Spatial differences in exposure to HPV vaccine information on Twitter and its association with coverage

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Global Challenges in Vaccine Acceptance Science, Annecy

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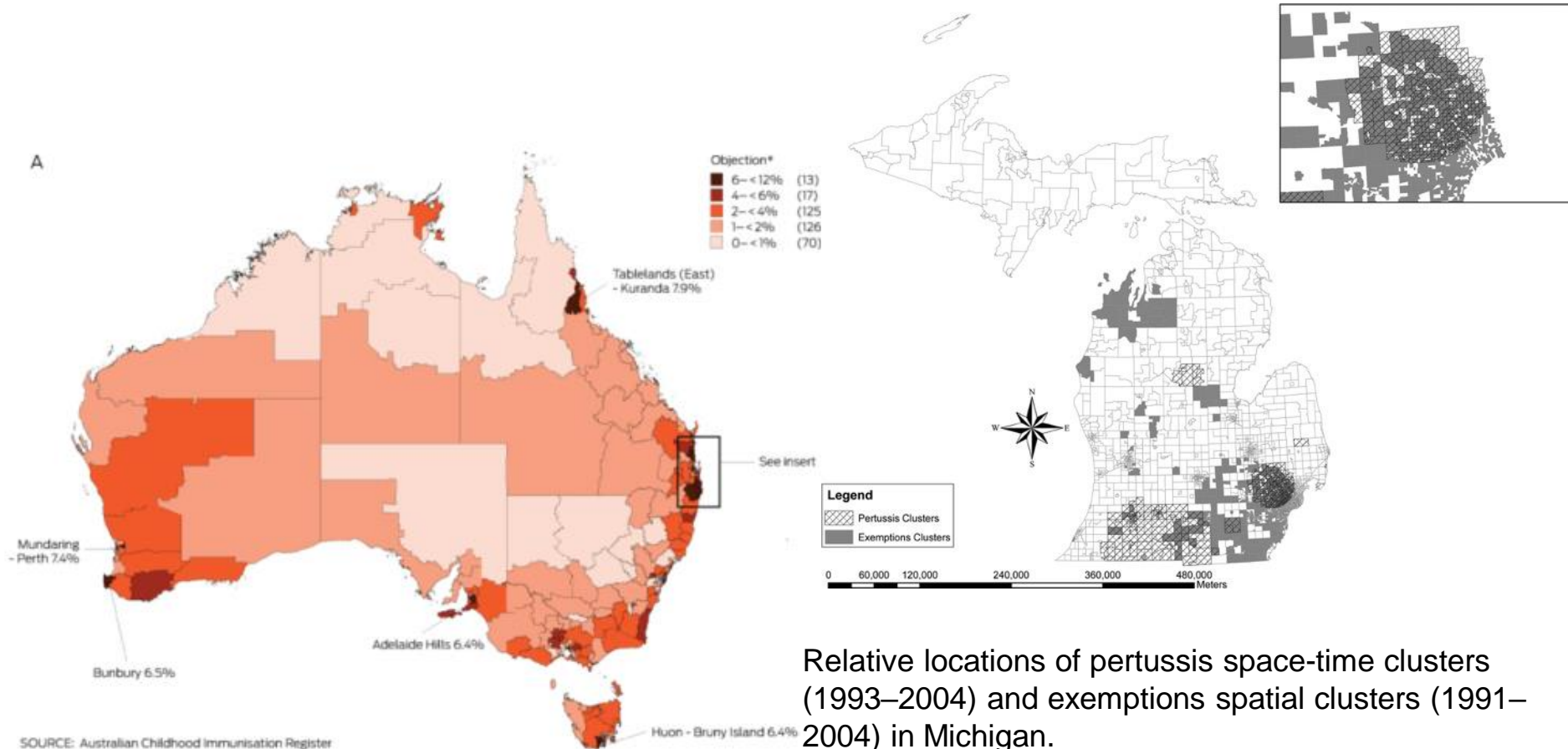THE UNIVERSITY OF
SYDNEY

Acknowledgements

Adam Dunn, Didi Surian, Enrico Coiera, Centre for health Informatics, Macquarie University

Aditi Dey, National Centre for Immunisation Research and Surveillance
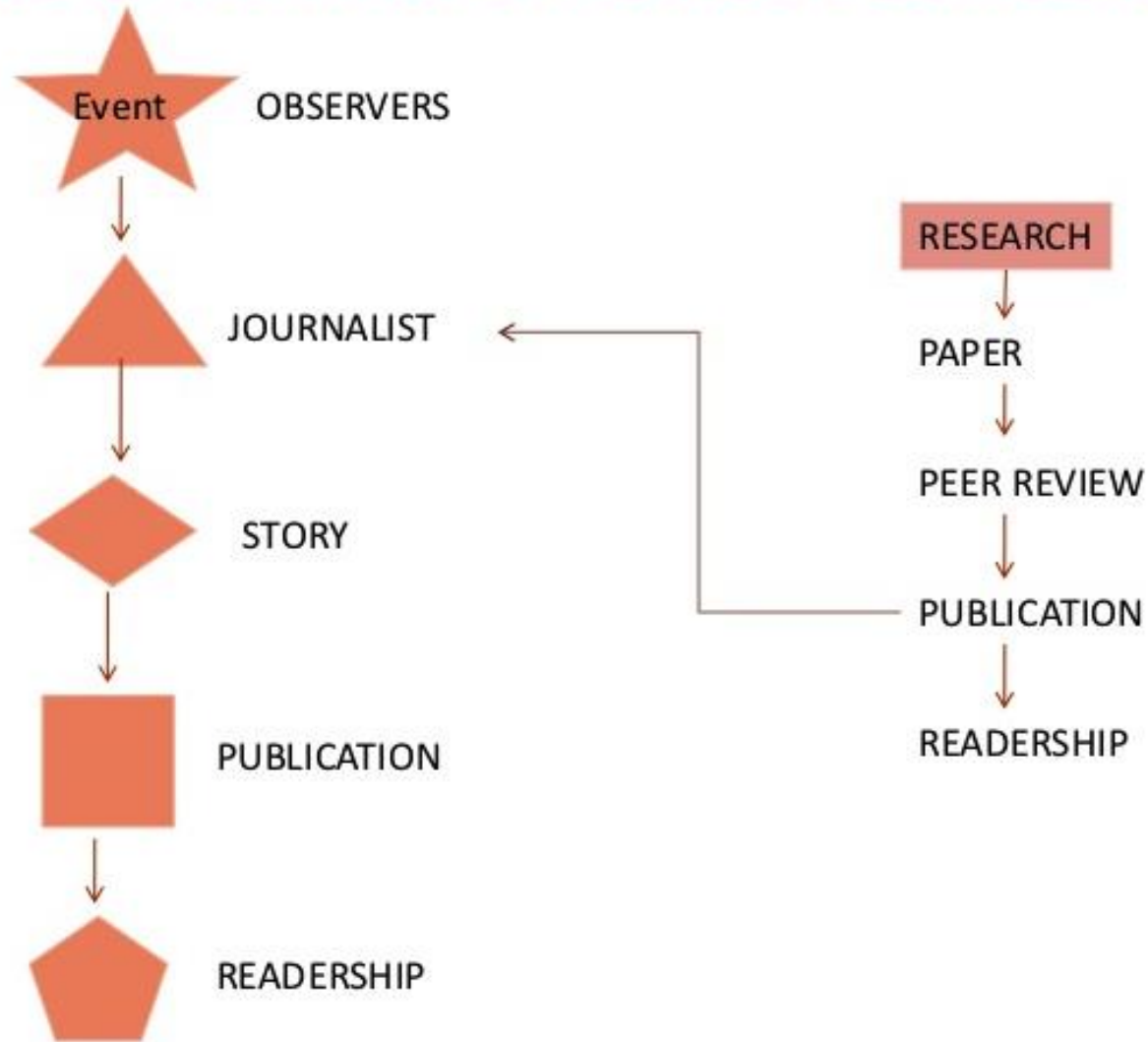
Ken Mandl, Harvard Medical School

