Improving Asthma Management in Primary Care Using Computerized Monitoring and Decision-Support

A Cluster Randomized Trial of Computerized Decision-Support and Asthma Home Management
CIHR Grant# MCT-67814
Trial Registration #: NCT00170248
Asthma Exacerbation in Canada

Health Care Cost due to Uncontrolled Asthma in 2004

- Total: $162 Million
- Hospitalization: $102 Million
- Unscheduled Visits: $33 Million
- ER Visits: $19 Million

(Seung SJ, Canadian Respiratory Journal 2005)

(Canadian Community Survey, 2005)
Canadian Clinical Guidelines for Asthma
(Boulet et al., CMAJ, 1999)

- Critical factors to achieve optimal management:
  1. Use of Preventive Therapy
  2. Written Action Plan and Effective Self-Monitoring
## Systematic Review of Computerized Decision-Support in Improving Quality of Care and Patient Outcomes

Garg et.al. JAMA, March 9, 2005

<table>
<thead>
<tr>
<th>Improvement in Quality of Care</th>
<th>Number of Trials</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic Decision-Making</td>
<td>10</td>
<td>40%</td>
</tr>
<tr>
<td>Patient Care Reminder Systems</td>
<td>21</td>
<td>76%</td>
</tr>
<tr>
<td>Disease Management Decision-Support</td>
<td>37</td>
<td>62%</td>
</tr>
<tr>
<td>Drug Dosing</td>
<td>29</td>
<td>66%</td>
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</table>

<table>
<thead>
<tr>
<th>Improvement in Patient Outcomes</th>
<th>Number of Trials</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>All systems</td>
<td>52</td>
<td>13%</td>
</tr>
<tr>
<td>Year (Author)</td>
<td>Intervention</td>
<td>Result</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2002 Eccles</td>
<td>Guideline-based treatment recommendations based on information for EMR on</td>
<td>Almost no access of decision-support. No change in consult rates, treatment indicators, quality</td>
</tr>
<tr>
<td>(UK)</td>
<td>control status for 60 clinics and 2,230 asthma patients</td>
<td>of life.</td>
</tr>
<tr>
<td>2005 Tierney</td>
<td>Guideline-based care suggestions at the time of computerized order-entry for</td>
<td>No difference in guideline adherence, patient satisfaction, quality of life, medication adherence,</td>
</tr>
<tr>
<td>(USA)</td>
<td>706 asthma outpatients to 246 physicians, pharmacists, both vs. controls</td>
<td>ER visits/hospitalizations</td>
</tr>
<tr>
<td>2008 Taylor</td>
<td>Guideline-based decision-support at the time of computerized order-entry in</td>
<td>Improved asthma documentation with decision-support. No outcome measures.</td>
</tr>
<tr>
<td></td>
<td>the ED for 50 physicians in 50 encounters</td>
<td></td>
</tr>
</tbody>
</table>
Can Computer-Assisted Disease Management Target Key Barriers in Improving Asthma Management

Cabana et al., JAMA

**Patient Challenges in Optimal Management**
- Lack of knowledge about therapy and prevention
- Not receiving prescriptions for appropriate therapy
- Not picking-up prescription
- Delay in detection of deterioration and early treatment
- Lack of communication with physician
- Lack of action plan

**Key Critical Factors to Achieve Optimal Management**
- Asthma Maintenance Therapy
- Regular Disease Management And Self-monitoring

**Physician Challenges in Optimal Management**
- **Knowledge:**
  - Lack of awareness of existing guideline
- **Attitudes:**
  - Lack of motivation to modify office routine
  - Lack of conviction to produce desired patient outcome
- **Environmental:**
  - Lack of time
  - Lack of resources
  - Lack of organizational infrastructure
  - Complexity of guideline use
Purpose
To reduce the rate of asthma exacerbations by improving the quality of asthma management in primary care

Objective
To determine if computerized support for asthma management with:
   1) surveillance,
   2) decision-support,
   3) home monitoring
would reduce the rate of asthma exacerbations, and whether the intervention effect was modified by control status
Methods

