Using Twitter for Academic Research

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The Twitter Research Team

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MEXICO

GULF OF MEXICO

THE BAHAMAS

CUBA

ATLANTIC OCEAN

PACIFIC OCEAN

UCSF Twitter Research Projects

* **Public Health Surveillance of Dental Pain via Twitter**.
  Journal of Dental Research, 2011. Natalie Heaivilin; Barbara Gerbert, PhD; Jens Page; Jennifer Gibbs, DDS, PhD. (published)

* **What Do People Tweet About Pain? Toothaches, Backaches, Earaches, and Headaches. Implications of using social media to collect and deliver targeted health care information.**
  Kristina Ahlwardt; Janice Y. Tsoh, PhD; Natalie Heaivilin; Barbara Gerbert, PhD. (manuscript in progress)

* **Public Health Surveillance of Broadcast Information Regarding Dental Pain.** Christina Diep; Barbara Gerbert, PhD; Jennifer Gibbs, DDS, PhD. (manuscript in progress)

* **Twitter Survey of Contractions and Labor Pains**.
  Tirah Samura, MD; Naomi Stotland, MD; Janice Y. Tsoh, PhD; Natalie Heaivilin; Barbara Gerbert, PhD. (Coding)

* **Pediatric Dental Experiences Reported on Twitter.**
  Shirin Mullen, DDS; Barbara Gerbert, PhD; Natalie Heaivilin; Janice Y. Tsoh, PhD. (finalizing coding scheme)

* **People Tweeting about Their Orthodontic Treatment**.
  April Cole; Janice Tsoh, PhD; Natalie Heaivilin; Barbara Gerbert, PhD. (developing codebook)

Twitter, Inc.

* Launched publicly in July 2006

* A social networking medium of status updates, known as *tweets*.

* Asks the question, "What are you doing?"

* All tweets are 140 characters or fewer

* Ways to post a tweet:

  * Applications on mobile devices

  * Web interface (Twitter, Facebook, etc.)

  * Text messages from mobile devices

* Global Usage

* Majority of content is public
(Moore 2009)

http://www.beevolve.com/twitter-statistics/
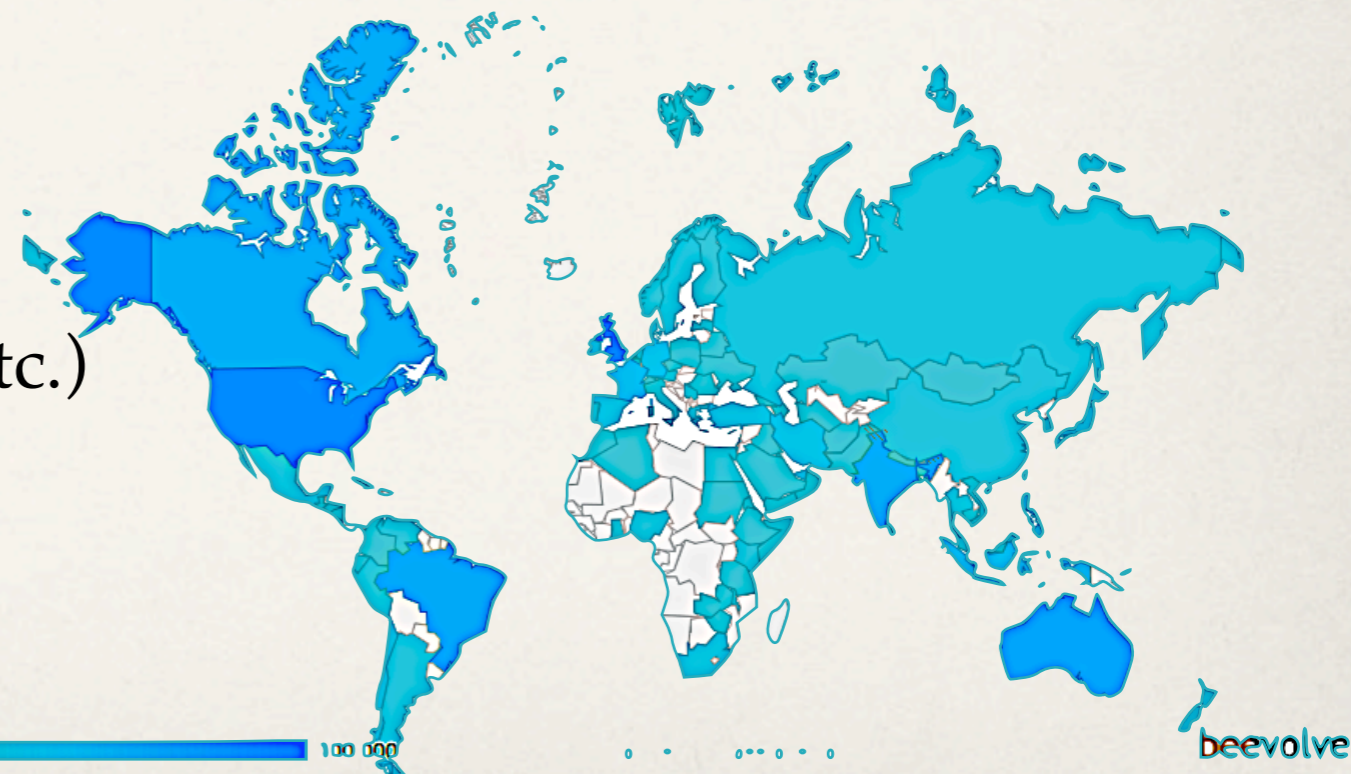
Historical Tweets

@jack
Jack Dorsey ✓

just setting up my twttr

21 Mar 06 via web

Retweeted by GiuliaMingy and 3095 others

@Astro_TJ
TJ Creamer

Hello Twitterverse! We r now LIVE tweeting from the International Space Station -- the 1st live tweet from Space! :) More soon, send your ?s

22 Jan via web   ☆ Favorite   ↻ Retweet   ↩ Reply
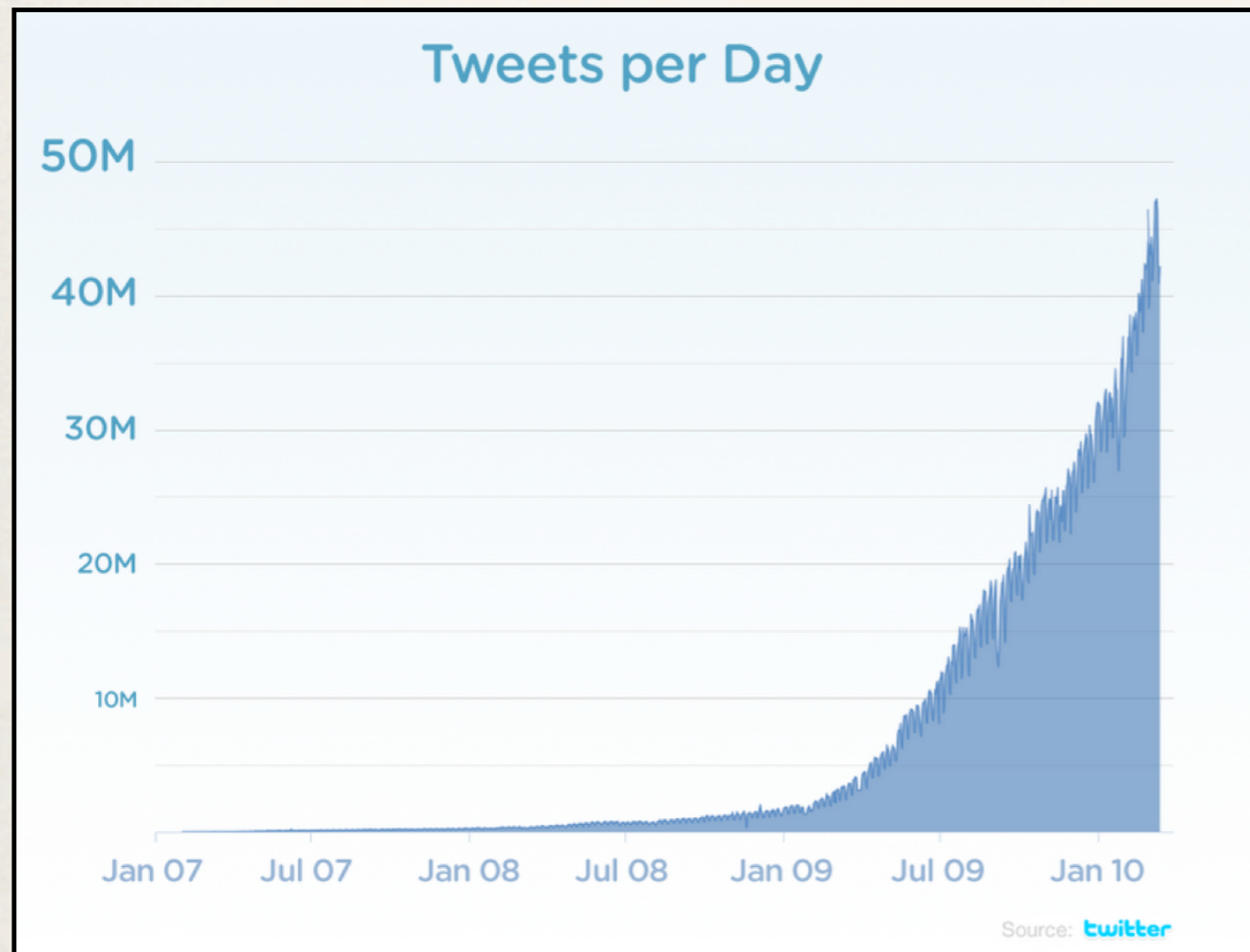
Tweet Preservation
Wednesday, April 14, 2010

@librarycongress
Library of Congress

Library to acquire ENTIRE Twitter archive -- ALL public tweets, ever, since March 2006! Details to follow.

