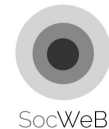


Deriving Population-Level Insights in Digital Mental Health: Opportunities and Challenges of Social Media

Munmun De Choudhury

munmund@gatech.edu

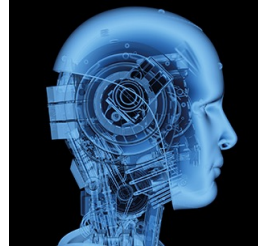
School of Interactive Computing | Georgia Tech



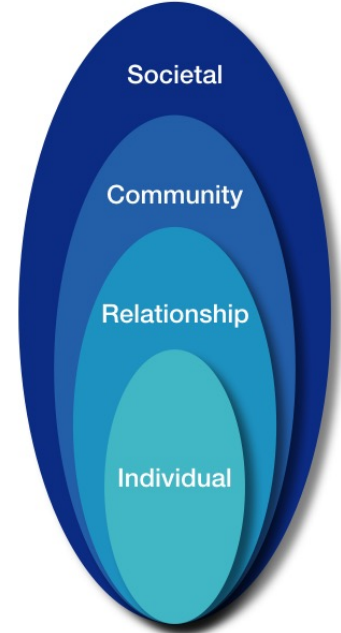
Computational and AI artifacts for social good
Understand and improve wellbeing



Social Media



Human/Stakeholder-Centered
AI + Interdisciplinary



Theory Centered

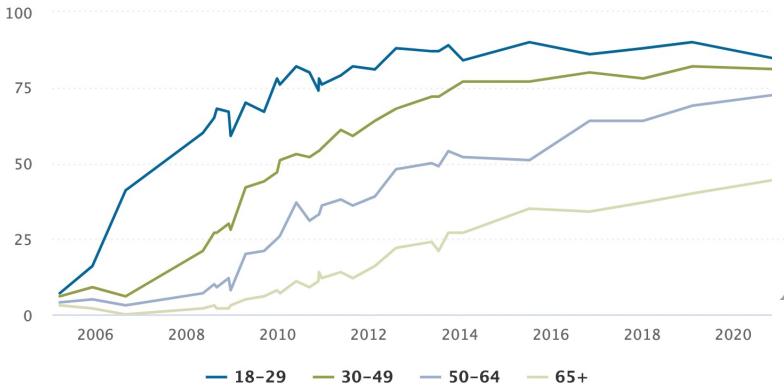
No relevant disclosures or COIs



Sorrowing Old Man ('At Eternity's Gate'), by van Gogh

A Revolution

% of U.S. adults who say they use at least one social media site, by age

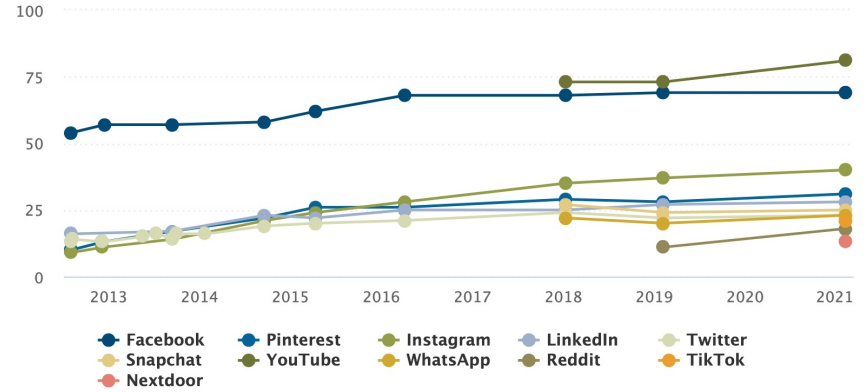


Note: Respondents who did not give an answer are not shown.

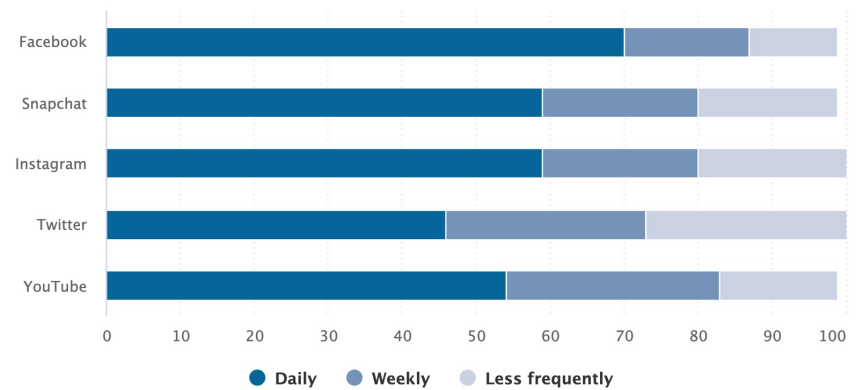
Source: Surveys of U.S. adults conducted 2005-2021.

