



*Serving Sonoma, Napa, Marin & Yolo Counties*

## Track 1: Adopting a Risk Stratification Model That Utilizes EHR Data

### Additional Activities:

**10:45 AM – 1:30 PM**

\*Help Squad – one-on-one PCMH and Meaningful Use Support (Innovation Room)

\*Promising Practices Gallery Walk Raffle (Inside perimeter of the office)

**1:00 PM**

\*Promising Practices Raffle (Training Room)

*See the back of your agenda to participate*

# Whole Person Care: Data Structure and Identification Strategy for High-Risk Patients



Dan Brown  
Contra Costa Health Services  
November 28, 2017

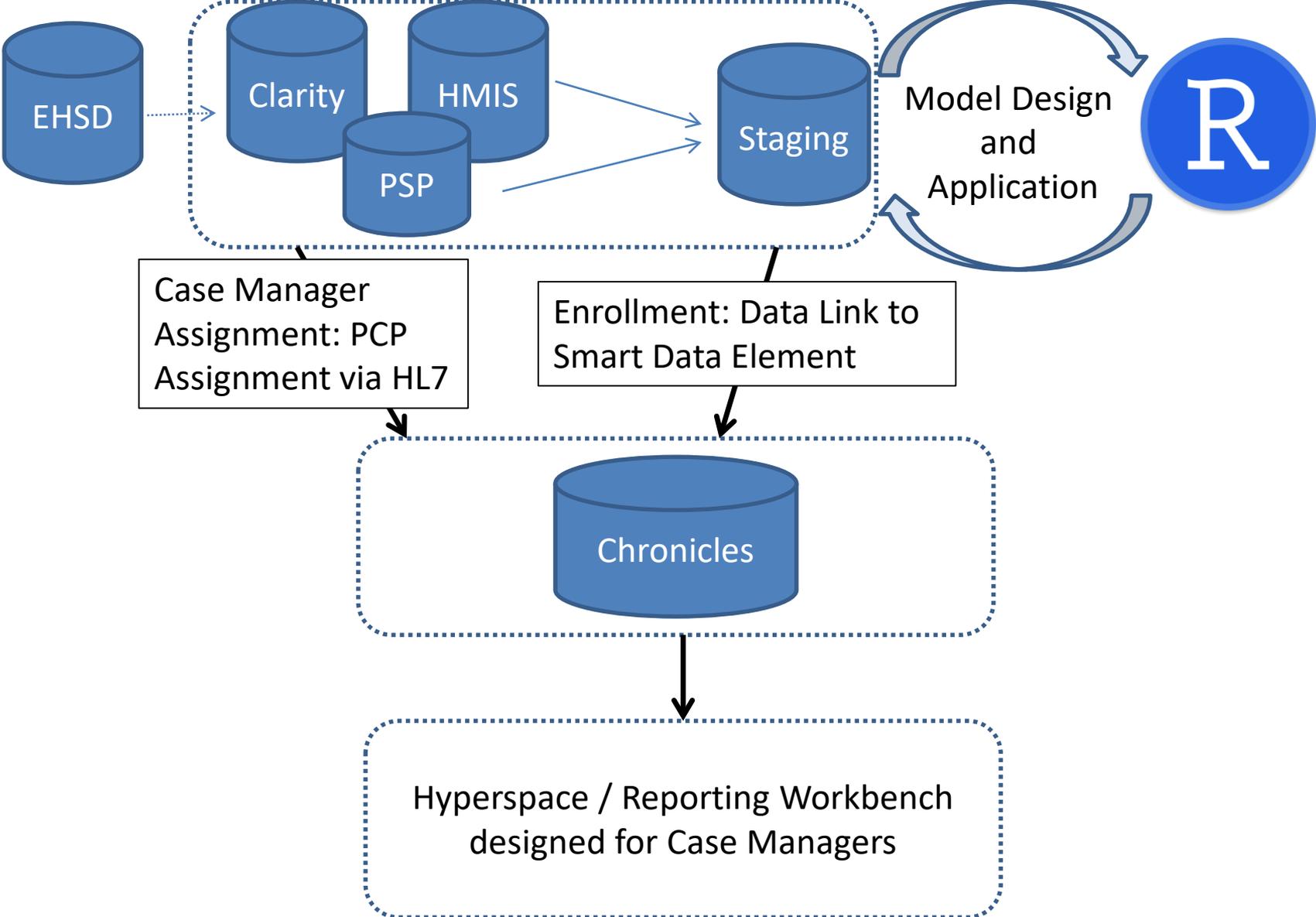
# Background

- Whole Person Care / Community Connect
- Medicaid waiver program
- Designed to fuel communication between health delivery, behavioral health and social services
- Coordinate care for target populations to improve outcomes
- Enrollees in Contra Costa county will have a team of case managers connecting them with services
  - PHNs, Housing, AOD, Social Workers, community health workers

# Background - cont

- We want to target this to a large high-risk population that need the service
- 14,000 enrollees by end of 2017
- Combining data from various county service deliveries allows us to identify risk factors that predict future care needs
- We then link this model with our current population to enroll high-risk patients and assign them case managers

# From Model to Front-Line Staff



# Incorporation of Modelling Into Workflow

- Key challenges
  - Creating a historical data mart
    - Longitudinal population level risk factors
  - Merging data sets from different sources
  - Pushing data into EHR
  - Incorporating risk into case manager selection
  - Building an interface in the EHR for front line staff

# Building the Data Mart

- 3 Different Domains of Data
  - Utilization
  - Social Determinants
  - Disease
- External Sources of data:
  - Insurance status (MEDS)
  - Homeless Management system
  - Detention
  - Mental Health
  - Foster care
  - Other case management

# Building the Data Mart

**Eligibility:**  
MEDS files (State Eligibility)

**Demographics:**  
MEDS  
ccLink

**Social Factors:**  
Foster Care (EHSD)  
Disability  
Detention (JMS)  
Homeless (HMIS)  
Mental Health  
Services (PSP)

