Suicide Risk Stratification Tools

Considerations for Clinical Use

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HealthPartners Institute
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PHQ9 Item 9

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems? *(Use "✓" to indicate your answer)*	Not at all	Several days	More than half the days	Nearly every day
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

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At-Risk Patients at HealthPartners

- Every week, patients complete 6000-7000 PHQs at our clinics
- ~80 patients/week score a 2 or 3 on item 9 of the PHQ
- Providers asked: what does an elevated score on item 9 really mean?

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Research paper

Suicidal ideation reported on the PHQ9 and risk of suicidal behavior across age groups

Rebecca C. Rossom[a,*], Karen J. Coleman[b], Brian K. Ahmedani[c], Arne Beck[d], Eric Johnson[e], Malia Oliver[e], Greg E. Simon[a]

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[b] Kaiser Permanente Southern California Department of Research and Evaluation, Pasadena, CA, United States
[c] Henry Ford Health System, Behavioral Health Services and Center for Health Policy and Health Services Research, Detroit, MI, United States
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[e] Kaiser Permanente Washington Health Research Institute, Seattle, WA, United States

- 939,246 PHQ9s completed by 297,290 outpatients in 2010-2012
- 4 Mental Health Research Network (MHRN)-affiliated healthcare systems:
  - HealthPartners
  - Group Health (Kaiser Washington)
  - Kaiser Colorado
  - Kaiser Southern California

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	PHQ9s	Item 9 = 0	Item 9 = 1	Item 9 = 2	Item 9 = 3
Total Sample	939,268	748,040 (80%)	122,716 (13%)	41,055 (4%)	27,457 (3%)
Sex					
Male	283,515	217,225 (77%)	42,725 (15%)	14,396 (5%)	9,169 (3%)
Female	655,753	530,815 (81%)	79,991 (12%)	26,659 (4%)	18,288 (3%)
Race/Ethnicity					
White	694,378	556,681 (80%)	89,881 (13%)	28,829 (4%)	18,987 (3%)
Asian	27,090	20,455 (76%)	4,242 (16%)	1,526 (6%)	867 (3%)
Black	52,372	40,361 (77%)	6,901 (13%)	3,018 (6%)	2,092 (4%)
Hawaiian/ Pacific Islander	3,654	2,723 (75%)	522 (14%)	208 (6%)	201 (6%)
Native Amer./ Alaskan Nat.	13,272	10,307 (78%)	1,763 (13 %)	679 (5%)	523 (4%)
Other or >1	59,141	44,746 (76%)	9,107 (15%)	3,178 (5%)	2,110 (4%)
Hispanic					

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		PHQ9s	Item 9 = 0	Item 9 = 1	Item 9 = 2	Item 9 = 3
Total Sample		1,228,308	1,023,903 (83%)	131,773 (11%)	43,494 (4%)	29,138 (2%)
Age	18-29	156,977	122,423 (78%)	22,554 (14%)	7,422 (5%)	4,578 (3%)
	30-44	252,863	203,294 (80%)	32,047 (13%)	10,656 (4%)	6,866 (3%)
	45-64	378,649	297,273 (79%)	51,650 (14%)	17,765 (5%)	11,961 (3%)
	65+	150,779	125,050 (83%)	16,465 (11%)	5,212 (3%)	4,052 (3%)
PHQ8	0-4	265,547	255,108 (96%)	8153 (3%)	1350 (1%)	936 (<1%)
	5-9	241,655	215,551 (89%)	23,234 (10%)	2220 (1%)	650 (<1%)
	10-14	203,482	155,630 (76%)	36,758 (18%)	8352 (4%)	2742 (1%)
	15+	228,584	121,751 (53%)	54,571 (24%)	29,133 (13%)	23,129 (10%)
Charlson	0	583,688	469,153 (80%)	74,874 (13%)	23,865 (4%)	15,796 (3%)
	1	154,940	122,410 (79%)	20,531 (13%)	7,339 (5%)	4,660 (3%)
	>1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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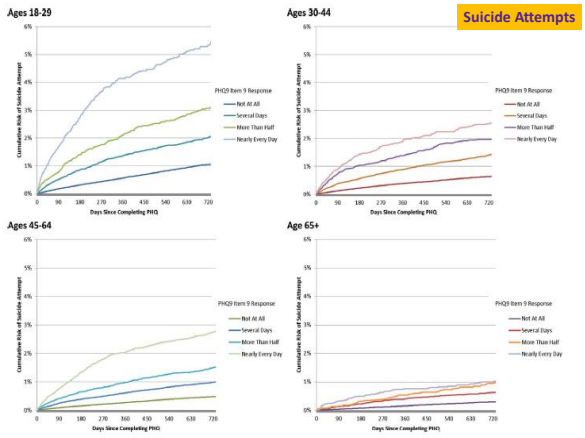