PEW RESEARCH CENTER

% of U.S. adults who say they ever use ...



Among U.S. adults who say they use ____, the % who use each site ...

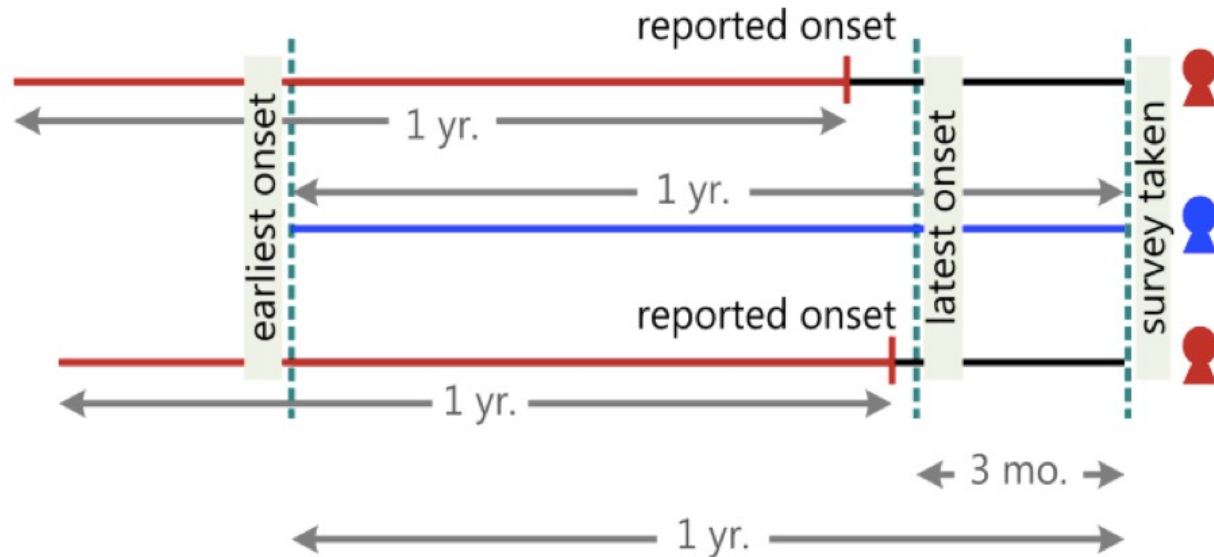


The slide features a white background with a title centered in black text. At the top and bottom of the slide, there are horizontal bars composed of several colored segments: blue, purple, orange, and grey.

Social Media – A New Potential in Digital Mental Health

Social Media Language and Behavior Predicts Onset of Major Depressive Disorder

- 476 individuals (233 female) recruited via Amazon's Mechanical Turk; took CES-D/BDI and consented to accessing their Twitter data

