THE VALUE OF PERFORMANCE.

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Application of Integrated Health Analytics in a Regulatory Environment

National Predictive Modeling Summit

December 5, 2012

Morgan Crafts, MBA, PMP
Director of Technology
Health IT, Northrop Grumman Information Systems

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The Need for Data-driven Predictive Analytics

- Transformation's Three Part Aim:
  - Improve care
  - Improve population health
  - Reduce costs
- The Challenge:
  - Different members of the health community have access to different sets of data
  - Few have been able to look across the data sets to get a real and timely sense of the health ecosystem
  - Transformation could be accelerated through integrated health analytics information to inform strategy, guidance, operations, evaluation
- The Need:
  - A flexible and scalable predictive analytics platform that can rapidly provide integrated insights to a broad range of health decision makers

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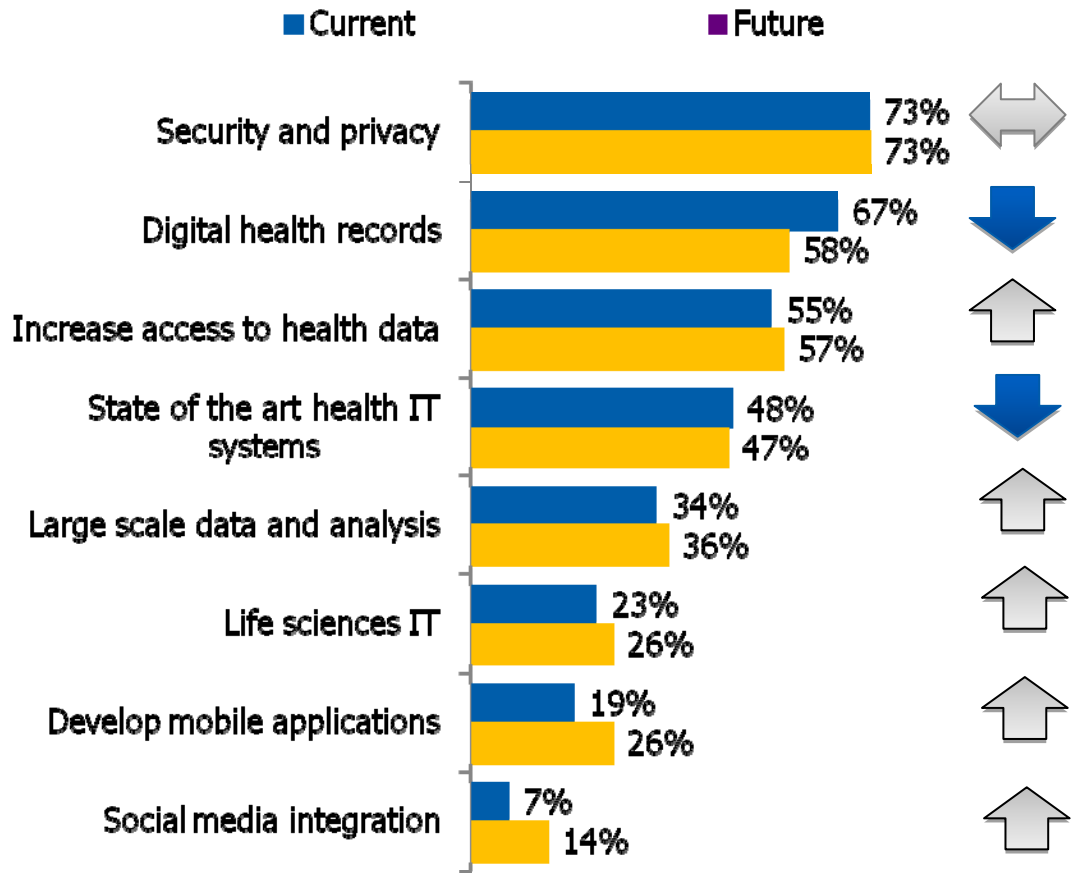
Health IT: *Current and Future Priorities*

- **Security and privacy are the most important priorities among health IT managers**. Seventy-three percent rank security and privacy among their agency's top three priorities, and the same amount say it will be the top priority in the next 12 months
- Digital Health Records and Increased access to health data are next most important priorities
- Mobile applications and social media are seen as having increased focus in the coming year

Current and Future Priorities



Percentage of respondents who ranked each item as one of top 3 priorities, n varies

Security and Privacy top current HIT Priorities -
Social Media and Mobility Expected to Increase in Importance

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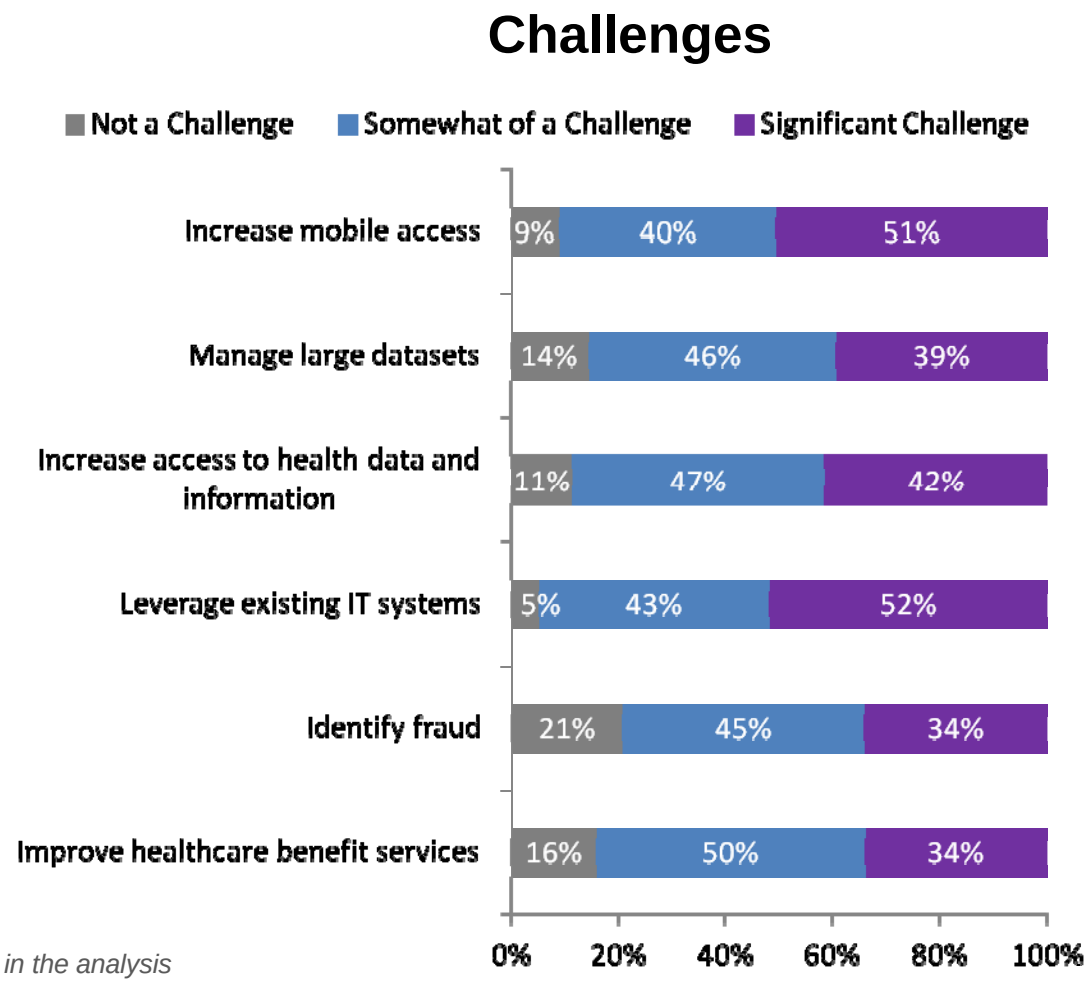
Health IT: *Challenges*

- Respondents were asked to identify challenges within their respective agencies; No item dropped below 79 percent, indicating relative parity among items listed
- **Ninety-five percent of respondents indicated that leveraging existing IT systems is a challenge;** The second largest challenge is increasing mobile access at 91 percent
- Seventy-nine percent of federal managers indicated that identity fraud was a challenge



Percentage of respondents, n=168
Respondents who indicated "Don't Know" were not included in the analysis

