

DISCOVERING WHAT WORKS. AND FOR WHOM.

Population Health 2.0 through Personalized Medicine

Colin Hill

CEO and Co-Founder





"Fifty-five percent of drugs used in America don't work for the patients they are prescribed for"

Why Now: For Many Patients, Treatments Are Ineffective

ANTI-DEPRESSANTS
(SSRIs)

38%



ASTHMA DRUGS

40%



DIABETES DRUGS

43%



ARTHRITIS DRUGS

50%



ALZHEIMER'S DRUGS

70%



CANCER DRUGS

75%



Source: Personalized Medicine Coalition

There is no “Average Cancer Patient”

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22
TP53	Deletion	Mutation	Mutation			Mutation		Mutation	Mutation	Mutation	Mutation	Mutation	Mutation	Mutation				Mutation			Mutation	
MDM2															Amplification							
MDM4				Amplification																		
PTEN		Mutation	Mutation			Mutation										Mutation		Deletion	Mutation			
PIK3CA				Mutation							Mutation		Mutation							Mutation		
PIK3R1											Mutation		Mutation									
IRS1	Mutation																					
RB1			Mutation			Deletion									Mutation							
CDK4								Amplification						Amplification							Amplification	
CDKN2A	Deletion			Deletion	Deletion		Deletion					Deletion	Deletion	Deletion		Deletion			Deletion	Deletion		
	Deletion																					
	Mutation																					
	Amplification																					

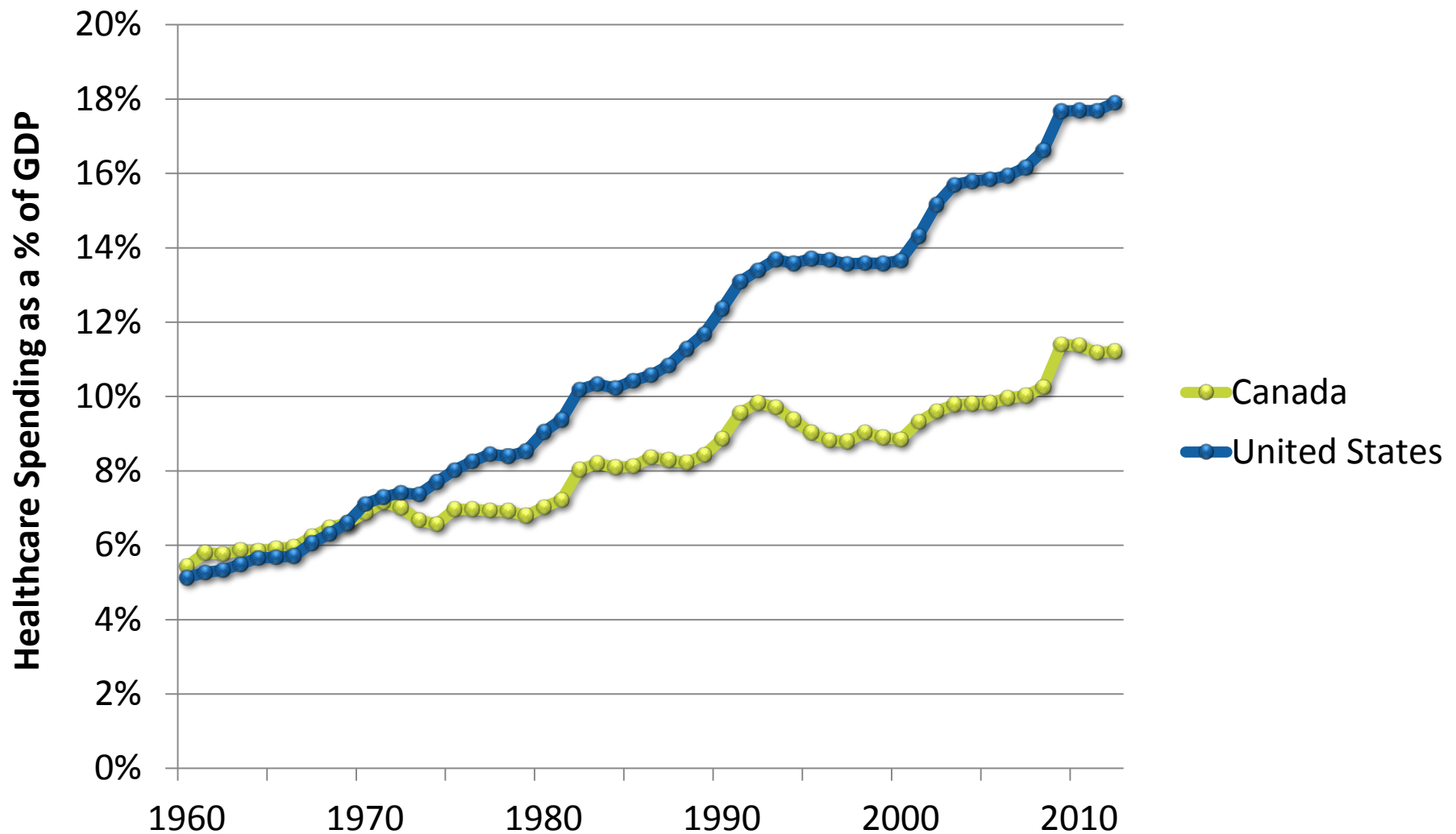
Global Genomic Analysis of Patient Tumors^{1,2,3}

- Significant number of altered genes
- Genetic alterations varied from tumor to tumor

