Clinical Integration & Population Health
Including Predictive and Prescriptive Analytics
and Decisioning Systems:
A GLIMPSE at the FUTURE
April 12, 2015

Dr. Gary Miner, Healthcare Predictive Analytics Vision and Thought Leader, Dell Software
Dr. Ken Yale, Vice President of Clinical Solutions, ActiveHealth Management

DISCLAIMER: The views and opinions expressed in this presentation are those of the author and do not necessarily represent official policy or position of HIMSS.

www.himssconference.org
Dr. Gary Miner

- Works for Dell Statistica Software and is a thought leader and member of the Dell analytic solutions innovation team.
- Doctorate from the University of Kansas, Post-doctoral fellowships in Behavioral Genetics (University of Minnesota) and Psychiatric Epidemiology and Biostatistics (NIH/University of Iowa).
- Research focuses on: Familial Alzheimer’s Disease.
- Organized the first International Conference on Familial Alzheimer’s Disease held in Tulsa, OK.
- Prolific writer with numerous works to his name including: *Familial Alzheimer’s Disease*, *Caring for Alzheimer’s Patients*, and *Practical Predictive Analytics & Decisioning Systems for Medicine*.

Dr. Ken Yale

- Works at ActiveHealth Management, a research-based, advanced clinical decision support, data analytics and care management company.
- Holds a teaching appointment in predictive analytics in healthcare with the University of California, and on several industry boards and committees.
- Previously founded and built innovative health companies in medical management, health data analytics, and patient engagement.
- Held senior government posts in the White House, U.S. Senate, and U.S. Public Health Service.
Conflict of Interest Statement

Gary Miner, PhD employed by Dell
He is also an instructor at the University of California
Has no real or apparent conflicts of interest to report.

Ken Yale, DDS, JD employed by ActiveHealth Management, an independent subsidiary of Aetna. He is also an instructor at the University of California
Has no real or apparent conflicts of interest to report.
POPULATION HEALTH and SUB-POPULATION HEALTH:

*Health and Care Transformation coming in three waves:*

a) Provider *Evolution*

b) Consumer Retail *Revolution*, and

c) Health System *Devolution*

PREDICTIVE ANALYTICS – DECISIONING – PRESCRIPTIVE ANALYTICS:

*Reaching maturity in data analytics*

‘FLIPS’ in how HEALTHCARE is being delivered to populations:

*True Personalized Medicine* - *Person-Centered HealthCare*

Thus: reaching all populations AND reaching every individual
Learning Objectives

• Identify technologies and applications that foster PHM (*Population Healthcare Management*) and strategies to engage physicians and care teams in promoting their use.

• Describe the benefits of shifting from disease management to wellness management and the utilization of resources that support this model.

• Explain how processing data from disparate applications can be used to create information and knowledge to improve patient wellbeing.

• Understand how predictive and prescriptive analytics will provide the models that will provide both increased accuracy in medical diagnosis and treatment and enhance bringing medical costs under control.

• Create awareness of how the future will be centered around new models of population / sub-population healthcare delivery where the core-concept is ‘The Person - The Patient’ including transformations like a) Provider Value Evolution, b) Consumer Retail Revolution, and c) Health System Devolution – all of which leads to ‘Precision Medicine’
What do T-BONE STEAKS have to do with HEALTHCARE – especially POPULATION HEALTH CARE?

We will let this question ‘stick with you’ until the end of our presentation.

BUT now to the concerns of POPULATION and SUB-POPULATION HEALTHCARE and Predictive Analytics & Prescriptive Modeling.
OECD Country Rankings
Dysfunctional System

Aggregate Hospital Payment-to-cost Ratios for Private Payers, Medicare, and Medicaid, 1990 – 2010

Distribution of Hospital Cost by Payer Type (% of Total Cost)

Source: Avalere Health analysis of American Hospital Association Annual Survey data, 2010, for community hospitals.

