Session 043 PD - Recent SOA Health Research Projects

**Moderator:**
Steven C. Siegel, ASA, MAAA

**Presenters:**
Robert D. Lieberthal
Adam Ryan Singleton, FSA, MAAA
SOA Health Research Projects – A Brief Overview

STEVEN SIEGEL
Research Actuary
Society of Actuaries

Society of Actuaries Annual Meeting
October 16, 2017
Two Approaches: Sponsored Practice Research and Direct In-house Research
Sponsored Practice Research

Projects recently completed

• Calculating Margins for Rate Setting in Medicaid Managed Care Organizations
• Risk Adjustment Tool Comparison
• Annual Update to Long Term Healthcare Cost Trends Models
• Massachusetts Health Insurance Reform
• Risk Scoring in Health Insurance: A Primer
Direct In-house Health Research Projects

• Opioid Overdose Deaths In the United States
• Affordable Care Act: Competition and Premiums
• An Examination of Risk in the ACA Small Group Market
• Reported Fraud Recoveries US Commercial Health Market
• Excess health costs associated with Heat Events
• Large Claims and Claimants Models
• Provider Attribution
• Profiling Opioid Prescription Patterns in Medicare Data
Health Section Research – Get involved!

Send us an idea
Read our reports and listen to our podcasts
Participate on a project oversight group (POG)
Respond to an RFP
Serve on the Health Section Research Committee
Sponsored Practice Research

Two projects underway for today’s session
  • Provider Networks in the Exchanges (aka High Performance Networks)
  • Healthcare Fraud

Opportunity to provide feedback for the final reports coming out later this year
Contact information at the SOA

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  ssiegel@soa.org

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  rowen@soa.org
Examining Predictive Modeling Based Approaches to Characterizing Healthcare Fraud

Robert Lieberthal, PhD
Presentation for the SOA Annual Meeting
October 16, 2017
Acknowledgements and disclosures

Jing Ai, PhD and Skyla Smith
Project Oversight Group (POG)
Outline

• Background
• Objectives
• Methods
• PRISMA Guidelines
• Results
• Conclusions
Background
Why is understanding Healthcare Fraud important?

- **$MONEY$$**
  3-10% of all Healthcare spending
  ($68 billion to $226 billion) that is potentially fraudulent

- Improve public policy making
- Suspicion ranking guides resource allocation
- Reducing pressure and cost of compliance for law abiding providers, facilities and their patients
**Background**

How did the current project get started

- Proposal to the Society of Actuaries from University of Hawaii and University of Tennessee

- Funded by the Health Section

- **Two primary aims**
  - Designed to provide educational material on data driven methodologies to detect healthcare fraud
  - Provide an up-to-date view on existing research into healthcare fraud detection methods
Objectives
Systematic Review Process

1. Develop a Research Question
2. Define Inclusion and Exclusion Criteria
3. Locate Studies
4. Select Studies
5. Assess Study Quality
6. Extract Data
7. Analyze and Present Results
8. Interpret Results

Health Systems

Fraud
Preferred Reporting Items for Systematic Reviews and Meta-Analyses (The PRISMA Group, 2009)

PRISMA 2009 Checklist

<table>
<thead>
<tr>
<th>Section/topic</th>
<th>#</th>
<th>Checklist Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHODS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate if a review protocol exists. If and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</td>
</tr>
<tr>
<td>Information sources</td>
<td>7</td>
<td>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</td>
</tr>
<tr>
<td>Study selection</td>
<td>9</td>
<td>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).</td>
</tr>
<tr>
<td>Data collection process</td>
<td>10</td>
<td>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</td>
</tr>
<tr>
<td>Data items</td>
<td>11</td>
<td>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</td>
</tr>
<tr>
<td>Risk of bias in individual studies</td>
<td>12</td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
</tr>
<tr>
<td>Summary measures</td>
<td>13</td>
<td>State the principal summary measures (e.g., risk ratio, difference in means).</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>14</td>
<td>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I²) for each meta-analysis.</td>
</tr>
<tr>
<td>Risk of bias across studies</td>
<td>15</td>
<td>Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).</td>
</tr>
<tr>
<td>Additional analyses</td>
<td>16</td>
<td>Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.</td>
</tr>
</tbody>
</table>

Keywords

- Preferred Reporting Items for Systematic Reviews and Meta-Analyses (The PRISMA Group, 2009)

Methods
**Methods**

**Data Collection Process**

- **Data collection process**
  - Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.