14 Apr via web   ☆ Favorite   ↻ Retweet   ↩ Reply

Twitter Users & Tweets/day
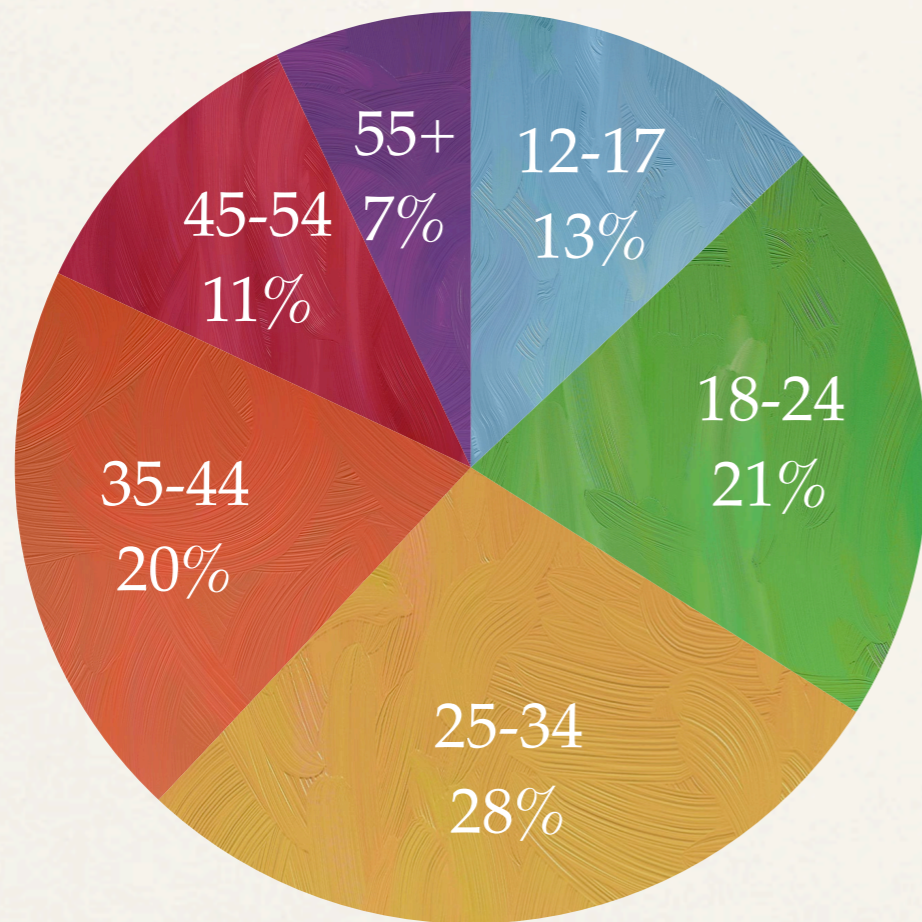

Tweets per Day

Source: twitter
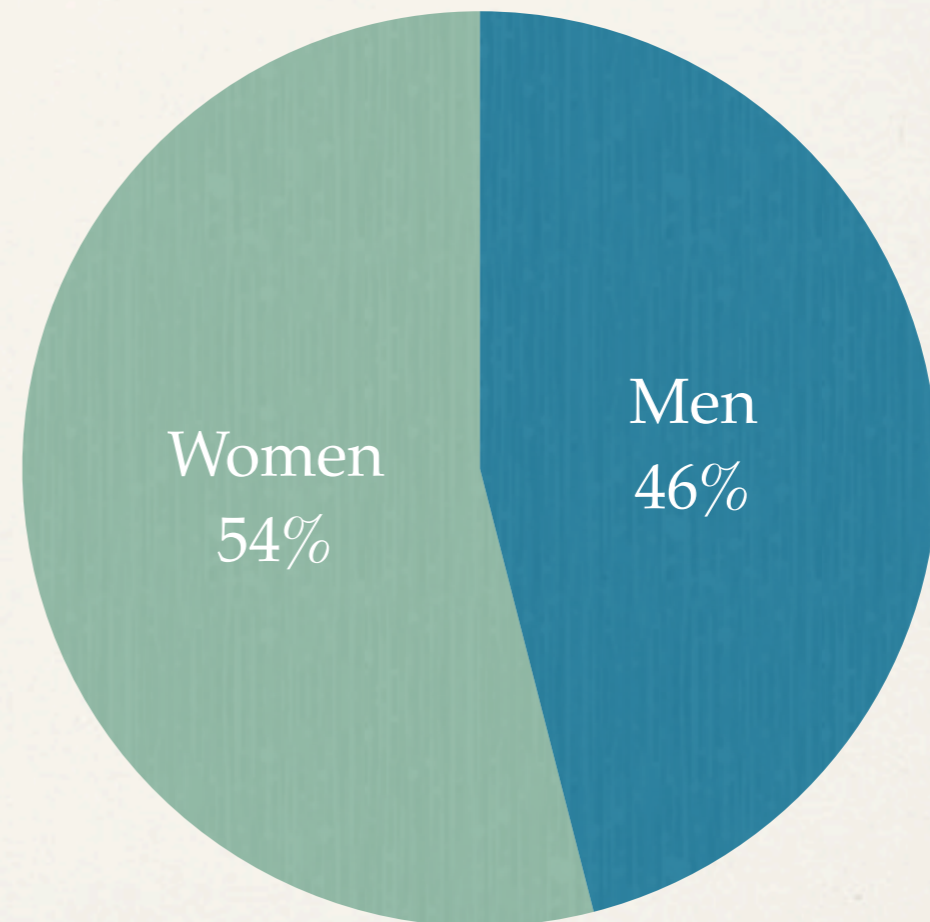
* January 2010:
    * 50M Tweets/day
* September 2011:
    * 100M Active Twitter Users
* March 2012:
    * **340M Tweets/day**
    * **140M Active Twitters Users**
    * 28 languages

Demographics of American Twitter Users

Age

- 12-17 13%
- 18-24 21%
- 25-34 28%
- 35-44 20%
- 45-54 11%
- 55+ 7%

Gender

- Men 46%
- Women 54%

Ethnic Composition: Monthly Twitter Users vs. US Population

Ethnic Composition

Legend:
- Twitter
- 2011 Census

Y-axis: 0%, 20%, 40%, 60%, 80%

X-axis: White, African-American, Hispanic, Asian, Other
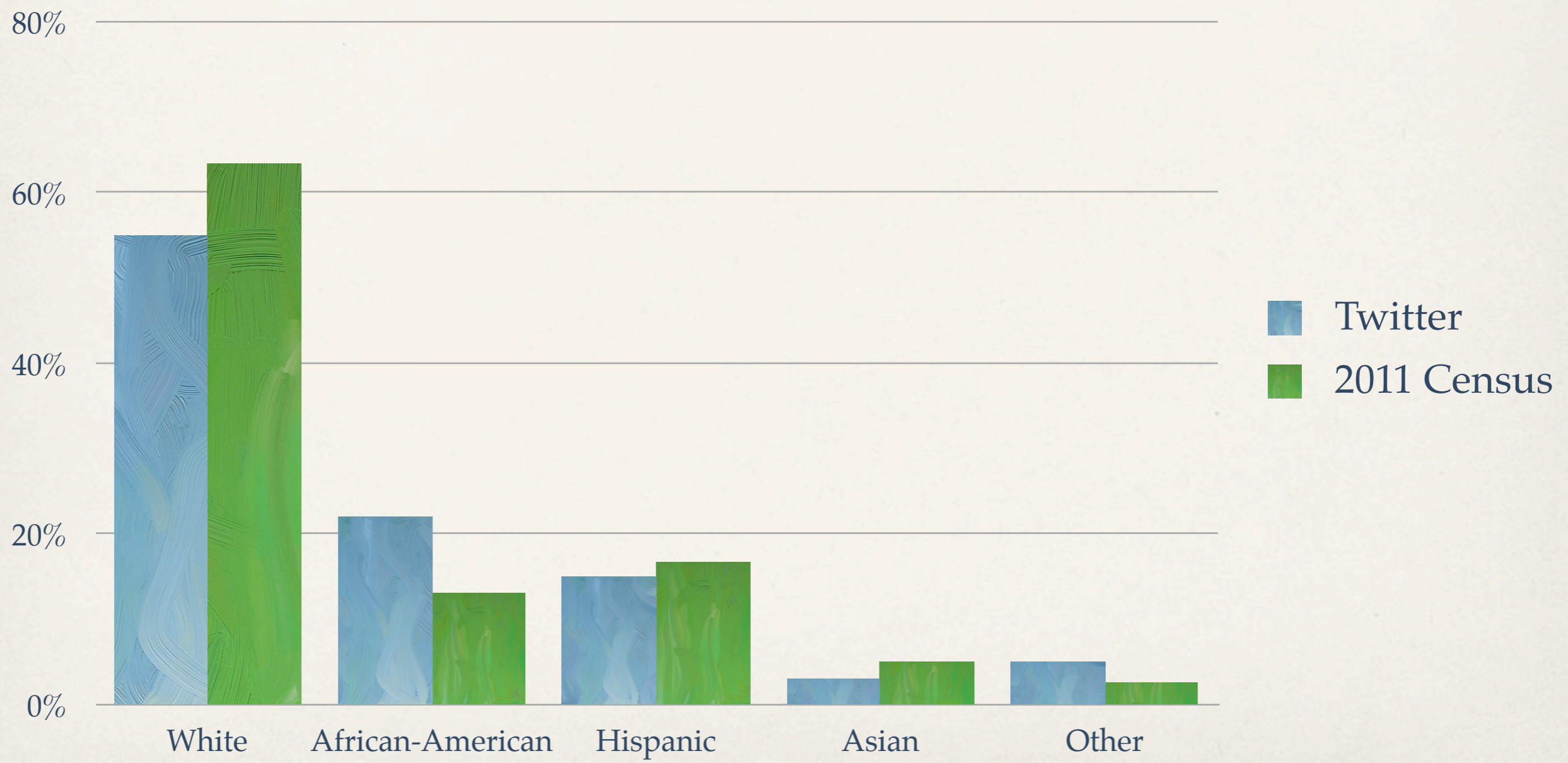
10% of Americans 12 years and older use Twitter

Do you ever post tweets on Twitter?

% saying yes

100

75

50

25

0

■ 2010   ■ 2011   ■ 2012

How often do you use Twitter?

