



Enhancing Public Health: Leveraging Multi-Armed Bandit for Vaccination Outreach

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ABOUT OUR COMPANY

CVS Health is a leading American healthcare company with a wide network of pharmacies and clinics, providing vital access to medications and healthcare services for millions.

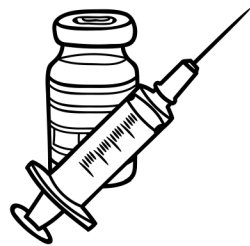
Embracing technology, CVS is driving positive change by leveraging innovative solutions to enhance its services.



Problem Statement



BACKGROUND



Extremely low current vaccination rate via SMS outreach



Large volume of messages via traditional A/B testing



Traditional A/B testing lacks the contextual and interpretability



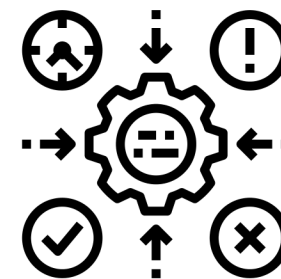
SOLUTION



Create personalized SMS campaign with different verbiages by developing **multi-armed bandits (MAB) models**

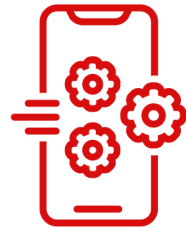


Measure **the uplift in performance** to enhance efficiency and cost-effectiveness in experimentation



To utilize the effectiveness of **contextual MAB** in incorporating different factors to derive actionable interoperable insights

Dataset Overview



1000+
FEATURES



100M
PATIENTS



7 TYPES OF
VACCINES

TYPE OF DATA USED



2022 Vaccine
Measurement Data



Prescription Pickup
Record Table



Patient Data like Age,
Gender, Income



10 Verbiages: Value,
Cost, Safety, etc

Data Preprocessing



Exploratory Data
Analysis

Helped in determining the
focused vaccine for MAB



Clustering
Techniques

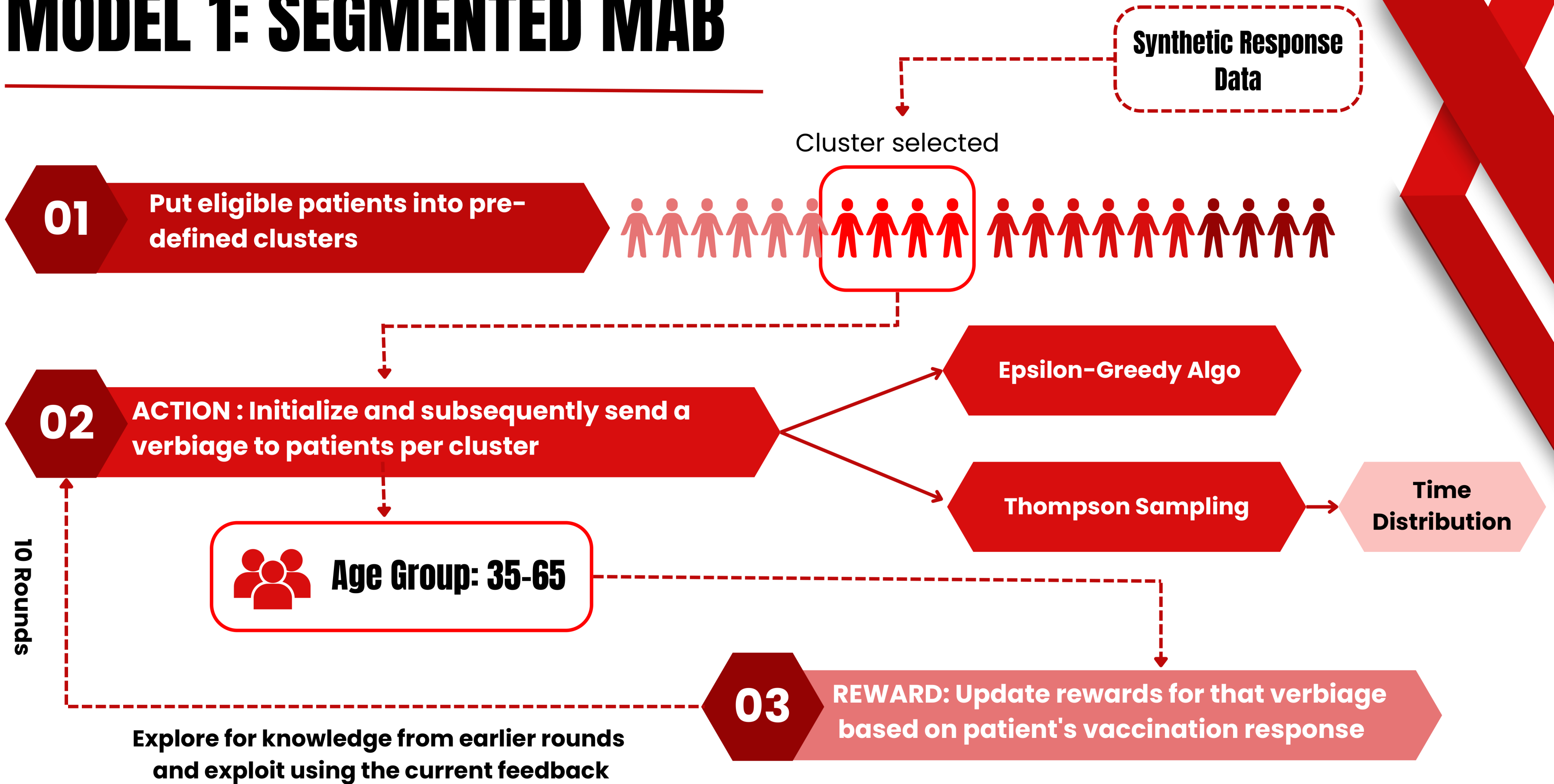
Identified the right features
for the contextual MAB