Design:
• Cluster randomized trial with 6 to 36 months of follow-up

Population:
• Primary care physicians in fee-for-service private practice
• Asthma patients: > 5 years old (no diagnosis of COPD)

Outcome:
• Rate of out-of-control asthma episodes (ER visit for asthma and/or > 500 doses of fast-acting beta-agonist in 6 months)

Analysis:
• GEE Poisson regression, physician=cluster, patient=unit of analysis
### Basic MOXXI Primary Care Information System

**Drug Profile - 10 Drug(s)**

<table>
<thead>
<tr>
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<tr>
<td><strong>TAMOXIFEN 2MG</strong></td>
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<tr>
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<tr>
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<tr>
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<tr>
<td><strong>TAMOXIFEN 0.0025MG</strong></td>
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</tbody>
</table>

**Patient $ | RAMQ $:** 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 12 / 26 | 0 / 0 | 0 / 0 |

**New Prescription**

**Add New Drug:**

<table>
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<tr>
<th>Drug</th>
<th>Posology</th>
<th>Quantity/Duration</th>
<th>Indication(s)</th>
<th>Stop/Change Reason</th>
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<tbody>
<tr>
<td><strong>GABAPENTIN</strong></td>
<td>CAPSULE</td>
<td>30 Day(s)</td>
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<tr>
<td><strong>100MG CAPSULE</strong></td>
<td></td>
<td>6 Refills</td>
<td></td>
<td></td>
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<tr>
<td><strong>Sample:</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Note:</strong></td>
<td></td>
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</tr>
</tbody>
</table>

**Health Conditions (10):**

- Type 2 diabetes mellitus: 2009
- Hyperlipidemia, unspecified: 2009
- Phobic anxiety disorders: 2009
- Nonorganic insomnia: 2009
- Essential (primary) hypertension: 2009
- Heart failure: 2009
- Asthma: 2009
- Constipation: 2009
- Rheumatoid arthritis, unspecified: 2009
- Cough: 2009

**Life Events (0):**

**Other (0):**
The Intervention: 1) Daily Surveillance of ER Visits and Rescue Medication to Assess Asthma Control

Analysis of Daily Downloads of Information from the Provincial Insurance Billing Data
The Intervention: 2) Computerized Decision Support for Evidence-Based Asthma Management

1. Please validate drugs and posologies
   - TheSINOL HFA 100/MCG
   - FLOVENT DISKUS 100/MCG

2. Respiratory-related ER Visits & Faba Medication Usage
   - Respiratory-related ER visit in the past 3 months: 1 visit(s)
   - Dispensed FABA medications in the past 3 months: dose >= 250

3. In the last week, the patient has:
   - Trouble breathing on 4 or more days
   - Use of rescue inhaler 4 or more times
   - Awakened due to asthma
   - Unable to carry out usual activities
   - Missed school or work because of asthma
   - Had an urgent medical visit for asthma

4. Update

5. Select Recommendation
   - ADD LABA SEREVENT DISKUS 50 1 INH BID.
   - STOP FLOVENT DISKUS & START ADVAIR DISKUS 100 1 INH BID.
   - INCREASE FLOVENT DISKUS DOSE & CHANGE STRENGTH TO 250 1 INH BID.
   - ADD LTN SINGULAR 10MG PO QD.
   - Determining Drug: (FLOVENT DISKUS 100/MCG 1 INH BID)

6. Prescribe Fast Acting B Agonist (FABA) if needed
   - SALBUTAMOL MDI 100 1-2 INH AS NEEDED
   - TERBUTALINE 500 1 INH AS NEEDED

7. Apply Changes
   - Proceed with Changes
   - Proceed with Changes And Print
The Intervention: 3) Home Monitoring of Asthma by Specialized Nurses - Technology Enabled Referrals

