Understanding, Predicting, and Preventing Suicidal Behavior: Current Gaps and Opportunities for Using Advances in Computing

Matthew Nock, Ph.D.

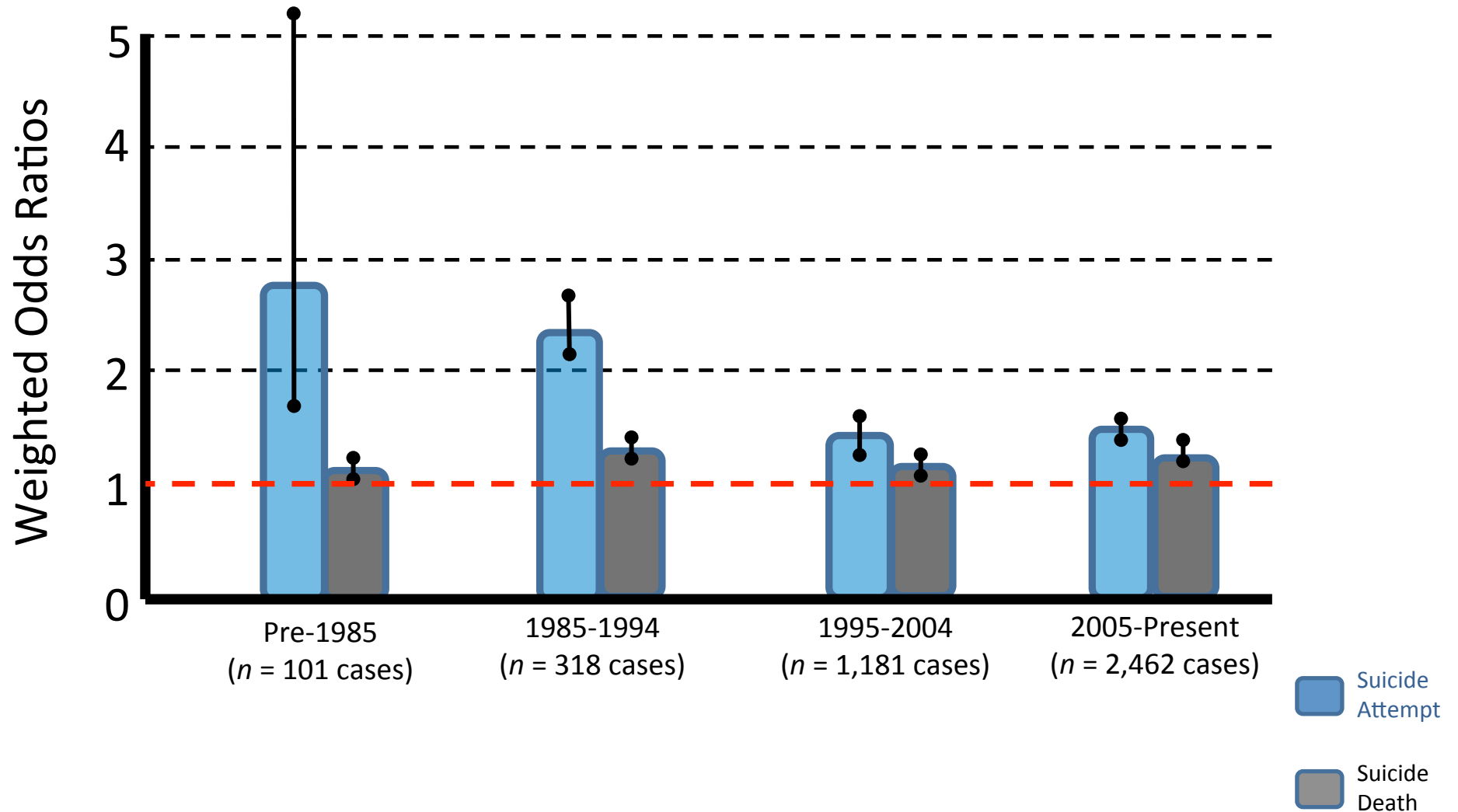## Harvard University

Disclosures and Acknowledgements

- Disclosures/conflicts: None

- Acknowledgements:
  - Nock (2015). *AAS Conference*
  - Nock (2016). *J Anxiety and Depression*