**Disease:**  
Diagnoses (ccLink -  
problem lists and  
claims history)  
Prescriptions  
(ccLink - pharmacy  
claims)

**Utilization:**  
ED Visits  
Ambulance  
(ccLink)

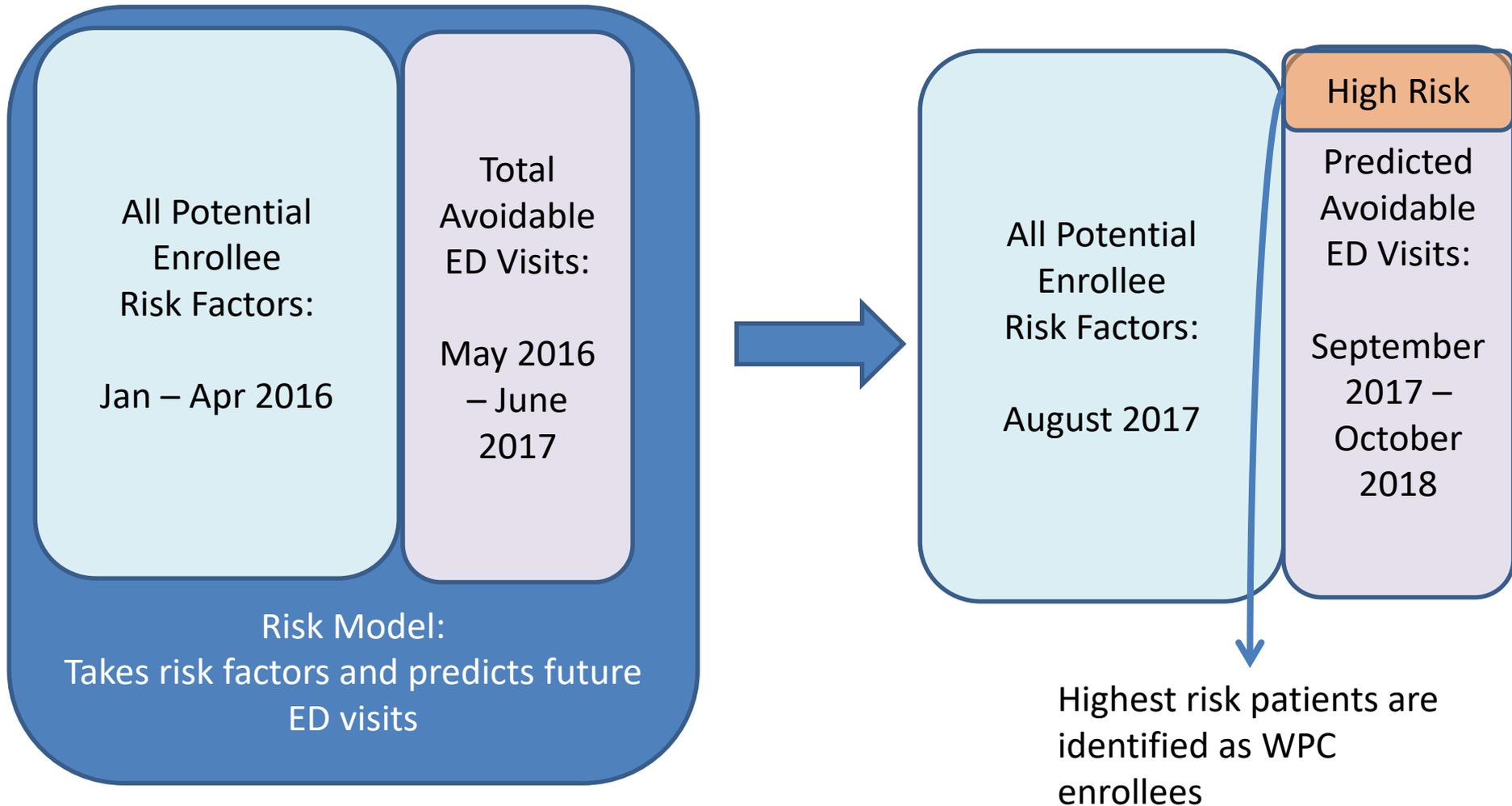
**Staging Table:**  
Risk Factors for All  
Potential Enrollees