(1) Includes Medicaid Disproportionate Share payments.
(2) Uncompensated care represents bad debt expense and charity care, at cost.
(3) Non-patient represents costs for cafeterias, parking lots, gift shops and other non-patient care operating services and are not attributed to any one payer.
Complexity of Modern Medicine

"The complexity of modern medicine exceeds the inherent limitations of the unaided human mind"
– David Eddy, 1990

Transformational Waves c. 2010

WAVE 1
PATIENT-CENTERED CARE
2010-2016

FROM
Physician-centered
Transactional; isolating
Sick-care
Inaccessible
Patient turnover-volume
Unwarranted variation

TO
Patient-focused
Care team managed
Health and well-being
Convenient and 24/7
Patient health-value
Evidence-based standard

WAVE 2
CONSUMER ENGAGEMENT
2014-2020

FROM
Uninformed
Limited engagement
Isolated individual
Limited consequence
Bricks, office hours
Physician opinion

TO
Informed, shared decisions
Highly engaged/empowered
Socially connected
Financial rewards/incentives
Virtual, mobile, anytime

WAVE 3
SCIENCE OF PREVENTION
2018-2025

FROM
Basic health management
Symptom treatment
One-size-fits-all
Limited biomarkers
Big pharmaceuticals
Medical competencies

TO
Genome-linked life plan
Monitoring and prevention
Personalized therapies
100% accurate diagnostics
Tailored gene/microbiome therapies
Life, social, and ethics competencies

Source: Oliver Wyman analysis
Provider Value Evolution
2010-2018
- Population Health Management
- Descriptive Analytics
- Clinical and Claims Data

From
Volume, patient turnover
Physician-Centered
Provider transaction, episodic
Sick care
Inaccessible
Unwarranted variation

To
Value, patient health
Patient-Centered
Care Team, Coordinated
Wellness and prevention
Convenient, 24/7
Evidence based protocols

Source: 2014, Oliver Wyman
New Provider Business Models

Evolution of the Delivery System

Pay for Volume
Healthcare Delivery

PCMH
Medical Home
Primary Care Practitioners

Provider Network
Specialty Providers

Clinically Integrated Networks/Systems

Accountable Care
Accountable Care Organizations

Healthcare Financing and Management
Pay for Value
New Provider Business Needs

Evolving Payment Methodology

- Full Capitation
- Global DRG Fees: Hospital & Physician
- Global DRG Fees: Hospital
- Global Fees: Primary Care
- FFS and Shared Savings
- FFS and P4P
- Fee-for-Service and DRG

Evolving Maturity

- Independent Hospital and Physician Practices
- PCP Group Practices
- Multi-Specialty Physician Group Practices
- Integrated Delivery System PHO
- Clinically Integrated Network
- ACO

Health Data Input

- Managing Clinical Quality
- Managing Health Costs
- Managing Risk

Health Information Output

Greater Need For New Support Systems And Services

Health Plan

Population Health Management Targets

5% Poly chronic

20% Chronic and at-risk

75% Healthy, minor issues

% of Population

% of Expenditure

45%
ER visits, over-utilization, high care variation, non-compliance

35%
Infections, complications, and rehospitalizations

20%

Source: Oliver Wyman
Population Health Management Tools

Accountable Care Solutions

- Health Plan
- Price & Cost
- Consumer
- HIE
- Mobile IoT
- CDS Data Analytics

Source: 2014, Healthagen, an Aetna Company
Health and Care Transformation Update

Consumer Retail Revolution
2015-2020
- Personal Health Management
- Predictive Analytics
- Exogenous Data

From
Uninformed
Limited engagement
Isolated patient
Limited consequences
Bricks, office hours
Physician opinion

To
Informed, shared decision-making
Patient-engaged, empowered
Socially interconnected consumer
Financial rewards, incentives
Virtual, mobile, anytime/anywhere
Evidence-based medical facts

Source: 2014, Oliver Wyman
Health Data Volume Exploding

Data storage has grown significantly, shifting markedly from analog to digital after 2000
Global installed, optimally compressed, storage

SOURCE: McKinsey Global Institute analysis
Health Data Variety Expanding

Four distinct big data pools exist in the US health care domain today with little overlap in ownership and low integration.