Leveraging Existing HIT Systems is a Top Health IT Challenge

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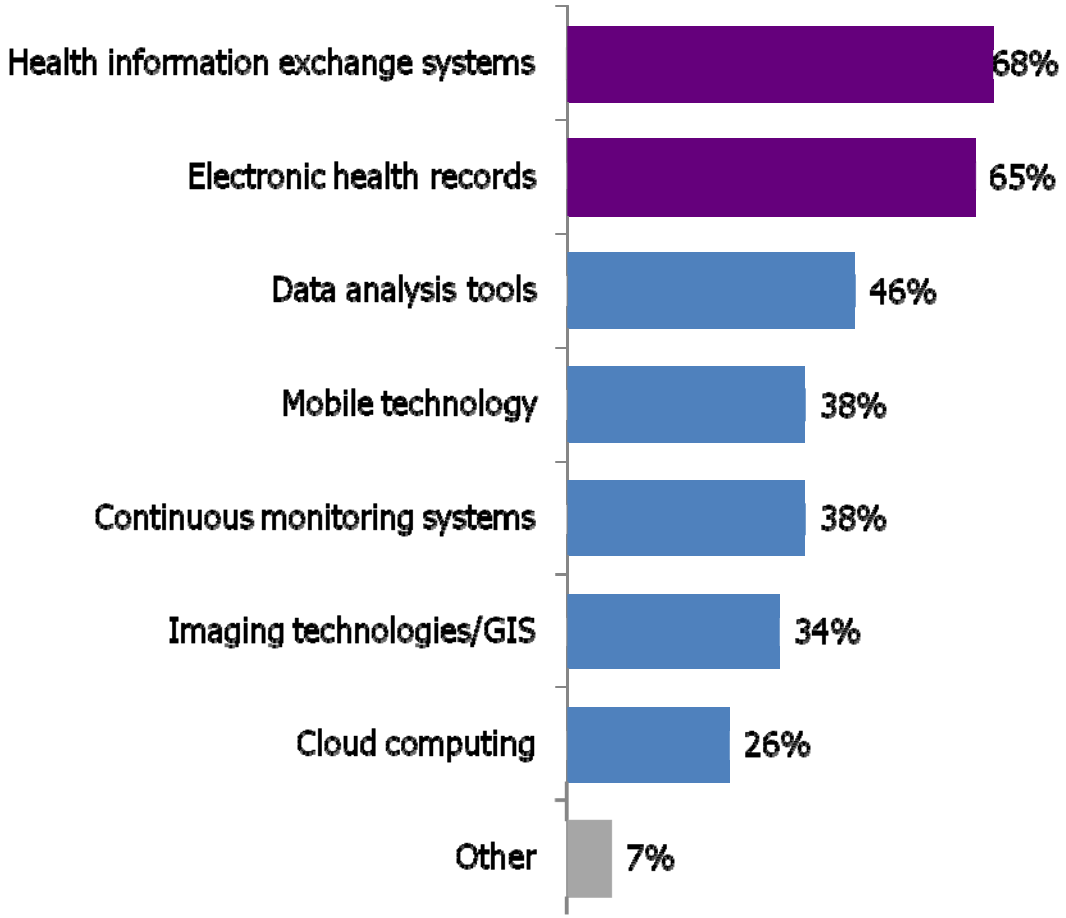
Health IT: *Tools*

- Federal managers were asked to select the tools that improve their agency's health outcomes
- **Health information exchange (HIE) systems (68 percent) and electronic health records (65 percent)** are the most helpful tools when it comes to improving health outcomes
- Data analytic tools, mobile technology and continuous monitoring systems high on list

Tools That Can Improve Health Outcomes



Percentage of respondents, n=205
Respondents could select more than one answer

NG technology focus/tool development in line with survey observations

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Applying Prediction: Sample Current Health Challenges

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Focus Areas	Unsolved Problems		
Health Systems Management	Predictive Models for Fraud Prevention	Personalized Medicine: Analytics from global benchmarks to personal life indicators	Disability analytics: tracing life events for the population (plus migration of legacy code)
State Health & Human Services	Complex business rules management for eligibility across programs	Multi-state reusable solutions to control costs, improve speed to deploy: SaaS	
Public Health	Heterogeneous data mining at national, state and personal levels	Data security; secure protection and sharing	Multi-platform affordability: from cloud to mobile, international to personal
Military Health	Modernization of complex legacy (Gordian knot)	Data security; secure protection and sharing	Multi-platform affordability: clinician and citizen data analysis & access

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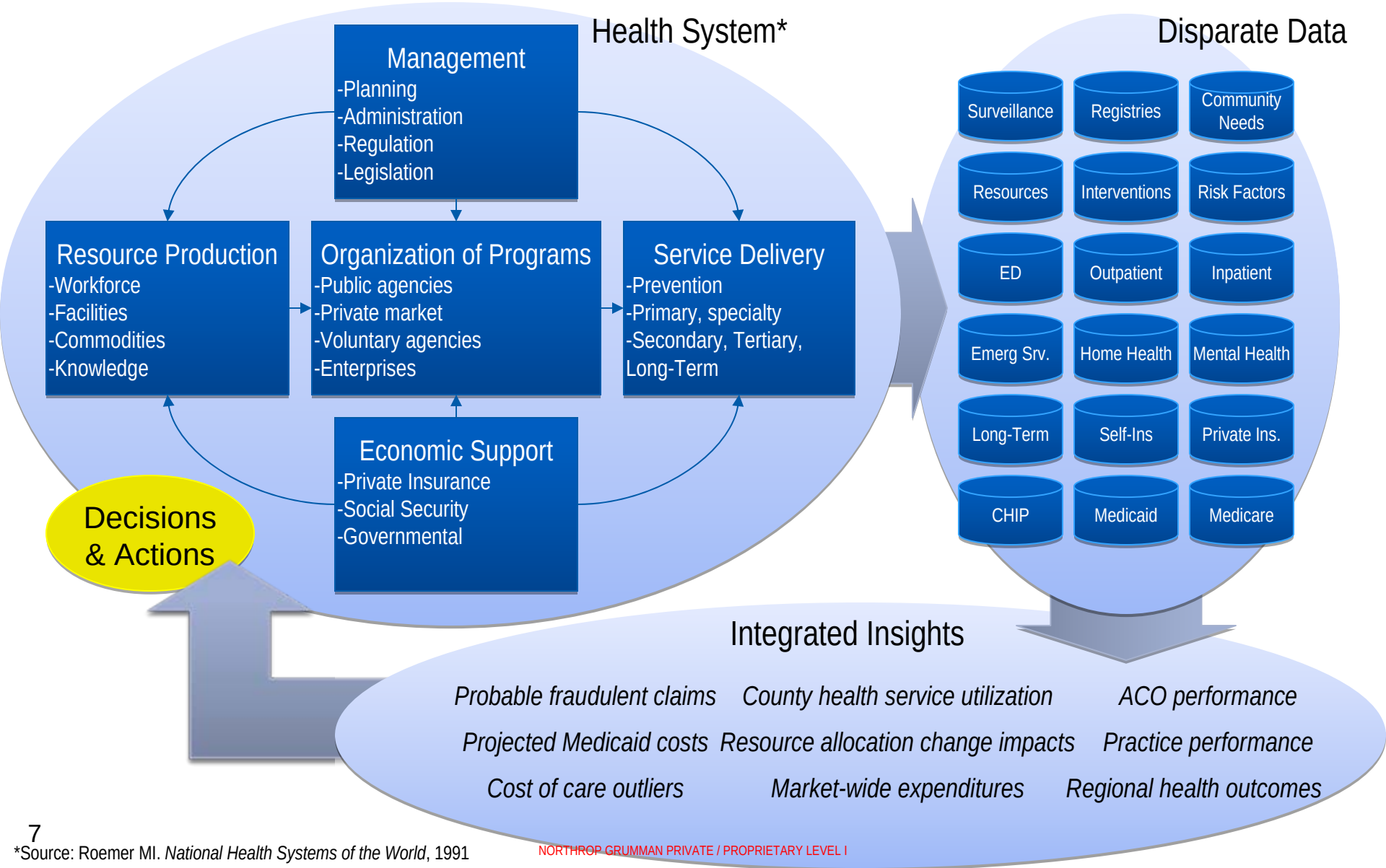
Analytics-Supported Decision Making



*Source: Roemer MI. *National Health Systems of the World*, 1991

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Types of Health Analytics and Markets

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Focus areas to drive down health costs

Health Research
(NIH, FDA, DOE, Pharma)

Healthcare
(CMS, VA, DOD/MHS)

Biomedical Research - Data Standards

- Clinical Data Interchange Standards Consortium (FDA, NIH)
- "Common Data Elements"

Implication: Integrate conventional clinical data with imaging data and various genome-based data

Generative Modeling (vs. Statistical Modeling)

- Simulated data vs. real world data
- Local risk events modeled at transactional and individual level

Implication: New models for health surveillance; shifts focus away from traditional analytic methods

Medical Informatics - Patient Code Data

- EHRs based on integrated data
- Replace ICD-9 with ICD-10
- Health Information Exchange

Implication: Track lifetime spending by individuals, new risk management models for payers and Providers

Market Size: Federal market of ~$4-6B in during the next 5 years (CMS, CDC,FDA, NIH)

Genome-based Data

- Pre-symptomatic diagnostics
- Personalized medicine

Implication: Potential of predictive health

Public Health Analytics

Biosurveillance, geographic information systems, disease modeling, prevention, health impacts, policy formation

Implication: Linking public health data to other types of health data provides a understanding of population health

Clinical Data Collection

- Integration of data across healthcare and federal systems to monitor individual and population health
- Implantable sensors automatically report health data on real-time data streams

