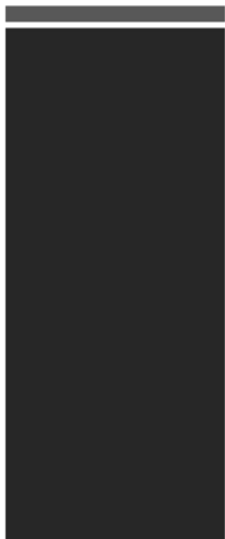


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# Real-Time AI Analytics to Thrive in a Value-Based World

Calum A. MacRae, MD, PhD

Brigham and Women's Hospital  
Harvard Medical School  
Broad Institute of Harvard and MIT  
Harvard Stem Cell Institute



## Disclosures

- Revenue from gene testing in cardiomyopathies
- Patents for cardiotoxicity testing and drug discovery in zebrafish
- Patents for sensor development
  
- Novartis
- AtlasVenture
- ArrayBioPharma
- Biogen Idec
- Sanofi
- Merck
- Pfizer
- Vertex
- Clarify Health
- Microsoft
- AHA/Verily/AstraZeneca/Quest Diagnostics
- Apple
  
- **Academic self-interest**

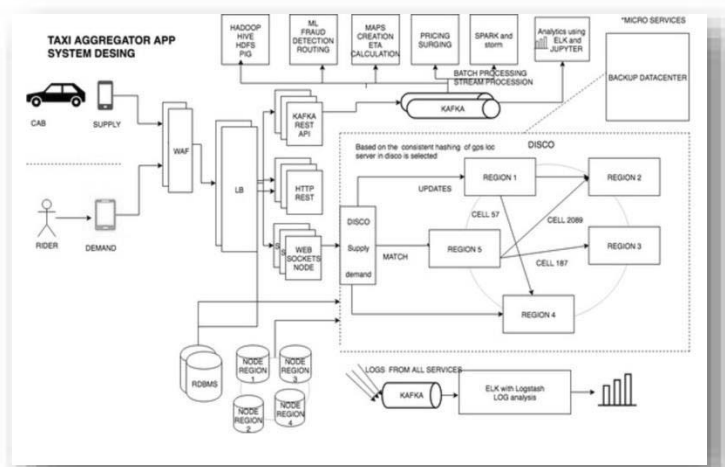
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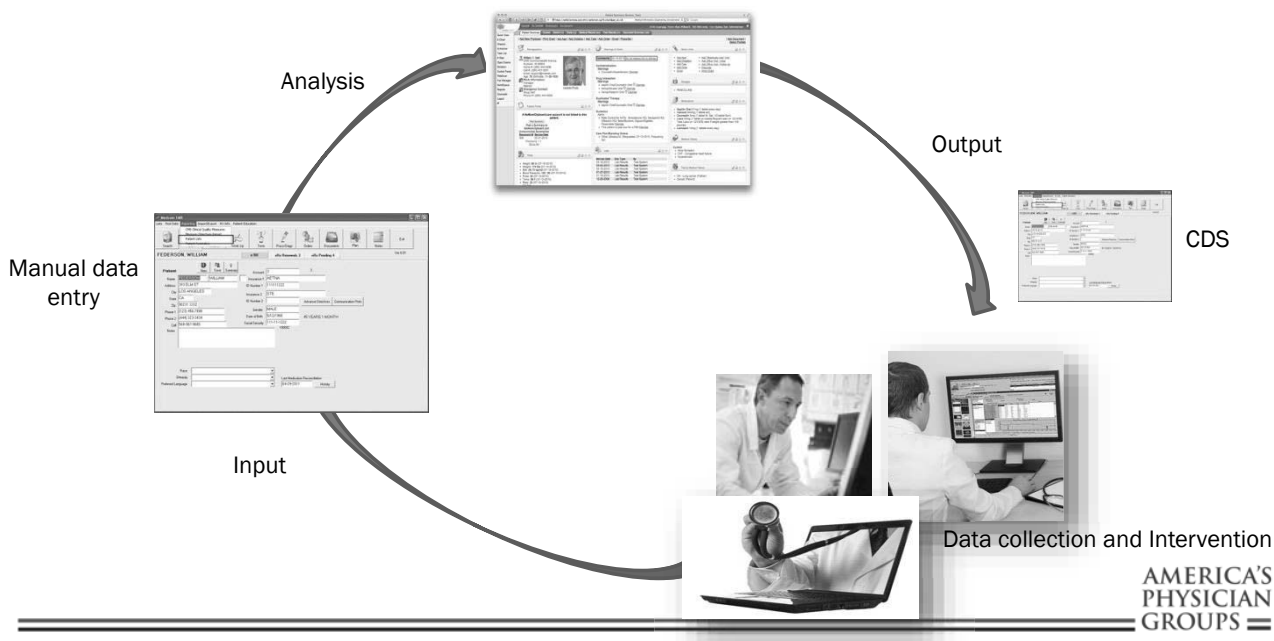
## Where is AI used outside medicine?

- Manufacturing
  - Production line - Autos
  - On the fly manufacture - Dell
- Retail
  - Supply chain - Walmart
  - Distribution logistics - Amazon
- Travel
  - Task shifting - SABRE
  - Task elimination - Uber
- Entertainment
  - Preference mapping - Netflix
- Education/Training
  - Knowledge mapping - many
- Finance
  - High-frequency trading - all

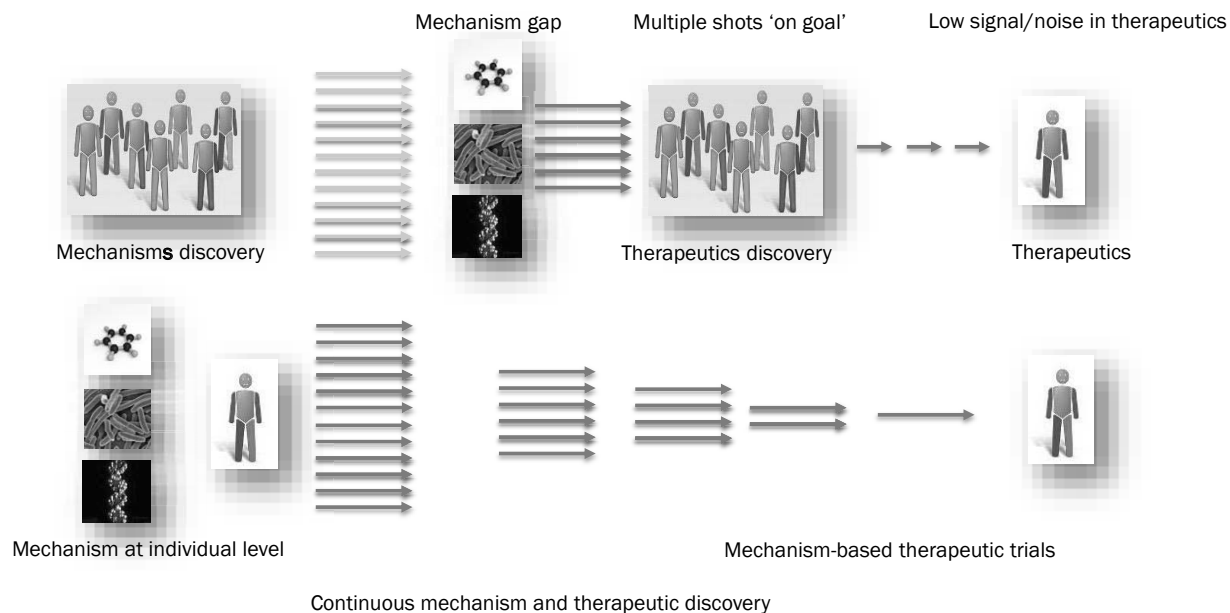


Uber Tech Stack

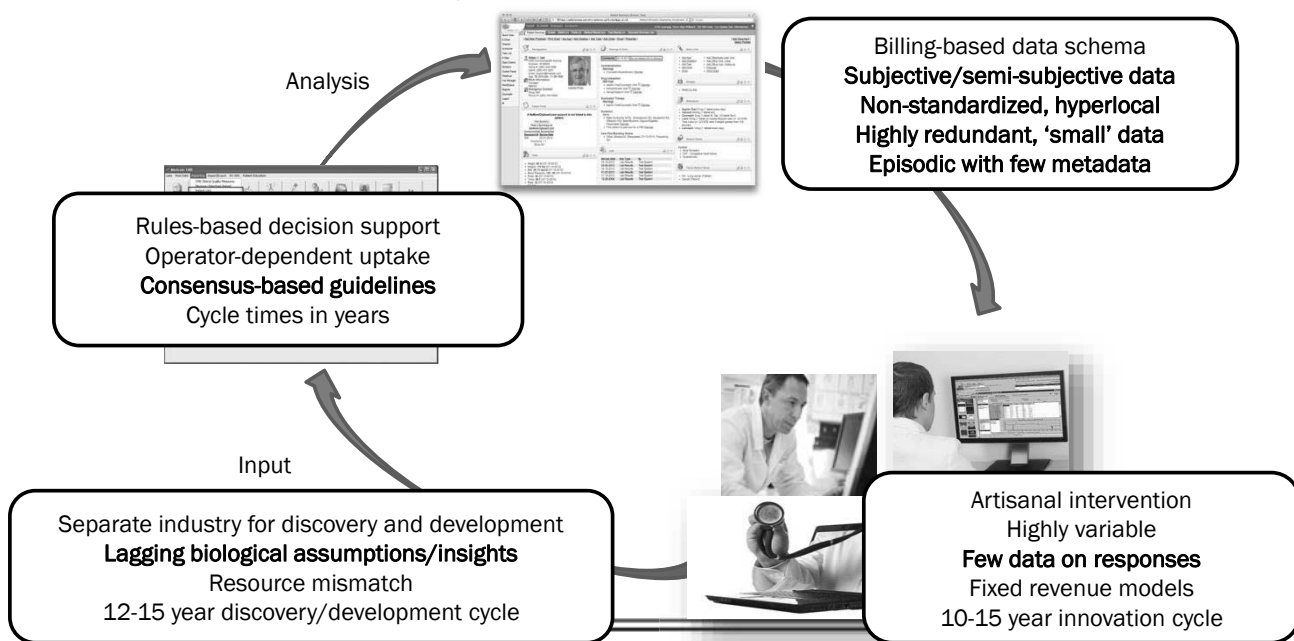
## Where could AI be used in medicine?



## Where could AI be used in translation?



## Limits of the current 'system'



## Rate-limiting deficits in information content

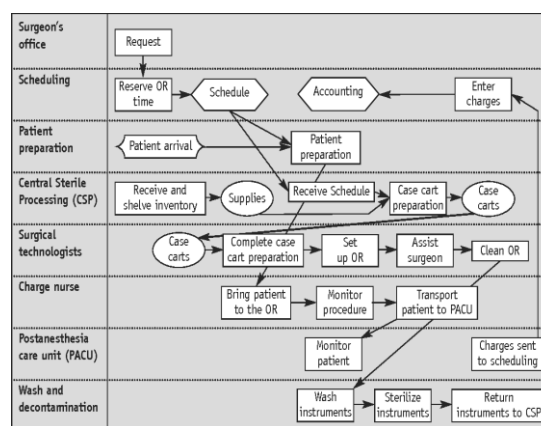


- **Phenotype (what we measure) is limiting in multiple areas of biomedicine**
  - Cross-sectional collection of static or limited dynamic range data
  - Almost all aggregates
  - Unidimensional with no organizing metadata
- **Few if any conditioning variables ever measured- eg nutrition, social determinants**

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## Clinical process improvement - where the data exist today

- Typical clinical process flow
- Systems in place for data collection
  - Transactions
    - Overt
    - Hidden
  - Metadata present
- Outcomes models
  - Internal
  - External
  - Integrated
- Billing/Compliance/Supply chain
- Productivity metrics
- Active asset management - Early ROI

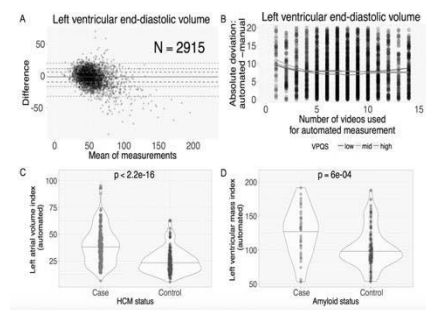
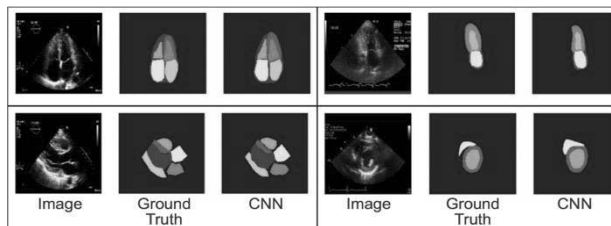


Perioperative workflow

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## AI and imaging: early impact

- Standardized data formats
- Models trained on discrete outputs
  - Traditional modality-specific
  - Novel-intermediate
  - Novel emergent
- Real-time deployment of analytics
- Provider augmentation
- Clinical decision support
- Coupling with definitive execution
- Closed loop optimization

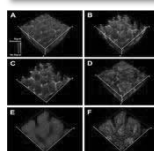
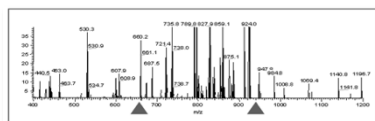


Deo et al 2018 Circulation

## Moving beyond legacy data at the bedside



Glycosuria



Specific metabolites

Microbiome

Microcirculation confocal imaging

Adipose tissue mapping

Thermography

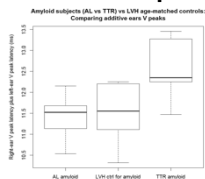
EKG

.....

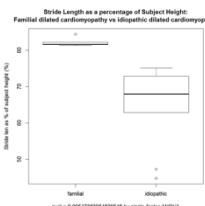
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# Multidimensional computable phenotypes

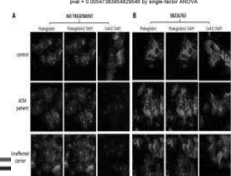
## Heart failure phenotypes



Auditory evoked responses

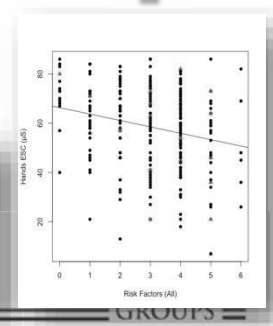
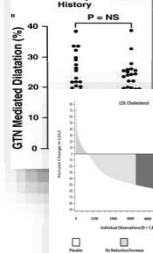
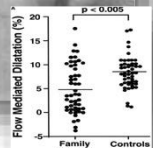
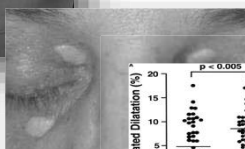
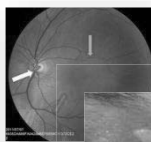


Stride length

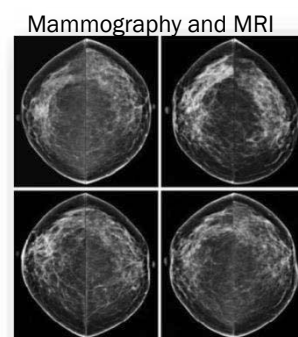
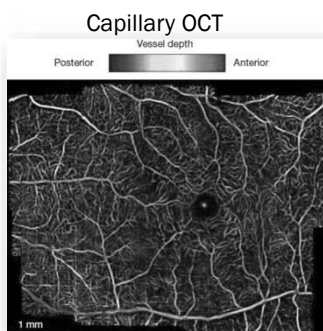
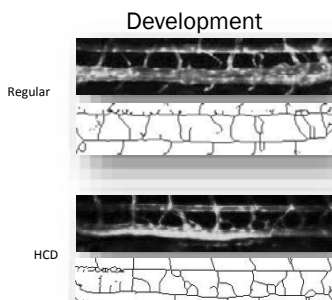


Skin cell biology

## Potential preclinical CHD phenotypes

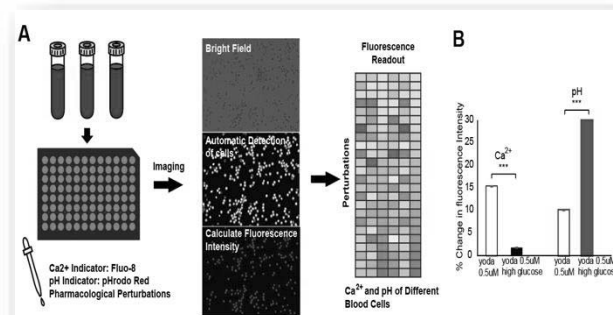
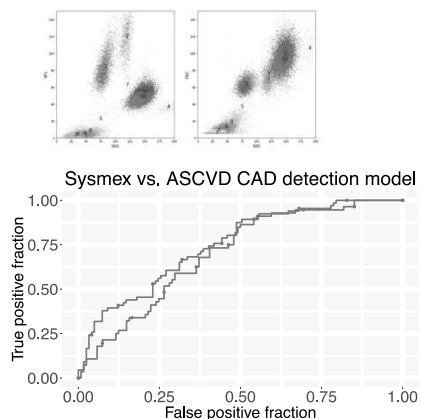