12% Nearly every day

23% At least once/week

16% At least once/month

20% Less than once/month

29% Several Times/day
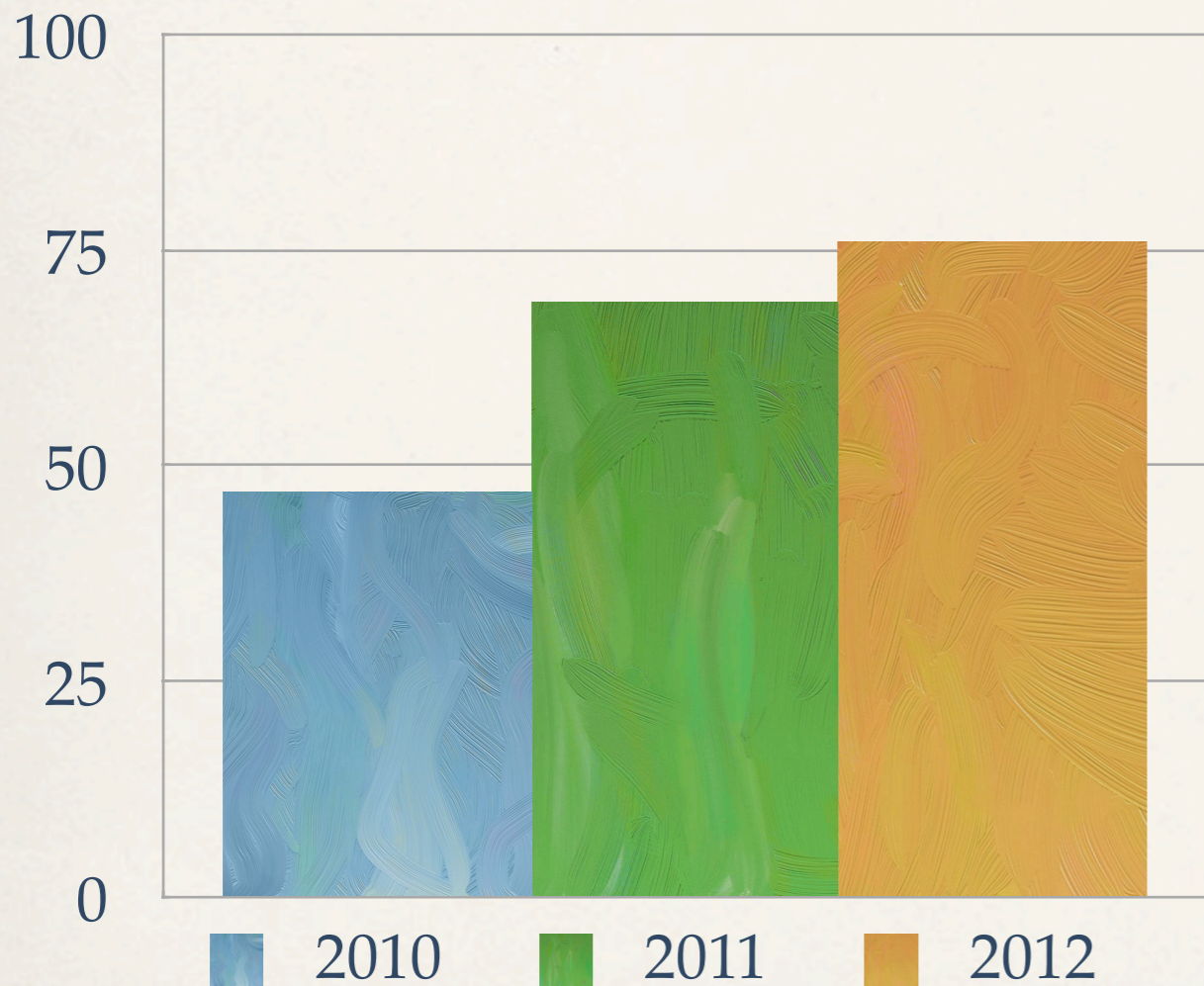
- 75% of Twitter users *actively* use Twitter
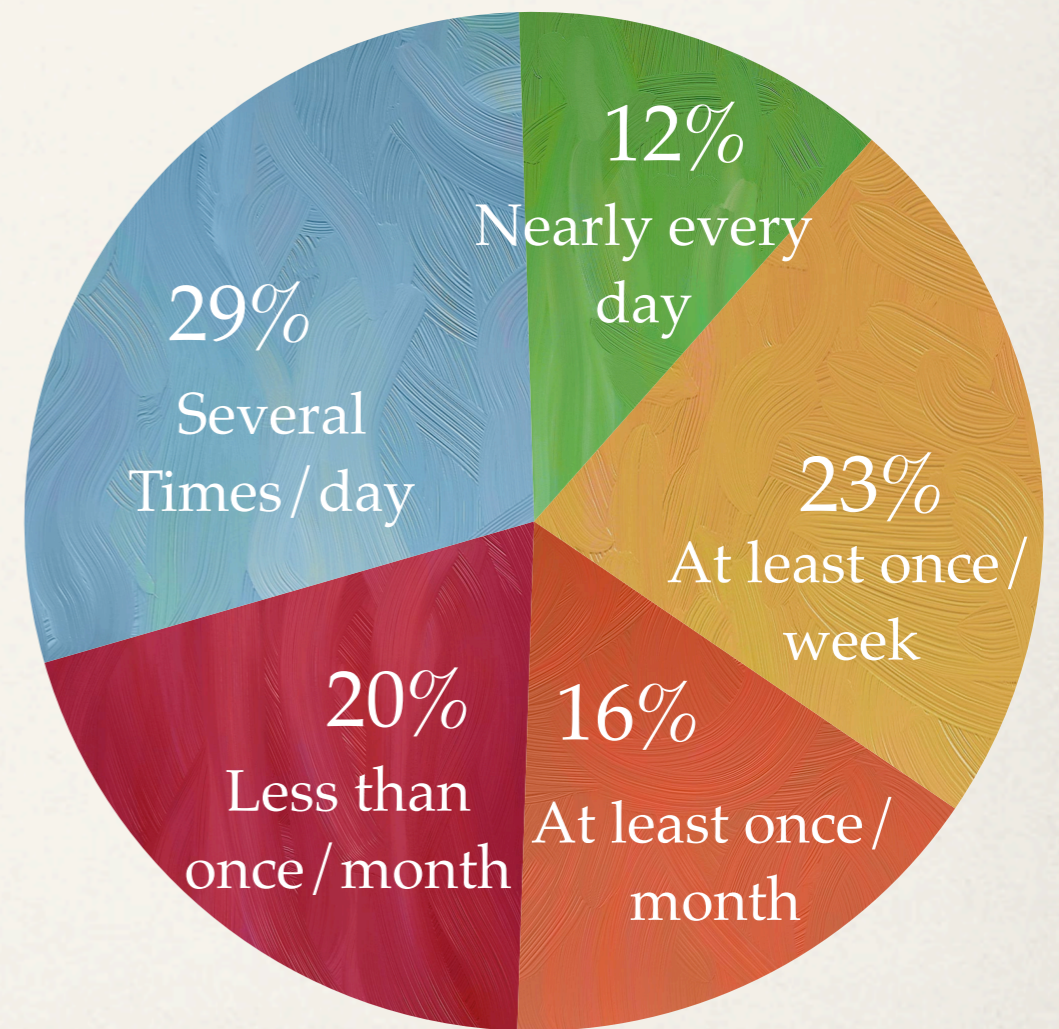
- 41% of Twitter users use Twitter daily
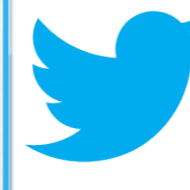
Do people tweet about their health?

Cough... cough.. cough..

18 Oct

still very ill from Broncitus,3 weeks now,of course I know that smoking does not help,but it is my addiction,and I am dealing with it!
Expand

20 Oct

Moany tweet: Have lost a whole day to a vicious migraine. Anyone here ever cured their migraines for good? Have tried most things in 30 yrs!
Expand

11h

Wish I wasn't so terrified of the dentist, this toothache is becoming unbearable. Wanna be able to eat chocolate :(
Expand

18 Oct

My daddy is diagnosed with melanoma. One of the worst types of cancer :"(please pray for him everyone
Expand

Relevance in Research:

* **Demand for Information**: "61% of U.S. adults search for health information online, and 59% of adult Internet users have looked online for information about specific diseases or treatments (Pew Research, 2009, 2011)."

* **Traditional Sources**: "On the other hand, peer-review journal articles and professional presentations are still the two major methods used by researchers to disseminate their work (Chen et al., 2010; CTSA Consortium 2008). "

* **Communication Gap**: "As a result, 'scientists are failing at communicating science to the (wide) public' (The Welcome Trust, 2001; Wilcox, 2012)."

Disseminating UCSF research & connecting with disease communities via social media automation, CTSI, UCSF. Chatterjee 2012. http://open-proposals.ucsf.edu/itcontest/proposal/139

Demand for Information

A recent case report shows that more people look at research articles promoted on social media compared to those that are not promoted on social media.