Implication: Big data and data management challenges; real-time decision support

Health Innovation
(NIH, FDA, Pharma, Industry, DARPA, Other DoD, VA)

Public Health
(CDC, SAMHSA, DoD, Other HHS)

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Integrated Health Analytics: "Analytics Fan" Layered Framework

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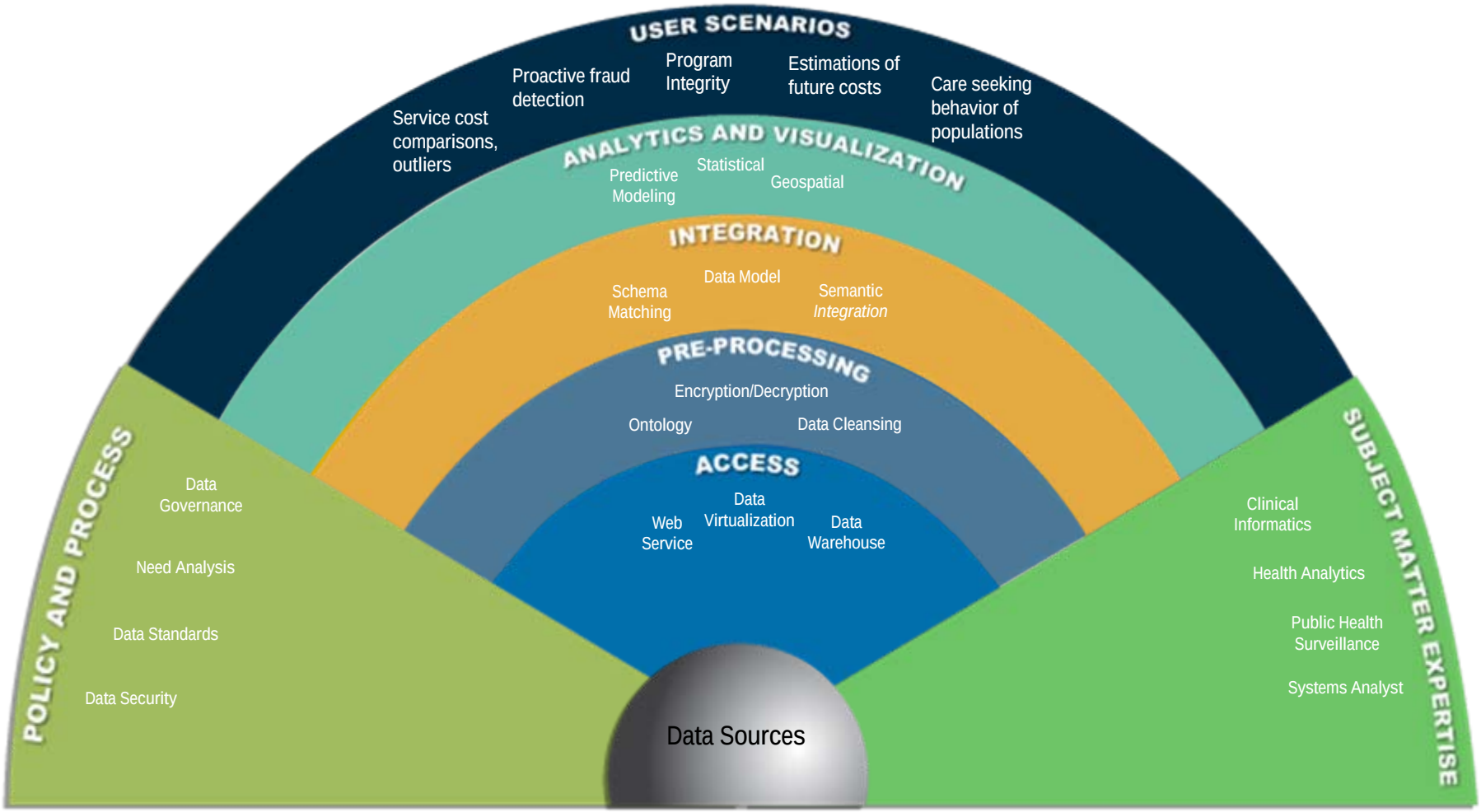

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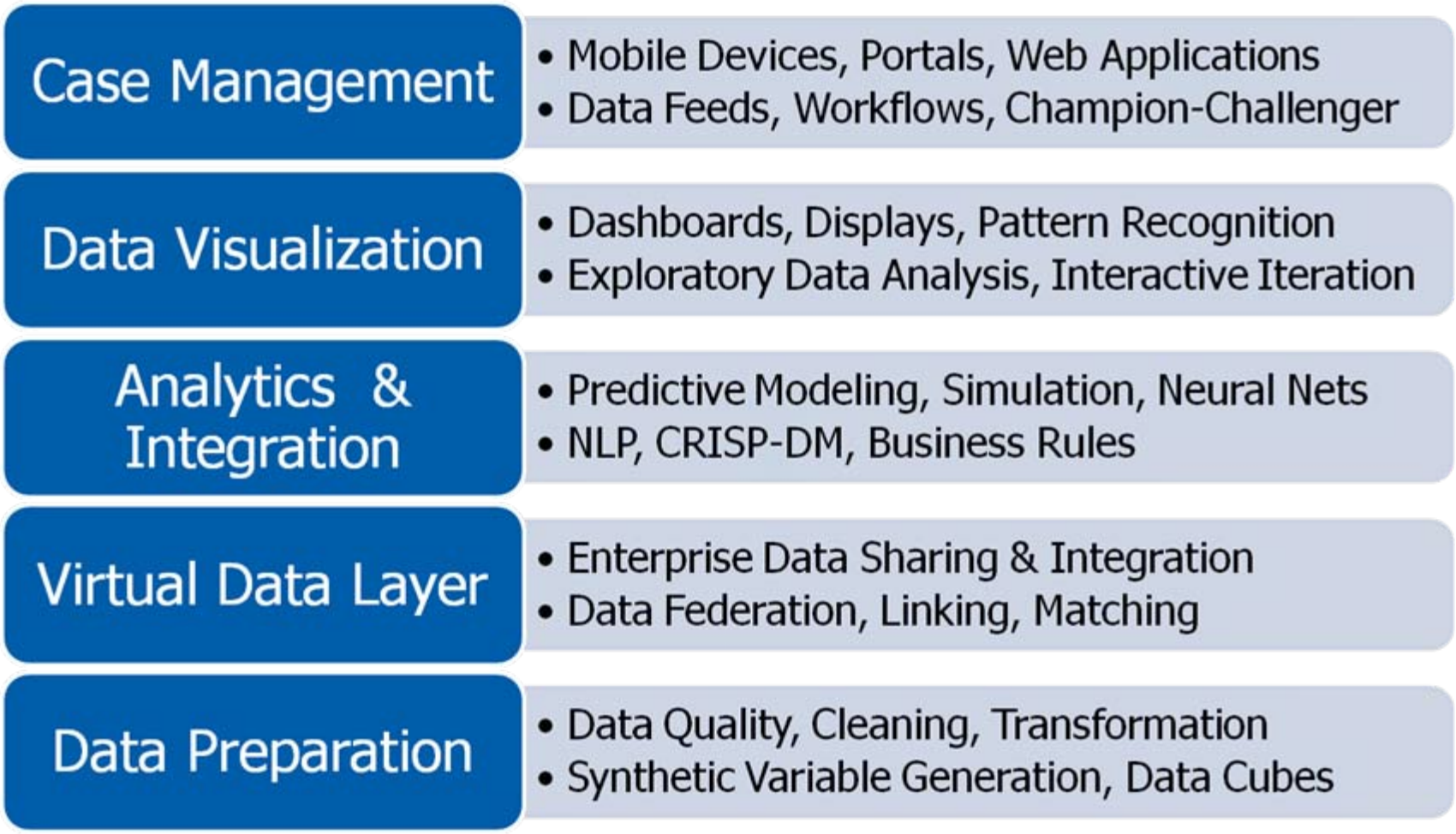
Conceptual Framework



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Analytics Maturity Model

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Foundational / Tactical

Descriptive Analytics provides limited overview

- Limited data governance
- Limited quality assurance
- Analyses are typically ad hoc and reactive
- Inconsistent use of BI tools
- More detailed reports require laborious data gathering and aggregation

Strategic Enablers

Predictive Analytics allows forecasting and planning

- Formal data management exists for critical projects
- Enterprise reporting with standard BI tools is established for relevant centrally controlled data sources
- Decision makers still depend on data mining specialists for more detailed information
- Advanced analytics and predictive models periodically available to provide decision support

Highly Strategic

Prescriptive Analytics suggests possible interventions

- Holistic systems approach to data governance
- Automatically available analyses of key performance indicators
- Power users can run additional ad hoc queries and reports
- Data mining system allows users to apply analytical tools without deep expertise
- Continuous real-time monitoring and alerts with drill-down capabilities
- Rich visualization tools
- BI integrated with business process management in a closed-loop to improve results

