



2017 SOA  
**Annual Meeting  
& Exhibit**

Oct. 15-18, 2017  
Boston, MA

## 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**

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# Examining Predictive Modeling Based Approaches to Characterizing Healthcare Fraud

Robert Lieberthal, PhD

Presentation for the SOA Annual Meeting

October 16, 2017



THE UNIVERSITY OF  
TENNESSEE  
KNOXVILLE

**BIG ORANGE. BIG IDEAS.®**

# 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

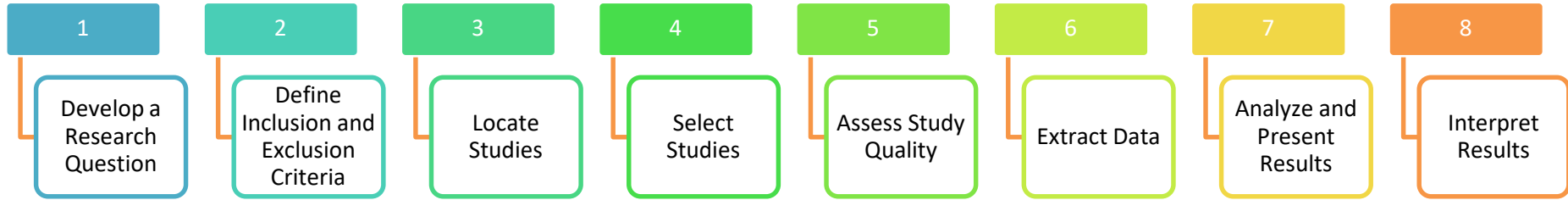
# Background

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



Systematic Review  
Methodology

Scholarly/ Academic  
Journals; Working  
Papers; Conference  
Proceedings

8 Academic Databases

Published January 1,  
2001 to Present

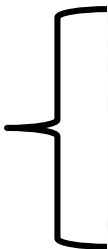
Keywords

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



### PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
<b>METHODS</b>			
Protocol and registration	5	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.	
Eligibility criteria	6	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.	
Information sources	7	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.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	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	11	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	12	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	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	

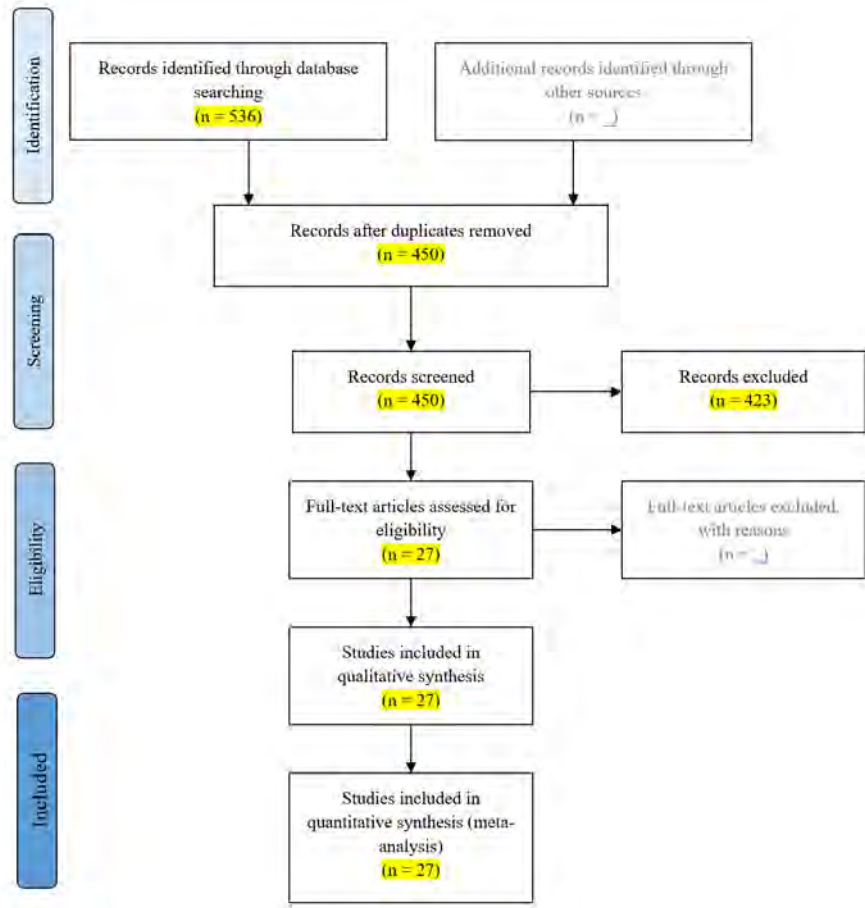


METHODS		
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.
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Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.