• "Tweeted" articles were downloaded more often than non-tweeted articles

• Implication: Twitter is a promising dissemination tool for relaying research findings to the public outside academia

Monthly Download Counts of Top Papers
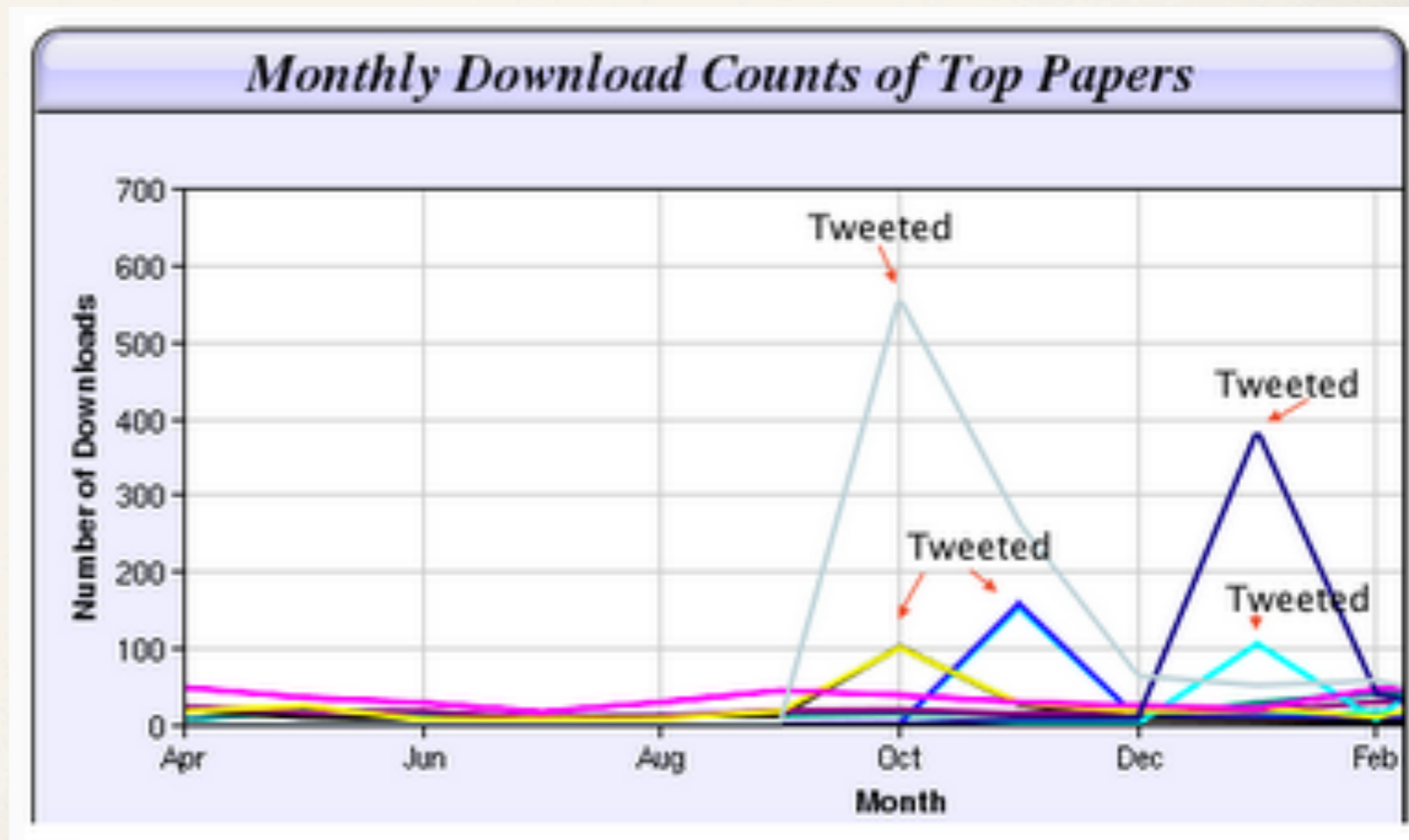
*Prior to tweeting links to her articles, there had been only one or two download(s) of each article.

(Terras 2012)

Twitter Use in Health-Related Research: Examples in Literature

1. Using Twitter to identify use and misuse of antibiotics

Dissemination of health information through social networks: Twitter and antibiotics

Scanfeld et al., 2010

Aim 1: Content analysis and categorization of tweets related to antibiotics
Aim 2: Investigate misuse or misunderstanding of antibiotics expressed by Twitter users

* **Search Terms:** cold + antibiotic(s), extra + antibiotic(s), flu + antibiotic(s), leftover + antibiotic(s), share + antibiotic(s)

* N = 971 tweets

* **Example**:

    * *Go get a shot, babe. Or some Murine ear drops from Walgreens. I can also mail outmy leftover antibiotics.*

* **Conclusions**:

    * Antibiotic use, misuse and related information is shared extensively on Twitter

    * Twitter offers a venue to identify misuse or misunderstanding of antibiotics

    * HCP's can use social media to collect and disseminate trustworthy information thereby promoting healthy behaviors to the public.

Categorization of antibiotic-related tweets

Tweet Category	Frequency
General use	289 (30%)
Advice/Information	157 (16%)
Side effects/Negative Reactions	113 (12%)
Diagnosis	102 (10%)
Resistance	92 (9%)
Misuse/Misunderstanding	55 (6%)
Positive Reactions	48 (5%)
Animals	46 (5%)
Other	42 (4%)
Wanting/Needing	19 (2%)
Cost	8 (1%)

Twitter Use in Health-Related Research: Literature Review

2. Using Twitter to track and measure activity of influenza-like illnesses

Please...

tweet your distance!

The Use of Twitter to Track Levels of Disease Activity and Public Concern in the U.S. during the Influenza A H1N1 Pandemic

Signorini et al., 2011

Aim 1: To track and measure the activity of influenza-like illnesses (ILI)

Aim 2: To track rapidly evolving public sentiment with respect to H1N1 in the US

✤ **Search Terms:** *flu, swine, influenza, tamiflu, vaccine, oseltamivir, zanamivir, relenza, amantadine, rimantadine, pneumonia, h1n1, symptom, syndrome, and illness*

✤ **Conclusion**:

  ✤ Estimates of ILI derived from Twitter accurately track reported disease levels.

  ✤ Twitter can be useful for measuring public interest, tracking and forecasting disease activity

  ✤ Earlier detection of ILI's can improve clinical and public health responses
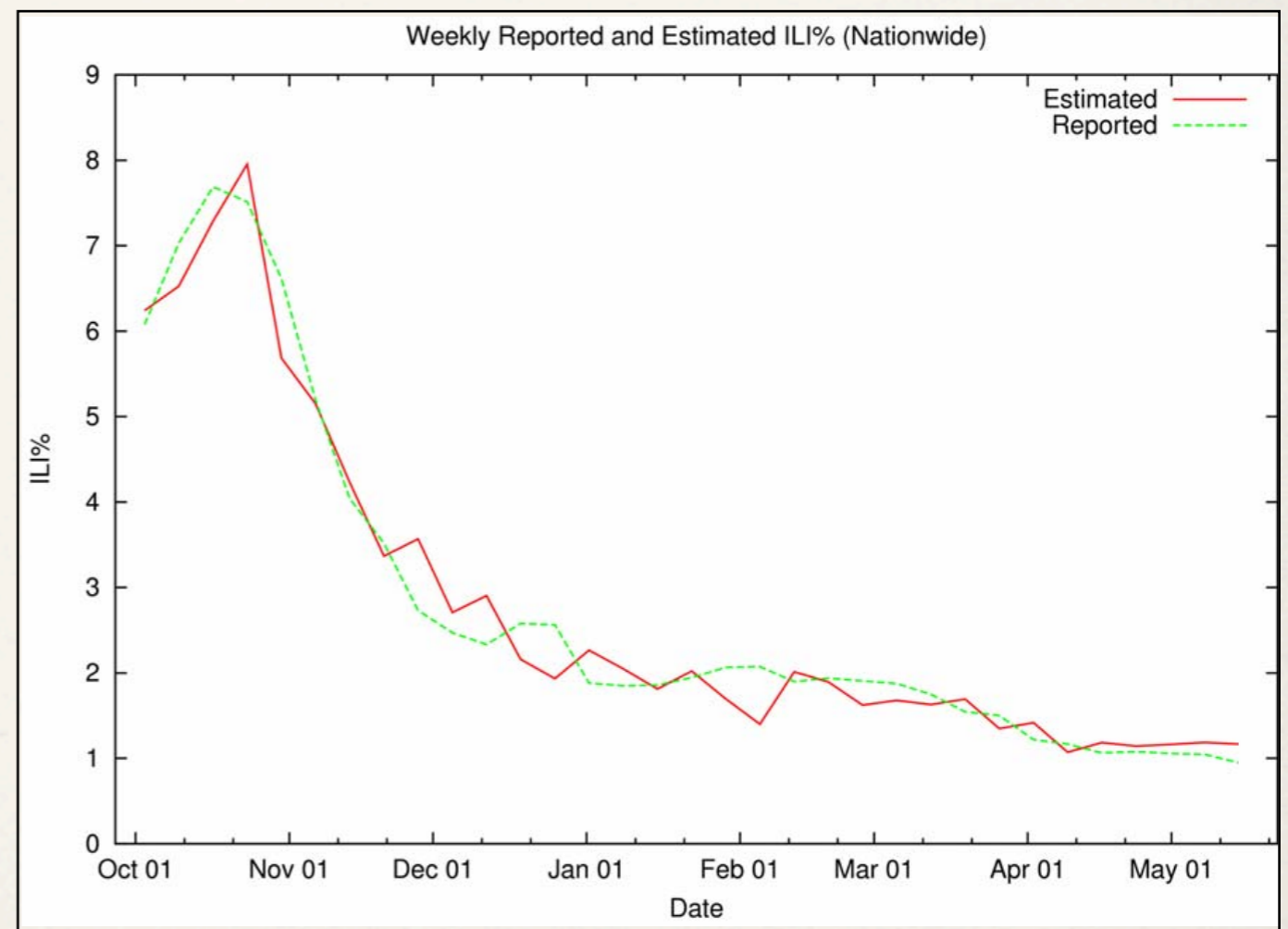
CDC reports (green) and estimates from Twitter feed (red) show similar trends, thereby indicating Twitter's potential use in accurately tracking ILI's.

Twitter Use in Health-Related Research: Literature Review

3. Using Twitter to assess moods of individuals on an global scale

Diurnal and Seasonal Mood Vary with Work, Sleep, and Daylength Across Diverse Cultures

Golder & Macy, 2011

Aim: To analyze hourly, daily, and seasonal affect of millions of individuals worldwide using Twitter posts. (PA = Positive Affect (enthusiasm, delight, activeness, alertness); NA = Negative Affect (distress, fear, anger, guilt, disgust))

❖ **Sample**:

- ❖ 2.4M users in 84 countries

- ❖ 509M Tweets from Feb. 2008 to Jan. 2010 (~50% contained words identifying PA/NA).

