

# Inovalon AI Project Briefing

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*In partnership with*



# Overview: AI-Powered Projects



## Patient condition gap detection in medical chart review

- The developed NLP pipeline improves coding efficiency by automation
- Product sold to several clients
- \$1 million+ margin per year



## Pharmacy demand prediction

- Deployed by Ability Network on a daily basis



## Patient risk prediction using claim codes

- First of its kind, effective for patient Adverse Drug Event risk prediction, especially for rare drugs
- Ready to deploy in API on InovalonOne platform (potential clients: Walgreens, Eli Lilly)



## Call center optimization (ongoing)

- A/B test shows the AI Reach Score can effectively identify easy-to-reach members





# Thought Leadership In AI-powered Healthcare Analytics



Patient Disease Identification in Clinical Notes, 2018 IEEE International Conference on Healthcare Informatics (ICHI)

- ICHI is a premier community forum on the application of computer science to address problems and support research in healthcare
- Sponsored by the National Science Foundation



Patient ADE Risk Prediction through Hierarchical Time-Aware Neural Network Using Claim Codes, 2020 IEEE International Conference on Big Data (IEEE Big Data)

- IEEE BigData provides a leading forum for disseminating the latest research in Big Data sponsored by:



DI++: A Deep Learning System for Patient Disease Identification in Clinical Notes, (Under Review at the Journal of *Artificial Intelligence in Medicine*)

# Call Center: Improve Member Reach and Conversion



## Call Center

- 10 million phone calls a year for screenings and follow-ups
- Major product line



## Challenges

- Low reach rate (~7%)
- Low conversion rate
  - ~40% reached members make an appointment
  - ~50% no show to appt





### Step 1

Predict member reachability for call prioritization



### Step 2

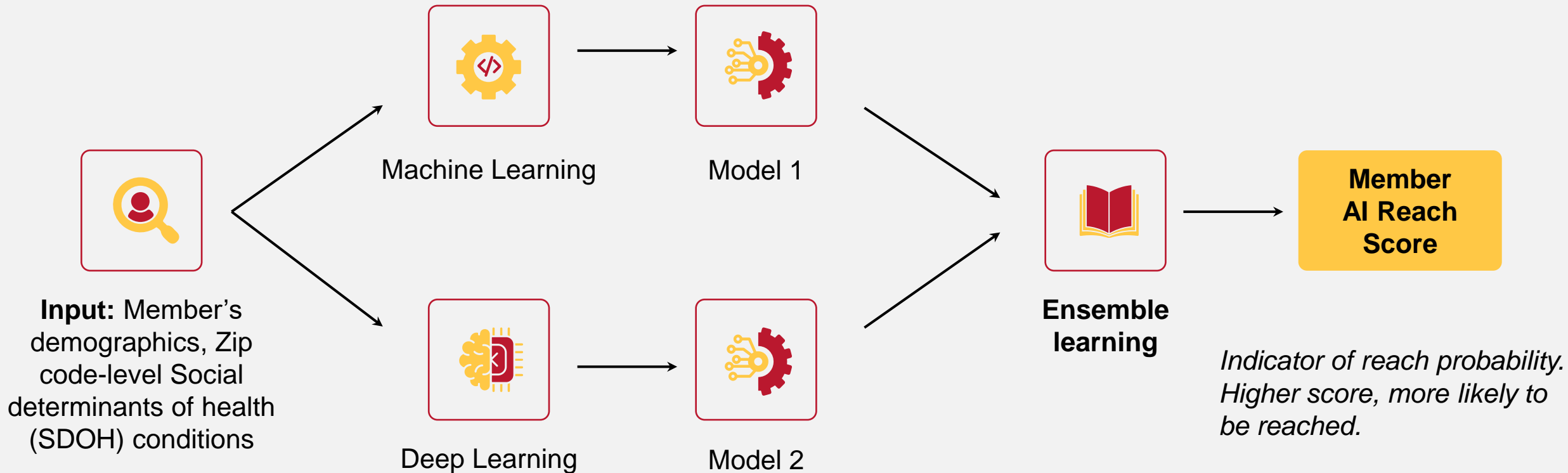
Predict ideal calling time to improve reach rate