# Original Risk Score Components

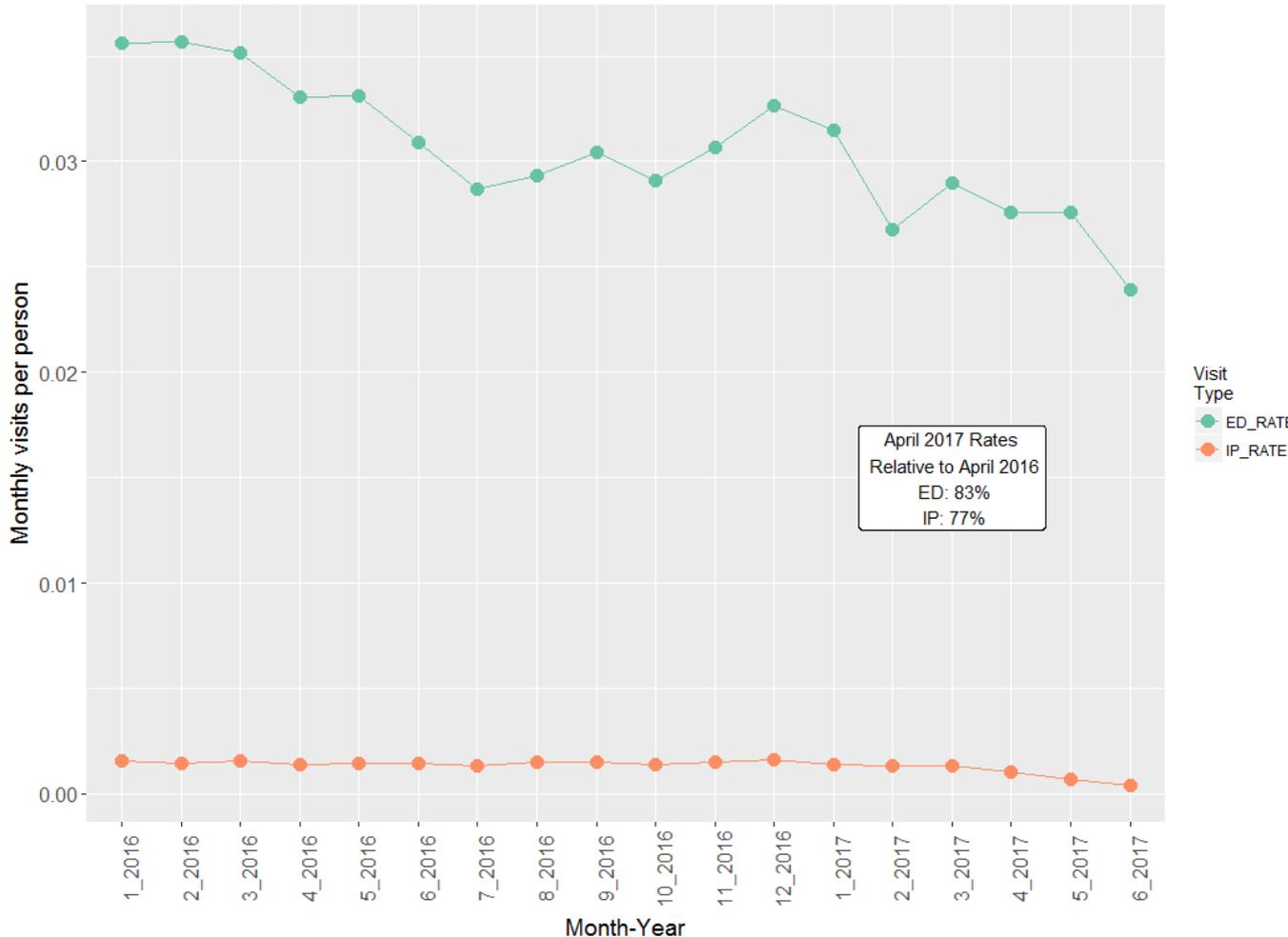
DISEASES	Count	Points	SOCIAL / BEHAVIORAL DETERMINANTS	Y/N	Points	UTILIZATION	No. of Visits	Points		
Each Chronic Condition = 5 points (Organ Disease Group based on PRIME 2.3)	1	5	Homeless flag generated in the past 13 months in ccLink?	Y	2.67	Number of times seen in the ED/PES in the last 13 months	3	3		
			Is a foster child in the last 13 months. *Assign 11 points if foster kid is on Psychotropic Medication.	Y	2.67*	Number of hospitalizations in the last 13 months	2	4		
			Medi-cal Share of Cost	Y	2.67	Number of times used Ambulance transportation for Medical Emergency in the last 13 months	2	2		
			Employment status in ccLink (Unemployed = Y)	Y	2.67	<b>Sub Accute Days</b>	<b>12</b>	<b>12</b>		
			<b>Disabled</b>	<b>N</b>	<b>0</b>	<b>Answer Y or N to the following:</b>				
			Has AB109 Flag in the last 13 months	Y	2.67	Was seen by Healthcare for Homeless in the past 13 months?	Y	1		
			SBIRT - Alcohol/Drugs in the last 13 months	Y	2.67	Discharged and admitted to a Skilled Nursing facility in the last 13 months	Y	1		
			SBIRT - Depression in the last 13 months	N	0					
			Has been 5150'd in the last 13 months	N	0					
			Spoken language is non-english	N	0					
			Booked in Detention facility in the past 3 years	N	0					
			Activity in HMIS in the last 13 months	Y	2.67					
			Receiving Mental Health Services in the last 13 months?	Y	2.67					
			Access line/MH Referral in the last 13 months?	y	2.67					
			Referral to respite in the last 13 months	Y	2.67					
<b>Point totals:</b>		<b>5</b>			<b>24.03</b>			<b>23</b>		
<b>Max Points Possible:</b>		<b>20</b>			<b>40</b>			<b>40</b>		

# Building the Model



# Defining the Outcome

Avoidable ED and IP Visit Rates  
WPC Eligible Population: Jan 2016 - Jun 2017



- Avoidable ED visits defined by NYU algorithm\*
- Classification system based off diagnosis
- Probability of being avoidable
- We defined as 'avoidable' any visit with a positive probability

\* <https://wagner.nyu.edu/faculty/billings/nyued-background>

# Original Risk Model

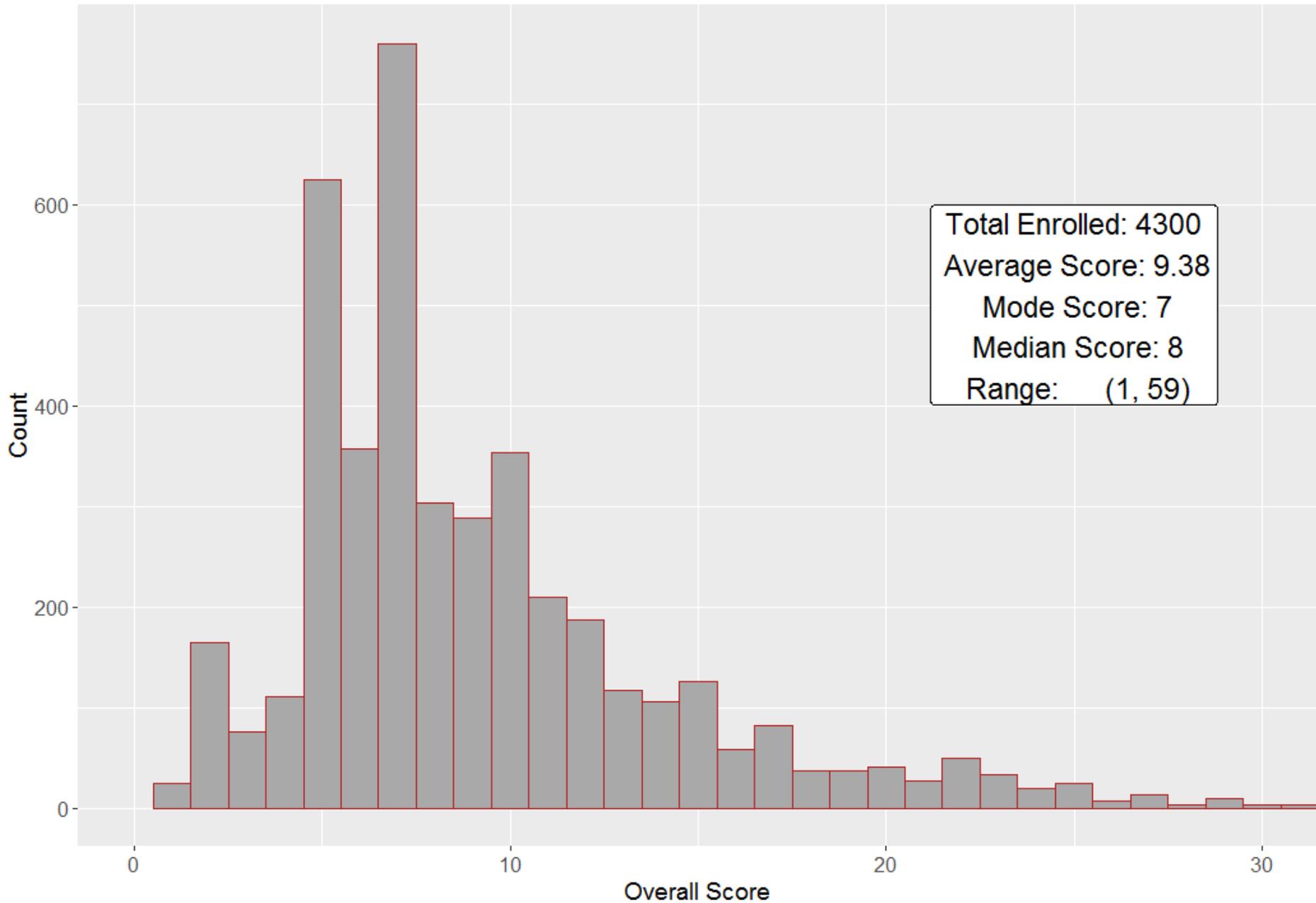
		Estimate	Std. Error	Pr(> t )	Estimate	Std. Error	Pr(> t )
Risk Score Domain	(Intercept)	0.40	0.002	0.00	0.54	0.006	0.00
	Disease Domain	0.02	0.001	0.00	0.02	0.002	0.00
	Social Domain	0.05	0.001	0.00	0.10	0.002	0.00
	Utilization Domain	0.71	0.001	0.00	0.69	0.002	0.00
Month (relative to Jan '16)	February '16	0.03	0.003	0.00	0.04	0.005	0.00
	Mar '16	0.05	0.003	0.00	0.07	0.005	0.00
	Apr '16	0.08	0.003	0.00	0.11	0.005	0.00
Sex (relative to F)	Age	-	-	-	0.00	0.000	0.00
	M	-	-	-	-0.04	0.004	0.00
	Trans	-	-	-	0.23	0.241	0.35
	U	-	-	-	-0.15	0.259	0.56
Race / Ethnicity (relative to White)	Native American / Alaskan Native	-	-	-	0.09	0.027	0.00
	Asian	-	-	-	-0.07	0.007	0.00
	Black / African American	-	-	-	0.14	0.006	0.00
	Declined / Unknown	-	-	-	0.12	0.008	0.00
	Hawaiian / PI	-	-	-	0.08	0.017	0.00
	Hispanic / Latino	-	-	-	0.00	0.006	0.55
	More than One Race	-	-	-	0.09	0.013	0.00
	Other Race	-	-	-	0.18	0.008	0.00
English Language	-	-	-	-0.15	0.005	0.00	