Data pools:
- Pharmaceutical R&D data
  - Owner: Pharmaceutical companies, academia
  - Example datasets: clinical trials, high throughput screening (HTS) libraries
- Clinical data
  - Owners: providers
  - Example datasets: electronic medical records, medical images
- Activity (claims) and cost data
  - Owners: payors, providers
  - Example datasets: utilization of care, cost estimates
- Patient behavior and sentiment data
  - Owners: various including consumer and stakeholders outside health care (e.g., retail, apparel)
  - Example data sets: patient behaviors and preferences, retail purchase history, exercise data captured in running shoes

Integration of data pools required for major opportunities.

SOURCE: McKinsey Global Institute analysis
Health Data Velocity Increasing

**Computation capacity has also risen sharply**
Global installed computation to handle information

<table>
<thead>
<tr>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^{12}$ million instructions per second</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.001</td>
<td>6</td>
<td>6</td>
<td>6.379</td>
</tr>
</tbody>
</table>

**Detail**

- Pocket calculators
- Supercomputers
- Servers and mainframes
- Mobile phones/PDA
- Video game consoles
- Personal computers

**SOURCE:** Hilbert and López, “The world’s technological capacity to store, communicate, and compute information,” *Science*, 2011

**SOURCE:** McKinsey Global Institute analysis

NOTE: Numbers may not sum due to rounding.
Health and Care Transformation Update

Health System Devolution
2018-2025
- Precision Health Management
- Prescriptive Analytics
- Genomics

From
Basic health management
Symptomatic treatment
One-size-fits-all
Limited biomarkers
Mass produced pharmaceuticals
Medical competencies

To
Genomic-linked life plan
Continuous monitoring and prevention
Personalized treatments
100% accurate diagnoses
Tailored gene/microbiome therapies
Life/social/ethics competencies

Source: 2014, Oliver Wyman
Analytics Key to Transformation

Source: Competing on Analytics, Davenport/Harris, 2007
## Healthcare Analytics Market Today

<table>
<thead>
<tr>
<th>Traditional</th>
<th>Provider Value Evolution</th>
<th>Consumer Retail Revolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Reporting (26%)</td>
<td>Scorecards</td>
<td>Patient &amp; Exogenous Data</td>
</tr>
<tr>
<td>Operational Reporting (24%)</td>
<td>Risk Management</td>
<td>Population Micro-Segments</td>
</tr>
<tr>
<td>Revenue/contract reports (20%)</td>
<td>Patient Satisfaction/Loyalty</td>
<td>Predictive Modeling Individuals</td>
</tr>
<tr>
<td>Cost Management (16%)</td>
<td>Facility-Specific CDS</td>
<td>Real Time PA for Consumers</td>
</tr>
<tr>
<td>CDS/EBG (14%)</td>
<td>Resource/Price Monitoring</td>
<td>Personalized Care Plans</td>
</tr>
<tr>
<td></td>
<td>Actuarial/contract modeling</td>
<td>Real-Time at Point of Care</td>
</tr>
<tr>
<td></td>
<td>Risk Stratification</td>
<td>Multi-Modal</td>
</tr>
<tr>
<td></td>
<td>Utilization Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Registries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Network/facility optimization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDS on Integrated Data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Real-Time Risk Identification</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Real-Time Referral Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Predictive Model Consumers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply Chain Optimization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PHM scorecards</td>
<td></td>
</tr>
</tbody>
</table>

Source: 2014, The Advisory Board
Healthcare Analytics Tomorrow

Collect
Large volumes of data ingested from a variety of health and exogenous sources:
- Medical, Rx, and behavioral claims
- Labs and biometrics
- Physician and inpatient EMR
- Physician feedback
- Nurse Care Manager
- Member self-report