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Table 2
Hazard ratios for suicide attempts at 30 days and 365 days after completion of the PHQ9 by age group. Question 9 of the PHQ9 asks about thoughts of being better off dead or of hurting oneself in some way over the last two weeks. Response options include "not at all" (Q9=0), "several days" (Q9=1), "more than half the days" (Q9=2), or "nearly every day" (Q9=3).*

		30 Days		365 Days	
Age Group	PHQ9 item 9 score	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Ages 18–29	Q9=0	[reference]		[reference]	
	Q9=1	2.49	2.08–2.98	1.53	1.29–1.82
	Q9=2	3.95	3.08–5.07	1.91	1.48–2.47
	Q9=3	7.61	5.52–10.49	3.37	2.42–4.70
	Q9 > 0	3.42	2.83–4.14	1.79	1.48–2.17
Ages 30–44	Q9=0	[reference]		[reference]	
	Q9=1	2.63	2.19–3.16	1.62	1.36–1.93
	Q9=2	4.22	3.31–5.39	2.04	1.61–2.59
	Q9=3	5.61	4.26–7.39	2.49	1.90–3.25
	Q9 > 0	3.34	2.83–4.14	1.75	1.47–2.08
Ages 45–64	Q9=0	[reference]		[reference]	
	Q9=1	2.49	2.10–2.94	1.53	1.30–1.81
	Q9=2	4.12	3.32–5.13	1.99	1.59–2.49
	Q9=3	8.15	6.25–10.72	3.63	2.71–4.85
	Q9 > 0	3.59	3.03–4.26	1.88	1.59–2.23
Ages 65+	Q9=0	[reference]		[reference]	
	Q9=1	2.71	2.08–3.55	1.67	1.28–2.19
	Q9=2	4.28	2.98–6.14	2.07	1.42–3.01
	Q9=3	4.86	3.25–7.29	2.16	1.43–3.25
	Q9 > 0	3.35	2.59–4.34	1.75	1.35–2.29

p=0.116

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	Q9=2	4.22	3.31–5.39	2.04	1.61–2.59
	Q9=3	5.61	4.26–7.39	2.49	1.90–3.25
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	Q9=3	8.19	6.25–10.72	3.63	2.71–4.85
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Ages 65+	Q9=0	[reference]		[reference]	
	Q9=1	2.71	2.08–3.55	1.67	1.28–2.19
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	Q9=3	4.86	3.25–7.29	2.16	1.43–3.25
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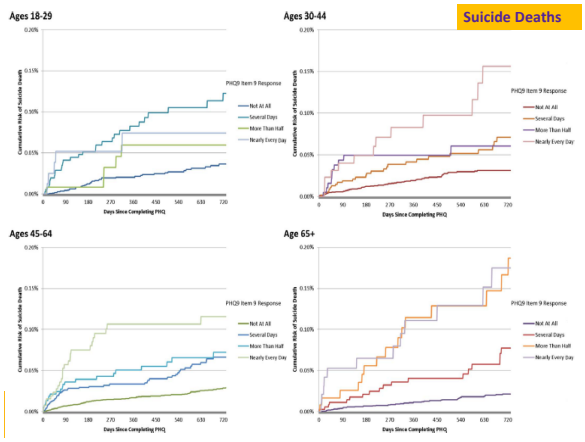