# Individual Factor Risk Model

	Estimate	p-value		Estimate	p-value	
	Age	0.000	0.07	(Intercept)	0.032	0.00
	Age^2	0.000	0.00	Homeless (last 13 months)	-0.004	0.21
	Male Sex	0.009	0.00	Not Employed	-0.009	0.00
	Asian	0.002	0.47	Disabled	0.003	0.25
	Black/African American	0.004	0.21	AB - 109	-0.005	0.85
Race/Ethnicity (Relative to White)	Hawaiian/Pacific Islander	0.019	0.02	SBIRT- Alcohol/Drugs	0.021	0.10
	Hispanic/Latino	0.000	0.89	SBIRT - Depression	0.000	0.97
	>1 Race/Other/AI/AN	0.021	0.00	5150 in last 13 months	-0.256	0.00
	Declined/Unknown	0.009	0.01	English Language	0.000	0.87
	Unknown	-0.001	0.73	Booked in Detention in Last 3 years	0.024	0.00
Marital Status (Relative to Single)	Widowed	0.001	0.80	HMIS in last 13 months	0.046	0.00
	Married/LP	-0.012	0.00	Accessed PSP MH Services in Last 13 months	0.054	0.00
	Divorced/Separated	0.009	0.15	Accessed PSP SU Services in Last 13 months	0.011	0.22
Region (Relative to Central)	Region EAST	0.005	0.02	Access Line Usage	-0.007	0.34
	Region UNKNOWN	0.002	0.82	Referred to Respite	-0.101	0.01
	Region WEST	0.000	0.86	Subacute Days	-0.097	0.00
	ED Visits (Linear)	0.145	0.00	Ambulance Uses in Past 13 Months	-0.004	0.00
	ED Visit Count = 1	-0.037	0.00	Seen by Homeless Services in Past 13 months	0.052	0.00
Reference Group: 0 ED Visits	ED Visit Count = 2	-0.078	0.00	Skilled Nursing Facility: Admit or Referral	-0.074	0.00
	ED Visit Count = 3	-0.128	0.00	Indicator of Chronic Condition	-0.003	0.35
	ED Visit Count = 4+	-0.231	0.00	Number of Chronic Conditions	0.000	0.82
	PES Visits (Linear)	0.136	0.00	Disease Group Count	0.004	0.07
	PES Visit Count = 1	-0.016	0.13			
	IP Visits (Linear)	0.020	0.00			
	IP Visit Count = 1	0.063	0.00			