Identify
CDS identifies opportunities for health improvement using:
- Predictive analytics
- Evidence-based algorithms

Stratify
Individuals are assessed for risk and impactability:
- Healthy, no risks
- Low risk
- Moderate to high risk
- Acute or complex

Recommend
Individuals are referred to available programs:
- General wellness
- Decision support
- Lifestyle coaching
- Condition management
- Maternity support
- Case management
- Transitions/Compassionate care

Segment and Communicate
Consumers grouped by needs, behaviors and preferences
Communications tailored and engagement mode selected/promoted

Engage
Engagement modes vary by opportunity:
- High-tech digital to high-touch one-on-one
And use consistent content across all services:
- Individualized
- Clinically robust
- Prioritized
- Motivational
- Health literate
- "Snackable"

Report
Enhanced engagement reporting

Source: © 2015, ActiveHealth Management, an Aetna Company @docyale
VALUE FOCUS: improved quality and affordability, including quality control and “lean” management principles, improving operating processes and results of a hospital or other healthcare facility … this involves the ‘Lean Hospital Movement’

PREDICTIVE ANALYTICS applied to 1) healthcare administration, 2) healthcare diagnosis, and 3) healthcare (treatments) delivery – for the individual patient

DECISIONING SYSTEMS: the 3rd necessary component to insure that ACTION results from the PA analysis models, thus leading to “prescriptions” that are more accurate, with less chance of side effects including hospital readmissions
What Results?

Reducing Errors

Reducing Costs

Improving Outcomes
Seven Ways PA Improves Healthcare

1. Increase the accuracy of diagnoses
2. Help preventive medicine and public health
3. Gives physicians answers for individual patients
4. Provide employers/hospitals predictions about insurance
5. Allows researchers to develop prediction models without thousands of cases, and increasing accuracy over time
6. Pharmaceutical companies better meet need for drugs
7. Patients get better outcomes

Source: Linda Miner, PhD
http://www.elsevier.com/connect/seven-ways-predictive-analytics-can-improve-healthcare
Predicting MI With Near 100% Accuracy

ER patients with "possible heart attack" symptoms

Testing causes overcrowding, clinical risk and duplication of effort, costing billions annually. Up to 85% are ultimately diagnosed with other conditions.*

In a study‡ of ER practices on chest pain patients, doctors introduced advanced data mining algorithms to predict test outcomes and score likelihood of impending cardiac events vs. stress-induced ischemia.

Results:

• Near 100% accuracy compared to traditional tests
• “A substantial subset of patients [could be] safely discharged without performing MPS and subsequent outpatient follow-up”
• Enhancing ER practices with predictive analytics would improve patient care (reduced time and stress) and cut medical costs (fewer overnight stays, fewer tests, and reduced physician time)
• Analytics could someday replace costly medical tests.

‡ Sergii Alekseiev, MD, and Ambria Harris, DO, 2013
Study results showed 100% specificity using one data mining algorithm (Boosted Trees), and 100% sensitivity using a different predictive algorithm (Neural Networks).
Predicting MI With Near 100% Accuracy

As a result of their findings, the study’s authors suggest implementing change of emergency room practices.
A Prediction Model for Life or Death

Disseminated Intravascular Coagulation (DIC) Symptoms at Admission

- Joint Project between Loma Linda Medical School and St. Francis Medical Center Tulsa
- Phase I and Phase II

Source: Goldstein, Khichi, Miner & Tinsley
Overview of DIC Project

- DIC is a pathological condition of system-wide hemorrhaging and clotting, occurring secondary to other conditions such as trauma or infection and many times following surgery.
- Some cascade triggers are known, however, the individualized triggers are not.
- Some children with sepsis, for example, develop coagulopathy and expire, while others do not.
- We wanted to develop an accurate prediction model, which could yield clues as to increasing good outcomes.