### Step 3

Personalized adaptive member engagement to improve conversion rate

# Predict Member Reachability using AI (i.e., AI Reach Score)



# AI Reach Score: A/B Test



**Question:** Can the AI Reach Scores identify easy-to-reach members?

## Pilot test setting



Duration: 8/25 - 9/22, 2021

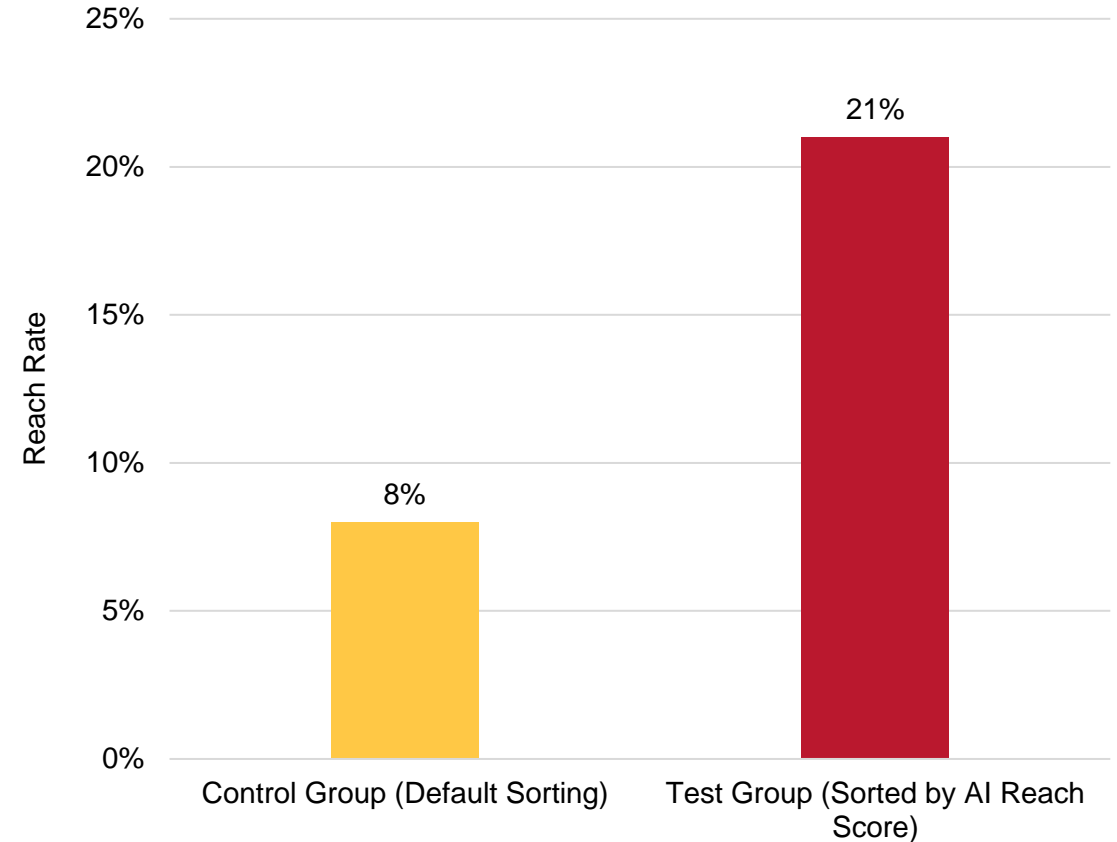