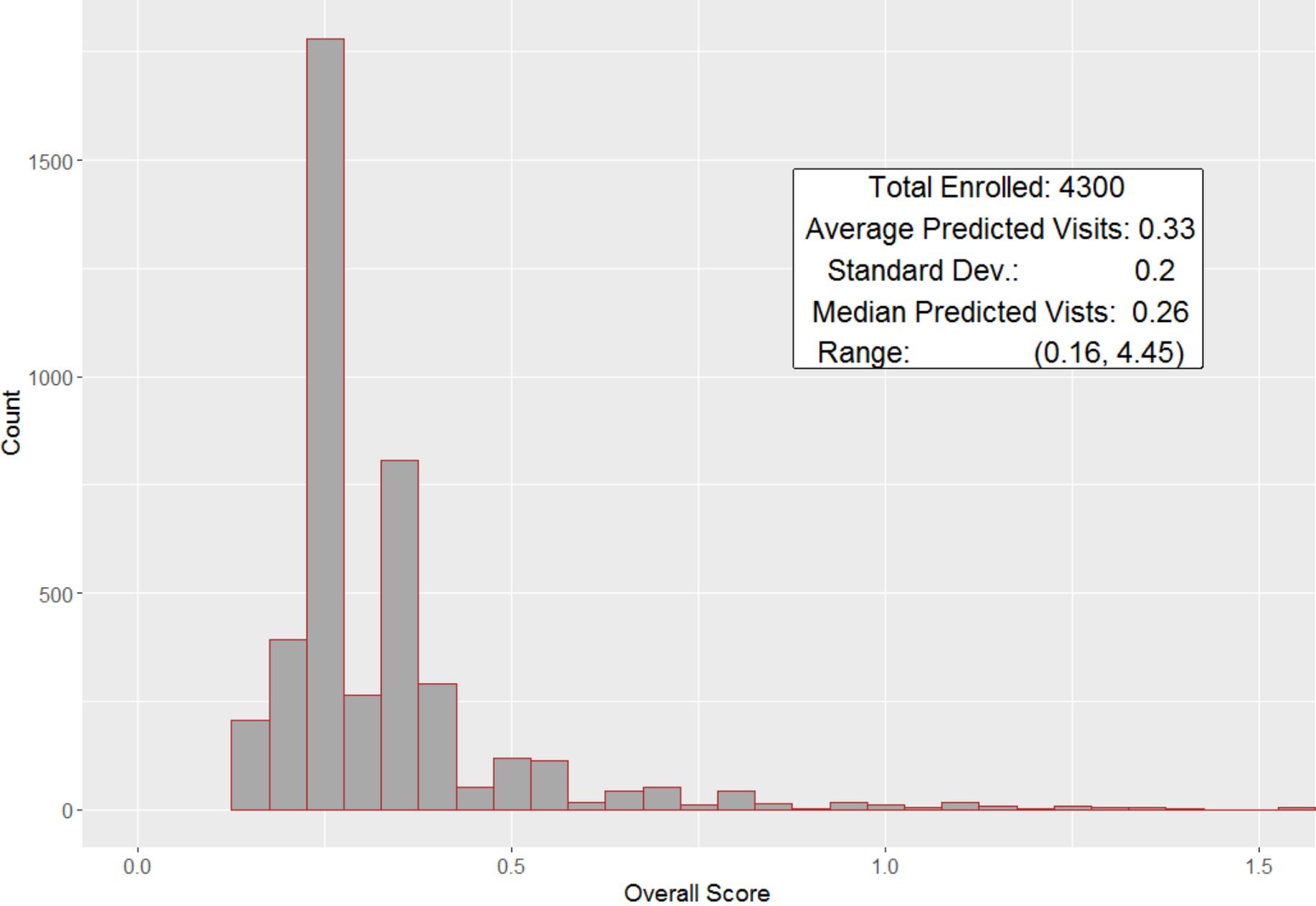
# Distribution of (Original) Overall Risk Score

September WPC Enrollees



# Distribution of Predicted Avoidable ED Visits in Next 13 Months

September WPC Enrollees



# Model Performance

- Does being a top 20,000 risk score predict being in the top 20,000 for avoidable ED visits?

		High ED Visits	
		1	0
Top Risk Score	1	9,339	12,321
	0	11,143	148,828
Sensitivity		45%	
Specificity		92%	
PPV		43%	
NPV		93%	

Sensitivity: A person with high outcomes will have a top risk score 45% of the time

Specificity: A person with low outcomes will not have a top risk score 92% of the time

PPV: Of the people we predict will have high outcomes, 43% of them will

NPV: Of the people we predict will have low outcomes, 93% of them will

# Next Steps – New Variables

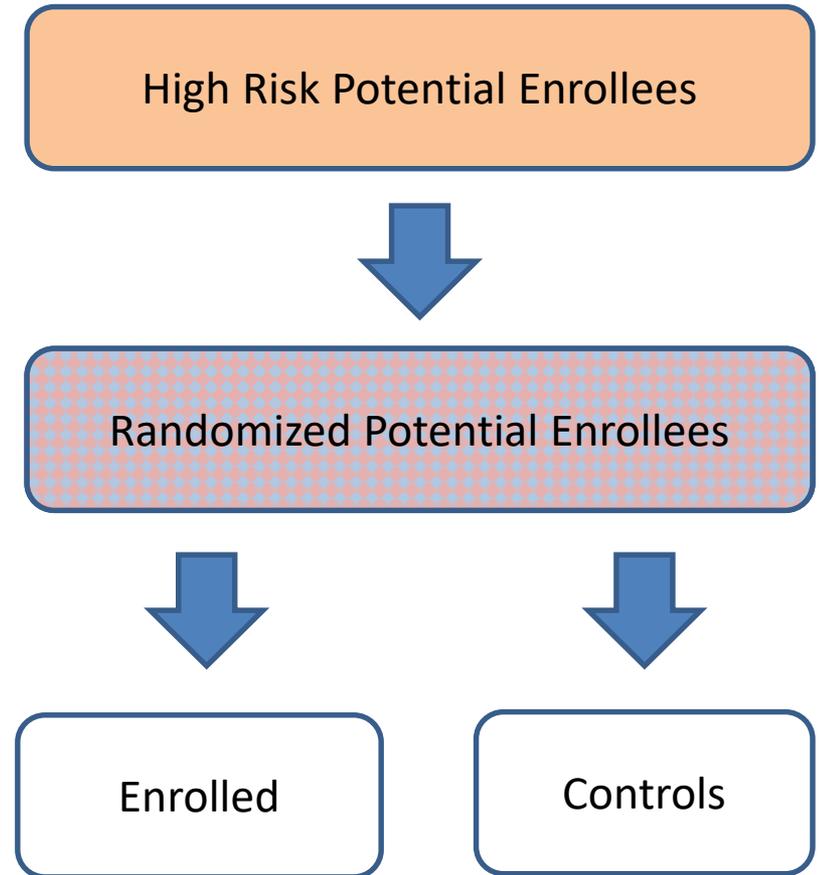
- Biometric Information
  - BMI, Blood Pressure,
- Polypharmacy
- Specific Diagnoses
  - Diabetes, CHD, mental health
- GIS Data
  - Local measures of Social Determinants
  - Same house ER visit rates

# Next Steps – New Targets and Algorithmic Approaches

- Use avoidable in-patient visits as target
  - High-acuity tier of care with PHN as primary care coordinator
- Incorporate modern machine-learning techniques into risk modelling
  - Tree-based
  - Deep Learning
  - Cross-Validated Risk as key decider

# Randomization and Evaluation

- Delivering case management to high risk patients is an evaluation challenge
- If these patients still have higher than average ED visits, is the program ineffective?
- A control group with a similar risk profile can help to answer this
- Control status stays in evaluation database (program staff is blinded)