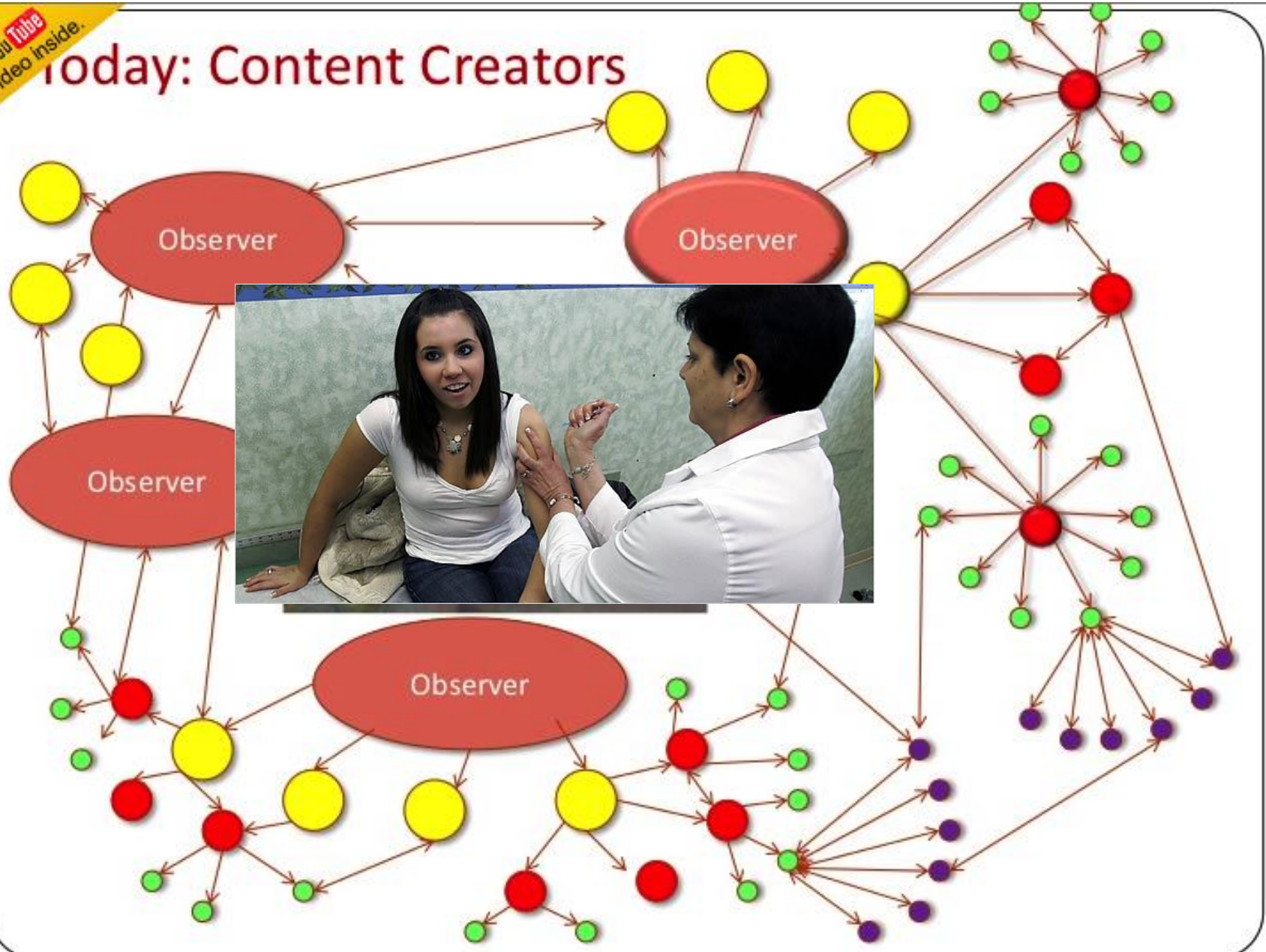# Geographic networks influence sentiment and dx transmission

A

Objection*
- 6–<12% (13)
- 4–<6% (17)
- 2–<4% (125)
- 1–<2% (126)
- 0–<1% (70)

Tablelands (East) – Kuranda 7.9%

See insert

Mundaring – Perth 7.4%

Bunbury 6.5%

Adelaide Hills 6.4%

Huon – Bruny Island 6.4%

SOURCE: Australian Childhood Immunisation Register

Legend
- Pertussis Clusters
- Exemptions Clusters

0 60,000 120,000   240,000   360,000   480,000 Meters

Relative locations of pertussis space-time clusters (1993–2004) and exemptions spatial clusters (1991–2004) in Michigan.

Saad B. Omer et al. Am. J. Epidemiol. 2008;168:1389-1396

What about online networks?