- **Data items**
  - List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.

- **Risk of bias in individual studies**
  - Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.

- **Summary measures**
  - State the principal summary measures (e.g., risk ratio, difference in means).

- **Synthesis of results**
  - Describe the methods of handling and combining results of studies, if done, including measures of consistency (e.g., I²) for each meta-analysis.

- **Risk of bias across studies**
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- **Additional analyses**
  - Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.

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**Prisma Diagram**

**Study Selection**

**Began Analysis of Results**
## Methods

### Article Characteristics

<table>
<thead>
<tr>
<th>Study Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>1</td>
<td>A Fraud Detection Approach with Data Mining in Health Insurance</td>
</tr>
<tr>
<td>2</td>
<td>A prescription fraud detection model</td>
</tr>
<tr>
<td>3</td>
<td>A process mining framework for the detection of healthcare fraud and abuse</td>
</tr>
<tr>
<td>4</td>
<td>A scoring model to detect abusive billing patterns in healthcare insurance claims</td>
</tr>
<tr>
<td>5</td>
<td>An adaptation of the Minimum Sum Method</td>
</tr>
<tr>
<td>6</td>
<td>An interactive machine-learning-based fraud and abuse detection system in healthcare insurance</td>
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<tr>
<td>7</td>
<td>Computer-aided auditing of prescription-drug claims</td>
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<tr>
<td>8</td>
<td>Cost-based quality measures in subgroup discovery</td>
</tr>
<tr>
<td>9</td>
<td>Creating and validating a tool able to detect fraud by prescription falsification from health insurance administration databases</td>
</tr>
<tr>
<td>10</td>
<td>Detecting fraud in health insurance data: Learning to model incorporate Steele’s low distributions</td>
</tr>
<tr>
<td>11</td>
<td>Detecting hospital fraud and claims abuse through diabetic outpatient services</td>
</tr>
<tr>
<td>12</td>
<td>Detecting Medicare abuse</td>
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<tr>
<td>13</td>
<td>Detecting Potential Overstaying in Medicare Reimbursement via Hours Worked</td>
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<tr>
<td>14</td>
<td>A Hybrid Knowledge/Statistical-Based System For The Detection Of Fraud</td>
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<tr>
<td>15</td>
<td>A Multidimensional Data Model and Analysis Techniques for Fraud Detection</td>
</tr>
<tr>
<td>16</td>
<td>Fraud in the health systems of Chile: A detection model</td>
</tr>
<tr>
<td>17</td>
<td>Improving Fraud and Abuse Detection in General Physicians Claims: A Data Mining Fraud</td>
</tr>
<tr>
<td>18</td>
<td>Identical Control Differences Between Community Health Centers That Did Or Did Not Experience Fraud</td>
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<td>19</td>
<td>Leveraging Big Data Analytics to Reduce Healthcare Costs</td>
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<td>20</td>
<td>Multi-stage methodology to detect health insurance claim fraud</td>
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<td>On-staff sampling and retro estimation in Medicare and Medicaid benefit integrity investigations</td>
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<td>Outlier detection in the healthcare fraud: A case study is the Medicaid dental domain</td>
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<td>23</td>
<td>Overpayment models for medical audits: multiple regression</td>
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<td>24</td>
<td>Physician Medicare fraud characteristics and consequences</td>
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<tr>
<td>25</td>
<td>The effects of the fraud and abuse enforcement program under the National Health Insurance program in Korea</td>
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<td>26</td>
<td>What are the Characteristics that Explain Hospital Quality? A Longitudinal PRIDIT Approach</td>
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### Methodology