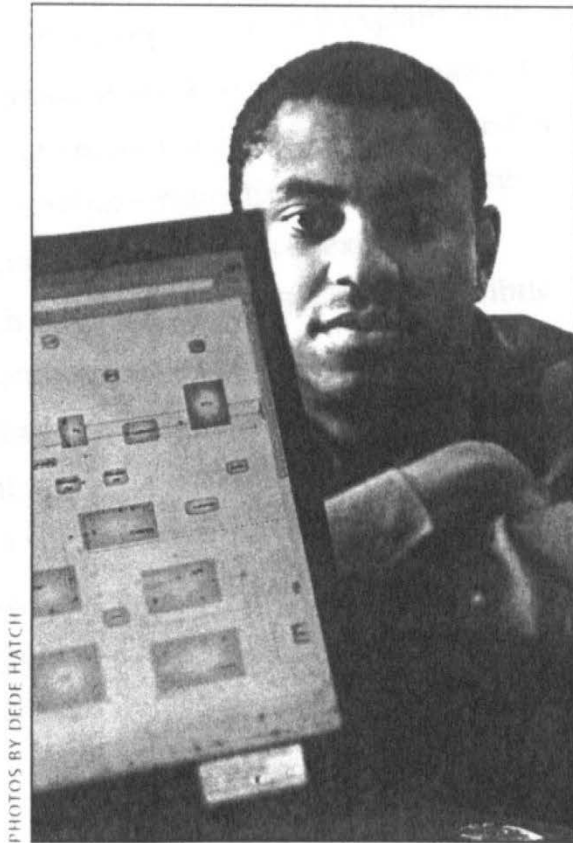
1. Parsons D.W. et al., *Science*, 2008.
2. Jones S. et al., *Science*, 2008.
3. The Cancer Genome Atlas Research Network, *Nature*, 2008.

➤ *Astronomically large number of possible network hypotheses*

The Staggering Cost of Healthcare



Founding GNS Healthcare



PHOTOS BY DEDE HATCH



Colin Hill, CEO of GNS, and Iya Khalil, vice president of research and development, cofounded the company, based on an initial business plan that the two Cornell physicists developed after taking entrepreneurship classes at the Johnson School.

Markets We Serve

Health Plans

- Risk of adverse events & medication adherence (claims, consumer data)
- Progression to metabolic syndrome & risk factors (multi-source data)
- Adverse drug events (Medco)
- Effectiveness of CMS quality measures (MDS, Oasis data)

Providers

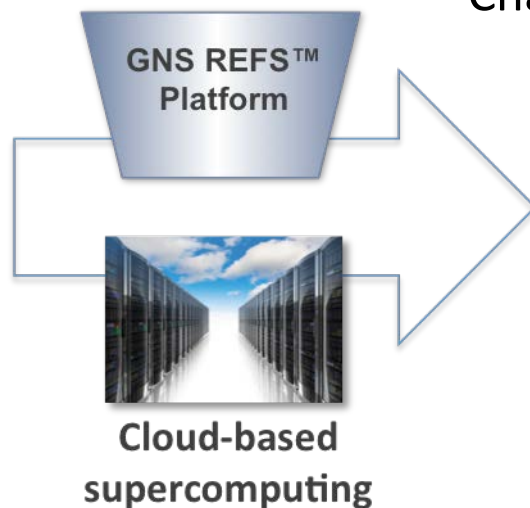
- Preterm births (genomic, claims, EMR data)
- Progression to Type 2 Diabetes (EMR data)
- CHF Readmissions & adverse drug events (EMR data)

Pharmaceutical Manufacturers

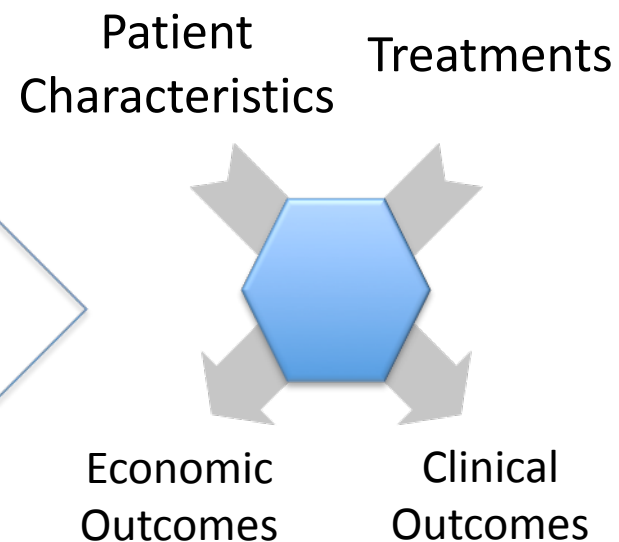
- Drug switching for Multiple Sclerosis (claims data)
- Individual risk for Type 2 Diabetes (EMR data)
- Optimal drug regimens for Rheumatoid Arthritis (registry data)
- Progression in Rheumatoid Arthritis (clinical trial data)



