TEXTING AND BOTS FOR BEHAVIOR CHANGE: LESSONS LEARNED ACROSS 2 INTERVENTIONS TO IMPROVE CHRONIC DISEASE MANAGEMENT

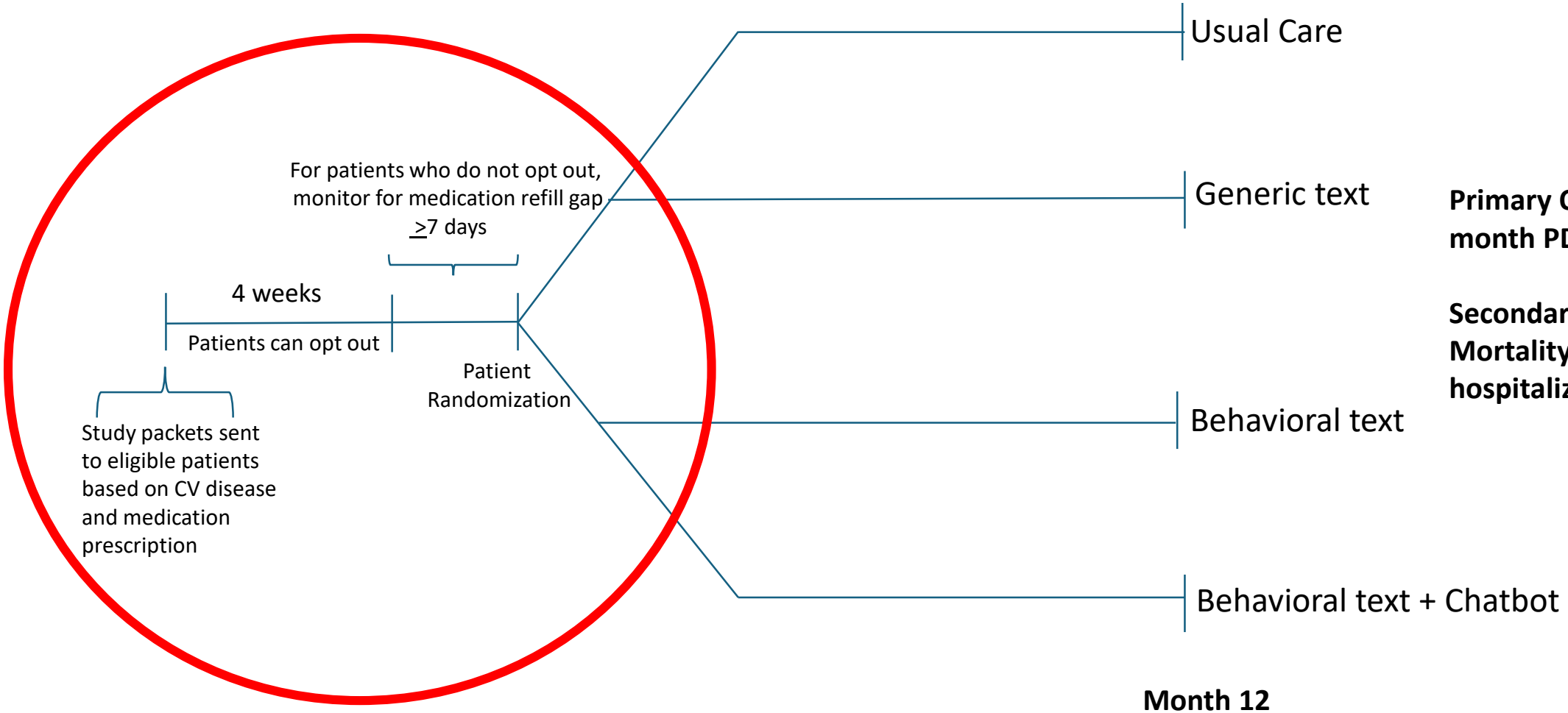
Sheana Bull, PhD, University of Colorado School of Public Health

Michael Ho, MD, PhD, Kaiser Permanente Colorado

OUTLINE

1. **Study design of text messaging interventions**
2. Texting infrastructure and design of messages
3. Evolution of text messaging to chatbot
4. Who participates in text messaging trials
5. Message engagement and results

NUDGE: OPT OUT APPROACH



Primary Outcome: 12-month PDC

Secondary outcomes: Mortality, ED visit, hospitalization

Nudge

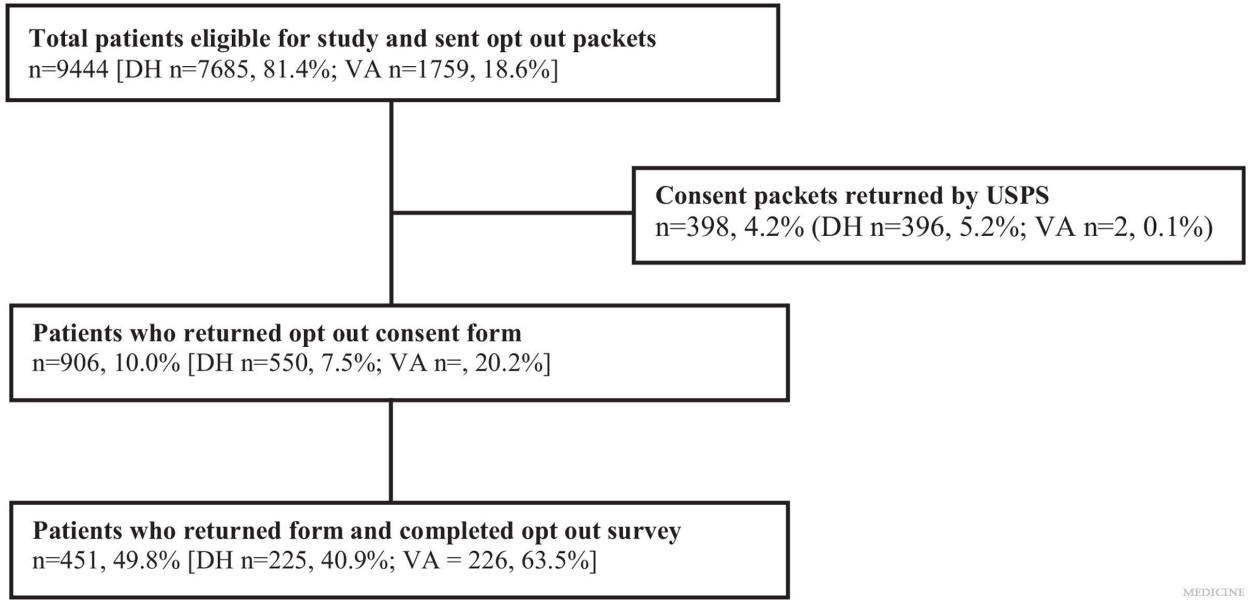
Observational Study

Medicine®

OPEN

Leave me out: Patients' characteristics and reasons for opting out of a pragmatic clinical trial involving medication adherence

Lisa Caputo Sandy, MA[a,b,*], Thomas J. Glorioso, MS[c], Kevin Weinfurt, PhD[d], Jeremy Sugarman, MD, MPH, MA[e], Pamela N. Peterson, MD, MSPH[f,g], Russell E. Glasgow, PhD[h,i], P. Michael Ho, MD, PhD[c,g]



PATIENT POPULATIONS

	Survey respondent N = 451	Opt-out population N = 906	Eligible for inclusion N = 8140	*P*-value
Age				<.001
0 to 40	0 (0)	1.5% (14)	6.3% (511)	
41 to 50	6.9% (31)	4.3% (39)	14.6% (1187)	
51 to 60	14.2% (64)	14.2% (129)	26.2% (2130)	
61 to 70	33.0% (149)	35.9% (325)	30.6% (2488)	
71 to 80	32.4% (146)	33.4% (303)	17.6% (1431)	
81+	8.6% (39)	10.6% (96)	4.8% (393)	
Missing	4.9% (22)	0 (0)	0 (0)	
Gender				<.001
Female	28.4% (128)	35.8% (324)	45.7% (3724)	
Male	65.2% (294)	63.9% (579)	54.1% (4407)	
Transgender/other	0 (0)	0.2% (2)	0 (4)	
Missing	6.4% (29)	0.1% (1)	0.1% (5)	
Race				<.001
White	56.8% (256)	76.3% (691)	72.3% (5888)	
Black	9.1% (41)	13.7% (124)	16.0% (1300)	
Multiple	2.4% (11)	0.4% (4)	0.8% (68)	
Other	8.2% (37)	5.4% (49)	9.2% (748)	
Missing	23.5% (106)	4.2% (38)	1.7% (136)	
Hispanic				<.001
Yes	29.9% (135)	33.6% (304)	54.2% (4411)	
No	60.3% (272)	63.4% (574)	44.7% (3642)	
Missing	9.8% (44)	3.1% (28)	1.1% (87)	
Number of medication classes, mean (standard deviation)*	–	2.6 (1.5)	2.6 (1.5)	.28
Healthcare system				<.001
VA	50.1% (226)	39.3% (356)	17.2% (1401)	
Denver health	49.9% (225)	60.7% (550)	82.8% (6739)	