Control group: Call according to the existing sorting mechanism



Test group: Call in the descending order of AI Reach Score

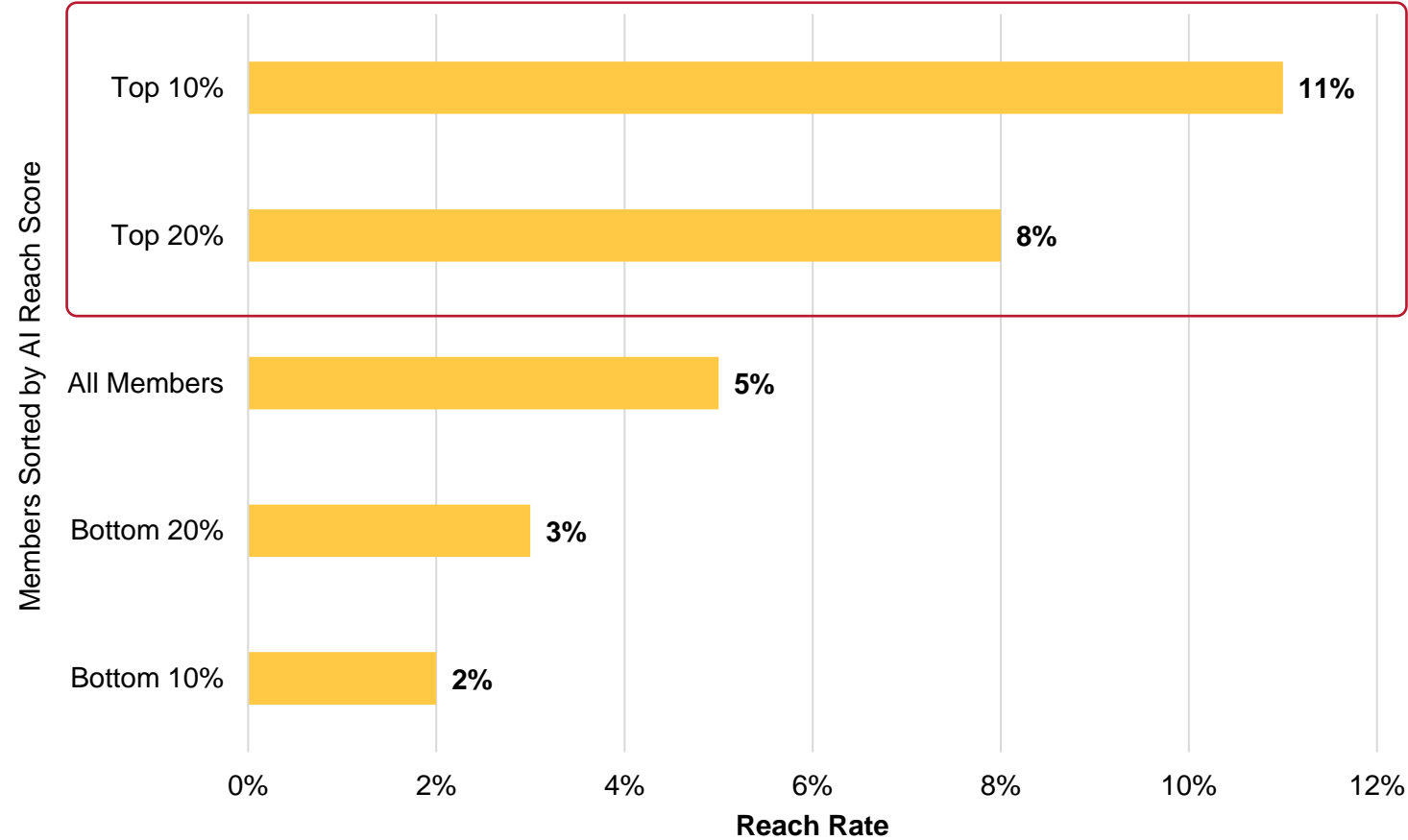
Reach Rate by Groups



8/31/2021  
8:00 AM TO 8:59 AM

AI Reach Scores can effectively identify easy-to-reach members