Real World and Clinical Patient Data



Predictive Models



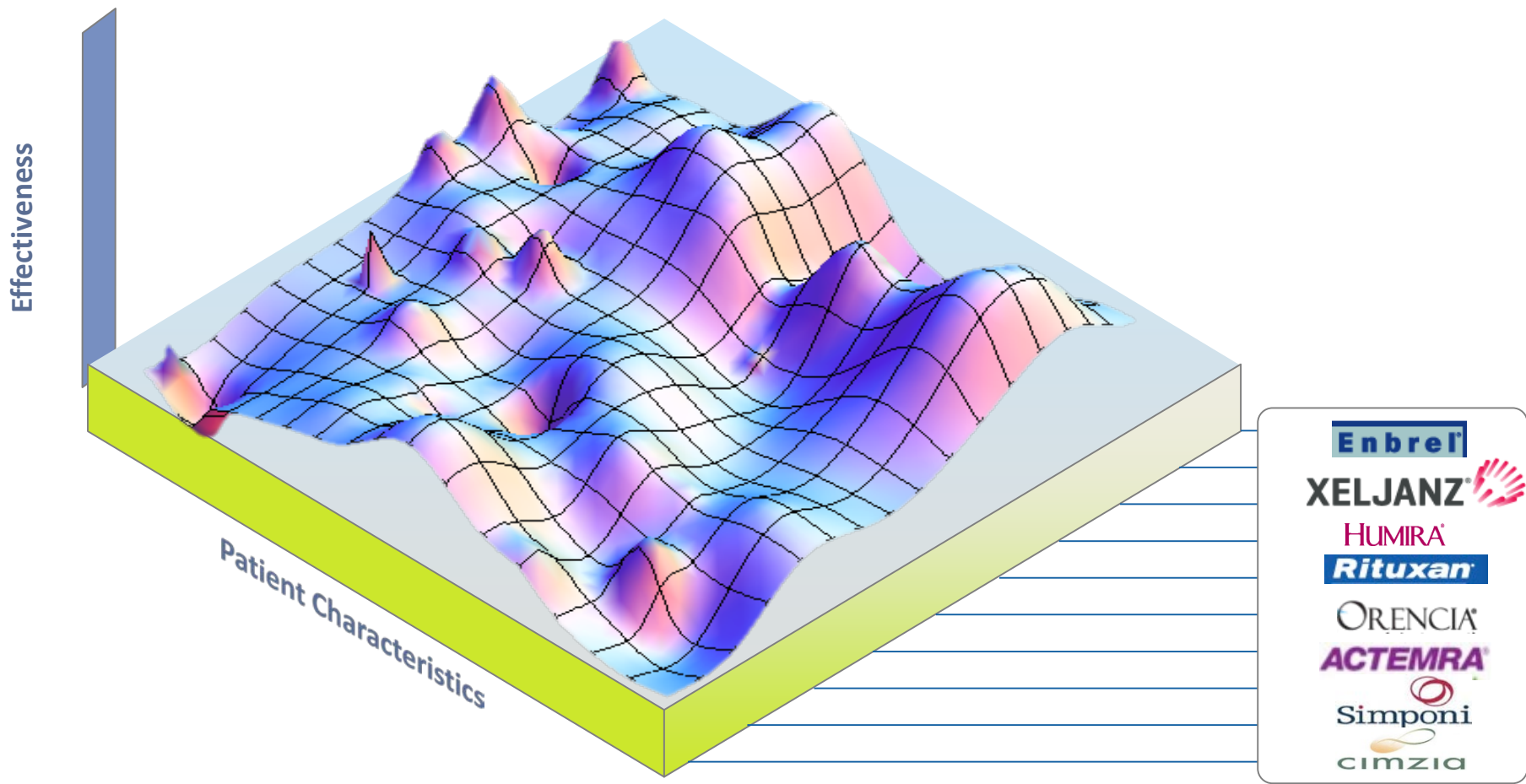
***Does patient X respond
to treatment Y?***



Treatment Y

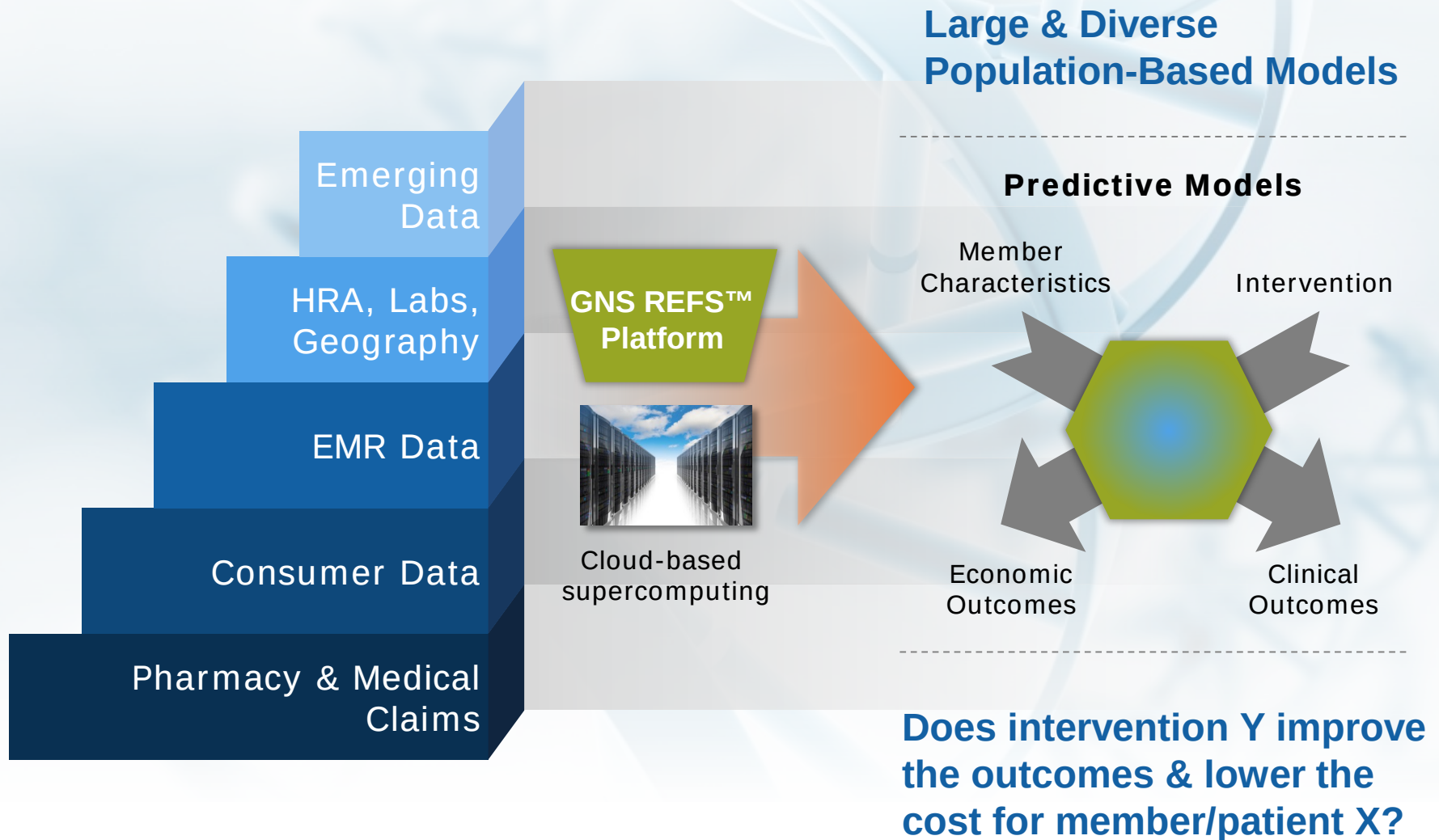
	1	2	3	4	5	6
1						
2						
Patient X						
4						
5						
6						

