A Case Study of Real World Data in Health Economics and Outcomes Research

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June 25, 2014
Overview

• Introduction

• Selected EHR Studies

• Key Lessons
BHE Overview

• Independent, full-service research organization
• Specializing in data analytic solutions and custom research
• Interdisciplinary staff
• Customer-focused
• Proven track record over the past 18 years
• Substantial experience with novel data sources, including EMR
What Does Emergence of EMR Data Mean for HEOR?

• Richer information than claims data alone

• EMR data have similar, but also different challenges

• Possibilities to collaborate with provider groups, IDNs, and ACOs
Richer Data

• Clinical details
• Treatments provided
• Populations served
Clinical Details

- Labs PLUS physiologic measures
  - Blood pressure, BMI, smoking, mortality in most systems

- Notes available in all systems, but not always readily-accessible (may need manual review)
  - Identify poorly-coded conditions
  - Document disease severity
Treatments Provided

• By day in hospital (sometimes hour : minute)

• Bridging between inpatient and outpatient care

• In various care units (ER, CCU, others)
Populations

• Insured and non-insured

• Additional sociodemographics (possibly)
EMR has Similar Challenges to Claims Data

• Heavy reliance on ICD-9 coding

• Not all medical encounters are captured

• Lack of standardized data

• Can be expensive to access

• Potentially large (big) data
But Perhaps More Challenging to Address...

- Leakage (don’t know what you don’t know)
  - Patients not typically enrolled in a network

- Unpopulated/underpopulated/non-structured fields make things big and messy

- Somewhat new ("emerging" source...)

Case Study 1: INR and Mortality

Failure to correct International Normalized Ratio and mortality among patients with warfarin-related major bleeding: an analysis of electronic health records


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Summary. Background: Delayed correction of blood clotting times as measured by the International Normalized Ratio (INR) is associated with adverse outcomes among certain patients with warfarin-related major bleeding. However, there are limited data on the association between INR correction and mortality. Objective: To assess factors associated with 30-day mortality and time to death in patients receiving fresh frozen plasma (FFP) for warfarin-associated major bleeding. Methods: A retrospective database analysis was undertaken with electronic health record data from a large integrated health system. Patients met the following criteria: major hemorrhage diagnosis; INR ≥ 2 on the day before or day of receipt of FFP; and prescription fill for warfarin within 90 days. INR correction (defined as INR ≤ 1.3) was evaluated at the last available test 1 day following the start of FFP administration. Kaplan–Meier curves and Cox proportional hazards models were used to identify factors associated with mortality.

Keywords: Emergency medicine, fresh frozen plasma, hemorrhage, International Normalized Ratio (INR), mortality, warfarin.

Introduction

Warfarin, a widely used anticoagulant, is used primarily for the treatment and prevention of thromboembolic complications associated with vascular conditions (e.g. atrial fibrillation) and events (e.g. myocardial infarction). In recent years, generic warfarin and branded Coumadin use in the USA has steadily increased from approximately 21.1 million outpatient prescriptions in 1998 to approximately 30.6 million prescriptions in 2004 [1]. However, warfarin use is often associated with a high incidence of adverse events, ranking ninth on the US Food and Drug Administration’s Adverse Event Reporting System list of prescription drugs with serious outcomes [1]. The most

Highlights: Study Case 1

• Data from regional, integrated network used to explore relation between reversal of INR and outcomes for patients with anticoagulation-related bleeding

• About 400 cases were identified, one-third of whom had their INR corrected (<1.3) within 2 days

• ICH patients without early reversal had significantly higher 30-day mortality

• Relatively small sample size, limited data on bleed severity

• Lessons: Complex data to work with, allow proper schedule/budget
Patient Selection: Case Study 1

Patients receiving FFP at any time during the period January 2004 to January 2010 N = 6215

Presence of a major hemorrhage diagnosis during the episode surrounding FFP administration (defined as 1 day prior to FFP administration to 1 day following FFP administration) N = 1374

≥1 elevated INR result (defined as an INR ≥ 2) where the result was available 1 day prior to or on the day of receipt of FFP, with at least 1 additional INR result available on the day of receiving FFP or the day after N = 672

≥1 medication order containing warfarin with the order day prior to or on the first day of the episode, and the discontinuation day sooner than 7 days prior to the start of the episode N = 414

Patients surviving for at least 48 h surrounding FFP administration N = 405

Fig. 1. Patient selection flowchart. FFP, fresh frozen plasma; INR, International Normalized Ratio.
Findings: Case Study 1

A

Log rank $P = 0.167$

B

Log rank $P = 0.039$

C

Log rank $P = 0.327$

Case Study 2: PAD Re-Intervention

 Failure of Surgical and Endovascular Infrapinguinal and Iliac Procedures in the Management of Peripheral Arterial Disease Using Data from Electronic Medical Records

Matthew Sussman, MA, Rajiv Mallick, PhD, Mark Friedman, MD, Victoria Federico, BA, Leon Josephs, MD, Paul Vaitkus, MD, and Joseph Menzin, PhD

ABSTRACT

Purpose: To understand rates of procedure failure among patients undergoing revascularization for peripheral arterial disease (PAD) in clinical practice.

Materials and Methods: This retrospective analysis of patients with PAD who underwent a PAD-related procedure used claims and electronic medical record data from 2005 to 2009. Procedures were grouped by type (endovascular [ie, angioplasty with/without stent, atherecomy] or surgical [ie, bypass surgery, endarterectomy, thrombectomy]) and site (ie, iliac, infrapinguinal). The study assessed antiplatelet and anticoagulant agent use; procedure failure, defined as a subsequent procedure or amputation; and predictors of time to procedure failure.