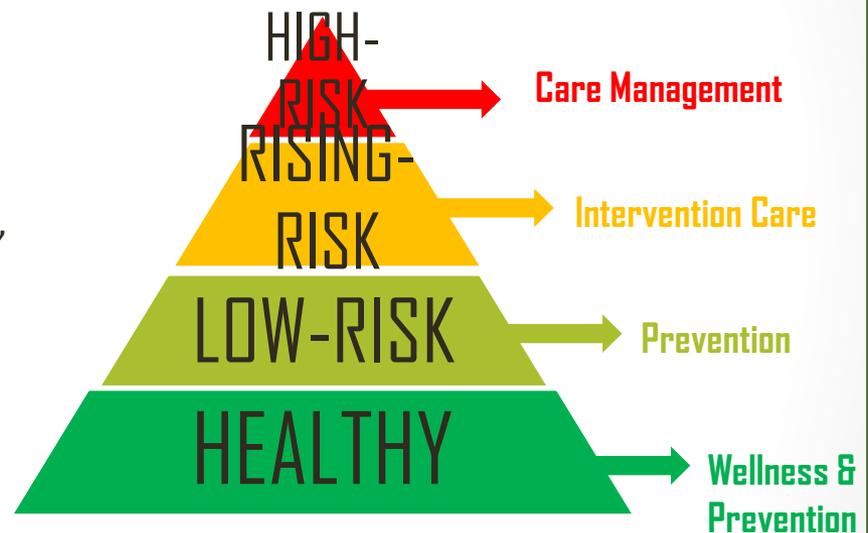
# **Risk Stratification for Identifying Patients for Care Coordination**

**Future of Complex Care Symposium**

November 28, 2017

# How do we define “risk” and “risk stratification”?

- No ideal definition for “high risk” or “high-need” patients.
- Patient often has one or more of the following characteristics:
  - History of high-cost, high resource utilization, and/or multiple chronic conditions.
- Risk stratification is the process of segmenting patients into different levels of risk.
- High interest in whole population risk stratification & risk-stratified care management.



# But... What if we don't have claims data?

- Consider alternative models.
- Health Center EHRs can be a key source of data:
  - Clinical diagnoses
  - Behavioral health diagnoses
  - Social determinants of health (housing, food insecurity, etc.)
  - Functional limitations (ADLs or IADLs)
  - Patient activation/readiness data
  - Real-time data!
- **Challenge:** there isn't an "out of the box" solution for non claims-based risk stratification models



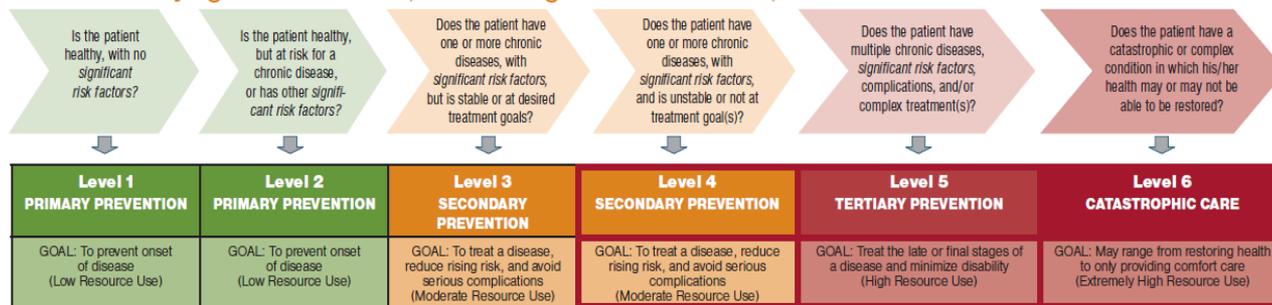
# Non Claims-Based Models

The American Academy of Family Physicians has created a comprehensive rubric to help identify your patients' risk category (July 2015).

**Table 1: Example of Potentially Significant Risk Factors to be Considered when Assigning Risk Levels**

Clinical Diagnoses, Behavioral Health, Special Needs	Potential Physical Limitations	Social Determinants	Utilization	Clinician Input (Personal Knowledge)
<ul style="list-style-type: none"> <li>Any chronic disease, particularly that is not at desired goal</li> <li>Multiple co-morbidities</li> <li>Chronic pain</li> <li>Substance abuse</li> <li>Behavioral health diagnosis</li> <li>Terminal illness</li> <li>Advanced age with frailty</li> <li>Pre-term delivery of newborn</li> <li>Patients with special needs</li> <li>Dental health</li> <li>Dementia/Alzheimer's Disease</li> </ul>	<ul style="list-style-type: none"> <li>Non-ambulatory</li> <li>Needs Assistance with Activities of Daily Living (ADLs)</li> <li>Severely diminished functional status</li> <li>Declining eyesight</li> <li>Extreme weakness or fatigue</li> <li>At risk for falls</li> </ul>	<ul style="list-style-type: none"> <li>Lack of financial support</li> <li>Lack of family support that impacts care</li> <li>Unemployed</li> <li>Homelessness</li> <li>No health insurance</li> <li>Low health literacy</li> <li>Unsafe home environment</li> <li>Lack of transportation</li> <li>Language barriers</li> <li>Lives alone</li> </ul>	<ul style="list-style-type: none"> <li>Frequent hospitalizations</li> <li>Frequent ER or urgent care visits</li> <li>Multiple providers</li> <li>Hospital readmission within 30 days</li> <li>Major procedure in last year</li> <li>Chronic kidney disease</li> <li>Brain trauma</li> <li>Expensive medications</li> </ul>	<ul style="list-style-type: none"> <li>Polypharmacy</li> <li>High-risk medications</li> <li>Difficulty following treatment plan</li> <li>Difficulty taking medications as prescribed</li> <li>Recent visit to a long-term facility or other transition of care</li> <li>Spouse recently deceased</li> <li>Low confidence or ability for self-management</li> <li>Answer the question: Is this patient likely to be hospitalized in the next 30 days?</li> </ul>

**Table 2: Identifying Disease Burden, Determining Health Risk Status, and General Care Plan Considerations**



# Non Claims-Based Models

National Academy of Medicine released a Special Publication, *“Effective Care for High Need Patients”* in July 2017. Findings include:

- The high-need patient population is **diverse, complex, expensive, and dynamic**. Addressing their needs will require the appropriate **balance between standardized and customized approaches to care**.
- Segmenting high need patients into smaller homogeneous subgroups using a **“taxonomy”** represents one promising tool to inform and target care and should be rapidly tested in real-world settings in conjunction with care models that have been shown to work.
- Effective tools and care models **must extend beyond strictly medical approaches to address social and behavioral factors**.