Demographics of survey respondents were collected via the questionnaire

Analysis at 2 of 3 sites

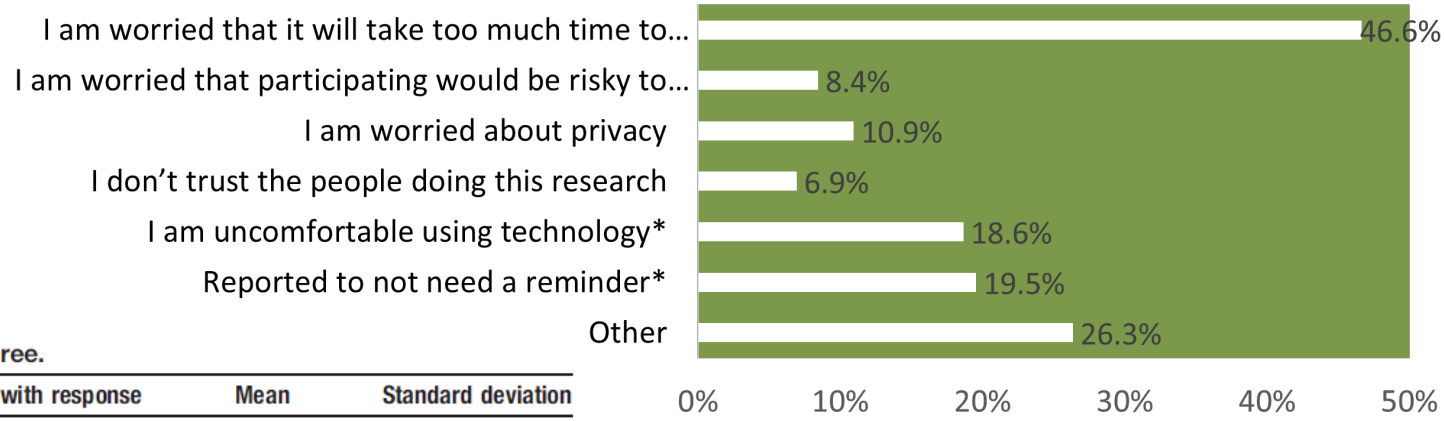
~10% opted out

Patients opting out were:

- **Older**
- **White**
- **Non-Hispanic**
- **VA patients (vs. DH)**

Nudge

REASONS FOR OPTING OUT



Trust scores. Individual scores range from 1 for strongly disagree to 5 for strongly agree.

	Proportion with response	Mean	Standard deviation
Trust in HCS			
My HCS does its best to make patients' health better.	83.6%	4.2	0.9
Patients received high quality medical care at my HCS	83.4%	4.2	0.9
My HCS gives excellent medical care	81.8%	4.1	0.9
My HCS experiments on patients without them knowing*	74.9%	3.7	1.1
Aggregate trust in HCS score (range 4–20)	74.3%	16.2	3.1
Trust in research			
Doctors who do medical research care only about what is best for each patient	78.3%	3.5	1
Doctors tell their patients everything they need to know about being in a research study	75.8%	3.5	1
Medical researchers treat people like "guinea pigs" *	74.1%	3.6	1.1
I completely trust doctors who do medical research	75.2%	3.4	1
Aggregate trust in research score (range 4–20)	70.3%	14	3.1
Trust in physicians			
Sometimes doctors care more about what is convenient for them*	76.9%	3.3	1.1
Doctors are extremely thorough and careful	79.8%	3.9	0.9
I completely trust doctors' decisions about which medical treatments are best	81.2%	3.7	1
A doctor would never mislead me about anything	79.4%	3.5	1.1
All in all, I trust doctors completely	81.4%	3.7	1
Aggregate trust in physicians score (range 5–25)	74.3%	17.9	4.1

HCS = health care system.

CONCLUSIONS

- In a low-risk intervention using an opt out consent approach, patients who identified as Black, Hispanic, and primary Spanish speakers were more likely to remain in the study.
- The most common reason for opting out was concern about the study taking too much time (46.6%).
- Trust did not appear to be a significant factor in opting out, contrary to assumptions.
- An opt out approach in the appropriate clinical trial context may be a way to diversify clinical trial populations and improve external validity of results.

Nudge

Research Letters

Secondary analysis of electronic opt-out consent in pragmatic research: A study design method to diversify clinical trials?

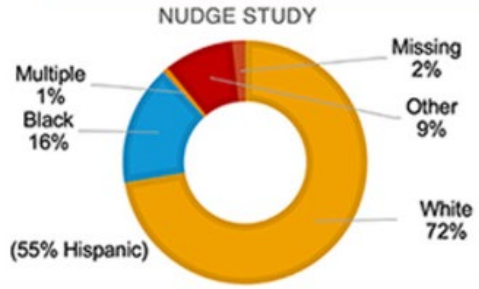
Prerna Gupta, MD[a], Lisa C. Sandy, MA[b], Thomas J. Glorioso, MS[c], Amber Khanna, MD, MS[a], Prateeti Khazanie, MD, MPH[a], Larry A. Allen, MD, MHS[a], Pamela N. Peterson, MD, MSPH[a,d], Sheana Bull, PhD, MPH[e], and Pei Jai Michael Ho, MD, PhD[a,c] *Aurora, CO*

Patients can opt out anytime from receiving messages by texting "STOP" or responding "STOP" to an interactive voice recording.

6,396 patients randomized to receive messages

537 (8%) opted out after a median **44 days**

- Hispanic and Black patients opt out less than other groups ($p < 0.001$)
- Similar opt out rates among men and women, final cohort is 47% women



Conclusion:

- In the first large, multicenter cardiovascular trial using opt out consent, opt out rates are low, with a high participation rate of 92%.
- Often under-represented patients opt out at lower rates compared to White patients.
- Further research is necessary to see how opt out enrollment functions in other trial settings, and to explore patients' reasons for participation.

Federal Communication Commission: Dec 2023 amendment to Telephone Consumer Protection Act (TCPA)

- **Change to TCPA consent requirement**. The TCPA and the FCC's implementing rules **require callers to obtain consumer consent for certain calls and texts sent using an automatic telephone dialing system or made using a prerecorded or artificial voice.** If a robocall or robotext includes or introduces an advertisement or constitutes telemarketing, the prior express consent must be writing.