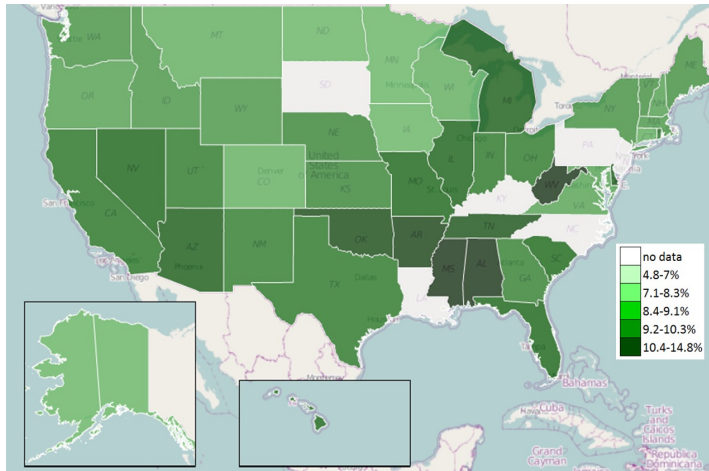


A Social Media Index

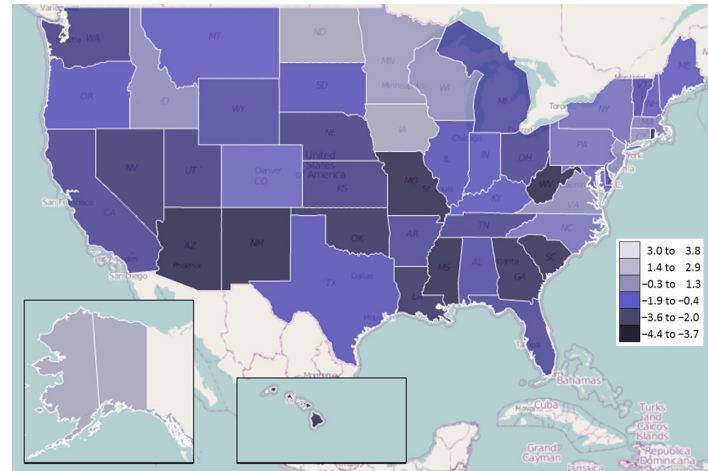
$$SMDI(t) = \frac{n_d(t) - \mu_d}{\sigma_d} - \frac{n_s(t) - \mu_s}{\sigma_s}$$

standardized difference between frequencies of depression-indicative and standard posts, compared to a period before between k and $t-1$ ($1 \leq k \leq t-1$)

actual (BRFSS data)



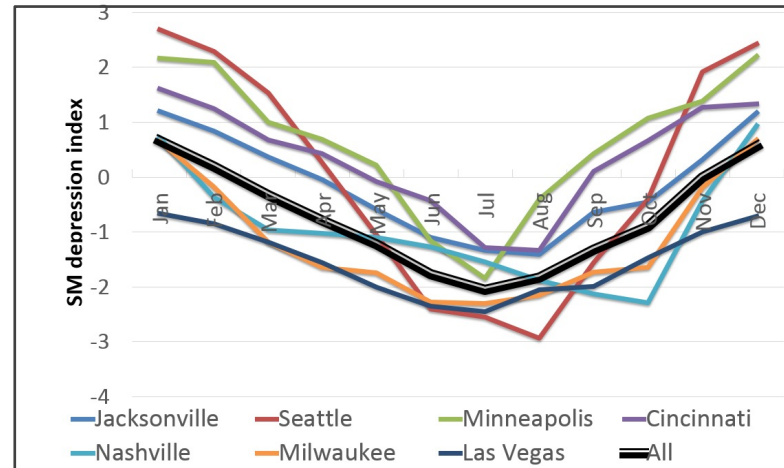
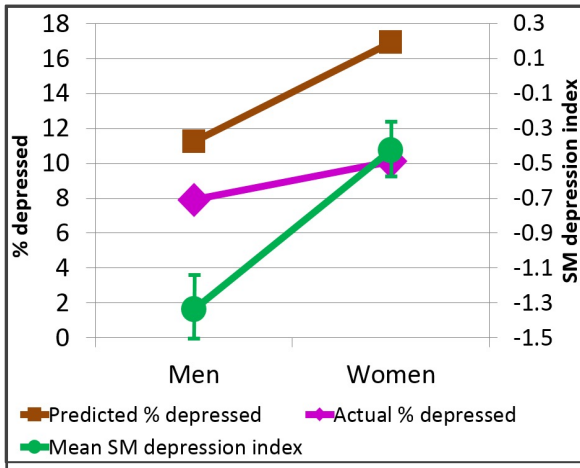
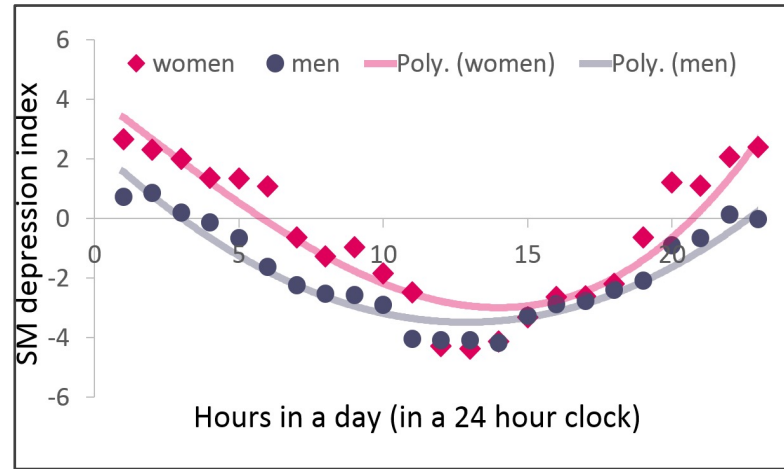
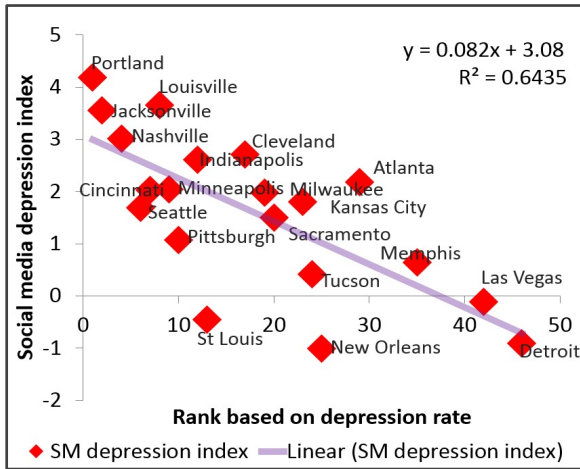
predicted (SMDI)




least squares regression fit yields correlation of 0.52


Population Insights

(De Choudhury, Counts, Horvitz, WebSci 2013)