Provide an improved path to evidence-based decision-making

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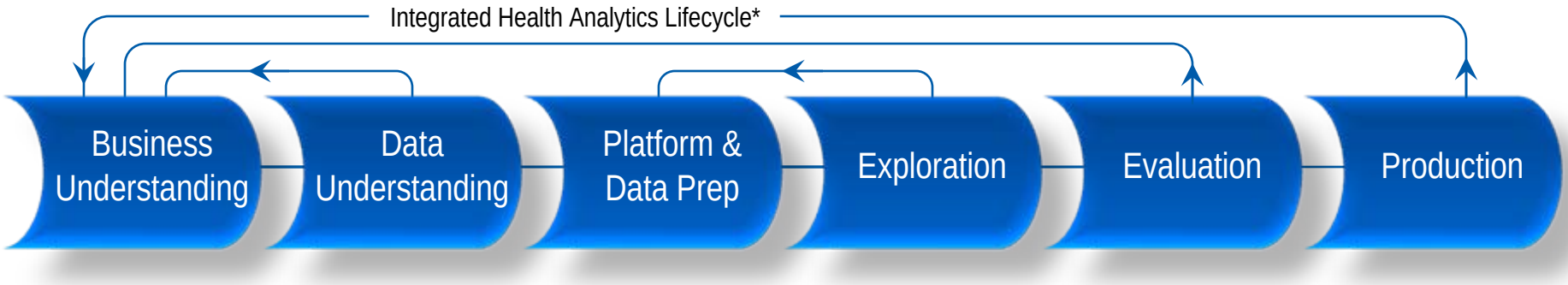
Development Process via CRISP-DM



- Determine business objectives
- Identify desired insights
- Assess environments
- Form project plan

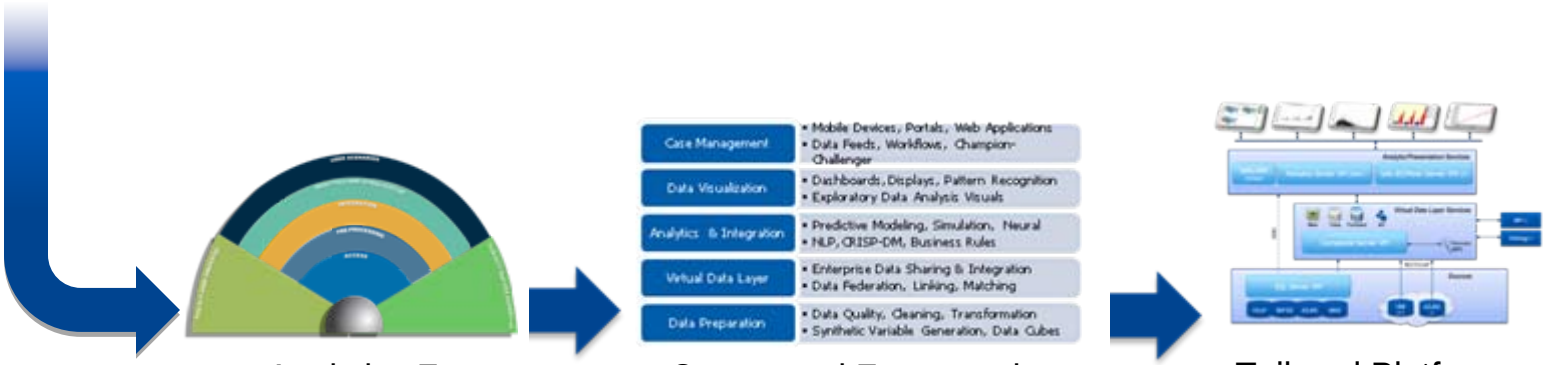
- Review data sources
- Verify data quality and completeness
- Form analytics plan
- Identify needed reference arch elements

- Construct tailored platform
- Access data sources
- Preprocess data
- Format and integrate data

- Apply analytics techniques
- Generate initial insights
- Describe findings

- Evaluate results
- Assess alignment with business objectives
- Plan for ongoing access
- Determine next steps

- Add new analytic views
- Sustain platform
- Monitor and maintain data source access



Analytics Fan | Conceptual Framework | Tailored Platform

*Adapted from: Cross Industry Standard Process for Data Mining (CRISP-DM), Visual Guide by Nichole Leaper

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Predictive Analytics Capabilities

- Provide flexibility to work with pre-existing architecture as well as new architectures
- Reduces costs and time for integration among different data sources
- Offers robust analytics, visualizations and reporting customized to customer needs managing “big data”
- Cuts operational costs
- Generates resources and support for evidence-based decision-making within “big data”

Partnering opportunities provide a win-win situation for Northrop Grumman and its partners.

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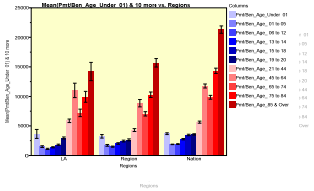
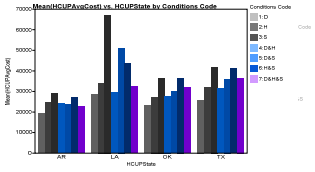
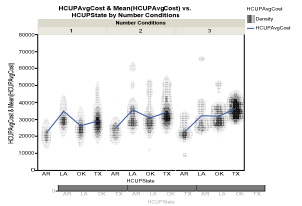
Data-driven Modeling for Health Condition, Service, and Population Costs



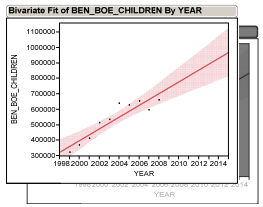
Average payment per beneficiary in age groups for state, regional, and national levels ➔ Identify high-cost sub-populations



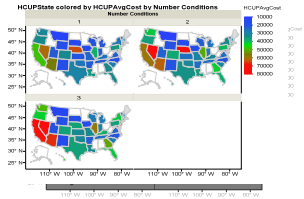
Variations among nearby states in average healthcare costs by disease conditions (diabetes, heart disease, stroke) ➔ Locations with high risk groups as well as positive results



Contrast average healthcare costs in nearby states accounting for number of risk factors (disease burden) ➔ Impact of multiple risk factors on healthy population



Trends in number of child Medicaid beneficiaries over last 10 years ➔ Increased eligibility & reimbursement requirements for ARA



State differences in average healthcare costs by number of risk factors (disease burden) ➔ National trends in cost impact of risk factors

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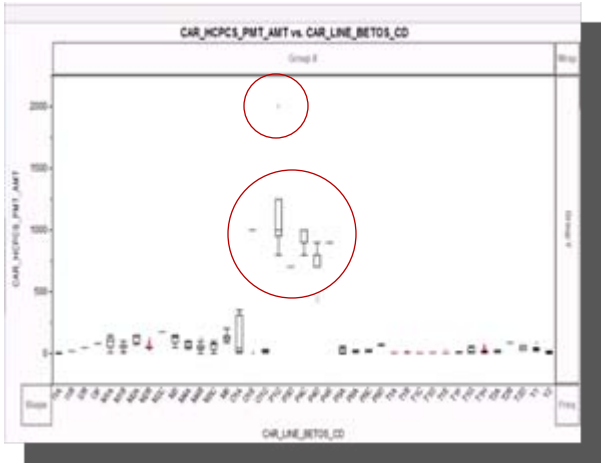
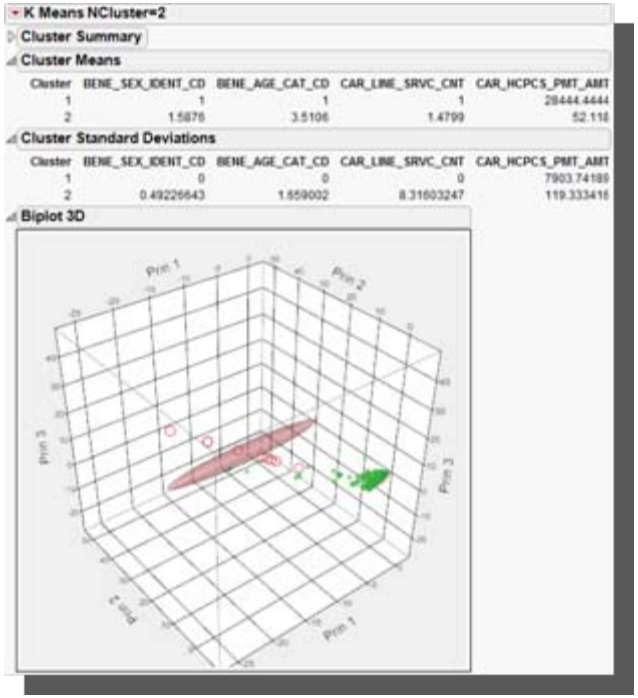
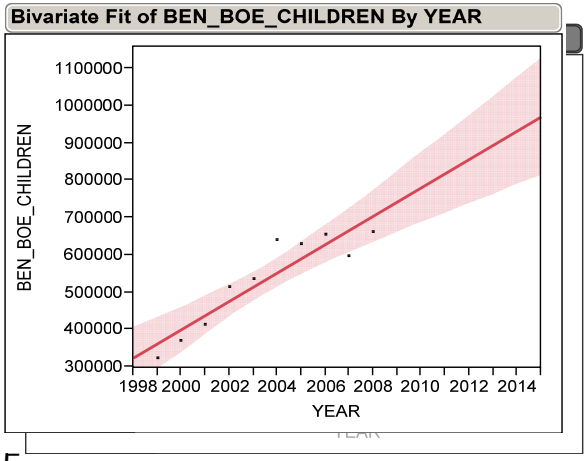
Fraud Predictive Analytics Visualizes Suspicious Information for Investigation