Suicide is Complicated Problem

- Human minds have been studying it for thousands of years

- 10th leading cause of death (no change in past 100 years)

- We have made some progress
    (e.g., identified risk factors, promising treatments)

- Progress is slow, stagnant
    "In God we trust. All others must bring data" –W. Edwards Deming

Prediction of Suicide Attempts and Death: 1965-Present

Weighted Odds Ratios

Pre-1985 (*n* = 101 cases)	1985-1994 (*n* = 318 cases)
1995-2004 (*n* = 1,181 cases)	2005-Present (*n* = 2,462 cases)

Suicide Attempt

Suicide Death

Franklin, Ribeiro, Fox, Bentley, Kleiman, Jaroszewski, Chang, & Nock (under review).

Top Five Predictor Categories across Decades

Pre-1985
1. Demographics
2. Internalizing Symptoms
3. Life Events
4. Prior SITBs
5. Externalizing Symptoms

73.8%
of all cases

1985-1994
1. Internalizing Symptoms
2. Prior SITBs
3. Life Events
4. Demographics
5. Externalizing Symptoms

73.2%
of all cases

1995-2004
1. Internalizing Symptoms
2. Demographics
3. Externalizing Symptoms
4. Prior SITBs
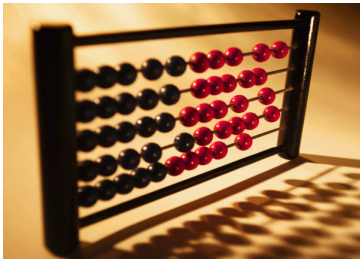5. Life Events

76.3%
of all cases

2005-Now
1. Demographics
2. Internalizing Symptoms
3. Externalizing Symptoms
4. Prior SITBs
5. Life Events

80.3%
of all cases

Same predictors + Same methods = Same Results

Enormous gaps in understanding, prediction, and prevention

Franklin, Ribeiro, Fox, Bentley, Kleiman, Jaroszewski, Chang, & Nock (under review).

Time is right for convergence between the study of this complex problem and development of new technologies and computing approaches to help solve it.
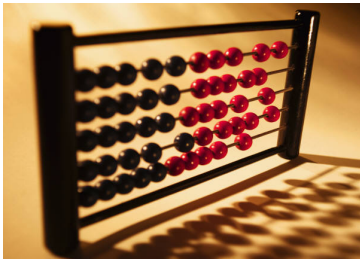
Time is right for convergence between the study of this complex problem and development of new technologies and computing approaches to help solve it.

?

Gaps in Understanding

1. Need methods for _combining_ known risk factors

    (predicting rare events; extreme weather forecasting)

2. Need new _objective_ markers of suicide risk

    (blood tests, x-rays, MRI)

3. Need data on _imminent_ risk

    (online consumer behavior)

Exciting Opportunities!

1. Need methods for *combining* known risk factors

    (predicting rare events; extreme weather forecasting)

2. Need new *objective* markers of suicide risk

    (blood tests, x-rays, MRI)

3. Need data on *imminent* risk

    (online consumer behavior)

1. Need method of _combining_ risk factor data

- Risk factors have been identified

	Lifetime Attempt	12-month Attempt
Sociodemographics (age, sex, unmarried)	√	√
Child adversities	√	√
Traumatic life events	√	√
Physical illness	√	√
Family history of mental disorder, suicide	√	√
Personal history of mental disorder	√	√
Past suicide attempt	√	√

- ~99% of studies examine bivariate RFs; few efforts to develop and test methods of combining risk factors

- **NEEDED**: Methods of combining risk and protective factors to more accurately predict suicide attempts