Prisma Diagram

Study Selection

Began Analysis of Results





Article  
Characteristics

Data

Methodology

Results &  
Conclusions

Assessment of  
Bias

Assessment of  
the Study Pros  
and Cons

## Identification Dashboard for Targeted Studies

### Row Labels

Row Labels	Study Number
A Fraud Detection Approach with Data Mining in Health Insurance	25
A prescription fraud detection model	1
A process-mining framework for the detection of healthcare fraud and abuse	2
A scoring model to detect abusive billing patterns in health insurance claims	17
A survey on statistical methods for health care fraud detection	8
An adaptation of the Minimum Sum Method	20
An interactive machine-learning-based electronic fraud and abuse detection system in healthcare insurance	19
Computer-aided auditing of prescription drug claims	9
Cost-based quality measures in subgroup discovery	24
Creating and validating a tool able to detect fraud by prescription falsification from health insurance administration databases	7
Detecting fraud in health insurance data: Learning to model incomplete Benford's law distributions	16
Detecting hospital fraud and claim abuse through diabetic outpatient services	3
Detecting Medicare abuse	23
Detecting Potential Overbilling in Medicare Reimbursement via Hours Worked	26
EFD: A Hybrid Knowledge/Statistical-Based System For The Detection Of Fraud	21
Fraud in Medicaid: A Multidimensional Data Model and Analysis Techniques for Fraud Detection	14
Fraud in the health systems of Chile: a detection model	12
Improving Fraud and Abuse Detection in General Physician Claims: A Data Mining Study	10
Internal Control Differences Between Community Health Centers That Did Or Did Not Experience Fraud	15
Leveraging Big Data Analytics to Reduce Healthcare Costs	27
Multi-stage methodology to detect health insurance claim fraud	11
On stratified sampling and ratio estimation in Medicare and Medicaid benefit integrity investigations	18
Outlier detection in healthcare fraud: A case study in the Medicaid dental domain	13
Overpayment models for medical audits: multiple scenarios	5
Physician Medicare fraud: characteristics and consequences	4
The effects of the fraud and abuse enforcement program under the National Health Insurance program in Korea	6
What are the Characteristics that Explain Hospital Quality? A Longitudinal PRIDIT Approach	

### INSTRUCTIONS:

1. Click any filter within the 5 variable lists.
2. If multiple items are desired within 1 list, click the check mark icon next to the title of the slicer table.
3. To start a selection over, press the delete filter button.
4. Ex: Click USA in Country, click multiple button in field and click HSR & RMI, click provider in level of analysis; 2 papers with these filters are shown
5. Click expand (+) 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.

### Country

Australia
Chile
France
Iran
Korea
Netherlands
Taiwan
Turkey
Unidentified
USA
Various

### Field

Computing Information ...
Health Economics
Health Services Research
Risk Management & Insu...
Unidentified

### Claim Type

Dental
Disability income (medic...
Drug
Medical
Medical & Drug
Medical, Dental & Drug
Medical: Pediatric servic...
Unidentified

### Level of analysis

Academic databases
Claims
Clinic (17 different speci...
Community Health Cente...
Convicted Physicians
Facility
Falsified prescriptions
Health centers: Hospitals...
Patient, facility
Practitioner, cost per pat...
Prescription
Prescription claims
Provider
Seven different levels; (L...
Total payment for a pop...
Unidentified