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Table 3
Hazard ratios for suicide deaths at 30 days and 365 days after completion of the PHQ9 by age group. Question 9 of the PHQ9 asks about thoughts of being better off dead or of hurting oneself in some way over the last two weeks. Response options include "not at all" (Q9=0), "several days" (Q9=1), "more than half the days" (Q9=2), or "nearly every day" (Q9=3).*

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Age Group	PHQ9 Item 9 score	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Ages 18–29	Q9=0	[reference]		[reference]	
	Q9=1	3.94	1.81–8.56	2.58	1.35–4.91
	Q9=2	2.27	1.10–4.69	1.04	0.44–2.46
	Q9=3	3.29	1.62–6.68	1.74	0.85–3.57
	Q9 > 0	3.46	2.05–5.87	1.98	1.22–3.22
Ages 30–44	Q9=0	[reference]		[reference]	
	Q9=1	2.30	1.27–4.15	1.50	0.76–2.98
	Q9=2	3.44	1.25–7.89	1.45	0.58–3.62
	Q9=3	5.69	2.62–12.34	3.00	1.29–7.01
	Q9 > 0	2.93	1.71–5.00	1.67	0.93–2.99
Ages 45–64	Q9=0	[reference]		[reference]	
	Q9=1	2.87	1.66–4.98	1.88	1.17–3.01
	Q9=2	3.33	1.50–7.85	1.58	0.79–3.15
	Q9=3	5.63	2.69–11.81	2.97	1.39–6.36
	Q9 > 0	3.36	1.95–5.77	1.92	1.22–3.02
Ages 65+	Q9=0	[reference]		[reference]	
	Q9=1	4.22	2.05–8.65	2.76	1.36–5.60
	Q9=2	12.95	4.57–36.68	5.96	1.54–23.04
	Q9=3	10.81	3.63–32.17	5.70	1.65–19.70
	Q9 > 0	6.97	3.04–15.96	3.98	1.56–10.12

p=0.346.
* Models adjusted for gender, healthcare system, patient mental health treatment status, visit type, Charlson score and race/ethnicity.

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Hazard ratios for suicide deaths at 30 days and 365 days after completion of the PHQ9 by age group. Question 9 of the PHQ9 asks about thoughts of being better off dead or of hurting oneself in some way over the last two weeks. Response options include "not at all" (Q9=0), "several days" (Q9=1), "more than half the days" (Q9=2), or "nearly every day" (Q9=3).[a]

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	Q9=3	3.29	1.62–6.68	1.74	0.85–3.57
	Q9>0	3.46	2.05–5.87	1.98	1.22–3.22
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	Q9=1	2.30	1.27–4.15	1.50	0.76–2.98
	Q9=2	3.14	1.25–7.89	1.45	0.58–3.62
	Q9=3	5.69	2.62–12.34	3.00	1.29–7.01
	Q9>0	2.93	1.71–5.00	1.67	0.93–2.99
Ages 45–64	Q9=0	[reference]		[reference]	
	Q9=1	2.87	1.66–4.98	1.88	1.17–3.01
	Q9=2	3.43	1.50–7.85	1.58	0.79–3.15
	Q9=3	5.63	2.69–11.81	2.97	1.39–6.36
	Q9>0	3.36	1.95–5.77	1.92	1.22–3.02
Ages 65+	Q9=0	[reference]		[reference]	
	Q9=1	4.22	2.05–8.65	2.76	1.36–5.60
	Q9=2	12.95	4.57–36.68	5.96	1.54–23.04
	Q9=3	10.81	3.63–32.17	5.70	1.65–19.70
	Q9>0	6.97	3.04–15.96	3.98	1.56–10.12

p=0.346.
[a] Models adjusted for gender, healthcare system, patient mental health treatment status, visit type, Charlson score and race/ethnicity.