1. Need method of _combining_ risk factor data

- Borges et al (2006): Risk index for 12-month suicide attempt <u>among ideators</u>
- N=5,692 respondents in NCS-R (retrospective self-report)
- Predictors included: Prior SA and 0-11 count of other risk factors

Risk Group	Distribution	Probability of Attempt
Very low	19.0%	0.0%
Low	51.1%	3.5%
Intermediate	16.2%	21.3%
High*	13.7%	78.1%

*High risk group accounted for 67.1% of all suicide attempts in sample

- Borges et al (2012): Replicated approach using data from 21 countries (N=108,705)

- Further developing "concentration of risk" approach in different settings using predictive modeling approaches

Borges et al. (2006). Psychological Medicine.

Borges et al. (2012). Journal of Clinical Psychiatry.

1. Need method of _combining_ risk factor data

- Kessler et al (2015): Developed machine learning algorithm to predict 12-month suicide deaths following 53,769 hospitalizations over 6 years

Figure 2. Concentration of Risk of Posthospitalization Suicides by Ventile of Predicted Risk Based on the Discrete-Time Penalized Survival Model With a Mixing Parameter Penalty of 1.0
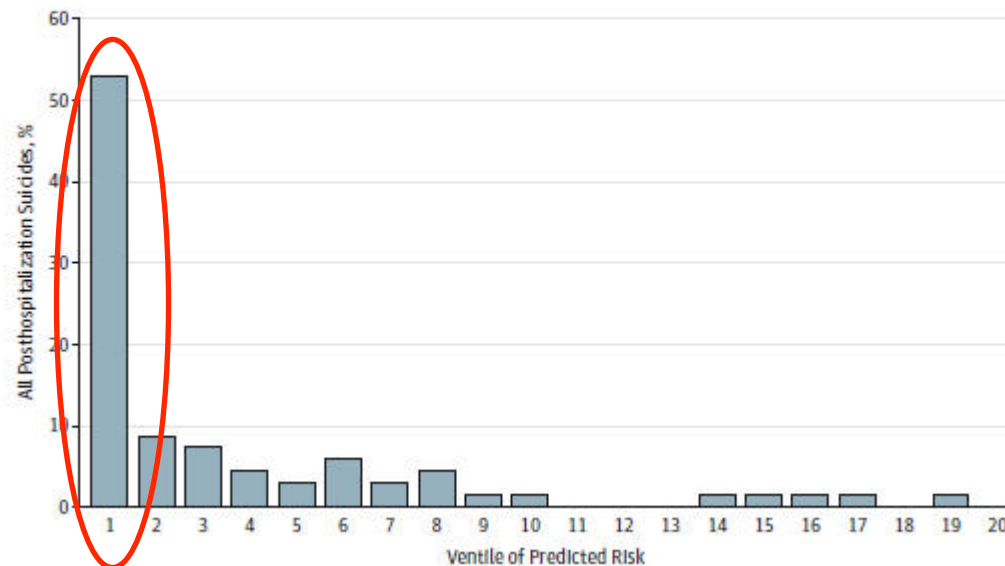
*First ventile: 52.9% of suicides, rate=3,824/100,000 (vs. 18.5 in Army)

*46.3% of this group had either: suicide death, accidental death, attempt, or re-hospitalization

*All done with data lying dormant in medical & other records

*Current project using data from 7 civilian healthcare systems

Kessler et al. (2015). JAMA Psychiatry.