❖ **Conclusion**:

- ❖ Seasonal moods showed that PA increases with increase in day length

- ❖ Temporal affective pattern similarly shaped across countries

- ❖ **Global** collection of real-time data augments traditional research methods
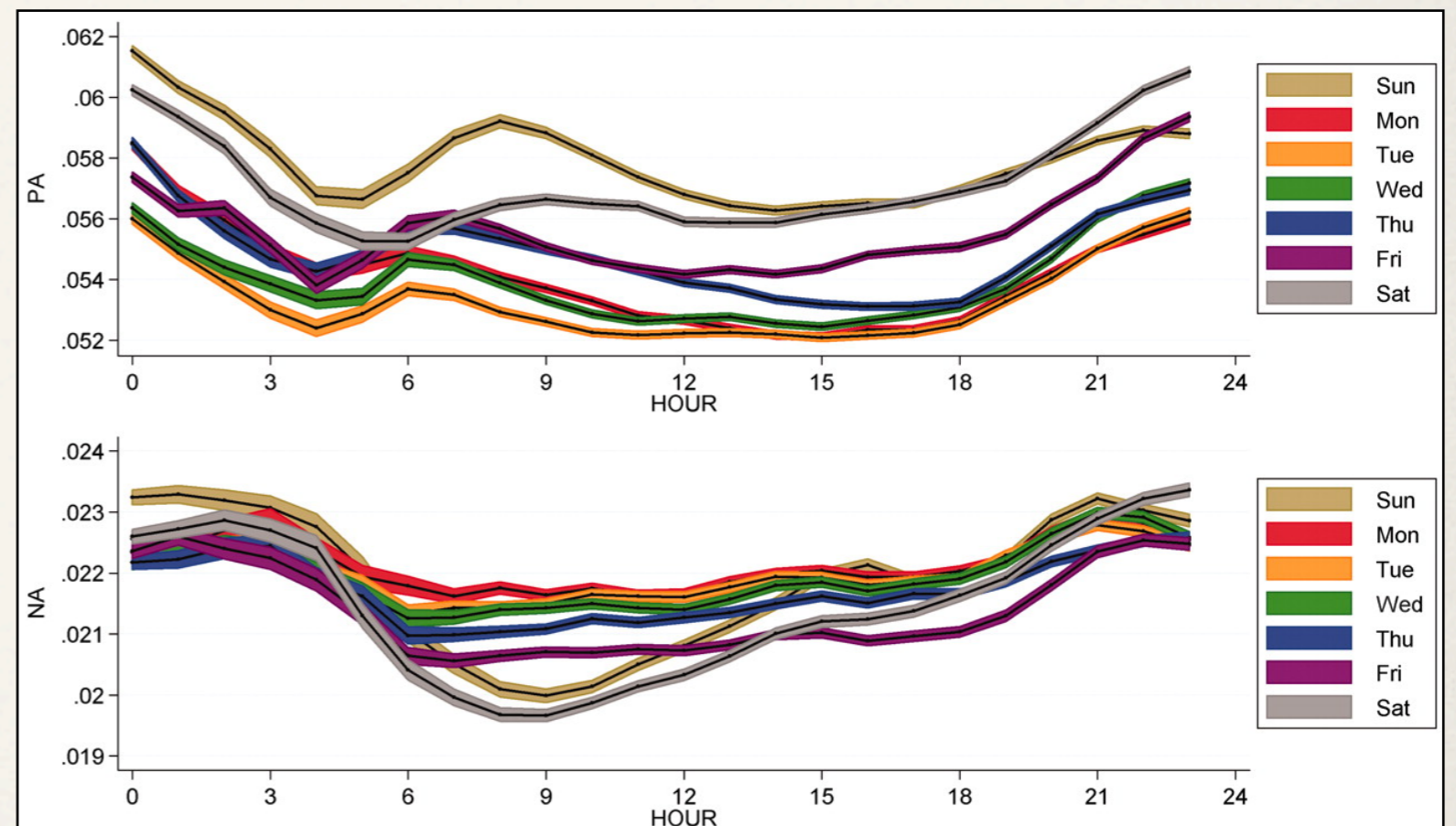
Hourly changes in individual affect broken down by day of the week. PA higher and NA lower on weekend days.

Twitter Use in Health-Related Research: Literature Review

4. Using Twitter to identify sports-related head injuries

SAVE A BRAIN. WEAR A HELMET.

'What's happening?' A content analysis of concussion-related traffic on Twitter

Sullivan et al., 2012

Aim: To determine the concept and context of concussion-related tweets

- **N = 1000 tweets** using search terms, *concussion, concussions, concuss, consussed* and their respective hashtags

- **Example**:
  - *Yep. Pretty sure it's a concussion. What do I do? No sleeping, right?*

- **Conclusion**:
  - Twitter serves as a powerful broadcast medium for sports concussion information and education
  - Insight into how Twitter is being used to propagate injury information
  - Propagation of misinformation could lead to unfavorable outcomes

Categorization of concussion tweets	
Tweet Category	Frequency
News	468 (33.2%)
Personal Information/Situation	377 (26.8%)
Inferred Management	181 (12.9%)
Downplay	107 (7.6%)
Advertising	95 (6.7%)
Report Signs/Symptoms	83 (5.9%)
Miscellaneous/Irrevelant	56 (3.9%)
Seeking/Clarifying Status	23 (1.6%)
Seeking Explicit Advice	19 (1.4%)

Twitter Use in Health-Related Research: Literature Review

5. Using Twitter to identify and address the negative portrayal of epilepsy

What kind of bird do you want to be on Twitter?

Epilepsy in the Twitter era: a need to re-tweet the way we think about seizures.

McNeil et al., 2012

Aim 1: Investigate how seizures are portrayed in social media

Aim 2: To analyze Twitter's potential for dissemination of health care information

- **N = 1504 tweets** using search terms *seizure* and *seizures*.

- **Examples**:
  - *Six weeks today without a seizure. Hopefully I'll get my driver's license back in another 6.* **(Personal Account)**
  - *Mariah Carey looks like she has a seizure when she sings.* **(Metaphorical)**

- **Conclusion**:
  - Twitter can facilitate communication about seizures and epilepsy.
  - Potential for fueling stigma could be counteracted with increased awareness through dissemination of accurate disease information

Categorization of seizure tweets	
Tweet Category	Frequency
Metaphorical	477 (32%)
Personal Accounts	462 (31%)
Informative	185 (12%)
Ridicule/Joke	138 (9%)
Miscellaneous	119 (8%)
Opinion	84 (6%)
Advice Seeking	39 (2%)

Twitter Use in Health-Related Research: Literature Review

6. Using Twitter to identify the spread of misinformation to Twitter users seeking help with smoking cessation.

You can do it.

Twitter=quitter? An analysis of Twitter quit smoking social networks

Prochaska et al., 2012

Aim: To examine the activity and content of Twitter quit smoking social network accounts

647 of the 4753 total tweets related to US Tobacco Treatment Clinical Practice Guidelines (14% of total tweets)

- **Sample:** 4753 tweets obtained from 153 quit smoking [twitter] accounts

- **Search Terms**: *quit OR stop smoking OR smoking cessation*

- **Conclusion**:
  - Interest in Twitter for creating social networks on quitting smoking
  - Nearly half of the accounts (48%) were commercially focused, most promoting programs and products with limited demonstrated efficacy
  - Need for dissemination of accurate information

**Grouped by categories, the tweets advised:**

#	
159	• Exercise for quitting smoking
124	• FDA cessation medications
86	• Support from family/friends
83	• Developing a quit plan
57	• Use of quitlines
56	• Relaxation strategies
29	• Physician advice
29	• Distraction techniques
19	• Self-rewards
5	• Group/individual counselling

Figure 2 Tweet content of the eight twitter accounts providing personal communications to support cessation.

The Present Topic of Study: Reports of dental pain on Twitter

Molar Bear @molarbear   8h
You don't understand pain unless you've experienced **toothache**
Top Tweet
Expand

Odontalgia (toothache)

odontalgia [oh-don-TAL-juh] {noun}
pain in a tooth; toothache. "This
odontalgia is really ruining my day!"
#WednesdayWordoftheWeek

8:05 AM Aug 25th via HootSuite

ReachTeachUnite
LCCT

http://twitter.com/ReachTeachUnite/statuses/22095554348

✤ Orofacial pain accounts for 40% of the $80 billion pain-related health care costs (Israel and Scrivani, 2000)

✤ Odontalgia: pain originating in the tooth (often acute, severe pain with consequent negative effects on the sufferer's everyday life.)

✤ Estimated 12% or more of population affected by odontalgia at any given time (Lipton 1993)

How we Began.

1. Picked a topic of interest
    1. Dental Pain
2. Advanced Search
    1. *toothache, tooth+ache, dental/tooth+pain*
3. Read tweets and took notes.

https://twitter.com/search-advanced

Advanced Search

Words

All of these words	
This exact phrase	
Any of these words	toothache, tooth+ache, dental+pain, tooth+pain
None of these words	bieber, RT
These hashtags	
Written in	English (English) ▲▼

People

From these accounts	
To these accounts	
Mentioning these accounts	

Places

Near this place	

Other

Select: ☐ Positive :)   ☐ Negative :(☐ Question ?   ☐ Include retweets

Search

Results using our Search Terms

Answers in the Twitterverse

Real-time Tweets: people experiencing toothaches right now

Spam in the Twitterverse

Ask the Twitterverse

10m
ok show update, toothache all last night and this morning, face swollen now and i cant open my right eye all the way.. sorry back tommorow!
Expand

11m
'I really feel like I have tooth ache in my shoulder' @LukeCarter19
Expand

22m
A child who has a toothache, or can't see blackboard, or fears for safety, or is homeless is not going to learn in school. #priorities
Expand

22m
See my answer on @HealthTap to: i am pregnant ,i have a bad toothache, and headache can i take a Mi[htap.us/3d0e]
Expand

28m
Last week was crazy! Got some upgrades and a tooth ache! New tech and pain don't mix! But this is a new week,wife... fb.me/21H31s4FD
Expand

38m
Gonna have to do a tom hanks casterway on this wisdom tooth if it doesn't stop hurting! #pain #poibtlesspain
Expand

51m
News -First aid treatment for toothache - dld.bz/bJ4GX
Expand

57m
Wisdom teeth/Tooth ache is causing me so much pain:(#helppppp
Expand

1h
How do I relieve tooth pain without seeing a dentist? - Let's Roll Forums letsrollforums.com/do-relieve-too...
Expand

Sunday, March 10, 13

Turning our interests into a Twitter project

Literature Search

⬇

Formulate Search Terms and Determine % Relevancy

⬇

Define and Refine Codebook

⬇

Preliminary Samples & Establish IRR

⬇

Official Sample of Random Tweets (~1000)

⬇

Code Tweets

⬇

Analyze and Report Data

⬇

Manuscript and Publication

⬇

Disseminate Findings

Public Health Surveillance of Dental Pain via Twitter

Aim 1: Obtain and analyze a cross-sectional sample of public tweets to determine the type and amount of information being broadcasted by users experiencing dental pain.

