

Our study shows that the 30-day readmission or ED visit rates were no different, if not lower, between POHM and historical cohorts. The costs, on the other hand were lower.
Based on the current literature, for hip or knee replacements, one would expect 2 – 5% of post-operative complication or readmission rates. In other words, 95 – 98% of patients would be safe to be discharged when surgically ready. With the advances in surgical techniques, anesthetic management, and post-operative analgesia, we believe that earlier discharge after surgery is becoming more feasible and accepted. As the technology evolves, the POHM infrastructure will be able to capitalize on more sophisticated monitoring, including the rapidly evolving “wearables”. The POHM solution is not expected to change complication rates but with reliable wireless connectivity, real time interactions with patients are feasible. Such continuity of care would allow a clinician to determine when a patient could be managed at home, return to a non-index hospital, or return to the index hospital expeditiously, thereby making earlier post-surgical discharge safer with better patient satisfaction.

Post-operative follow-up phone calls have been implemented in many centers. However, little evidence exists that follow-up phone calls by themselves actually reduce post-discharge readmission rates or ED visits. Of the various measures that mitigate post-discharge readmissions, continuity of care by the physician who treated the patient prior to admission is the most important factor in reducing readmissions. The model of care in our study supported the patient after discharge with a multi-disciplinary team, including the surgeon who had operated on the patient. We believe that the model of care is a crucial element in supporting the patient after discharge.
The result of the study was reviewed by the hospital as an important finding and led our hospital to partner with the Ontario TeleHealth Network (OTN). The cost associated with POHM technology (hardware and software) is expected to drop further in the future. Additionally, the ability to scale up as well as to maintain updates, maintain patient privacy, confidential data repository, to add other devices onto the system, as well as the ability to negotiate pricing by bulk has increased the ease of application of POHM.

There are limitations to the current study. Retrospective historical data were used as controls but conducting a concurrent controlled study was not feasible. The sample size being small, we could not draw statistical significance of differences in 30-day ED visits or readmissions although a trend of higher rates in the control group was seen. There is a potential of missing the 30-day returns in the control group if a patient did not return to our hospital or was readmitted at another hospital. Nevertheless, the trend being already higher in the control group would suggest that if there were a bias, it would have been an under-documenting of the 30-day mortality, readmissions, or ED visits in the control group. In addition, the cost tracking over the two periods in the chart audit was based on the same provincial methodology and, with a relatively stable inflation rate, we believe the true cost differences are reflected in our comparisons. The physician costs both in terms of consults, both in patients with longer LOS and in patients with 30-day ED visits or readmissions were not tracked. As alluded to earlier, 30-day ED visits or readmissions in the control group to non-index hospitals were not tracked and their costs therefore are not included. Nevertheless, the bias would have been in favour of the control group.
We believe POHM is a new paradigm of post-acute care model for surgical recovery, providing better surgical access by further reducing length of stay; reducing 30-day emergency department visits by providing continuity of care and addressing patient concerns; and reducing 30-day readmission rates by stratifying post-discharge management at home, at a non-index hospital, or return to the index hospital.

Conflict of Interest
None

Acknowledgements
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