2. Need _objective_ markers of suicide risk

- Current assessment methods are limited by reliance on explicit report

- Problematic because:
  - Motivation to conceal suicidal thoughts
  - Suicidal thoughts are often transient in nature
  - May lack conscious awareness of current risk or ability to report on it

- 78% of patients who die by suicide in hospital deny thoughts/intent (Busch, Fawcett & Jacobs, 2003)

- **NEEDED**: Methods of assessing risk not reliant on self-report

Measuring Implicit Suicidal Cognition

Death

Me

Life

Not Me

Death   Life

Me   Not Me

Death   Life

Me   Not Me

my

Death

Me

Life

Not Me

Death

Life

Me

Not Me

living

Death

Life

Me

Not Me

them

Death | Life
Me | Not Me

Death | Life

Me | Not Me

survive

Death   Life

Me   Not Me

Death

Life

Me

Not Me

dead

Death

Me

Life

Not Me

Death

Life

Me

Not Me

I

Death	Life
Me	Not Me

Death	Life
Me	Not Me

suicide

Death	Life
Me	Not Me

Life	Death
Me	Not Me

Life

Death

Me

Not Me

survive

Life	Death
Me	Not Me

Life	Death
Me	Not Me

mine

Life	Death
Me	Not Me

Life   Death

Me   Not Me

                    dead

Life	Death
Me	Not Me

Life

Death

Me

Not Me

their

Life	Death
Me	Not Me

Life

Death

Me

Not Me

|

Life	Death
Me	Not Me

2. Need _objective_ markers of suicide risk
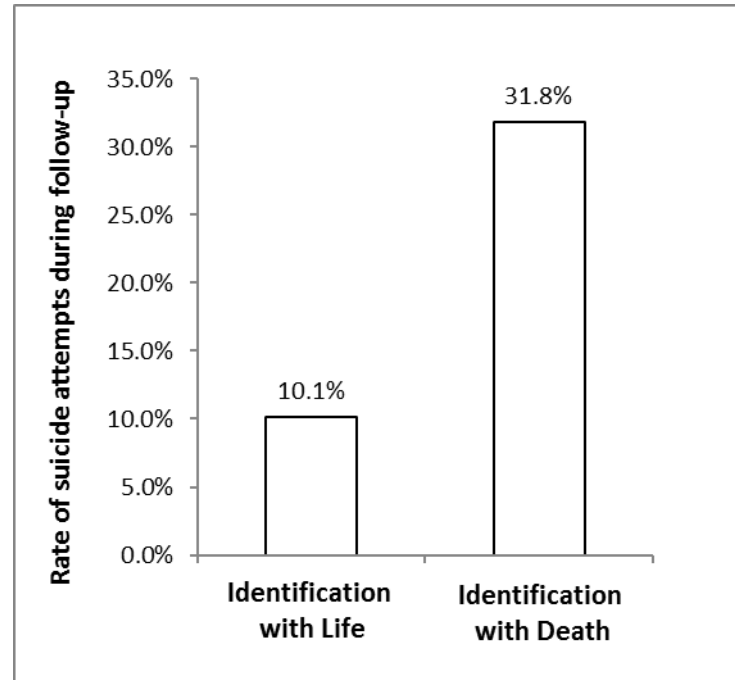
*Those with death ID were more likely to make an attempt after discharge

*IAT added incrementally to prediction of SA beyond diagnosis, clinician, patient, and SSI (OR=5.9, *p*<.05)
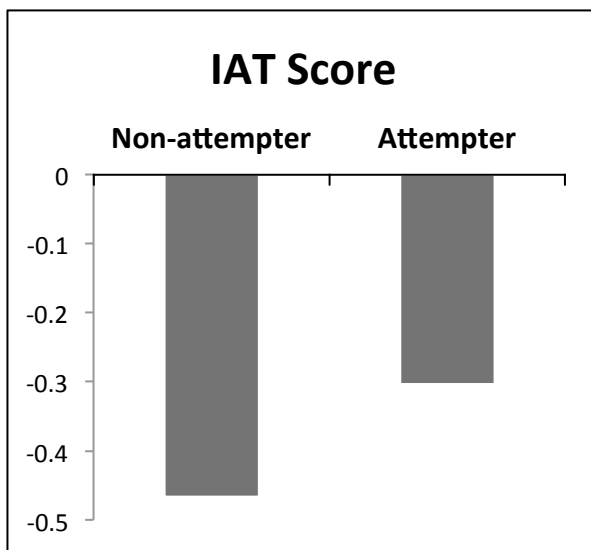
*Sensitivity= .50; Specificity= .81

Nock et al (2010). *Psychological Science*.