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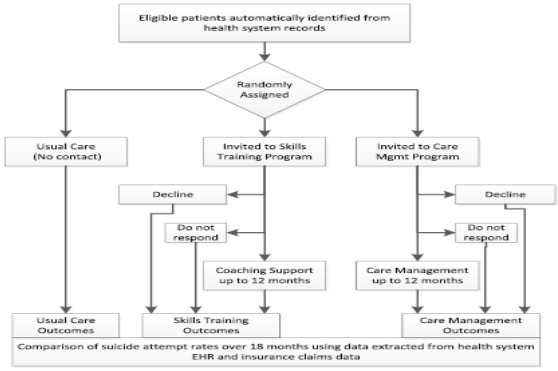
SPOT (Suicide Prevention Outreach Trial)



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Suicide Prevention Outreach Trial

Dialectical Behavior Therapy Skills Training (1/3)

- Multimedia online program based on Marsha Linehan's Dialectical Behavior Therapy (DBT)
- Assists participants in developing specific emotion regulation skills
- Supported by MyChart messages from an online coach to encourage continued engagement with online program
- Intended to supplement, not replace or interfere with, usual care

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Now Matters Now Website

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Suicide Prevention Outreach Trial

Risk Assessment and Care Management (1/3)

- Based on the Perfect Depression Care Program at Henry Ford
- Systematic outreach: MyChart, phone
- Risk assessment using Columbia Suicide Severity Risk assessment
- Encourages/facilitates follow-up care following risk-based care pathways
- Meant to supplement, not replace or interfere with, usual care

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Suicide Prevention Outreach Trial

Study Status:

- 18,889 patients enrolled across 4 sites
- 2760 patients enrolled at HP & PN
- Study will close this fall
- Study results will be available early next year

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Shortcomings of Risk Stratification using PHQ9 Item 9

- SENSITIVITY: 35% of suicide attempts and suicide deaths occur in those responding "not at all"
- EFFICIENCY: 6% of visits with responses of "more than half" or "nearly every day" account for 39% of events
- UTILITY: PHQ9 is not recorded for many visits

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Predicting Suicide Attempts and Suicide Deaths Following Outpatient Visits Using Electronic Health Records

Gregory E. Simon, M.D., M.P.H., Eric Johnson, M.S., Jean M. Lawrence, Sc.D., Rebecca C. Rossom, M.D., M.S., Brian Ahmedani, Ph.D., Frances L. Lynch, Ph.D., Arne Beck, Ph.D., Beth Waitzfelder, Ph.D., Rebecca Ziebell, Robert B. Penfold, Ph.D., Susan M. Shortreed, Ph.D.

Settings

- 7 MHRN health systems with 8 million members:
  - HealthPartners/Park Nicollet
  - Henry Ford
  - Kaiser Colorado
  - Kaiser Hawaii
  - Kaiser Northwest
  - Kaiser Southern California
  - Kaiser Washington

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Suicide Risk Calculator Project

- Visit Sample
  - Age 13+
  - Specialty MH visit or primary care visit with MH diagnosis 2009-2015
- Outcomes
  - Encounter for self-inflicted injury/poisoning in 90 days
  - Death by self-inflicted injury/poisoning in 90 days

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Suicide Risk Calculator: Predictors

Approximately 150 indicators for each visit:

- Demographics (age, sex, race/ethnicity, neighborhood SES)
- Mental health, substance use dx (current, recent, last 5 yrs)
- Mental health inpatient, ED utilization
- Psychiatric medication dispensings (current, recent, last 5 yrs)
- Co-occurring medical conditions (per Charlson index)
- PHQ8 and item 9 scores (current, recent, last 5 yrs)

Approximately 200 possible interactions (e.g. item 9 score with diagnosis of bipolar disorder)