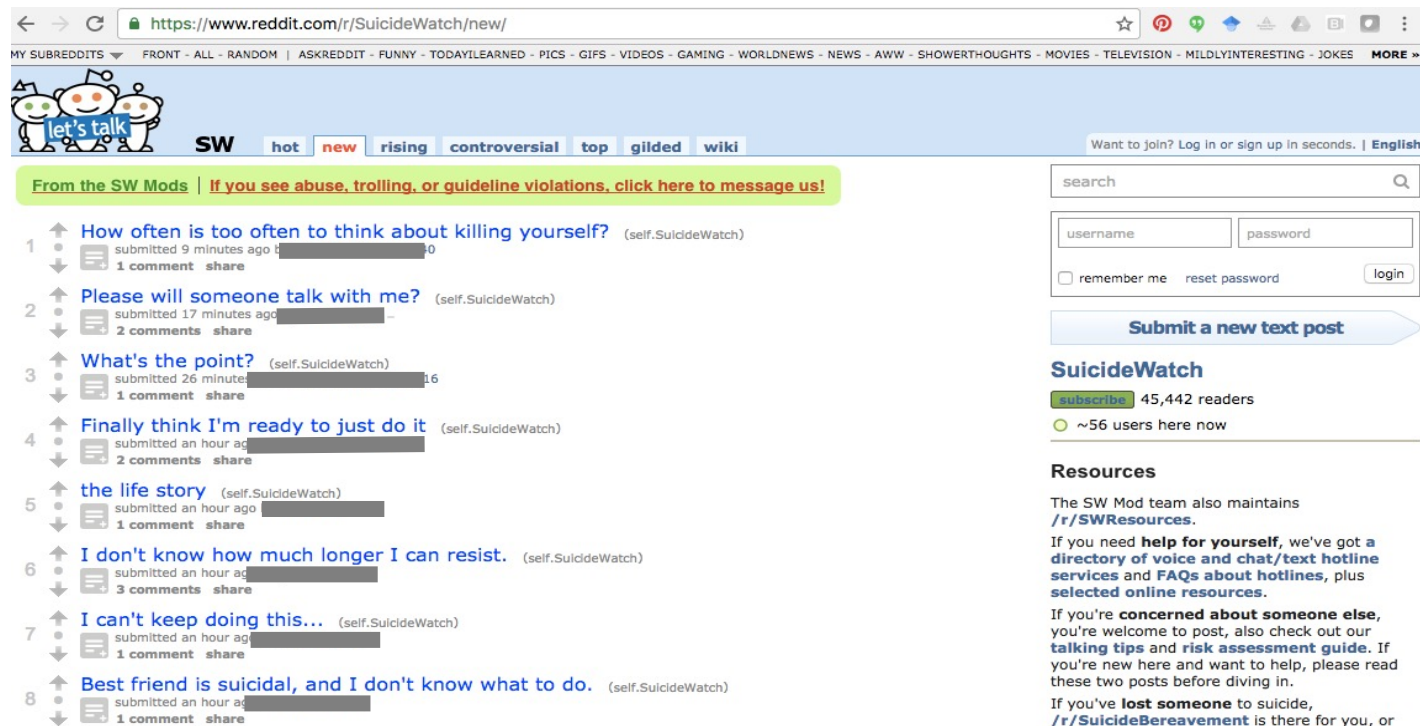




Mental health risks as a precursor
of suicidal thoughts and behaviors
– where social media can help



Media Health Discourse in Social Media Predicts Shifts to Suicidal Ideation



The screenshot shows the Reddit interface for the r/SuicideWatch subreddit. The browser address bar displays <https://www.reddit.com/r/SuicideWatch/new/>. The subreddit header includes the 'let's talk' logo, the name 'SW', and sorting options: hot, new, rising, controversial, top, gilded, and wiki. A green banner from the moderators reads: "From the SW Mods | If you see abuse, trolling, or guideline violations, click here to message us!". The main content area lists eight posts, each with a title, author, submission time, and engagement metrics (comments and shares). The sidebar on the right features a search bar, login fields for username and password, a 'remember me' checkbox, a 'reset password' link, and a 'login' button. Below the login fields is a 'Submit a new text post' button. The sidebar also displays the subreddit name 'SuicideWatch', a 'subscribe' button, 45,442 readers, and approximately 56 users online. A 'Resources' section follows, stating that the SW Mod team maintains a directory of services and FAQs, and provides links to help for oneself, help for others, and bereavement resources.