## Orthogonal information: cutting across 'disease silos'



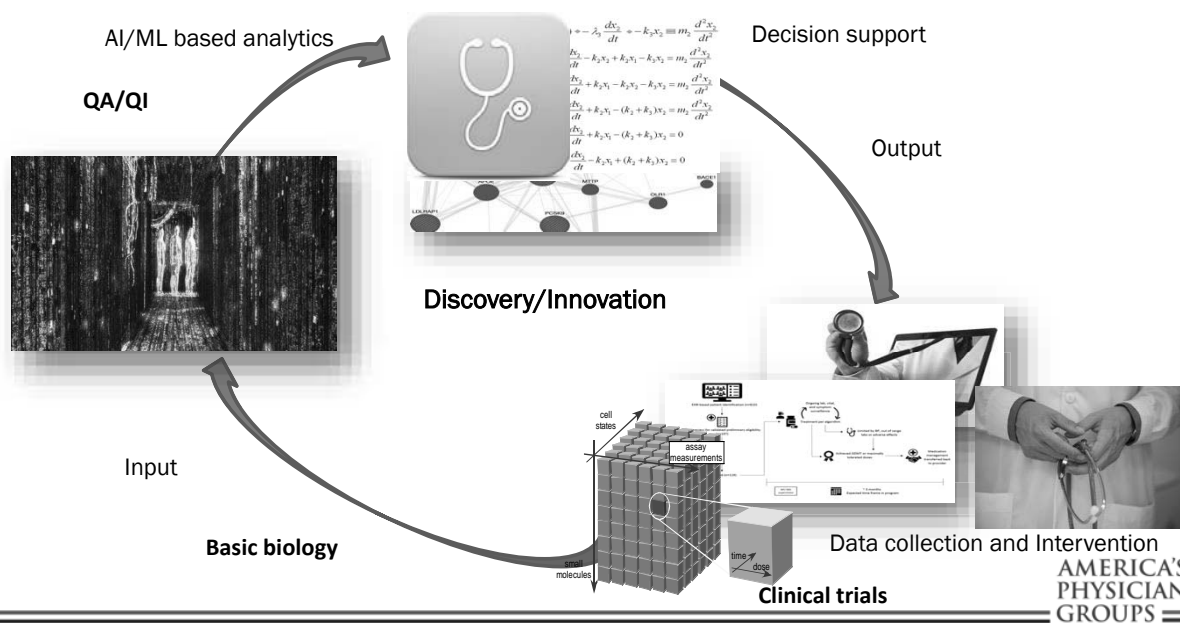
1.2M mammograms

## Creating scale: e.g. single cell measurements with AI

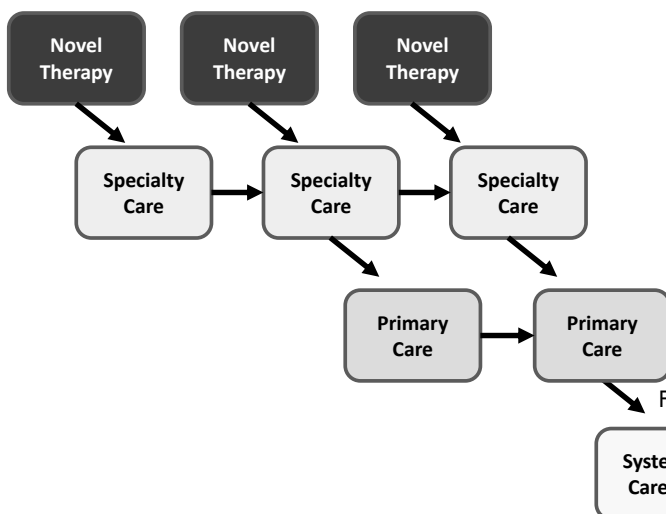


- Panel of >100 functional assays: conversion to microfluidics-based imaging
- Discrete perturbations
- Cell biology at population scale
- Suppressible phenotypes from individual patients

## The missing link in 'learning' systems: transactions



## Evolution of care delivery is blocked

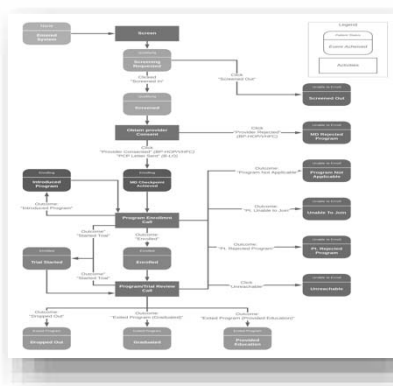
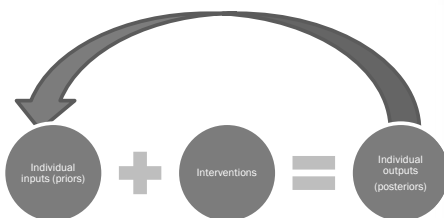


### Examples for system care

- Anticoagulation
  - "Coumadin clinic 2.0"
- All screening
- HTN
- Diabetes
- Lipids
- Mental Health
- Cancer survivorship
- COPD

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## Deconvoluting medicine into biological care transactions



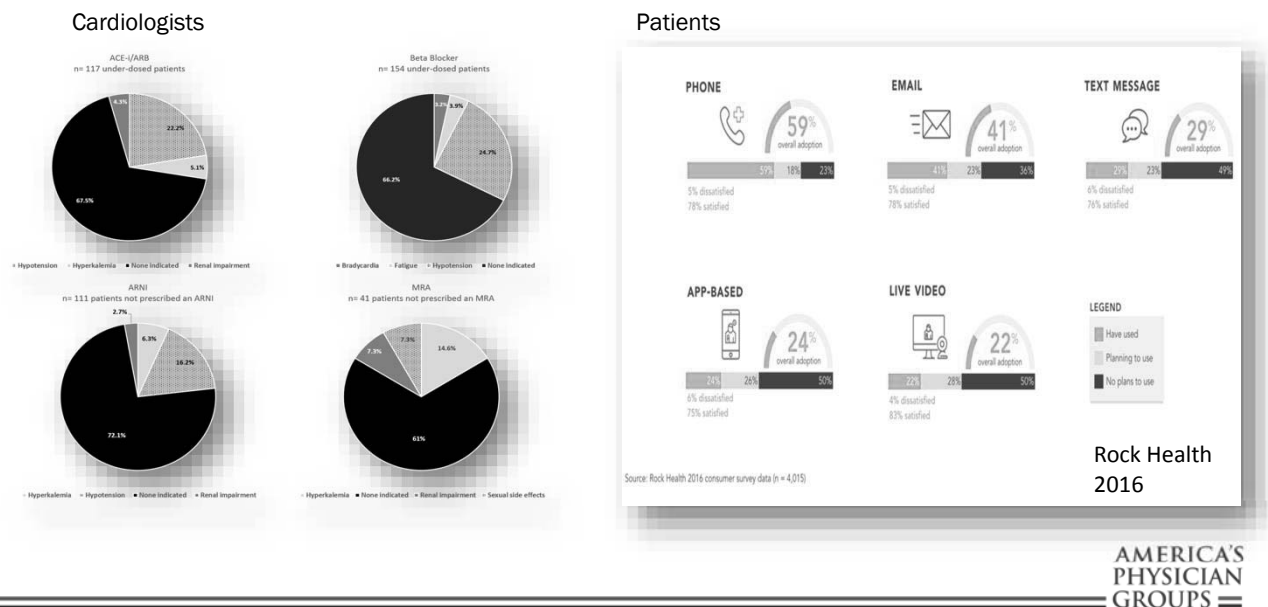
Clinical transactions as (bio)logical operators  
 Completely uniform  
 Underlying complexity nominal  
 Inputs and outputs consistent  
 Initial algorithm modified iteratively by data

Structured subroutines  
 Readily administered by untrained personnel  
 Rapidly transitioned to patient

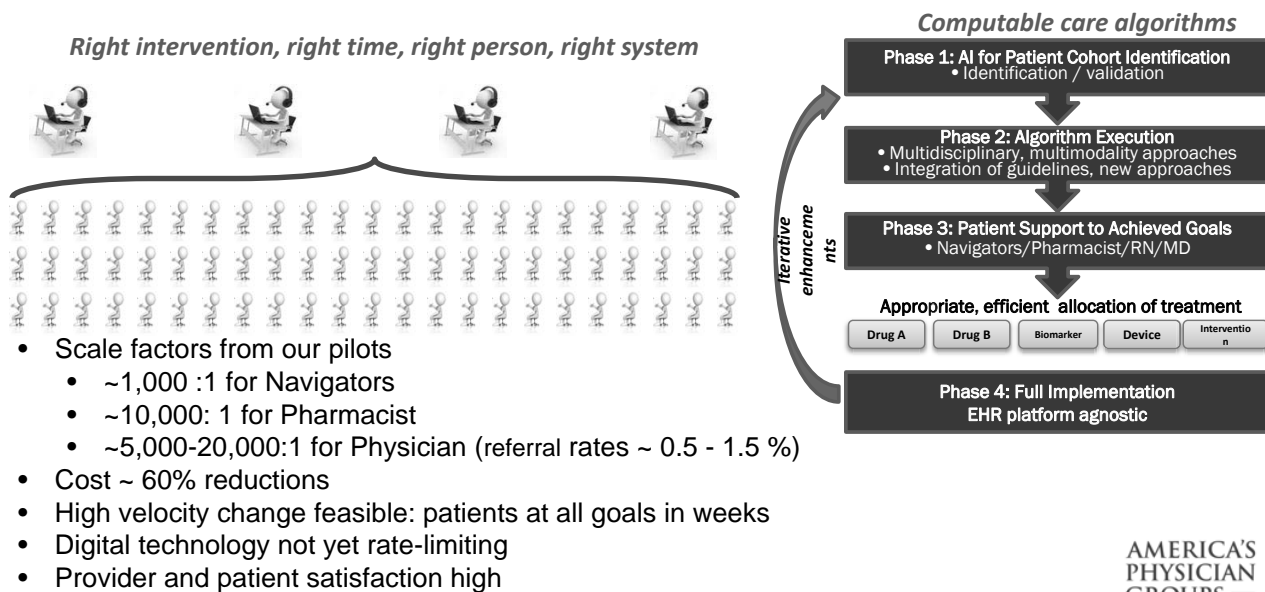
**Workflow redesign and software creation in parallel**



## Internal change is slow: drugs or digital



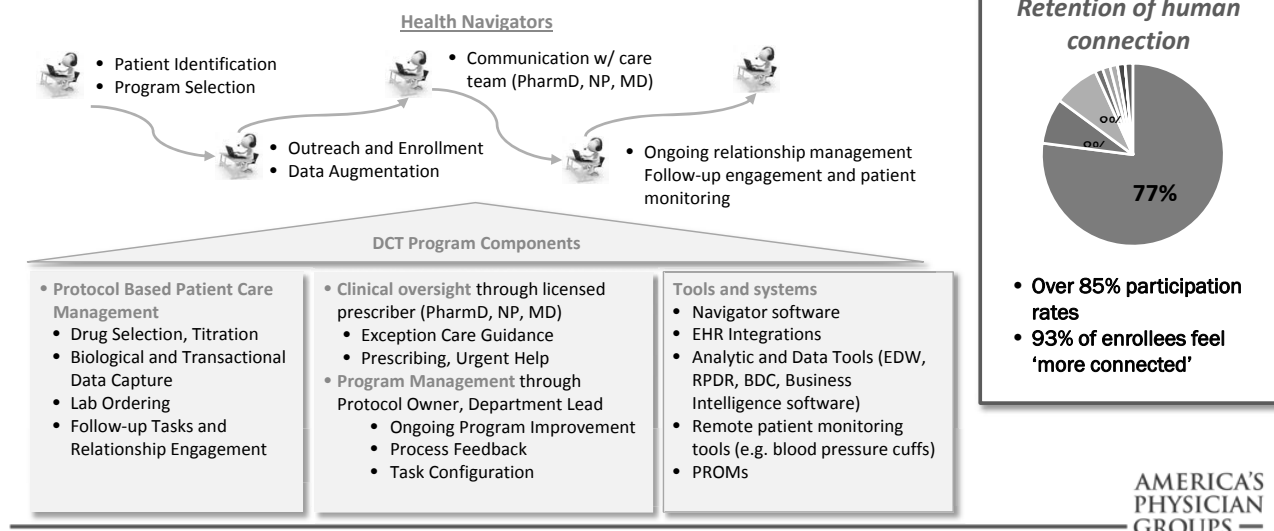
## Task shifting and automation: systematizing care



- Scale factors from our pilots
  - ~1,000 :1 for Navigators
  - ~10,000: 1 for Pharmacist
  - ~5,000-20,000:1 for Physician (referral rates ~ 0.5 - 1.5 %)
- Cost ~ 60% reductions
- High velocity change feasible: patients at all goals in weeks
- Digital technology not yet rate-limiting
- Provider and patient satisfaction high

## Initial systems work and can learn by design

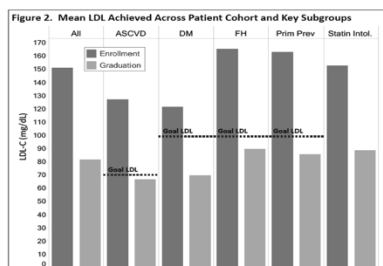
### Digital Tools and High Touch Model executed through New Clinical Workforce



## New workflow and automation drive value

### Lipids Optimization

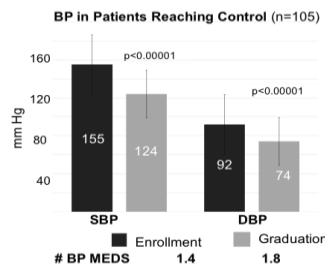
1012 pts with high ASCVD risk  
(Partnership with BCBSMA)



✓ Obtained 40% reduction in LDL within 12-16 week timeframe; better than standard therapeutic trial

### Hypertension Management

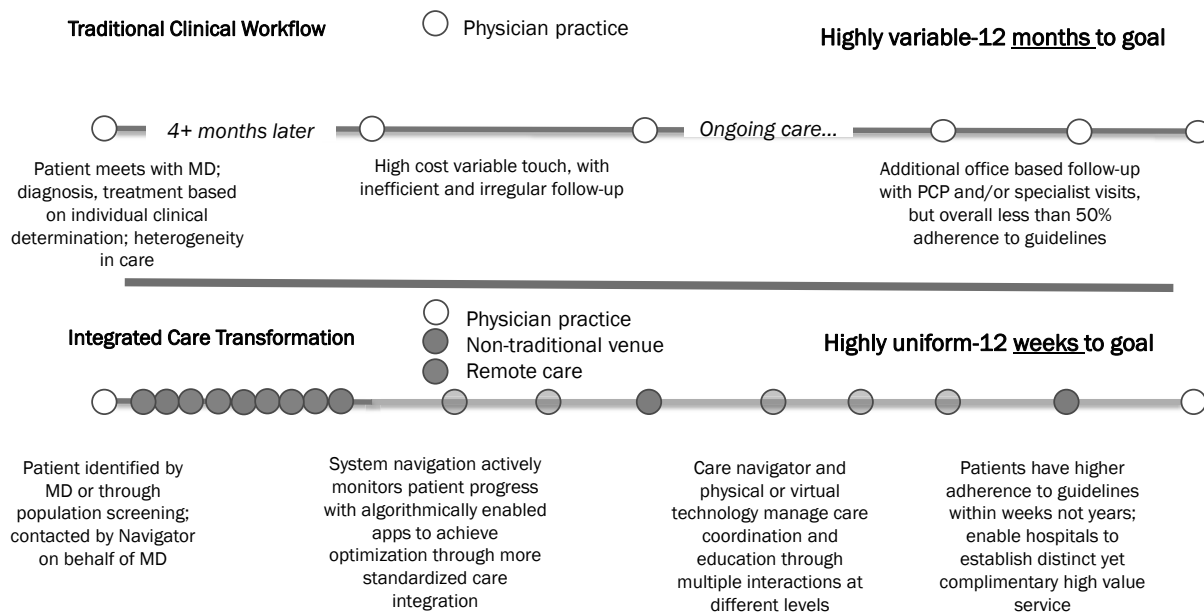
450 pts with high ASCVD risk  
(Partners Internal)