Aim 2: Explore whether Twitter provides a novel vehicle of real-time information to be used for research purposes

- ✤ **Search Terms**: toothache, tooth +ache, tooth+pain, and dental+pain

- ✤ N=772 tweets

- ✤ **Information Extracted**:

  - ✤ Content of Tweet and unique tweet id number

  - ✤ User info (eg. gender, location, number of followers, number of people following)

  - ✤ Date and time posted

Figure 2. Word cloud created from tweet content for the 772 randomly collected tweets (http://www.wordle.net/). Font size correlates with the greater frequency of the word used in tweets related to dental pain.

Number of tweets extracted per day using search terms

Number of Tweets Extracted (y-axis)

Days (x-axis)

Day	toothache/tooth ache	dental pain	tooth pain
7/26/10	543	22	125
8/3/10	607	26	121
8/11/10	589	20	130
8/19/10	589	27	133
8/27/10	517	16	119
9/5/10	570	6	85
9/11/10	496	15	96

Legend: ▇ toothache/tooth ache ▇ dental pain ▇ tooth pain
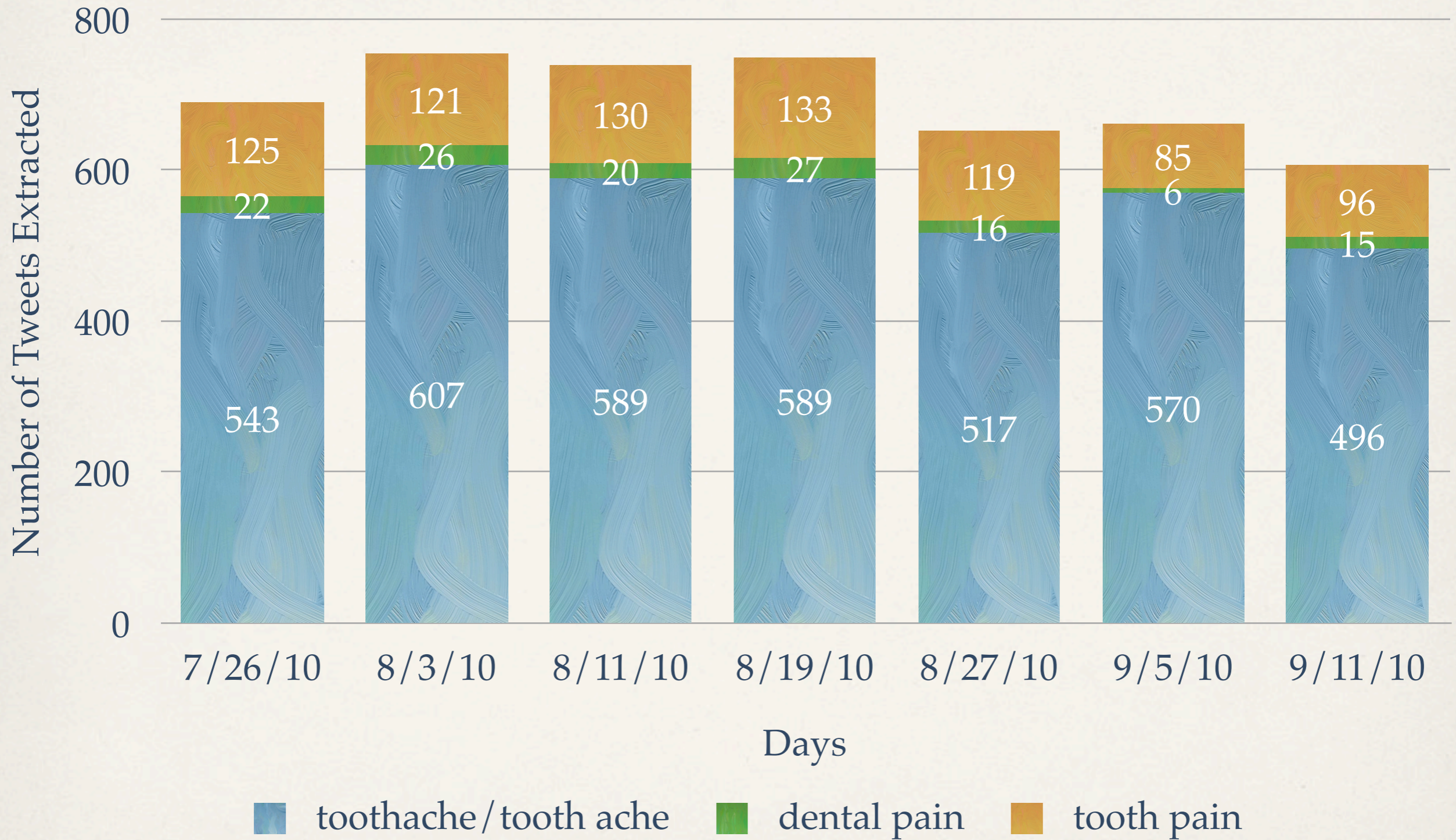
(Average: 694/day in 2010)

Sunday, March 10, 13

Classification of Tweets into Primary and Secondary Categories*

Examples of tweets with primary and secondary classifications.		
Tweet	Primary Category (PC)	Secondary Category (SC)
"I think I'm dying. Headache, toothache plus it's hot >_< <--- DEAD"	1. Statement 2. Co-morbidity	1.1. Catastrophic 2.1. Head and Neck
"Just bit into a chocolate biscuit and a tooth fell out. Just had to take a 2 paracetamol to kill the pain. Visit to the dentist tomorrow"	1. Action	1.1. Medication 1.2. Dentist
"@username Great. Now it's like a song that I can't get out of my mind. But at least it will take my mind off my toothache. . . ."	1. Coping Mechanism	1.1. Distraction
"I cannot wait to get this wisdom tooth pulled. . .my body is immune to every pain medicine . . .and I have taken EVERYTHING"	1. Relief Status 2. Action 3. Wisdom	1.1. No Relief 2.1. Medication 2.2. Dentist
"Ugh! The pain is unbearable. . .This dentist needs to hurry up. . .I feel like yanking the tooth out myself! Lol"	1. Action 2. Dentist	1.1. Dentist 2.1. Discontent
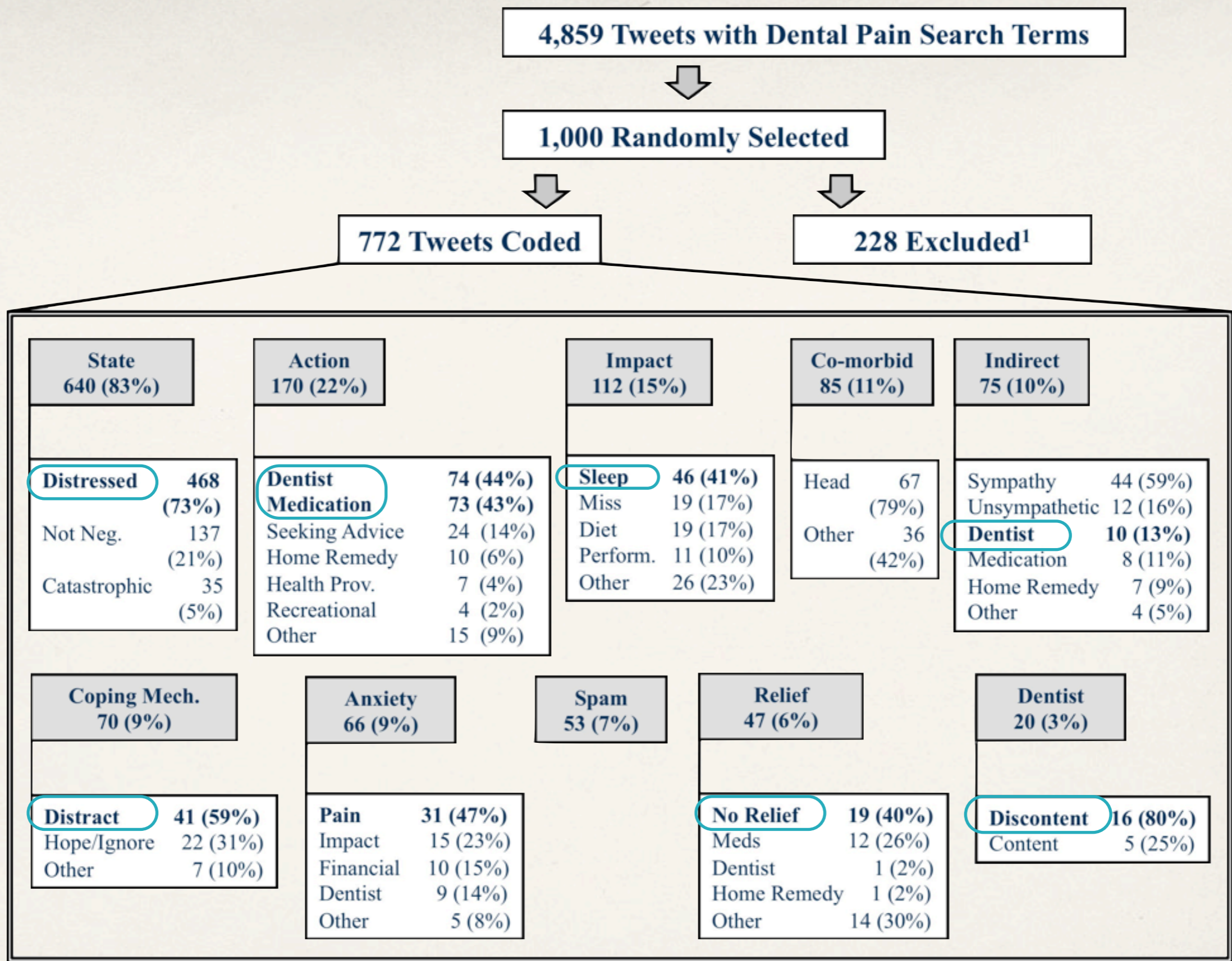
Frequencies of primary categories (PC) and secondary categories (SC), n (%).