Anomaly Detection: Payment per Medicare beneficiary by hospital type of service code ➔ Identify services and individual cases with extreme values



Cluster Analysis: Clusters of high average costs vs. low average costs in Medicare patients ➔ Investigation of patient groups & procedures



Predictive Modeling: Predicting number of child Medicaid beneficiaries from last 10 years ➔ Increased eligibility & reimbursement requirements for ARA

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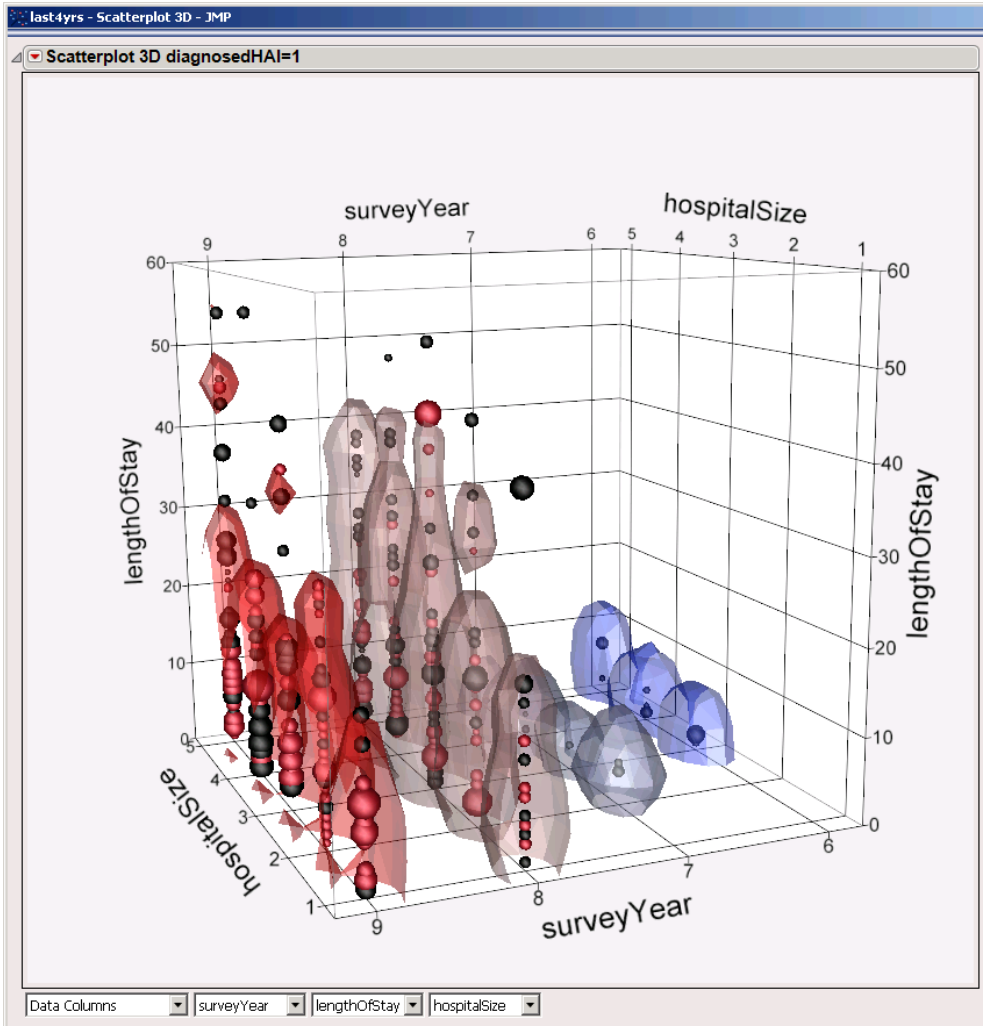
Hospital Acquired Infections (HAI) Data

- Two million patients/yr acquire HAI's – approx $28-$33B dollars in healthcare spending
- HHS goal to reduce HAIs by 25-50% in 5 yrs.
- RADC conducted exploratory analysis of HAI data from the National Hospital Discharge Survey
- Found that HAI reporting significantly increased over the study period (regulations and acceptability increasing)
- Identified data that supported known conditions:
  - Longer hospital stays lead to increased likelihood of infection
  - Hospital size scales concordantly with hospital stay
- <u>Showed CMS customer that over 50% of HAI costs were paid by Medicare and Medicaid</u>



RADC supports projects that advance health information & knowledge

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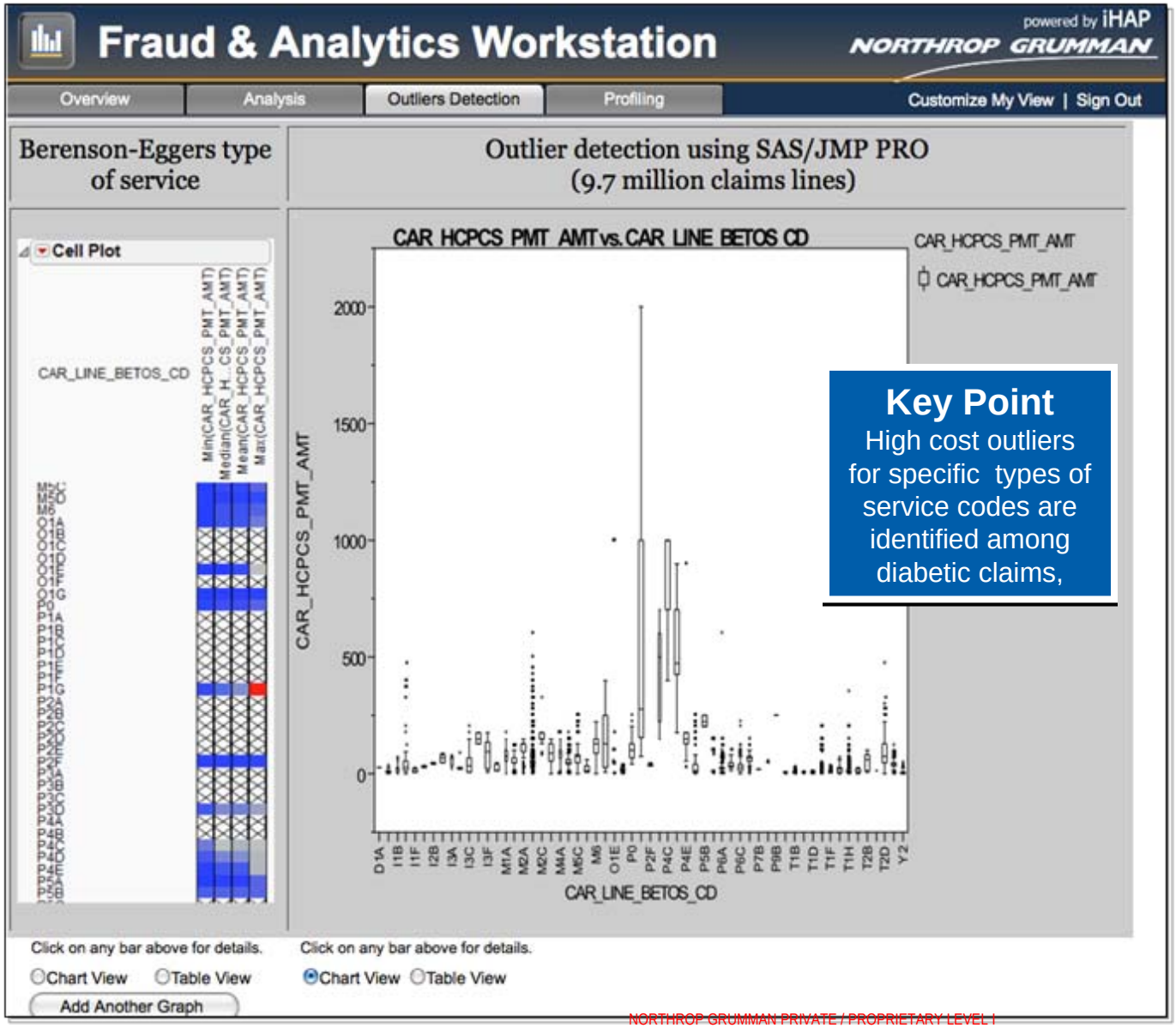
Fraud Analytics Workstation: Anomaly Detection



- User interface for FAW – used to demonstrate different fraud scenarios
- Outliers Detection tab connects to SAS product for identifying anomalies
- Using CMS PUF of over 9.7 million rows of claims data sample from 2008.
- Subset of claims by ICD-9 coding for diabetics.
- Identifies the high cost outliers for different type of service codes
- Several kinds of charts can be output for user.

