

Health Care Data Analytics:  
Fraud Detection, Audits &  
Network Analysis

Visualizing Complexity and the Unexpected

May 13, 2016





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### Who We Are at FTI Consulting

**Michael Salve, Ph.D.**  
Senior Managing Director

- Testifies in State and Federal Court on FCA matters and **OMIG hearings** on sampling issues.
- Results of his statistical work have been presented to the **CMS, ZPIC and Medicare**.
- He has been deposed by the **US DOJ** and has been cross examined by the **New York State Office of the Medicaid Inspector General**.
- Adjunct faculty at CUNY where he teaches Econometrics, and Law and Economics in the graduate economics program.

**Robert Fuite, CFA, MA**  
Managing Director

- Expertise in the fields of economics, mathematics, statistics, and **computer science**.
- Complex and big data analytics, false claims act litigation, designing **statistical samples and extrapolations** in healthcare litigation and constructing the appropriate **database architecture for medical claim line/record review and analysis**.
- Retained to perform proper extrapolation methodologies to unknown populations and identify potential bias in existing samples.

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### Who Our Clients Are

Anyone in the Healthcare Industry with Claims Data . . .

- Providers being audited for overpayments;
- Defendants in a *qui tam* False Claims Act action;
- Pharmacies with government payor credit balances;
- Providers who want help negotiating with Medicare statisticians (including Medicare Advantage);
- TPAs who want statistical benchmarking;
- Private health plans using TPAs to adjudicate claims;
- Health insurers seeking patterns of known fraud.

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## Healthcare Audits: Sampling, Claims Analysis & Extrapolation




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## The Rise of Healthcare Audits:

- The healthcare landscape has changed, State and Federal government entities such as CMS and the OIG are now combating alleged waste and abuse with new data analytics, pattern recognition and analysis tools.
- They are also mandated to apply statistical sampling and extrapolation methods to their audits. In this climate the OIG's RAT-STATS software and sampling are hot topics.
- Providers are confronted by an ever increasing alphabet soup of governmental organizations that conduct healthcare audits.
  - **Human Services Office of Inspector General (OIG)**
    - The OIG "conducts and coordinates criminal, civil, and administrative investigations of fraud, waste, abuse, and misconduct related to more than 100 Department of Health and Human Services (HHS) programs and operations."
  - **State Healthcare Regulator/Inspector Entities**
    - New York Office of Medicare Inspector General (OMIG)



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## The Rise of Healthcare Audits:



- U.S. Department of Justice (DOJ)
  - False Claims Act (FCA) litigation
- There are a myriad of sources of potential healthcare audits that involve sampling, to name but a few.
  - Zone Program Integrity Contractors (ZPICs)
    - The perilous thing about the ZPIC is its ability to initiate a fraud investigation. The bottom line is that the supplier does not want the Medicare contractor to turn its file over to the DOJ OIG.
  - Other Contractor Audits - Medicare Administrative Contractors (MAC) / Recovery Audit Contractors (RAC)
  - State Medicare Audit - NY OMIG
- These audits may use statistical sampling to calculate and extrapolate the amount of overpayments made on all claims during a time period subject to the audit. This allows the audit to generate large overpayments with minimal work.
- One of the prominent tools of the OIG is a statistical software program called RAT-STATS

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### The Rise of Big Data in Health Care Analytics

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### The Rise of Data – Health Care & Big Data

- Past decade:
  - Huge increase in data collection and storage;
  - Huge advances in computing power ability to analyze data using statistics, mathematics and computer science. Specifically:
    - Graph or Network Theory
    - Complexity Systems
    - Machine Learning:
      - Supervised Machine Learning
      - Unsupervised Machine Learning
    - Cloud Computing



■ We will focus on  
Networks and Fraud in Healthcare Data

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### What are Other Players Doing About Fraud, Waste & Abuse?

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### Network Theory: The New Language of Statistics

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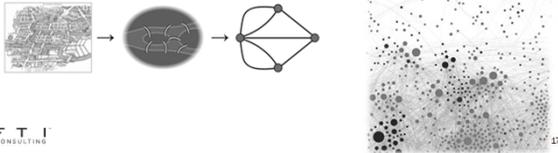
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### Network Analysis: New Concepts & Ideas

- Network analysis is visualizing and evaluating relationships and flows between physicians, rendering organizations and patients.
- It helps to create simple, yet powerful tools and models for understanding the behavior of complex reimbursement data.
- Complexity made simple through the use of graphs –
- **Graphs:** The study of graphs, which are mathematical structures used to model pairwise relations between objects. A "graph" in this context is made up of "vertices" or "nodes" and lines called "edges" that connect them.