The Holy Grail of Personalized Medicine

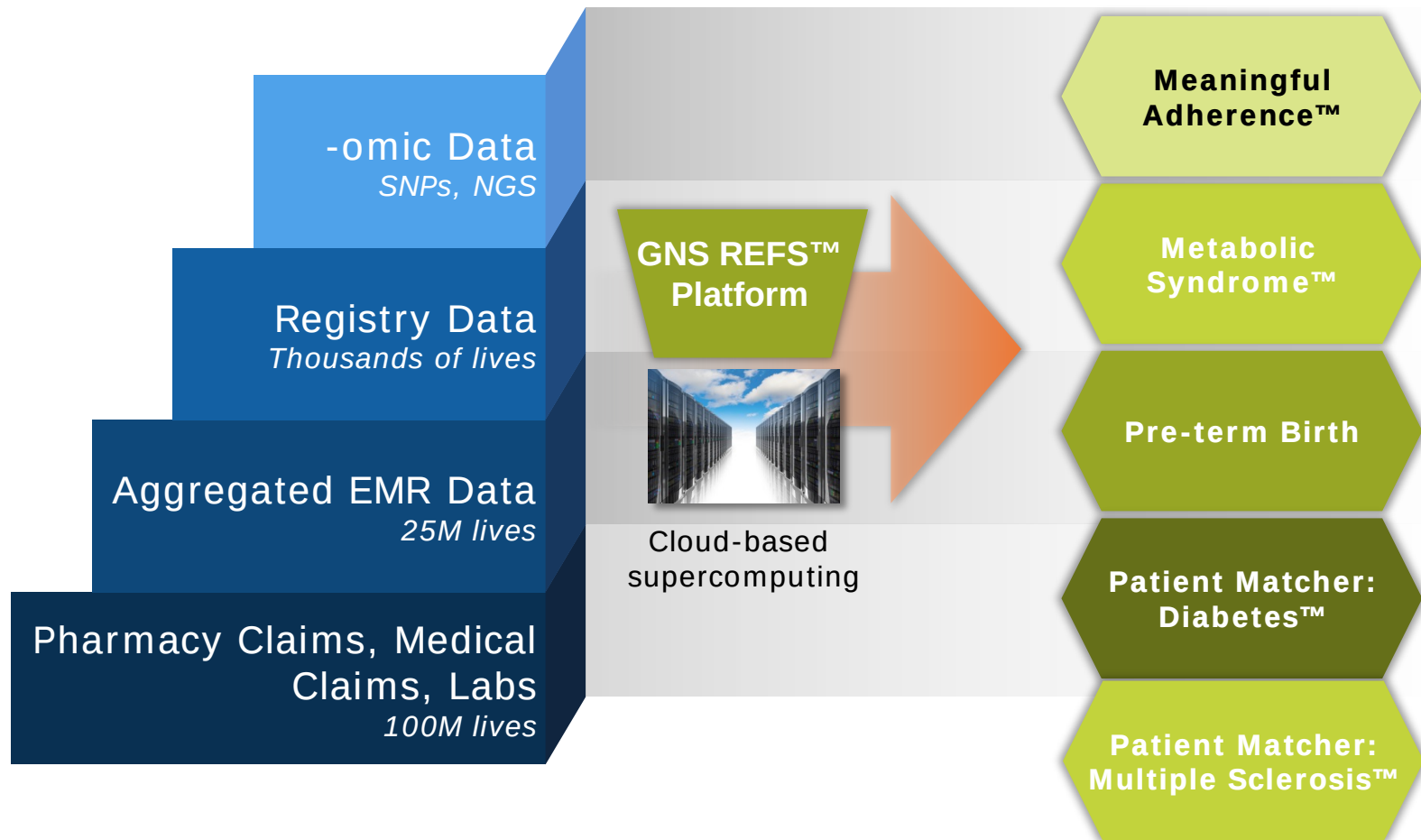


GNS Healthcare

Actionable insights & ROI from data-driven models & software



Integrating the Patient “Data Stack” to Power Next Gen Products



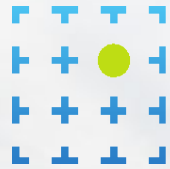
GNS Innovation with Health Plans



- ▶ GNS partnered with Aetna to apply our proprietary analytics platform to uncover new risk factors in Metabolic Syndrome
- ▶ Our platform generated individualized insights using available heterogeneous data in 3 months
- ▶ We demonstrated that improving waist circumference and blood glucose yielded the largest benefits on subsequent risk and medical cost

A person with dark skin and dreadlocks is captured mid-jump, wearing a purple t-shirt, grey shorts, and white sneakers with green accents. They are jumping over a body of water. In the background, a large steel truss bridge spans the water, and a city skyline is visible on the horizon under a cloudy sky.

aetnaSM



GNS HEALTHCARE

DISCOVERING WHAT WORKS. AND FOR WHOM.