# Analysis of Actual Reach Rate by Predicted AI Reach Score



AI Reach Scores correlates strongly with actual reach rate



Period: **8/25 to 9/22**



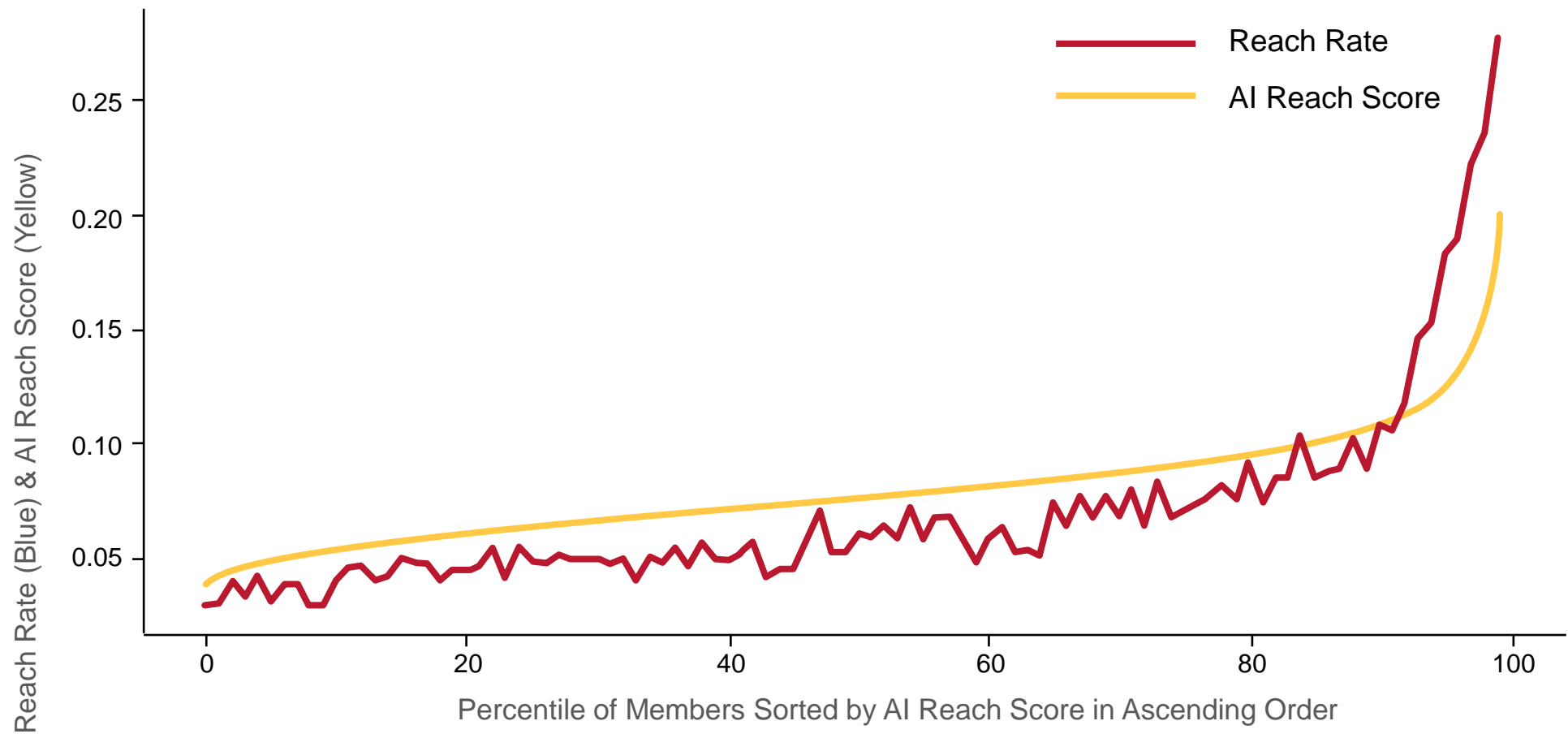
Number of Members:  
**40,086**



Number of Calls: **183,898**



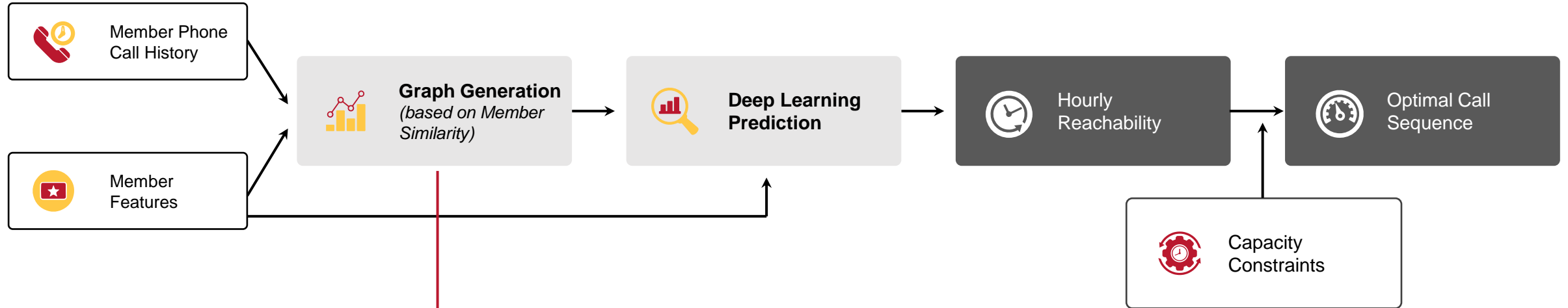
# High Correlation Between AI Reach Score and Actual Reach Rate