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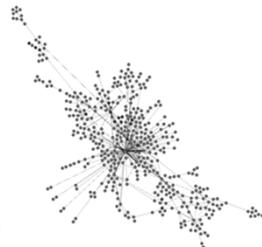
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### The Real World is Interconnected

- Networks and interconnectedness are all around us
- Social networks are not just for Facebook and LinkedIn. Networks or associations can be created from many different sources:
  - Medicare reimbursement data for chiropractic manual therapy
  - Multiple doctors seeing the same patient on the same day
  - Doctors in a facility charging the same set of CPT codes
  - The same doctors working in different facilities
  - Doctors working on same patients and charging same percentages in excess of UCR



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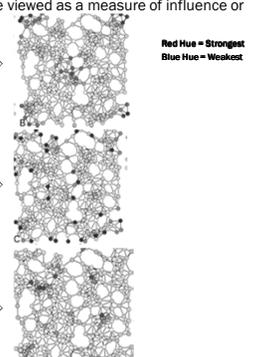
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### New Language of Network Statistics

- **Node centrality:** Node centrality can be viewed as a measure of influence or importance in a network model
- **Closeness:** average distance that each node is from all other nodes in the network
- **Betweenness:** number of shortest paths in a network that traverse through that node
- **Degree/Strength:** number of links of the node



Red Hue = Strongest  
Blue Hue = Weakest

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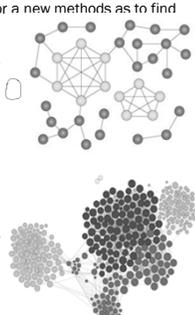
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### New Language of Network Statistics

■ The New Average and Standard Deviation:

- **Sub-graphs or Groups:** Network sciences now allow for a new methods as to find clusters or subgroups
- **Cliques:** a completely connected network, where all nodes are connected to every other node
- **Modularity:** measures the strength of division of a network into modules (also called groups, clusters or communities).  
- "all-my-friends-know-each-other".  
This is sometimes described as the friends of my friends . . . are my friends



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### The New Language of Statistics: Network Visualizations and Applications to Health Care

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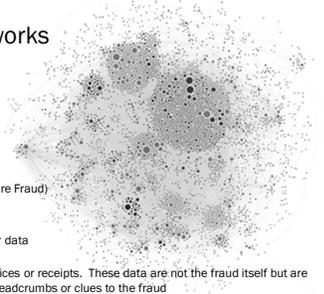
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## Fraud and Networks



- **Why is Fraud so challenging?**
  - Uncommon
  - Well considered
  - Purposefully concealed
  - Time-evolving
  - Often involves multiple people or teams
  - Can appear in many types and forms
  - Hard to detect (Bank Robbery v. Health Care Fraud)
- **What is the "Fraud Generating Process"?**
  - People commit fraud, not invoices or other data
- Typically we have data, such as claims, invoices or receipts. These data are not the fraud itself but are the **symptoms of the fraud**. They are the breadcrumbs or clues to the fraud
- This is what makes fraud detection a challenge. The visible clues or data pieces are simple clues which may or may not indicate the fraud and they are not the fraud generating mechanism or process.
- This new science of networks or social network analysis now allows the ability to focus on the real fraud generating process, people.

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## How Can Networks Help in Fraud Detection?

- **"Birds of a Feather Flock Together" – Homophily**
  - When do social networks help in fraud detection?
  - When there are observable effects present in the network or "birds of feather stick together" Which is called "Homophily in the network sciences"
- **In sociology:**
  - "People have strong tendency to associate with others whom they perceive as being similar to themselves in some way (e.g. same hobbies, interests, etc.)."
- **In fraud networks:**
  - Fraudulent people are more likely to be connected to other fraudulent people and legitimate people are more likely to be connected to other legitimate people.
- The more your social network influences your fraudulent behavior the more social network analysis will assist with fraud detection. That is the more homophilic the network the more effective the tool.



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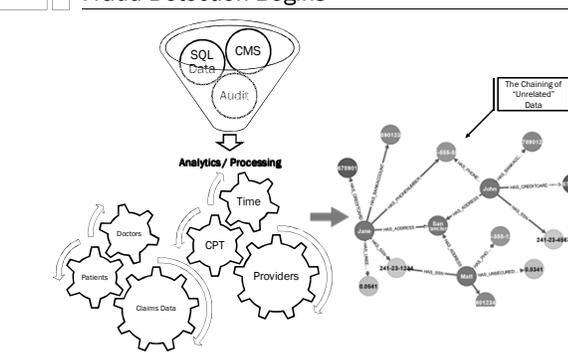
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## How a Network Visualization & Fraud Detection Begins



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## Health Care Network Analytics Case Study

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### Case Background

- Large healthcare provider that operated numerous care facilities.
- A Whistleblower filed a lawsuit against the provider and the DOJ elected to join the case.
  - Case captions will often be "United States of America, ex Rel. Jane Doe"
- Allegations involved the provider making "false claims" or billings to the US. Gov't.
  - False Medical Certifications
  - Up-coding
- The case involved 960,000 medical claims and tens of thousands of patients.
  - The DOJ's expert elected to perform a stratified random sample of patients that involved 1200 claims were selected the claims reviewed for overpayments and false claims.
  - Of these 1200 medical claims 150 were identified as being a "false claim"
- These 150 false claims were extrapolated to the entire population of 960,000 claims for tens of millions of dollars.