Aetna & GNS Healthcare

**Learning Models for Metabolic Syndrome
from Medical Claims Data**

Highlights

- Data Integration
- Mass personalization
- Simulation of individual response to interventions

METHODS

Novel Predictive Models for Metabolic Syndrome Risk: A “Big Data” Analytic Approach

Gregory B. Steinberg, MB, BCh; Bruce W. Church, PhD; Carol J. McCall, FSA, MAAA; Adam B. Scott, MBA; and Brian P. Kalls, MBA

The growing prevalence of metabolic syndrome in the United States, and globally, is alarming. Metabolic syndrome is generally defined as having three or more of five common biological abnormalities out of range: waist circumference, blood pressure, elevated triglycerides, low high density lipoproteins (HDL), and increased insulin resistance. Analysis¹ suggests that almost one-third of US adults, or approximately 80 million people, meet the Adult Treatment Panel III criteria for metabolic syndrome, with prevalence increasing significantly with age and body weight.² An additional 45%, or approximately 104 million people, have 1 or 2 risk factors for developing metabolic syndrome.

These trends have profound clinical and financial implications. Individuals with metabolic syndrome are twice as likely to develop cardiovascular disease and 5 times more likely to develop diabetes mellitus, both of which mean higher than average annual healthcare costs. Workplace participation and productivity of individuals with metabolic syndrome are also negatively impacted.³

Health insurance companies have large quantities of data relevant to metabolic syndrome, including demographic data, diagnosis and procedure claim data, lab results, prescription data, and care management program data. Using “big data analytics” to interrogate large, complex data sets can generate meaningful insights about individuals with or at risk of developing metabolic syndrome.

We applied a proprietary “big data” analytic platform—Reverse Engineering and Forward Simulation (REFS)—to the data set of 1 of Aetna’s larger nationwide retail customers and calculated:

- The subsequent risk of metabolic syndrome, both overall and by metabolic syndrome risk factor, at both a population and individual level
- The impact of incremental changes in risk factors on the overall subsequent risk of metabolic syndrome and on costs

ABSTRACT

Objectives

We applied a proprietary “big data” analytic platform—Reverse Engineering and Forward Simulation (REFS)—to dimensions of metabolic syndrome extracted from a large data set compiled from Aetna’s databases for 1 large national customer. Our goals were to accurately predict subsequent risk of metabolic syndrome and its various factors on both a population and individual level.

Study Design

The study data set included demographic, medical claim, pharmacy claim, laboratory test, and biometric screening results for 36,944 individuals. The platform reverse-engineered functional models of systems from diverse and large data sources and provided a simulation framework for insight generation.

Methods

The platform interrogated data sets from the results of 2 Comprehensive Metabolic Syndrome Screenings (CMSSs) as well as complete coverage records; complete data from medical claims, pharmacy claims, and lab results for 2010 and 2011; and responses to health risk assessment questions.

Results

The platform predicted subsequent risk of metabolic syndrome, both overall and by risk factor, on population and individual levels, with ROC/AUC varying from 0.80 to 0.88. We demonstrated that improving waist circumference and blood glucose yielded the largest benefits on subsequent risk and medical costs. We also showed that adherence to prescribed medications and, particularly, adherence to routine scheduled outpatient doctor visits, reduced subsequent risk.

Conclusions

The platform generated individualized insights using available heterogeneous data within 3 months. The accuracy and short speed to insight with this type of analytic platform allowed Aetna to develop targeted cost-effective care management programs for individuals with or at risk for metabolic syndrome.

Am J Manag Care. 2014;20(6):e221-e228

AJMC

GNS Healthcare Data Integration

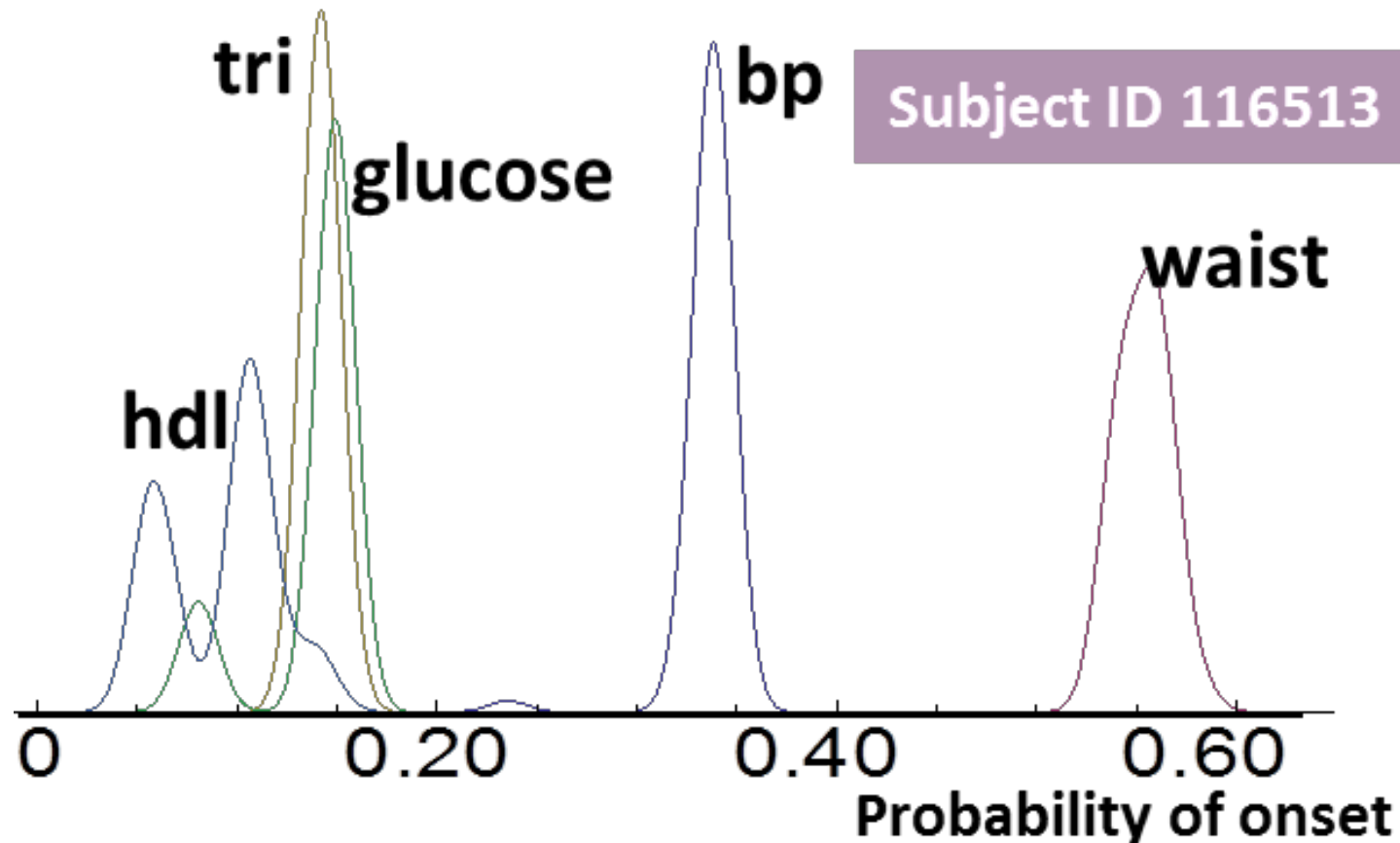
- The data derived from diverse sources, was heterogeneous, and was largely collected for other ends