1 ↑ How often is too often to think about killing yourself? (self.SuicideWatch)
submitted 9 minutes ago by [redacted] 0
1 comment share

2 ↑ Please will someone talk with me? (self.SuicideWatch)
submitted 17 minutes ago by [redacted] -
2 comments share

3 ↑ What's the point? (self.SuicideWatch)
submitted 26 minutes ago by [redacted] 1.6
1 comment share

4 ↑ Finally think I'm ready to just do it (self.SuicideWatch)
submitted an hour ago by [redacted] -
2 comments share

5 ↑ the life story (self.SuicideWatch)
submitted an hour ago by [redacted] -
1 comment share

6 ↑ I don't know how much longer I can resist. (self.SuicideWatch)
submitted an hour ago by [redacted] -
3 comments share

7 ↑ I can't keep doing this... (self.SuicideWatch)
submitted an hour ago by [redacted] -
1 comment share

8 ↑ Best friend is suicidal, and I don't know what to do. (self.SuicideWatch)
submitted an hour ago by [redacted] -
1 comment share

search

username password

remember me reset password login

Submit a new text post

SuicideWatch

subscribe 45,442 readers

~56 users here now

Resources

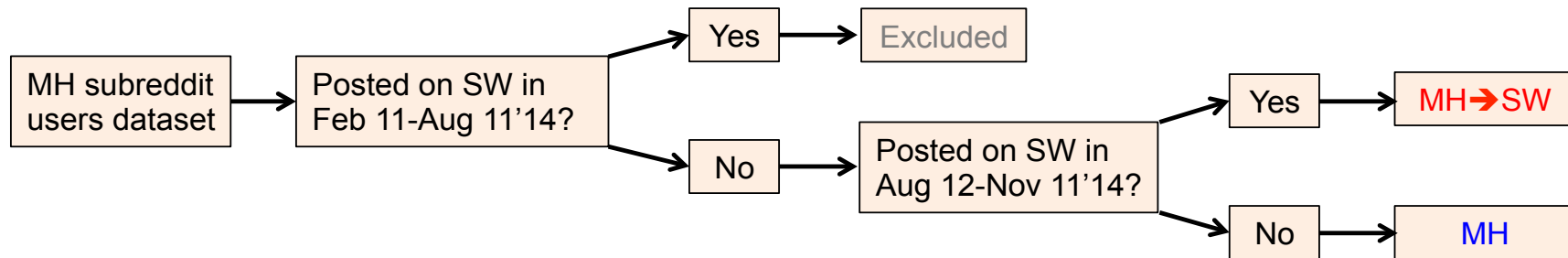
The SW Mod team also maintains [/r/SWResources](#).

If you need **help for yourself**, we've got a **directory of voice and chat/text hotline services** and **FAQs about hotlines**, plus **selected online resources**.

If you're **concerned about someone else**, you're welcome to post, also check out our **talking tips** and **risk assessment guide**. If you're new here and want to help, please read these two posts before diving in.

If you've **lost someone** to suicide, [/r/SuicideBereavement](#) is there for you, or

Propensity Score Matching



- Work within the potential outcomes framework for causal modeling, applying stratified propensity score matching to estimate causal effects

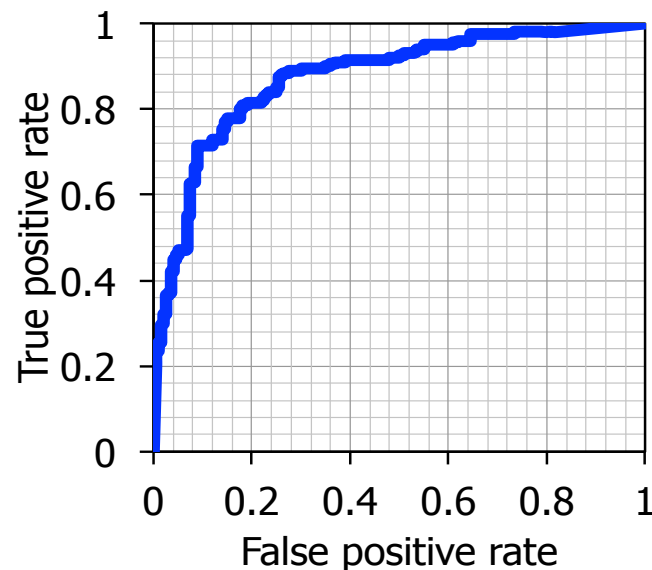
Patterns of Mental Health Discourse on Social Media Predict Future Suicidal Ideation

depression	+30%	differences	-57%
useless	+51%	always a	-56%
suicidal	+34%	be working	-56%
medicine	+52%	keep your	-56%
locked	+51%	preferred	-56%
no friends	+51%	awesome I	-56%
loneliness	+50%	and enjoy	-55%
alone I	+34%	it work	-55%