1. Clinical and functional groups	Children with complex needs	Non-elderly disabled	Multiple chronic	Major complex chronic	Frail elderly	Advancing illness
	2. Behavioral and social assessment					
Behavioral Health Factors						
Social Risk Factors						

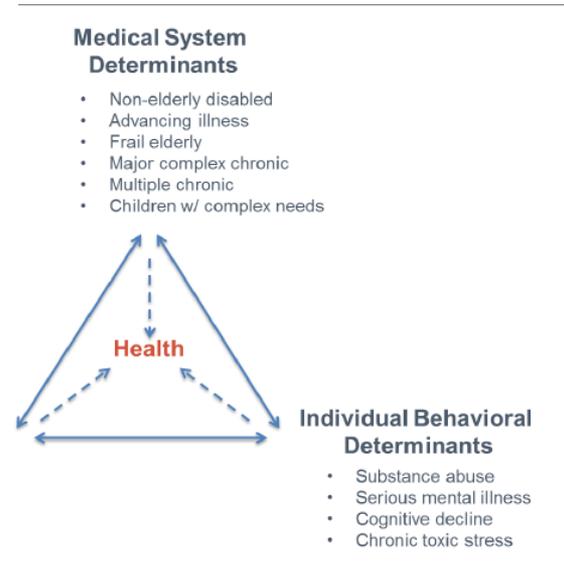
**FIGURE 3-1** A conceptual model of a starter taxonomy for high-need patients.

NOTE: For this taxonomy, functional impairments are intrinsically tied to the clinical segments.

SOURCE: Abrams presentation

## NAM Taxonomy

Taxonomy was influenced by recent taxonomies developed by Harvard T.H. Chan School of Public Health, and The Commonwealth Fund.



**FIGURE 3-2** A framework for health with all of the factors that would go into an ideal taxonomy.

SOURCE: David Labby via Abrams presentation.

# RCHC Case Study

- **Challenge:** We wanted a simple method for calculating patient risk (with data we already have access to) so we can better identify patients who may benefit from case management/more intensive care. We do not currently have Medi-Cal claims data.
- **Potential Solution:** a “home grown” risk stratification model incorporating EHR and hospital utilization data.
  - Health centers in Sonoma County receive data from our main hospital on a monthly basis
    - Ideal if hospital utilization is included but IS NOT A REQUIREMENT

# Our Risk Model

- Influenced by AAFP and other risk models (like HCC conditions)
- Incorporates risks, chronic conditions, SDOH, medications, ED utilization, and admissions

## Point Values:

- Risks = ½pt
- Chronic conditions = 1pt
- SDOH and utilization mixed

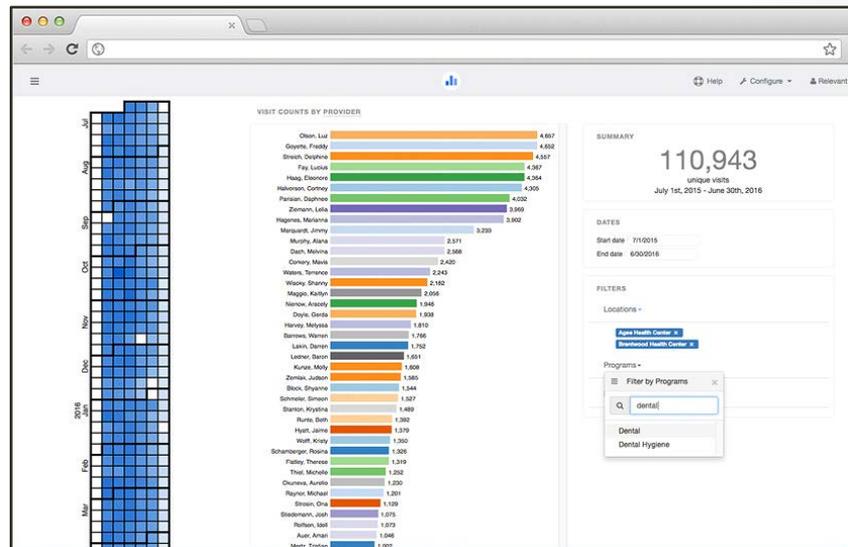
## Risk Level”

- 0-2 points = Low Risk
- 3-4 points = Medium Risk
- >5 points = High Risk

Risks	Point Value	Fields	Fields
BMI >29		0.5 Vitals	BMI field
smoking		0.5 Struc Data	Social history
prediabetes		0.5 Dx	Group - prediabetes
high triglycerides		0.5 Dx	E78.1
arthritis		0.5 Dx	Group - Arthritis
chronic pain (no opiates)		0.5 Dx	G89.4
Hypertension		0.5 Dx	I10
Conditions	Point Value	Fields	Fields
CHF		1 Dx	Group - CHF
COPD		1 Dx	Group - COPD
DM		1 Dx	Group - DM
CAD		1 Dx	Group - CAD
PVD/PAD		1 Dx	Group - vascular disease
MH		1 Dx	Group - 2703 MH diagnosis
Addiction		1 Dx	Group - sub use dx
Chronic Pain		1 Dx	G89.29
Stroke		1 Dx	Group - stroke
Cognitive decline		1 Dx	group - cog decline
Chronic Stress/Trauma		1 Dx	group - trauma
ESLD/Cirrhosis		1 Dx	Group - Cirrhosis
Add on	Point Value	Fields	Fields
Homeless		1 demogr	Info scrn
no insurance		0.5 demogr	Info scrn
Disabled? Or Dual		1 demogr	Info scrn
on anticoagulation		1 med	group - anticoagulation and other anticoag
on benzos		0.5 med	group - benzodiazapines
ED use >2		1 st Joes	
Hospital admit >0		1 st Joes	
>9 meds		1 Med list	
>9 conditions		1 Prob list	
uncontrolled illness add on		0.5 Dx	group - uncontrolled
FLAG - NEEDED	Point Value	Fields	Fields
ESRD		flag Dx	Group - ESRD
HIV		flag Dx	Group - HIV
Cancer		flag Dx	Group - Cancer
0 - 2 points		Green	
3-4 points		Yellow	
>5		Red	
unpointed		Grey	

# Building it into Analytics

- Ideally we would want the risk score to display in the EHR, unfortunately not an option for us.
- **Alternative Option: build it into analytics**



# Now what do we do with this information?

- Running lists of patients for interventions
  - Behavioral health
  - Care Management
  - Team nurse visits
  - Shared / Group visits
- Care teams – see the number at huddle
- Use alerts/visit planning to drive services for particular risk groups
- Panel adjustment or staffing adjustment for high risk panels

# Identifying Patients for Intervention

Reports: High-Risk Patients With An Appointment Today ⓘ

## Description

A list of patients with an appointment today who have a risk score greater than or equal to 5.0.

▶ Run Report

Expected run time: 2.321 sec.