18 Million Claims Events from 36 Thousand Individuals



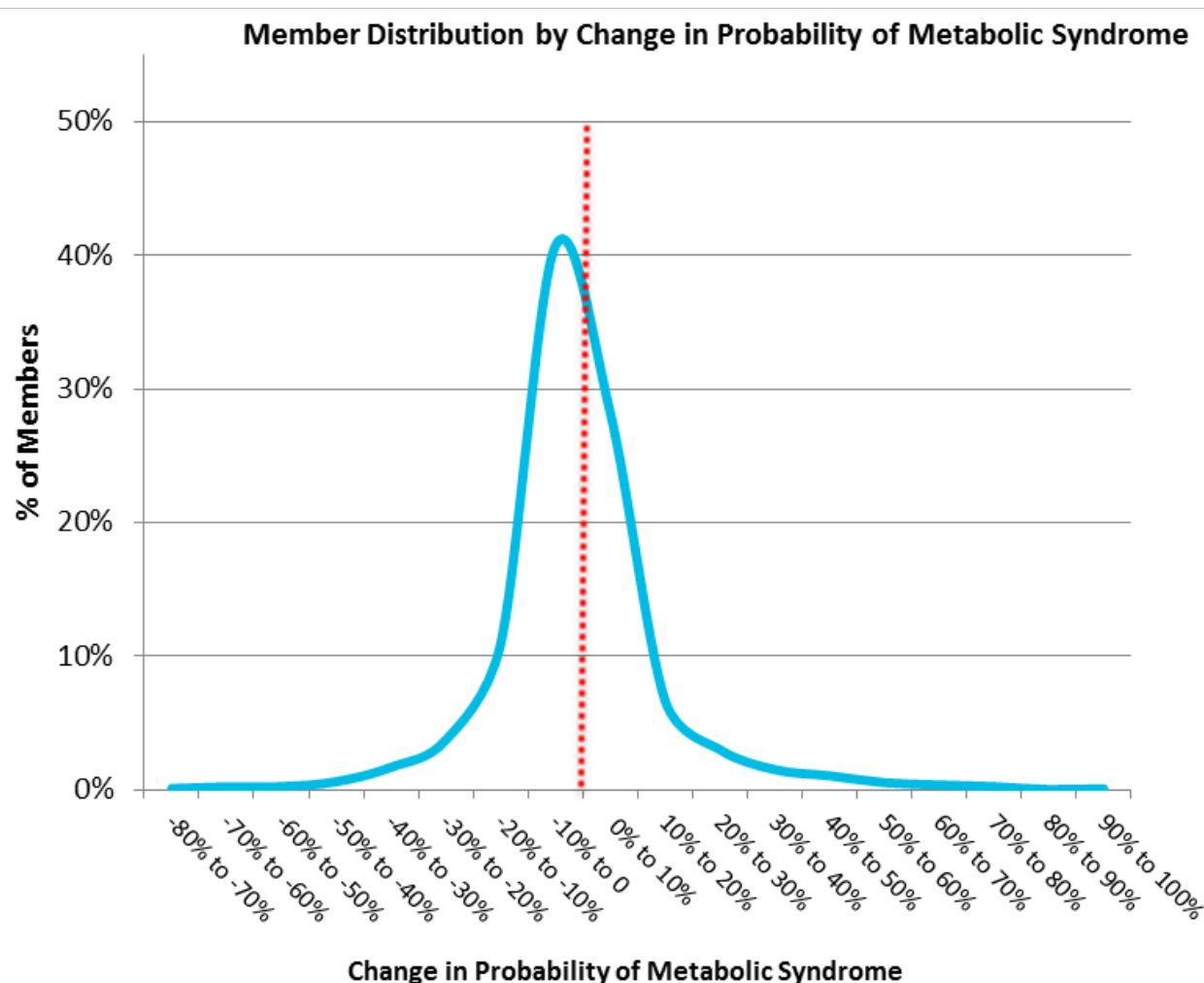
GNS Healthcare Mass Personalization

- Individual predictions based on REFS™ simulations for the entire population



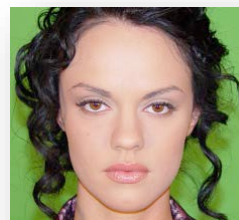
GNS Healthcare Predicting the Effect of an Intervention