Results: A sample of 248 patients with PAD who underwent a PAD-related procedure was identified. The population was 59% male, had a mean age of 73 years, and had a mean follow-up of 23 months. Endovascular procedures alone were performed in 37% of patients, with the remainder receiving surgery only or surgery with an endovascular procedure, and 79% of patients had an infrapinguinal intervention. Antiplatelet and anticoagulant use rates after the procedure were 90% and 25%, respectively. After their initial procedure, 20% of patients required a second procedure or amputation, with an average failure time of 228 days. Patients treated with infrainguinal procedures had a significantly higher failure rate versus those treated with iliac procedures (23% vs 8%; P = .011). In multivariate analysis, patients without anticoagulant use before the procedure were at significantly lower failure risk (P = .022).

Conclusions: Repeated intervention and/or major amputation after revascularization of PAD was common. Further investigation of the factors associated with procedure failure is warranted.
Study Highlights

• Data (claims, manual review of EMR) from regional, integrated network used to explore factors associated with re-intervention for treatment of PAD

• About 250 cases were identified, 20% of whom had a second PAD-related procedure on the same lower limb or had amputation over 2 years

• Few factors were predictive of procedure failure for PAD

• Relatively small sample size, potential confounding

• Lessons: Interesting to compare claims and EMR encounters for consistency; need EMR data for “sided-ness”
Findings: Case Study 2

Figure 2. Kaplan–Meier survival analysis: time to any failure iliac index procedure vs. infrainguinal index procedure.
### Findings: Case Study 2 (continued)

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Hazard Ratio</th>
<th>95% Confidence Limits</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (vs &lt; 70 y)</td>
<td>1.024</td>
<td>0.494–2.123</td>
<td>.949</td>
</tr>
<tr>
<td>Age 70–79 y</td>
<td>1.821</td>
<td>0.792–4.189</td>
<td>.158</td>
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<tr>
<td>Age ≥ 80 y</td>
<td>1.597</td>
<td>0.855–2.983</td>
<td>.142</td>
</tr>
<tr>
<td>Male sex (vs female)</td>
<td>0.699</td>
<td>0.272–1.795</td>
<td>.457</td>
</tr>
<tr>
<td>History of stroke</td>
<td>0.729</td>
<td>0.376–1.413</td>
<td>.349</td>
</tr>
<tr>
<td>History of atrial fibrillation, MI, or CHF</td>
<td>1.166</td>
<td>0.631–2.152</td>
<td>.624</td>
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<td>Diabetes</td>
<td>0.804</td>
<td>0.383–1.690</td>
<td>.565</td>
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<td>Current smoker</td>
<td>1.032</td>
<td>0.534–1.994</td>
<td>.926</td>
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<tr>
<td>Endovascular index procedure (vs surgical)</td>
<td>3.017</td>
<td>0.984–9.251</td>
<td>.053</td>
</tr>
<tr>
<td>Infrainguinal index procedure (vs iliac)</td>
<td>1.538</td>
<td>0.824–2.870</td>
<td>.177</td>
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<tr>
<td>No baseline antiplatelet use (vs baseline use)</td>
<td>0.401</td>
<td>0.183–0.878</td>
<td>.022*</td>
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<tr>
<td>No baseline anticoagulant use (vs baseline use)</td>
<td></td>
<td></td>
<td>.024*</td>
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<tr>
<td>Overall model</td>
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</tbody>
</table>

Data source: Fallon Community Health Plan and Reliant Medical Group, Worcester, MA. CHF = congestive heart failure, MI = myocardial infarction.
* Significant at P < .05.
Key Lessons

• Knowing when EMR data add value

• Understanding differences among data sources—claims are pretty uniform, not EMR

• Takes time to learn how to use EMR data

• Need more published examples on methods and results
REVIEW ARTICLE

A review of uses of health care utilization databases for epidemiologic research on therapeutics

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Accepted 16 October 2004

Abstract

Objective: Large health care utilization databases are frequently used in variety of settings to study the use and outcomes of therapeutics. Their size allows the study of infrequent events, their representativeness of routine clinical care makes it possible to study real-world effectiveness and utilization patterns, and their availability at relatively low cost without long delays makes them accessible to many researchers. However, concerns about database studies include data validity, lack of detailed clinical information, and a limited ability to control confounding.

Study Design and Setting: We consider the strengths, limitations, and appropriate applications of health care utilization databases in epidemiology and health services research, with particular reference to the study of medications.

Conclusion: Progress has been made on many methodologic issues related to the use of health care utilization databases in recent years, but important areas persist and merit scrutiny. © 2005 Elsevier Inc. All rights reserved.

Keywords: Utilization databases; Claims data; Therapeutics; Pharmaco-epidemiology; Confounding (epidemiology); Adverse drug reactions; Drug utilization
The Big Data Problem Facing Pharma

Data
• Multiple providers of data with varying degrees of quality
• Varied and proprietary data models and formats

Technology
• Costly and time consuming to set up and maintain in-house IT
• Inability to rapidly scale to meet growing data processing needs
• Slow to adopt innovative technologies

Expertise
• Strained internal capacity and budgets
• Industry-wide shortage of skilled resources
• Reliance on outside experts
"Is this a good time to tell you I don't know what 'big data' means?"
Challenges in executing database studies

• Finding appropriate resources
• Acquiring data in a timely fashion
• Long feedback loop
• Ever-changing priorities
• Scope creep
• Slow contracting processes
Opportunities for HEOR groups

• Gain experience with latest (big) data sources

• Engage with IDNs and ACOs on comparative effectiveness and risk-based contracting

• Others?
Conclusions

• EMR data can add value when applied to the right questions

• EMR data availability presents significant opportunities for learning

• However, more research is needed to help us understand the reliability and validity of EMR data