Establishing an Opioid Prescription Stewardship Program Utilizing Education and Machine Learning

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From Left to Right: Ashley Rimay, PharmD, BCPS; Louis Palmisano, BIT; Christine Collins, RPh, MBA

Introduction
Healthcare Facilities
- 1,165 licensed bed health system
- Over 3,200 affiliated physicians, over 900 residents and fellows
- 4 inpatient hospitals including: Level I trauma hospital for adults and pediatric patients Rhode Island Hospital (RIH), The Miriam Hospital (TMH), Bradley Hospital (BH), Newport Hospital (NPH)
- Outpatient provider offices, ambulatory services and behavioral health residential locations
- Primary teaching hospitals for the Warren Alpert Medical School of Brown University

Background
- Between 1999 and 2016: 350,000 opioid overdose deaths in the US alone, with a 200% increase in death rates since 2000
- Provider diversion and a lack of accountability with controlled substances has led to multimillion dollar fines for health systems
- Over 1.5 million electronic prescriptions are written annually from our health system, including over 360,000 controlled substances scheduled 2 through 4, making the task of monitoring outpatient prescribing patterns a major challenge.

Purpose
Develop a controlled substance prescriptions stewardship program to monitor vast amounts of electronic health record data to detect potential diversion and over-utilization of opioids
Utilize machine learning to identify outlying prescribers
Audit prescribers on outlying prescriptions
Educate providers on controlled substance laws and guidelines
Improve prescribing practices based on metrics of decreased Morphine Equivalent Daily Doses (MEDD), benzodiazepine co-prescribing and naloxone co-prescribing.

Description of the Program
Assembling the team: hospital and pharmacy leadership representing both inpatient and outpatient pharmacy, a pharmacy data scientist, a controlled substance pharmacist (CSP), a pharmacist informatics coordinator, a senior clinical pharmacist specialist, and physician chief medical officer (CMO)
Creating a model:
- A supervised XgBoost classification model was trained
- Results were grouped by provider to visualize the entire organization for quick identification of uncommon prescribing practices
- Information about the encounter is stored in a data warehouse along with the model’s prediction
- A web-based dashboard is refreshed daily as a scatterplot that aggregates patient-level predictions by provider. The scatterplot presents total prescriptions along the y axis and total predicted prescriptions along the x axis.

Implementing the auditing process:
- Monitoring the dashboard for outlying prescribers
- Selecting 15 random prescriptions that were not predicted to be written by our model
- Assessing for compliance to controlled substance laws
- Communicating results to appropriate physician leadership
- Physician peer clinical evaluation and follow-up audits

Provider education includes:
1) Background on national incidences related to opioid prescribing
2) Implications of diversion for organizations and physicians
3) Data from the Rhode Island (RI) Medical Board on license reprimands related to opioid prescribing
4) RI Controlled Substance Law on prescribing acute vs. chronic pain
5) Proper electronic prescribing in the electronic medical record

Results
- Results were grouped by provider to visualize the entire organization for quick identification of uncommon prescribing practices
- Information about the encounter is stored in a data warehouse along with the model’s prediction
- A web-based dashboard is refreshed daily as a scatterplot that aggregates patient-level predictions by provider. The scatterplot presents total prescriptions along the y axis and total predicted prescriptions along the x axis.

Experience with the Program

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Conclusion
- The implementation of a CS prescription stewardship program based on education and machine learning was effective at reducing inappropriate opioid prescribing in a large academic health system, based on metrics of decreased MEDD, increased naloxone and opioid co-prescribing.
- Health systems should foster collaboration between pharmacists, data scientists, physicians and leadership to develop a controlled substance prescription stewardship program.

References

Acknowledgements
Andrew Zullo, PharmD, PhD Clinical Pharmacist Specialist in Healthcare Analytics, Lifespan; Assistant Professor of Health Services, Policy and Practice and Epidemiology, Brown University School of Public Health

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% Improvement in Key Prescribing Metrics

Department
- % decrease in MEDD per provider per encounter
- % increase in naloxone co-prescribing post intervention
- % decrease in benzodiazepine co-prescribing post intervention

Table
<table>
<thead>
<tr>
<th>Metric</th>
<th>Departments Educated</th>
<th>Departments Not Yet Educated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average change in MEDD per encounter</td>
<td>-14.4%</td>
<td>+0.39%</td>
</tr>
<tr>
<td>Average change in benzodiazepine co-prescriptions</td>
<td>-9.7%</td>
<td>-4.35%</td>
</tr>
<tr>
<td>Average change in naloxone co-prescriptions</td>
<td>+15.7%</td>
<td>+5.07%</td>
</tr>
</tbody>
</table>

Graph
- % Improvement in Key Prescribing Metrics

Graph Description
- % decrease in MEDD per provider per encounter
- % increase in naloxone co-prescribing post intervention
- % decrease in benzodiazepine co-prescribing post intervention

Acknowledgements
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