Prediction

Model	Deviance	df	χ^2	<i>p</i> -value
Null	9190.6	0		
Linguistic Structure	5083.7	5	4106.9	$< 10^{-6}$
Interpers. Awareness	7949.6	4	1241	$< 10^{-9}$
Interaction	4429.2	8	4761.4	$< 10^{-6}$
Content	2793.5	15000	6397.1	$< 10^{-10}$
Full	1864.4	15017	7326.2	$< 10^{-10}$

Actual/Predicted	Class 0	Class 1	Total
Class 0	73	15	88
Class 1	20	68	88
Accuracy	83.5%	77.5%	80% (mean)
Precision	.79	.82	.81 (mean)
Recall	.83	.78	.81 (mean)
F-1	.81	.8	.80 (mean)



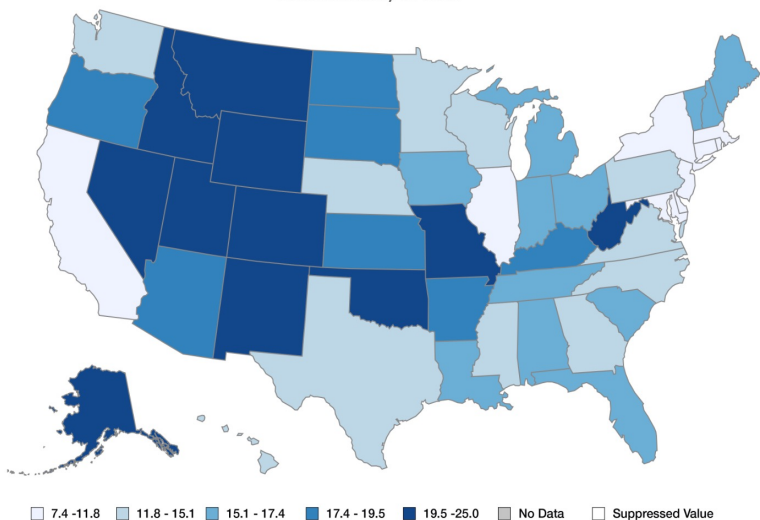
Envisioning social media as part of
a “data ecology” in suicidal risk
prediction

(Choi, Sumner, Holland, Zwald, Bowen, Wang, Law, Taylor, Konjeti, De Choudhury; JAMA Network Open)

Can We Accurately Forecast Nationwide Suicide Rates?

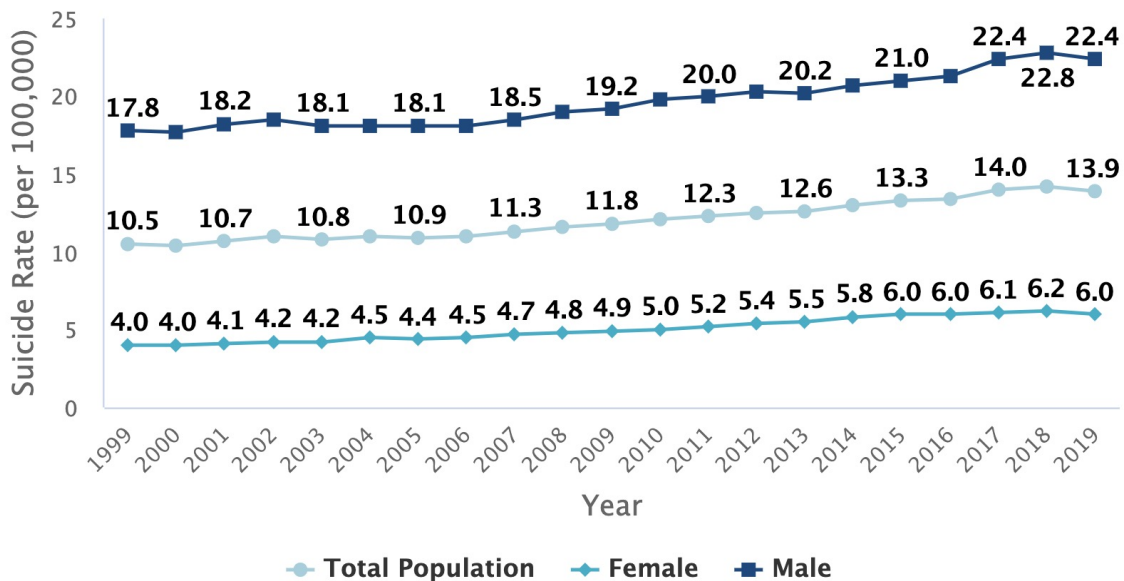
Age-Adjusted Suicide Rates in the United States
(by state; per 100,000; 2019)