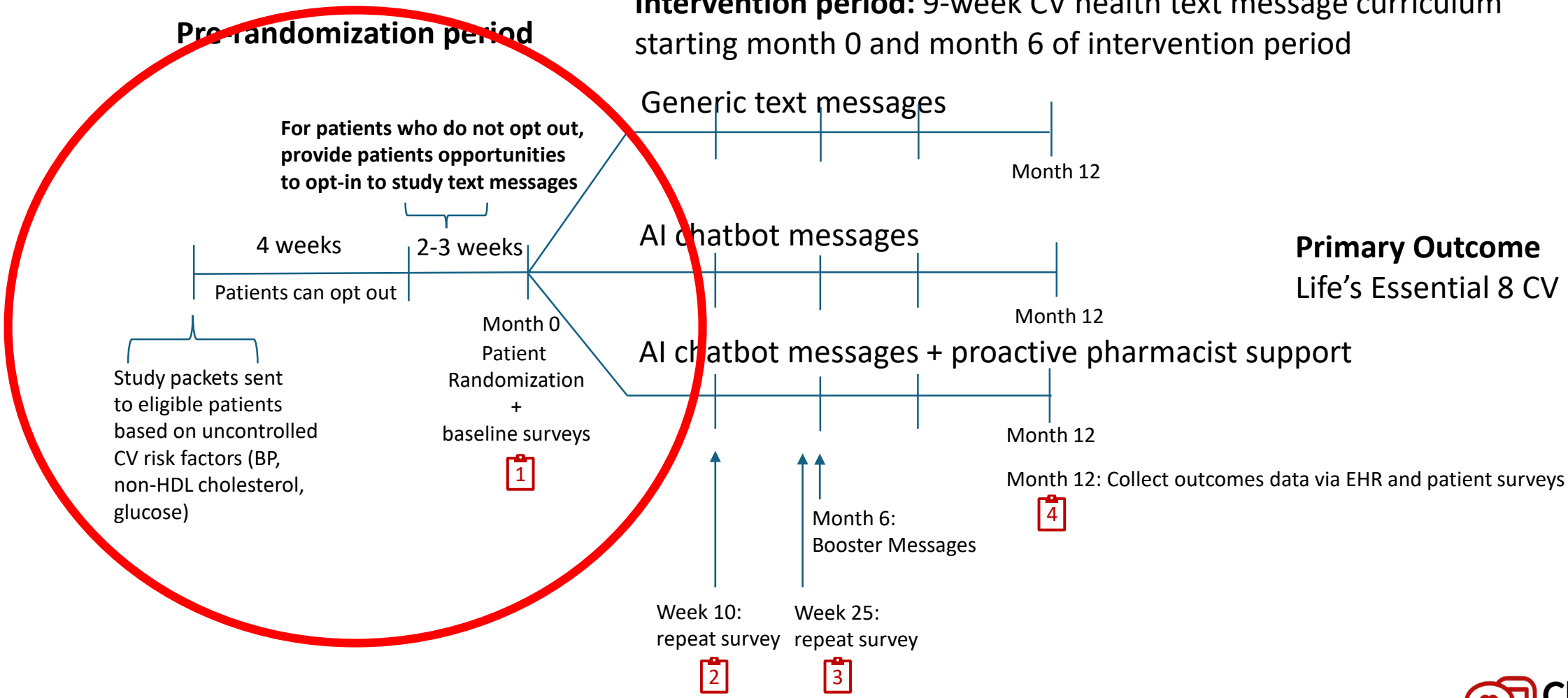
- **The new rule is intended to close the "lead generator loophole" that has resulted in consumers receiving calls and texts from multiple businesses based on a single grant of consent.** The new rule amends the definition of "prior express consent" in the TCPA rules (47 C.F.R. Sec. 64.1200(f)) to provide:

- Encourages providers to make email to text an opt-in service. The FCC has also issued a proposal to require providers to obtain consumer opt-ins for texts originating from email addresses.

- Clarifies that the texter or caller has the burden to prove they have consent that satisfies the TCPA and FCC rules.

- Clarifies that consumer consent to a seller is not transferrable or subject to sale to another seller.

CHAT FOR HEART HEALTH (C4HH): OPT-IN APPROACH



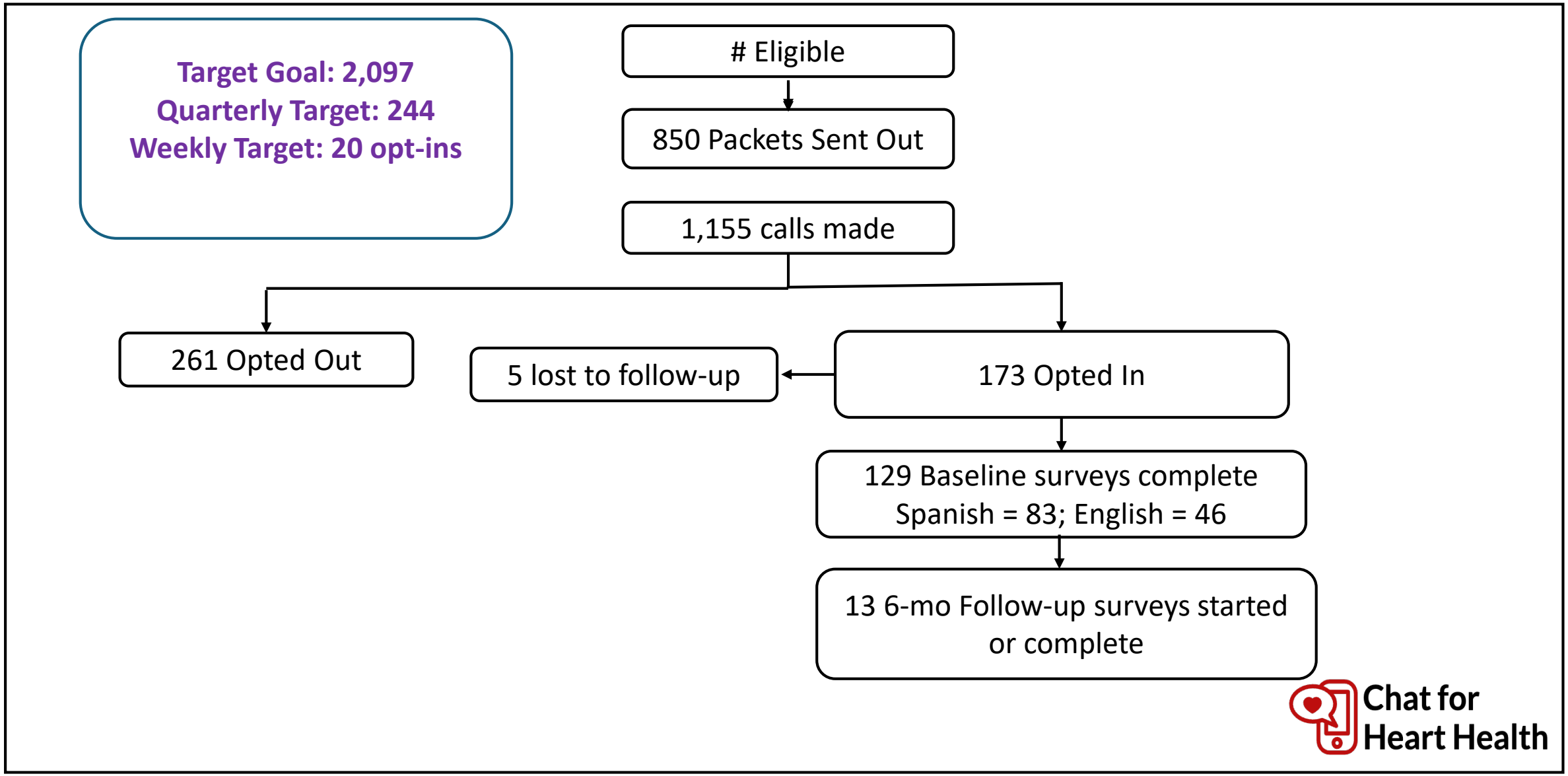
Primary Outcome

Life's Essential 8 CV risk factor

Surveys include Mini Eats, questions on physical activity, sleep, smoking, and disease management

Chat for Heart Health

C4HH Recruitment to Date

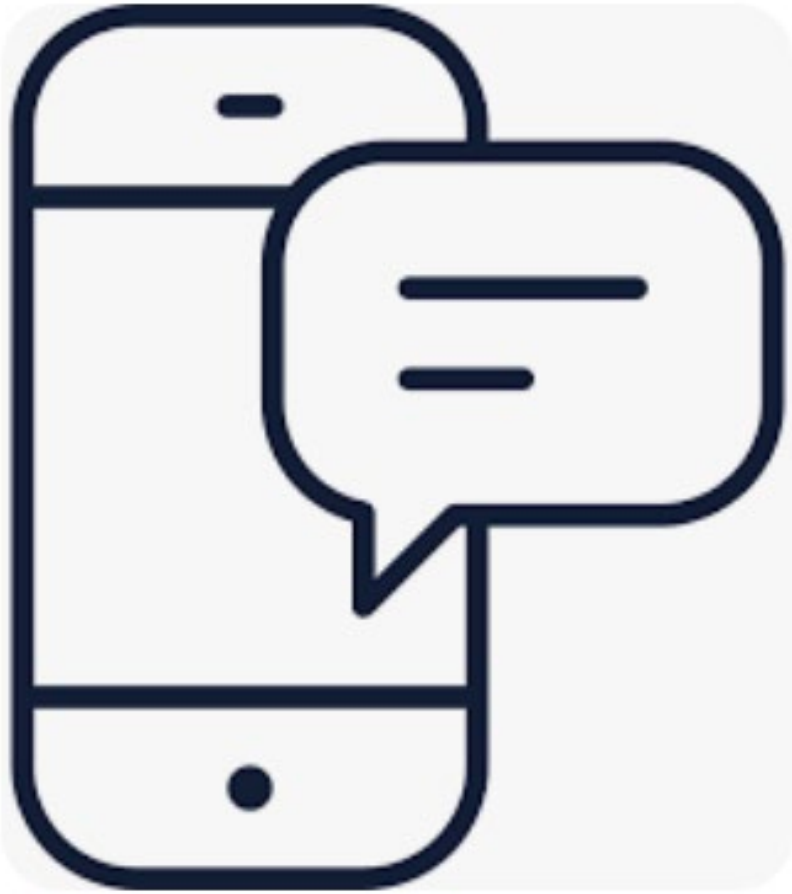


OUTLINE

1. Study design of text messaging interventions
2. **Texting infrastructure and design of messages**
3. Evolution of text messaging to chatbot
4. Who participates in text messaging trials
5. Message engagement and results