MOXXI Systems

Asthma Home Monitoring

Monitor asthma control, assist in use of action plan, feedback to physician
<table>
<thead>
<tr>
<th>#</th>
<th>NAM</th>
<th>First Name</th>
<th>Last Name</th>
<th>Enrollment Date</th>
<th>Scheduled</th>
<th>Last Contacted</th>
<th>Monitoring Call</th>
<th>Control</th>
<th>Status</th>
<th>Last Call</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>March 8th, 2007</td>
<td></td>
<td></td>
<td>New</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>March 20th, 2007</td>
<td></td>
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<td>New</td>
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<td>November 21st, 2006</td>
<td>March 28th, 2007</td>
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<tr>
<td>4</td>
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<td>April 18th, 2007</td>
<td>March 21st, 2007</td>
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<td>5</td>
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<td></td>
<td></td>
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<td>April 30th, 2007</td>
<td>April 2nd, 2007</td>
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<td>6</td>
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<td></td>
<td>March 1st, 2007</td>
<td>April 30th, 2007</td>
<td>April 16th, 2007</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
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<td>January 29th, 2007</td>
<td>May 1st, 2007</td>
<td>April 24th, 2007</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
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<td>8</td>
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<td></td>
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<td>April 18th, 2007</td>
<td>May 3rd, 2007</td>
<td>April 26th, 2007</td>
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<tr>
<td>9</td>
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<td></td>
<td>March 6th, 2007</td>
<td>May 9th, 2007</td>
<td>April 11th, 2007</td>
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<td>11</td>
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<td>October 3rd, 2006</td>
<td>May 16th, 2007</td>
<td>April 12th, 2007</td>
<td>Ongoing</td>
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</table>
# Asthma Home Care System

Receive and Send Information to the Referring Physician

<table>
<thead>
<tr>
<th>Menu</th>
</tr>
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<tbody>
<tr>
<td>Patients to call</td>
</tr>
<tr>
<td>Help</td>
</tr>
<tr>
<td>Contact Us</td>
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</tbody>
</table>

## Patient Detail Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone 1</th>
<th>Preferred Time to Call</th>
</tr>
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<tbody>
<tr>
<td>ABCD2006060605</td>
<td>(450) 999-9999</td>
<td>9 AM</td>
</tr>
<tr>
<td>Doe</td>
<td>(450) 666-9999</td>
<td>Control Status</td>
</tr>
<tr>
<td>John</td>
<td>(450) 777-9999</td>
<td></td>
</tr>
</tbody>
</table>

## Allergy List
- HISTAMINE

## Problems List
- ASTHMA
- ASTHMA, EXERCISE INDUCED

## ER Visit & Faba Use
- Respiratory Related ER Visits: (1)
  - March 30th, 2006
    - Exercise induced asthma attack
- Fast Acting Beta2 Agonist Dose < 250
- Dispensed Fast Acting Beta2 Agonist

## Symptoms Check List History
- April 10th, 2006
  - Awakened due to asthma
- Had trouble breathing on 4 or more days
- Unable to carry out usual activities
- March 28th, 2006
  - Unable to carry out usual activities
Facilitating Two-Way Communication between Nurse Care Manager and Primary Care Physician
Results
Population Enrollment and Follow-up

81 primary care physicians
4,447 asthma patients

Randomized

Intervention Group
40 physicians
2,273 patients

Control Group
41 physicians
2,174 patients

De-consented MDs=5 (99 patients)

De-consented MDs=3 (67 patients)

Analyzed
### Physician Characteristics

<table>
<thead>
<tr>
<th>Physician Characteristics</th>
<th>Control</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N(%)</td>
</tr>
<tr>
<td>Female</td>
<td>19 (46.3%)</td>
<td>17 (42.5%)</td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 14 years</td>
<td>4 (9.8%)</td>
<td>4 (10.0%)</td>
</tr>
<tr>
<td>15-24 years</td>
<td>11 (26.8%)</td>
<td>12 (30.0%)</td>
</tr>
<tr>
<td>25-34 years</td>
<td>22 (53.7%)</td>
<td>17 (42.5%)</td>
</tr>
<tr>
<td>&gt; 34 years</td>
<td>4 (9.8%)</td>
<td>7 (17.5%)</td>
</tr>
<tr>
<td>Practice size</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td></td>
<td>1,318 (721)</td>
<td>1,485 (734)</td>
</tr>
<tr>
<td>Number patients/day</td>
<td>18 (6.8)</td>
<td>19 (7.1)</td>
</tr>
<tr>
<td>Number practice settings</td>
<td>1.9 (1.1)</td>
<td>1.9 (1.4)</td>
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</tbody>
</table>
### Patient Characteristics

