A Systems+IT Approach to Accelerate Adoption of Depression Care in Safety-Net Diabetes Clinics: A Comparative Effectiveness Trial

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September 19, 2013

ACKNOWLEDGEMENTS

- U.S. Department of Health and Human Services
- Los Angeles County Department of Health Services
- Study participating sites and patients
- DCAT team at USC, R&I of LACDHS, and 4PatientCare

Overview

- Objectives:
  - Demonstrate a Systems+IT Approach to Accelerate Adoption of Depression Care Management
  - Present findings of a comparative effectiveness trial "DCAT" to test the intervention
  - Discuss prospects of Systems+IT Approach to deliver better and safer healthcare at lower cost

Poll Question #1

- What is your primary role in VA?
  - student, trainee, or fellow
  - clinician
  - researcher
  - manager or policy-maker
  - Other

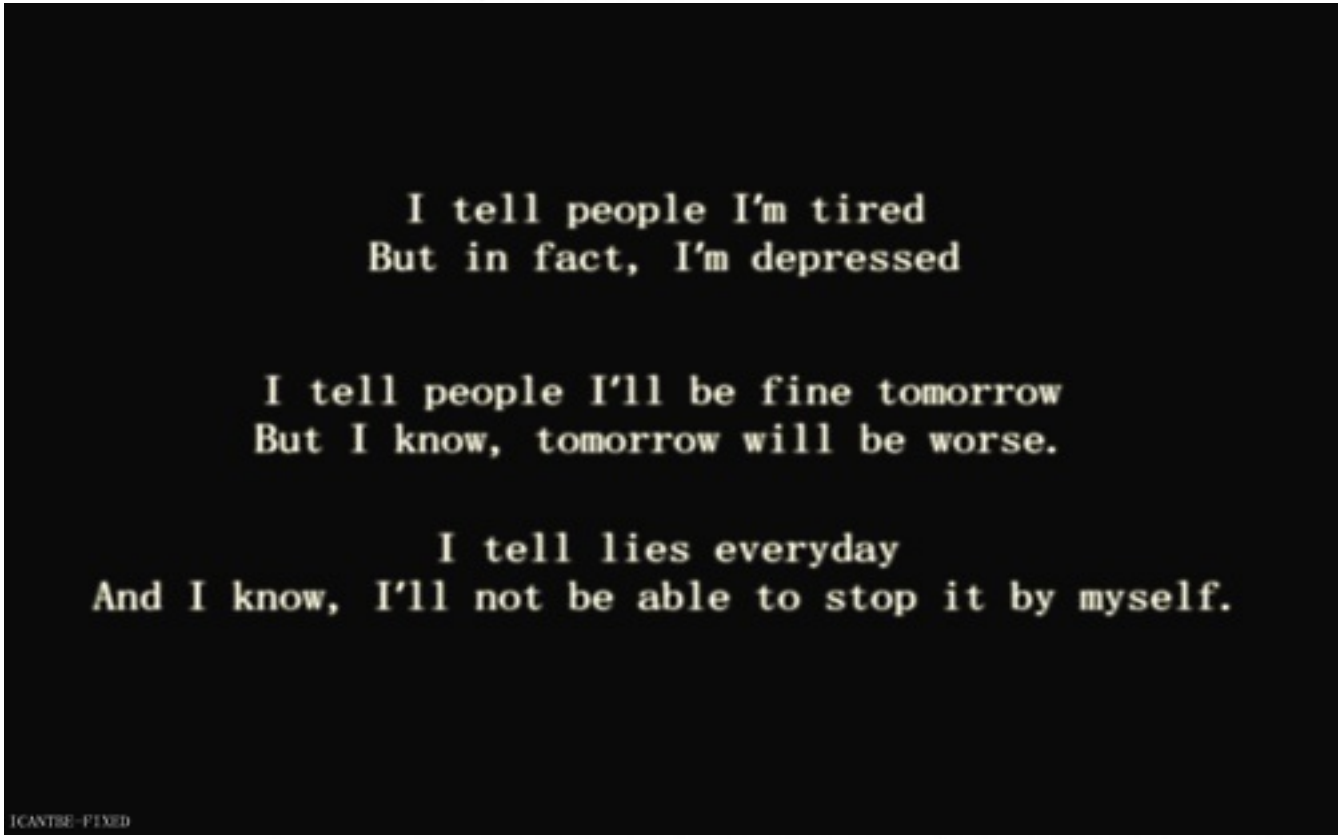
Poll Question #2

- Which best describes your experience in *health services* research?
  - I have not done health services research
  - I am involved in health services research in VA settings
  - I am involved in health services research outside VA settings
  - I am involved in health services research both outside and in VA settings

Poll Question #3

- Which best describes your experience in *depression care*? [Select all that apply]
  - My work is not related to depression care
  - I am involved in primary care for people with depression
  - I am part of the collaborative depression care team
  - I am involved in mental health services
  - I am involved in research related to depression care

Suffering in Silence



Adopted from http://www.healthshire.com/93-depression-quotes/

Significance of Treating Depression

- Depression is a common comorbidity in primary care, affecting 16% of adults in the United States[1]
  - impairs patient functional status
  - worsens clinical outcomes
  - increases healthcare cost
- The economic burden of depressive disorders is estimated to be $83.1 billion
- A significant public health challenge is sub-optimal identification and treatment of clinically significant depression among *low-income minority* patients.[2]

Depression and Diabetes

- The odds of comorbid depression in patients with Diabetes Mellitus (type 2 diabetes) doubles that in the non-diabetic population[3].
- Among low-income minority diabetes population, 1 in 3 patients are suffering from major depressive disorder[4].