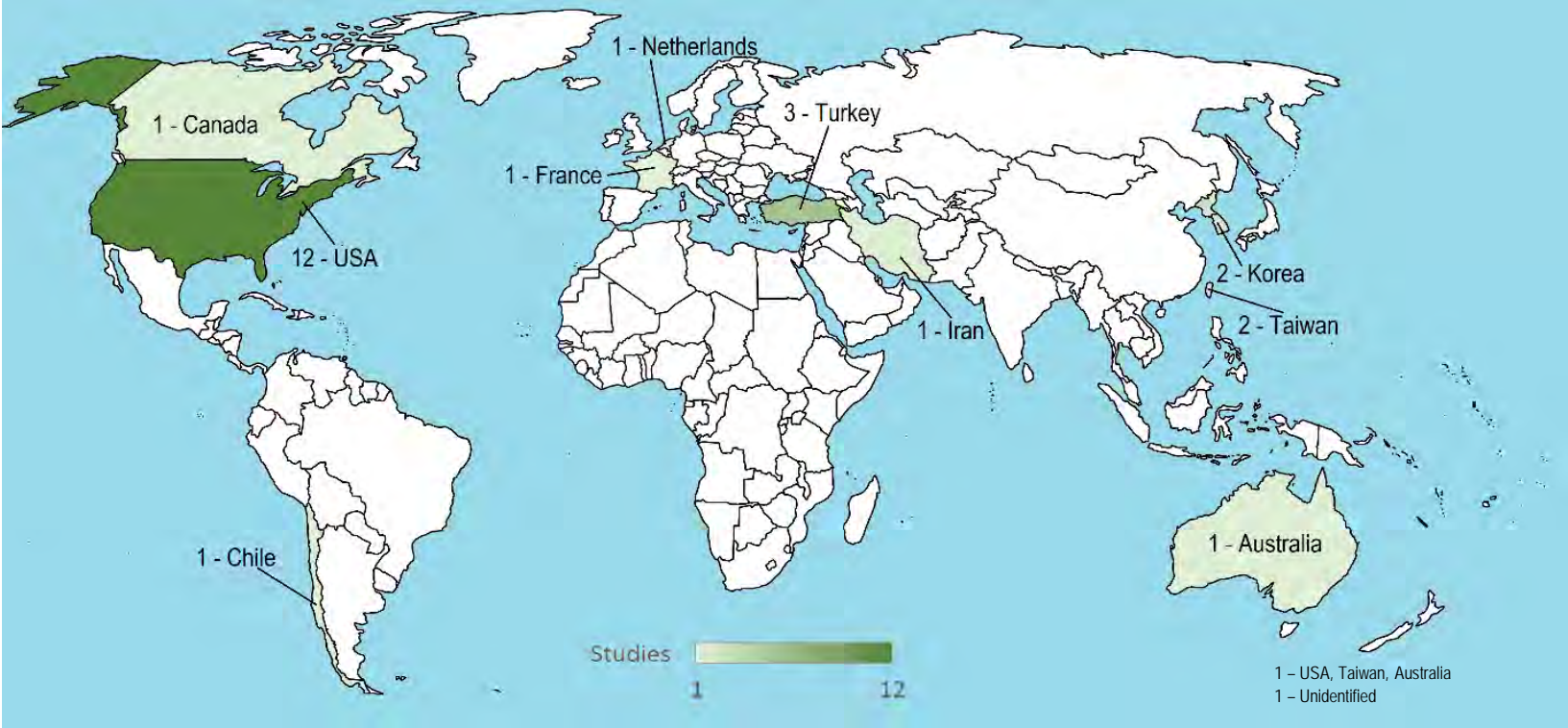
### Approach

Classification of excluded...
Conversion of Medicare ...
Data Mining
Data mining; validation b...
Electronic Fraud Detection
Fraud detection tool
Literature Review
Literature review; Data ...
Multistage approach incl...
PRIDIT
Random sampling; Mont...
Regression
Statistical analysis and D...
Statistical/Data Mining
Stratified sample and int...
Survey
Unidentified