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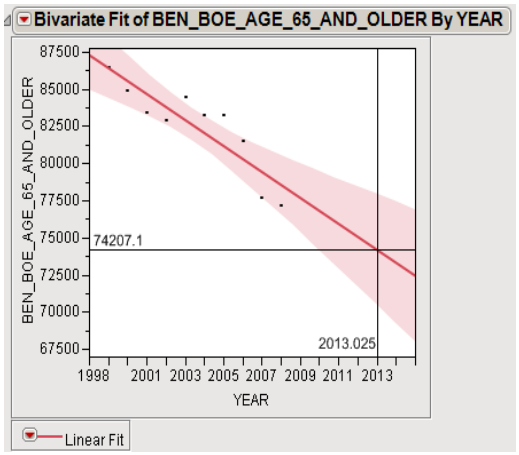
Medicaid Eligibility Projections*



Linear Fit

BEN_BOE_AGE_65_AND_OLDER = 1831633.3 - 873.03636*YEAR

Summary of Fit

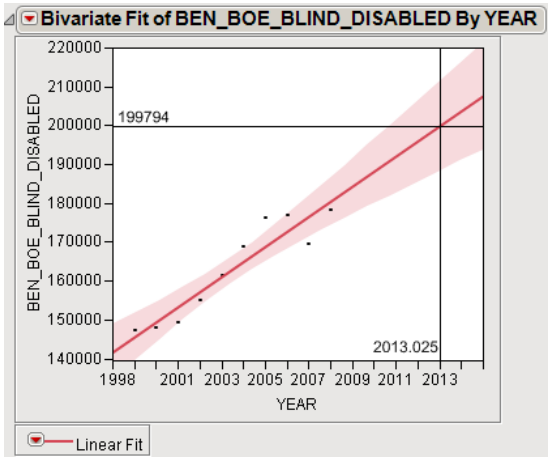
RSquare	0.781461
RSquare Adj	0.754144
Root Mean Square Error	1482.604
Mean of Response	82504.9
Observations (or Sum Wgts)	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	62880881	62880881	28.6067
Error	8	17584916	2198114.5	Prob > F
C. Total	9	80465797		0.0007*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1831633.3	327030.3	5.60	0.0005*
YEAR	-873.0364	163.2293	-5.35	0.0007*



Linear Fit

BEN_BOE_BLIND_DISABLED = -7609385 + 3879.4242*YEAR

Summary of Fit

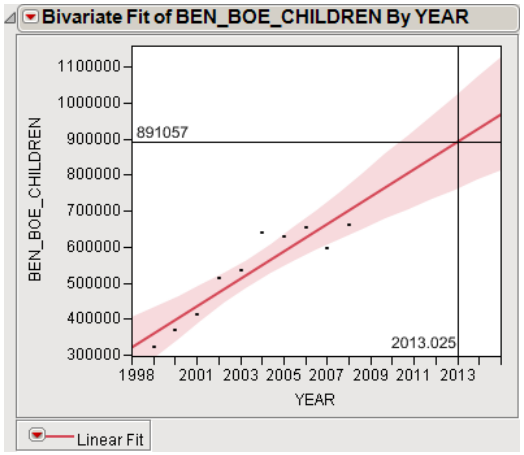
RSquare	0.881257
RSquare Adj	0.866414
Root Mean Square Error	4573.008
Mean of Response	163041.7
Observations (or Sum Wgts)	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1241619427	1.2416e+9	59.3724
Error	8	167299225	20912403	Prob > F
C. Total	9	1408918652		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-7609385	1008706	-7.54	<.0001*
YEAR	3879.4242	503.4716	7.71	<.0001*



Linear Fit

BEN_BOE_CHILDREN = -75534106 + 37966.891*YEAR

Summary of Fit

RSquare	0.84606
RSquare Adj	0.826818
Root Mean Square Error	52007.04
Mean of Response	532560.3
Observations (or Sum Wgts)	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.1892e+11	1.189e+11	43.9683
Error	8	2.1638e+10	2.7047e+9	Prob > F
C. Total	9	1.4056e+11		0.0002*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-75534106	11471626	-6.58	0.0002*
YEAR	37966.891	5725.787	6.63	0.0002*

*Excludes expansion population

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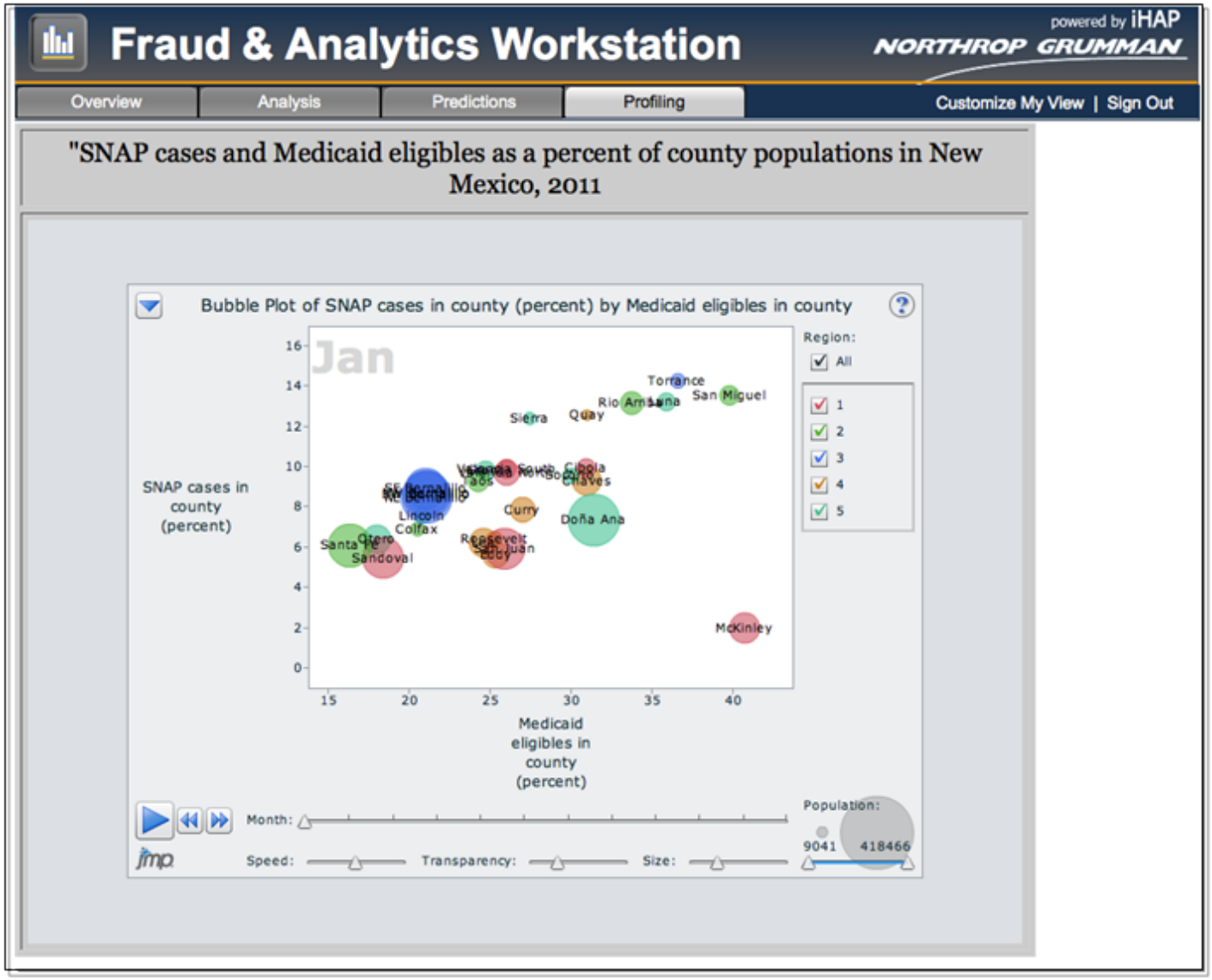
FAW Prototype: Portal Showing SNAP Cases & Medicaid Eligibles in New Mexico Counties



- This user interface tab shows a flash file of a bubble chart that displays the percent of Medicaid eligibles and percent of population on SNAP (food stamps) over time
- Bubbles float to show changes: population, percentage of SNAP recipients as well as percentage of Medicaid eligibles over time for the counties shown

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Applied Predictive Analytics: In Process

Macro-Level Research	Identification of Avoidable Expenses ★ Population-based Analysis ★ Geographic-based Analysis Cost and Performance Trends ★ Procedural Effectiveness Preventative Campaign Effectiveness ★
Measures and Benchmark Reports	Identification of Avoidable Expenses ★ Cost Measures ★ Quality Measures ★ Meaningful Use Reporting Key Performance Indicators Operations Reporting Hospital Average Length of Stay Hospital Readmission Rate Hospital Infection Rate Procedure Effectiveness Cost per Incidence of Care ★ Evidence-Based G/L Compliance