Evidence-based Depression Care Practices

- Screening adults for depression when staff-assisted depression care supports are in place (U.S. Preventive Services Task Force, 2009)
- An adaptive treatment approach with periodic monitoring is needed to find successful choices of antidepressant medication (American College of Physicians, 2008)[5]
- Team-based collaborative depression care model is effective[6]

Barriers of Adopting and Sustaining Evidence-based Depression Care

- Patient barriers
  - Patient preference, cultural perceptions, and socio-economic barriers[7]
- Provider/organizational barriers[8]
  - use of psychotherapy
  - increased workload for clinic staff
  - delay in receiving outcomes data
  - lack of resources to sustain the program

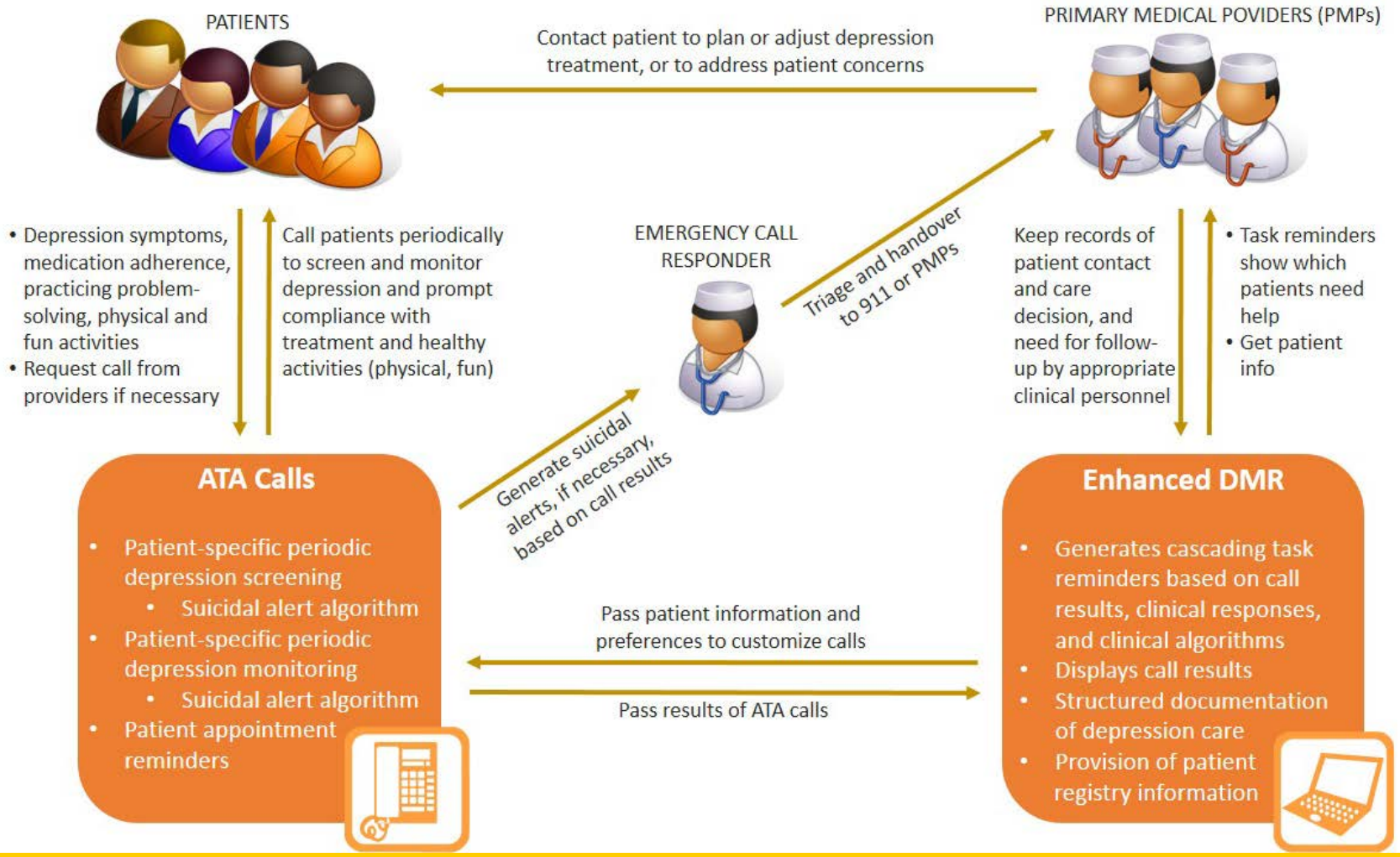
Poll Question #4

- Which of the following is required for sustainable adoption of collaborative depression care by organizational decision-makers and providers [Select all that apply]
  - Provider access to easily applied treatment guidelines
  - treatment consistent with patient preferences
  - technologies to facilitate information exchange between primary care physicians and depression care providers
  - technologies to facilitate routine monitoring of patient depression symptoms and treatment adherence and satisfaction

A Healthcare Systems Engineering Approach

- Diabetes-Depression Care-management Adoption Technology (DCAT) is an innovative fully automated telephonic assessment and remote monitoring (ATA) call system
  - periodic screening and monitoring
  - treatment adherence tracking
  - relapse prevention
  - identification of patient unmet needs
- The assessed data were integrated with an enhanced disease management registry (DMR) for automated provider notification, tasking, and emergency alerts

The DCAT Schema



Automated Telephonic Assessment Call Modules

- ✓ PHQ (PHQ-2 or PHQ-9)
- ✓ Pain
- ✓ Activity
- ✓ Psychotherapy
- ✓ Antidepressant Adherence
- ✓ Patient call request

PATIENT HEALTH QUESTIONNAIRE (PHQ-9)

Language: ◯ English ◯ Spanish Date: 8/3/2011

Over the last 2 weeks, how often have you been bothered by any of the following problems *(click in box to indicate your answer)*

Question	Not at all (0 point)	Several days (1 point)	More than half the days (2 points)	Nearly every day (3 points)
1. Little interest or pleasure in doing things	☐	☐	☐	☐
2. Feeling down, depressed, or hopeless	☐	☐	☐	☐
3. Trouble falling or staying asleep, or sleeping too much	☐	☐	☐	☐
4. Feeling tired or having little energy	☐	☐	☐	☐
5. Poor appetite or overeating	☐	☐	☐	☐
6. Feeling bad about yourself - or that you are a failure or have let yourself or your family down	☐	☐	☐	☐
7. Trouble concentrating on things, such as reading the newspaper or watching television	☐	☐	☐	☐
8. Moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual	☐	☐	☐	☐
9. Thoughts that you would be better off dead, or of hurting yourself in some way	☐	☐	☐	☐
	Add columns:	0	0	0

Total:

DCAT Antidepressant Adherence Module

Module 5

1. Has anyone prescribed a medication for depression for you?

2. Do you have the medication?

If yes, go to the next question. Otherwise, skip to question 4

3. How many days in the past week did you take the medication?

4. Are you having any problems taking this medication, or having any side effect that bothers you?

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ATA integrates patient clinical information to trigger calls

Data from Disease Management Registry (DMR) to intelligent interactive messaging solution system (updated daily)

DCAT Enrollment

- MRUN
- Clinic
- Patient name, DOB, Address
- Patient telephone number, best call time and day, do not call time and day
- Language (English, Spanish)
- PIN selection (y/n), PIN number
- DCAT enrollment date
- Baseline PHQ-9 score
- DCAT status (active, graduated, declined, dismissed, invalid phone#, deceased)

ASR Call Decision Table

- **DCAT Baseline** PHQ-9 ≥8 (y/n)
- **DMR Clinician** assessed PHQ-9 ≥8 in the past 6 months (y/n)
- **ASR Call** PHQ-9 ≥8 in the past 6 months (y/n)
- **DCAT Baseline** currently taking antidepressant (y/n)
- **DMR** Prescribed antidepressant in the past 6 months (y/n)

Yes to at least one item

No to ALL Qs

- Received **psychotherapy** in the past 6 months (y/n) — **Yes**
- **DMR** Currently prescribed antidepressant (y/n) — **Yes**

ATA input includes patient preferences:

Data from Disease Management Registry (DMR) to intelligent interactive messaging solution system (updated daily)

DCAT Enrollm

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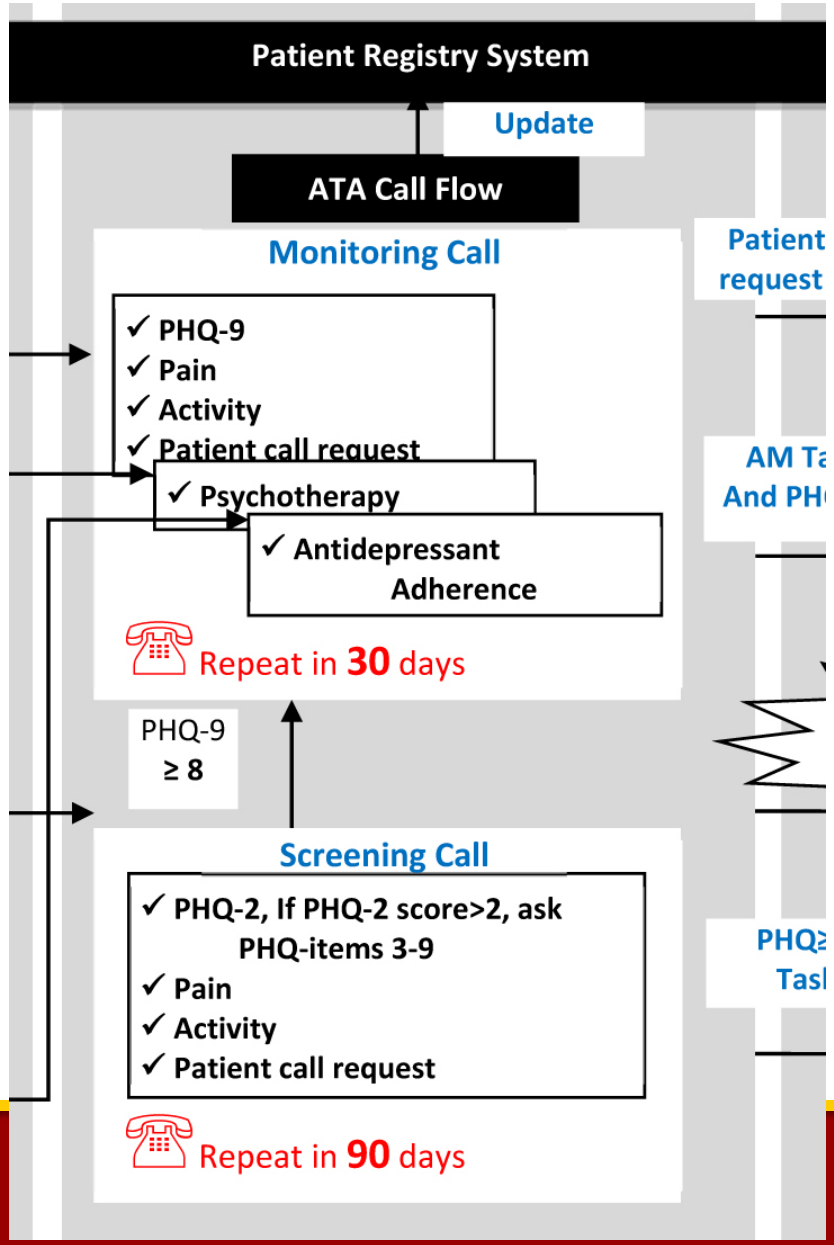
No to ALL Qs