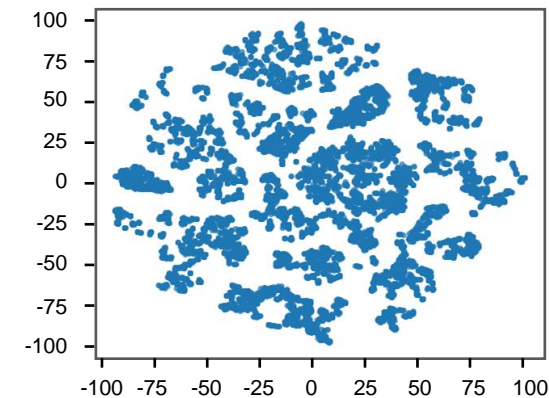
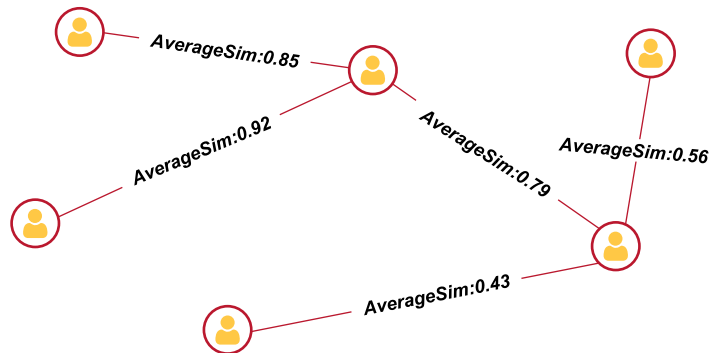
**AI Reach Scores correlates strongly with actual reach rate**

## Step 2

# Predict ideal calling times and optimize calling sequence to improve reach rate within capacity constraints (ongoing)



The similarity between member and member is calculated based on *their phone call history and features*



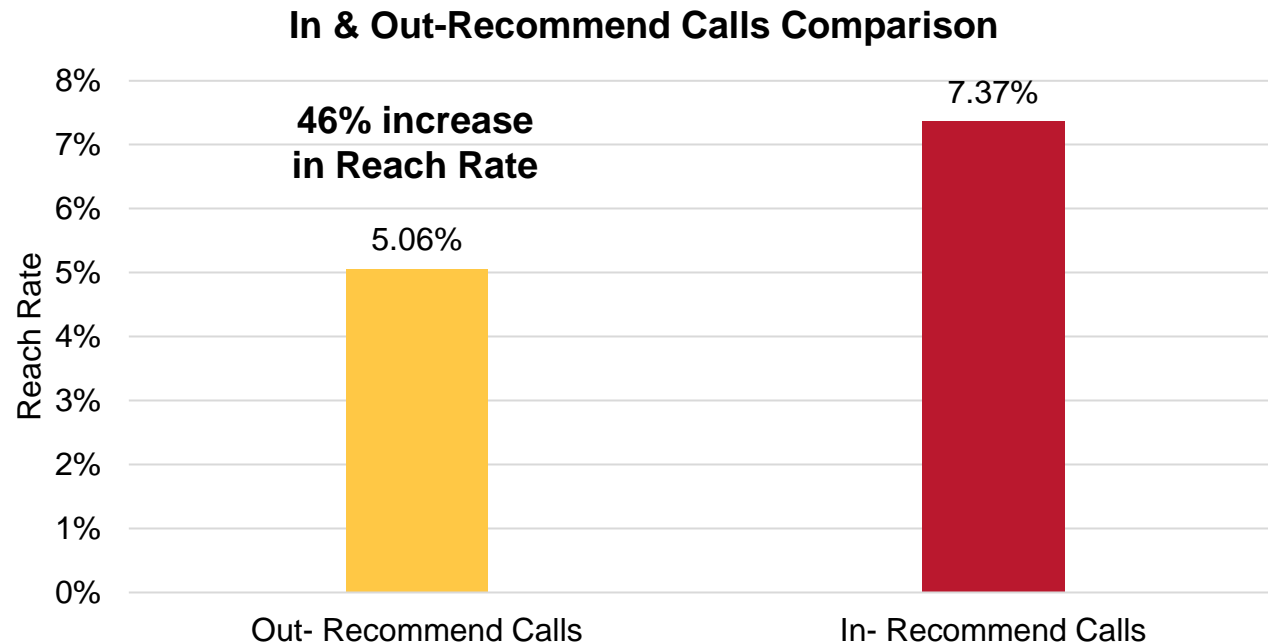
The member embeddings extracted from the graph can effectively subdivide members (*blue dots*) into different subgroups