TEXT MESSAGING SYSTEM

- Ample evidence now exists demonstrating the benefit of using text messaging in support of health behavior and access to care
  - Improves adherence to medical appointments
  - Improves health behaviors related to chronic illness management
- Initial systems deployed unidirectional text messages using SMS
  - Texting is ubiquitous, increasing reach
  - Theory in message design is impactful



MESSAGE DEVELOPMENT

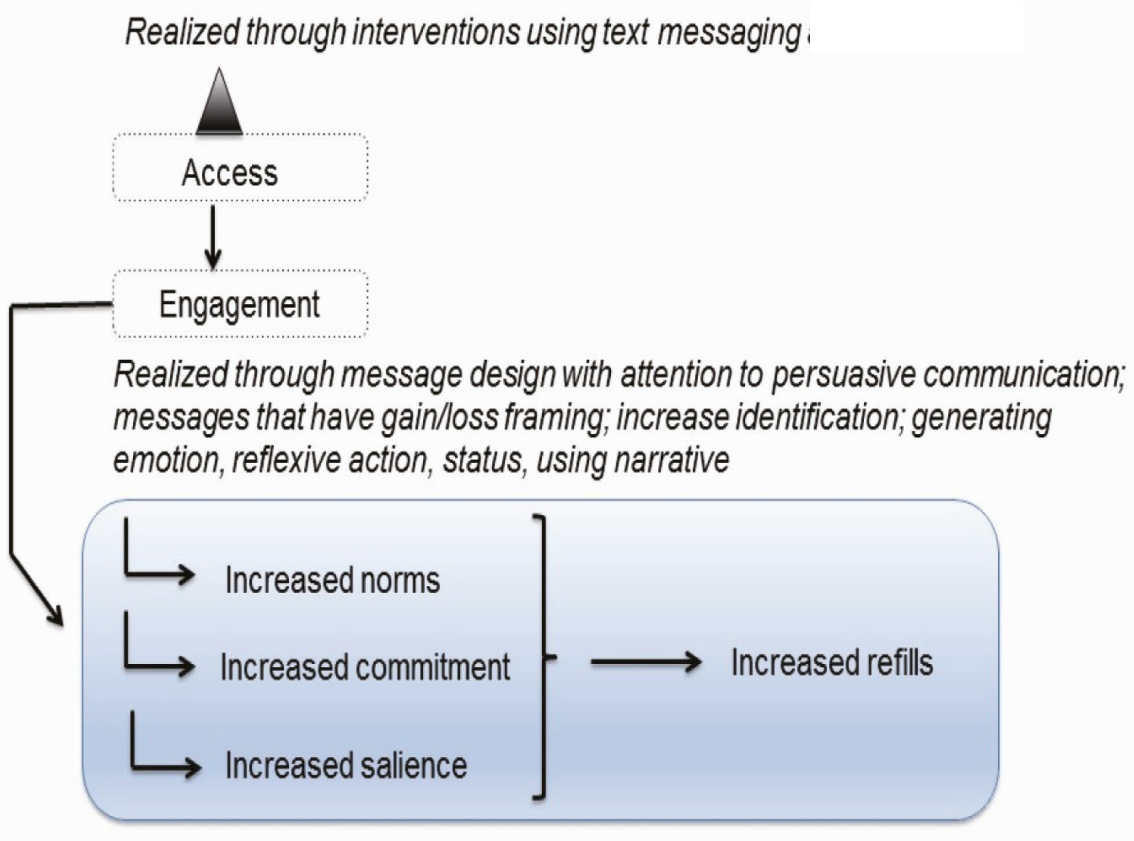
Community Advisory Panel

A Nudge-specific Advisory Panel provided additional input on both the messages and the opt out packets.

1. Panel included patients, providers, health care leaders, and pharmacists
2. Panel recommendations led to:
    - Added an option for patients to indicate they had leftover medications (responding “Done”)
    - Improved the interactive voice response (IVR) messages by using a robotic voice rather than human voice
    - Provided specific suggestions of way to disseminate findings, including identifying communications platforms at the HCS

Nudge

Integrated theory of mHealth



TBM

BRIEF REPORT

Nudge me: tailoring text messages for prescription adherence through N-of-1 interviews

Joy Waughtal,[1,*] Phat Luong,[1] Lisa Sandy,[1] Catia Chavez,[1] P. Michael Ho,[1,2] Sheana Bull[1]

Transl Behav Med, Volume 11, Issue 10, October 2021, Pages 1832–1838, https://doi.org/10.1093/tbm/ibab056

Nudge

MESSAGE DEVELOPMENT - Creation of culturally appropriate nudges

N of 1 interview findings

- 35 patients provided their perspectives of our messages, creating an iterative message design process
- Collected via 1 on 1 interviews in both English and Spanish
- Disliked messages with humor and emojis
- Preferred positive messages (avoiding hospitalization versus possibility of death)
- Preference for direct and simple communications
  - Disliked messages that mentioned other names
  - Disliked messages that referenced general terms, e.g., “your neighbor”

Nudge

AN EXAMPLE OF SLIDE USED IN THE N OF 1 INTERVIEWS

SCREEN 2

Day 1 continued…

A B C

Nudge

TRACKING OF PATIENT FEEDBACK

	We noticed that you haven't refilled at least one of your meds. Reply 1 to let us know that you'll get them refilled in the next 2 days	Will you get your refill? Reply 1 for yes	We know you're busy - when do you think you'll pick up your medication refills? Reply 1=today, 2=tomorrow, 3=the day after that
	Screen2		
	A	B	C
Offensive			
Don't Understand			
Don't Like			2
TOTAL NEGATIVE (SUM of first 3 variables)	0	0	2
Positive Response	1	1	
Other suggestions or feedback for specific messages		UCH116 "Positive simple quick reminder"	UCH116-"big brother like"

Nudge

MESSAGE EVOLUTION

Table 2 | Examples of message evolution

Original	Intermediate	Final
Tell us your best strategy to make getting refills a habit! Text 1 = set my alarm; 2 = rely on my family; 3 = make it part of my weekly routine; 4 = other or unknown.	We noticed you didn't refill some of your meds. Tell us why! Text 1 = too expensive; 2 = I forgot; 3 = I don't like taking them; 4 = Other.	Hi (FIRST NAME) We noticed you haven't refilled your (DRUG NAME). Reply 1 = you'll get them refilled in the next 2 days 2 = I'm still working on a plan to get this done.
👋 Hi, me again. I know I'm needy, but I'd feel better if you refilled your meds [TS: Inline image present. Retain.].	Your pharmacist misses you!	Hi (FIRST NAME) It's easy to forget to get your meds – that's what we're here for! Reply 1 = I have a plan to get your prescription Reply 2 = I'll get to it later this week.
Joe always remembers his meds – he makes a habit of going every Friday since the pharmacy is right near his favorite menudo spot! Make a healthy habit by planning your regular medication pick up.	Your neighbor always remembers their meds – they make a habit of going every Friday since the pharmacy is right near their favorite menudo spot! Make a healthy habit by planning your regular medication pick up.	Hi (FIRST NAME) I care about my well-being. I will get to the pharmacy by: Reply 1 = I'll do it today! Reply 2 = I'll do it later this week.