Results table

Petaluma Team 1

Petaluma Team 2

Petaluma Team 3

RP Team 1

RP Team 2

Petaluma Specialty & Women's Health +

starttime	patient	acctnum	visittype	resource	department	apptdate	riskscore	Totals
08:45:00	[REDACTED]	22027.1	OV	Pendleton	Petaluma Medical Team 1	2017-09-14	6.0	1
09:00:00	[REDACTED]	48759.1	OV	Hameed	Petaluma Medical Team 1	2017-09-14	7.0	1
09:15:00	[REDACTED]	2439.1	OV	Pendleton	Petaluma Medical Team 1	2017-09-14	8.0	1
09:45:00	[REDACTED]	111450	OV	Hameed	Petaluma Medical Team 1	2017-09-14	5.5	1
10:00:00	[REDACTED]	38209.1	OV	Pendleton	Petaluma Medical Team 1	2017-09-14	6.5	1
10:15:00	[REDACTED]	152386	OV	Pendleton	Petaluma Medical Team 1	2017-09-14	8.5	1
10:30:00	[REDACTED]	117161	OV	Hameed	Petaluma Medical Team 1	2017-09-14	9.0	1
11:00:00	[REDACTED]	112488	OV	Pendleton	Petaluma Medical Team 1	2017-09-14	5.5	1
	[REDACTED]	2099.1	OV	Chi	Petaluma Medical Team 1	2017-09-14	5.0	1
13:45:00	[REDACTED]	27033.1	ABS	Sandhu	Petaluma Medical Team 1	2017-09-14	5.0	1
			OV	Hameed	Petaluma Medical Team 1	2017-09-14	5.0	1
14:15:00	[REDACTED]	165822	ABS	Sandhu	Petaluma Medical Team 1	2017-09-14	5.5	1
16:00:00	[REDACTED]	116380	OV	Hameed	Petaluma Medical Team 1	2017-09-14	6.0	1
Totals								13

Yolanda Briscoe has 11 appointments on 09/14/2017

# Care Team Alerts

8:30 AM [Redacted] 53 years old MRN: 35785.1 PCG: Dalbir Khalsa  
RP Intake

Risk Score: 6.0

### Care Gaps

Due for Colorectal Cancer Screening  
*Recommended Intervention:* Order Colonoscopy or Fit Kit Today

Due for Screening Vitamin D Level (Dx of Depression)  
*Recommended Intervention:* Order Vitamin D Test

### Quality Measure Warnings

*Patients with CHF on ACE or ARB*  
*Behavioral Health - PHQ-9 in Patients With Depression*  
*QIP Colorectal Cancer Screening - Non Compliant List*

Alert based on risk >3

9:00 AM [Redacted] 31 years old MRN: 192824 PCG: lun-lu Aileen Chen  
MH Intake

Risk Score: 3.5

### Care Gaps

Due for HIV Screening  
*Recommended Intervention:* Order HIV Screening Lab

Not Web-Enabled  
*Recommended Intervention:* Web Enable Patient Today

Due for Smoking Cessation Treatment  
*Recommended Intervention:* Order RX Or Referral to SMV Smoking Cessation Group

Due for smoking cessation counseling  
*Recommended Intervention:* Counsel patient to quit smoking (document in preventive medicine window)

Due for PRAPARE

# Panel Analysis

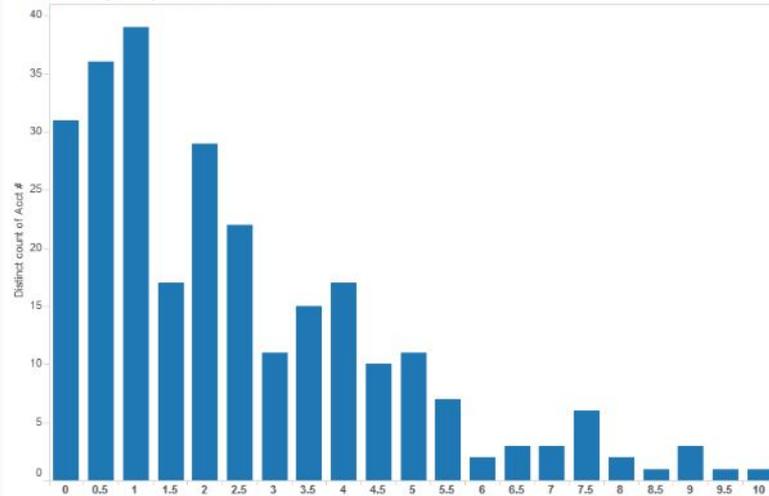
Provider Risk Panel Patient List

Provider  
Oryn, Danielle E

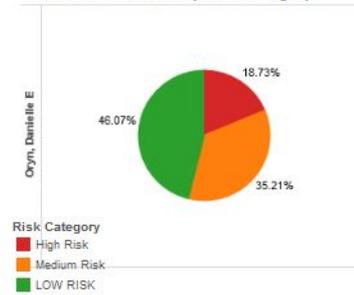
## Adult Patients

Provider	AVG RISK SCORE	Adult Patients
Oryn, Danielle E	2.46	267

### Patient Complexity Distribution



### Total Adult Patients by Risk Category



### Percent of Panel With High Risk Chronic Condition (1 Point)

Diabetes	CAD	CHF	COPD	PVD	Serious MH Diagnosis	Substance Abuse	Chronic Pain (On Opiates)	Cirrhosis	Coumadin
18.0%	1.9%	2.6%	5.6%	0.4%	25.1%	9.7%	11.2%	1.5%	2.2%

### Percent of Panel With Moderate Risk Chronic Condition (0.5 Point)

BMI >29	Tobacco Use	PreDM	HTN	High Triglycerides	High Arthritis Dx	Chronic Pain (NO Opiates)	Benzo Rx
37.5%	17.2%	11.2%	39.7%	7.5%	5.6%	2.2%	10.9%

### Other Risk Conditions (1 Point, Uncontrolled Chr. Illness =0.5 Points)

Homeless	Uninsured	Disabled	High ED Use	Hospital Adm.	10 or More Diagnoses	10 or More Meds	Uncontrolled Chr. Illness
5.6%	14.2%	15.4%	4.1%	2.2%	34.5%	30.0%	5.2%

# Key Takeaways

- 1. Risk stratification is important for:**
  - Directing and improving patient care
  - Preparing for payment reform
- 2. No “one size fits all” model for risk stratification**
- 3. Variety of ways to utilize risk scores in conjunction with analytics**

Thank you!