# Results

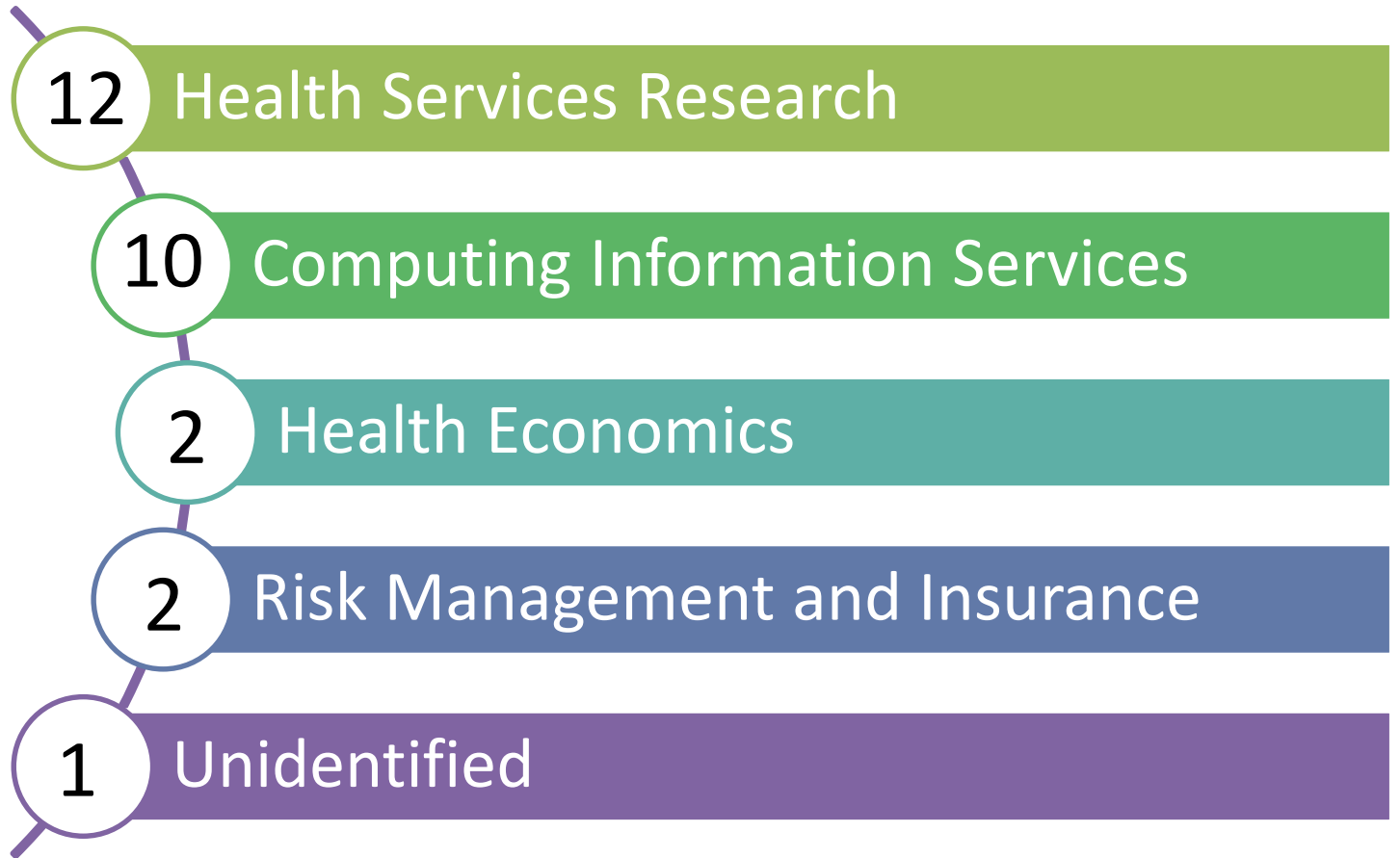
Study characteristic: Year	N
2001 – 2004	1
2005 – 2007	4
2008 – 2010	6
2011 – 2013	7
2014 – 2016	9