Conclusions

- People tweet about dental pain and describe experiences in terms of pain intensities, actions taken, impacts and causes.

- Twitter is a novel way to collect **real time, self-reported data** on health-related information, including personal experiences with dental pain. It augments traditional studies by minimizing recall bias and demand characteristics.

- There is an evident need for Twitter users to be able access information about their specific health concerns.

- With these data we hope to foster a better understanding of individuals' experiences with pain, leading to innovative ways of using social media to deliver evidence-based and individually relevant information to patients.

Twitter Projects in Progress
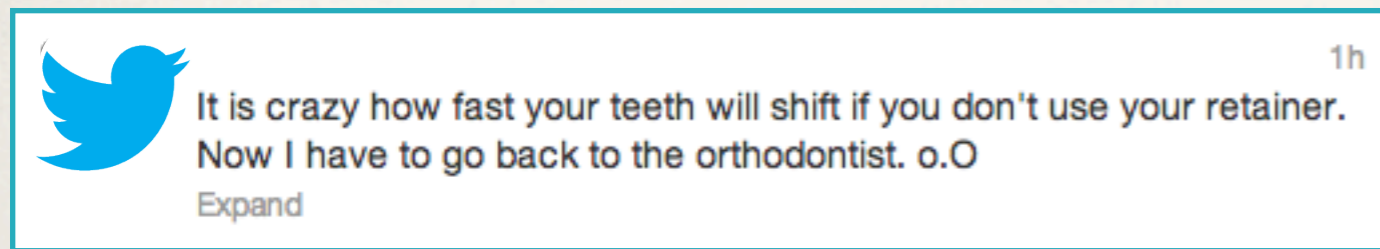
Orthodontic Twitter Reports

Aim: To explore Twitter as a source of real time data related to orthodontics and the social impact of dentofacial appearance.
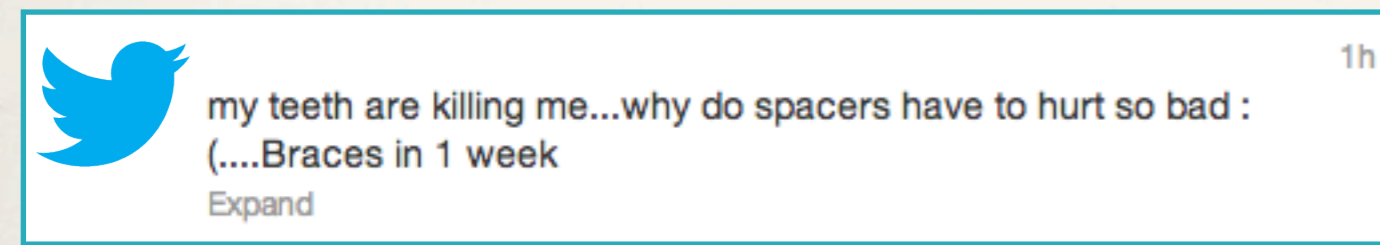
Cole et al.

Search Terms:

Any: teeth hurt OR teeth pain OR teeth sore OR teeth killing OR teeth crooked OR teeth straight OR band teeth **All:** braces OR retainer OR orthodontist OR spacer
None: -wisdom -http -RT
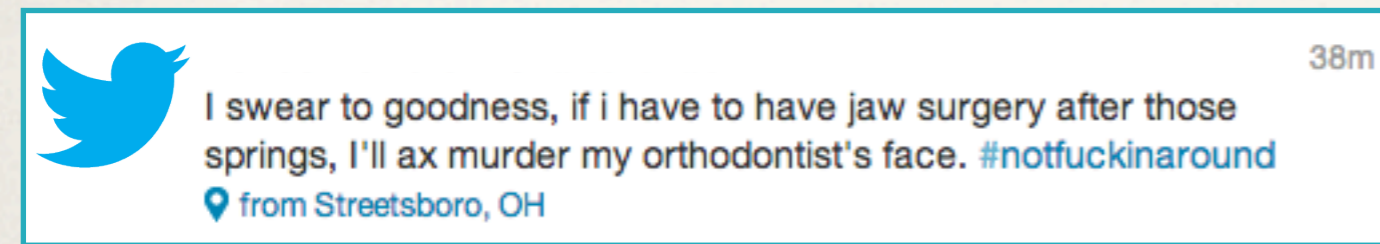
1h
It is crazy how fast your teeth will shift if you don't use your retainer. Now I have to go back to the orthodontist. o.O
Expand

1h
my teeth are killing me...why do spacers have to hurt so bad :(....Braces in 1 week
Expand

38m
I swear to goodness, if i have to have jaw surgery after those springs, I'll ax murder my orthodontist's face. #notfuckinaround
⚲ from Streetsboro, OH

Huffington Post @HuffingtonPost   27 Oct
East Coast braces for approaching storm huff.to/WP2b9v
View summary

Observed Categories

Pain

Action in response to pain

Comment on HCP/Treatment

Access to care

Compliance

Lack of understanding

Outcomes of care

Advice

Esthetics

Pediatric Dentistry on Twitter

Aim: Obtain and analyze a cross-sectional sample of public tweets to determine the type and amount of information being broadcasted by users related to pediatric dentistry.

<div align="right">Mullen et al.</div>

- **Goal:** N=1000 tweets

- **Examples:**
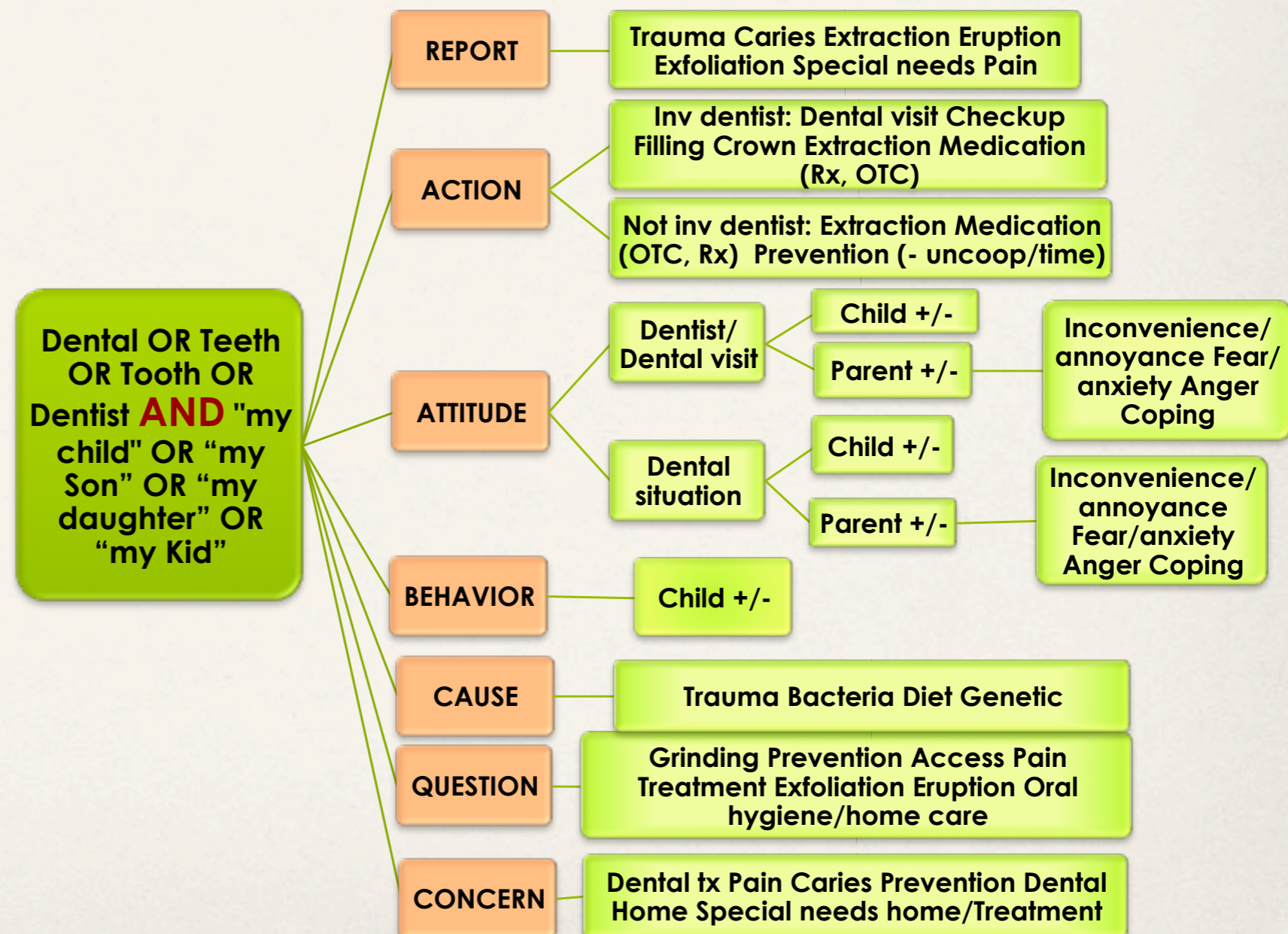
  - *My daughter is 7 months old and she has 7 teeth.... Is that normal?! I feel like she's hiding steroids in her diaper.. Wtf!*

  - *3rd time at the dentist and my son wouldn't let them touch his teeth..... (Pissed off)*

  - *Omg My daughter grinding her teeth so hard in her sleep .. What does that mean ?*

Dental OR Teeth OR Tooth OR Dentist AND "my child" OR "my Son" OR "my daughter" OR "my Kid"

- **REPORT** — Trauma Caries Extraction Eruption Exfoliation Special needs Pain

- **ACTION**
  - Inv dentist: Dental visit Checkup Filling Crown Extraction Medication (Rx, OTC)
  - Not inv dentist: Extraction Medication (OTC, Rx) Prevention (- uncoop/time)

- **ATTITUDE**
  - Dentist/ Dental visit
    - Child +/-
    - Parent +/- → Inconvenience/ annoyance Fear/ anxiety Anger Coping
  - Dental situation
    - Child +/-
    - Parent +/- → Inconvenience/ annoyance Fear/anxiety Anger Coping

- **BEHAVIOR** — Child +/-

- **CAUSE** — Trauma Bacteria Diet Genetic

- **QUESTION** — Grinding Prevention Access Pain Treatment Exfoliation Eruption Oral hygiene/home care

- **CONCERN** — Dental tx Pain Caries Prevention Dental Home Special needs home/Treatment

A Qualitative Survey of Labor Pains on Twitter

Aim: To determine how people use Twitter to discuss their labor pains & contractions.