✓ Average weeks to control: ~ 7 weeks

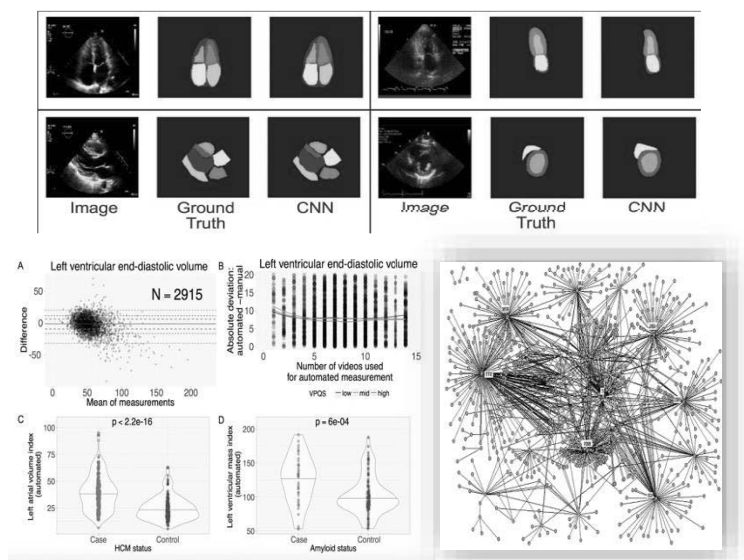
**Based on LDL and BP reductions, annual TME reduction in target population estimated from \$900-\$1300, or 6%-12% of TME**

## Fundamental care transformation

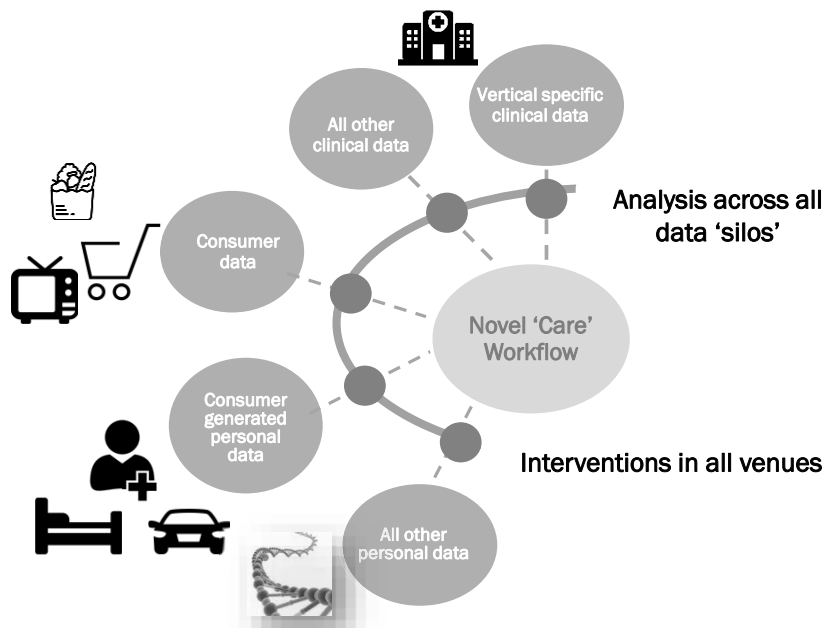


## Continuous improvement

- Broader SMRT on FHIR platform
- Current machine-learning based care programs
  - Heart failure: outpatient
  - Heart failure: inpatient
  - Anticoagulation
  - Periprocedural care
  - Atrial fibrillation
  - Diabetes
  - Hyperkalemia
  - Anemia
- Core analytics
  - Full automation: e.g **echo**
  - Real time learning
  - Precision clinical decision support
  - Direct to intervention
  - Clinical trial infrastructure
- Integrating new phenotypes
  - Transactions
  - Existing technologies-e.g. communication
  - Emerging digital and wet lab technologies
- Patient centered systems



## Data flow and analytic change venues for care delivery

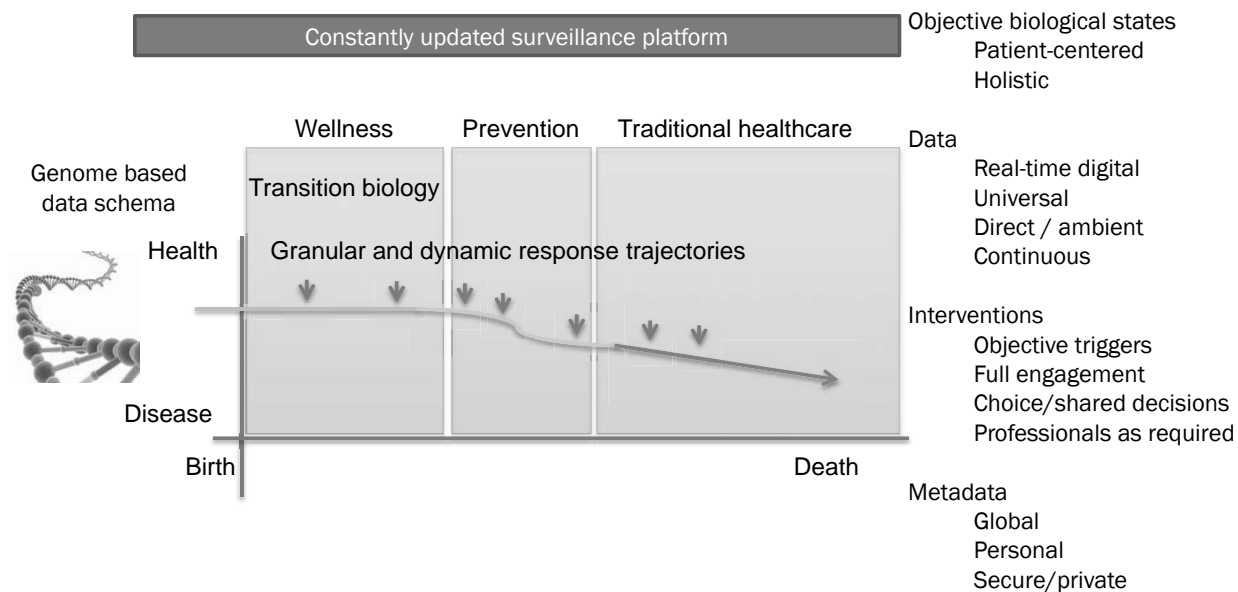


### Maintaining the human touch



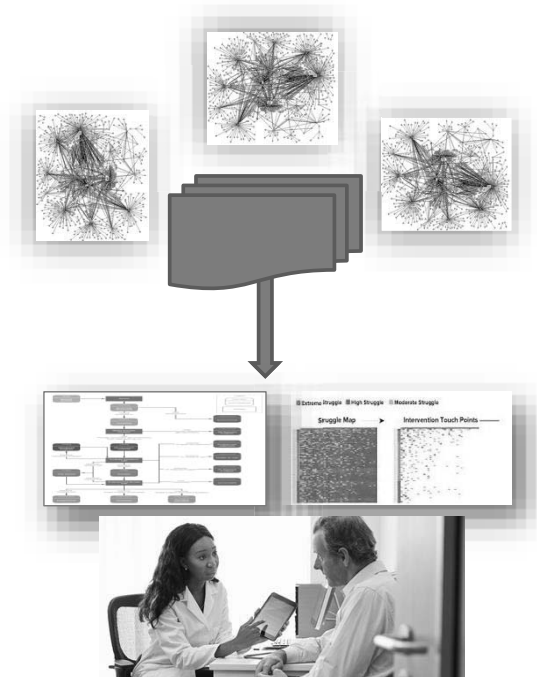
- Clinicians
- MD/NP/RN/Ph/MA
- Store associates
- Community
- Family
- AI augmentation

## Ideal: computable trajectories from wellness to disease



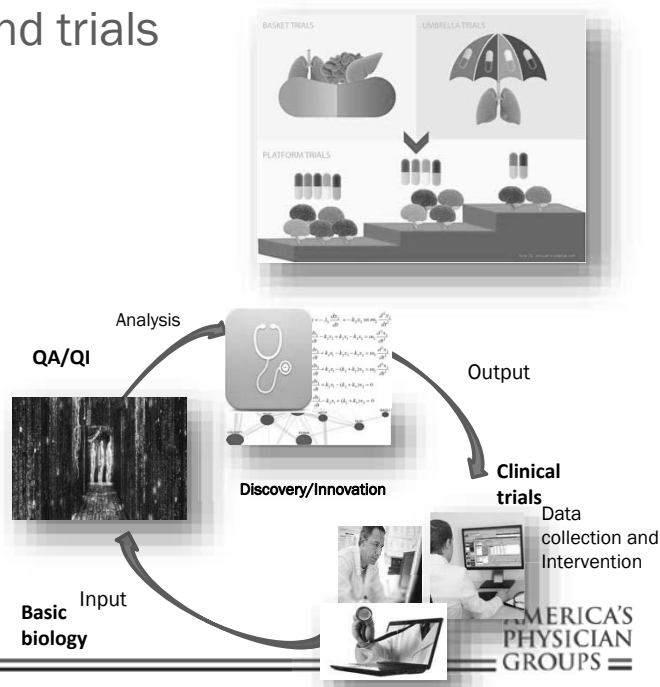
## Parallel efforts necessary in education

- Real time integration
  - New data
  - 'Learned' knowledge base
  - System data
- 'Just-in-Time' education/information
- Parallel knowledge mapping
  - Refocused education
  - In-line CME/Coaching/Compliance
- Graded intervention
  - Provider investigation
  - Provider CDS
  - Task-shifted
  - Fully automated or devolved
- Training for new roles
  - Care pathway architects
  - Medical developers
  - Population directors
  - Medical systems analytics



## New 'real world' innovation and trials

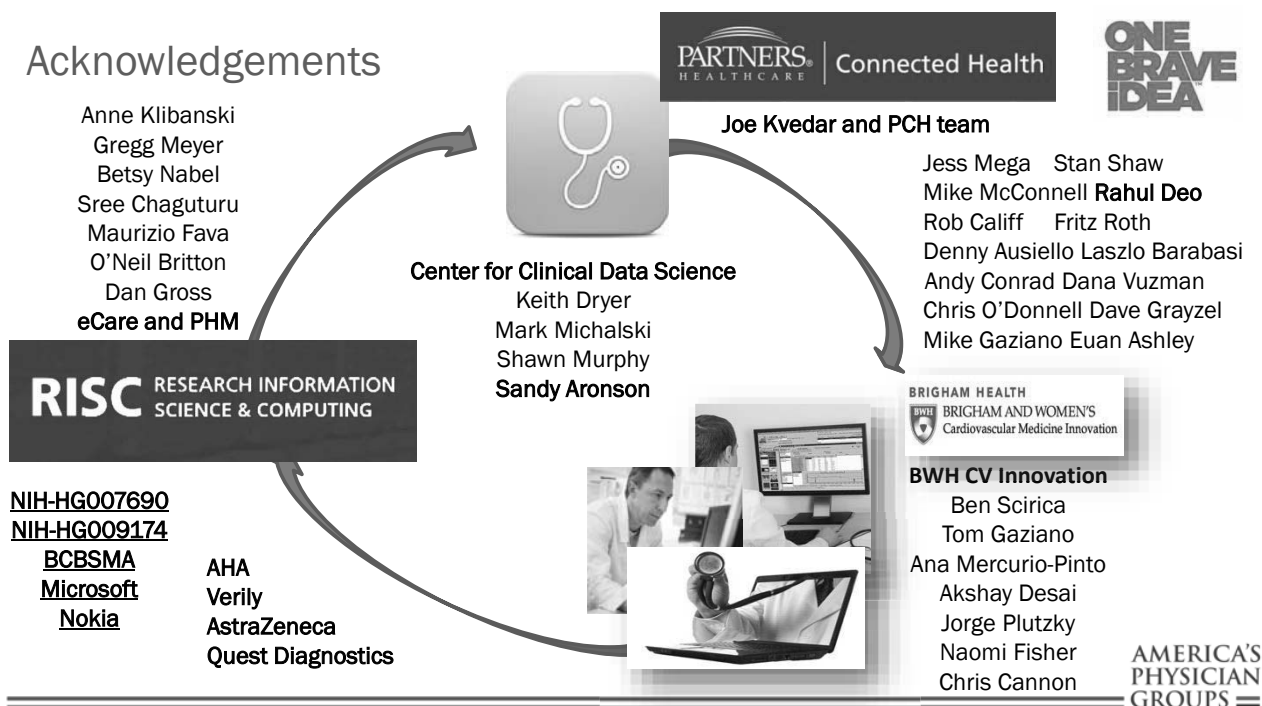
- Discrete disease entities
  - Mechanisms not biomarkers
  - Genetics
- Novel and adaptive trial designs
  - Basket
  - Umbrella
  - Platform
- Real world evidence
- Learning health systems
  - Direct to intervention
  - A/B testing
  - Recruitment/ event adjudication
- All a function of data return cycle
  - Robust biological logic
  - Integrate care, innovation and discovery



## Summary

- **To be precise assessment must be comprehensive**
- Increasing **information content** the key to redesign of healthcare
  - New data scope/scale and new data architecture; **has to come from outside medicine**
  - New analytics-continuous
  - **Improved measurement and distribution of risk and value**
- Even rudimentary 'systems' can create a **transactional** foundation for **rapid cycle innovation**
- **Existing digital technologies can already improve outcomes and reduce cost with AI**
- **Workflow and culture change will dominate any transformation**
- Truly scalable systems are feasible: the right data, the right transactions and the right culture
  - Patient-centered and holistic
  - Shared lexicon and perturbations for both wellness/disease: **removing silos, de-medicalization**
  - Exponential increase in data collected
  - Transactional execution measured
- Unified discovery-development-translation-care
- **Human health and disease** is the only design constant in the new AI driven health ecosystem
  - Lean, agile, non-incremental: a true 'operating system' for wellness and healthcare
  - Retraining clinicians as developers, data scientists, care pathway architects, human biologists.....

## Acknowledgements



## Current system

- Care is **expectant** and **provider centric**
- Care is episodic and **F2F**
- Encounters ad hoc/focused on data intake
- Proven therapies **variably** deployed
- Limited standardization
- Semi-subjective **legacy** data **entry**
- Ingestion external data difficult/**manual**
- Clinicians **burned out**, lower in license
- **High cost, variable touch**
- **Non-scalable**
- Classification low resolution and subjective
- Risk estimates low resolution/population
- AI difficult: few meta data
- Innovation cycle: **12-15 years**
- **QA/QI, Innovation and Research: off-line**

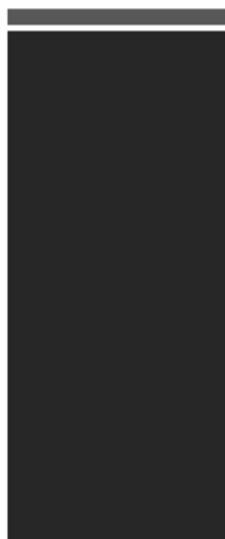
## Future state

- Care is **triggered** and **patient centric**
- Care is continuous, asynchronous and **remote**
- Encounters planned / focused on interpretation
- Proven therapies **uniformly** deployed
- Fully standardized with objective exceptions
- Objective data **streaming from all sources**
- Ingestion external data seamless
- Clinicians **re-professionalized**, top of license
- **Low cost, high touch**
- **Highly scalable**
- Classification granular and objective
- Risk estimates-high resolution individual
- AI-by design, integrated metadata,
- Innovation cycle: **12-16 weeks**
- **QA/QI, Innovation and Research: integrated**
- **Real world continuous care**

## Rapid ecosystem evolution

Partners	Drivers	Specific Projects	Stated Objectives
<b>Payers</b>	Cost containment Improved outcomes Patient/MD satisfaction	Lipid optimization Blood pressure control Virtual HF  Multiple disease states Acute care episodes	Risk optimization Appropriate specialty pharmacy Remote co-management AMC insights Evaluation of novel Rx: risk sharing
<b>Providers</b>	Cost containment Improved outcomes Access to discovery FOMO	Lipid optimization Blood pressure control Virtual HF  Multiple disease states Acute care episodes	As for Payers  Network growth Catch-up/Moat building Clinical trials
<b>PBMs</b>	Business model realignment	Risk factor optimization Chronic disease management	Remote co-management Algorithm access and maintenance Differentiation
<b>Pharma/Biotech &amp; Biomarkers (Wet/Digital)</b>	Market penetration/positioning Reduction trial costs Discovery platforms	Virtual HF clinic Lipids/DM/Inflammation Hybrid trials Disease stratification	Implementation velocity Business intelligence/Education Discovery platform (+ecosystem) New business models: risk sharing
<b>Tech</b>	Device validation Data capture Data analytics Market entry	Multiple device/drug combos Analytics eg Genomics  Multiple disease states Acute care episodes	Ecosystem development Market entry Discovery
<b>Retail</b>	Business model realignment Leveraging physical plant Leveraging extant data	Global care platforms Data collection-store/kiosk	Remote co-management Disease management support Life bundles
<b>Government</b>	Value measurement Value attribution	HF consortium	Value measurement New payment models

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## Real-Time Advanced Analytics to Thrive in a Value-Based World

Jean Drouin, MD | November 2019





## Overview of today's discussion



Consider the potential of technologies from other industries to drive value, reduce waste, and improve quality



Discuss how predictive analytics will enable better assessments of quality, outcomes, and effectiveness in care delivery



Show of how these analytics can be used by providers to succeed in value-based models

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These industries made massive business model changes...  
inside of a few years



### BASEBALL

WINS ABOVE  
REPLACEMENT



### FINANCE

INSTANT CREDIT  
APPROVAL

### Advanced Analytics

Build Your Sales with Engine Recommendations

Product recommendations helps give your customers a shopping experience in which 1 year online store's user experience with the right algorithm provided by engine recommender. Below are some common algorithms used for engine recommendations include:

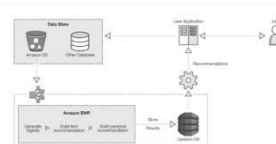


Figure 1: Recommendation pipeline, green portion is open code running on AWS

### ONLINE RETAIL

PREDICTIVE PURCHASE  
RECOMMENDATIONS

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## Big data + analytics crushes prior methods



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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**GUT-BASED SCOUTING**



**LONG PAPER APPLICATIONS**



**MULTIPLE TRIPS TO THE STORE**

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## So why is healthcare still so far behind the curve?