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<thead>
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<td>Data mining: validation...</td>
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<td>Literature review: Data...</td>
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<td>Multistage approach...</td>
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### Results & Conclusions

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<td>Fraud detection tool...</td>
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### Assessment of Bias

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<th>Pros and Cons</th>
<th>BIG IDEAS</th>
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### Assessment of the Study Pros and Cons

<table>
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<th>BIG IDEAS</th>
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<tr>
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INSTRUCTIONS:
1. Click any filter within the 5 variable lists.
2. If multiple items are desired within a list, click the check mark option next to the title of the listed table.
3. To start a selection over, press the delete filter button.
4. Click USA in Country, click multiple buttons in field and click HS & RW, click provider in level of analysis; 2 papers with these filters are shown.
5. Click expand [+1] next to each Title to see Authors, Journal year.
6. Press delete filter on each list to start over.
7. Variables can be chosen in any order.

INSTRUCTIONS Cont.
1. The “Article Details” tab can be used to obtain full details on papers of interest.
2. Use the drop-down arrow next to the “Number” column in the “Article Details” tab to filter by the identified study number.
3. Ex. After steps 1-7, the paper of interest was numbered 24. In the “Article Details” tab the drop-down arrow next to “Number” gives the option to filter only paper 24.
## Results

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<td>2005 – 2007</td>
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<td>2008 – 2010</td>
<td>6</td>
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<tr>
<td>2011 – 2013</td>
<td>7</td>
</tr>
<tr>
<td>2014 – 2016</td>
<td>9</td>
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Results
Results
Field
12  Health Services Research
10  Computing Information Services
  2   Health Economics
  2   Risk Management and Insurance
  1   Unidentified
Results

Claim Type

Medical: 15
Dental: 1
Drug: 5

2 - General Insurance Claims/ No specific type
Results
Level of Analysis & Approach

22 Studies

11 Studies

Data Mining
Results
Risk of Bias

- 5 of 27 = Author affiliation to public insurer data
- 8 of 27 = Government funding
- 7 of 27 = Funding from a private insurance company
Conclusions

Methods and literature

Limited number of validated methods

Literature is spread among many academic fields
Conclusions

Future research

Majority of studies available utilize public and social health insurance systems

Main gaps include the validation of existing methods, proof of intent to commit fraud, and estimation of the fraud rate for many programs
Next steps

Completion and publication of a report of our findings

An SOA webinar describing methods for fraud detection actuaries can use in their practice
References

Backup slides
Background
What is going on now?

Recovery Audit Contractors
The RACs detect and correct past improper payments so that CMS and Carriers, FIs, and MACs can implement actions that will prevent future improper payments
• Review claims on a post-payment basis
• Use the same Medicare policies as Carriers, FIs and MACs: NCDs, LCDs and CMS Manuals
• Two types of review:
  • Automated (no medical record needed)
  • Complex (medical record required)
• Can not review claims paid prior to October 1, 2007
• Will be able to look back three years from the date the claim was paid
• Required to employ a staff consisting of nurses, therapists, certified coders, and a physician CMD
Results

Summary Measures

**Pros of the Methodology**
- Ease of implementation/simplicity
- Flexibility
- Use of common/standard methods or common/available software
- Able to handle large numbers of variables
- Facilitates auditing/resource allocation to fraud detection

**Cons of Methodology**
- Dimensionality/large amount of data required
- Challenging or opaque method
- Required data not always available
- Computationally expensive model/long run times
- Use of subjective measures
- Exclusion of types of healthcare professionals
- Missing data
- Difficult to generalize
- Reliance on expert opinion
- Methods not described in the paper
- Restrictive assumptions
- Requires a validation sample

**Assumptions**
- Fraud results in outliers/common patterns exist in regular care
- Data accuracy
- Managers/directors are able to provide meaningful data
- Payments are either totally legitimate or totally fraudulent
- Validity of expert opinion

**Additional Recommendations/Conclusions**
- Improve cost or cost-effectiveness of fraud detection and prevention
- Validate results
- Replicate results in other settings