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### Social Network Analysis – Mapping Health Care Data

- Mapping The Doctor's Relationships
  - By using the claims data itself we were able to create a network of the doctor relationships..
  - We create a link between doctors if they treated the same patient.

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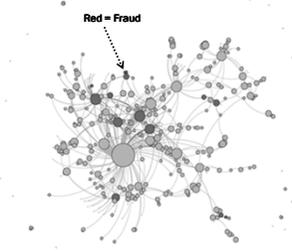
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### Social Network Analysis – Mapping Health Care Data

■ Mapping The Doctor's Relationships

- By calibrating the node size to match *degree*, we can see that the doctors associated with the fraudulent claims are often:



- Doctors associated with fraud also appear to be associated with one another.
- "Red Begets Red" (**Homophily**)
- Many of the fraudulently associated doctors have many connections and are towards the center of the network, but are not its heart
- More advanced network techniques indicate that the more "influence" a doctor has on the network the less likely associated claims will be fraudulent
- The fraudulently associated doctors have a high number of low quality or low influence connections
- Isolate and help define the "Racket"

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### Social Network Analysis – Alternative Layouts

■ Revisualization of data - Providers v. Doctors



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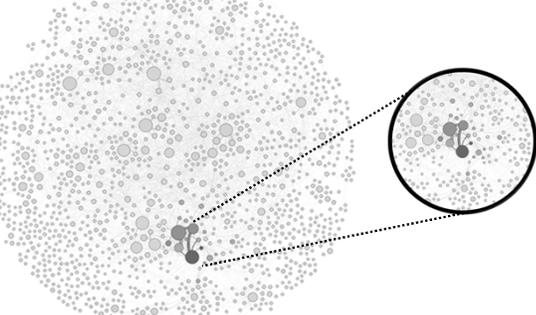
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### Social Network Analysis – Alternative Layouts

■ Revisualization of data - Providers v. Doctors



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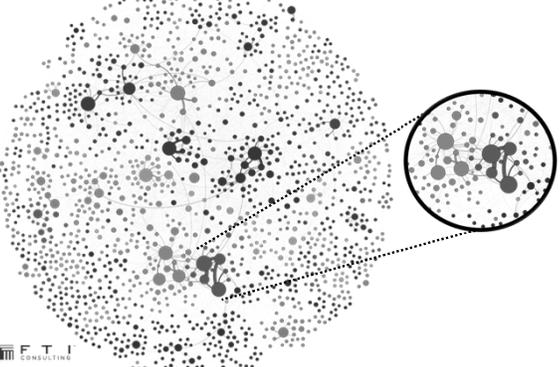
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**Social Network Analysis – Alternative Layouts and ‘Communities’**



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**Who We Are**

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Senior Managing Director

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**About**

Michael Salve is a Senior Managing Director in FTI Consulting's Economic Consulting Services practice based in New York City. Dr. Salve is an applied economist with experience in advanced quantitative methods, statistical studies, healthcare claims sampling, False Claims Act matters, econometric modeling, ZPIC audits, network analysis and commercial disputes. He holds a doctorate in economics, with concentrations in both applied econometric and statistical techniques and industrial organization. He currently serves as an adjunct faculty member at Hunter College in New York City where he teaches Econometrics, and Law and Economics in the graduate economics program. Dr. Salve has extensive experience in designing statistical samples, developing complex extrapolation and benchmarking models, and evaluating achieved precision levels for clients in the healthcare industry. He also uses network analysis to reveal unexpected, yet systematic, relationships among admitting physicians, lending physicians and other providers with respect to their common billing and claim submission patterns. He also testifies on the use of econometric and statistical models for estimating exposure and potential damages for healthcare clients in litigation. Results of his statistical work have been presented to the SEC and DOJ. He has presented testimony in federal court in a qui tam false claims act matter

and has also been deposed by the US DOJ and has been cross examined by the New York State Office of the Medicaid Inspector General. He has constructed sampling techniques used to develop statistically reliable results for inclusion in expert testimony. Specifically, he has assisted healthcare clients and lending institutions in areas such as addressing allegations of fraudulent or improper billing practices and quantifying financial accuracy measures. Dr. Salve has successfully worked with teams of professionals from engaging law firms on issues relating to relevant data requests during the discovery period, proper extrapolation methodologies to unknown populations and identification of potential bias in existing samples. Prior to joining FTI Consulting, Dr. Salve was a Principal with the Forensic and Dispute Services Group of a Big Four Accounting Firm, where he led the Economic Consulting Services practice in New York and was a Managing Director at a private consulting firm where he led the statistical sampling work in the US. He has been a teaching fellow and graduate mathematics instructor at Boston College and was an adjunct faculty member at Suffolk University.

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