Data Courtesy of CDC



Age-Adjusted Suicide Rates in the United States (1999-2019)

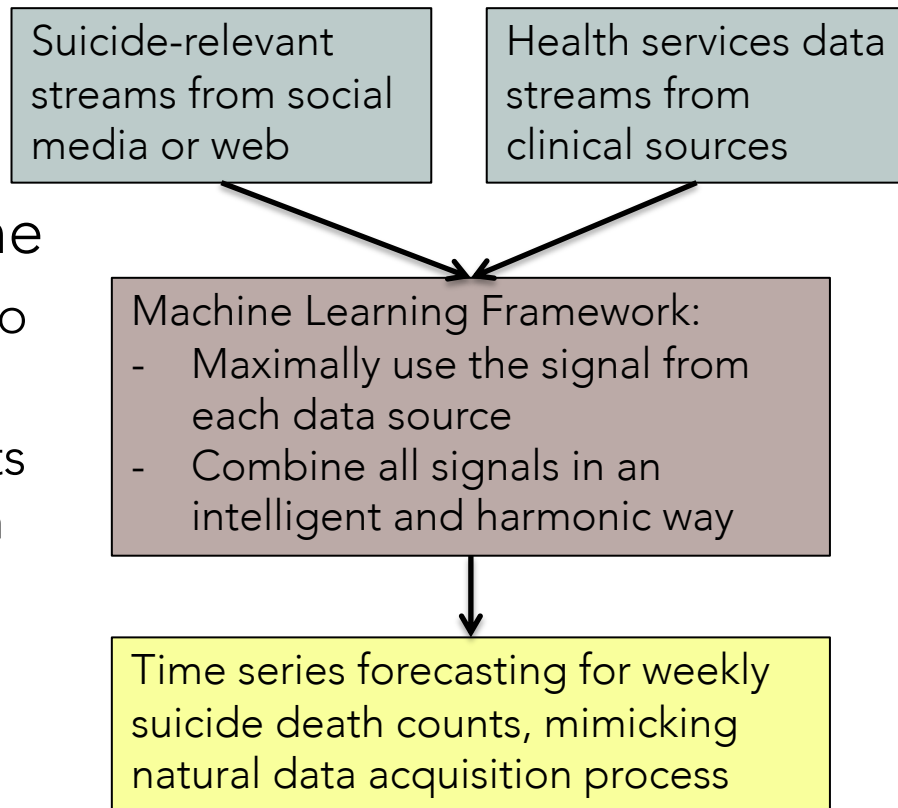
Data Courtesy of CDC



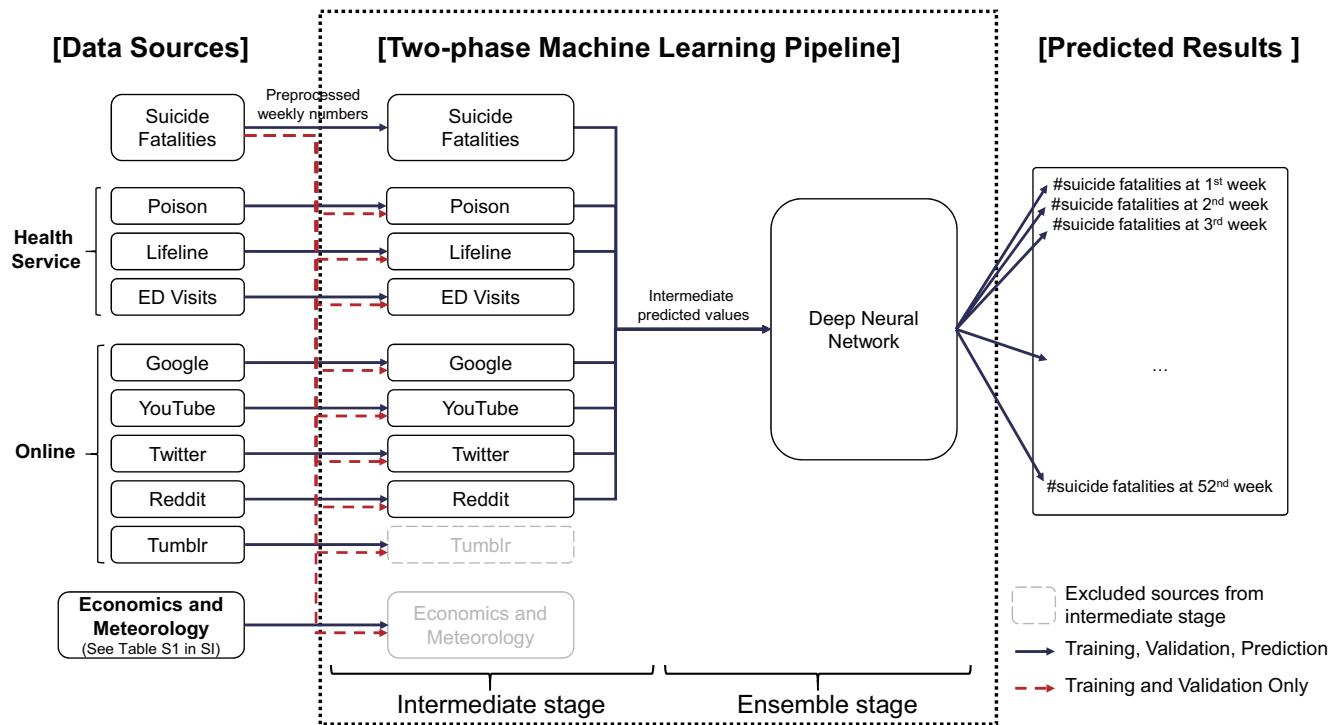
Partly supported by a contract from the CDC

Combining Real-Time Datasets

- Goal: Building a machine learning framework to predict suicide death counts in real-time
 - ◆ Time series forecasting problem to predict weekly number of suicide
 - ◆ Using multiple time series datasets collected and pre-processed from both social media and clinical sources



Overall Architecture



Prediction Results (Ensemble Model)

Ground truth: 14.47

Ensemble Type	Pearson Coeff.	RMSE	MAPE	SMAPE	Annual Estimated Rate (Error %)
Health Services Data Sources	0.802	56.847	5.457	2.629	15.08 (4.14%)
Online Data Sources	0.633	52.035	4.189	2.149	14.12 (2.49%)
