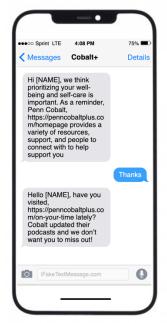
# **Supplemental Online Content**

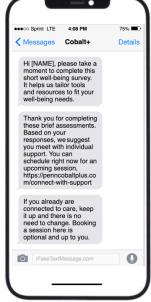
Agarwal AK, Southwick L, Gonzales RE, et al. Digital engagement strategy and health care worker mental health: a randomized clinical trial. *JAMA Netw Open*. 2024;7(5):e2410994. doi:10.1001/jamanetworkopen.2024.10994

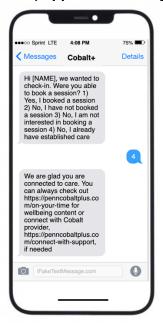
- **eFigure 1.** Monthly Automated Text Messages Associated With Mental Health and Penn Cobalt Resources And Mental Health Assessments (e.g., PHQ-9 and GAD-7) Appointment Triage Text Messages and Roles
- eFigure 2. Mental Health Assessments (e.g., PHQ-9 and GAD-7) Appointment Triage Messaging
- **eFigure 3.** Safety and Suicidality
- eFigure 4. Safety and Suicidality Findings
- eTable 1. GLM Model on Complete Cases: 6-Month GAD-7
- eTable 2. Anxiety and Depression Comparison With Imputed Data
- eTable 3. Well-Being Index Comparison With Observed Data
- eTable 4. WHO-5 Comparison With Observed Data
- eTable 5. Leaps Comparison With Observed Data
- eTable 6. GEE With AR(1)

This supplemental material has been provided by the authors to give readers additional information about their work.

### eFigure 1. Monthly automated text messages related to mental health and Penn Cobalt resources and mental health assessments (e.g., PHQ-9 and GAD-7) appointment triage text messages.







### eFigure 2. Mental health assessments (e.g., PHQ-9 and GAD-7) appointment triage messaging

# PHQ9<10 AND GAD7 < 10

- Thank you for completing these brief assessments. Your responses suggest that meeting with 1:1 support could be helpful. There are sessions open today and later this week, URL
- · If you already are connected to care, keep it up and there is no need to change. Booking a session here is optional and up to you.

### PHO9>10 and <19 AND GAD7 > 10 and < 19

- Thank you for completing these brief assessments. Based on your responses, we suggest you meet with individual support. You can schedule right now for an upcoming session, URL
- If you already are connected to care, keep it up and there is no need to change. Booking a session here is optional and up to you.

#### Severe PHQ9 >19 OR GAD7 >19

- Thank you for completing the brief assessments. Based on your responses, you need individual support. You can schedule right now for an upcoming session, URL. Please remember to sign into Cobalt to see their offerings.
- If you are in crisis or having thoughts of suicide or feel unsafe, reply with "A" for 24/7 confidential and free crisis
- [If A] Please go to your nearest emergency room or visit one of these 24/7 confidential and free services: • Penn Crisis Response Center: call 215-829-5433
- National Suicide Prevention Line: call 988
- · Crisis Text Line: text HOME to 741 741 or https://www.crisistextline.org

# PHQ9, Q9 > 0

- Hello PARTICIPANT FIRSTNAME. thank you for completing these brief assessments. Based on your responses, you will receive a phone call from the Penn Behavioral Health Services team within 1 business dav.
- Please remember, this number is not a crisis response line. If you in crisis or are having thoughts of suicide or feel unsafe, please go to your nearest emergency room or visit one of these 24/7 confidential and free services: • Penn Crisis Response Center: call 215-829-5433 National Suicide Prevention
- Line: call 988
- · Crisis Text Line: text HOME to 741 741 or https://www.crisistextline.org/

Hi [NAME], we wanted to check-in. Were you able to book a session?

- A. Yes, I booked a session
  - [If A] Glad to hear
- B. No. I have not booked a session [If B] You can schedule right now for an upcoming appointment, URL. Please remember to sign into Cobalt to see their offerings. Need help booking an appointment? If yes, text Y.
- C. No, I am not interested in booking a session
- [If C] Not a problem. Could you tell us why not?
- D. No, I already have established care
  - [If D] We are glad you are connected to care. You can always check out URL for wellbeing content or connect with Cobalt provider, URL, if needed. Please remember to sign into Cobalt to see their offerings.