Nudge

OUTLINE

1. Study design of text messaging interventions
2. Texting infrastructure and design of messages
3. **Evolution of text messaging to chatbot**
4. Who participates in text messaging trials
5. Message engagement and results

Chatbots and AI Chatbots

- Texting has evolved to the use of chatbots (conversational agents)
  - “Fixed-state” bots utilize static messaging, e.g., choose the best answer from the list below, 1, 2, 3 etc.
  - Dynamic, Artificially Intelligent bots
    - Allow users to generate questions in their own words
    - The systems read the queries and then utilize natural language processing (NLP) to interpret the intent behind the question
    - Once intent is established, the system can retrieve a response from the web (generative) or a closed, curated library
    - When the system cannot correctly interpret the intent behind the query, we intervene to reclassify, and subsequently the system uses machine learning (ML) to reclassify moving forward

Chatbots and AI Chatbots

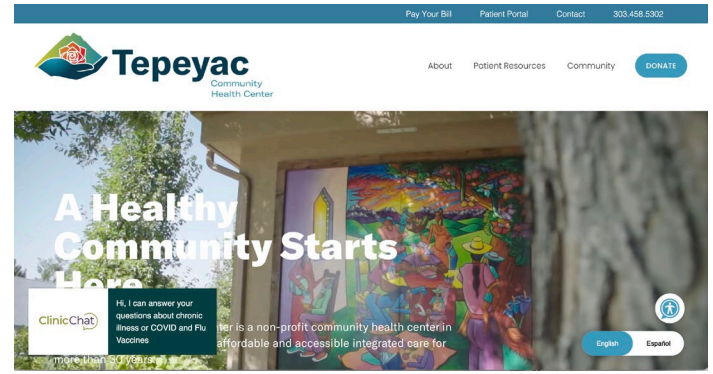
- Generative AI for messaging (e.g., Chat GPT, Open AI)?
  - Can misinform
  - Can Hallucinate
- Alternative: use closed libraries that are curated
  - Medically accurate information
  - Theoretically informed message design
- AI is still used in NLP and ML

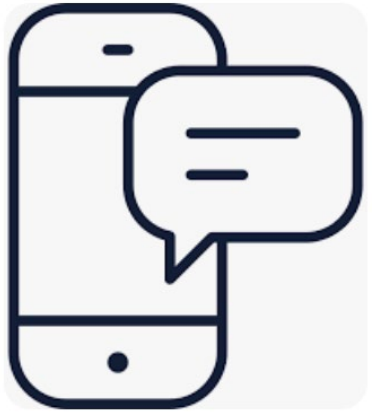
Chatbots and AI Chatbots

Bots can sit on a website, and can also be utilized via text messaging, and WhatsApp

Do they work as well or better than text messaging?

- Fixed message bots may be equivalent to texting
- AI Chatbots on a website need to generate engagement
- AI Chatbots delivered by text or WhatsApp can “push” messages to users to prompt engagement

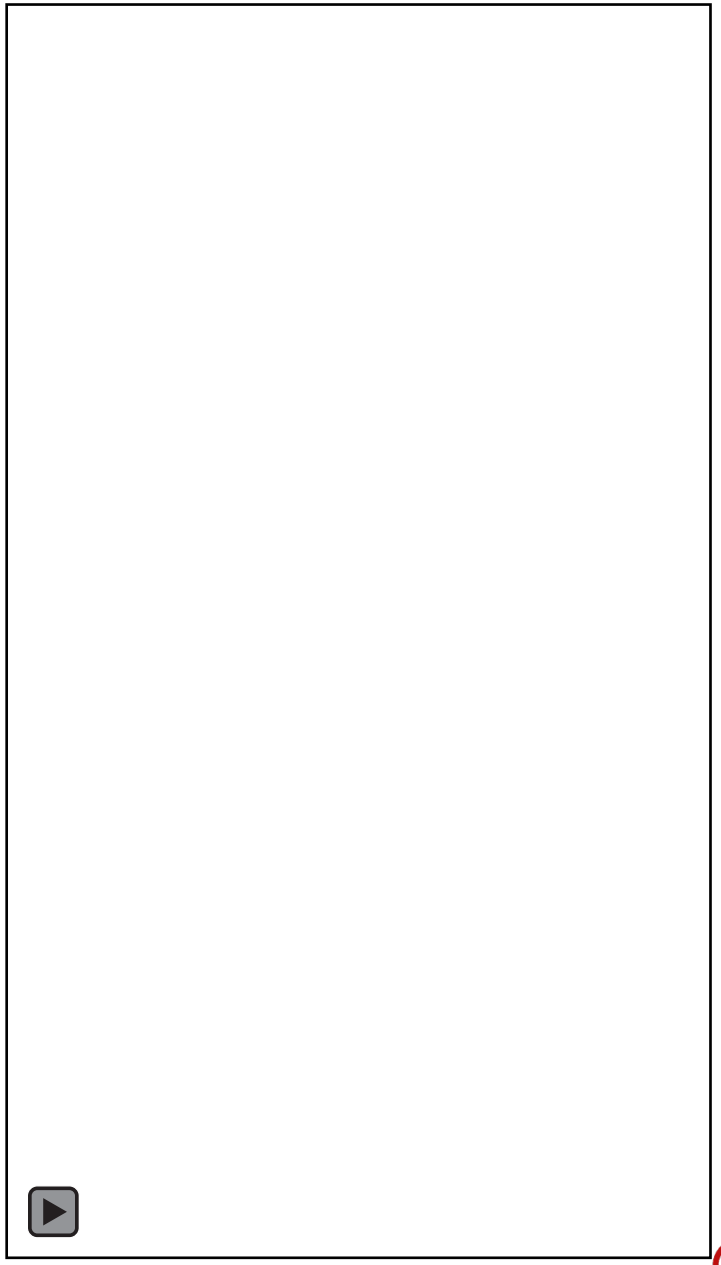




Utilizing AI Chatbots for LE8

Chat for Heart Health

Chat 4 Heart Health demo



Chat for Heart Health

OUTLINE

1. Study design of text messaging interventions
2. Texting infrastructure and design of messages
3. Evolution of text messaging to chatbot
4. **Who participates in text messaging trials**
5. Message engagement and results

NUDGE STUDY PARTICIPANT DEMOGRAPHICS

	Generic reminder texts	Behavioral texts	Behavioral + Chatbot texts	Usual Care
	N = 2324	N = 2305	N = 2319	N = 2321
Age	59.9 (12.5)	60 (12.9)	60.1 (12.7)	60.1 (12.6)
Sex				
Female	1087 (47%)	1075 (47%)	1101 (47%)	1088 (47%)
Male	1237 (53%)	1230 (53%)	1218 (53%)	1233 (53%)
Race				
American Indian or Alaska Native	22 (1%)	27 (1%)	23 (1%)	35 (2%)
Asian	29 (1%)	31 (1%)	21 (1%)	29 (1%)
Black or African American	391 (17%)	378 (16%)	356 (15%)	392 (17%)
Multiple	10 (0)	14 (1%)	16 (1%)	9 (0)
Native Hawaiian/Pacific Islander	3 (0)	2 (0)	6 (0)	3 (0)
White	1601 (69%)	1615 (70%)	1646 (71%)	1598 (69%)
Ethnicity				
Hispanic	1100 (47%)	1147 (50%)	1168 (50%)	1149 (50%)
Non-Hispanic	1204 (52%)	1141 (50%)	1134 (49%)	1150 (50%)
Preferred Spanish language communication	619 (27%)	650 (28%)	682 (29%)	654 (28%)
Marital				
Married	994 (43%)	940 (41%)	980 (42%)	950 (41%)
Single	883 (38%)	883 (38%)	870 (38%)	874 (38%)
Divorced/Widowed	434 (19%)	464 (20%)	452 (19%)	483 (21%)
Insurance				
Medicare	853 (37%)	878 (38%)	860 (37%)	889 (38%)
Medicaid	659 (28%)	632 (27%)	629 (27%)	665 (29%)
Commercial	463 (20%)	471 (20%)	500 (22%)	441 (19%)
VA	8 (0)	7 (0)	8 (0)	12 (1%)
None	218 (9%)	221 (10%)	192 (8%)	202 (9%)