**Assumptions**

**Data Accuracy**
- Managers/directors are able to provide meaningful data
- Payments are either totally legitimate or totally fraudulent
- Validity of expert opinion

**Fraud Results in Outliers/ Common Patterns Exist in Regular Care**
- Fraud results in outliers
- Common patterns exist in regular care
## Results

### Summary of Methodologies

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Literature Review</td>
<td>10</td>
</tr>
<tr>
<td>Suspicion Scoring</td>
<td>7</td>
</tr>
<tr>
<td>Examination by Experts</td>
<td>6</td>
</tr>
<tr>
<td>Box Plot</td>
<td>2</td>
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<td>Clustering</td>
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<td>Logistic Regression</td>
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<td>Neural Network</td>
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<td>Classification Trees</td>
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<td>Linear Regression</td>
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<td>Random Sampling</td>
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</table>
### Results

#### Example Summary Measures

<table>
<thead>
<tr>
<th>Study Number</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Prevalence</th>
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<tbody>
<tr>
<td>1</td>
<td>77.4%</td>
<td>6%</td>
<td>Not Reported</td>
</tr>
<tr>
<td>3</td>
<td>100% (all models)</td>
<td>1%, 9%, 15% (three models used)</td>
<td>Not Reported</td>
</tr>
<tr>
<td>17</td>
<td>Not Reported</td>
<td>Not Reported</td>
<td>6% of Clinics suspicious</td>
</tr>
<tr>
<td>18</td>
<td>Not Reported</td>
<td>Not Reported</td>
<td>5% of providers requiring further analysis</td>
</tr>
<tr>
<td>19</td>
<td>93.5% - 88.5%</td>
<td>53.8% - 83.4%</td>
<td>Not Reported</td>
</tr>
<tr>
<td>21</td>
<td>Not Reported</td>
<td>Not Reported</td>
<td>4.12% reported to Fraud unit</td>
</tr>
<tr>
<td>22</td>
<td>99.71%</td>
<td>99.86%</td>
<td>8.60%</td>
</tr>
<tr>
<td>27</td>
<td>85%</td>
<td>85%</td>
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</table>
SOA Health Research Project
Provider Networks in Exchanges

ADAM R. SINGLETON
Consulting Actuary
UHAS, Inc.

Society of Actuaries Annual Meeting
October 16, 2017
For Today

- Overview of the Project
- Key Results
  Higher Performing Networks
  Case Studies
  Network Pricing
- Q&A
Purpose of the Project

• For multiple audiences who have an interest in:
  • Networks on Individual Exchanges
    • Types of Networks – Alternative, Narrow, Broad, Higher Performance
    • Premium & Member Contributions – Six Case Studies
  • Network Development (in or outside of Exchanges)
    • Network development process
    • Provider contract pricing model
  • How to improve financial performance
    • Key elements done by Higher Performing Networks
    • Example of best practices for Higher Performing Networks
  • Impact of Individual Exchanges on Buyers & Providers
    • Buyers: Individuals, Carriers, and State Regulators
    • Providers: Hospitals and Physicians
Research Approach and Data

• The authors performed most of the research
  • Greger Vigen, FSA, MBA – independent consultant with an extensive provider background, especially with higher performance networks.
  • Adam R. Singleton, FSA, MAAA – consulting actuary who specializes in analyzing and benchmarking provider networks.

• Six case studies
  • Data on premiums, market share, network composition, products, service areas, benefit designs, enrollment, and demographics
  • Material from many sources, collected at different times and in varying formats—public data at the state and federal level, rate filings, industry research, and news articles.
  • For consistency, we also used various Medicare sources for financial information on hospitals such as market share and their revenues from different types of payers.
Research Approach and Data

• Exhibits and tables are used to illustrate key concepts, important calculations and metrics.
  • They are based on the authors’ past experiences, and compared to recent data for reasonability.

• A variety of articles and public sources were used.
  • Most were articles on Exchanges.

• Sections related to higher performance networks used sources outside of Exchanges since much of the public material for this topic is not focused on Exchanges.