Sample Description

- 19.6 million visits for approx. 2.9 million people
- 51% MH specialty; 48% primary care
- Race/Ethn: 14% Hispanic, 9% African American, 5% Asian
- Insurance: 5% Medicaid, 20% Medicare
- Diagnoses: 1.5M Bipolar, 690K Schizophrenia/Psychosis
- 1.9M have PHQ item 9 score recorded
- 24,000 visits followed by suicide death (2108 deaths)
- 440,000 visits followed by suicide attempt (29,423 attempts)

The Math

- Separate models for MH specialty and primary care
- Separate models for prediction of suicide attempt and suicide death
- Model development followed current best practice:
  - Model training in 65% random sample
  - Variable selection using Penalized Lasso logistic regression model
  - Coefficient estimation using GEE model to account for multiple visits per person
  - Independent validation in remaining 35%

Suicidal Behavior in 90 days: Top 15 Predictors in MH Specialty Care

SUICIDE ATTEMPT FOLLOWING MH VISIT (of 110 selected)	SUICIDE DEATH FOLLOWING MH VISIT (of 62 selected)
Depression diagnosis in last 5 yrs.	Suicide Attempt in last year
Drug Abuse diagnosis in last 5 yrs.	Benzodiazepine Rx. in last 3 mos
PHQ9 Item 9 score =3 in last year	Mental Health ER visit in last 3 mos
Alcohol Use Disorder Dx in last 5 yrs	2nd Gen Antipsychotic Rx in last 5 years
Mental health inpatient stay in last yr.	Mental Health inpatient stay in last 5 years
Benzodiazepine Rx. in last 3 mos.	Mental Health inpatient stay in last 3 mos
Suicide attempt in last 3 mos.	Mental Health inpatient stay in last year
Personality disorder diag. in last 5 yrs.	Alcohol Use Disorder Dx in last 5 years
Eating Disorder diagnosis in last 5 yrs.	Antidepressant Rx in last 3 mos
Suicide Attempt in last year	PHQ9 Item 9 score = 3 with PHQ8 score
Mental Health ER visit in last 3 mos.	PHQ9 item 9 score = 1 with Age
Self-inflicted laceration in last year	Depression Dx in last 5 yrs. with Age
Suicide attempt in last 5 yrs.	Suic. Att. in last 5 yrs.with Charlson Score
Injury/poisoning diagnosis in last 3 mos.	PHQ9 Item 9 score = 2 with Age
Antidepressant Rx. in last 3 mos.	Anxiety Dx. in last 5 yrs. with Age

Similar predictors were selected for primary care visits

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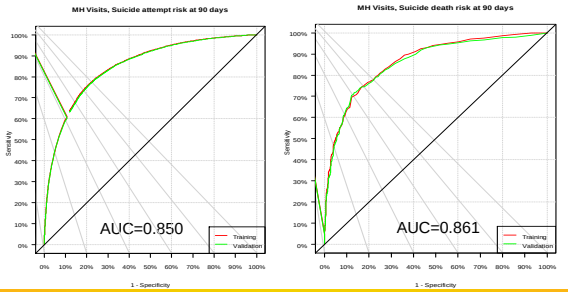
Predicting Suicidal Behavior in 90 Days After MH Visit



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AUC Values for Previous Risk Prediction Models

- Prediction of suicidal behavior:
  - Suicide death after medical hospitalization 0.74*
  - Suicide death after OP visit (Army STARRS) 0.67
  - Suicide death in VA service users 0.76*
  - Suicide attempt/death in health system 0.77
- Prediction of adverse medical events:
  - High ER utilization 0.71
  - Re-admission for CHF 0.62
  - In-hospital mortality after sepsis 0.76
  - Re-admission for CHF 0.78

* no independent validation, so this is probably an over-estimate

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Sensitivity – Fewer events "missed" at the bottom

% of Visits	Item 9 Score	Actual Risk	% of Attempts
2.5%	3	2.3%	20%
3.5%	2	1.4%	19%
11%	1	.72%	26%
83%	0	.19%	35%