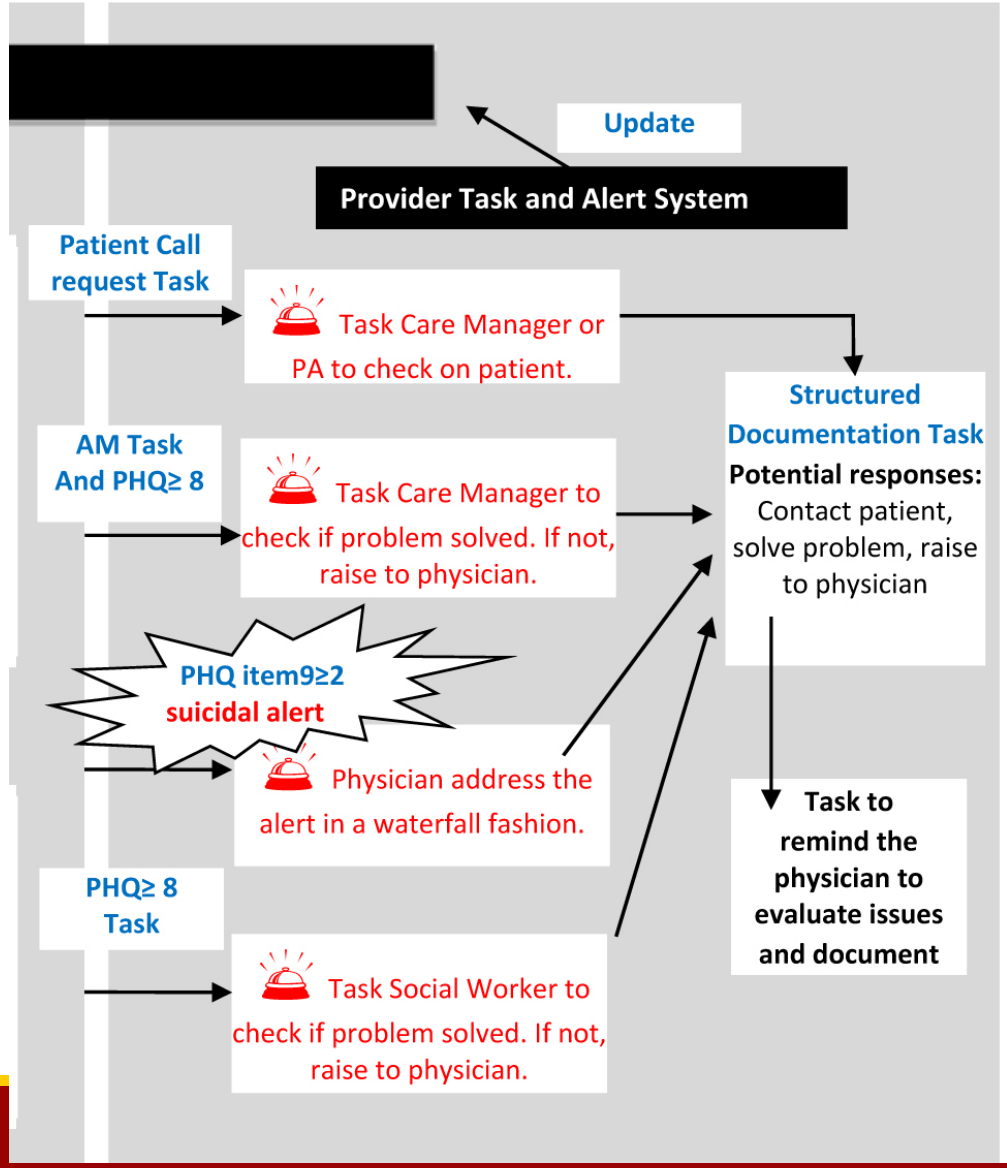
Received **psychotherapy** in the past 6 months (y/n) — **Yes**

DMR Currently prescribed antidepressant (y/n) — **Yes**

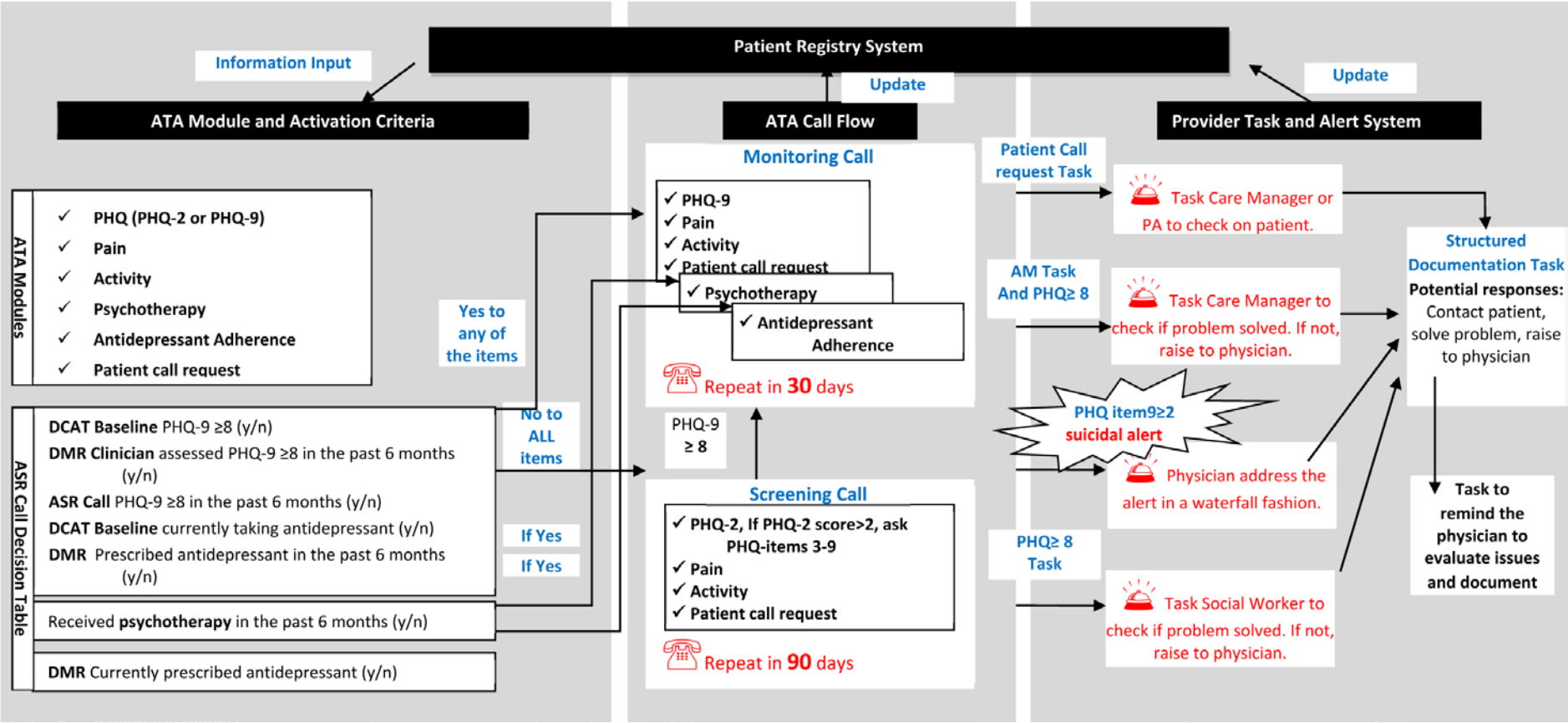
ATA calls are patient-specific and dynamic