Samura et al.

Examples:

✤ *Uhhh! I think its time!! The contractions aren't close enough, so I have to wait to go! But this hurts image when its stronger! Help me!*

✤ *damn #earlylabour atleast the docs were able to stop my contractions giving bub more time to cook*

Future Implications:

✤ Potential interventions for those with preterm labor symptoms.

✤ Tweet a link with advice for women uncertain about start of labor

Tweet
Copy and paste here if needed for reference

Felt like I had a few cramps this afternoon - is that what they mean by Braxton Hicks?

Q: Possible BH
Tweet is a questions about how to know if a sensation or contraction is consistent with a braxton hicks contraction. EXAMPLE Felt like I had a few cramps this afternoon - is that what they mean by Braxton Hicks?

○ 0
◉ 1

Q: What do Contractions feel like
Tweet is a question asking what a contraction feels like, or asking if the sensation they are describing is consistent with a contraction. Example: Anyone had a baby and can tell me what kind of pain a contraction is like Shap or dull pain!? HELP;

◉ 0
○ 1

Q: Stopping False Labor
Tweet is a question asking for advice or information about stopping false labor. (False labor may be described as braxton hicks, BH, false contractions, mini-contractions, pre-contractions). Example:

◉ 0
○ 1

Google Forms

What people tweet about pain

Aim: To examine how Twitter users experiencing **toothaches**, **backaches**, **earaches**, and **headaches** communicate their symptoms, suffering and actions taken to relieve pain.

Ahlwardt et al.

Legend:
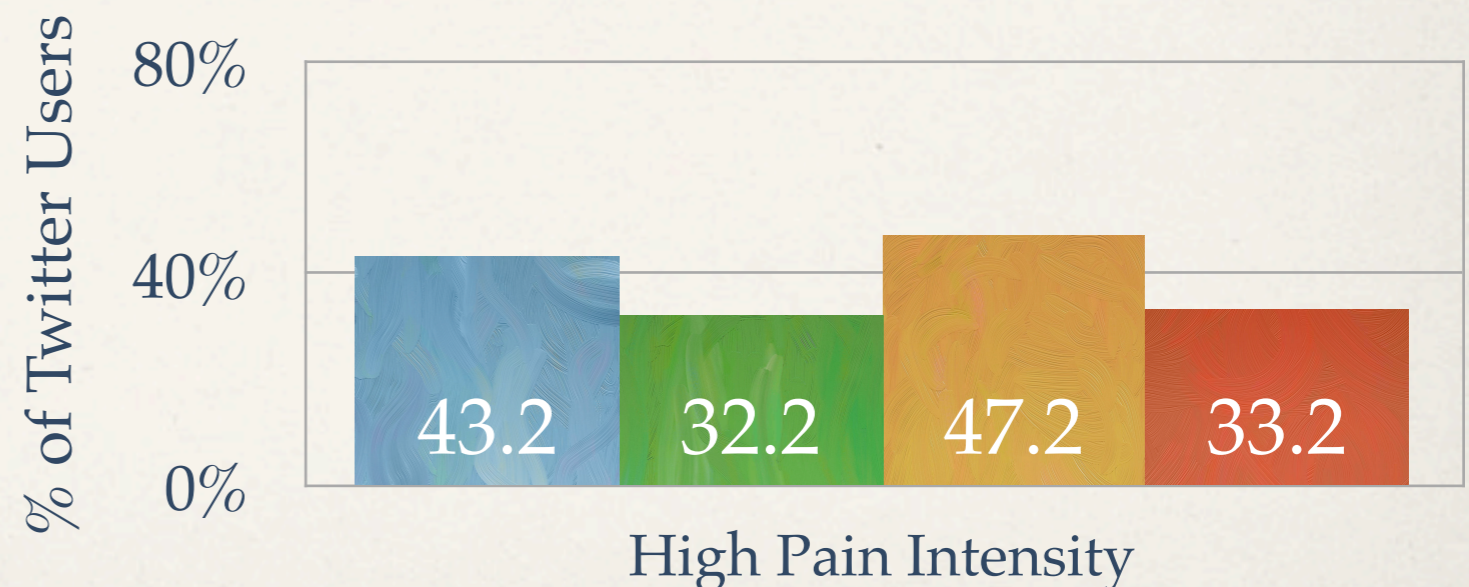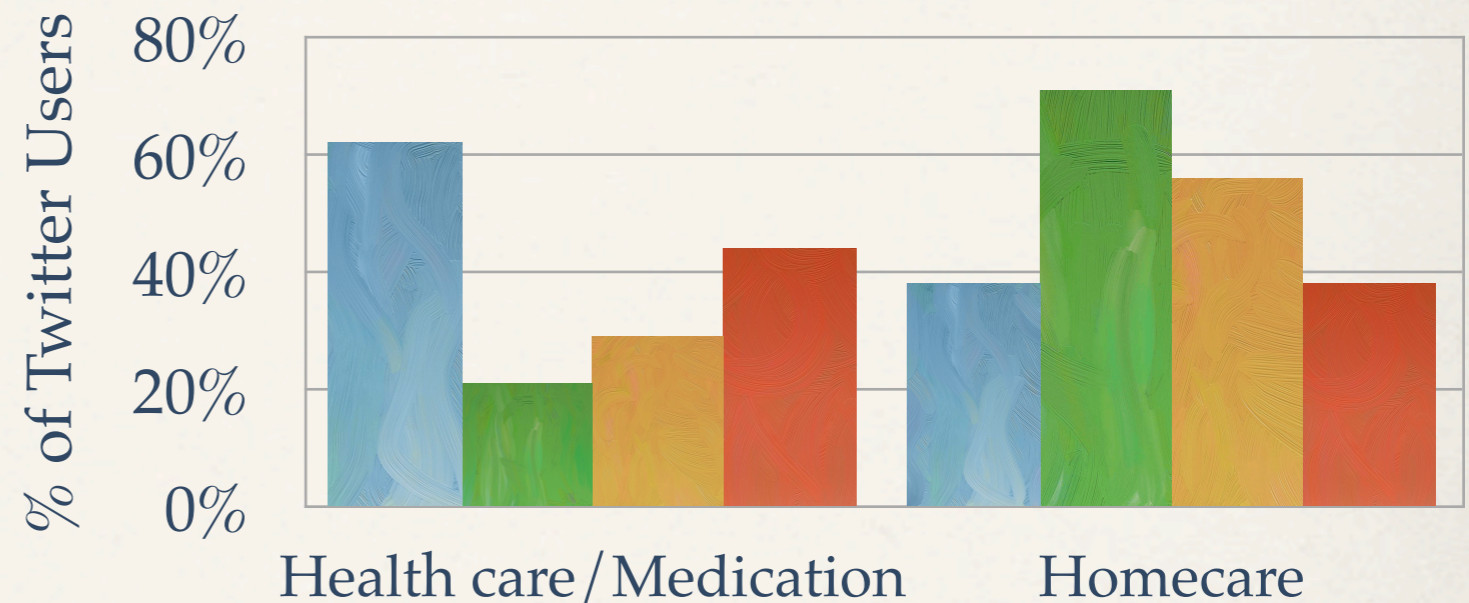- toothache
- headache
- backache
- earache

* **N** = 1200 tweets (300 per pain type)

* **Examples**:

  * *Head Hurt So Bad I Can't Even Go To Sleep.*

  * *My ear hurts again. >:(*

  * *I think I pulled a muscle in my back from dance! #pain :/*

* **Conclusions**:

  * People tweet about pain and describe different experiences for different types of pain in terms of pain intensities, health care seeking, impacts and causes.

Top chart: % of Twitter Users — Health care/Medication, Homecare

Bottom chart: % of Twitter Users — High Pain Intensity
- 43.2
- 32.2
- 47.2
- 33.2

Top: % of Twitter users for each pain type that seek health care, take medication, or use home care solutions.
Bottom: % of users reporting each pain type as high intensity

Limitations

Perspective on Using Twitter and other forms of Social Media for Research

A comment on Paul Eke's companion article to "Public Health Surveillance of Dental Pain via Twitter"

✤ "Twitter data exclude people who do not use Twitter, who are likely to be the most vulnerable in populations, and who are often unwilling to share their health experiences publicly. Intuitively, it can be speculated that persons who are ill, elderly, in discomfort, or disabled would be less likely to tweet, as would those who are illiterate or not 'computer savvy.'" (Eke 2011)

✤ "'Twitterers' are not knowingly participating in a study and are unaware that their tweets will be used to assess health status, both of which factors can influence their responses." (Eke 2011)

✤ Cannot determine incidence or prevalence because unique twitter user data for a given day is unavailable

✤ Content extraction is limited by established search terms

Web 2.0 Implications for Health Care

* It doesn't need to be Twitter. Many social networking sites exist that may be beneficial to health care professionals (HCP) and researchers.

* HCP's need to find beneficial ways to participate in social media because the public demands information and often use social media as a communication medium.

* HCP's can work towards developing a social networking site specific to health concerns and treatments, with an aim to provide accurate information in order to meet individual needs.

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Thank You!