The world as we knew it! Content Consumers

Event ★ OBSERVERS

▲ JOURNALIST

◆ STORY

■ PUBLICATION

⬠ READERSHIP

RESEARCH

PAPER

PEER REVIEW

PUBLICATION

READERSHIP

Today: Content Creators

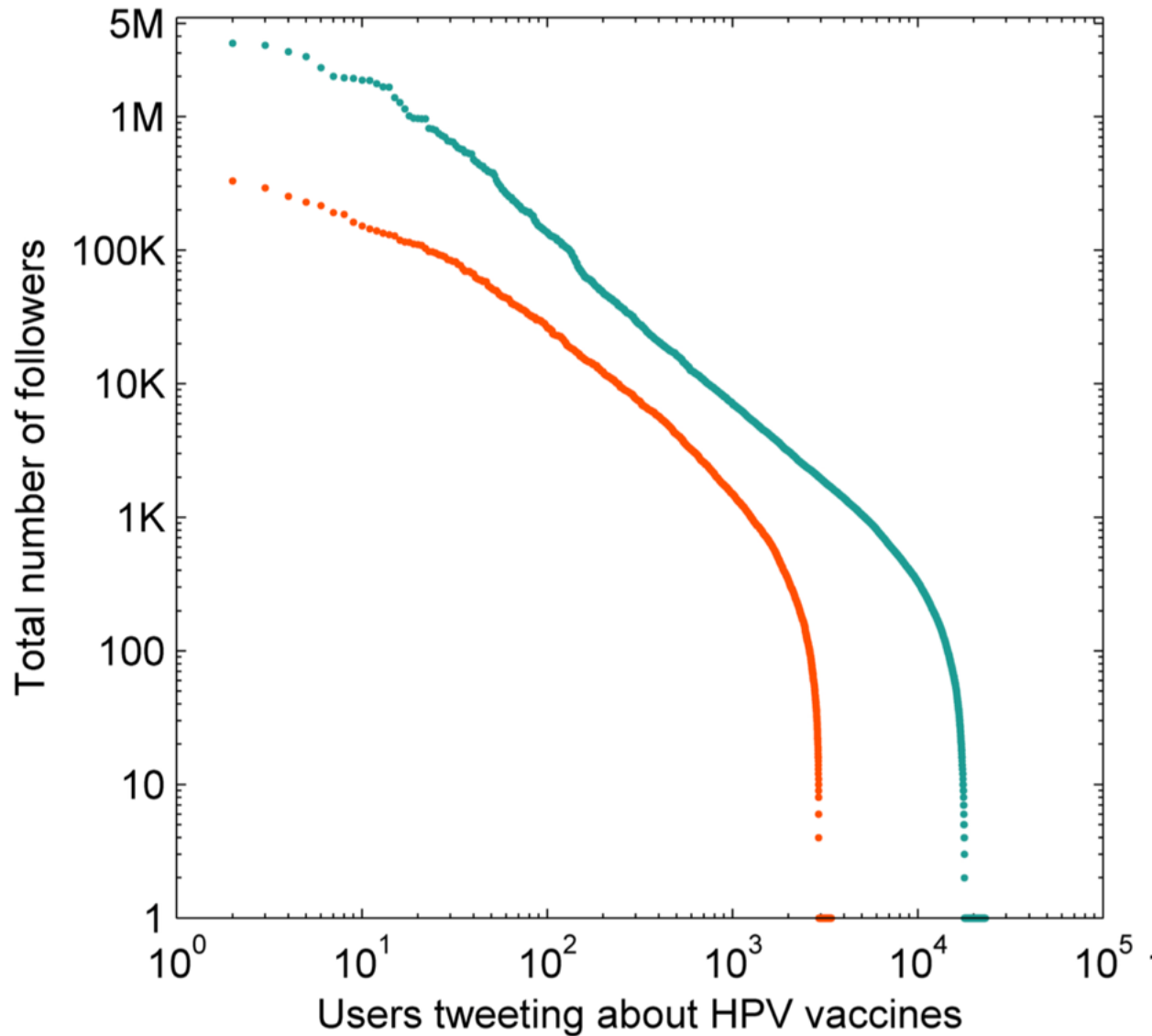Observer

Observer

Observer

Observer

You can count tweets but…

Figure 1. The number of tweets posted each day during the data collection period, including tweets rejecting the safety or value of HPV vaccines (orange) and all other HPV vaccine tweets (cyan). Gray vertical lines indicate Sundays. No corrections for time zone differences were applied.
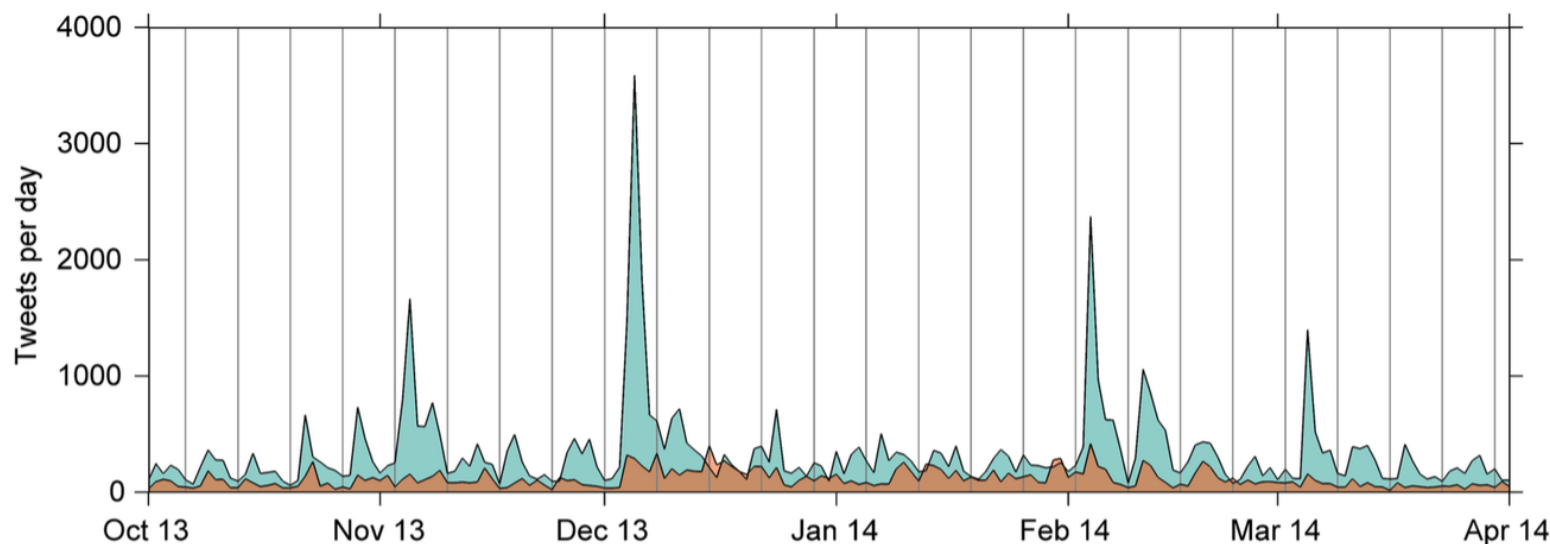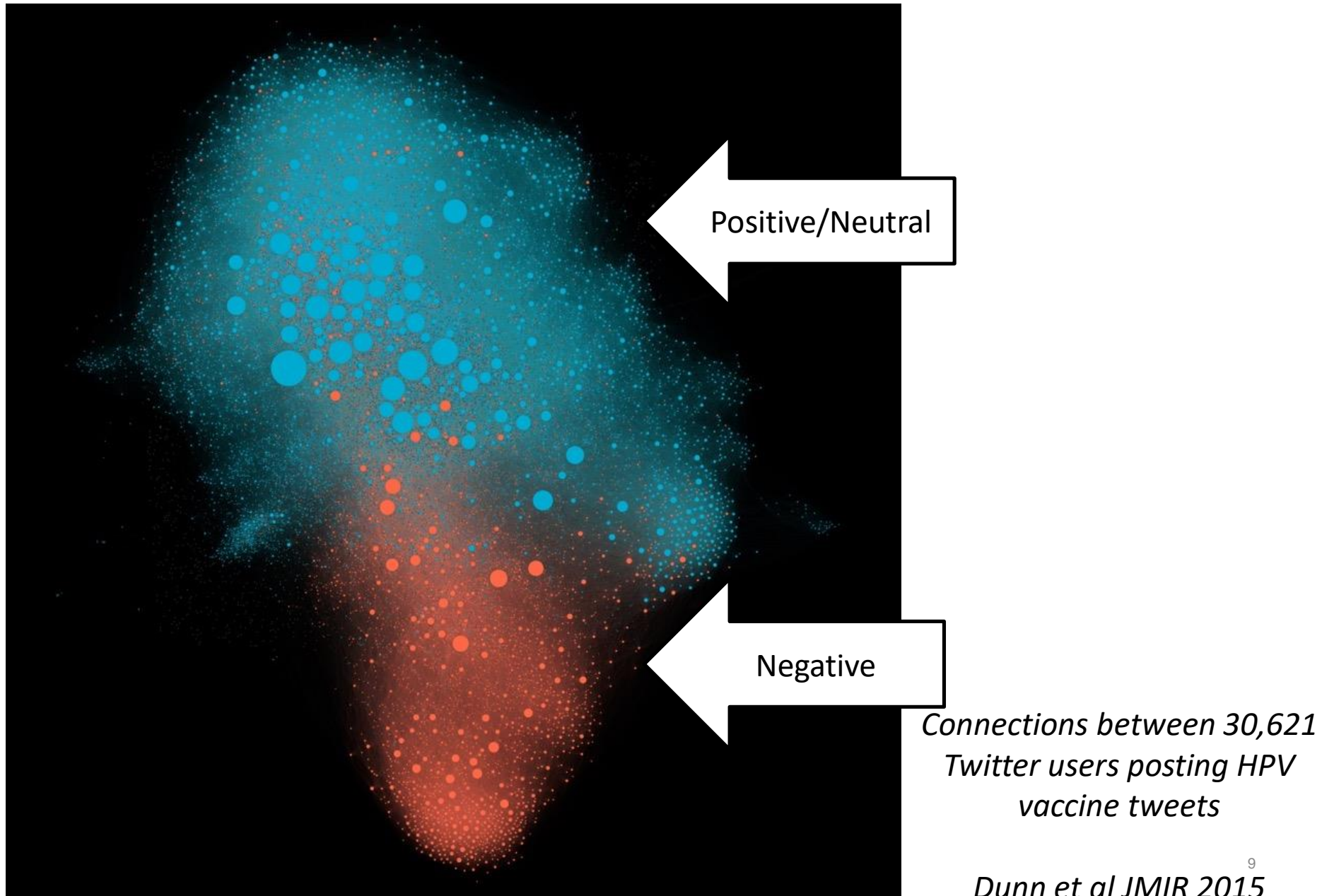
Dunn AG, Leask J, Zhou X, Mandl KD, Coiera E. Associations between exposure to and expression of negative opinions about human papillomavirus vaccines on social media: an observational study. *Journal of Medical Internet Research* 2015;17(6):e144

counting tweets won't tell you about reach

Measuring exposure to tweets is one option

Positive/Neutral

Negative

Connections between 30,621 Twitter users posting HPV vaccine tweets

Dunn et al JMIR 2015

Exposure won't tell you about behavioural impact

Message > Reach > Impact

NEWS Experience has taught us how

NEWS   OPINION   NATIONAL AFFAIRS   BUSINESS   TECHNOLOGY   HIGHER ED   MEDIA   SPORT

BREAKING NEWS | THE NATION | THE WORLD | FEATURES | IN-DEPTH | HEALTH & SCIENCE | INVESTIGATIONS | MAGAZIN

NEWS   Tweet 0   Recommend 0   A⁺ A⁻

Decline in vaccination rates due to parents who read up online about jabs

SUE DUNLEVY News Limited Network   May 22, 2013 12:00AM

Aim

To determine whether state level differences in exposure to information on Twitter about HPV vaccines were associated with state level differences in HPV vaccine coverage.

Mapping information exposure on social media to explain differences in HPV vaccine coverage in the United States

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[b] School of Public Health and Sydney Nursing School, The University of Sydney, Sydney, NSW 2006, Australia
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[d] Computational Health Informatics Program, Boston Children's Hospital, Boston, MA 02115, United States
[e] Department of Biomedical Informatics, Harvard Medical School, Boston, MA 02115, United States

Methods

– State level coverage NIS 13-17 years

– 10,084 females and 10,743 males in 2014

– 10,508 females and 11,367 males in 2015

– Measure of poverty, racial and ethnic composition, insurance coverage, education from 2014 census

– Tweets collected between 1 October 2013 and 30 October 2015 using API which repeatedly searches for tweets that include "Gardasil, Cervarix, hpv + vaccine*, cervical + vaccin*

– 273.8 million exposures to 258,418 tweets

– Classified by topic using machine learning methods.

– Compared the models with those based on insurance, income, education, and race/ethnicity.