Synthetic
Data creation

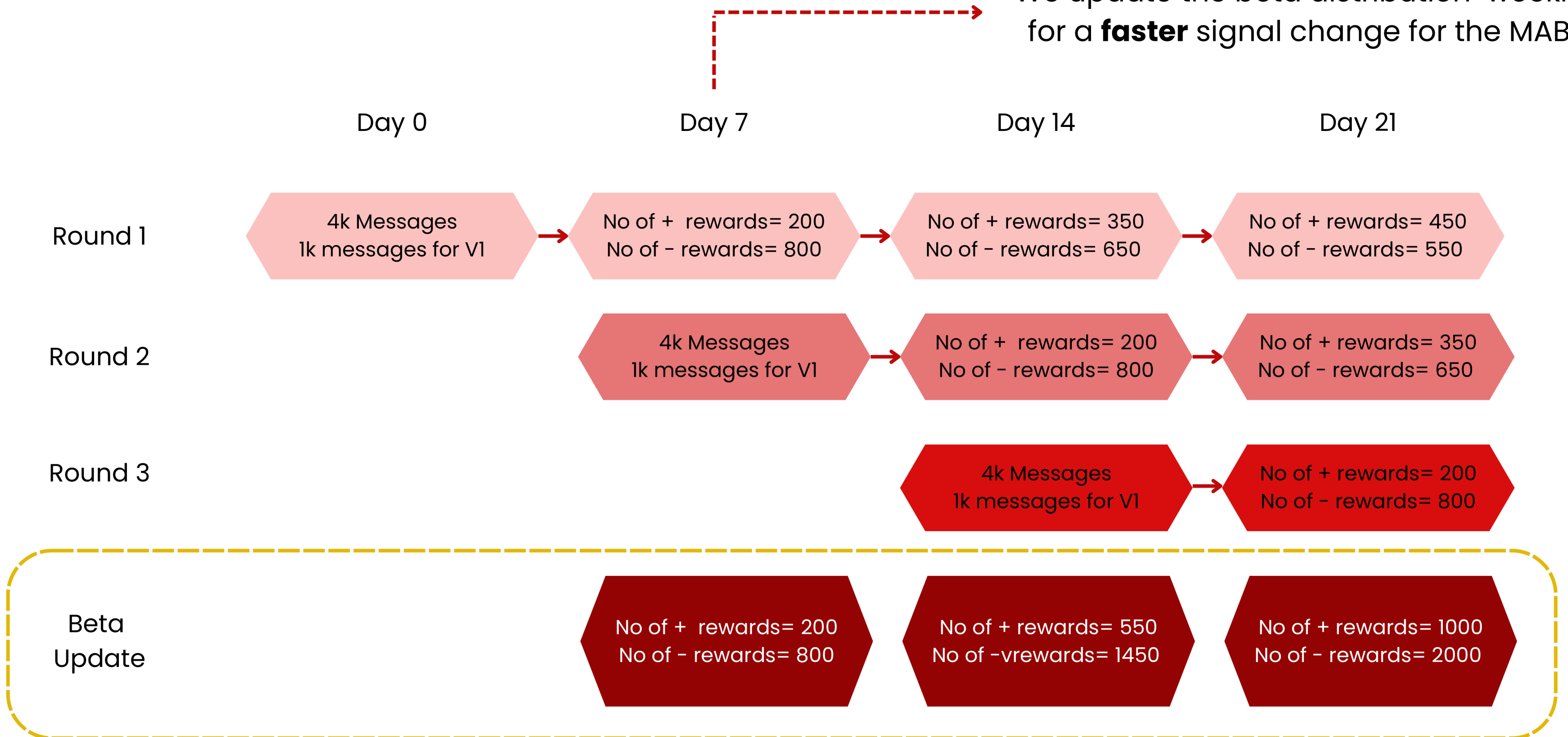
Created synthetic response
data for new verbiages