Baseline + Health Services Sources	0.832	46.096	4.367	2.123	14.91 (2.97%)
Baseline + Online Data Sources	0.737	80.478	7.306	3.841	13.37 (7.67%)
Health Services + Online Data Sources	0.791	43.239	3.806	1.916	14.31 (1.17%)
All Data Sources	0.811	44.439	4.006	2.001	14.40 (0.55%)

Takeaways

SELF-CARE

The New York Times

Is Everybody Doing ... OK? Let's Ask Social Media

Researchers are looking at online behavior to gauge public mental health. The results aren't pretty.



The path
forward...

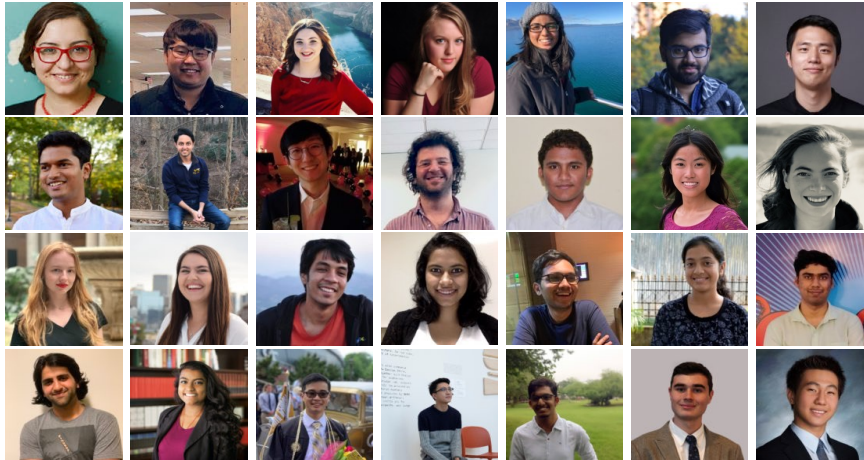
(Chancellor et al.; FAccT [previously FAT*] 2019)
(Lee et al.; Biological Psychiatry: CNN)



Daragh Walsh Kennedy

Thanks!

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<http://www.munmund.net>
[@munmun10](#)



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BE THE FUTURE



and many more...