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⊙ Sydney, New South Wales

🔗 sydney.edu.au/medicine/peopl…

🗓 Joined July 2009

Results

Distribution of 219.7 million potential exposures to HPV vaccine tweets by county

Legend:
- >0.91
- 0.82+
- 0.73+
- 0.64+
- 0.55+
- 0.45+
- 0.36+
- 0.27+
- 0.18+
- 0.09+
- <0.09
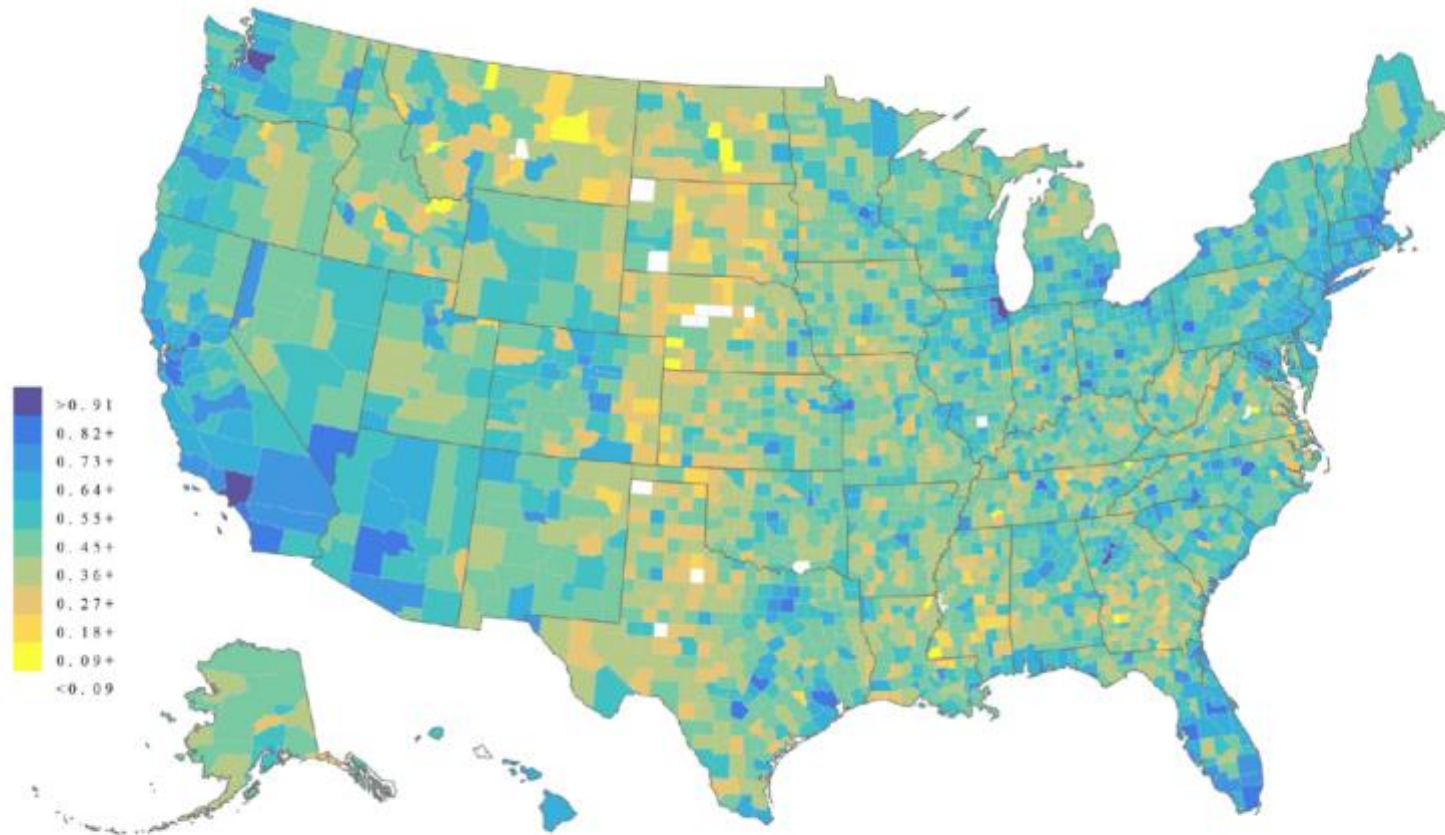
Fig. 1. The distribution of the 219.7 million potential exposures to HPV vaccine tweets by county. Colors are given by each county's percentile among total exposure counts, ranging from 0 to 19.7 million (New York County, NY). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Topic modelling
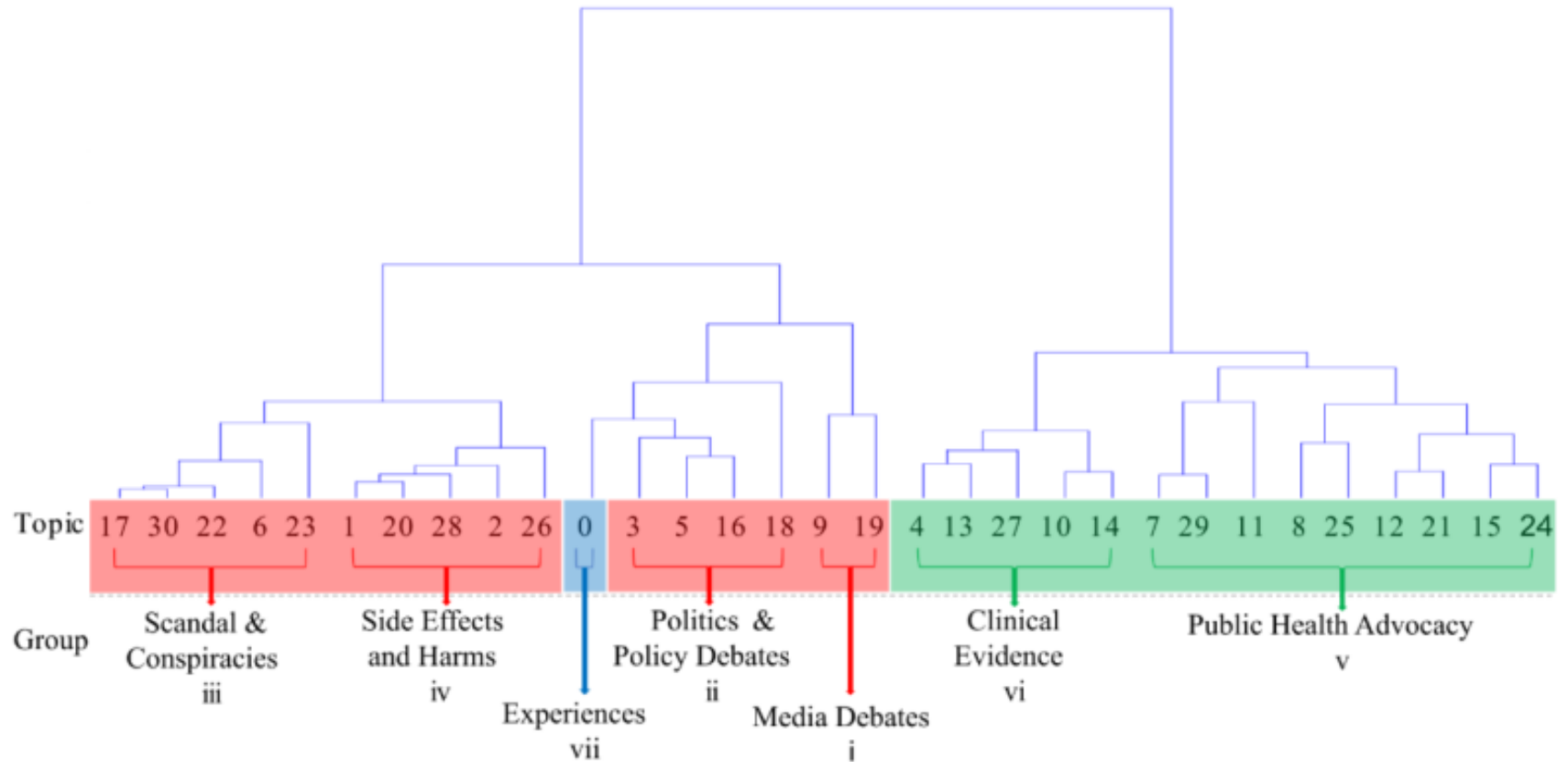
Example tweets from Topic 26:
- "#Gardasil #Vaccines "They've been robbed of their womanhood:" Two sisters face one life-changing diagnosis http://to.fox6now.com/..."
- "Please don't give the HPV vaccine to your boys or girls. http://www.wnd.com/... https://www.youtube.com/... http://healthimpactnews.com/..."