Member & Patient Analytics	Gaps in care High ED Utilization Unfilled Prescriptions ★ High Risk Members ★ High Prescription Utilization
Patient Centered Medical Home Analytics	Single Patient Visit Report Prioritized Patient Panel Report Complete Patient Panel Report Non-engaging Patient Report Population Performance Report
Quality Analytics	HEDIS Measures ★ Affordable Care Act Measures ★ AHRQ Measures Bayou Health Measures

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Virtual Data Layer | Anomaly Detection | Predictive Modeling | Cluster Analysis

Fraud Analytics Workstation

Home | Data Preparation | Model Management | Discovery Analytics | Reporting | Tools | Help

Login

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Alerts

17 Anomalies

Models: 2 ready for

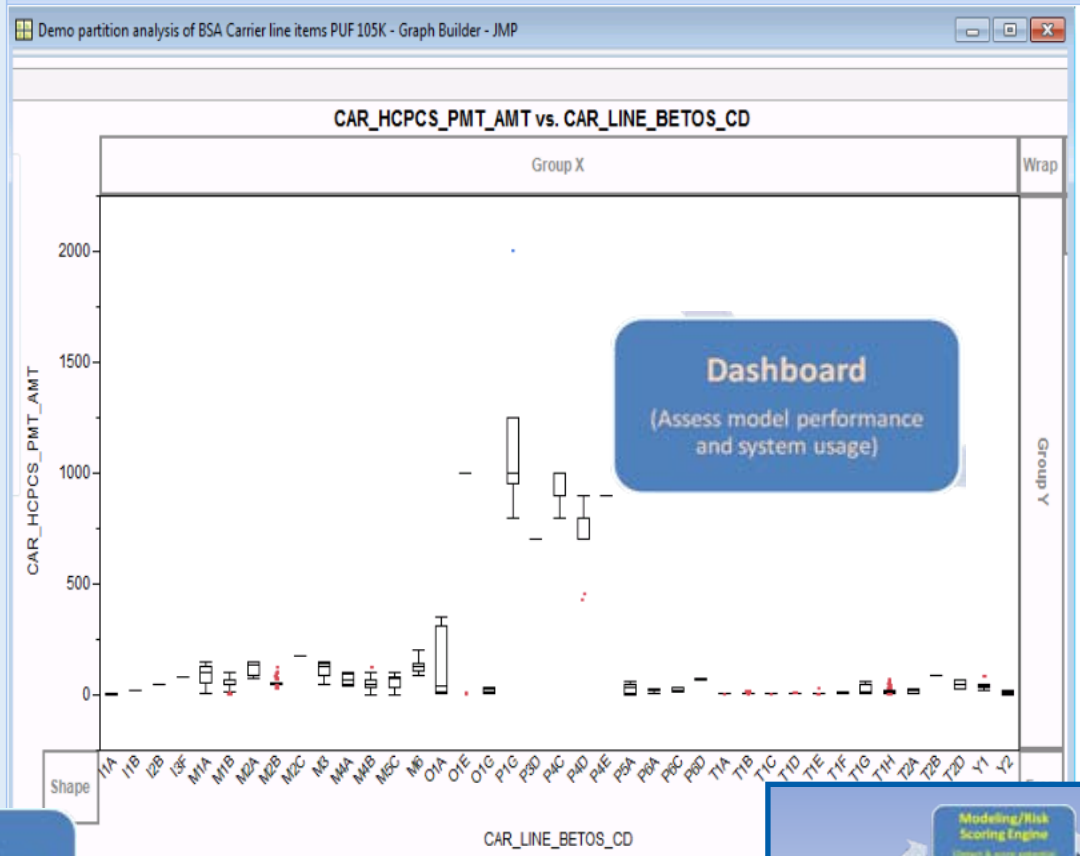
Data: Update in CMS

System update avail

Case & Workload Management

(Review & update cases)

Visualization/Reporting



Dashboard

(Assess model performance and system usage)

Data Preparation

- BRFSS
- CMS PUF
- CMS PUF 2
- NM MSR
- CMS Chronic
- HCUP
- MSIS

Model Management

- Load
- Create
- Modify
- Test/Verify
- Publish

Modeling/Risk Scoring Engine

(Detect & score potential frauds)

Discovery Analytics

- Anomaly Detection
- Predictive Modeling
- Cluster Analysis
- Social Network Analysis
- Natural Language Processing

Analysis Sandbox

(Perform Model Analysis)

Research Utilities

(Perform research on cases, beneficiaries, and providers)

cription: Anomaly: Cost distributions of service codes for diabetes

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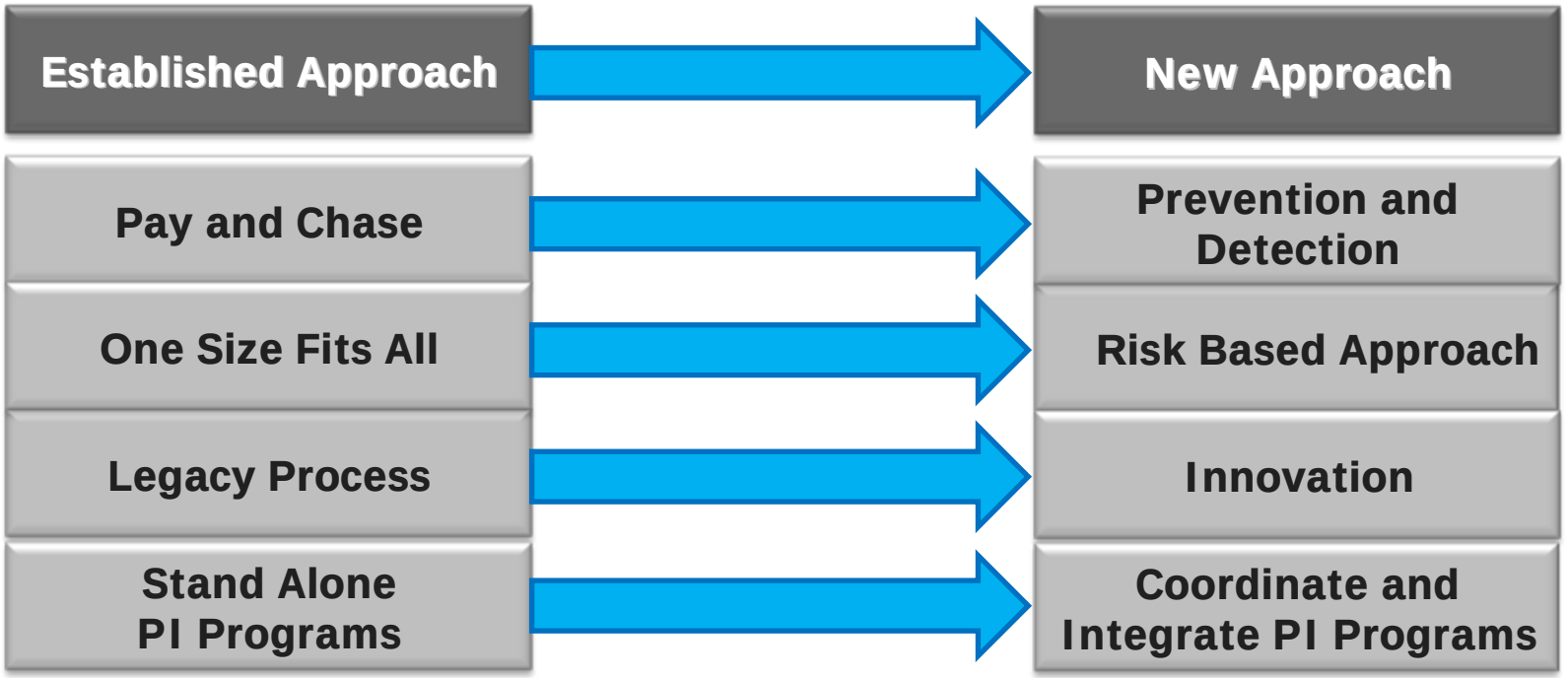
Strategic Direction

Section 4241 of the Small Business Jobs Act of 2010 (SBJA) mandates that CMS implement a predictive analytics system to analyze Medicare claims to detect patterns that present a high risk of fraudulent activity, and enables CMS to employ real-time, pre-payment claims analysis to identify emerging trends of potentially fraudulent activity.