MODEL 1: SEGMENTED MAB



Thompson Sampling with Time Distribution

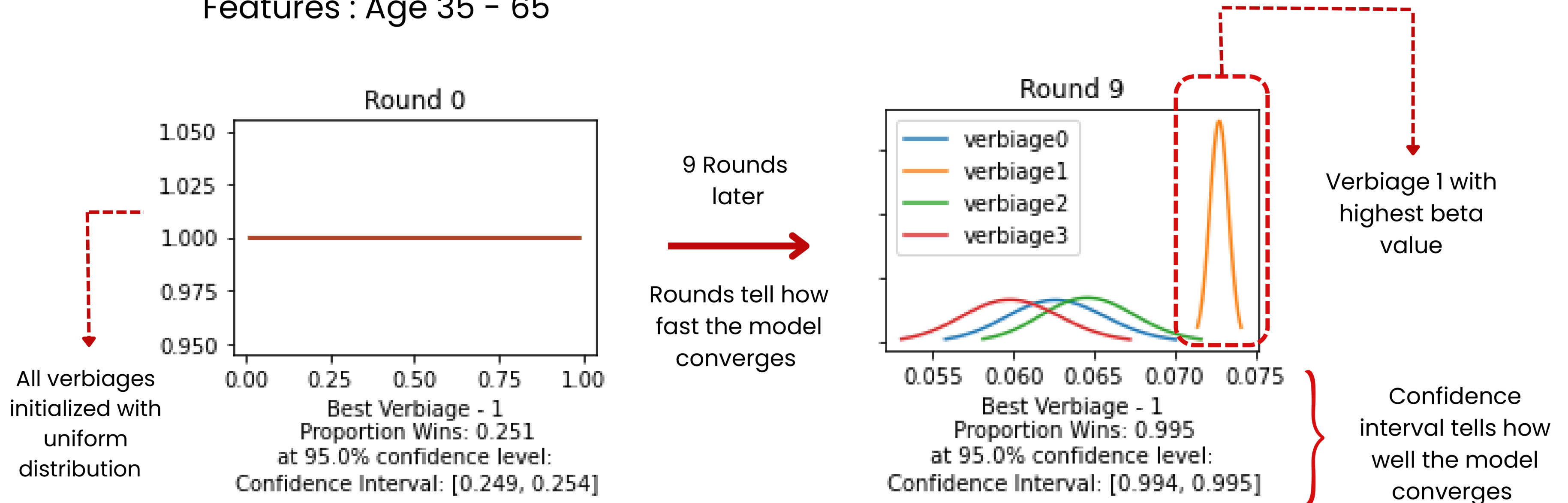
We update the beta distribution weekly for a **faster** signal change for the MAB



PERFORMANCE METRICS- PROPORTION WINS

Model: Segmented MAB-Thompson Sampling

Features : Age 35 - 65



The **Proportion Wins** is computed as the proportion of times where the best arm outperforms other arms using Monte Carlo simulations.

PERFORMANCE METRICS- A/B TESTING vs MAB

Case of Segmented MAB based on Age
% Increase in Vaccination rates compared to A/B testing

Feature: Age	Epsilon-Greedy Algo	Thompson Sampling
>65	1.33%	3.68%
35-65	2.42%	6.71%
<35	0.38%	0.00%
Overall	1.78%	4.39%