<table>
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<th>Patient Characteristics</th>
<th>Control</th>
<th>Intervention</th>
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<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1,457 (67.0%)</td>
<td>1,542 (67.8%)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-18 years</td>
<td>59 (2.7%)</td>
<td>124 (5.5%)</td>
</tr>
<tr>
<td>19-60 years</td>
<td>1,152 (53.2%)</td>
<td>1,197 (52.7%)</td>
</tr>
<tr>
<td>&gt; 60 years</td>
<td>963 (44.3%)</td>
<td>952 (41.9%)</td>
</tr>
<tr>
<td><strong>Out-Of-Control at 1st Visit</strong></td>
<td>280 (12.9%)</td>
<td>222 (9.8%)</td>
</tr>
<tr>
<td><strong>Baseline</strong> (12 mos pre-1st visit)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number Visits</td>
<td>10.3 (11.3)</td>
<td>9.7 (9.3)</td>
</tr>
<tr>
<td>% visits to Study MD</td>
<td>57.2 (29.8)</td>
<td>55.4 (29.2)</td>
</tr>
<tr>
<td>Number visits respirologist</td>
<td>1.4 (4.7)</td>
<td>1.3 (4.9)</td>
</tr>
</tbody>
</table>
Response to Alerts in the Intervention Group

2,172 asthma patients
17,378 visits in the follow-up period

Out-of-Control
2,006 visits (11.5%)

Accessed Decision-Support
797 visits (39.7%)
- Accepted 95 visits 14.6%
- Not Accepted 556 visits 85.4%
- No Decision-Support 146 visits

In-Control
15,372 visits (88.5%)

No Access
1209 visits (60.3%)

No Access
14,664 visits (95.4%)

Accessed Decision-Support
708 visits (4.6%)
- Accepted 71 visits 11.1%
- Not Accepted 566 visits 88.9%
- No Decision-Support 71 visits

Referred to Asthma Home Care
54 patients

No Access
14,664 visits (95.4%)
- Accepted 95 visits 14.6%
- Not Accepted 556 visits 85.4%
- No Decision-Support 146 visits

Referred to Asthma Home Care
10 patients
Increased Use of Preventive Therapy

Relative Increase in Inhaled Corticosteroids/ Rescue Medication Use: 1.11 (95% CI: 1.0, 1.23)
Rate of Out-of-Control Asthma Episodes in the Intervention and Control Group

Out-of-Control at First Visit: 704 (15.8%)

In-control at First Visit: 3,743 (84.2%)

Exacerbation Rate

- **Control**: RR: 0.87
  - 95% CI: 0.77, 0.99
- **Intervention**: RR: 1.00
  - 95% CI: 0.74, 1.36

Exacerbation Rate / 100/year
Summary and Discussion
The majority of asthma patients in primary care are in good control; however, the 15.8% were out-of-control at the first visit continued to experience high rates of exacerbations.

Physicians responded to recommended changes in treatment for 1 in 5-6 patients who were out-of-control, and in 1 in 10 for in-control patients.

There was a significant increase in inhaled steroids relative to rescue medication in the intervention group.

There was a significant reduction in asthma exacerbations for patients of physicians in the intervention group but ONLY for patients who were out-of-control at the first visit.
Other studies of health information technologies have shown that those that improve outcomes target high risk populations.


- High Risk Groups + Targeted Interventions
  - Anticoagulants
  - ICU infections
  - DVT
  - Adverse drug events

- Diffuse untargeted interventions and generic outcomes

- High Risk Group - disruptive intervention - delayed treatment
Health information technologies can enable better and more timely care but to need to be coupled with incentives to achieve optimal patient outcomes.

Maximum benefit will be achieved by targeting highest risk patients; this can be enabled through system analytics of patient data.

Future studies should focus on how integrated information systems can be used to provide earlier and more timely identification and intervention for patients experiencing deterioration in their health/disease status.