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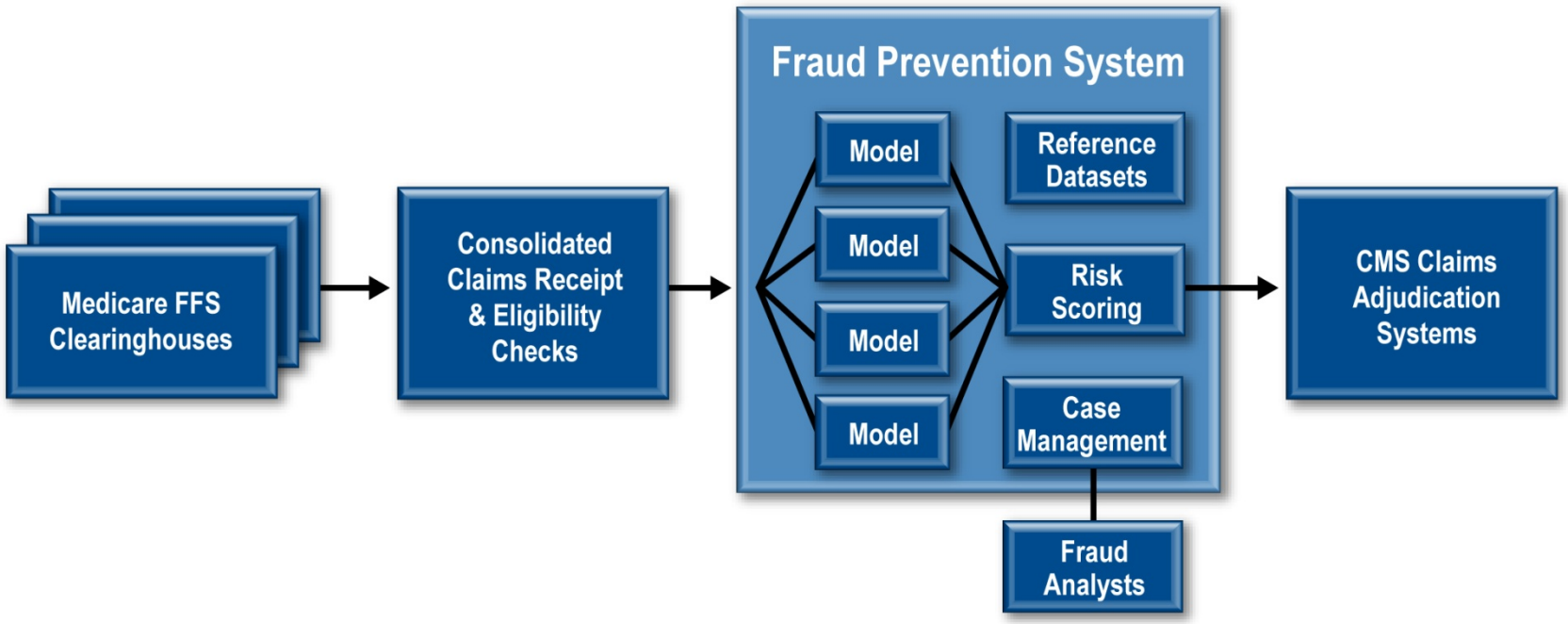
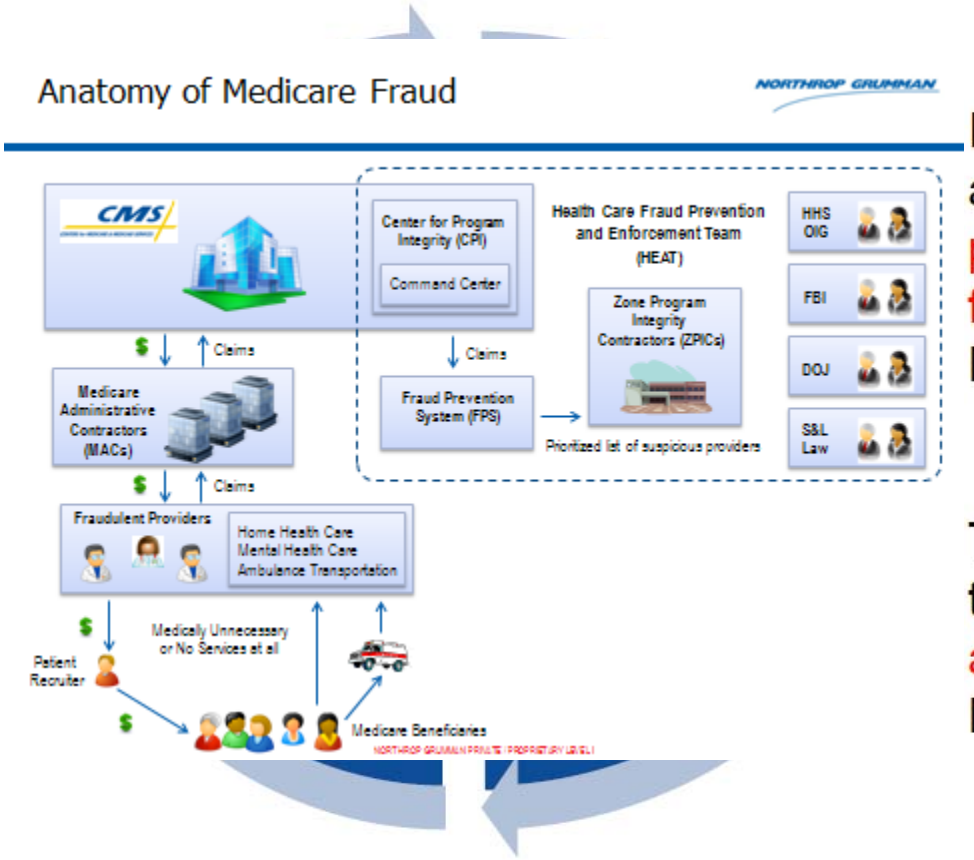
FPS Operation Flow



National Fraud Prevention Program
Two-pronged Approach

Take quick administrative action to prevent improper payments

Take quick action to remove bad actors from Medicare



Identify bad actors and prevent them from enrolling in Medicare

Take quick action to remove bad actors from Medicare

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Advantages of Fraud Prevention Program

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- Prevent the payment of claims that have been identified as potentially fraudulent
- Integrate predictive modeling as part of an end-to-end solution that triggers effective, timely administrative actions by CMS
- Assure that analytics are effective (minimize false positives), risk-based, and efficient
- Real-time access to high quality data
- Integration of multiple data sources (e.g., complaint data, compromised numbers)
- Understand patterns of care and utilization
- Understand payment errors and program vulnerabilities
- Identify areas for policy changes and provider education
- Allow interventions to be made before issues grow

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Limitations and Challenges for Predictive Modeling

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- Need accurate data to validate predictions.
- Access to certain variables limits measurement.
- Linking data is challenging.
- Correlation is not causation. Lots of confounding variables can get in the way.
- Difficult to predict from one group or situation to another environment.
- Experiments and trials to test relationships can be expensive and lengthy.

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Predictive Analytics & Personalized Medicine

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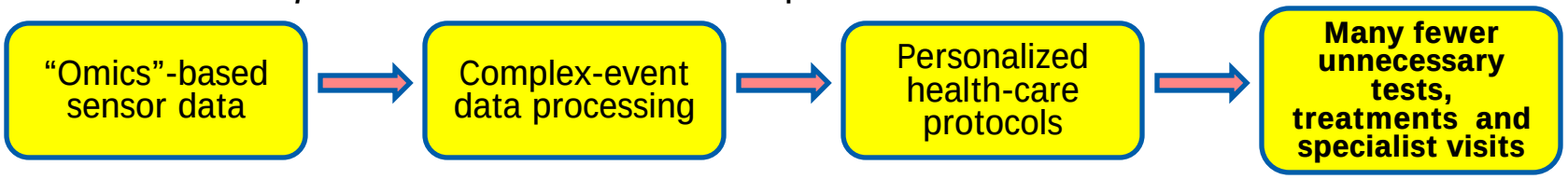
Personalized Medicine: A "Game Changing" Focus for Health

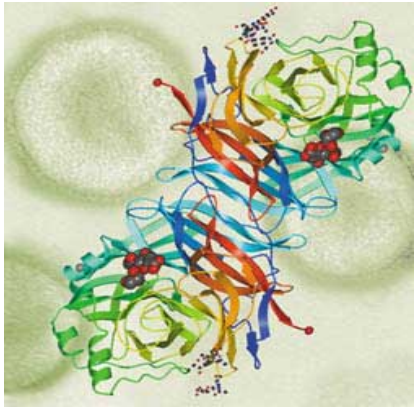
Uses information about a person's genes, proteins, and environment to prevent, diagnose, and treat disease – this includes such areas as genomics, proteomics, and metabolomics ("omics")

Paradigm shift that moves the current medical model of being *reactive* to disease to one that is more *proactive* for treatment and prevention



What will enable this revolution in healthcare?

- **Rapid reduction in cost** of genomic & proteomic analysis to become clinically affordable
- **Massive amounts of analyzed data** will help reduce cost of developing new cures, and allow better targeting of treatment/life-style recommendations to keep people healthier
- **Large, secure, reliable national Health IT systems** to support widespread clinical value and use



"Omics" discovery, development, and translation will be one of the major disruptive health advances of the 21st Century

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Predictive Analytics

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- Explosive data is a great asset and necessary
  - But, it hampers data integration, quality, standardization
- Data Scientists growth in developing comprehensive rules and algorithms
- The maturation of predictive analytics is creating the visibility to enable
  - Improved Health Outcomes
  - And Reduced Costs

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