Hi [NAME], we wanted to check in. Were you able to speak to someone from the Penn Behavioral Health Services team / EAP?

A. Yes

B. No

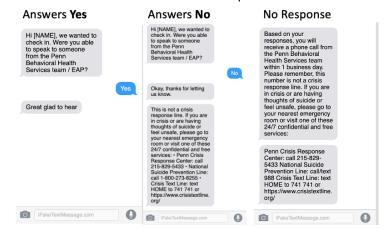
### eFigure 3. Safety and Suicidality

### **Participant Facing**

Participant expresses SI and immediately receives resources

Based on your responses, you will responses, you will receive a phone call from the ca

After 72 hours, all participants receive a follow-up text message and tailored resources based on their response



2). EAP providers logs into Penn Cobalt platform for user information

### **Employee Assistance Provider (EAP) Internal Workflow**

1). EAP receives email alert



## eFigure4. Safety and Suicidality findings

212 surveys (5.2%) screened positive for Suicide Ideation (SI)\* \*completed by 164 participants 59.9% (n=127 participants) assessed for self-harm 40.0% (n=85 participants) were not assessed by Penn's Employee Assistance Program (EAP) for self-harm by EAP 2 patients unenrolled after expressing suicide ideation: 8 of 85 (9.4%) 57 of 85 (67%) 18 of 85 one was assessed by EAP participants have not responded to a (21%) one was not assessed but engaged in study study text used study responded to a study text activities (i.e., have not message or compensat message used compensation or completed a ion after SI responded to study text study survey messages) after SI

eTable 1. GLM model on complete cases: 6-month GAD-7

Variables	β (95% CI)	P value
Arm assignment	-0.67 (-1.13, -0.16)	0.01
Baseline GAD-7 score	0.60 (0.55, 0.65)	<.0001
Age	-0.01 (-0.03, 0.01)	0.29
Female	0.44 (-0.24, 1.13)	0.20
Race-Ethnicity		
Asian	-0.34 (-1.24, 0.55)	0.45
Black	0.17 (-0.41, 0.76)	0.56
Other	-0.06 (-1.38, 1.25)	0.92
White	0	
Hispanic	0.48 (-0.64, 1.60)	0.40
Married or with partner	0.08 (-0.43, 0.59)	0.76

Participant Roles

Role	Control (%)	Intervention (%)	Total (%)
Nurses	210 (50)	206 (50)	416 (33)
Physicians & Advance Practice Providers	85 (49)	89 (51)	174 (14)
Technicians (lab, pharmacy, radiology)	71 (47)	80 (53)	151 (12)
Registration Staff	54 (44)	68 (56)	122 (10)
Hospital and Outpatient Support (unit clerk, patient coordinator)	58 (50)	58 (50	116 (9)
Clinical Research	38 (47)	43 (53)	81 (6)
Food and Environmental Services	33 (55)	27 (45)	60 (5)
Medical Assistants	22 (51)	21 (49)	43 (3)
Therapists (occupational, physical, speech, respiratory, nutritionist)	23 (52)	21 (48)	44 (3)
Social Work and Behavioral Health	13 (43)	17 (57)	30 (2)
Pharmacists	26 (68)	12 (32)	38 (3)
Total	633	644	1,275

eTable 2. Anxiety and Depression Comparison with Imputed Data Paired t-test & arm comparison for GAD7, using imputed data

	Control	Intervention	Total	Difference	P Value
# of participants	633	642	1275		
GAD7_bl, mean (std)	5.79 (4.77)	6.03 (4.88)	5.91 (4.83)	0.24 (-0.29,0.77)	0.3723
6-month					
GAD7_6m, mean (std)	5.57 (5.34)	5.07 (4.97)	5.32 (5.40)	-0.50 (-1.04, 0.04)	0.0686
6-month change, mean (std)	-0.22 (4.71)	-0.96 (4.65)	-0.59 (4.96)	-0.74 (-1.23, -0.26)	0.0027
6-month change, 95% CI	(-0.59, 0.15)	(-1.32, -0.60)	(-0.87, -0.32)		
Paired t-test P-value	0.2418	<.0001	<.0001		
9-month					
GAD7_9m, mean (std)	4.95 (4.81)	4.32 (4.74)	4.63 (4.69)	-0.62 (-1.16, -0.08)	0.0237
9-month change, mean (std)	-0.85 (4.71)	-1.71 (4.48)	-1.28 (4.51)	-0.86 (-1.38, -0.34)	0.0012
9-month change, 95% CI	(-1.21, -0.48)	(-2.06, -1.36)	(-1.53, -1.03)		
Paired t-test P-value	<.0001	<.0001	<.0001		