*Replication in ED in Alberta, Canada (n=107)

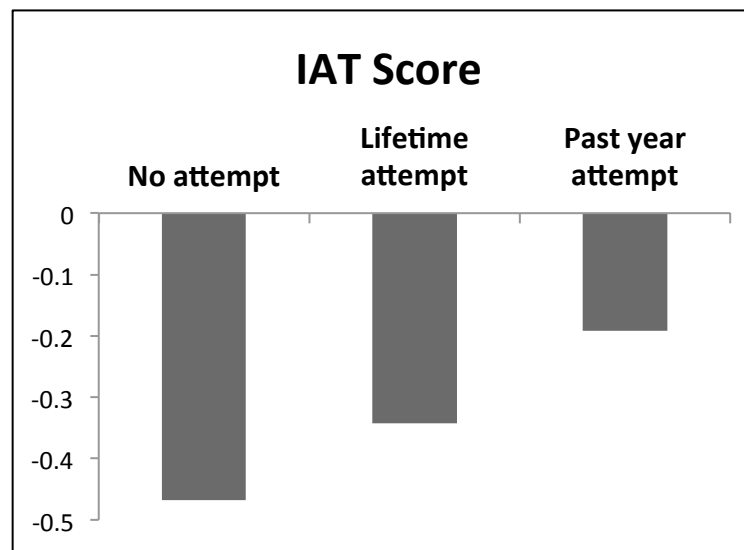*IAT added incrementally to the prediction of self-harm at 3-month follow-up (OR=5.1, *p*<.05)

*Sensitivity= .43; Specificity= .79

Randall et al (2013). *Psychological Assessment*.

2. Need _objective_ markers of suicide risk

- Effects also observed in more general population
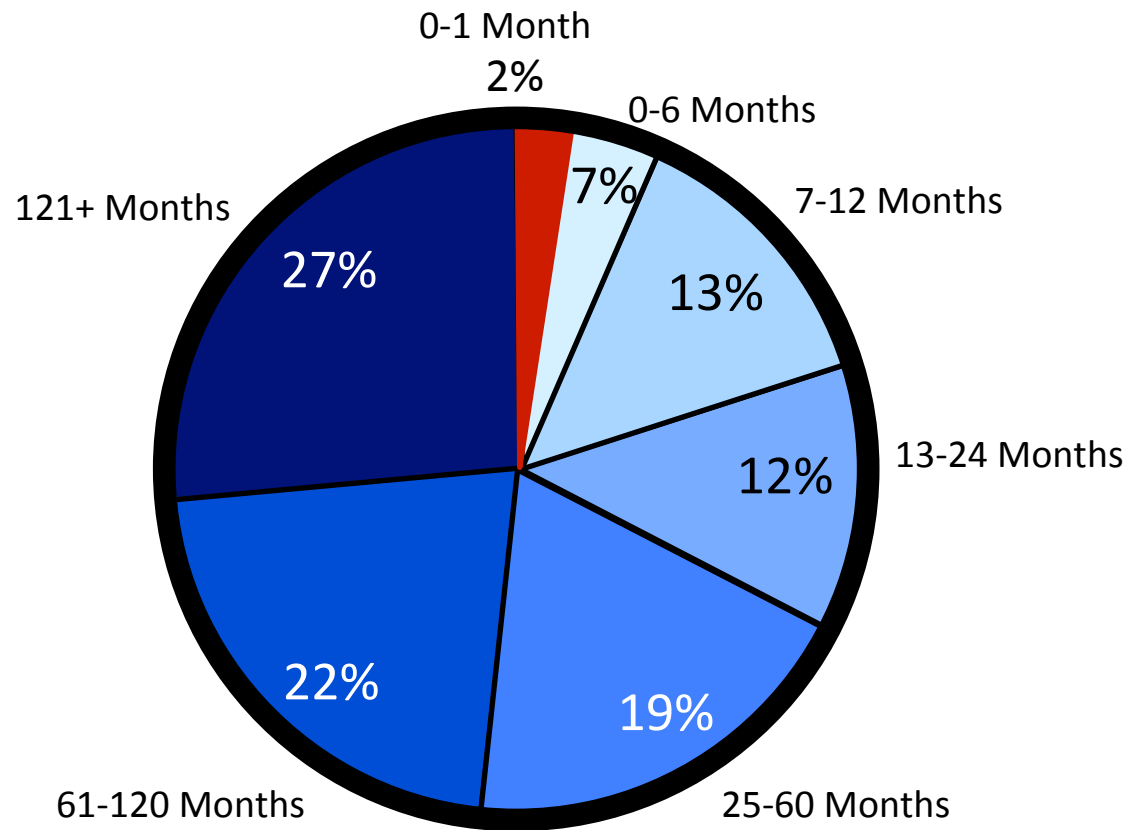
- www.ImplicitMentalHealth.com