NUDGE STUDY QUALIFYING CONDITIONS AND MEDICATIONS

	Generic reminder texts	Behavioral texts	Behavioral + Chatbot texts	Usual Care
Qualifying Condition(s)				
Hypertension	1837 (79%)	1829 (79%)	1821 (79%)	1864 (80%)
Diabetes	1148 (49%)	1164 (50%)	1162 (50%)	1149 (50%)
Hyperlipidemia	1072 (46%)	1052 (46%)	1089 (47%)	1054 (45%)
Coronary artery disease	305 (13%)	325 (14%)	352 (15%)	328 (14%)
Atrial fibrillation	132 (6%)	152 (7%)	130 (6%)	134 (6%)
>1 qualifying condition	1406 (60%)	1390 (60%)	1410 (61%)	1438 (62%)
Baseline Medication Classes				
Active Class(es)				
1	597 (26%)	564 (24%)	567 (24%)	557 (24%)
2	551 (24%)	572 (25%)	584 (25%)	591 (25%)
3+	1176 (51%)	1169 (51%)	1168 (50%)	1173 (51%)
Medication class(es) with refill gap				
1	1626 (70%)	1604 (70%)	1603 (69%)	1635 (70%)
2	449 (19%)	464 (20%)	455 (20%)	437 (19%)
3+	249 (11%)	237 (10%)	261 (11%)	249 (11%)
Intervention Delivery				
Text messages	2126 (91%)	2089 (91%)	2117 (91%)	0 (0)
Interactive voice response telephone messages	198 (9%)	216 (9%)	202 (9%)	0 (0)

Nudge

Chat 4 Heart Health Pilot Study Participant Demographics

	All	Control	AI Chat	AI Chat + Pharm	P-Value
	N = 87	N = 29	N = 29	N = 29	
Site					>0.99
Denver Health	30 (34%)	10 (34%)	10 (34%)	10 (34%)	
Salud	27 (31%)	9 (31%)	9 (31%)	9 (31%)	
Stride	30 (34%)	10 (34%)	10 (34%)	10 (34%)	
DEMOGRAPHICS					
Age - Mean (SD)	55.6 (11.1)	53 (11.8)	55.5 (9.8)	58.2 (11.4)	0.22
Gender					0.01
Female	51 (59%)	23 (79%)	16 (55%)	12 (41%)	
Male	36 (41%)	6 (21%)	13 (45%)	17 (59%)	
Race					0.04**
White	66 (76%)	20 (69%)	21 (72%)	25 (86%)	
Black	5 (6%)	0 (0%)	5 (17%)	0 (0%)	
Ethnicity					<0.001 **
Hispanic	77 (89%)	29 (100%)	20 (69%)	28 (97%)	
Non-Hispanic	10 (11%)	0 (0%)	9 (31%)	1 (3%)	

Chat for Heart Health

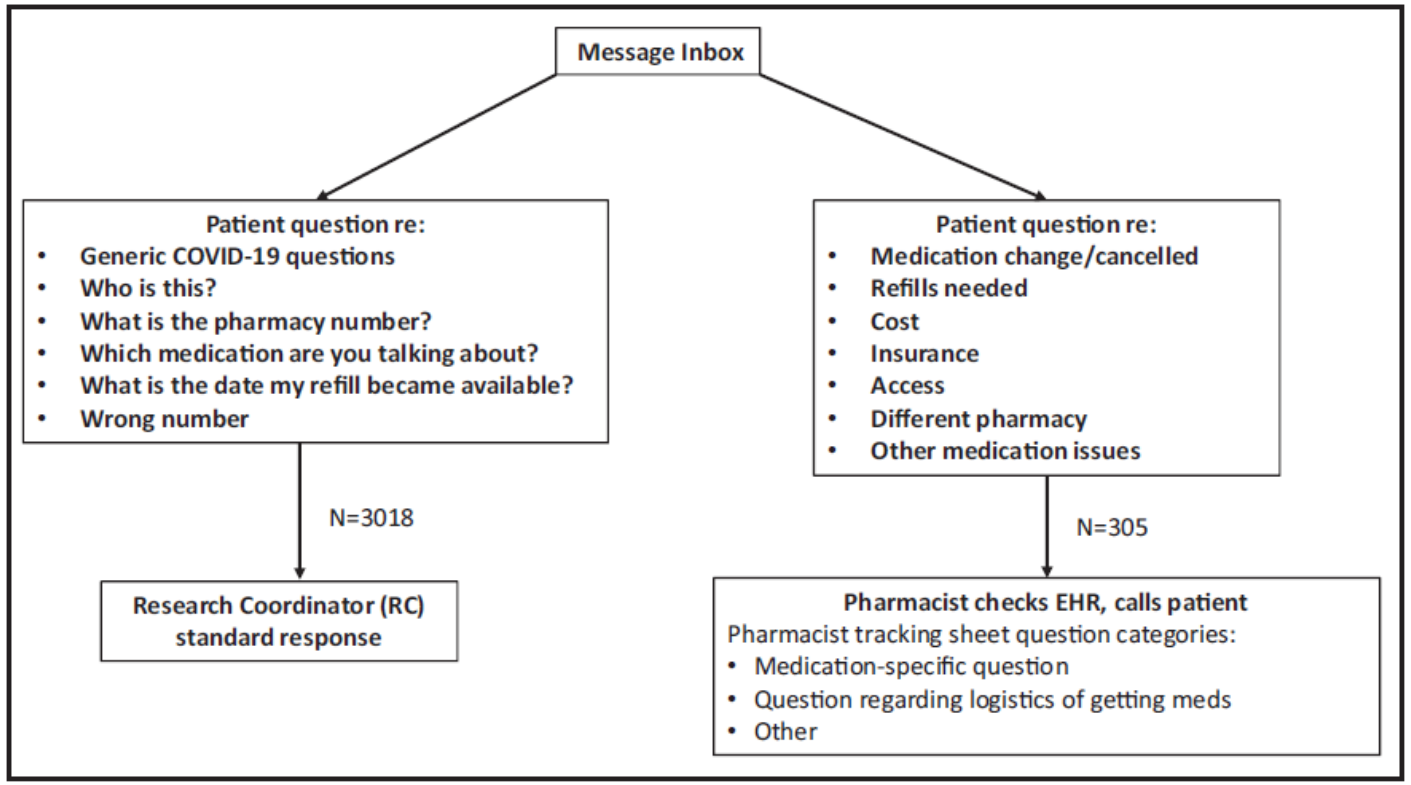
Chat 4 Heart Health Pilot Study Qualifying Conditions

QUALIFYING CONDITION	ALL	USUAL CARE	AI CHATBOT	CHATBOT + PHARM	P-VALUE
Diabetes					
N Eligible	54 (62%)	19 (66%)	16 (55%)	19 (66%)	0.64
HBA1c - Mean (SD)	9.8 (1.7)	9.9 (1.9)	10 (2.1)	9.6 (0.9)	0.75
HBA1c - Median (IQR)	9.4 (8.6, 10.5)	9.3 (8.5, 11.3)	9.2 (8.5, 10.3)	9.7 (8.8, 10.4)	
Hyperlipidemia					
N Eligible	25 (29%)	8 (28%)	9 (31%)	8 (28%)	0.95
Non-HDL - Mean (SD)	192 (71.6)	207.8 (52.8)	181.2 (79)	188.5 (85)	0.75
Non-HDL – Median (IQR)	209 (128, 245)	219.5 (192, 230)	197 (114, 245)	200.5 (124.2, 260.2)	
Hypertension					
N Eligible	17 (20%)	7 (24%)	5 (17%)	5 (17%)	0.75
Diastolic - Mean (SD)	90.2 (6.3)	88.4 (4)	90.8 (9.9)	95 (4.2)	0.46
Diastolic - Median (IQR)	91 (89, 92)	90 (87, 91)	94 (86.8, 98)	95 (93.5, 96.5)	
Systolic - Mean (SD)	158.8 (16.5)	166.2 (17.5)	160 (28.3)	149.6 (7)	0.27
Systolic - Median (IQR)	153 (146, 170)	168.5 (156.5, 171.5)	160 (150, 170)	147 (146, 151)	

Chat for Heart Health

OUTLINE

1. Study design of text messaging interventions
2. Texting infrastructure and design of messages
3. Evolution of text messaging to chatbot
4. Who participates in text messaging trials
5. **Message engagement and results**



9.2% of messages were clinical questions

PRACTICE RESEARCH REPORT

Description of patient questions received by clinical pharmacists in the Nudge Study

Nudge

PHARMACIST QUESTIONS RECEIVED FROM PATIENTS

Questions to Pharmacist Within Specified Question Categories by Study Arm

Study Arm	Generic	Optimized	Optimized + Chatbot	P-Value
	N = 63	N = 110	N = 132	
Multiple Questions	16 (25.4%)	18 (16.4%)	27 (20.5%)	0.35
Question Categories				
Cost	8 (12.7%)	6 (5.5%)	14 (10.6%)	0.21
Logistic	23 (36.5%)	42 (38.2%)	52 (39.4%)	0.93
Medication Specific	31 (49.2%)	54 (49.1%)	62 (47.0%)	0.54
Other	8 (12.7%)	19 (17.3%)	27 (20.5%)	0.41

Table 4. Examples of Questions/Responses to Pharmacist

Category	Examples
Cost	"I can't afford the medication right now"
	"I am waiting to get paid to pick up my next refill"
	"Can you check to see if my insurance covers the refill?"
	"What is the cost?"
	"I lost my insurance; can you help me with reapplying for insurance?"
Logistic	"Which pharmacy can I pick it up at?"
	"Is the medication filled already or do I need to order the refill?"
	"Can I get the medication at a different pharmacy than I usually do?"
	"Can I get the medication mailed to me?"
Medication specific	"Can I get refills on my other medications too?"
	"What is that medication for?"
	"I don't like taking that medication, is there a different medication option to take?"
	"I have plenty of that medication at home, why do I need to get a refill now?"
	"I stopped taking that medication, am I supposed to still be taking it?"
Other	"Can you help me get an appointment with my doctor?"
	"I want to switch clinics, how to I do that?"
	"Can you help me get some [laboratory tests] ordered?"
	"Can you help me get my medical insurance back?"