# Paired t-test & arm comparison for PHQ9, using imputed data

	Control	Intervention	Total	Difference	P Value
# of participants	633	642	1275		
PHQ9_bl, mean (std)	5.71 (4.74)	5.92 (5.19)	5.81 (4.97)	0.21 (-0.34, 0.76)	0.4514
6-month					
PHQ9_6m, mean (std)	5.40 (5.36)	4.81 (5.56)	5.10 (5.22)	-0.60 (-1.23, 0.04)	0.0649
6-month change, mean (std)	-0.31 (4.84)	-1.11 (5.54)	-0.71 (4.96)	-0.81 (-1.41, -0.20)	0.01
6-month change, 95% CI	(-0.69, 0.07)	(-1.55, -0.68)	(-0.99, -0.44)		
Paired t-test P-value	0.1137	<.0001	<.0001		
9-month					
PHQ9_9m, mean (std)	5.02 (4.88)	4.28 (5.04)	4.64 (4.91)	-0.74(-1.29, -0.19)	0.0086
9-month change, mean (std)	-0.69 (4.42)	-1.64 (4.77)	-1.17 (4.55)	-0.95(-1.46, -0.44)	0.0003
9-month change, 95% CI	(-1.04, -0.35)	(-2.01, -1.27)	(-1.42, -0.92)		
Paired t-test P-value	<.0001	<.0001	<.0001		

eTable 3: Well Being Index Comparison with Observed Data

	Control	Intervention	Total	Difference	P Value
# of participants	633	642	1275		
WBI9_bl, mean (std)	2.70 (2.33)	2.72 (2.23)	2.71(2.28)	0.02 (-0.23, 0.27)	0.896
6-month					
# of non-missing records	528	484	1012		
WBI9_bl, mean (std)	2.70 (2.32)	2.64 (2.22)	2.67 (2.27)	-0.06 (-0.34, 0.22)	0.6815
WBI9_6m, mean (std)	2.24 (2.30)	2.05 (2.34)	2.15 (2.32)	-0.19 (-0.48, 0.10)	0.1912
6-month change, mean (std)	-0.46 (2.14)	-0.59 (2.20)	-0.52 (2.17)	-0.13 (-0.40, 0.14)	0.332
6-month change, 95% CI	(-0.64, -0.27)	(-0.79, -0.39)	(-0.65, -0.39)		
Paired t-test P-value	<.0001	<.0001	<.0001		
9-month					
# of non-missing records	498	473	971		
WBI9_bl, mean (std)	2.66 (2.34)	2.66 (2.25)	2.66 (2.29)	0.00 (-0.29, 0.29)	0.9956
WBI9_9m, mean (std)	2.14 (2.26)	1.72 (2.34)	1.94 (2.30)	-0.42 (-0.71, -0.13)	0.0043
9-month change, mean (std)	-0.52 (2.15)	-0.95 (2.43)	-0.73 (2.30)	-0.42 (-0.71, -0.13)	0.0043
9-month change, 95% CI	(-0.71, -0.33)	(-1.16, -0.73)	(-0.87, -0.58)		
Paired t-test P-value	<.0001	<.0001	<.0001		

eTable4: WHO-5 Comparison with Observed Data

	Control	Intervention	Total	Difference	P Value
# of participants	633	642	1275		
WHO5_bl, mean (std)	13.13 (5.33)	13.10 (5.26)	13.12 (5.29)	-0.03 (-0.61, 0.56)	0.9323
6-month					
# of non-missing records	508	461	969		
WHO5_bl, mean (std)	13.08 (5.36)	13.11 (5.24)	13.10 (5.30)	0.03 (-0.63, 0.70)	0.92
WHO5_6m, mean (std)	13.88 (5.23)	14.15 (5.43)	14.01 (5.33)	0.27 (-0.40, 0.95)	0.4246
6-month change, mean (std)	0.80 (4.67)	1.03 (4.61)	0.91 (4.64)	0.24 (-0.35, 0.83)	0.4228
6-month change, 95% CI	(0.39, 1.20)	(0.61, 1.46)	(0.62, 1.20)		
Paired t-test P-value	0.0001	<.0001	<.0001		