Example tweets from Topic 27:
- "New HPV vaccine could protect against 90% of cases of cervical cancer following a trial of more than 14,000 women http://www.dailymail.co.uk/..."
- "The quadrivalent vaccine may protect from cervical abnormalities.#HPV #Vaccine http://www.bmj.com/..."

Example tweets from Topic 0:
- "Got my 3rd HPV vaccine yesterday and my arm still hurts like a bitch 😫"
- "If u had the gardasil shot at the doctors u know that bitch hurts bad lmaoo and it leaves ur arm sore af for like a week"

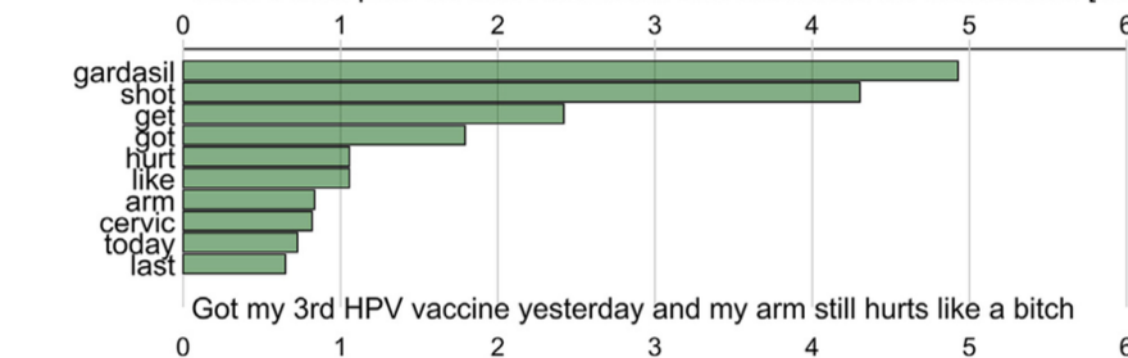(a) Community 24
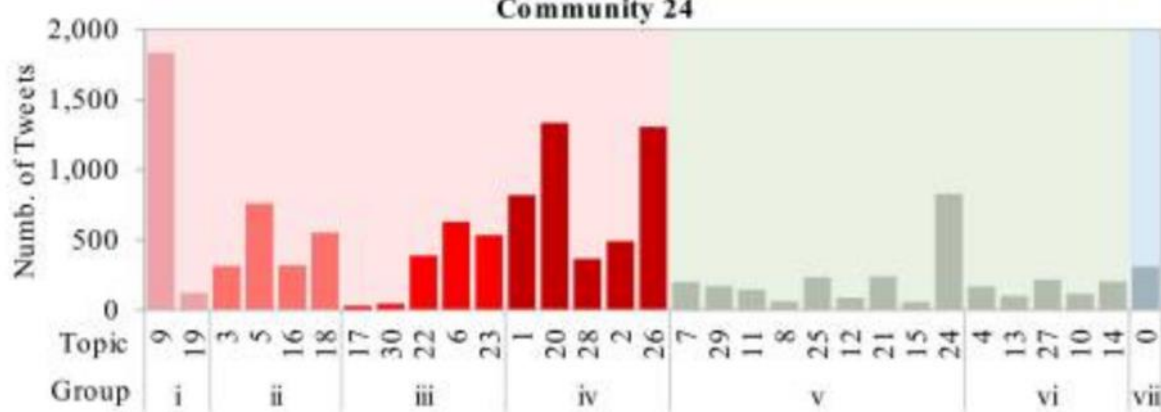
5275 users, 2.46 tweets per user
More harms/conspiracy

(b) Community 20
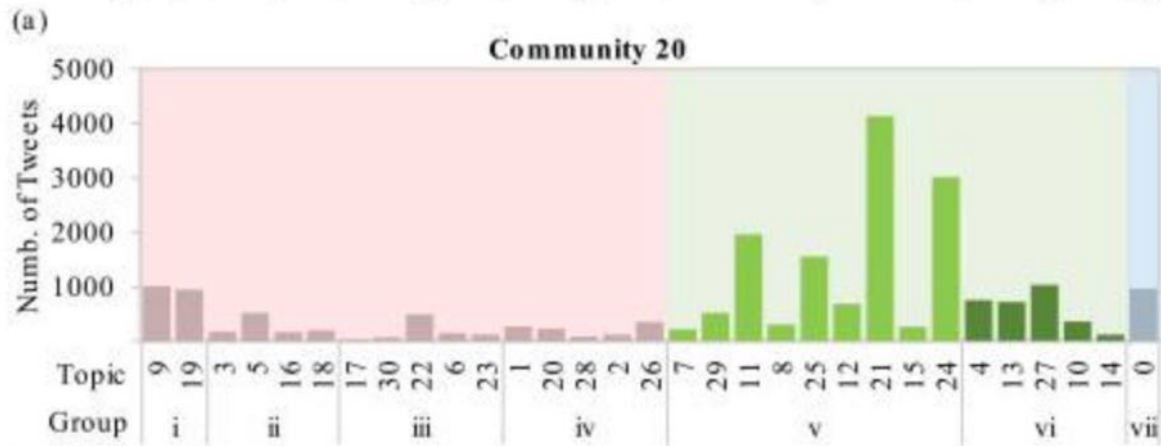
11,047 users, 1.96 tweets per user
More evidence/advocacy