- Individualized impact of improving medication adherence



GNS Meaningful Adherence™ Solution

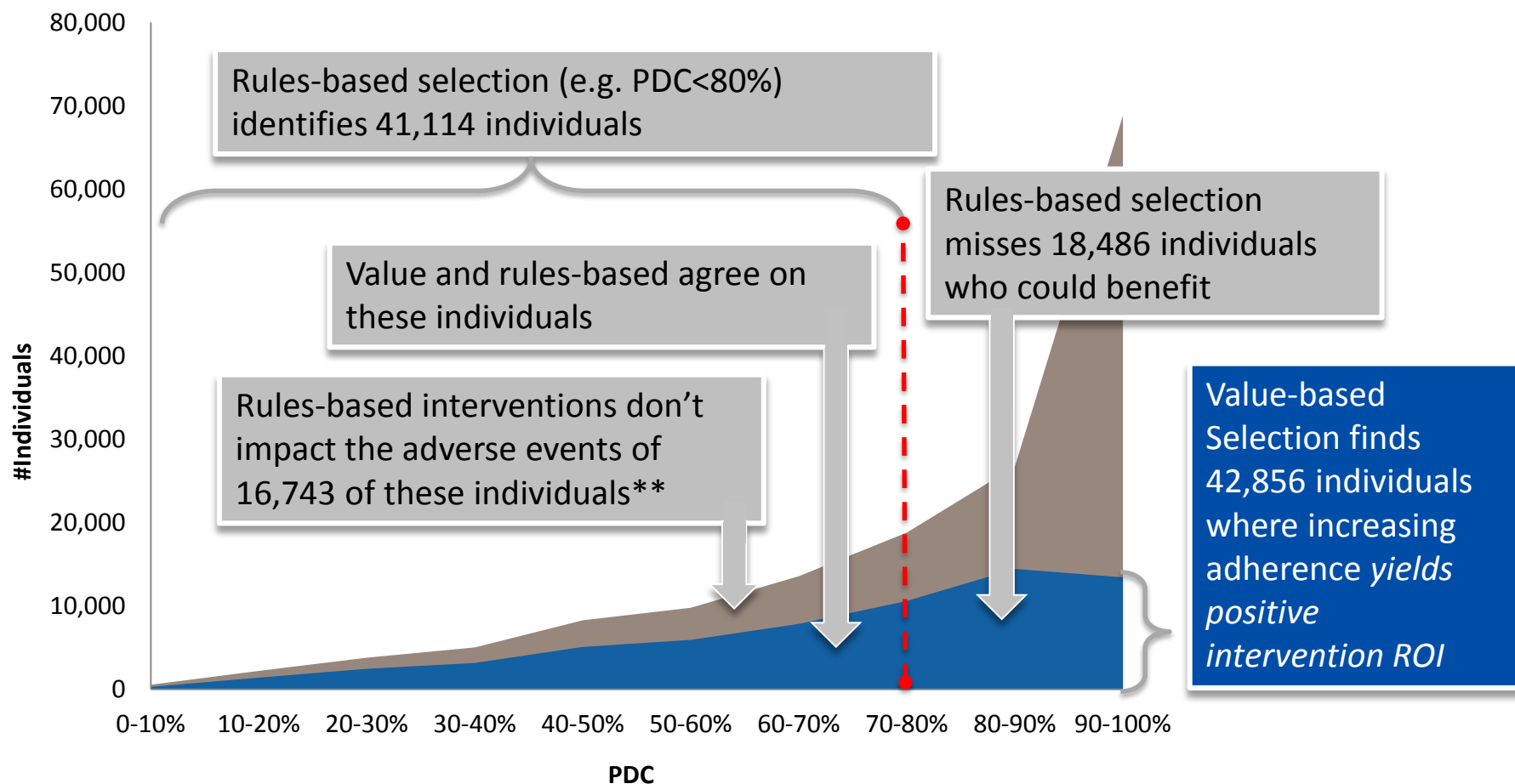
*Value-based selection informs interventions at the individual level.
Let's start with an example.*



	Larry	Nora	Ethel
Age	46	24	66
Current medication	Cardio + Diabetes	Cardio + Diabetes	Cardio
Prior condition-related events	Yes	No	No
PDC	44%	29%	82%
Event costs that could be avoided with increase in PCD	> \$14,000 25% Increase	< \$200 45% Increase	> \$10,000 10% Increase
Predicted adverse event(s)	ER & Hospitalization	ER	Hospitalization
Rules-based analysis	YES	YES	NO
Value-based analysis	YES	NO	YES