### Siloed repositories with restrictive data rights

Data sets are small and fragmented so we lack a universal, integrated view of patient journeys



### Messy data

Loading and cleaning new data takes weeks to months and still has data gaps and inaccurate data points



### Antiquated systems of intelligence

Rely on pre-determined metrics, the wrong units of analysis, non-predictive models



### Point solutions

Different vendors for individual analytics questions , reinventing the wheel

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## Translating what we've learned to taking on risk in healthcare



### UNDERSTAND DOCTOR PERFORMANCE

(WINS ABOVE REPLACEMENT)



### UNDERSTAND INDIVIDUAL PATIENT RISK PROFILES

(INSTANT CREDIT APPROVAL)



### MATCH TO THE RIGHT CARE

(PREDICTIVE PURCHASE RECOMMENDATIONS)

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## In order to take on risk with confidence you need actionable enterprise analytics

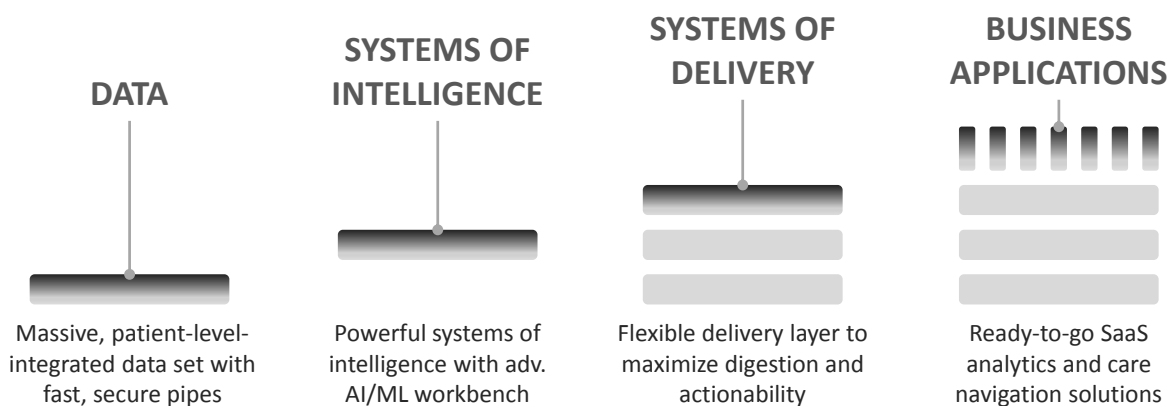
- **Ingest billions of diverse data in minutes**  
*Uploading large datasets in different formats can be tedious and time consuming*
- **Clean and address common missingness of raw data**  
*Healthcare data is messy, and cleaning can be a manual and frustrating process*
- **Link data at the individual member level to create care journeys**  
*A complete view of a member is near impossible without the right data and timeframes*
- **Quickly create care groupings and metrics by which to analyze the data**  
*Creating just one episode grouping or analysis metric can take hours of resources*
- **Build predictive models to inform critical decisions on member care**  
*Understanding how to use complex data to better member care is challenging*

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## The four components of advanced analytics platforms



AI / ML = artificial intelligence and machine learning

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## The foundation is longitudinal, patient-level datasets

	1 Government claims (Medicare)	2 Government claims (Medicaid)	3 Commercial claims	4 Clinical (EMR) data	5 Prescriptions and dispensation	6 Social and behavioral data
<b>Description</b>	<ul style="list-style-type: none"> <li>CMS Qualified Entity</li> <li>100% Medicare FFS data (Parts A and B) dating back to 2014</li> </ul>	<ul style="list-style-type: none"> <li>Tokenized claims, including both medical &amp; Rx, for Managed Medicaid population</li> </ul>	<ul style="list-style-type: none"> <li>Tokenized claims and remittance data, including some Medicaid and MA</li> </ul>	<ul style="list-style-type: none"> <li>Tokenized, EMR-derived clinical records including diagnoses (e.g., clinical labs), treatments and clinical outcomes</li> </ul>	<ul style="list-style-type: none"> <li>One year prescription history</li> <li>100% Medicare FFS data (Part D)</li> </ul>	<ul style="list-style-type: none"> <li>Social determinant &amp; consumer behavior data (~400 unique attributes / individual)</li> </ul>
<b>Annual lives</b>	40M annually	28M annually	80M annually	60M annually	90% of US population	Most of US Population
<b>Total lives</b>	54M	56M	150M	60M	90% of US population	Most of US Population
<b>Longitudinal lives</b>	100%	100%	35%+	N/A <sup>1</sup>	100%	n/a
<b>Time frame</b>	2014 - Present	2016 - Present	2014 - Present	2016 - Present	2014 - Present	Varies
<b>Refresh frequency</b>	Quarterly	Monthly	Daily to Monthly	Monthly	Annual, on demand	Daily, on demand
<b>Latency</b>	120 Days	Weekly to Monthly	Weekly to Monthly	Weekly to Monthly	Weekly to 120 Days	None

(1) We define longitudinally as "all the claims for a given patient". By the nature of EMR data, we can never guarantee that a single provider/EMR has 100% of a given patient's encounters.

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## The keys to clinician engagement



### ACCURACY

Built on broad national data set and designed with clinician input to precisely identify unwarranted variation



### TRANSPARENCY

Hundreds of individual inputs per member that physicians can see, not simple population-level adjustments and/or opaque risk scores



### ACTIONABILITY

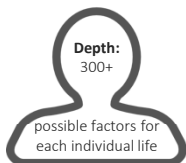
When applied across a range of metrics, root cause analysis gets to the source of the variation

## Accuracy: Train models on a vast scope of data and extensively validate to ensure precision and value

Models are trained on data that is immense in both breadth and depth...



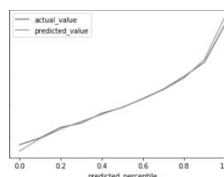
- **Medicare FFS:** 54M lives
- **Managed Medicaid:** 56M lives
- **Commercial:** 150M lives



- **Clinical:** HCCs, medical history, prescriptions, etc.
- **Demographic:** Age, gender, ethnicity, location, etc.
- **SDOH:** Education, job status, income, family support, etc.
- **SBDOH:** Exercise, social activity, tobacco/ alcohol, etc.

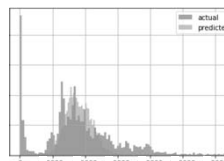
...and once trained, are extensively validated with data scientist and clinician input

### Precision of predictions vs. actuals on random sample



**Interpretation:**  
High level of fit, with acceptable level variation at either end

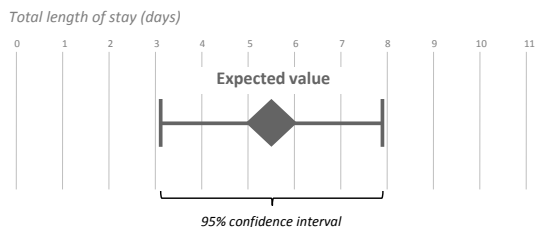
### National distributions of actual vs. predicted



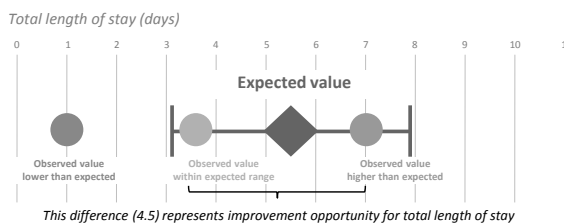
**Interpretation:** Variation at low end driven by significant number of patients at / around zero, due to seeking little to no care in calendar year. PCP attribution added as an input variable to account for this

## Accuracy: Case mix matters; no more black boxes

Expected values are generated specific to the patient and provider characteristics



And when compared to observed values highlight specific performance gaps



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## Transparency: Physicians are right to balk at analytics they don't believe account for nuances of their patients.

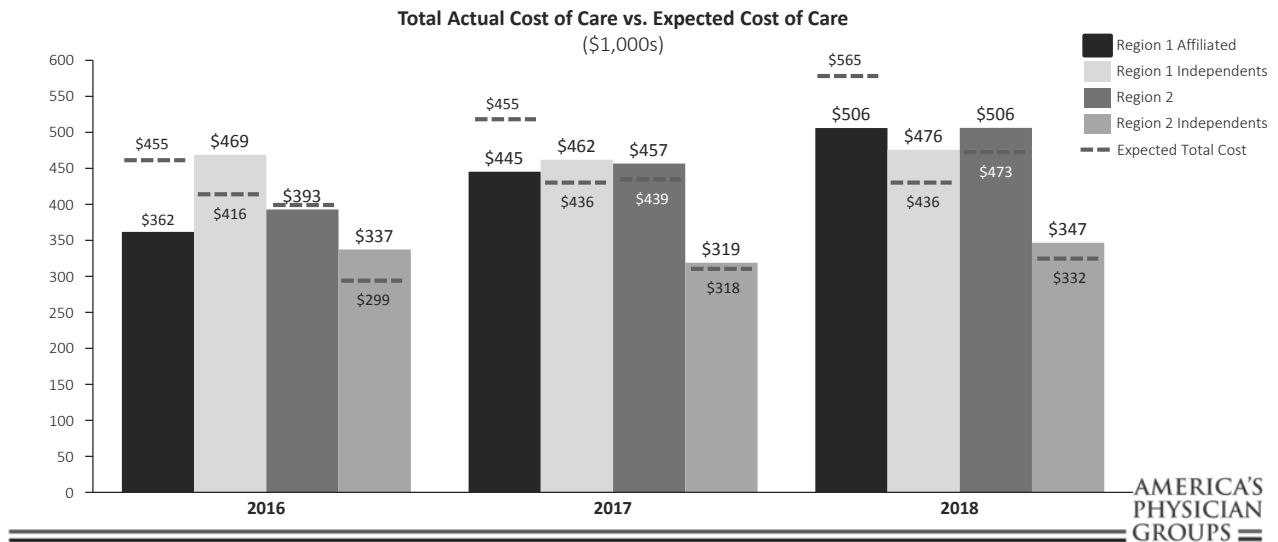
### Real-world expected value comparison

Dr. A has higher expected ICU/CCU utilization per CABG episode than Dr. B due to having a more complex patient panel across an array of factors

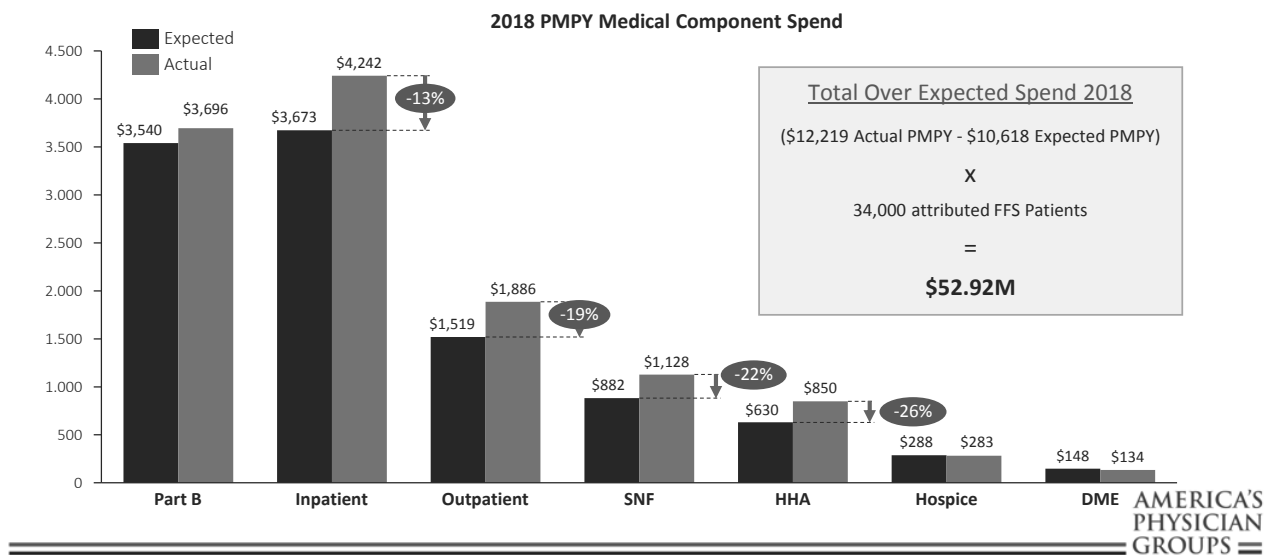
Top case-mix adjustment factors driving expected ICU/CCU utilization	Impact on Expected Value (in days)	Percent of patients with each adjustment factor	
		Dr. A	Dr. B
DRG 233 (Cardiac catheterization + major complications/comorbidities)	0.5	28%	3%
Cardio-Respiratory Failure & Shock	0.4	63%	7%
DRG 235 (Major complications/comorbidities)	0.3	40%	17%
Acute Renal Failure	0.2	30%	17%
Congestive Heart Failure	0.15	43%	14%
Acute Myocardial Infarction	0.1	45%	17%
Specified Heart Arrhythmias	0.05	45%	38%
Inpatient admission type: other	0.05	38%	72%
Coagulation defects and other specified hematological disorders	0.05	73%	7%
CABG – 3 vessels	0.05	50%	24%
Vascular disease	0.05	35%	31%
Renal failure – dialysis risk factor	0.05	3%	10%
DRG 234 (Cardiac catheterization w/o major complications/comorbidities)	0.05	5%	17%
Peripheral arterial disease risk factor	0.05	30%	24%

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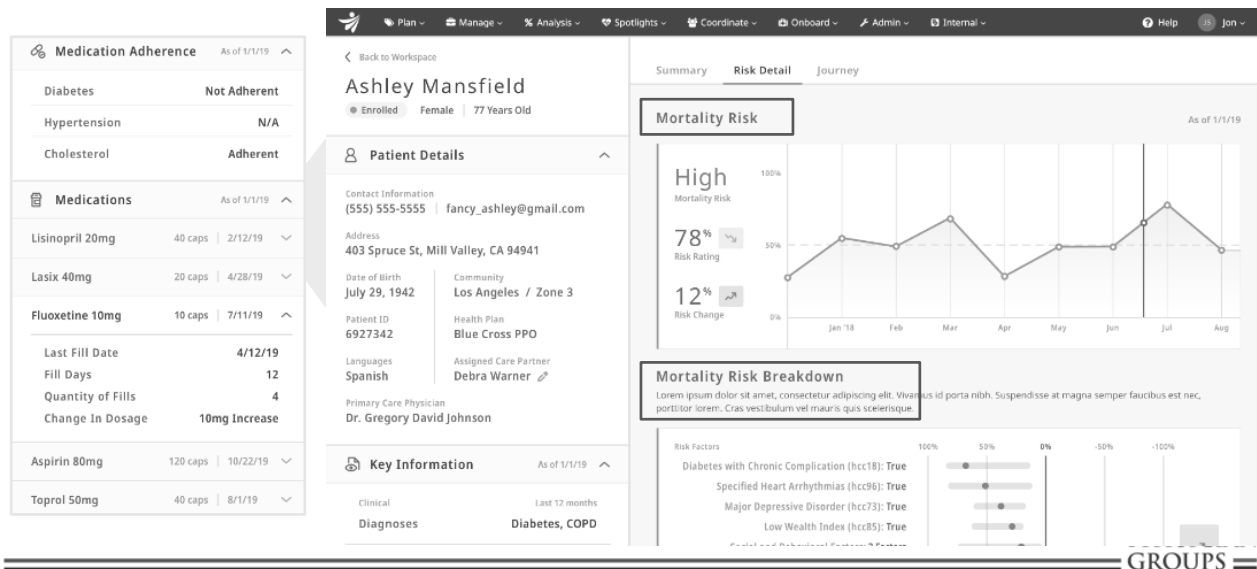
**Transparency: Region 1 medical groups consistently performed below expected total cost of care in 2018**