# Results



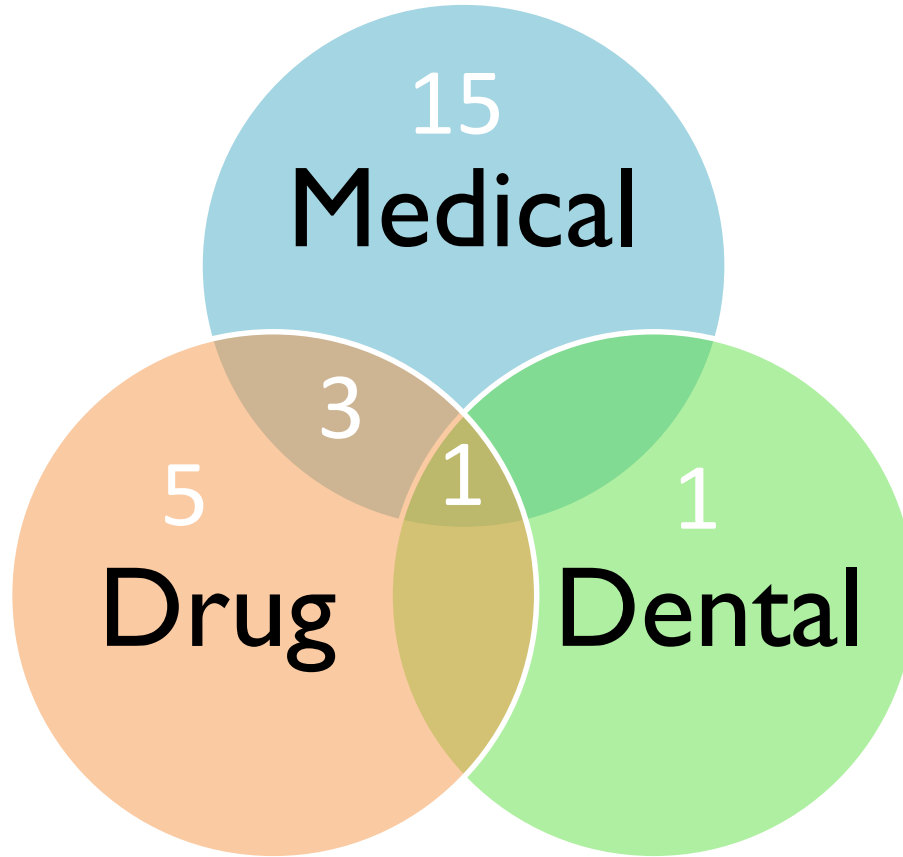
# Results

Field



# Results

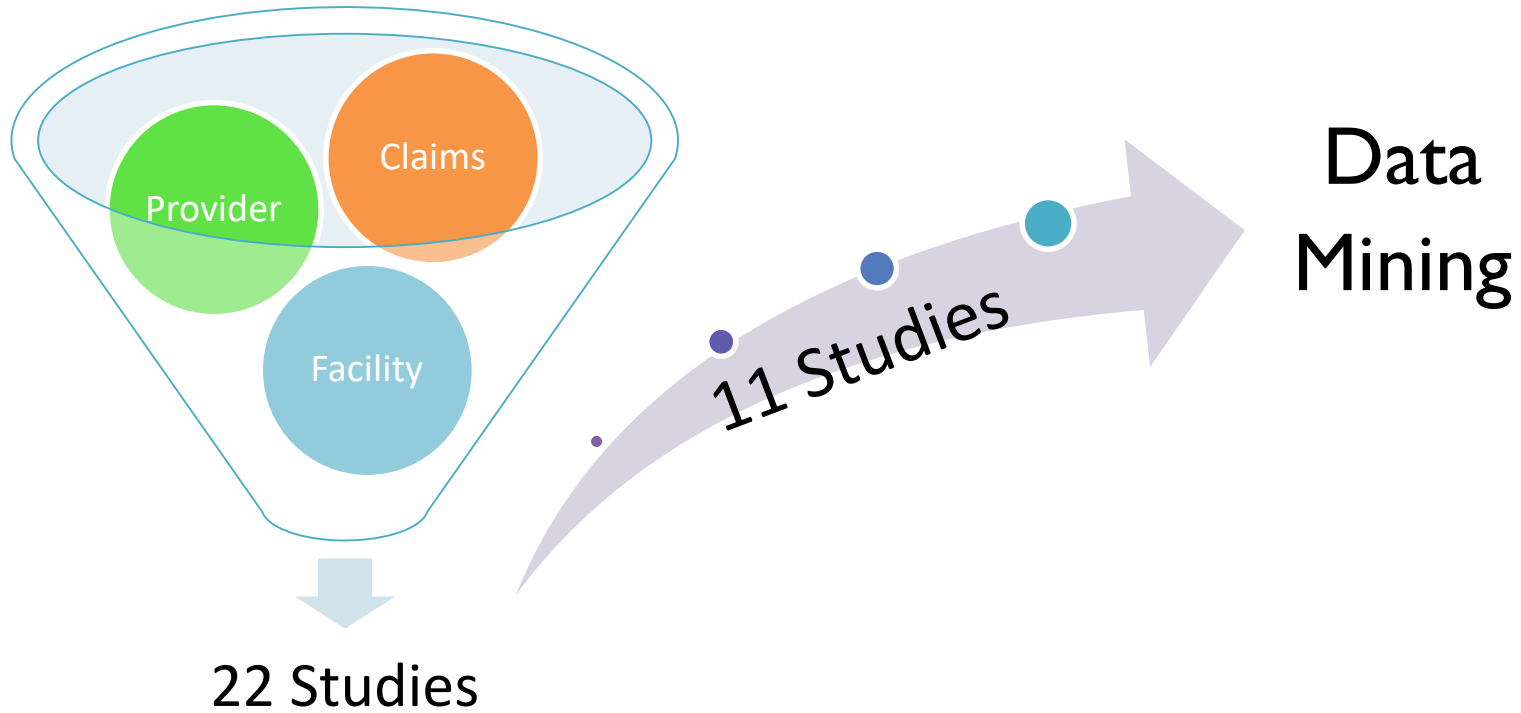
Claim Type



2 – General Insurance  
Claims/ No specific  
type

# Results

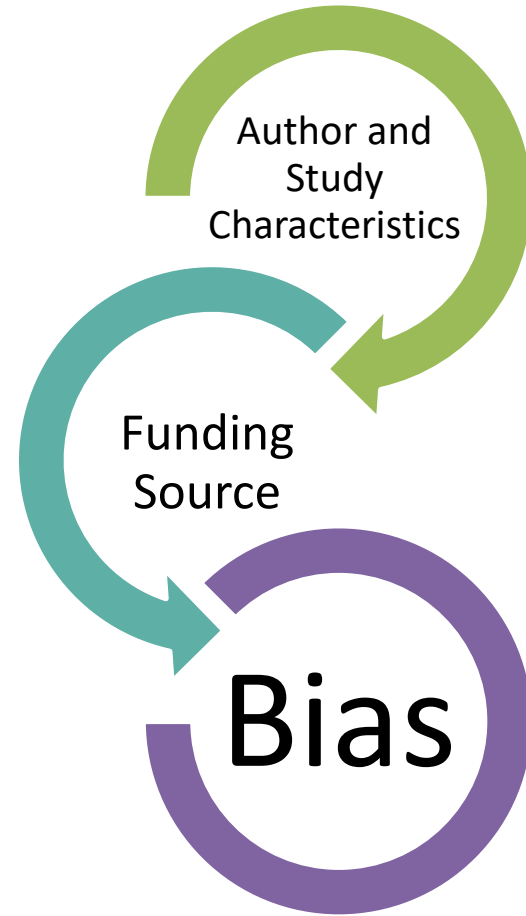
Level of Analysis & Approach



# Results

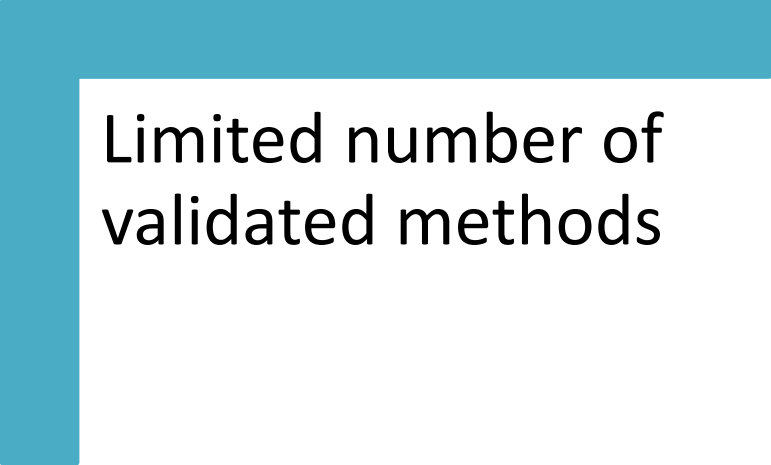
## Risk of Bias

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

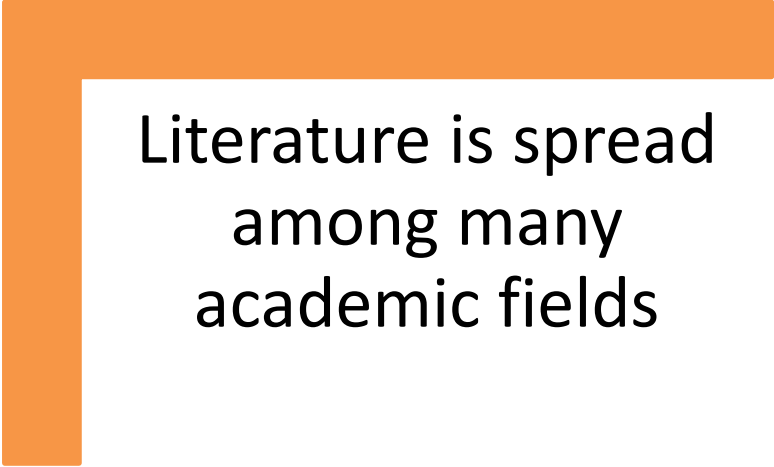



# Conclusions

Methods and literature



Limited number of  
validated methods

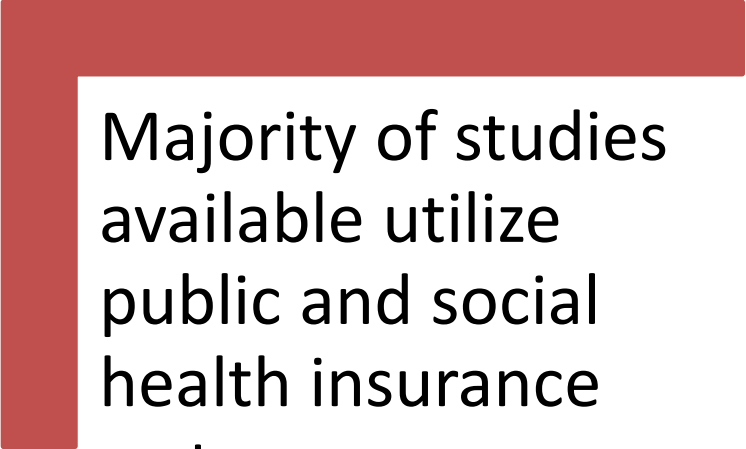



Literature is spread  
among many  
academic fields

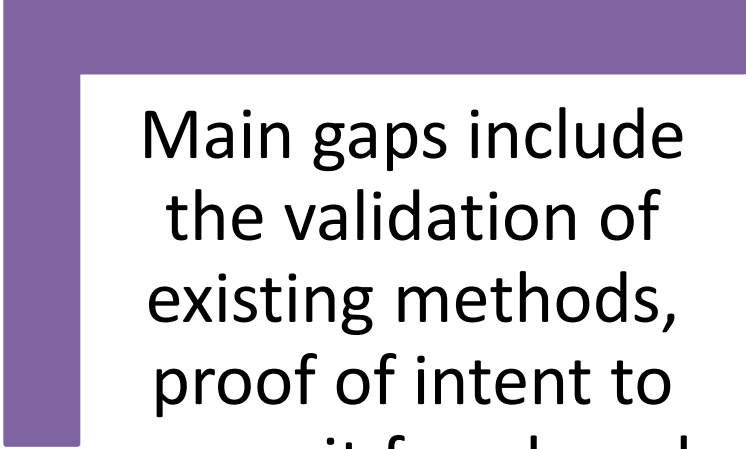


# Conclusions

Future research

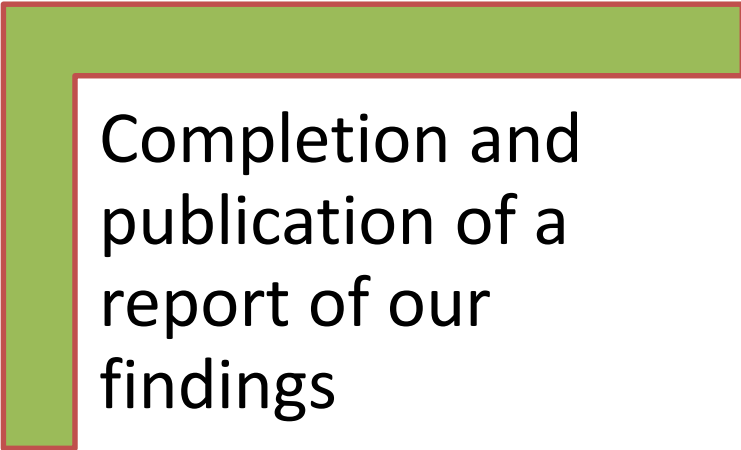


Majority of studies available utilize public and social health insurance systems

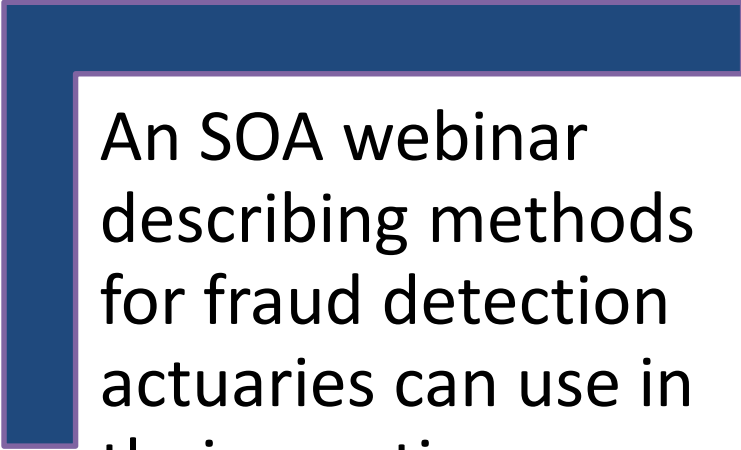