eTable 5: Leaps Comparison with Observed Data

	Control	Intervention	Total	Difference	P Value
# of participants	633	642	1275		
LEAPS_bl, mean (std)	4.43 (4.00)	4.51 (4.28)	4.47 (4.14)	0.08 (-0.38, 0.53)	0.7366
6-month					
# of non-missing records	517	473	990		
LEAPS_bl, mean (std)	4.44 (4.01)	4.43 (4.34)	4.44 (4.17)	-0.01 (-0.53, 0.52)	0.983
LEAPS_6m, mean (std)	5.25 (4.08)	4.94 (4.34)	5.10 (4.20)	-0.31 (-0.84, 0.21)	0.2428
6-month change, mean (std)	0.81(4.29)	0.51 (4.64)	0.67 (4.46)	-0.31 (-0.86, 0.25)	0.28
6-month change, 95% CI	(0.44, 1.19)	(0.09, 0.93)	(0.39, 0.95)		
Paired t-test P-value	<.0001	0.0178	<.0001		
9-month					
# of non-missing records	494	467	961		
LEAPS_bl, mean (std)	4.40 (3.94)	4.45 (4.28)	4.43 (4.11)	0.05 (-0.47, 0.57)	0.8535
LEAPS_9m, mean (std)	5.15 (4.30)	4.17 (3.93)	4.67 (4.15)	-0.97 (-1.50, -0.45)	0.0003
9-month change, mean (std)	0.74 (4.62)	-0.28 (4.12)	0.25 (4.41)	-1.02 (-1.58, -0.47)	0.0003
9-month change, 95% CI	( 0.33, 1.15)	(-0.65, 0.09)	(-0.03, 0.52)		
Paired t-test P-value	0.0004	0.1416	0.0848		

eTable 6: GEE with AR(1)