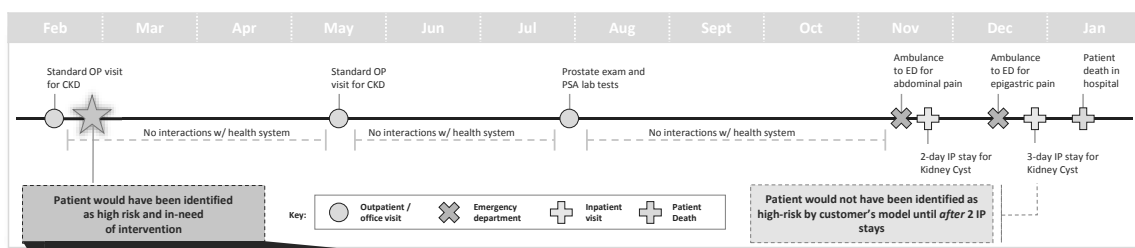
**Transparency: Medical Group I's overspend occurs across components of cost, but inpatient, outpatient, SNF, and HHA stand out**



## Actionability: Identify root cause drivers of individual risk through machine learning



## Actionability: Intervene on high risk patients ahead of significant utilization and spend



**High Risk**

### Patient Characteristics and History

Clinical Information:	Social Determinants:
Count of HCCs: 4	Age / Gender: 97 y.o. male
Key Diagnoses: Stage 4 CKD, Vascular Disease, Alcohol Abuse, Underweight	Wealth Index: Low-Middle Class
Encounters in Last 90 Days: 1 (outpatient procedure)	Address Stability: Unstable
	Household Members: 1 (Lives Alone)
	Caregiver in home: No

- Patient with high mortality risk identified **\10+ months before death**
- Earlier care intervention may have avoided **2 EMT transports, ED visits, and IP stays**
- Patient could have benefited from CKD programs, home visits, or palliative care



## Impact: Significant ROI potential from more informed, more timely patient care

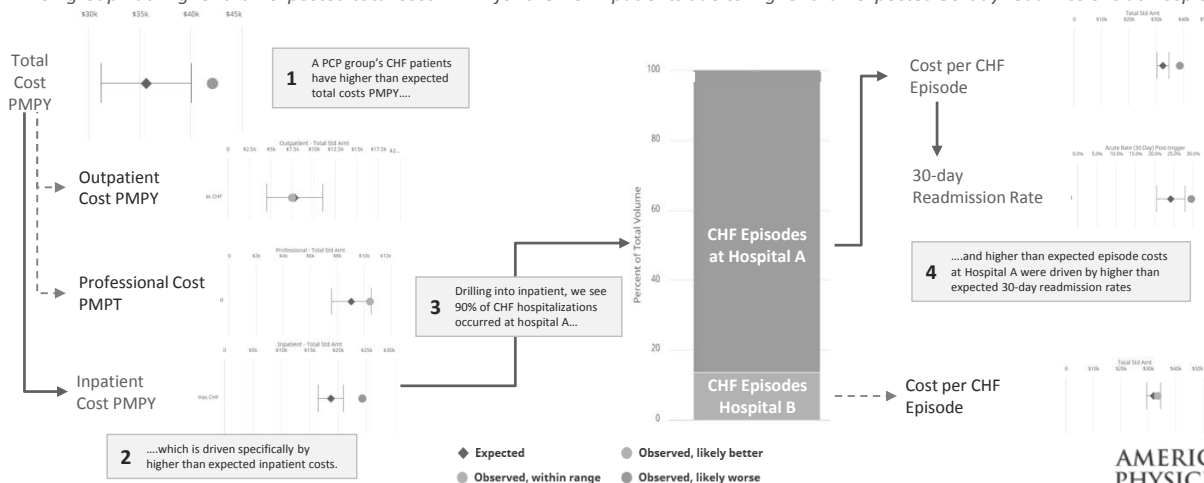


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## Actionability: Pinpoint drivers of cost variation through case-mix adjusted, AI automated root cause analysis

### Real-world root cause analysis example

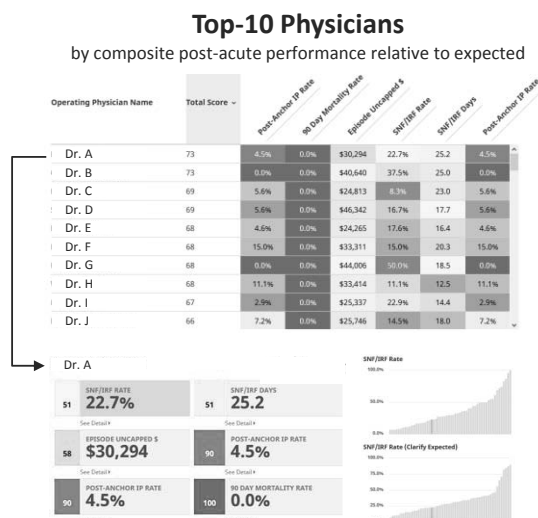
A PCP group had higher than expected total cost PMPY for their CHF patients due to higher than expected 30-day readmissions at Hospital A



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**Actionability:** Track physician performance with apples to apples metrics, attributed at specialty level

Who are my top physicians across my most important metrics?



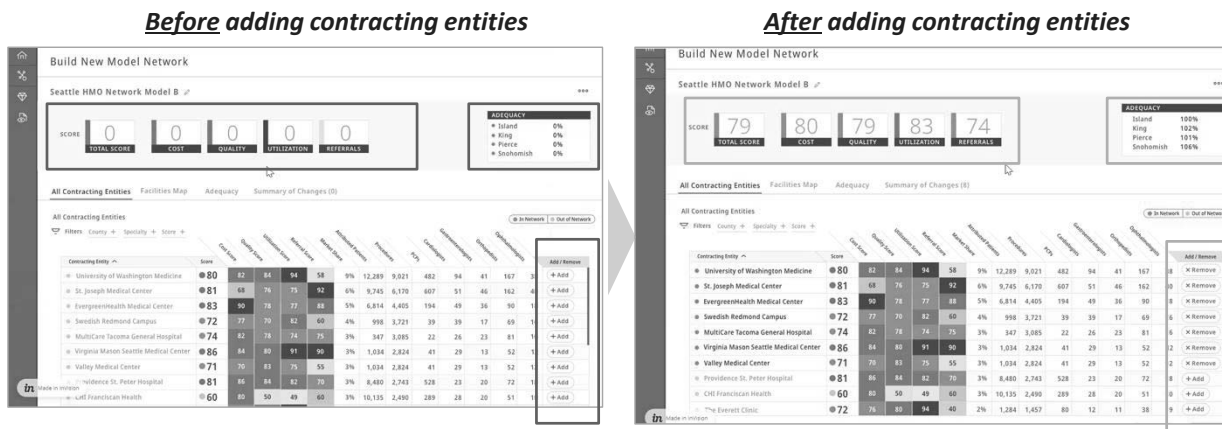
**Actionability:** Of 16 outliers, 1 is clear candidate to exclude, 9 are clear candidates to include, and 6 have potential to include

Legend Above NextGen ACO Benchmark Below NextGen ACO Benchmark

Physician Group Name	Provider NPI	2018 Attributed Members	2018 Difference to Benchmark Total	2017 Attributed Members	2017 Difference to Benchmark Total	Recommendation to Exclude / Include
Group 2	1234567890	14	\$182,656	11	\$52,709	Recommend to exclude; Above benchmark in both years
Group 1	1234567890	10	\$92,271	6	-\$31,038	Potential to include; Below benchmark in one of two years
Group 1	1234567890	17	\$74,159	6	-\$57,529	
Group 1	1234567890	15	\$48,710	10	-\$5,664	
Group 2	1234567890	1	\$39,223	2	-\$11,990	
Group 1	1234567890	9	\$5,451	9	-\$4,293	
Group 2	1234567890	1	-\$1,760	5	\$13,708	
Group 2	1234567890	3	-\$9,841	10	-\$39,743	Recommend to include; Below benchmark both years
Group 1	1234567890	1	-\$14,275	No attributed patients in 2017		
Group 2	1234567890	2	-\$27,252	6	-\$70,219	
Group 2	1234567890	8	-\$30,083	2	-\$6,018	
Group 2	1234567890	2	-\$41,189	5	-\$84,110	
Group 1	1234567890	3	-\$43,284	1	-\$2,493	
Group 2	1234567890	5	-\$124,849	5	-\$83,072	
Group 2	1234567890	9	-\$178,593	6	-\$133,908	
Group 2	1234567890	19	-\$186,802	3	-\$19,469	



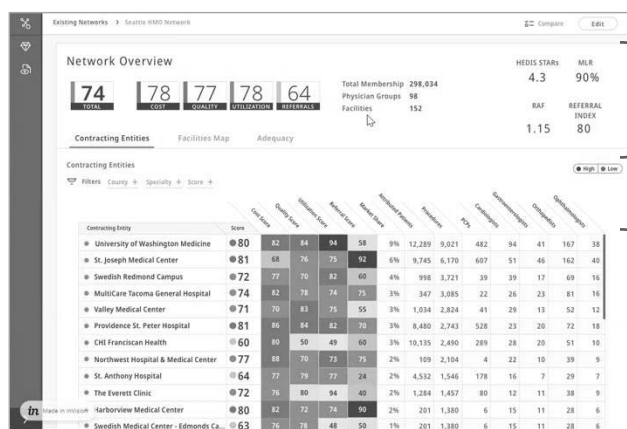
## Actionability: Dynamically build a high-value network



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## Case Study: Network Optimization

Forecast performance and actively managing cost & quality



Network-wide performance metrics

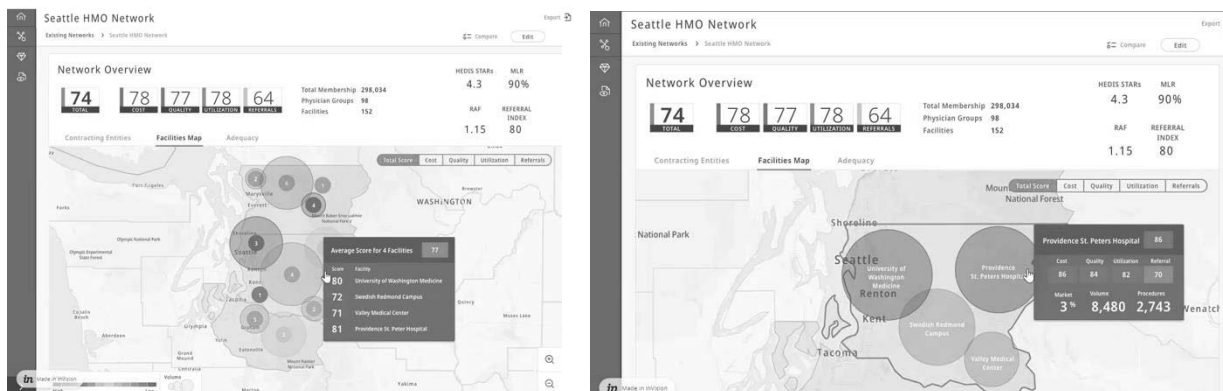
Descriptive statistics by contracting entity

Performance metrics by contracting entity

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## Case Study: Network Optimization

### Manage performance across geographies

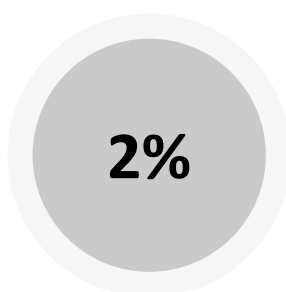


*Use mapping feature to understand performance of network within specific geographies*

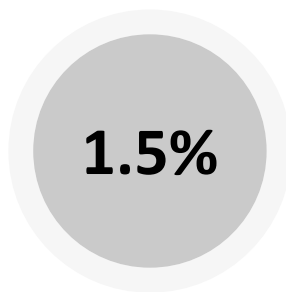
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## Case Study: Network Optimization

### Impact from network optimization



reduction in forecasted medical cost



reduction in IP re-admissions



increased analyst productivity

**Additional value generated from data-driven negotiations**

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Thank you!

Text APG to 33777 to request a copy of this presentation.



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## Appendix

- ACO Considerations
- Clarify CMS program diagnostic overview
- Case Studies
  - Pathways to success
  - NextGen
  - Direct Contracting
- Select Use Cases (sample)

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## New CMS payment models offer more opportunities for ACOs, but with more downside risk, insight is important

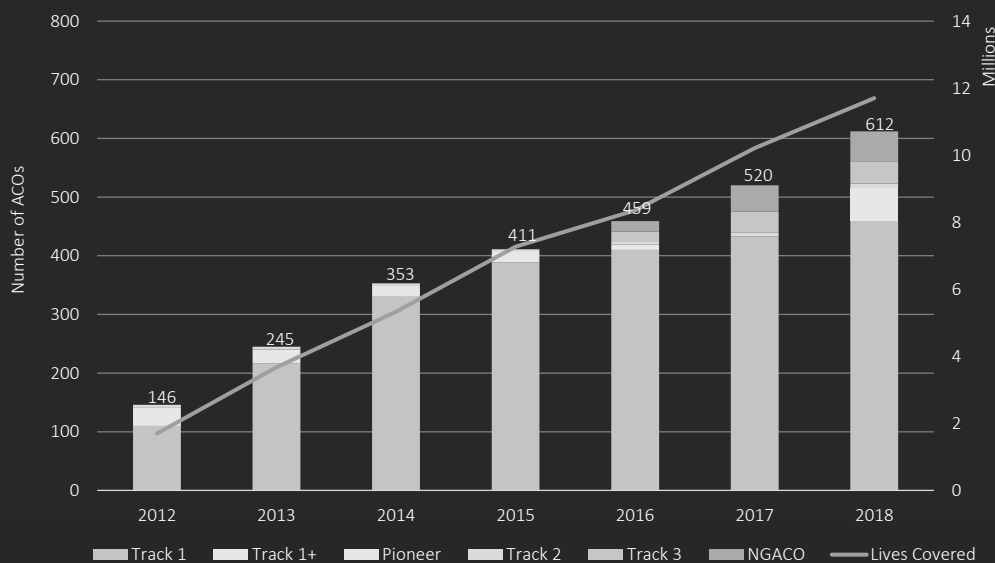
	Pathways to Success		Direct Contracting	
	Basic (5 Tracks: A, B, C, D, E)	Enhanced	Professional	Global
<b>Payment</b>	Shared Savings Program: Savings reconciled annually		Capitation: 7% of Total Cost of Care	Capitation: Total Cost of Care
<b>Predecessor</b>	MSSP Tracks 1 & 2	MSSP Track 3	N/A	NextGen ACO
<b>Risk</b>	40% - 50% ↑ 0% - 30% ↓	75% ↑ 40% - 75% ↓	50% ↑ 50% ↓	100% ↑ 100% ↓
<b>Attribution</b>	Prospective Methodology with voluntary alignment; ACO's required to notify beneficiaries		Prospective Methodology with voluntary alignment; ACOs allowed to promote alignment	
<b>Benchmark</b>	Weighted blend of historic regional and national FFS expenditures, depending on ACO size		<i>Clarify Latest: Blend of historic FFS and MA Rates</i>	
<b>Risk</b>	Change from previous year: Increase: 3% cap; Decrease: No Cap		<i>Clarify Latest: Likely similar to Pathways &amp; NextGen (cap of +/- 3% change from previous year)</i>	
<b>Efficiency</b>	None		<i>Clarify Latest: Adjustment based on efficiency</i>	
<b>Quality</b>	23 Measures in 4 domains (Patient/Caregiver Experience, Care Coordination, Preventive Health, At-Risk Population)		<i>Clarify Latest: Select group of measures; impact on discount or shared savings tbd</i>	
<b>Trend</b>	Weighted by market share		<i>Clarify Latest: Likely similar to Pathways Final Rule</i>	
<b>Waivers &amp; Incentives</b>	3-Day SNF, Telehealth (two-sided risk only), beneficiary incentives. APM status for Track E and Enhanced only.		<i>Clarify Latest: 3-Day SNF, Telehealth, Post-Discharge Home Visits; Care Management Home Visits</i>	