ATA calls notify providers to take actions



Automated Telephonic Assessment System Design



DCAT Provider Task Examples

| Lookup | Patients | ESS Access | Reports | Resources | MedRecon Access | Sign Out |

Program: DCAT-Technology Enhanced

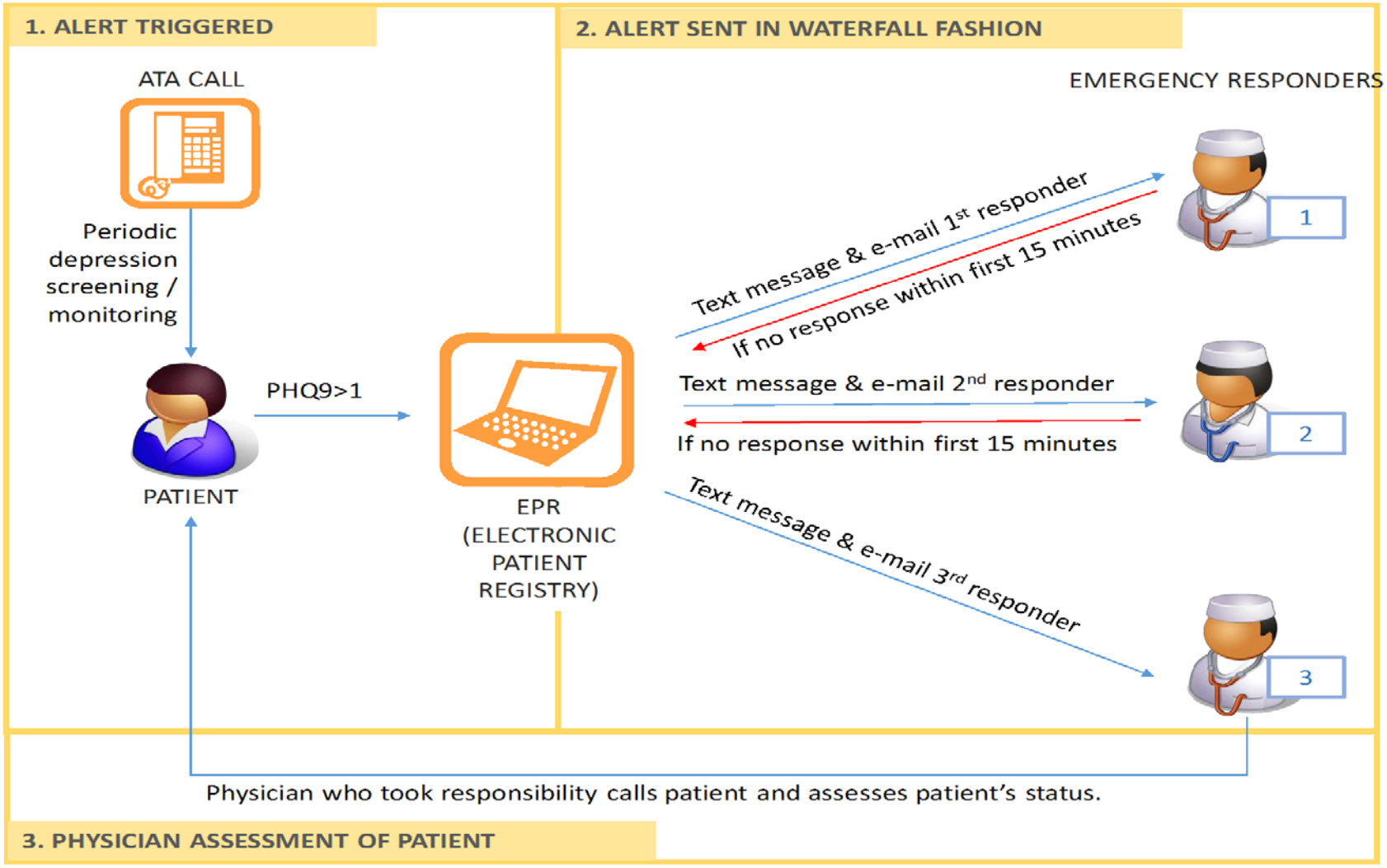
Tasks: Due + Overdue

Task Complete

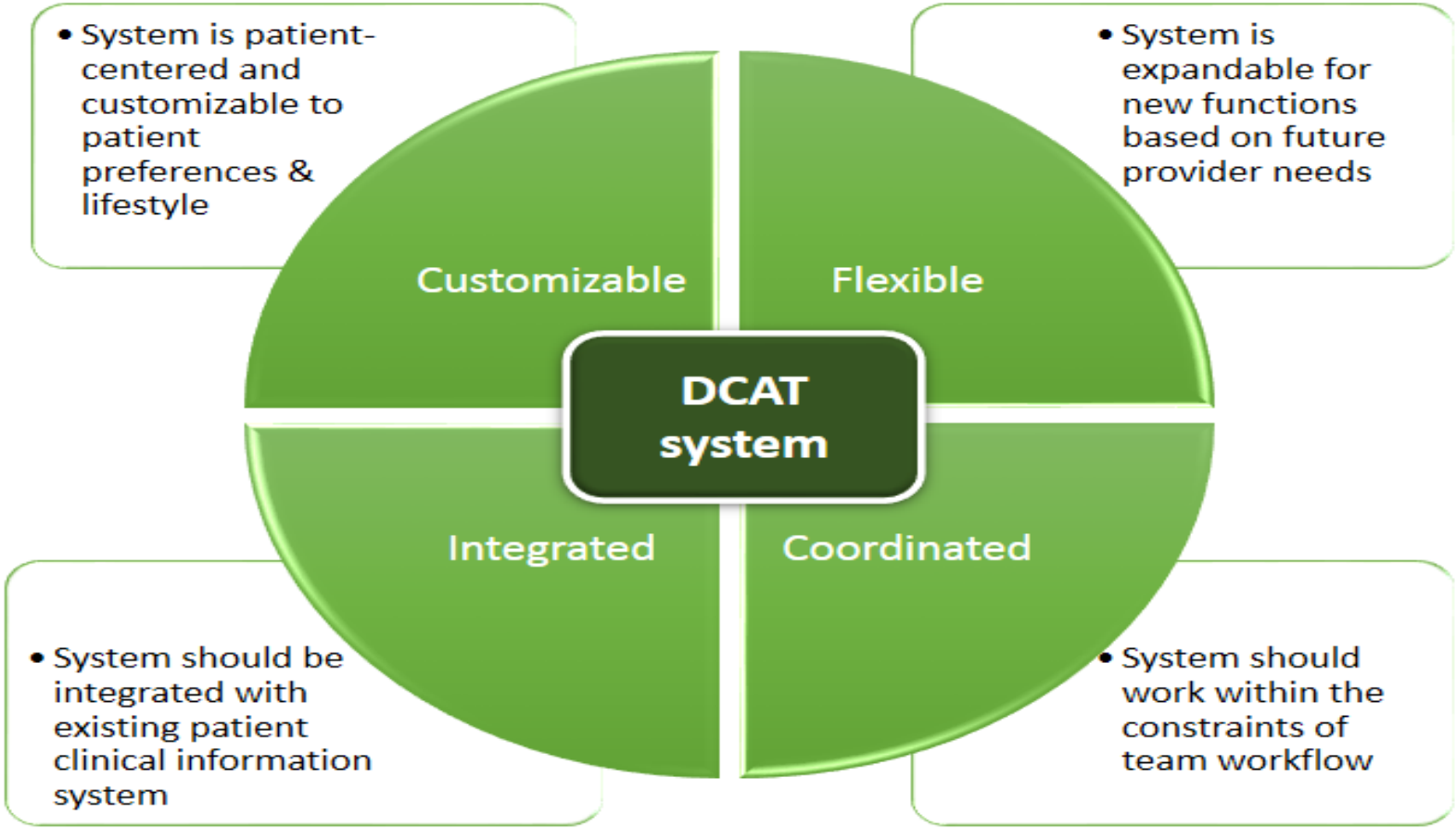
Drag a column header here to group by that column

#		Stage	Days	Group	Task	MRUN	Name	Assigned
	☐	Overdue	231	Call patient to complete PHQ	PA - PHQ incomplete in DCAT ASR call. Contact patient to complete all PHQ questions.	[redacted]	[redacted]	10/11/2011
	☐	Overdue	231	Call patient to complete PHQ	PA - PHQ incomplete in DCAT ASR call. Contact patient to complete all PHQ questions.	[redacted]	[redacted]	10/11/2011
	☐	Overdue	189	Depression issue unresolved	SW - Address depression concerns.	[redacted]	[redacted]	11/22/2011
	☐	Overdue	147	High PHQ score	SW - Contact patient to discuss concerns relating to depression.	[redacted]	[redacted]	1/3/2012

DCAT Alert System



Systems Engineering Principles



DCAT Implementation