Correlation	structure : Independe	nt						Correlation st	ructure : Autoregre	ssive					
CEE	on complete cases : (	24 D7						CEE adal au	complete cases : (	24 D7					
GEE model	on complete cases : C	3A D1						GEE model on	complete cases : C	JA DI					
outcome	parameter	Level1	Level2	Estimate	LowerCL	UpperCL	P value	outcome	parameter	Level1	Level2	Estimate	LowerCL	UpperCL	P value
GAD7	Intercept			7.6576	6.5991	8.7161	<.0001	GAD7	Intercept			7.6385	6.6114	8.6656	<.0001
GAD7	arm	1		0.2471	-0.2697	0.7639	0.3486	GAD7	arm	1		0.2485	-0.2681	0.7651	0.3457
GAD7	arm	0		0	0	0		GAD7	arm	0		0	0	0	
GAD7	time	6m		-0.2266	-0.5897	0.1364	0.2211	GAD7	time	6m		-0.2347	-0.5729	0.1035	0.1738
GAD7	time	9m		-0.941	-1.3352	-0.5467	<.0001	GAD7	time	9m		-0.9222	-1.2942	-0.5502	<.0001
GAD7	time	bl		0	0	0		GAD7	time	bl		0	0	0	
GAD7	arm*time	1	6m	-0.8003	-1.3594	-0.2411	0.005	GAD7	arm*time	1	6m	-0.7889	-1.3122	-0.2656	0.0031
GAD7	arm*time	1	9m	-0.9211	-1.4704	-0.3719	0.001	GAD7	arm*time	1	9m	-0.8723	-1.3932	-0.3514	0.001
GAD7	arm*time	1	bl		0	0		GAD7	arm*time	1	pl	0	0	0	
GAD7	arm*time	0		0		0		GAD7	arm*time	0	6m	0	0	0	
GAD7	arm*time	0	9m	0		0		GAD7	arm*time	0	9m	0	0	0	
GAD7	arm*time	0	bl	0	0	0		GAD7	arm*time	0	bl	0	0	0	
GAD7	age			-0.0674	-0.0888	-0.046	<.0001	GAD7	age			-0.0687	-0.0897	-0.0476	<.0001
GAD7	female			1.1288	0.4906	1.7671	0.0005	GAD7	female			1.2174	0.6062	1.8286	<.0001
GAD7	race_cat	Asian		-0.9581	-1.7119	-0.2043	0.0127	GAD7	race_cat	Asian		-0.8811	-1.6056	-0.1566	0.0171
GAD7	race_cat	Black		-0.3279	-0.9004	0.2445	0.2616	GAD7	race_cat	Black		-0.3033	-0.8688	0.2621	0.293
GAD7	race_cat	Other		0.0271	-1.2087	1.2628	0.9658	GAD7	race_cat	Other		-0.0991	-1.2557	1.0575	0.8666
GAD7	race_cat	White		0	0	0	-	GAD7	race_cat	White		0	0	0	
GAD7	hispanic			0.2795	-0.9205	1.4795	0.648	GAD7	hispanic			0.339	-0.7897	1.4678	0.5561
GAD7	married_or_partner			-0.1092	-0.5882	0.3697	0.6549	GAD7	married_or_partner			-0.1398	-0.6081	0.3285	0.5585
										-					
GEE model	on complete cases : F	HO						GEE model on	complete cases : F	HO					
OLL III OUE	T	1100						OLL III OUE! OII	Complete cases . I	1100					
outcome	parameter	Level1	Level2	Estimate	LowerCL	UpperCL	P value	outcome	param <i>e</i> ter	Level1	Level2	Estimate	LowerCL	UpperCL	P value
PHQ9	Intercept			7.078	6.0048	8.1512	<.0001	PHQ9	Intercept			7.1471	6.101	8.1931	<.0001
PHQ9	arm	1		0.2186	-0.32	0.7573	0.4263	PHQ9	arm	1		0.221	-0.3175	0.7594	0.4212
PHQ9	arm	0		0	0	0		PHQ9	arm	0		0	0	0	
PHQ9	time	6m		-0.3866	-0.7685	-0.0048	0.0472	PHQ9	time	6m		-0.3284	-0.6878	0.031	0.0733
PHQ9	time	9m		-0.8239	-1.2286	-0.4192	<.0001	PHQ9	time	9m		-0.7522	-1.1366	-0.3678	0.0001
PHQ9	time	bl		0	0	0		PHQ9	time	bl		0	0	0	
PHQ9	arm*time	1	6m	-0.8778	-1.4468	-0.3087	0.0025	PHQ9	arm*time	1	6m	-0.9104	-1.4522	-0.3687	0.001
PHQ9	arm*time	1	9m	-1.042	-1.6125	-0.4715	0.0003	PHQ9	arm*time	1	9m	-1.07	-1.6153	-0.5248	0.0001
PHQ9	arm*time	1	bl	0	0	0		PHQ9	arm*time	1	bl	0	0	0	-
PHQ9	arm*time	0	6m	0	0	0		PHQ9	arm*time	0	6m	0	0	0	
PHQ9	arm*time	0		0		0		PHQ9	arm*time	0	9m	0	0	0	
PHQ9	arm*time	0				0		PHQ9	arm*time	0	bl	0	0	0	
PHQ9	age			-0.043	-0.065	-0.0209	0.0001	PHQ9	age			-0.0457	-0.0674	-0.0241	<.0001
PHQ9	female			0.7914	0.1559	1.4268	0.0146	PHQ9	female			0.8823	0.2603	1.5043	0.0054
PHQ9	race cat	Asian		-0.8548	-1.6263	-0.0833	0.0299	PHQ9	race cat	Asian		-0.6951	-1.4813	0.0912	0.0832
PHQ9	race cat	Black		-0.2558	-0.8429	0.3313	0.3931	PHQ9	race cat	Black		-0.2489	-0.8331	0.3354	0.4039
PHQ9	race cat	Other		0.3904	-1.036	1.8169	0.5916	PHQ9	race cat	Other		0.1954	-1.1532	1.5441	0.7764
PHQ9	race cat	White		0		0		PHQ9	race cat	White		0	0	0	
PHQ9	hispanic			0.5321	-0.7427	1.8069	0.4133	PHQ9	hispanic			0.4325	-0.7581	1.6231	0.4765
	-			-0.5055		-0.0104		PHQ9				-0.576	-1.0642	-0.0879	0.0207
PHQ9	married_or_partner			-0.5055	-1.0005	-0.0104	0.0454	PHQ9	married_or_partner			-0.576	-1.0642	-0.0879	