CONCLUSIONS

- Few questions directed to clinical pharmacists
- Patients randomized to optimized texts had more questions
- Questions related to medications, refill logistics and costs

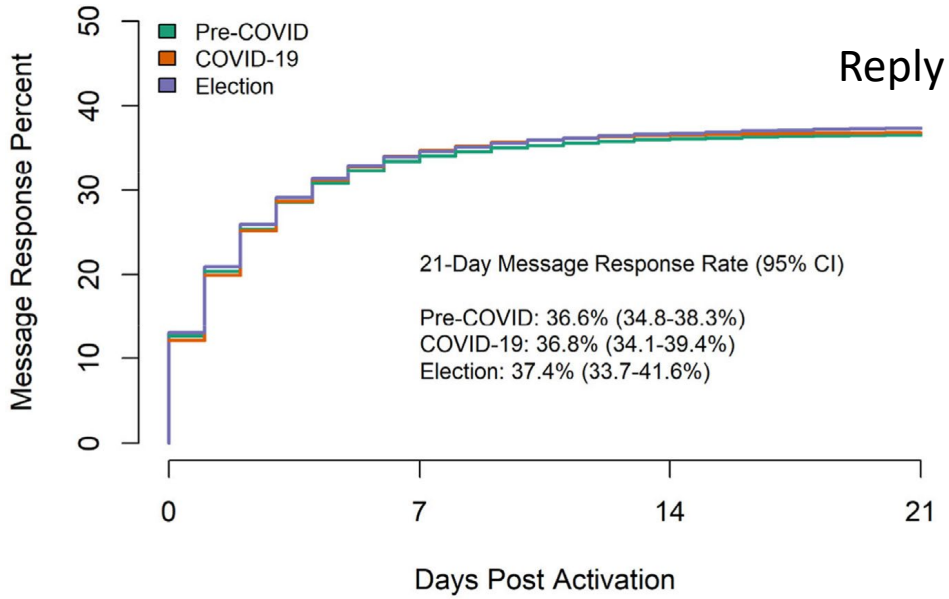
- We hypothesize that the optimized texts may have led to greater patient engagement and therefore more questions about their medications

Nudge

PATIENT ENGAGEMENT OVER TIME AND EVENTS

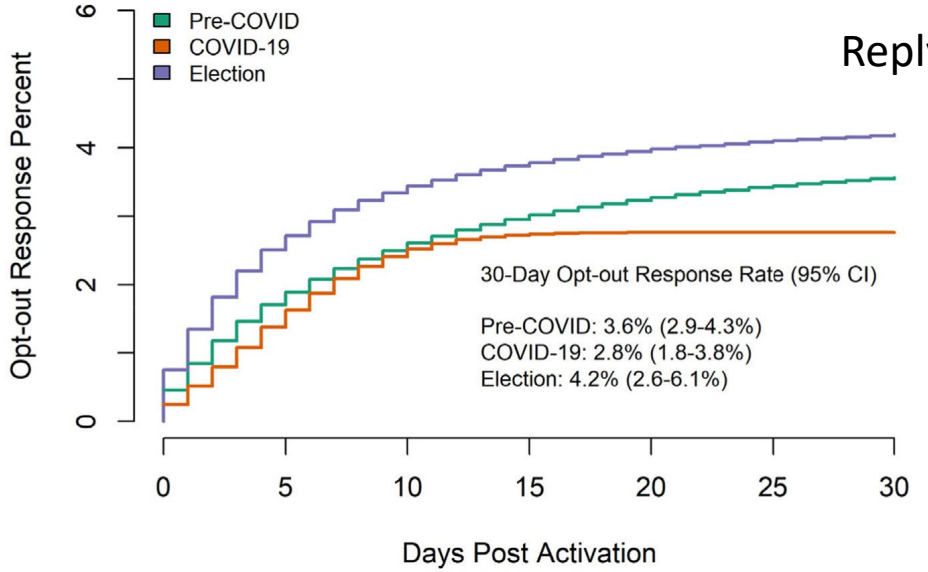
- Patients still engage and reply to text messages sent related to medication adherence despite major social events, notably the coronavirus disease 2019 (COVID-19) pandemic and the 2020 presidential election.
- Patient interaction with text messaging more likely related to ingrained behaviors than temporal societal factors.

Reply with “Done”



Time to patient text message response by time period (risk standardized). CI 5 confidence interval; COVID 5 coronavirus disease 2019.

Reply with “Stop”

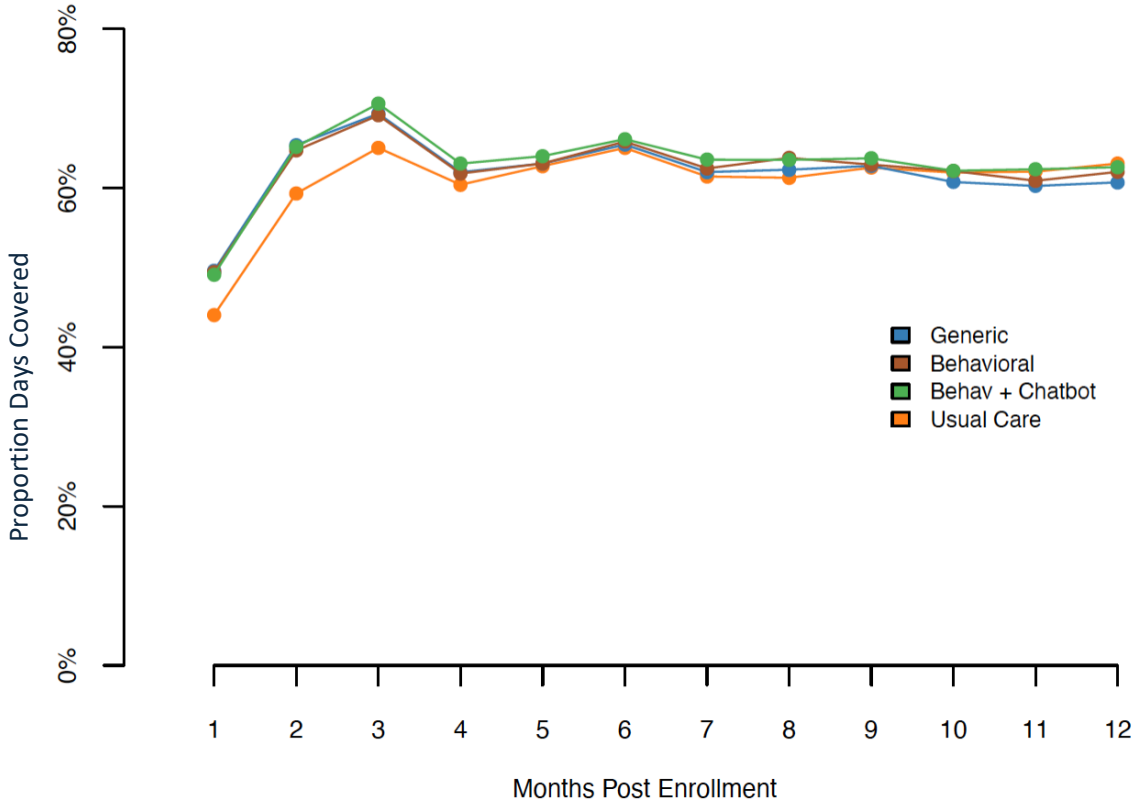


Time to patient opt-out by time period (risk standardized).