- Quality assurance testing was conducted before and throughout the implementation of the system.
- Issues included
  - Wrong assignment of tasks
  - Missing log-in credentials for some providers
  - Suboptimal documentation of task completion
- We added or modified features of the system based on feedback during implementation.

Implementation Results

- In the period 10/19/2011 – 1/9/2013
  - 2899 outgoing calls were made
  - 1100 tasks were generated
- The majority of tasks generated had been processed
  - Average task processing time were longer than anticipated, most of the lengthy processing times occurred in the beginning of the study
- 32 alerts from 22 patients over 15 months

Feasibility Evaluation of DCAT

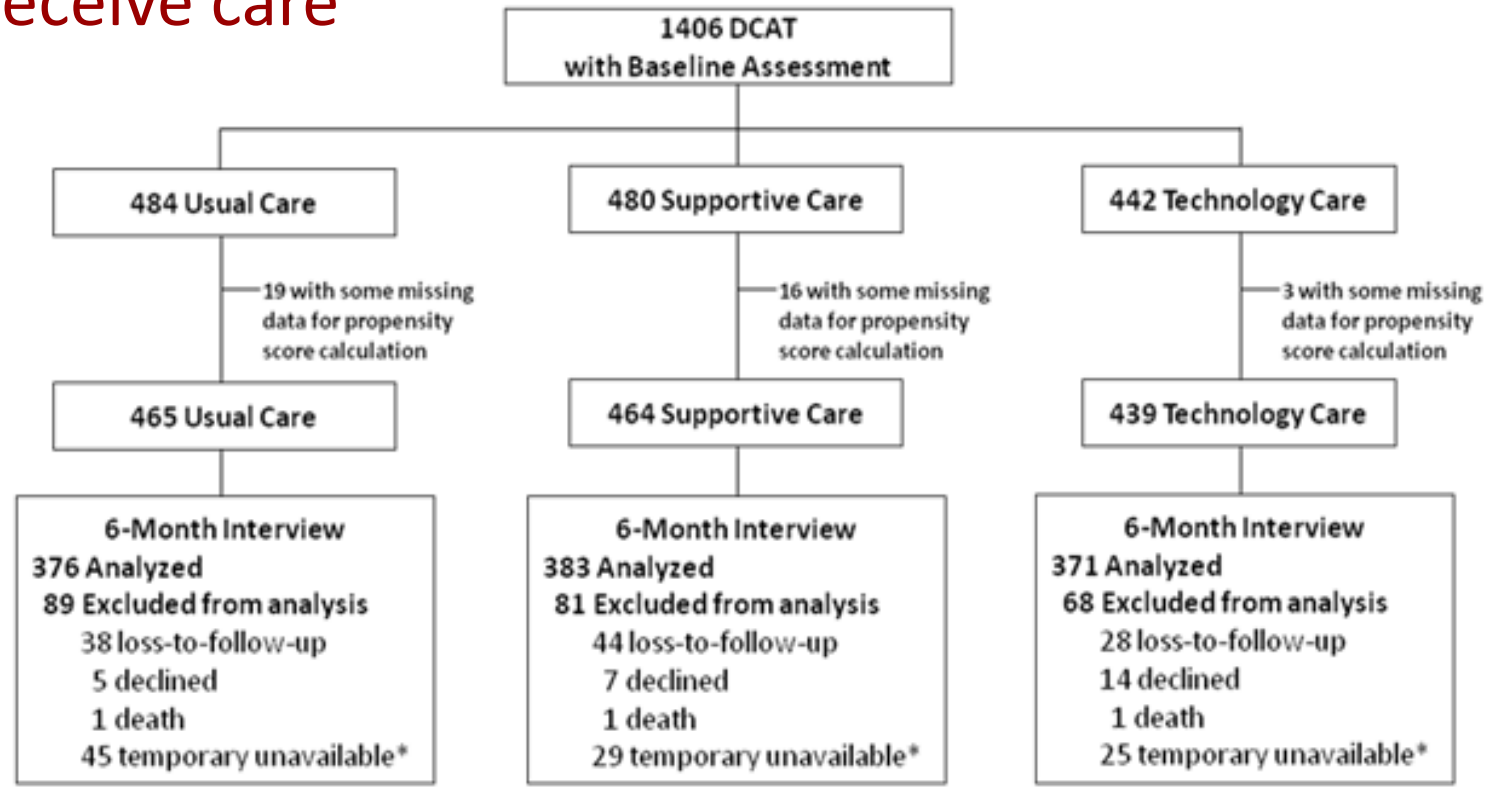
- During the initial 10 months of implementation
  - 51.6% calls are completed
  - 79.7% patients had completed at least one assessment.
  - Assessment completion rate is not correlated with PHQ scores
  - The system captured, on average, 98.5 percent of the voice or touchtone responses.
  - Pairwise comparison showed PHQ scores from ATA calls are indifferent from those obtained by clinicians or recruiters.