Source: Goldstein, Khichi, Miner & Tinsley
Goals of DIC Project

To see if a model could be generated that would use the variables listed \textbf{at admission} to predict death or discharge.

Source: Goldstein, Khichi, Miner & Tinsley
Phase I: Initial Model Development

- Dr. Khichi’s hospital: - Retrospective chart review
- **Inclusion**: all critically ill children, between 1/2011 and 3/2013 in which the critical illness could affect DIC parameters when admitted to intensive care.
- **Excluded**: hematology oncology patients with primary coagulopathy without critical illness affecting DIC parameters
- N = 30

Source: Goldstein, Khichi, Miner & Tinsley
Feature Selection

- Feature Selection generated 5 numerically measured variables and 4 text variables, out of all the variables.
- These selected variables were used competitively in data mining (Predictive Analysis).

Source: Goldstein, Khichi, Miner & Tinsley
SVM = “Support Vector Machines” modeled the lowest error rate at 3.3%, Meaning that this model was 96.66% ACCURATE in predicting patient outcome from DIC

Source: Goldstein, Khichi, Miner & Tinsley
Death

Lift Chart for *Death* shows relative effectiveness of models

Source: Goldstein, Khichi, Miner & Tinsley
Discharge

Lift Chart for *Discharge* shows relative effectiveness of models

Source: Goldstein, Khichi, Miner & Tinsley
Support Vector Machine Results

Interactive SVM: 93% accuracy

CROSS-VALIDATION (CV) Used for this “iterative SVM” analysis to help Determine ‘validity’ of the Model; this CV Accuracy was 86.6%, which for the Best model should be closer to the Test / Train Accuracies, e.g. about 93%;

More data needed to Increase validity of this model

The overall model suggests the direction one needs to pursue

Source: Goldstein, Khichi, Miner & Tinsley
Further Test and Develop the Predictive Analytic Model

At the end of the Phase I the research group wondered if more data could be obtained to test and refine the model. At this point, it looks good that this will happen.

Dr. Cynthia Tinsley and Dr. Mitch Goldstein have submitted the IRB application to Loma Linda University – the research group is awaiting approval.

According to Dr. Tinsley once we obtain IRB approval she will send it to the Virtual PICU (*Pediatric Intensive Care Unit*) for Loma Linda Medical Center – Children’s Hospital. Approval is expected.

Should all approvals for use of patient data be obtained, the research group will collect additional data (*in the thousands of cases*) to compare to the first analysis to use as validation tests and to further develop the prediction model.

Source: Goldstein, Khichi, Miner & Tinsley
Reducing Surgical Site Infections (SSIs) and readmissions with real-time predictive models during surgery

Results:
• Improved quality of patient care
• Reduction in SSIs and readmission rates
• $97,740 for each quarter of intervention

Dr. John Cromwell, associate chief medical officer and director of surgical quality and safety at the University of Iowa Hospitals and Clinics
What Does The Future Hold?
FLIP #1: The “Direct Care” Concept

- Formed because doctor(s) tired of “Not being able to really care for patients”
- Care model “flipped this around” - NO insurance forms needed for primary care
- Physicians can spend 45 minutes with a patient, seeing only 6 – 8 patients/day
- QUALITY TIME prevents health problems from escalating into expensive care propositions
- COST: $65 / MONTH / PATIENT

("….there are no INSURANCE CODES for ‘CURE’……")

Source: http://qliance.com/
FLIP #2: Value To The Patient

Value-Based Care:
1. Improve quality, safety, efficiency, and reduce health disparities
2. Engage patients and families
3. Improve care coordination
4. Improve population and public health
5. Ensure adequate privacy and security protections for personal health information

REFERENCES for “Value Based Care”:
FLIP #3: Comparative Effectiveness

RESEARCH GRANTS for PERSON CENTERED work
“FLIPPING” the way research is conducted, thought about, and acted upon

http://www.pcori.org/

Building a Patient-Centered Research Community
See how researchers and their patient partners are doing research differently
FLIP #4: Medicine Turned “Upside Down”