\*Some elements omitted, including high vs. low-cost ACO and 5% APM bonus

↑ / ↓ Upside / Downside Risk



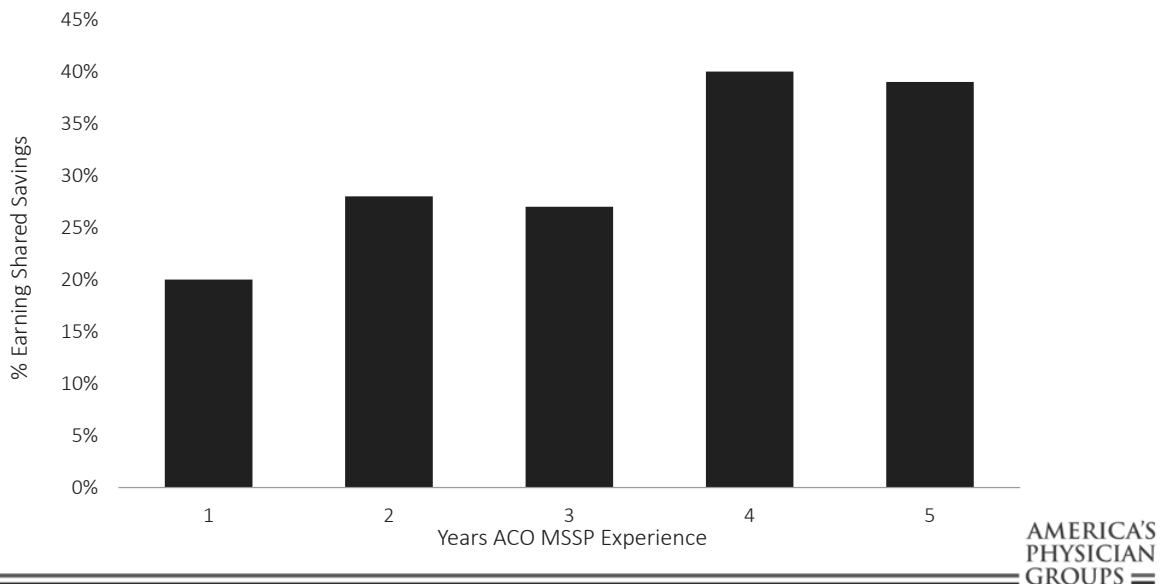
## Growth of ACOs Participating in Shared Savings



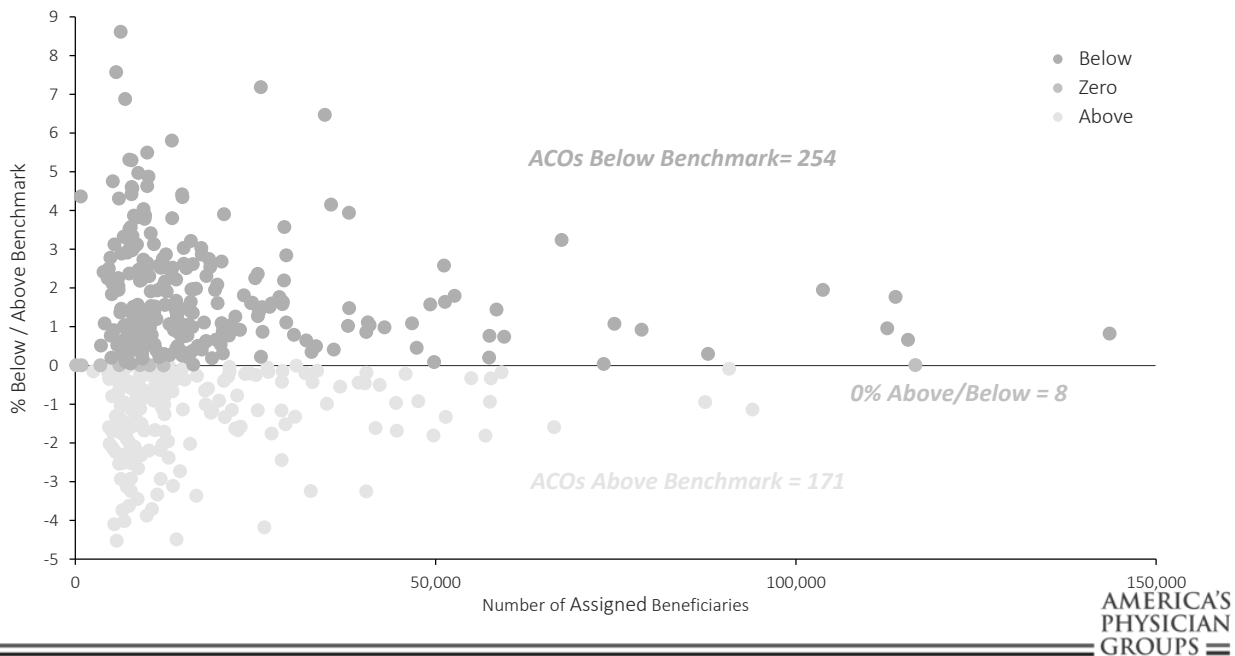
Does not include Comprehensive ESRD Care Participants  
Values sourced from CMS publicly available information



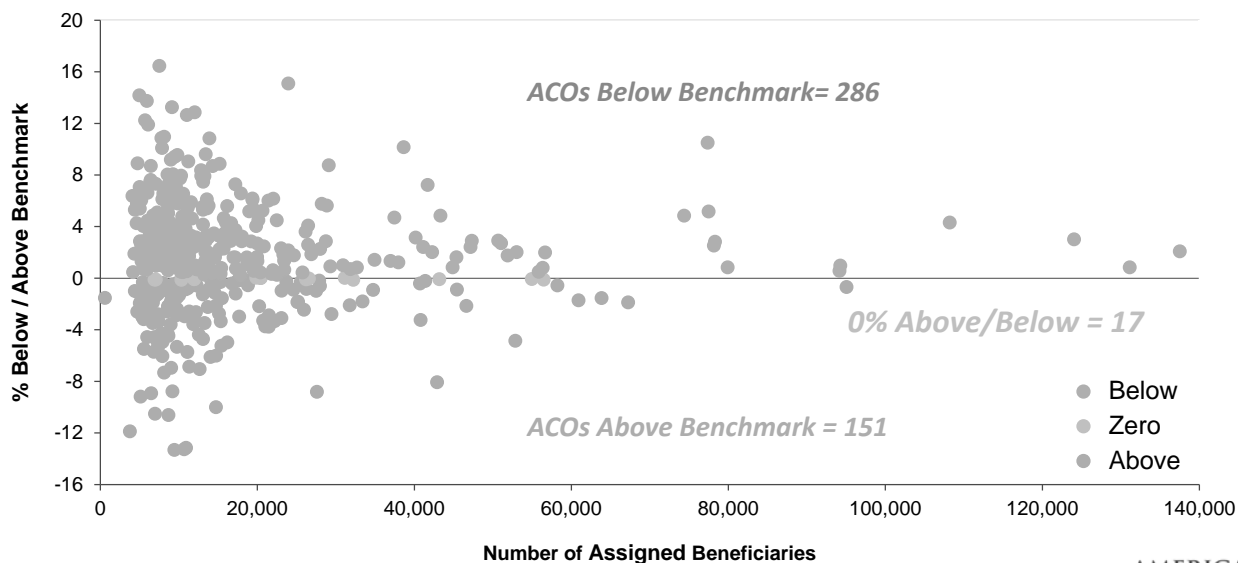
# ACOs Earning Shared Savings by Years Experience



Performance of MSSP Track 1 ACOs in 2017 (Pathways to Success Rules applied)



### Performance of MSSP Track 1 ACOs in 2018 (Pathways to Success Rules applied)



<sup>1</sup>Based on CMS public use files. Revisions to benchmarking methodology for Pathways not incorporated into these numbers. PMPY numbers based on attributed membership to losing ACOs as a denominator.  
<sup>2</sup>Based on membership to Track 1 ACOs who cleared their minimum savings rate and earned savings.



### Pathways to Success: Additional Details

	A	B	C	D	E	Enhanced	
<b>Shared Savings Rate</b>	40% x Quality Score	40% x Quality Score	50% x Quality Score	50% x Quality Score	50% x Quality Score	75% x Quality Score	
<b>Shared Loss Rate</b>	0% (Upside Only)		30%	30%	30%	40% - 75%	
<b>Loss Limit</b>	% Parts A+B Revenue	-	-	2%	4%	8%	-
	% Benchmark	-	-	1%	2%	4%	15%
<b>MSR / MLR</b>	Size-Dependent			Choice: 0% - 2% (0.5% increments)			
<b>APM Qualification</b>	No	No	No	No	Yes	Yes	





## Decisions about Your Pathways Track Matter

	Pathways Basic Track C			Pathways Enhanced		
	Loss	Baseline	Gain	Loss	Baseline	Gain
<i>Membership: 10,000</i> <i>CMS Benchmark: \$10,000</i>						
<b>Benchmark Expenditures</b> for ACO Assigned beneficiaries	\$100M	\$100M	\$100M	\$100M	\$100M	\$100M
<b>Actual Expenditures</b> (+5%, 0%, -5%)	\$105M	\$100M	\$95M	\$105M	\$100M	\$95M
<b>% Shared Savings / Losses</b>	30%	0%	50% x Quality Score	60%	0%	75% X Quality Score
<b>Total Savings / Losses</b>	<b>\$1.5M</b>	<b>\$0</b>	<b>\$2.3M</b>	<b>\$3.0M</b>	<b>\$0M</b>	<b>\$3.5M</b>

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## Decisions about Your Pathways Track Matter

	Pathways Basic Track C			Pathways Enhanced		
	Loss	Baseline	Gain	Loss	Baseline	Gain
<i>Membership: 10,000</i> <i>CMS Benchmark: \$9,500</i>						
<b>Benchmark Expenditures</b> for ACO Assigned beneficiaries	\$95M	\$195M	\$95M	\$95M	\$95M	\$95M
<b>Actual Expenditures</b> (+5%, 0%, -5%)	\$105M	\$100M	\$95M	\$105M	\$100M	\$95M
<b>% Shared Savings / Losses</b>	30%	0%	50% x Quality Score	60%	0%	75% X Quality Score
<b>Total Savings / Losses</b>	<b>\$3.0M</b>	<b>\$0</b>	<b>\$4.6M</b>	<b>\$6.0M</b>	<b>\$0M</b>	<b>\$6.9M</b>

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## Clarify Health’s CMS Program Diagnostic Commit with confidence

- ✓ Project your performance in each CMS program
- ✓ Evaluate individual provider performance
- ✓ Know your attributed members’ risk profiles before fully committing

### **FINANCIAL FORECAST**

Interactive financial model projecting your performance in each program based on your providers’ historic performance on all their Medicare FFS patients

“What if” scenarios to model potential impact of variations in quality, risk coding, and clinical savings

### **NETWORK DESIGNER**

Evaluation of individual providers in a market based on key factors that influence performance in CMS programs

Recommendation of providers for network inclusion by specific CMS program, given their potential for success managing their attributed population

### **POPULATION INSIGHTS**

Identification of your likely attributed patients including risk scores and clinical and social characteristics

Historic utilization of this population by service line and major components of spend

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## How it Helps: Cases from three current Clarify customers

**Program**

### **Pathways to Success**

**Key Questions**

- How are affiliated and independent physician groups performing against cost and quality benchmarks?
- Which groups should be included in a CMS Program?

### **NextGen ACO**

- Should two additional provider groups be added to the NextGen ACO?
- Will doing so improve overall performance?

### **Direct Contracting**

- Which Primary Care Providers across 13 markets are strong candidates for direct contracting?

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Pathways

**Customer Context:**

- **Integrated Hospital and Ambulatory Medical System**
  - Includes greater than 20 hospitals, 12,000 physicians, 3000 PCPs, and 100,000 attributed lives across urban and rural locations
  - 12 Employed and Independent Provider groups
  - Historically segmented between several market service areas

**Strategic Questions:**

- **What Pathway's Track Should we enter?**
- **Should we enter with all our provider groups?**
- **If we are unable to affect any change, how would we do?**

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Pathways



Outline **patient attribution** for current and potential set of physicians



Understand which **quality and financial benchmarks** will be set and how physicians are likely to perform against them



**Design a network** of participating physicians to maximize value

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Pathways

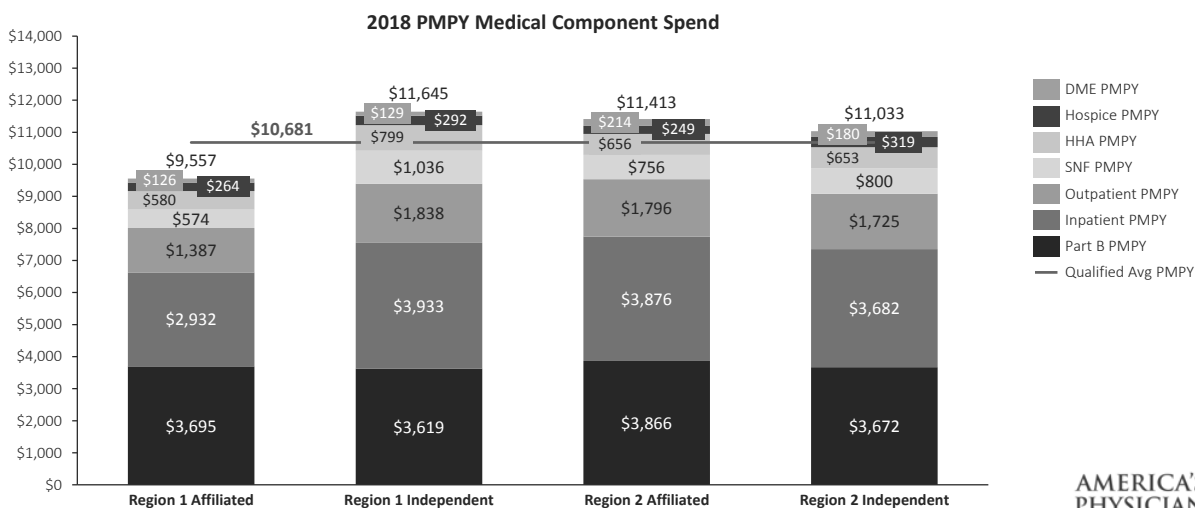
## The majority of the customer's Medicare FFS patients came from two groups

Attribution Summary	2016	2017	2018	YoY Growth
<b>Employed Region 1</b>	34,942	36,854	40,961	5.44%
Medical Group A	25,353	26,589	29,297	4.94%
Medical Group B	2,709	2,934	3,612	10.06%
Medical Group C	2,448	2,473	2,803	4.62%
Medical Group D	3,508	3,926	4,291	6.95%
Medical Group E	924	932	958	1.21%
<b>Employed Region 2</b>	4,824	4,864	5,505	4.50%
Medical Group F	4,652	4,687	5,302	4.46%
Medical Group G	155	163	190	7.02%
Medical Group H	17	14	13	-8.55%
<b>Independent (Both Regions)</b>	40,404	40,773	40,745	0.28%
Medical Group I	33,275	33,640	33,582	0.31%
Medical Group J	6,776	6,801	6,724	-0.26%
Medical Group K	284	261	288	0.47%
Medical Group L	69	71	151	29.83%
<b>Total</b>	<b>80,170</b>	<b>82,491</b>	<b>87,211</b>	<b>2.85%</b>

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## Region 1 would have achieved savings in 2018, but other groups would have lagged