Meaningful Adherence™ Leverages Value-Based Selection

*Value-based selection maximizes outcomes**

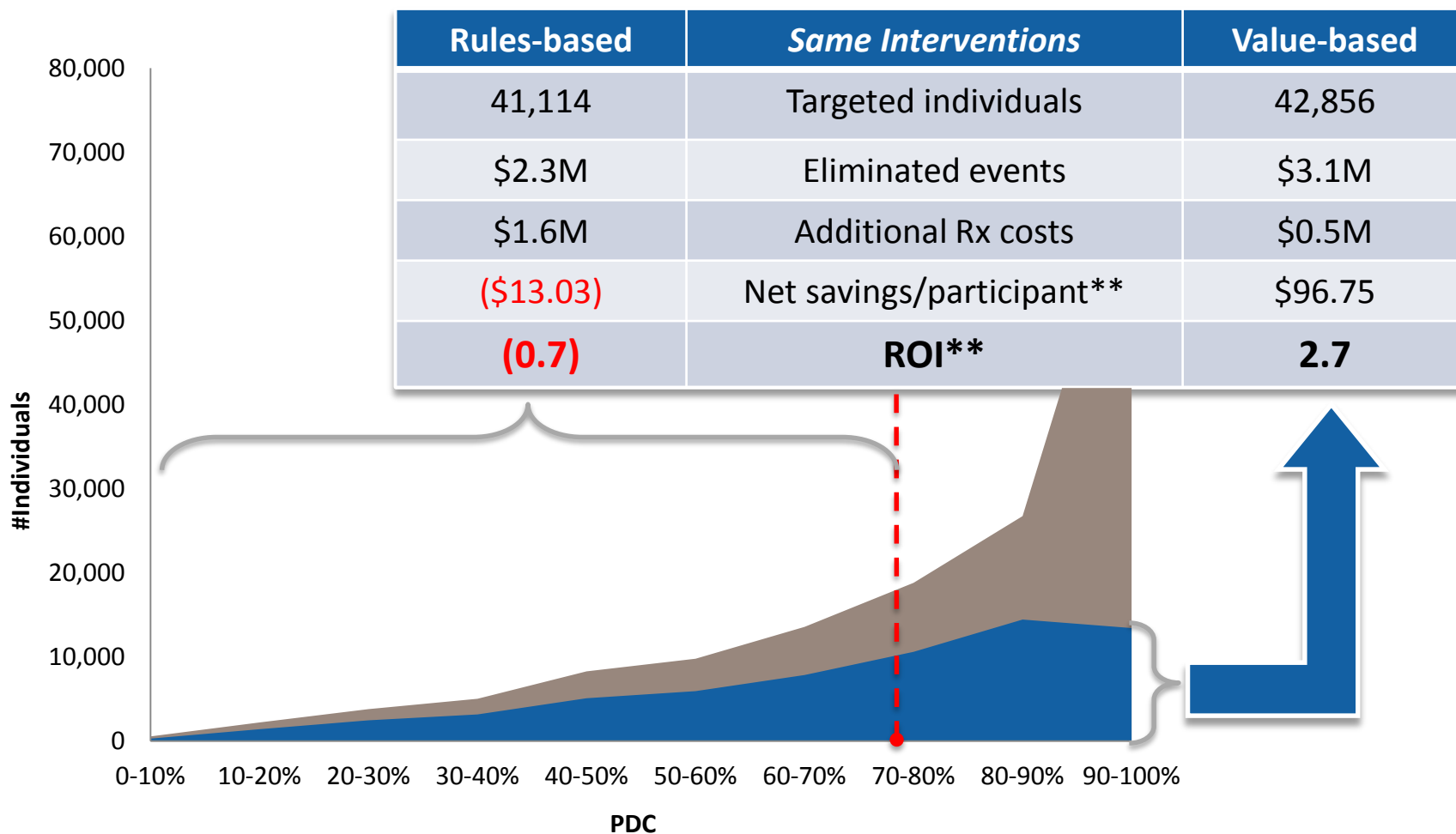


*1M member health plan with 104,521 members on cardiovascular, oral diabetic and respiratory medications

**But may have revenue impact based on STAR rating

Bottom Line Impact of Value-Based Selection

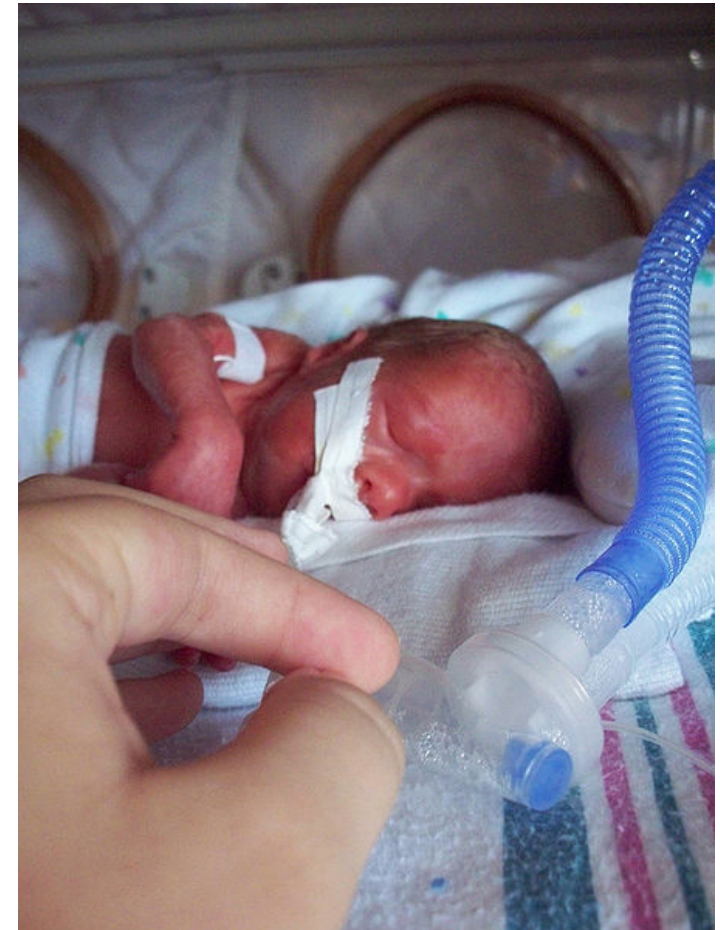
Optimizing people in interventions yields significant net savings



***But may have revenue impact based on STAR rating*

Predicting Preterm Birth with Inova Translational Medicine Institute

- Partnership to develop and commercialize computer models predicting risk of preterm birth
- Data include EMR, whole genome sequencing, gene expression, methylation, proteins, and clinical outcomes for >2400 individuals
- Partnership aims:
 - Identify underlying causal mechanisms of preterm birth
 - Predict personalized preterm birth risk
 - Accelerate the discovery of new diagnostic tools and treatments



Why Now: For Many Patients, Treatments Are Ineffective

ANTI-DEPRESSANTS
(SSRIs)

38%



ASTHMA DRUGS

40%



DIABETES DRUGS

43%



ARTHRITIS DRUGS

50%



ALZHEIMER'S DRUGS

70%



CANCER DRUGS

75%



Source: Personalized Medicine Coalition