Evaluate Effectiveness of DCAT

- A quasi-experimental comparative effectiveness trial was conducted
- Three programs are compared
  - Usual Care (UC)
  - Supported Care (SC): clinics with disease management program (DMP)
  - Technology Care (TC): DMP+DCAT
- About 1400 patients with Diabetes were enrolled from 8 primary care safety net clinics in the Los Angeles county
- The recruitment had a 92% acceptance rate. The majority (about 65%) were women and Spanish-speaking (about 83%). The baseline depression rate is 28.8%.

DCAT Comparative Effectiveness Trial

- Patients are assigned according to the locations they receive care



* Out of state/country, not a good time to talk, phone disconnected, etc.

Methods: Data Collection

- Data were collected for each ATA call and registry tasks
- All patients were interviewed at baseline, 6-, and 12-months follow-up to assess depression symptoms, diabetes symptoms, comorbid conditions, health status, functional status, self-care behaviors, stress, and satisfaction with care
- Healthcare utilization data (clinic visits, ER visit, hospitalizations, prescriptions, and lab tests) were obtained from electronic medical records

Balance Check of Selected Baseline Variables

	Arms (Exact or Mean Value)			Group Comparison p-value		
Characteristics	UC	SC	TC	UC vs. SC	UC vs. TC	SC vs. TC
Female	63%	69%	59%	0.002	0.02	0.46
Age	55.04	52.09	52.57	<0.0001	<0.0001	0.42
Preferred Language – Spanish	89%	78%	82%	<0.001	0.003	0.16
Onset Age of Diabetes	45.01	41.84	42.23	<0.0001	<0.0001	0.57
On Insulin	26%	63%	63%	<0.0001	<0.0001	0.84
SF Physical Score	43.04	45.81	43.95	0.0001	0.21	0.01
SF Mental Score	50.05	49.03	50.49	0.23	0.58	0.10
PHQ-9	6.67	6.93	6.37	0.50	0.43	0.17

An Extended PSM for Multiple Comparisons

STEP 1: Define Generalized Propensity Score

↓

STEP 2: Estimate Generalized Propensity Scores

↓

STEP 3: Predict Program Effects

Define Generalized Propensity Score

- Propensity score
  - the probability that a patient is likely to receive treatment given the patient's covariates
- Generalized Propensity Score[9-13]
  - the conditional probability of receiving a particular treatment given the pre-treatment variables
- In DCAT study, the generalized propensity scores were interpreted as the probabilities that a patient is likely to be in UC, SC, or TC arms respectively given this patient's baseline characteristics

Estimate Generalized Propensity Score

- All empirically important baseline variables that may influence outcomes were used in the estimation of generalized propensity score.
- In DCAT study, 25 clinically important baseline characteristics were used.
  - 10 demographic variables such as age, gender, etc.
  - 15 health status variables such as diabetes onset age, PHQ-9, chronic pain, etc.

Predict Program Effects

- 6 continuous and 4 binary outcomes were selected to evaluate effectiveness of DCAT

Outcome	Description
Continuous	
PHQ-9	Severity of depression
Diabetes Self Care	Number of days per week of self care
SF Mental Score	Overall mental health status
SF Physical Score	Overall physical health status
Satisfaction in Healthcare Available to You for Your Diabetes	Overall care satisfaction
Satisfaction in Help Received with Emotional Problem	Overall mental care satisfaction
Binary	
PHQ-9 ≥ 10	Threshold of clinical depression
≥50% PHQ Score Reduction	Depression treatment effect
Satisfied to Very Satisfied in Health Care for Diabetes	Dichotomous indicator of care satisfaction for diabetes
Satisfied to Very Satisfied in Help Received with Emotional Problem	Dichotomous indicator of overall mental care satisfaction

Linear Regression Analysis Results

M1: Outcome_6_Mon ~ Arm + Outcome_Baseline + Team + Insulin_0

Outcome	TC	SC	UC
PHQ-9 Score	-1.34 (0.01)	-0.88 (0.07)	
Diabetes Self Care			
SF Mental Score			
SF Physical Score			
Satisfaction in Healthcare Available to You for Your Diabetes	0.24 (0.01)		
Satisfaction in Help Received with Emotional Problem	0.25 (0.02)	0.38 (<0.01)	

M1_PS: model M1 plus propensity scores

Outcome	TC	SC	UC
PHQ-9 Score	-1.38 (0.01)	-1.38 (0.01)	
Diabetes Self Care			
SF Mental Score			
SF Physical Score			
Satisfaction in Healthcare Available to You for Your Diabetes	0.21 (0.03)		
Satisfaction in Help Received with Emotional Problem	0.26 (0.02)	0.42 (<0.01)	