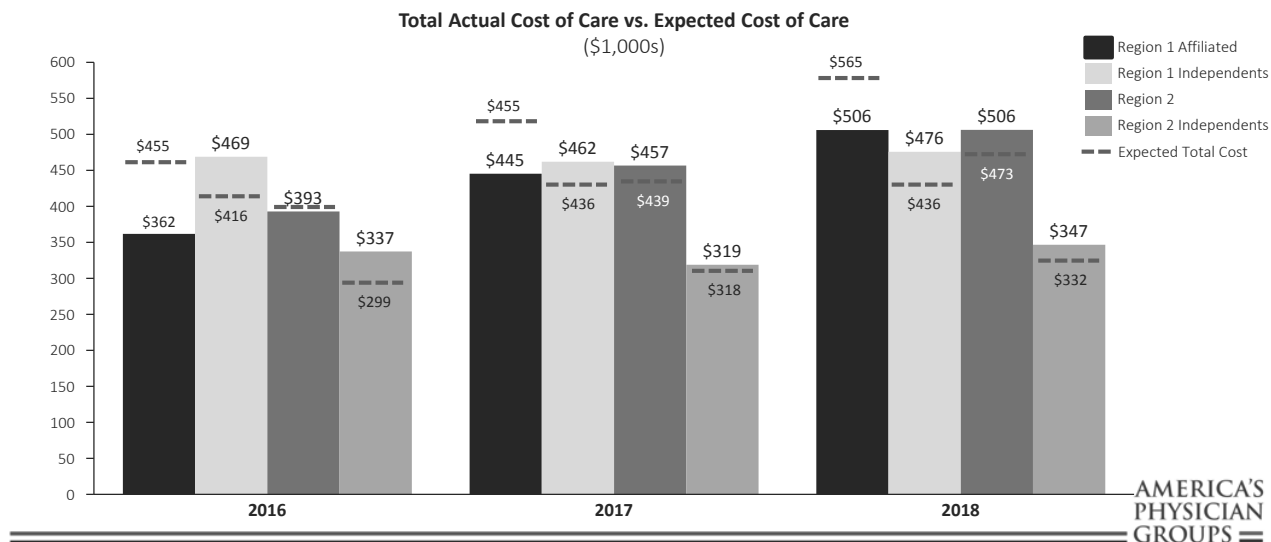
Pathways



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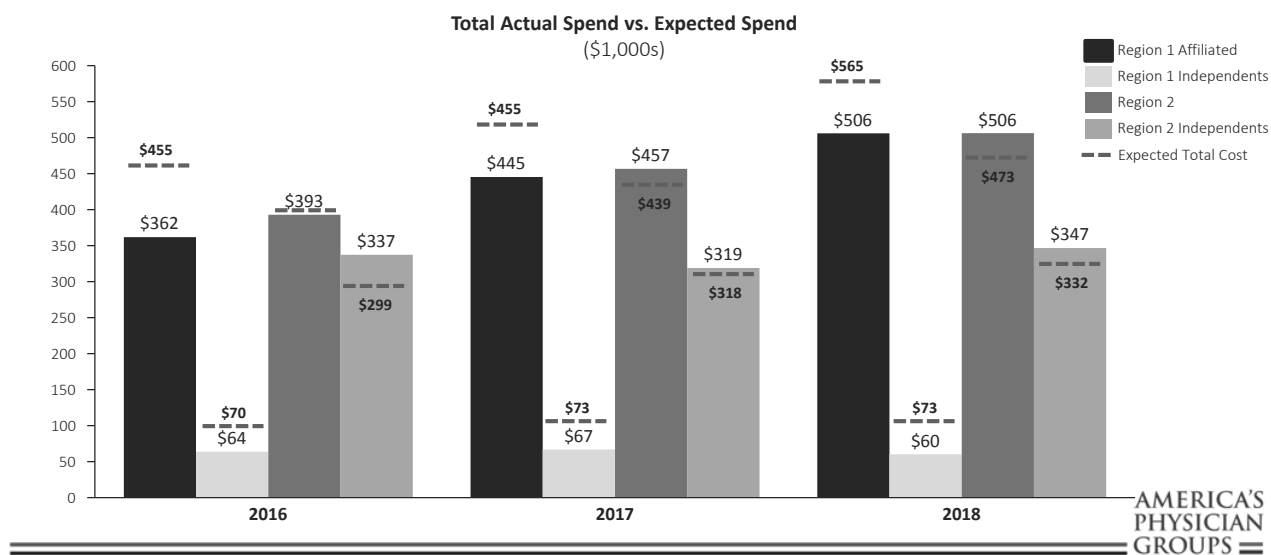
## Region 1 medical groups consistently performed below expected total cost of care in 2018

Pathways



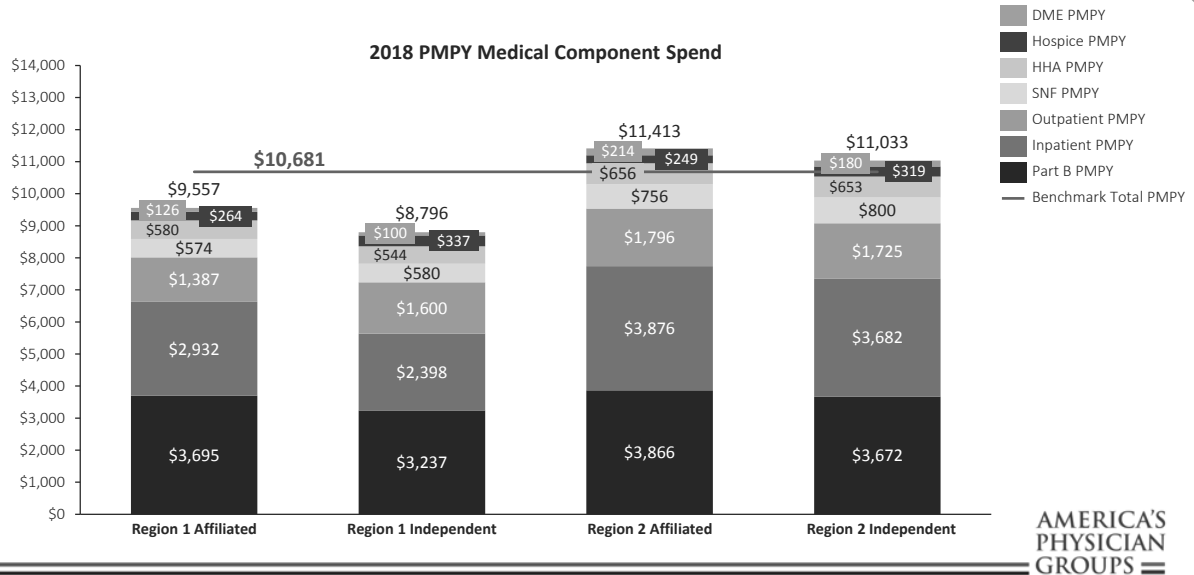
## Without Medical Group I, Region 1 Independents perform better on Total Cost in 2018

Pathways



Without Medical Group I, Region 1 affiliated medical groups and independents would consistently perform below expected PMPY spend

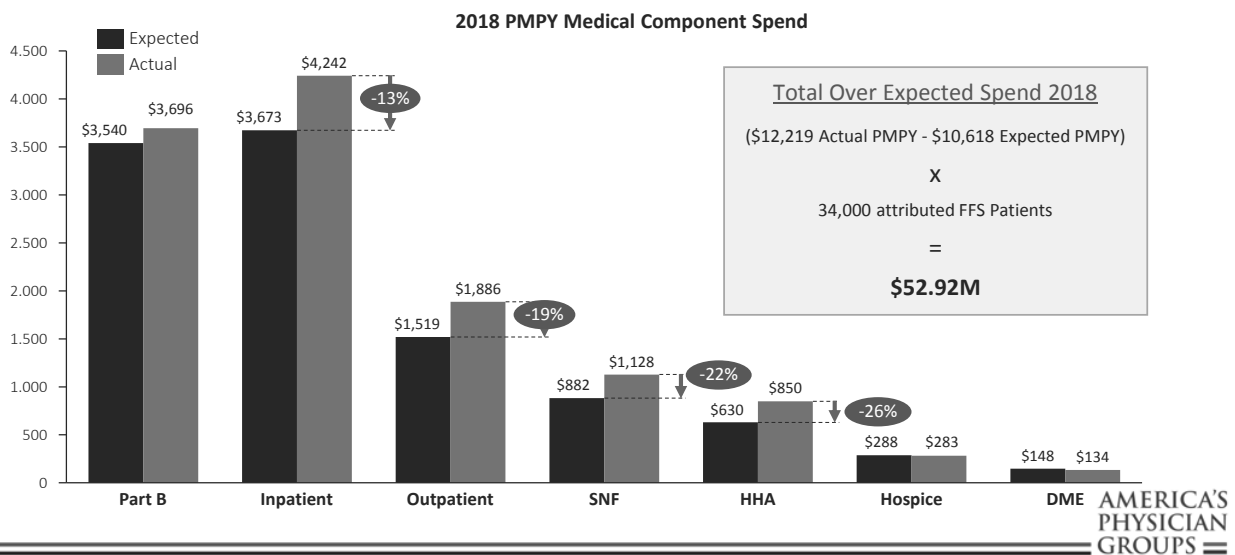
Pathways



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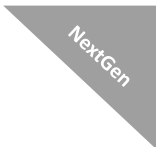
Medical Group I's overspend occurs across components of cost, but inpatient, outpatient, SNF, and HHA stand out

Pathways



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# NextGen ACO: Situation



**Customer Context:**

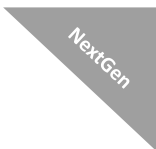
- **NextGen ACO on the East Coast**
- **Independent Multi-Specialty Group**
  - 600 physicians
  - 40 specialties
  - 11 Hospital Affiliations
- **~30,000 total attributed lives in 2018 NextGen ACO**

**Customer Questions:**

- Should we include two of our provider groups in our NextGen ACO?
- If in NextGen, how would the physicians in these groups have performed on the risk-adjusted total cost of care for their Medicare FFS patients?
- Using Clarify's Data Science, what would have been the expected total costs for these providers' panels, based on the medical characteristics of their patients?



# Clarify Objectives



Show financial impact if everyone is included



Provide Clarify recommendation on who to include/exclude and who is on the margin



Provide deeper analysis to inform inclusion decisions for physicians "on the margin"





NextGen

**~\$9M opportunity annually across both groups without excluding any physicians:** Collectively the 75 physicians with NGACO attributed patients in their panels would have generated ~\$11M in annual shared savings in 2017 and 2018. Assuming CMS receives 20%, that translates to ~\$9M in opportunity

**~\$11.5M opportunity if ACO only includes physicians that beat NGACO benchmark in both years:** Half of physicians outperformed NGACO benchmark both years. Including only them would boost upside, but reduce total attributed patients by ~45%

**Clarify's recommendation is more nuanced, including some physicians with costs above NGACO benchmark**

**Physicians with small NGACO attributed panel sizes (<20 patients) merit special consideration**

**Patterns of under- and over-performance are different for Provider Group 1 and Group 2**

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## Provider segmentation methodology: Approach for determining clear cases for inclusion/exclusion and those meriting deeper analysis

NextGen

Total Cost Performance Matrix



**Include: Exemplars**

- Physicians with total cost below Clarify expected values and within range (<=\$100 PMPM) of NGACO benchmark or lower
- Clear case to include, will serve as exemplars for others

**Include: Opportunities for improvement**

- Physicians with total cost higher than Clarify expected values but are within range (<=\$100 PMPM) of NGACO benchmark or lower
- Should include due to ability to generate shared savings, and have improvement opportunity to maximize value

**On the Margin: Worth deeper analysis**

- Physicians with total cost higher than Clarify expected values and are out of range (>\$100 PMPM) of NGACO benchmark
- While these physicians may have higher total cost than benchmark, they may be worth including if you believe you can influence their performance

**Exclude: Unlikely to add value**

- Physicians with total cost below Clarify expected values but are out of range (>\$100 PMPM) of NGACO benchmark
- Given that they are likely to not generate savings, and are already efficient, they are not good candidates to include in the ACO

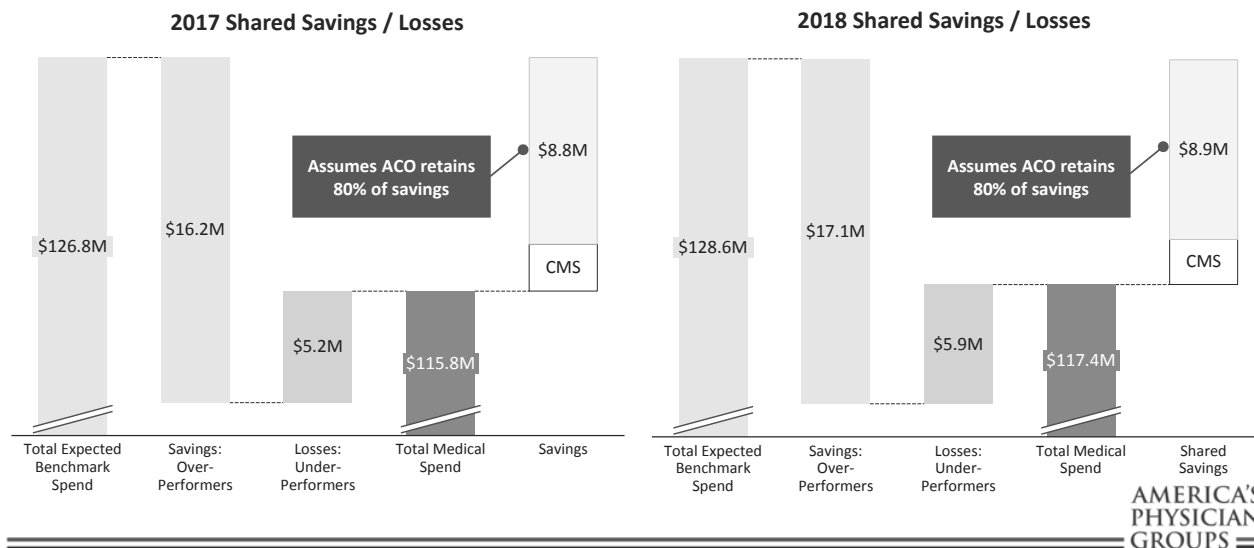
DTE = Difference to Expected: The delta between observed performance and what we would expect based on NGACO benchmark or Clarify expected models. Negative values mean that observed cost was lower than expected.

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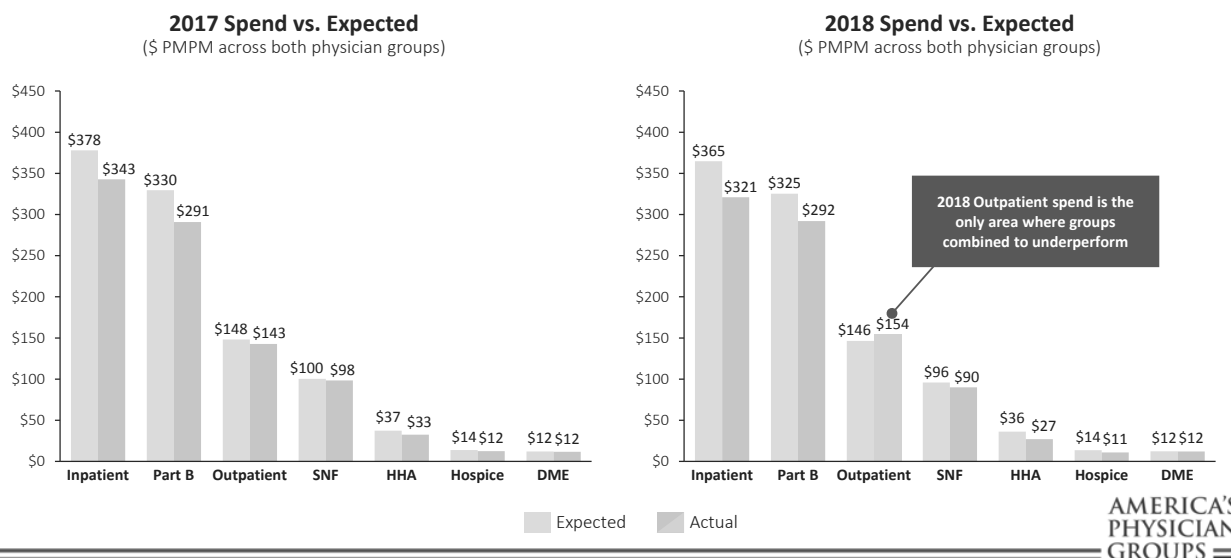
NextGen

## Financial impact: Together, both groups would have contributed \$17.7M in shared savings to the NextGen ACO over two years



## Component Spend: Both groups consistently outperform benchmarks in areas of component spend

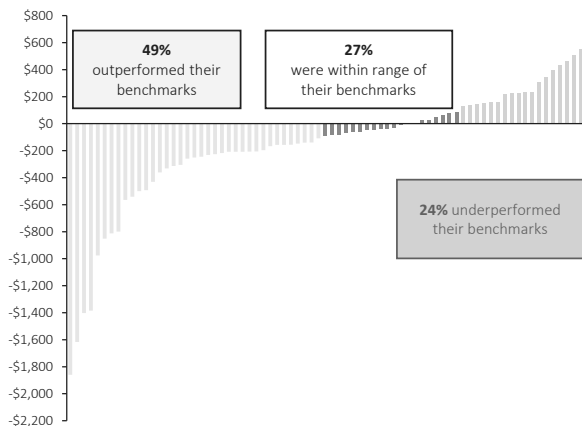
NextGen



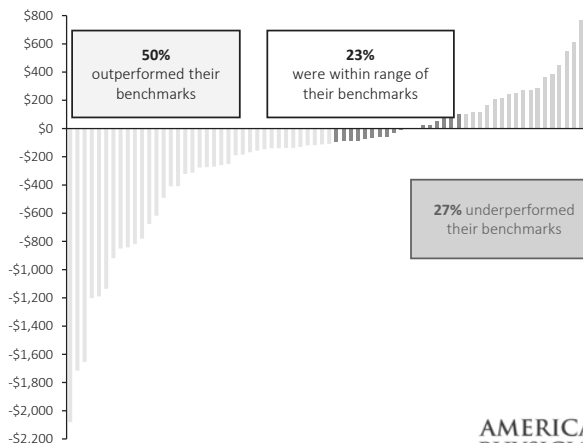
NextGen

## Physician performance distribution: Half of providers outperformed benchmark in both years, though proportion underperforming increased