% of Visits	Predicted Risk	Actual Risk	% of All Attempts
>99.5th	13.0%	12.7%	10%
99th to 99.5th	8.5%	8.1%	6%
95th to 99th	4.1%	4.2%	27%
90th to 95th	1.9%	1.8%	15%
75th to 90th	0.9%	0.9%	21%
50th to 75th	0.3%	0.3%	13%
<50th	0.1%	0.1%	8%

Excludes anyone who doesn't have a PHQ9

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Efficiency – Greater concentration of risk at the top

% of Visits	Item 9 Score	Actual Risk	% of Attempts
2.5%	3	2.3%	20%
3.5%	2	1.4%	19%
11%	1	.72%	26%
83%	0	.19%	35%

Percentile of Visits	Predicted Risk	Actual Risk	% of All Attempts
>99.5th	13.0%	12.7%	10%
99th to 99.5th	8.5%	8.1%	6%
95th to 99th	4.1%	4.2%	27%
90th to 95th	1.9%	1.8%	15%
75th to 90th	0.9%	0.9%	21%
50th to 75th	0.3%	0.3%	13%
<50th	0.1%	0.1%	8%

Excludes anyone who doesn't have a PHQ9

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Clinical Review & Education

JAMA Psychiatry | Review

Prediction Models for Suicide Attempts and Deaths
A Systematic Review and Simulation

Bradley E. Belsher, PhD; Derek J. Smolenski, PhD, MPH; Larry D. Pruitt, PhD; Nigel E. Bush, PhD; Erin H. Beech, MA; Don E. Workman, PhD; Rebecca L. Morgan, PhD, MPH; Daniel P. Evatt, PhD; Jennifer Tucker, PhD; Nancy A. Skopp, PhD

Supplemental content

IMPORTANCE Suicide prediction models have the potential to improve the identification of patients at heightened suicide risk by using predictive algorithms on large-scale data sources. Suicide prediction models are being developed for use across enterprise-level health care systems including the US Department of Defense, US Department of Veterans Affairs, and Kaiser Permanente.

OBJECTIVES To evaluate the diagnostic accuracy of suicide prediction models in predicting suicide and suicide attempts and to simulate the effects of implementing suicide prediction models using population-level estimates of suicide rates.

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Belsher Review Findings

FINDINGS From a total of 7306 abstracts reviewed, 17 cohort studies met the inclusion criteria, representing 64 unique prediction models across 5 countries with more than 14 million participants. The research quality of the included studies was generally high. Global classification accuracy was good (≥0.80 in most models), while the predictive validity associated with a positive result for suicide mortality was extremely low (≤0.01 in most models). Simulations of the results suggest very low positive predictive values across a variety of population assessment characteristics.

How to Interpret Risk Scores

- Unreasonable to expect the same high positive predictive value (PPV) that you would from diagnostic tools
- Use is most akin to using ACC/AHA risk equations to estimate 10- or 30-year CV risk (e.g., 10-year ASCVD risk of 15%)
- Similar to CV risk, models categorize patients into buckets of risk – high estimated risk prompts clinical action, like starting a statin

CSSRS

COLUMBIA SUICIDE SEVERITY RATING SCALE			
Please ask questions 1 & 2. If both answers are "no," end. Otherwise complete the entire survey.			
Question	No	Yes	Scoring
1. Have you wished you were dead or wished you could go to sleep and not wake up?			Score 1 point for each yes. The overall suicidality score is equal to the sum of the scores: **1-2:** Low suicidality **3:** Moderate suicidality **4-5:** High suicidality **6:** Severe suicidality
2. Have you actually had any thoughts of killing yourself?			
3. Have you been thinking about how you might kill yourself?			
4. Have you had some intention of acting on them?			
5. Have you worked out some or all of the details of how to kill yourself?			
6. Do you intend to carry out this plan?			
		Total Score	

CSSRS

If score is 1-2: Connect patient with behavioral health services

- If patients already have a behavioral health provider, they should them within 1-2 weeks.
- If patients do not have a behavioral health provider, they should make an appointment by calling 952-993-3307 at Park Nicollet and 952-967-7992 at HealthPartners.