Coefficient (p-value) — Significant Improvement at alpha=0.05

Coefficient (p-value) — Insignificant Effect

Coefficient (p-value) — Significant Negative Effect at alpha=0.05

Logistic Regression Analysis Results

M1: Outcome_6_Mon ~ Arm + Outcome_Baseline + Team + Insulin_0

Outcome	TC	SC	UC
PHQ≥10	-1.04 (<0.01)	-0.48 (0.1)	
≥50% PHQ Score Reduction		0.34 (0.11)	
Satisfied to Very Satisfied in Health Care for Diabetes	1.04 (<0.01)	0.73 (0.01)	
Satisfied to Very Satisfied in Help Received with Emotional Problem	0.51 (0.04)	0.94 (<0.01)	

M1_PS: model M1 plus propensity scores

Outcome	TC	SC	UC
PHQ ≥10	-1.11 (<0.01)	-0.76 (0.02)	
≥50% PHQ Score Reduction		0.51 (0.03)	
Satisfied to Very Satisfied in Health Care for Diabetes	1.01 (<0.01)	0.85 (0.01)	
Satisfied to Very Satisfied in Help Received with Emotional Problem	0.56 (0.03)	0.97 (<0.01)	

Coefficient (p-value) — Significant Improvement at alpha=0.05

Coefficient (p-value) — Insignificant Effect

Coefficient (p-value) — Significant Negative Effect at alpha=0.05

Summary of CER Results

- Both SC and TC significantly improve depression outcomes
- Only TC significantly improve overall patient satisfaction
- Neither SC nor TC were significant in improving diabetes self care
- Results are different by including propensity scores as variables in prediction model

Discussion

- DCAT demonstrates an example of applying Systems+IT approach to facilitate adoption of depression care management in safety-net primary care settings
  - Through patient ATA calls and enhanced disease registry for provider notification, tasking, and alerting
  - Augment diabetes-depression care management

Discussion

- Is Systems+IT approach a promising solution for better care at lower cost?
  - Many industries use technology to automate standardized protocols, producing highly reliable and easily scalable results that better achieve the consumer's desired results.
  - However, healthcare has not yet benefited from this application of technology.
  - Automation of processes of care can improve quality and provide patient-centered solutions for chronic diseases in an efficient, economical manner, even as enrolled populations are set to expand dramatically
  - More research is needed to understand, design, test, and evaluate Systems+IT approach

Systems Approach to Health: A working definition[14]

A systems approach to health is one that applies scientific insights to understand the elements that influence health outcomes; models the relationships between those elements; and alters design, processes, or policies based on the resultant knowledge in order to produce better health at lower cost

Reference

1. Egede, L. E., Zheng, D., & Simpson, K. (2002). Comorbid depression is associated with increased health care use and expenditures in individuals with diabetes. Diabetes Care, 25(3), 464-470.
2. Ani, C., Bazargan, M., Hindman, D., Bell, D., Rodriguez, M., & Baker, R. S. (2009). Comorbid chronic illness and the diagnosis and treatment of depression in safety net primary care settings. J Am Board Fam Med, 22(2), 123-135. doi: 10.3122/jabfm.2009.02.080035
3. Anderson, R.J., Freedland, K.E., Clouse, R.E., Lustman, P.J. (2001). The prevalence of comorbid depression in adults with diabetes: A meta-analysis. Diabetes Care, 24(6), 1069-1078. doi: 10.2337/diacare.24.6.1069
4. Ell, K., Katon, W., Cabassa, L.J., Xie, B., Lee, P. J., Kapetanovic, S., Guterman, J. (2009). Depression and diabetes among low-income Hispanics: Design elements of a socio-culturally adapted collaborative care model randomized controlled trial. The International Journal of Psychiatry in Medicine, 39(2), 113-132. doi: 10.2190/PM.39.2.a
5. Qaseem, A., Snow, V., Denberg, T.D., Forciea, M.A., Owens, D.K. (2008). Using second-generation antidepressants to treat depressive disorders: A clinical practice guideline from the American College of Physicians. Annals of Internal Medicine, 149(10), 725-733. doi:10.7326/0003-4819-149-10-200811180-00007
6. Katon, W. Unutzer, J., Wells, K., Jones, L. (2010). Collaborative derpession care: History, evolution and ways to enhance dissemination and sustainability. General Hospital Psychiatry, 32(5), 456-464.

Reference

7. Bell, R. A., Franks, P., Duberstein, P. R., Epstein, R. M., Feldman, M. D., Fernandez y Garcia, E., & Kravitz, R. L. (2011). Suffering in silence: reasons for not disclosing depression in primary care. *Ann Fam Med, 9*(5), 439-446. doi: 10.1370/afm.1277
8. Palinkas, L.A., Ell, K., Hansen, M., Cabassa, L., Wells, A. (2010). Sustainability of collaborative care interventions in primary care settings. Journal of Social Work, 11(1), 99-117. doi: 10.1177/1468017310381310
9. Imbens G (2000) The role of the propensity score in estimating dose-response functions. Bimetrika 87(3): 706–710.
10. Caliendo M and Kopeinig S (2008) Some practical guidance for the implementation of propensity score matching. Journal of Economic Surveys 22(1): 31–72.
11. Pasta D (2000) Using propensity scores to adjust for group differences: Examples comparing alternative surgical methods. 25th Annual SAS Users Group International Conference, Indianapolis, IN.
12. Rosenbaum P and Rubin D (1983) The central role of the propensity studies for causal effects. Biometrika 70(1): 41–55.
13. Spreeuwenberg M, Bartak A, Croon M, Hagenaars J, Busschbach J, Andrea H, Twisk J, and Stijnen T (2010) The multiple propensity score as control for bias in the comparison of more than two treatment arms: an introduction from a case study in mental health. Medical care 48(2): 166–174
14. Kaplan, G., Bo-Linn, G., Carayon, P., Pronovost, P., Rouse, W., Reid, P., Saunders, R. (2013). Bringing a systems approach to health. Discussion Paper, Institute of Medicine and National Academy of Engineering, Washington, DC. http://www.iom.edu/systemsapproaches

Thank you!

- Questions?

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