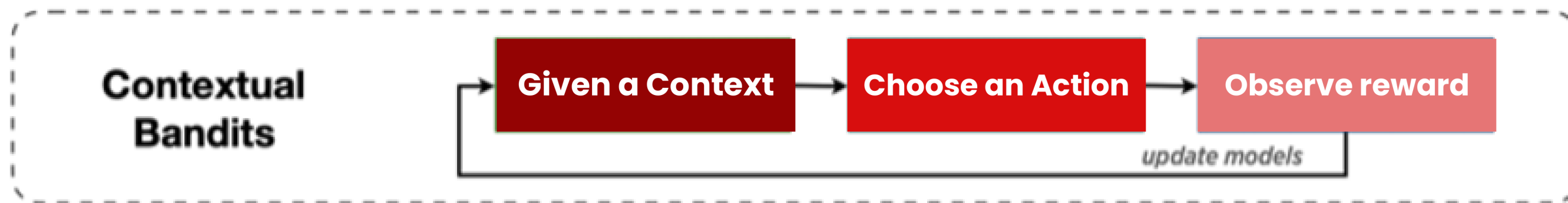
Thompson Sampling is performing better in more cases

MODEL 2: CONTEXTUAL BANDIT



VISION

Explore for knowledge and exploit current knowledge simultaneously



Goal: To maximize the rewards (Flu vaccination rate)