**2017 Total Cost vs. NGACO Benchmark**  
PMPM \$ across both physician groups



**2018 Total Cost vs. NGACO Benchmark**  
PMPM \$ across both physician groups



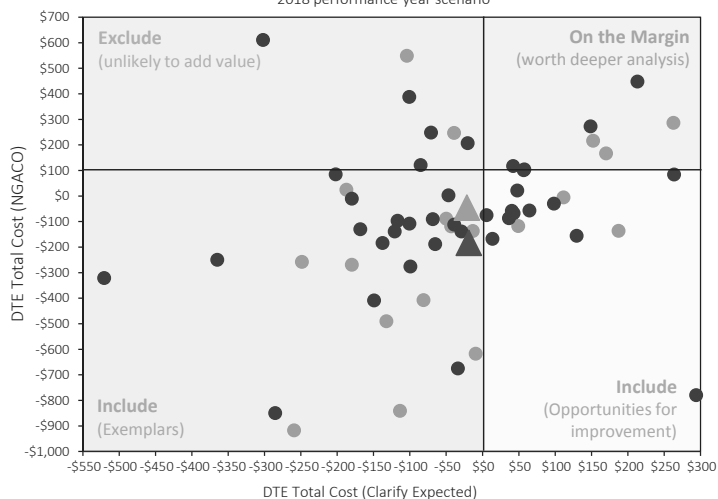
Notes: Results based on individual NPI Risk-Adjusted NGACO Benchmarks

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## Physician segmentation: Of the 58 providers in two groups, 7 are clear exclusions and 43 are clear inclusions

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**Total Cost PMPM Performance Matrix**  
2018 performance year scenario



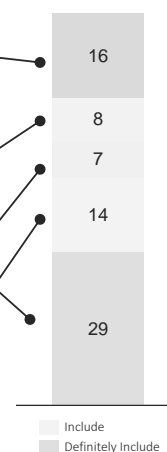
16 outliers not included in segmentation, with attributed panel <20 analyzed separately

8 "on the margin" physicians have deeper analysis to facilitate decision

7 are recommended for exclusion

43 are recommended for inclusion

- Group 1
- ▲ Group 1 Avg
- Group 2
- ▲ Group 2 Avg
- Outliers
- On the Margin
- Recommend Exclusion



DTE = Difference to Expected: The delta between observed performance and what we would expect based on NGACO benchmark or Clarify expected models. Negative values mean that observed cost was lower than expected.

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**Outlier analysis:** Of 16 outliers, 1 is clear candidate to exclude, 9 are clear candidates to include, and 6 have potential to include

Physician Group Name	Provider NPI	2018 Attributed Members	2018 Difference to Benchmark Total	2017 Attributed Members	2017 Difference to Benchmark Total	Recommendation to Exclude / Include
Group 2	1234567890	14	\$182,656	11	\$52,709	Recommend to exclude; Above benchmark in both years
Group 1	1234567890	10	\$92,271	6	-\$31,038	Potential to include; Below benchmark in one of two years
Group 1	1234567890	17	\$74,159	6	-\$57,529	
Group 1	1234567890	15	\$48,710	10	-\$5,664	
Group 2	1234567890	1	\$39,223	2	-\$11,990	
Group 1	1234567890	9	\$5,451	9	-\$4,293	
Group 2	1234567890	1	-\$1,760	5	\$13,708	
Group 2	1234567890	3	-\$9,841	10	-\$39,743	Recommend to include; Below benchmark both years
Group 1	1234567890	1	-\$14,275	No attributed patients in 2017		
Group 2	1234567890	2	-\$27,252	6	-\$70,219	
Group 2	1234567890	8	-\$30,083	2	-\$6,018	
Group 2	1234567890	2	-\$41,189	5	-\$84,110	
Group 1	1234567890	3	-\$43,284	1	-\$2,493	
Group 2	1234567890	5	-\$124,849	5	-\$83,072	
Group 2	1234567890	9	-\$178,593	6	-\$133,908	
Group 2	1234567890	19	-\$186,802	3	-\$19,469	

Legend

Below NextGen ACO Benchmark

Above NextGen ACO Benchmark

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## Direct Contracting: Situation

Direct Contracting

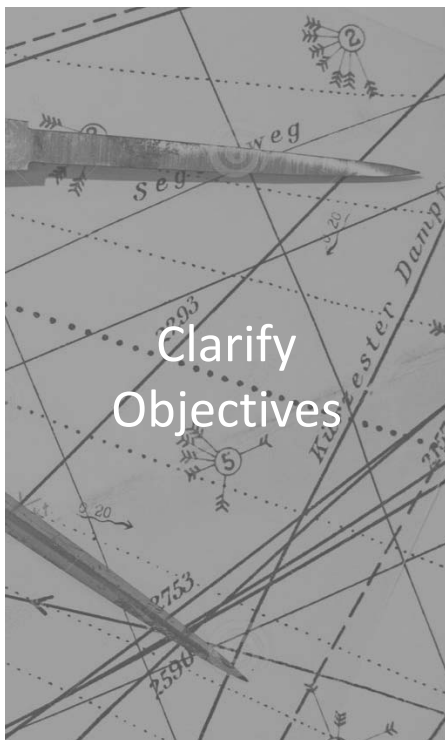
### Customer Context:

- **ACO Convener**
- ~200k FFS members
- >1500 PCPs
- 11 markets across 4 states

### Customer Questions:

- Determine the **optimal structure for participating in the CMS Direct Contracting** or Primary Care First models based on projected performance in current/future markets
- **Compare performance** under FFS models and core MA business to understand the tradeoffs and potential synergies of participating in the new models

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## Clarify Objectives

Direct Contracting



Estimate performance in current and future markets with all physicians participating



Determine optimal cohort of participating physicians for a direct contracting model



Assess the impact of including several independent physician groups in a contract

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## Results & Recommendations

Direct Contracting

### Current Market Performance

- Compared to risk-adjusted benchmarks in all 11 of their current markets, the entity would outperform capitation payments by **\$206M** in a Global Direct Contracting model starting in 2021 through 2024
- If moving all providers who were 10% above their benchmark in 2018 to a professional PBP model, the risk-protection would equal an additional **\$233M** from 2021-2024
- Benchmarks are increasing by **1.5-2% per year**, a faster rate than the **0-1% per year** increase in spend in most markets

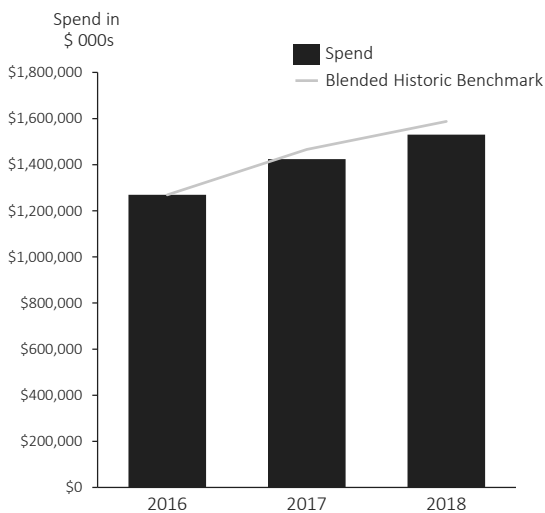
### Independent Group Analysis

- **6 groups** across were identified as potentially beneficial additions based on their attributed patient populations, risk ratios, and blend of provider performance (e.g., mix of high/low performers)
- Together the 6 groups account for an additional **\$44M in savings** in a Global PBP model

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Direct Contracting

# Global Baseline Performance across all markets



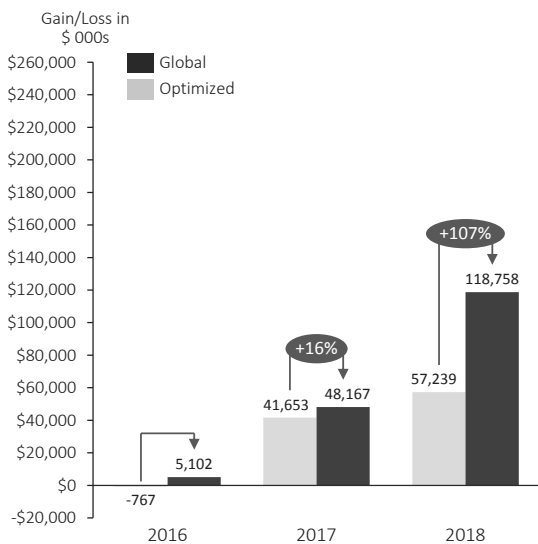
Market <sup>1</sup> (\$ 000s)	Actual Spend	Benchmark Spend	Gain/Loss
Market 1	\$44,240	\$56,038	\$11,798
Market 2	\$239,444	\$258,648	\$19,204
Market 3	\$34,875	\$35,174	\$299
Market 4	\$100,388	\$109,161	\$8,774
Market 5	\$167,075	\$178,306	\$11,231
Market 6	\$345,590	\$331,521	(\$14,069)
Market 7	\$50,162	\$60,195	\$10,033
Market 8	\$51,213	\$53,424	\$2,211
Market 9	\$79,119	\$90,564	\$11,445
Market 10	\$330,126	\$326,102	(\$4,024)
Market 11	\$88,046	\$88,385	\$339
<b>Total</b>	<b>\$1,530,279</b>	<b>\$1,587,518</b>	<b>\$57,239</b>

1. Data is for the most recent year available - 2018

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# Global vs. Optimized<sup>1</sup> Performance: All Markets

Direct Contracting



Market <sup>2</sup> (\$ 000s)	Global Gain/Loss	Optimized Gain/Loss	Difference
Market 1	\$11,798	\$11,798	-
Market 2	\$19,204	\$23,611	\$4,407
Market 3	\$299	\$776	\$4797
Market 4	\$8,774	\$10,596	\$1,822
Market 5	\$11,231	\$13,531	\$2,300
Market 6	(\$14,069)	\$29,738	\$43,807
Market 7	\$10,033	\$10,215	\$182
Market 8	\$2,211	\$5,106	\$2,895
Market 9	\$11,445	\$12,591	\$1,146
Market 10	(\$4,024)	(\$7,446)	(\$3,422)
Market 11	\$339	\$8,242	\$7,903
<b>Total</b>	<b>\$57,239</b>	<b>\$118,758</b>	<b>\$61,519</b>

1. Optimized = pushing all providers 10% above benchmark to Professional PBP  
2. Data is for the most recent year available - 2018

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# Market 6 Overview

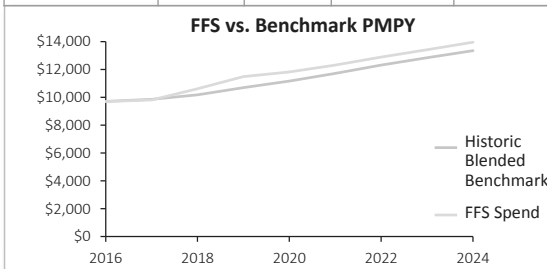
Direct Contracting

## Highlights

- Overall spend in Market 6 groups is outpacing benchmark growth by about 2% YOY a slight penalty in future years
- Consider moving individual providers >10% above benchmarking to Professional PBP
- Medical Group 3, in particular, is losing ~\$1.5K per patient
- Overall, all Market 6 groups would have lost \$14M in 2018

## 2018 Key Figures PMPY

Physician Group	Attributed Patients <sup>1</sup>	Total Spend	PMPY Benchmark	Total Gain/Loss
Medical Group 1	11,123	\$10,148	\$10,235	\$87
Medical Group 2	19,150	\$10,544	\$10,060	(\$486)
Medical Group 3	1,703	\$14,956	\$13,344	(\$1,612)
Medical Group 4	563	\$9,411	\$10,050	\$639

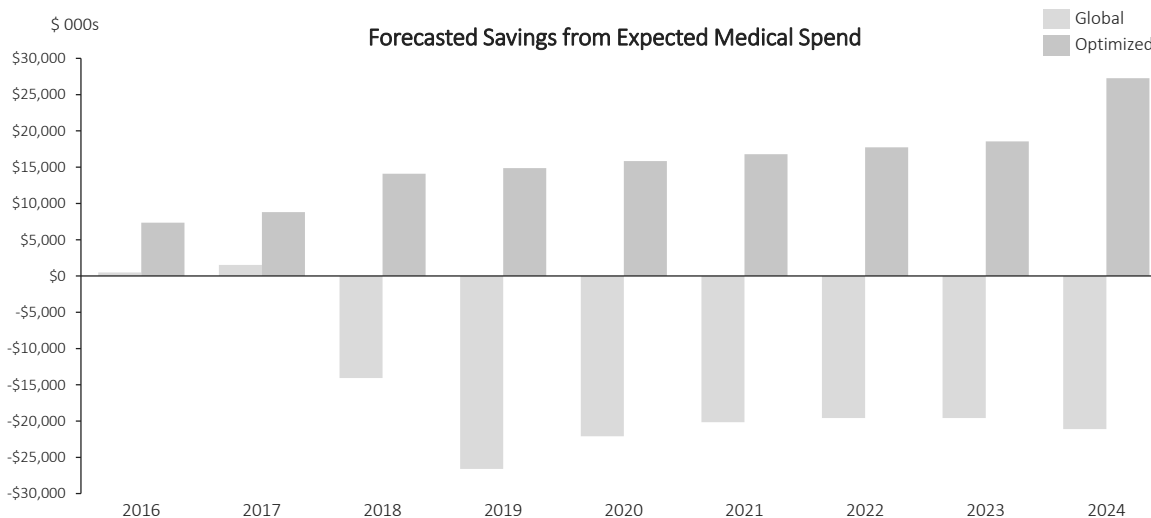


1. Data is for the most recent year available - 2018

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# Market 6 – Global vs. Optimized

Direct Contracting



1. Data is for the most recent year available - 2018

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# Clarify Health's CMS Program Diagnostic

## Commit with confidence

- ✓ Project your performance in each CMS program
- ✓ Evaluate individual provider performance
- ✓ Know your attributed members' risk profiles before fully committing

### FINANCIAL FORECAST

Interactive financial model projecting your performance in each program based on your providers' historic performance on all their Medicare FFS patients

"What if" scenarios to model potential impact of variations in quality, risk coding, and clinical savings

### NETWORK DESIGNER

Evaluation of individual providers in a market based on key factors that influence performance in CMS programs

Recommendation of providers for network inclusion by specific CMS program, given their potential for success managing their attributed population

### POPULATION INSIGHTS

Identification of your likely attributed patients including risk scores and clinical and social characteristics

Historic utilization of this population by service line and major components of spend

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# Our platform offers providers a full suite of solutions



**Grow & Optimize Revenue**



**Improve Quality & Reduce Medical Spend**



**Inform payer negotiations**



**Succeed in value-based care**

#### Network Referral Intelligence (NRI)

How do I attract more referrals and where can I reduce patient leakage?

#### Inpatient Care Improvement (ICI)

Where does unwarranted variation add to costs without improving quality?

#### Total Cost of Care Insights (TCI)

Where do I add or subtract value to payers along the care continuum?

#### Value-Based Program Analytics

How do I successfully design, negotiate, and deliver bundle payment programs?

#### Network Performance Optimization (NPO)

Who and where are the highest-value MDs in my network and in my market?

#### Data Supply

How do I get and use physician-level data to inform strategic decisions?

#### Member Risk Management (MRM)

Who are my high-risk patients and what interventions may help them?

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Interactive map with patient counts viewable by attributable physician(s) and sites of care



## DISEASE MAPPING FOR CLINICAL TRIALS

Rapidly identify highest volume investigators and care sites ranked by performance

### IMPACT

- Shorter study start-up times
- Less reliance on inaccurate enrollment estimates
- Reduction in non-performing sites (11% of sites do not enroll a single patient; 37% under-enroll)



Member profiles provide information about patient status used to guide care mgmt. interventions



## MEMBER RISK MANAGEMENT

Identify current / expected future high-risk members. Recommend specific intervention and improvement opportunities in quality of care

### IMPACT

- ~\$1M readmission reduction savings with just high-risk diabetics
- 2-3x increase in care manager productivity
- 50% increase in enrollment for end-of-life palliative care program







*Compare cost / quality performance for new or existing providers within selected geographies*

## NETWORK PERFORMANCE OPTIMIZATION

More quickly and accurately:

- Score new or existing providers
- Rank existing or potentially new markets
- Model impact of network design decisions

### **IMPACT**

- Reduced MLR / medical claim spend
- Grow membership in new markets
- Increase market share / improve access

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