• Pricing model examples used actual de-identified and modified historical claims from commercial and Medicare populations.
Key Results

• Provider Networks

Some networks produce higher financial performance.

Many are struggling.

• "Network" is used in a broad sense of the word and includes carrier-based networks, provider-based programs like ACO, PCMH, and bundles, and hospital-owned insurers.

• “Broad” Networks include most providers in an area and are typically what insured people have been using for many years.

• “Alternative” Networks are networks that may include different types of payment arrangements and usually offer few providers than broad networks. A “Narrow” network is an example.

• “Higher Performing Networks” are talked about on the next slides
Key Results

Core concept – HPN’s

A critical mass of responsible providers with the right support, authority, and aligned financial incentives will perform significantly better than the typical health program.

These experts take actions that health plans, employers, and members cannot.
Key Results

• Higher Performing Network (HPN) Characteristics
  • Depth and variety of actions and initiatives
  • Care coordination (early support for future at-risk members)
  • Management commitment and deep use of providers
  • Infrastructure (right information at right time)
  • Payment arrangements with buyers and the underlying health system
  • Carrier-based and provider-based HPNs have very different strengths. Strong HPNs use the best of both.
  • All twelve elements are listed in the session hand-out:
    “Lessons from Higher Performing Networks”

KEY ELEMENTS FOR FINANCIAL PERFORMANCE
Key Results

• Six Case Studies
• 2 – Southeast, 2 – Northeast, 1 – West, 1 - California
• Each market was different, but there were several consistent findings across all case studies.
• Hospital systems in many locations voluntarily aligned with specific carriers. There was a wide range of hospital coverage in each market.
• Many alternative networks had lower premiums. Broad network premiums were higher than average and sometimes were the most expensive products.
Key Results

• Case Studies

• When alternative networks had much lower premiums, the network generally had a large membership and market share.
  • Case Study #1 only alternative networks were offered.
  • Case Study #2 had more than 80% of Exchange members in alternative networks.
  • Case Studies #3 and #4 have most of their enrollment in smaller hospital networks.

• Lower premiums offset smaller hospital coverage.
Key Results

• Case Studies

• Depending on the market and specific organizations involved, each type of insurer (National, Regional, Medicaid, provider-owned, and Co-op) had products with below average premium and higher enrollment.

• Slight differences in premiums (and the resulting net member contributions) did not have much effect on member product selection. With similar premiums, a member does not have a compelling reason to choose an alternative network instead of a broad network. This was demonstrated in Case Studies #5 and #6, where many members selected broad networks, although alternative networks were available.
Key Results

• Network Pricing

• In addition to showing the typical network development process and financial decisions that carriers make when developing a network, the report shows examples of the financial impact of the ACA Exchanges to hospitals (also somewhat applicable to physicians). It includes a discussion about how, in some ways, the Exchanges aligned carrier and provider financial incentives.

• The aligned incentives of moving previously uninsured, non-paying patients to insurance products results in providers being paid for services that were previously unpaid by the patient.
Key Results

• Network Pricing

• When evaluating potential hospital partners for alternative networks, carriers must assess the cost levels required to achieve premium savings goals. This involves assessing contractual payment terms offered by hospitals, which requires significant analysis and complicated calculations.

• The report presents the typical steps that a carrier follows from start to finish.
Key Results

• Network Pricing

• Two pricing models are presented to communicate key concepts and point readers to potential data sources that they could use under similar circumstances.
  
  • Both models rely on claims data and proposed hospital reimbursement rates and payment terms to achieve targeted “unit costs”.
  
  • The **internal data model** relies on a carrier’s historical utilization and claims data for a hospital(s), or it uses “adjusted” data, where another similar hospital’s data is used with adjustments for the service mix and “billed charge-masters”.
  
  • The **external data model** relies on claims data from Medicare and/or Medicare hospital-cost-report data to establish benchmark metrics that can be relied upon to calibrate proposed hospital reimbursement terms to proposed contractual rates.