(c) Community 34
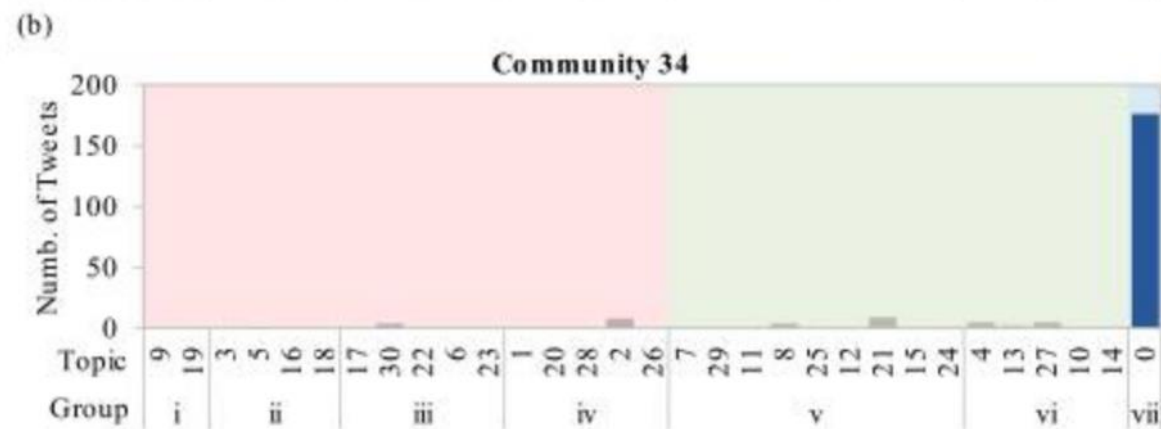
187 users, 1.16 tweets per user
More experiential

Today @KatieShow we're talking about #HPV & the controversy surrounding the vaccine - what are your thoughts? ktie.tv/1eMAEvz
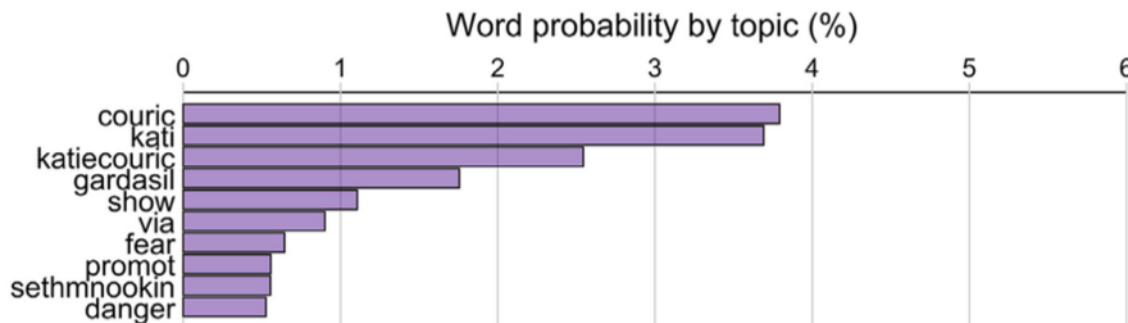
Katie Couric puts the anti-vaccination movement into the mainstream [latimes.com] A Disservice to all #katiecouric #HPV

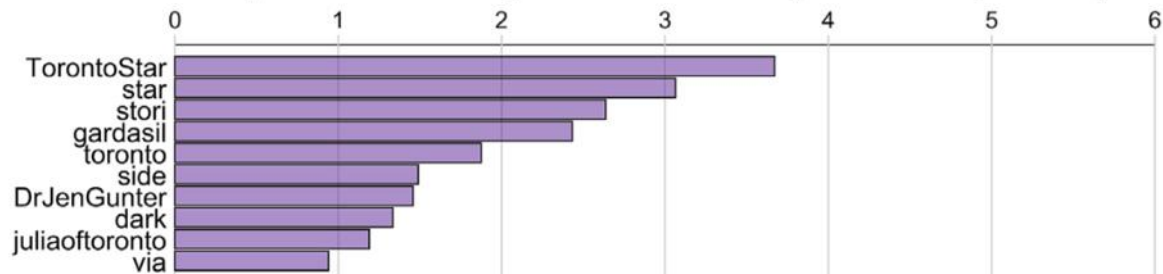Got my 3rd HPV vaccine yesterday and my arm still hurts like a bitch

"There was a bad story-management combination approved by me: a foreboding headline, undue emphasis on the front page and terrible timing.
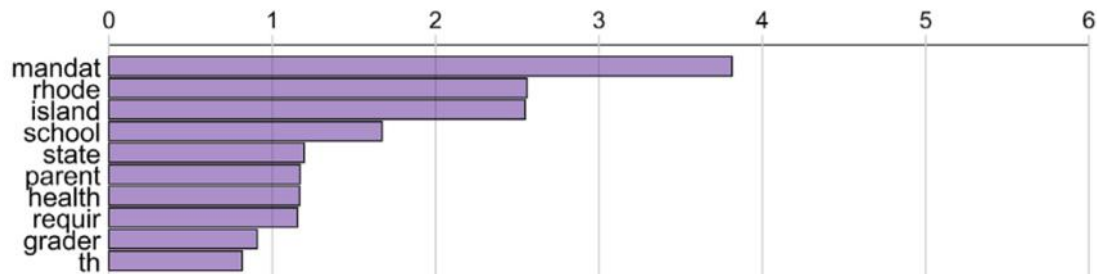
Female, 13-17, at least one dose (2015)
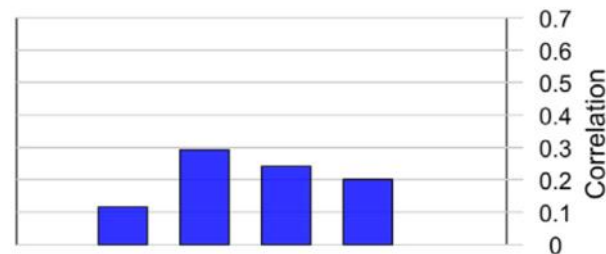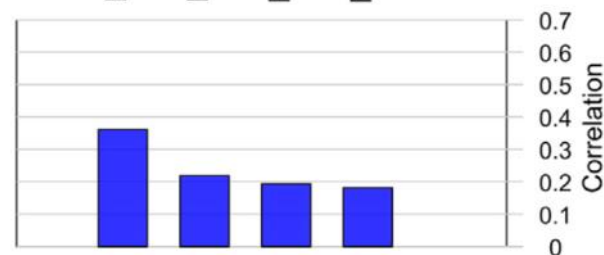
- All covariates including Twitter
- Only Twitter
- All covariates except Twitter
- Education covariates
- Insurance/poverty covariates