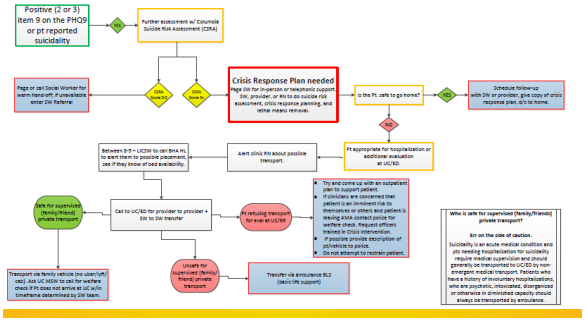
If score is 3-6: Patient needs an urgent referral to behavioral health

- During business hours, while patients are still in clinic, call 952-xxx-xxxx at Park Nicollet and 612-xxx-xxxx at HealthPartners for an urgent BH referral. Phone lines are monitored on non-holiday weekdays from 8 to 4:30.
- After hours, submit an urgent referral to behavioral health via Epic (REF729). Discuss ways to keep patient safe until they can be evaluated by behavioral health with patients, families and friends. If patients cannot maintain safety until then, send them to the emergency room for evaluation.
- Give all patients and families the national suicide hotline number (1-800-273-8255) and the crisis text line (text "MN" to 741741).

For all patients thought to be at immediate risk of self-harm: send patient to the emergency room via safe transport for evaluation.

Example Care Plan

MANAGEMENT OF SUICIDAL PATIENT IN AMBULATORY CARE



Overview Signed 8/14/2017 8:30 PM by [redacted] MSW

Crisis Response Plan

My early warning signs that I am in crisis: "I don't get out of bed. I don't take care of myself. I stay in my bathrobe. I don't want to do anything. It feels like too much effort. I stay up late and I sleep in late."

Things I can do and skills I can practice to help me feel better: "I go to laser therapy--red light therapy. I think I suffer from SAD. I pay my bills. Organize my house."

- **Go for a walk and Call my daughter when I can (usually monthly)**

Support person(s) I can contact (include phone number): [redacted] Ex-husband.

Things to avoid which make me feel worse: Rejection from men; conflict with mom; not taking care of my animals (like not walking my dog).

Things I can do to limit my access to lethal means: Patient understands she should secure her gun.

The best number my provider can call me at is: [redacted] cell

If I cannot be reached, my provider can call [redacted] emergency contact)

Contact info for resources:

- **Everett; 8am-5pm; 425-261-1500**
- **Everett Clinic; 8am-5pm; 425-261-1776**

After Hours:

- **The Suicide Lifeline Crisis Line 1 800 273 TALK (8255)**
- **Snohomish; (800) 584-3578; Volunteers of America Western Washington**

If I cannot keep myself safe, I will go to the nearest emergency room or call 911

My next appointment is: Patient will call and schedule Behavioral Health Access to schedule. She understands she can schedule with Social work in the interim if needed.

Potential Uses for Risk Prediction Scores

- During visits:
  - Trigger completion of Columbia Suicide Severity Risk Scale (CSSRS)
  - Trigger creation or updating of safety plan
- Between visits:
  - Outreach for higher-risk patients who cancel or fail to attend scheduled visits
  - Outreach for higher-risk patients without follow-up scheduled within recommended interval

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Document, document, document

- Document what you've asked, how your patient has answered, and your rationale for your clinical decisions
- Implementing tools in Epic (PHQ9, CSSRS, safety plans) can help with this documentation, but no tool replaces clinical judgement

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Next Steps

- Suicide Risk Calculator is planned to be a standard tool available in the predictive analytics suite in EPIC 2018
- BH care managers at HealthPartners will start using this tool in early summer
- Qualitative research around:
  - How do care providers interpret and use this tool?
  - How do patients feel about use of this tool, and how do they understand risk?

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Questions & Discussion

make good happen

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