IAT Score

Non-attempter   Attempter

0
-0.1
-0.2
-0.3
-0.4
-0.5

IAT Score

No attempt   Lifetime attempt   Past year attempt

0
-0.1
-0.2
-0.3
-0.4
-0.5

_N_ = 6,229; (3,115 + 3,114)

- One of many objective computerized tests
- Challenge: How/when to get tests like these to those at risk?

Glenn et al. (under review).

3. Need data on *imminent risk*

- Most data test prediction over 1+ years of follow-up

Follow-Up Lengths for All Longitudinal SITB Studies 1965-Present

0-1 Month 2%

0-6 Months 7%

7-12 Months 13%

13-24 Months 12%

25-60 Months 19%

61-120 Months 22%

121+ Months 27%

Franklin, Ribeiro, Fox, Bentley, Kleiman, Jaroszewski, Chang, & Nock (under review).

3. Need data on *imminent risk*

- Most data test prediction over 1+ years of follow-up

- No scientifically-informed basis for predicting attempts over the short-term (hours, days, or weeks)

- **NEEDED**: Studies that identify high-risk group and follow-them intensively for days/weeks
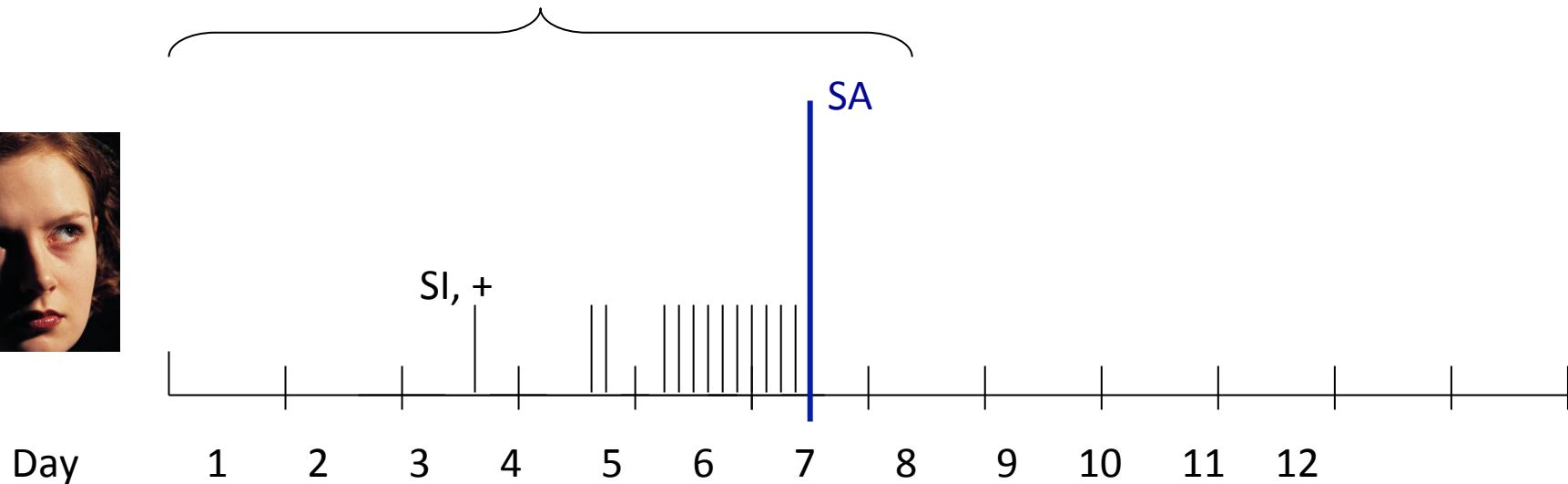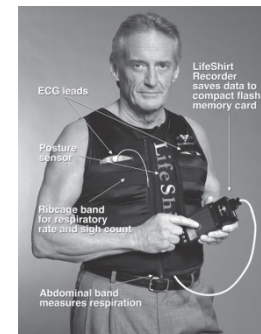
3. Need data on _imminent risk_