The Patient Will See You Now: The Future of Medicine is in Your Hands

Chapter 1: Medicine Turned Upside Down

Chapter 2: “Routine Medical Tests”

- what year MEDICAL TESTS were introduced and now what year discontinued, because there is no evidence that they are needed …
FLIP #5: Statistics Are Not Proof

TARNISHED GOLD: THE SICKNESS OF EVIDENCE-BASED MEDICINE

STATISTICS are NOT necessarily PROOF:
What is a CAUSE? “Causation VS Correlation” …
e.g. “Shaking Trees do not cause the Wind !!!!!!” …

Predictive Analytics Can Provide More Accurate Answers

Predictive Analytics can more easily get to the “causes” /
“accurate predictions” than all of the ‘traditional statistics in the world’
This is a FLIP in how we think about analyzing data “180 degree about face”

“Evidence-based medicine, the “gold standard” of medical decision making,
is increasingly unpopular with clinicians. They are right to have reservations. EBM breaks the laws of so many disciplines that it cannot be considered scientific or even rational. Decision science and cybernetics show the disturbing consequences of such flaws. EBM fosters marginally effective treatments, based on population averages rather than individual need………….. It is time for medical practitioners to discard EBM’s tarnished gold standard, reclaim their clinical autonomy, and provide individualized treatments to patients. “
FLIP #6: Genomics and Precision Medicine

GENOMICS for fully INDIVIDUALIZED - PERSONALIZED medicine:

• Within 3 – 5 years there will be an incredible number of Illnesses / disorders that can be attributed to a gene or ‘set of genes’

• Ability to sequence the genome is increasing in speed and affordability, in some places happening in almost real-time, adding to Predictive Analytic models to “score” a person / patient at time treatment is needed…

• Healthcare delivery team will be able to accurately diagnose and give ‘BEST TREATMENT’ delivering “Real – ‘Evidence Based Medicine’ ”

• P4 = Predictive, Preventive, Personalized, Participatory
Big Data and Prescriptive Analytics

BIG DATA and Prescriptive Analytics enables Rapid Transformation of Diverse Unstructured Data into Actionable Insights
Advantages of Predictive/Prescriptive Analytics

Reduce Errors
- Diagnosis – correct for the individual (e.g., known cancer gene mutations).
- Treatment – provide correct treatment for the individual
- Example: Predict wound closure needed to prevent infection.

Reduce Costs
- Avoid hospitalization for those who don’t need it.
- Predict how long an individual needs to stay in the hospital, reduce readmissions.
- Give medications only to those who need it.

Improve Outcomes
- Predict who is most at-risk for infection and provide corrective measures.
- Avoid disease before it happens.
- Better diagnoses and treatments, can reduce the number of resources needed to treat.
Maturity Reached with Prescriptive Analytics

What happened?
How Many? How Often?
Where? What is the problem?

Why is this happening?
What will happen next?
What if the trends continue?

What is the best that can happen?

Optimization & Simulation ---
PRESCRIPTIVE ANALYTICS

Predictive Modeling, Data Mining, Machine Learning & Forecasting
Risk Mitigation (readmission, etc.) Scenario & Strategic Planning Diagnosis & Treatment Optimization

Statistical Analysis

Visualization
Clustering
Root Cause Analysis
Statistical Process Control

Patient Segmentation – population subs-groups
Hospital bed use - Demand Forecasting
Fraud Detection - provider coding / insurance claims
Loyalty & Churn

Summary & Ad-hoc Reports

Operational Reporting
Compliance & safety
Monitor processes and trends

Query Drill Down & Alerting

Data discovery and investigation
Take action on key issues

Accuracy Advantage

Analytics Evolution

Source: 2015, Dell Software
Again: “What do T-BONE STEAKS have to do with HEALTHCARE – especially POPULATION HEALTH CARE?”