## Step 2

# Preliminary Evaluation of Calling Time Recommendation



We developed an algorithm to recommend optimal calling times for individuals



### Data: Anthem Medicare:

- 15,000 members
- Training period: 2/22 to 6/30
- Test period: 7/1 to 7/29



**In-recommend Calls:** a call in the test period during the recommended time; 2,076 calls



**Out-recommend Calls:** a call in the test period outside the recommended time; 44,904 calls



We proposed an algorithm to optimize calling sequence within capacity constraints

## Step 2

# Online A/B Test Design



How to render the optimal sequence from call center to Genesys?

Call Center



**Original calling list: A**



Genesys

Call Center



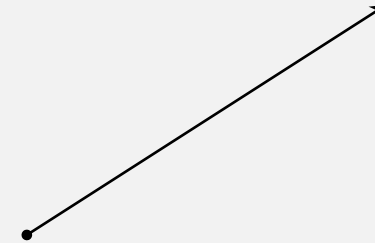
**Original calling list: A**



AI Models



**Original calling list: A\***



Genesys



# Deeper Insights into Pandemic Impact



**Question:** How has the pandemic impacted important societal trends like birth rate?

## Analysis



Data Source: **MORE<sup>2</sup> Registry<sup>®</sup>**



Data Period: 1/1/2018-1/1/2021



Analysis: Compare trends in birthrate across subgroups, identifying demographics that have been most heavily impacted



**The New York Times**

*The U.S. Birthrate Has Dropped Again.  
The Pandemic May Be Accelerating the Decline.*

# **Additional Completed Projects**

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The background of the slide features a blurred image of people in business attire giving thumbs up, suggesting a successful outcome. In the foreground, wooden blocks spell out the word 'SUCCESS' on a blue and white striped surface. A thick yellow diagonal line runs from the top right towards the bottom left, separating the text area from the background image.

S U C C E S S

# Patient Condition Gap Detection (HEDIS HCC Coding)



We developed a system to extract patient conditions from medical charts with clinical notes