Data on each event:

- **Frequency, intensity, duration**
- **Triggers: context, affect, etc.**

EMA

SA

SI, +

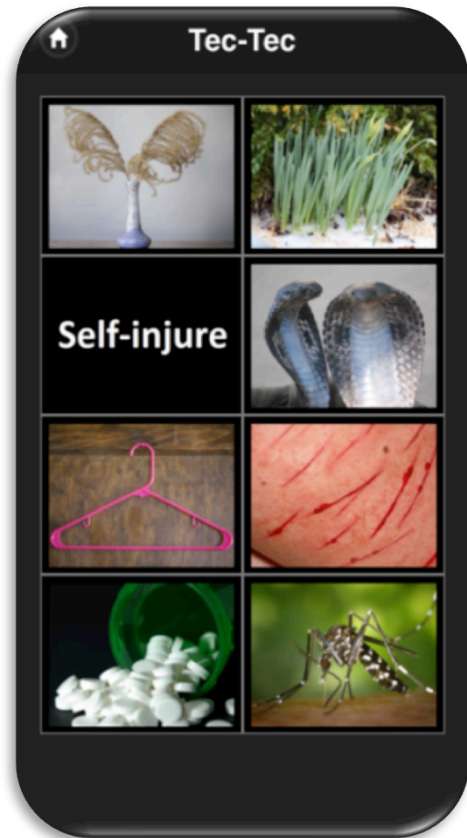Day   1   2   3   4   5   6   7   8   9   10   11   12

- Newer studies are incorporating real-time app/web/social media data, physiological monitoring and interventions.

Nock et al. (2009; under review); Kleiman et al. (in progress);

Therapeutic Evaluative Conditioning (TEC)

Brief, Game-Like Mobile App

Tested in Three Large Web-Based RCTs

Self-Cutting: 42-49% Reductions

Suicide Plans: 21-64% Reductions

Suicidal Behaviors: 20-57% Reductions

Franklin, Fox, Franklin, Kleiman, Ribeiro, Jaroszewski, Hooley & Nock (2016).

Conclusions

- Opportunities for advance:
  - Prediction using available data
  - Detection using new objective measures
  - Short-term prediction (and intervention) via mobile/web

- Key challenges:
  - How to deliver risk scores to clinicians? Patients?
  - Which assessments and which interventions with which patients?
  - Ethics of passive monitoring and implicit interventions?

- Don't forget to call your mother (Happy Mother's Day!)

A Path Forward…

- To solve extremely complex problems in novel ways…

- "*Convergence* – merging of [expertise] distinct technologies and disciplines into a unified whole that creates new pathways and opportunities" - Phillip Sharp, MIT

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