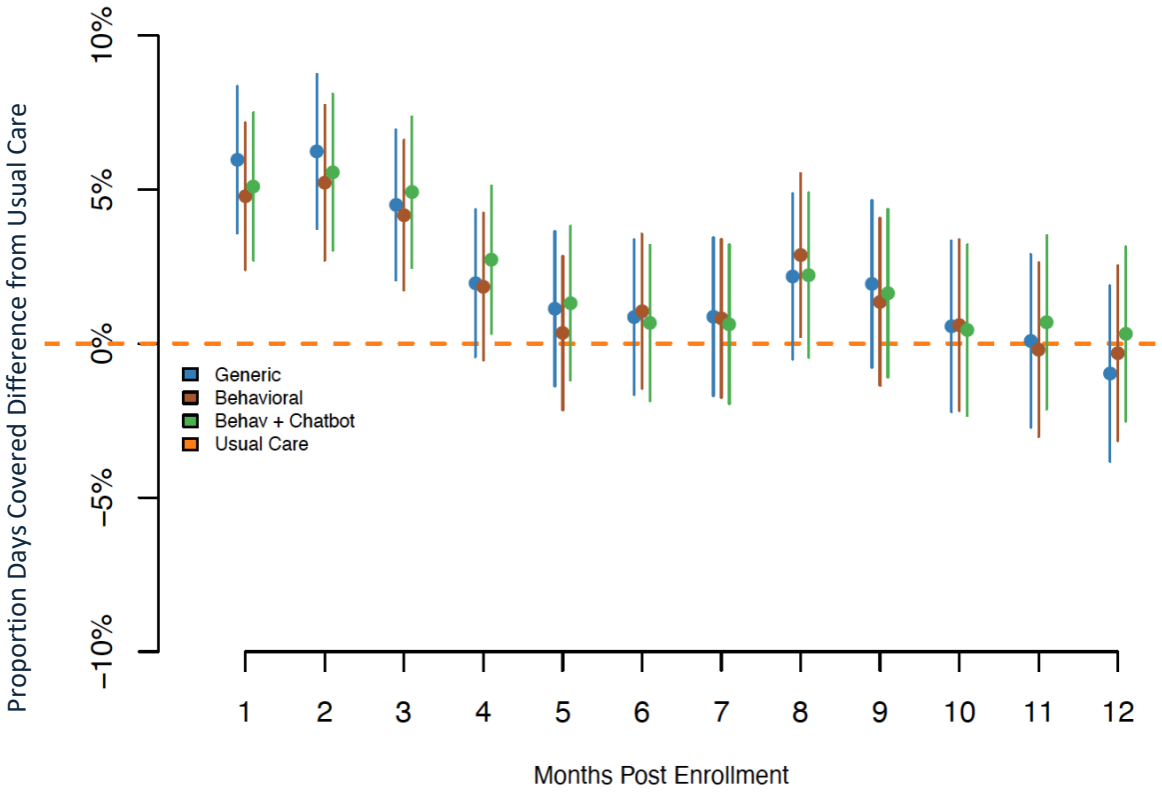
Nudge

NUDGE STUDY MAIN FINDINGS

Monthly proportion days covered stratified by treatment group



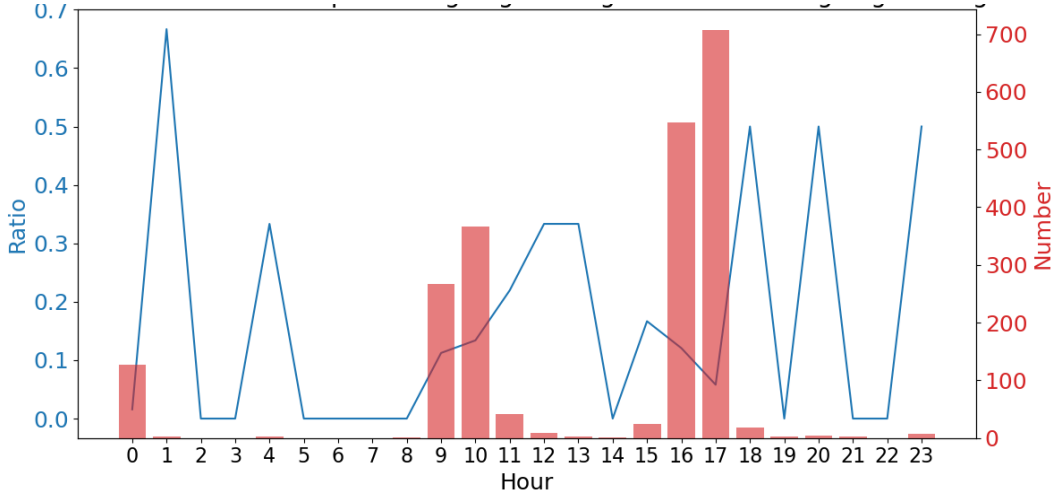
Adjusted difference in proportion days covered from Usual Care stratified by follow-up month



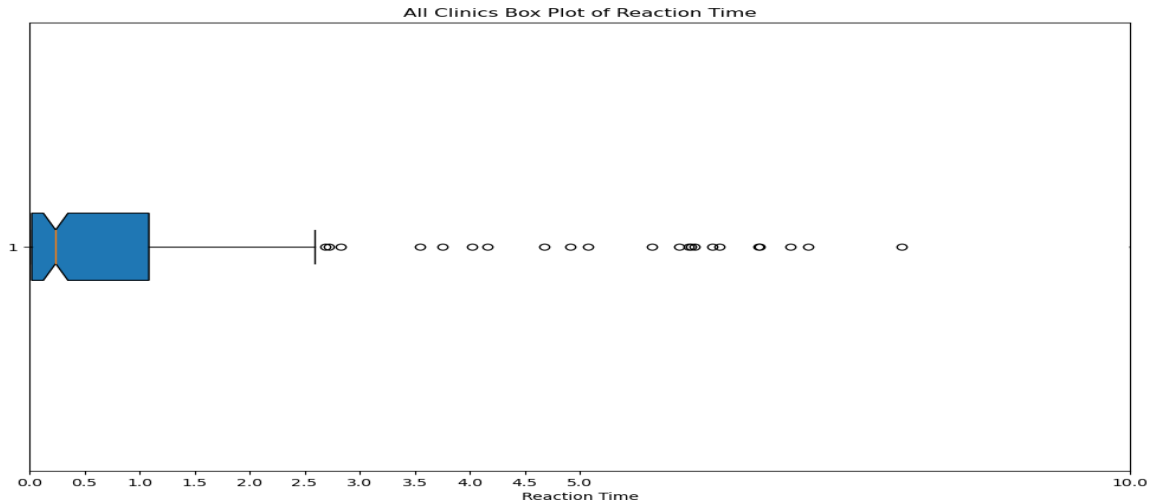
Nudge

CHAT 4 HEART HEALTH PILOT ENGAGEMENT DATA

Ratio of number of replied messages to total outgoing messages



Total # of outgoing messages



Reaction time: Time difference (in hours) between receipt of the outgoing message and incoming message

Chat for Heart Health

CHAT 4 HEART HEALTH UH3 ENGAGEMENT DATA

Top five topics with user-initiated messages	Number of user-initiated messages
Healthy Eating	297
Physical Activity	218
Manage Cholesterol	157
Quitting Smoking	154
Medication Management	149

- Total outgoing messages: 7,854
- Average outgoing messages per user: 50
- Total number of user-initiated messages: 1494
- Average number of user-messages: 21

Chat for Heart Health

CHAT 4 HEALTH UH3 ENGAGEMENT DATA

System challenges and solutions

- SHAFT legislation and phone carriers
- Message blocking by third party vendors

- Movement from Vonage to Twilio
- Whitelisting content

Chat for Heart Health

CONCLUSIONS

- New FCC regulations has impacted study design
- Challenge with text messaging interventions is assessing patient engagement with the messages
- Other text messaging interventions have demonstrated effectiveness in changing patient behavior
- Evolving innovations in technology-based communication are prompting new research questions
  - What is the efficacy of AI Chatbots?
    - What is the optimum intervention approach to using AI Chatbots?
  - How can we best motivate engagement with AI Chatbots?
  - How do we optimize use of new innovations while avoiding pitfalls (e.g., generative AI?)
  - How can we scale AI Chatbot systems, and what are the impacts at scale?