Context : Patient features

AGE

INCOME



Action/Arm: Text messages with different verbiages

Model:
Thompson
Sampling

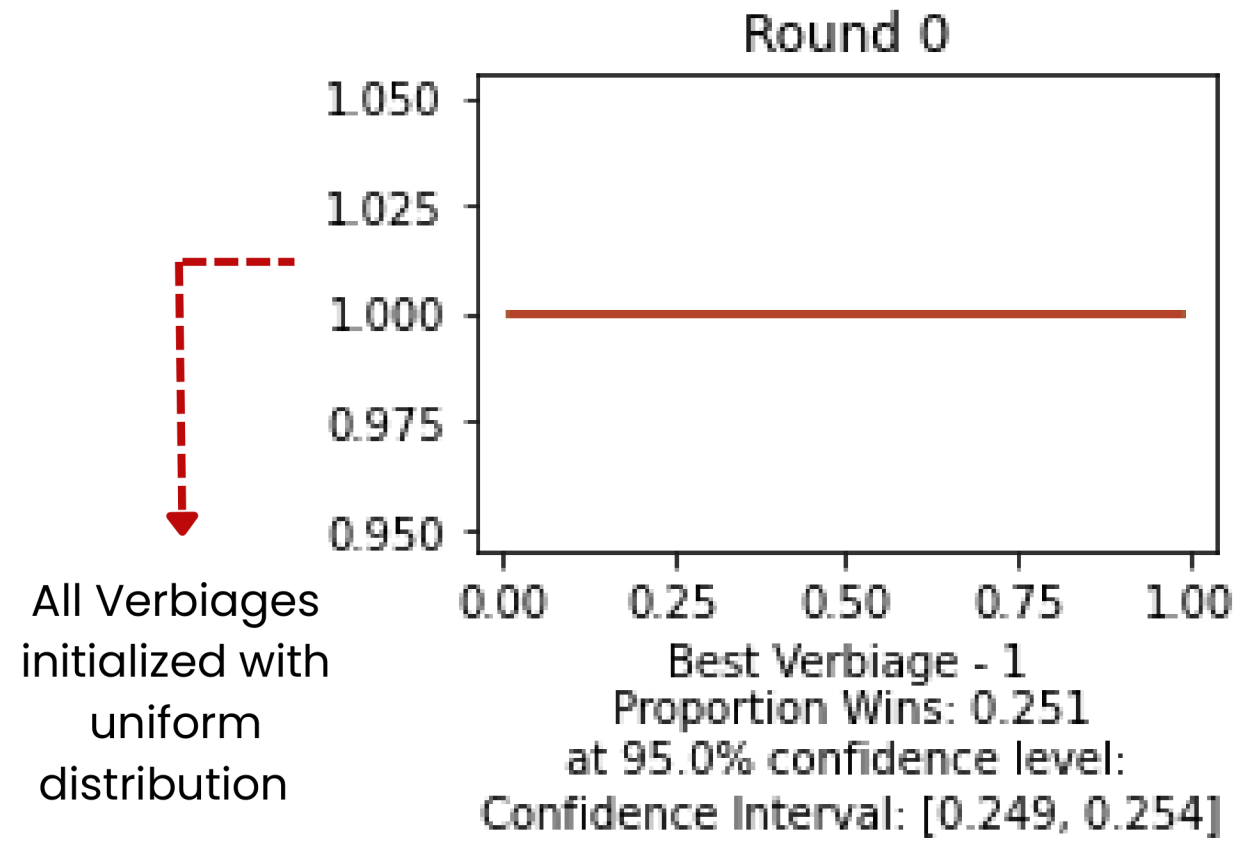
PERFORMANCE METRICS

Model: Contextual MAB
Features : Age, Income

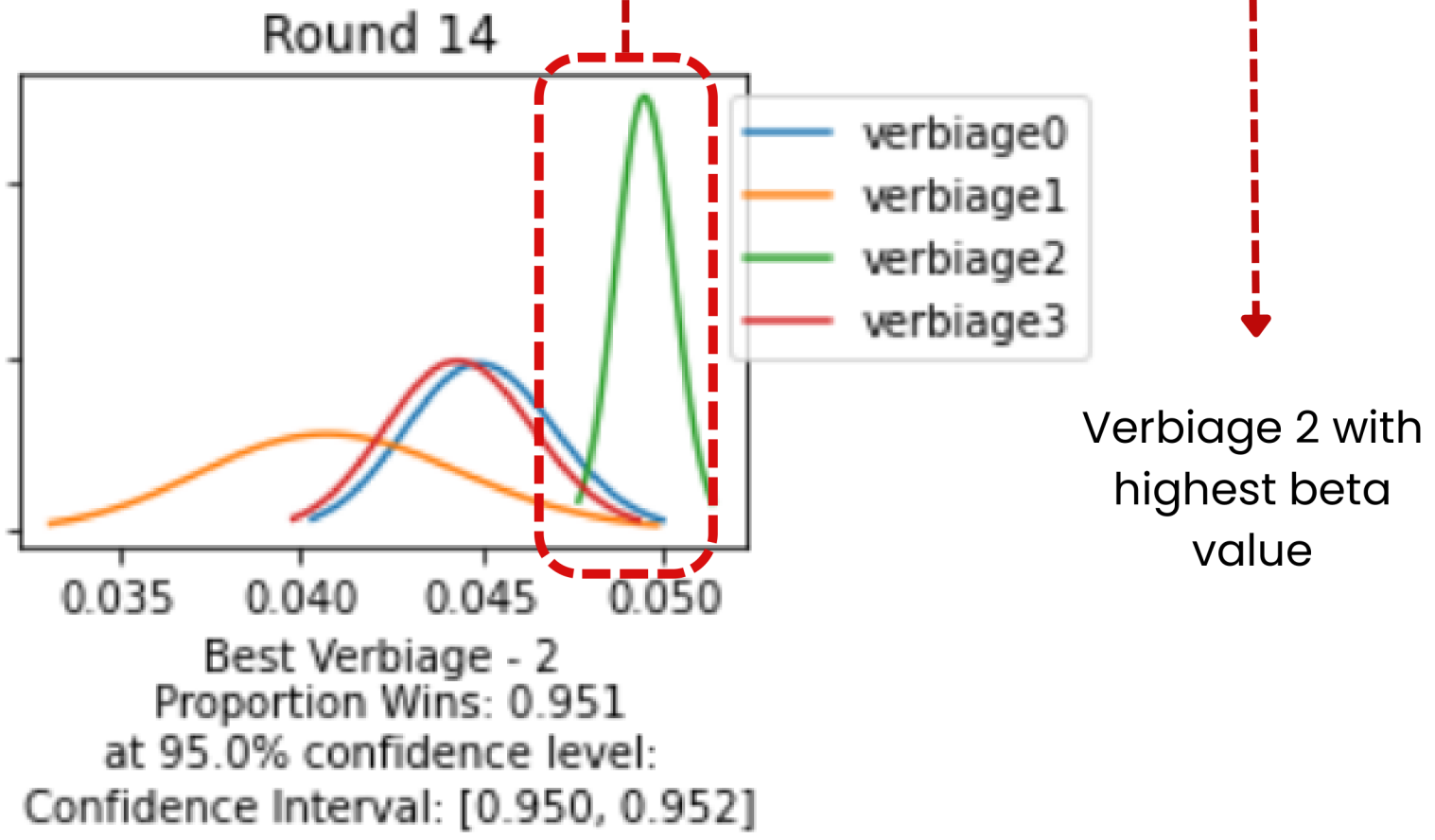
4.61% Improvement in vaccination rate across all features

Proportion Wins:

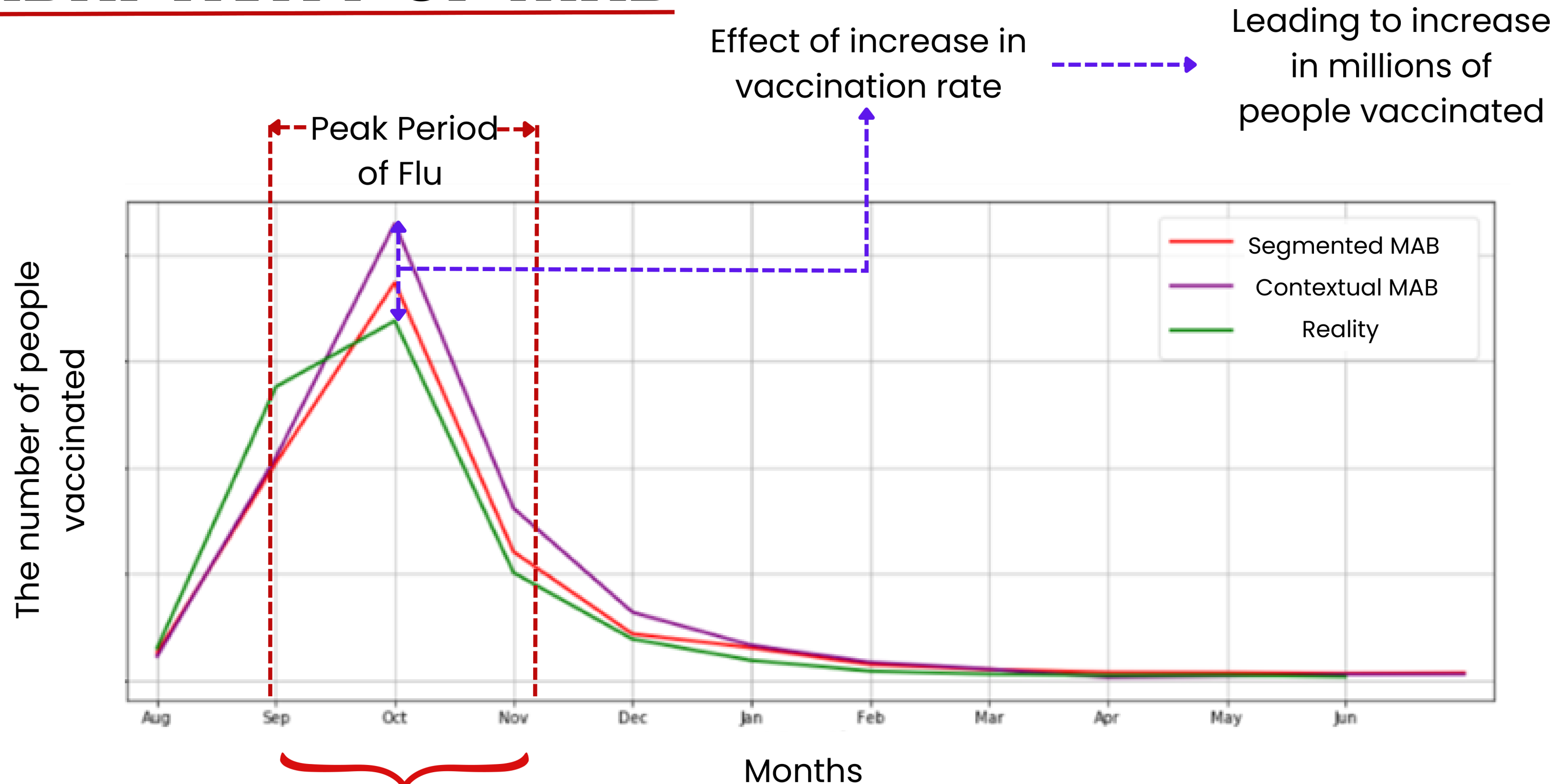
Features : Age 35 - 65, Income Above 70k



14 Rounds later



ADAPTIVITY OF MAB



Unlike A/B testing, MAB efficiently leverages peak periods of flu campaigns, leading to escalated vaccination rates.

Faster convergence with less volume of messages

RESULTS & IMPACT



\$ 1 M



\$ 12M

Projected Cost savings
per campaign

Projected Cost savings
per annum



85%

Decrease in
message overload



Better Adaptivity & Interpretable

Results using
contextual MAB



5%

Increase in flu vaccination
rates across all features



Millions of patients

Get vaccinated with boosted
engagements & enhanced loyalty

ACKNOWLEDGMENT

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Thank You

"Empowering Health, One Arm at a Time"