Main gaps include the validation of existing methods, proof of intent to commit fraud, and estimation of the fraud rate for many programs

## 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

- PLoS Medicine (OPEN ACCESS) Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097.  
doi:10.1371/journal.pmed1000097

# Backup slides

# Background

What is going on now?



## Recovery Audit Contractors

The RACs detect and correct past improper payments so that CMS and Carriers, Fls, 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, Fls 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

## Segment 1



- Health care
- Healthcare
- Health insurance
- Medicare
- Medicaid
- Obamacare
- Affordable care act
- Health services
- Fraud
- Cheat
- Falsification
- Corruption
- Kickback

## Segment 2



- Detect
- Detection
- Prevent
- Prevention
- Deterrence
- Audit
- Auditing

### *Academic Search Complete*

- Segment 1 = 273
- Segment 2 = 991,578
- Combined segments 1 and 2 = **80**

### *Business Source Complete*

- Segment 1 = 189
- Segment 2 = 110,789
- Combined segments 1 and 2 = **75**

### *EconLit*

- Segment 1 = 35
- Segment 2 = 17,446
- Combined segments 1 and 2 = **6**

### *Medline (via EBSCOHost)*

- Segment 1 = 287
- Segment 2 = 1,628,700
- Combined segments 1 and 2 = **119**

### *OneSearch (Primo Central Index)*

- Segment 1 = 604
- Segment 2 = 2,359,751
- Combined segments 1 and 2 = **153**

### *ProQuest Business Collection*

- Segment 1 = 191
- Segment 2 = 100,765
- Combined segments 1 and 2 = **54**

### *ScienceDirect*

- Segment 1 = 19
- Segment 2 = 90,145
- Combined segments 1 and 2 = **12**

### *Web of Science*

- Segment 1 = 126
- Segment 2 = 1,970,421
- Combined segments 1 and 2 = **37**

# Results

## Summary Measures



### Additional Recommendations/ Conclusions

- Improve cost or cost-effectiveness of fraud detection and prevention
- Validate results
- Replicate results in other settings



### 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

# Results

## Summary of Methodologies

Literature Review - 10	Suspicion Scoring - 7	Examination by Experts - 6
Box Plot - 2	Clustering - 6	Logistic Regression - 2
Neural Network - 2	Classification Trees - 2	Linear Regression - 6
Significance Testing - 7	Peak Analysis - 1	Random Sampling - 4



# Results

## Example Summary Measures

Study Number	Sensitivity	Specificity	Prevalence
1	77.4%	6%	Not Reported
3	100% (all models)	1%, 9%, 15% (three models used)	Not Reported
17	Not Reported	Not Reported	6% of Clinics suspicious
18	Not Reported	Not Reported	5% of providers requiring further analysis
19	93.5% - 88.5%	53.8% - 83.4%	Not Reported
21	Not Reported	Not Reported	4.12% reported to Fraud unit
22	99.71%	99.86%	8.60%
27	85%	85%	Not Reported

# 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.