Now, to answer this question –
What do T-BONE STEAKS have to do with HEALTHCARE – especially POPULATION HEALTH CARE, as we view it today?

- Gary’s boyhood days living in rural Minnesota late 1940’s and 1950’s: Physician payment included a GIFT: FROZEN PACKAGE OF T-BONE STEAKS
- Care was very direct: the doctor bill was low, we could pay – no insurance forms to deal with
- 1940’s government put controls on increasing wages; to attract employees companies started giving Health Benefits – accelerating development of health insurance companies
- Even in 1971, when a friend started practice in Atlanta his office visit charge was only $8 …..
- But medicine was developing all kinds of ‘miracle life saving’ expensive procedures, and insurance companies increased premiums, lowered benefits & increased deductibles
- Many companies reduced benefits, people without company insurance found it difficult to buy ‘affordable insurance’; thus the ‘under-served’ and ‘non-served’ populations increased

(Now instead of “gifts”, patients & attorneys present Malpractice Lawsuits !!!!!)
- Today POPULATION HEALTH is a critical concern; new methods are used to deal with the underserved and non-served populations, such as the ‘Primary Care / Direct Care’ model: “going back” to: the doctor bill is low and affordable – no insurance forms to deal with

So the future may be ‘closer to my boyhood days of the 1950’s’?
POPULATION HEALTH and SUB-POPULATION HEALTH: 
*Health and Care Transformation coming in three waves:*

a) Provider *Evolution*
b) Consumer Retail *Revolution*, and
c) Health System *Devolution*

PREDICTIVE ANALYTICS – DECISIONING – PRESCRIPTIVE ANALYTICS: 
*Reaching maturity in data analytics*

‘FLIPS’ in how HEALTHCARE is being delivered to populations: 
*True Personalized Medicine - Person-Centered HealthCare*

Thus: reaching all populations AND reaching every individual
Conclusion

We have come a ‘long way’ since the 1950’s, - or ‘Have We’? in regards to

Population Health Management?
Predictive Analytics Resources

- **Predictive Analytics**: The power to predict who will click, buy, lie, or die by Eric Siegel
- **Clinical Integration**: Population Health and Accountable Care
- **Practical Predictive Analytics and Decisioning Systems for Medicine**: Informatics Accuracy and Cost-Effectiveness for Healthcare Administration and Delivery Including Medical Research
Additional Tutorials and Case Studies – from Patient, Provider, and/or Payer perspectives:

TUTORIAL-C - Constructing Decision Trees for Medicare Claims Using R and Rattle: Page 316

TUTORIAL-D - Predictive and Prescriptive Analytics for Optimal Decisioning: Hospital Readmission within 30 days: Page 341

TUTORIAL-I - Detection of Stress-Induced Ischemia in Patients with Chest Pain After “Rule-Out ACS” Protocol (100% sensitivity and 100% specificity for impending heart attack): Page 544

TUTORIAL-J1 - Predicting Survival or Mortality for Patients with Disseminated Intravascular Coagulation (DIC): Page 558

TUTORIAL-S - Availability of Hospital Beds for Newly Admitted Patients: The Impact of Environmental Services on Hospital Throughput: Page 817

TUTORIAL-T - Predicting Vascular Thrombosis: Predictive Analytic Models and Building an Ensemble Model for “Best Prediction”: Page 832

TUTORIAL-U - Predicting Breast Cancer Diagnosis Using Support Vector Machines (SVM): Page 850

CHAPTER 24: Predicting and Decisioning in REAL TIME for Surgical Site Infections (SSI) (final decision and action taken in the Operating Room before wound closure) – using a ‘Predictive Analytics and Decisioning System’. (University of Iowa National Demonstration Project) Page 1030

Source: Practical Predictive Analytics and Decisioning Systems for Medicine, 2015
Questions?

Gary D. Miner, PhD
Dell Software Healthcare Practice
@Gary_Miner

Ken Yale, DDS, JD
ActiveHealth Management
@docyale