Male, 13-17, at least one dose (2015)

- All covariates including Twitter
- Only Twitter
- All covariates except Twitter
- Education covariates
- Insurance/poverty covariates

Pearson's R
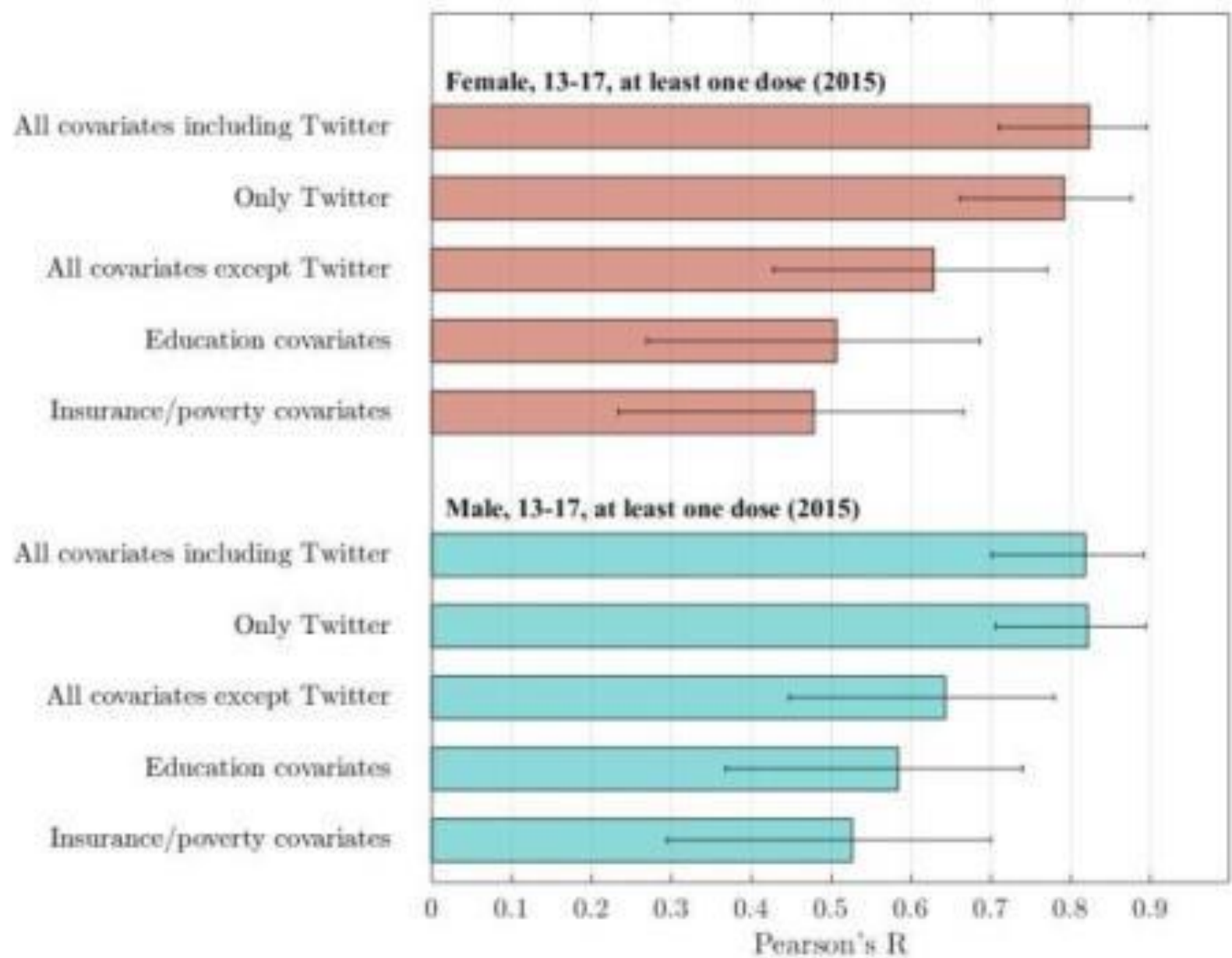
Limitations

We did not show direction of effect

Only Twitter

Uncorrected for differences in demographics between whom we measure and their population

Discussion

- In the US and with HPV vaccine, measures of information exposure derived from Twitter explained differences in coverage not explained by socioeconomic factors
- Vaccine coverage was lower in states where safety concerns, misinformation, and conspiracies made up a higher proportions of exposures
- Coverage most closely correlated with topics in mainstream news media (Couric, Toronto Star and advocacy)
- Socio-economic factors remain significant - insurance and poverty Pearson's R 0.62 for females 3 doses (Twitter only 0.78)
- On Twitter (and elsewhere) young people are describing their HPV vaccination experiences

Conclusions

- Efforts to reduce socio-economic barriers remain important.
- Twitter sentiment is likely to reflect and predict behaviour
- Twitter data has potential as a surrogate indicator for localised differences in acceptance.
- Routine systems to monitor exposure could identify where misinformation is over represented and guide interventions.
- The young person's vaccination experience is important. Young people can lack knowledge, feel anxious and find pain difficult. Strategies to assist them are known and effective.*
- Our research is now focusing on machine learning of information quality. We will correlate child vaccination coverage with sentiment and information quality.

Davies C, Skinner SR, et al (2017)'Is it like one of those infectious kind of things?'
The importance of educating young people about HPV and HPV vaccination at
school, Sex Education, 17:3, 256-275,

Thank you

Australian Collaboration of Social Sciences in Immunisation
COSSI