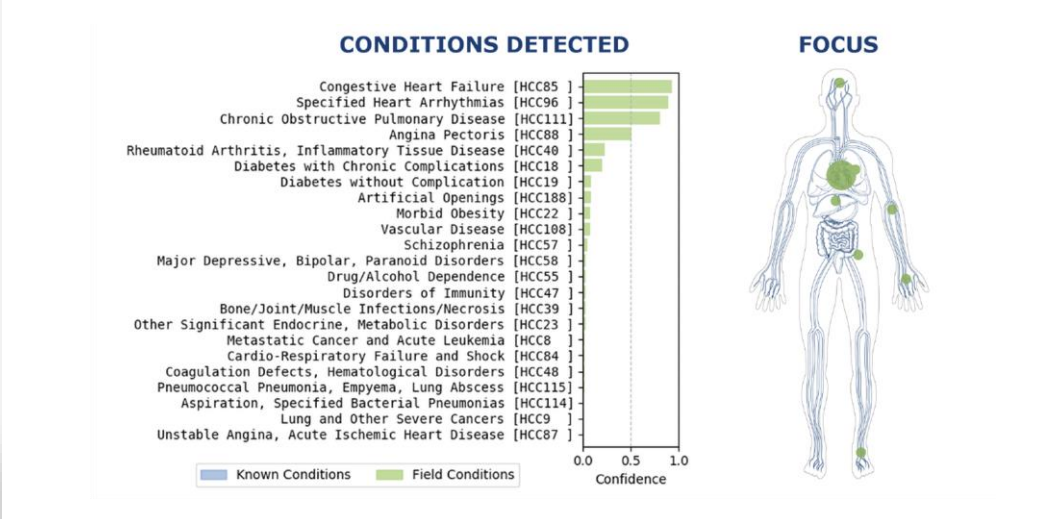


Significance: Identify gaps in data



Outcomes:

- Outperform legacy system by 20% accuracy increase and \$1 million+ margin per year
- Successfully launched the solution to alleviate labor-intensive medical record review operations in both Healthcare Risk Adjustment and Quality Improvement space, with a client-facing web application to manage end-to-end workflow with NLP features
- Publication at IEEE ICHI and another manuscript under review



Evaluation:

Systems	F1 Score
cTAKES	0.51
ConText	0.56
Inovalon System	0.79
BERT	0.72
DI++ (Our System)	0.81



Data Source: MORE<sup>2</sup> Registry<sup>®</sup>

James Doe

James Doe

Male DOB: 3/21/1932

Previous Tobacco Use: Signed On - 01/01/2014

Smoked Tobacco Use: former smoker

Pack-years: 0

Year started: 1960

Year quit: 1980

Year Started Quit: 25 years 8 months 2 days

Myocardial Perfusion Imaging

**History: Risk factors:** COPD Family history of coronary artery disease. Former tobacco use. Hypertension.

Study Date: 02/01/2015

Room: CTCU

READING John Smith MD  
ADMITTING Jane Doe MD  
ATTENDING Lisa Davis MD  
ORDERING Dr. Jenn  
NUCLEAR TECH Dr. Wonder  
NUCLEAR TECH David Goodhealth  
OTHER  
REFERRING

Indications: Jaw pain, SOB, primary Dr Danner

History: Risk factors: COPD Family history of coronary artery disease. Former tobacco use. Hypertension.

He does not drink alcohol.

**Additional Social History (reviewed - no changes required):**

Children: 8 children  
Lives with: spouse/partner  
Retired from being a buyer  
Works part time at  
quit smoking in 1987

**Allergies:**

\* ELIMAX (Critical)

## Review of Systems

**General:** Complains of fatigue.

**Cardiovascular:** Complains of lightheadedness/dizzy, chest pain or discomfort, shortness of breath with exertion, swelling of hands or feet, difficulty breathing while lying down.

**Respiratory:** Patient denies sputum, wheezing, shortness of breath, excessive snoring, chronic cough.

**Musculoskeletal:** Complains of back pain arthritis.

The remainder of the complete review of systems was negative.

Baseline	57	185/86 (119)	Sinus brady	None	-
Regadenoson (Lexiscan); 1 min	85	180/86 (117)	NSR, ventricular bigeminy	Headache, mild chest tightness	occasional couplet
Recovery; 1 min	81	177/86 (116)	NSR	-	ventricular trigemny
Recovery; 2 min	77	154/78	-	Subsiding, no c/o chest	-

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HCC 40

Works part time at LifeWay Christian bookstore  
quit smoking in 1987

**Review of Systems**

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# Patient Health Risk Assessment



We developed an AI based model to predict the risks of a patient experiencing a given adverse event if taking a drug, using the medical claim history



Significance: AI support for pharma for personalized medication with safety improvement



Outcome:

- Empirical evaluation demonstrates superior performance
- Publications at IEEE BigData conference



## Models

## Accuracy

## AUC

Random Forest

0.78

0.75

XGBoost

0.80

0.76

LSTM

0.84

0.81

CNN

0.83

0.80

**HTNNR (Our Model)**

**0.88**

**0.89**



*The first work for personalized ADE risk prediction using patient's medical claim history*

**Data Source:**

**MORE<sup>2</sup> Registry<sup>®</sup>**