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APPENDIX

METHODS

An exempt certification was obtained from the UCSF Committee on Human Research.

Data Extraction

We collected tweets from each day of the week (Monday-Sunday) over a period of 7 wks (July 26, 2010 and September 12, 2010) to obtain tweets from a maximum number of unique users and to ensure that all days of the week were represented in the dataset. Tweets were collected using the search terms “toothache OR tooth ache OR dental pain OR tooth pain”. We developed a software utility, using the Python programming language, to mine Twitter as a data source in near-real time. The program utilized the Search and User portions of Twitter’s Application Programming Interface (API). This allowed us to automate the extraction of tweets meeting the search criteria and correlate them with the author’s user information. This process occurred daily and constrained the search to tweets authored during the previous 24 hrs over the seven-week period (JP). From this dataset, 1000 tweets were randomly selected for analysis. Results could refer to experiences of dental pain which was currently occurring or had occurred in the past, or the user could be anticipating future pain. Since our search criteria utilized words in the English language, our dataset consisted primarily of user content posted in English. No attempt was made to obtain content in other languages.

In addition to collecting the user-generated post or tweet, we extracted non-private user-specific information, including identification number, user name, profile name, profile picture, self-identified geographic location, TweetID (a unique number given to each tweet), number of status updates, and number of followers. Gender was coded by using profile name, user name, and picture. Geographical location was coded using the user-identified location, if provided, or the time zone.

Criteria for Inclusion and Exclusion

All criteria for inclusion or exclusion are based on the content of the tweet and not on any Twitter user parameters. All content meeting the search criteria were included in the initial dataset,

Public Health Surveillance of Dental Pain via Twitter

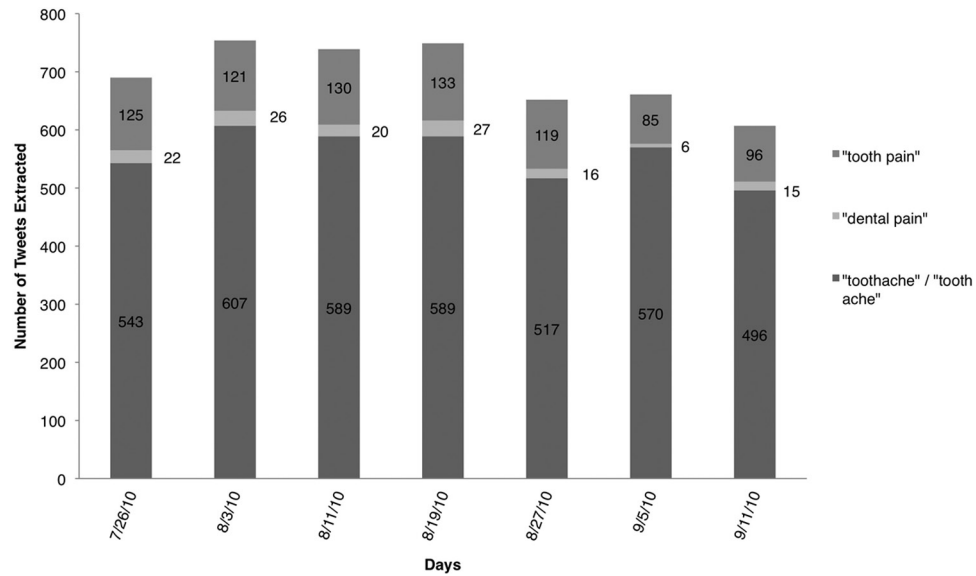
from which 1000 tweets were randomly selected. Content was excluded from the dataset of 1000 tweets for any of the following reasons: (1) Content was re-tweeted (meaning that this tweet was re-posted by a user who is not the original author); (2) content was unrelated to dental pain (*e.g.*, ‘You’re so sweet you give me a toothache!’); (3) content was in another language (*e.g.*, used English word “toothache”, but remaining content was in another language); (4) content was a subsequent post from the same user (*i.e.*, only one post was analyzed *per* user); or (5) the content was un-interpretable for any other reason. This resulted in a dataset of 772 tweets for analysis.

Further Information on Coding Strategy and Protocol

The primary category represents the major themes that were communicated in tweets meeting the search criteria and not mutually exclusive, so one tweet could meet the criteria for one or more primary categories. Once the primary category or categories of the tweet were determined, we evaluated which secondary category or categories were applicable (for examples, see Table 2 in the main paper). These secondary categories are also not mutually exclusive, with the exception of those falling under the primary category “Statement”. The Web-based application Google Forms was used for data entry such that the coder had to answer whether the content of an individual tweet related to each of the 14 primary categories. If the coder indicated that the tweet met the criteria of one of the primary categories, he/she was then prompted with subsequent questions relating to the relevance of secondary categories. The data were compiled by the application into a Web-based spreadsheet that was converted into an Excel (Microsoft Excel 2008) spreadsheet for further analysis.

Inter-rater Reliability

To measure inter-rater reliability, two investigators (NH, BG) extracted and coded 100 tweets from the primary dataset. Inter-rater reliability for each category was calculated by Cohen’s kappa [mean $\kappa = 0.96$, 95% CI, 0.95, 0.98]; percent differences (mean PD = 0.96), 95% CI, 0.95, 0.98], and prevalence-adjusted, bias-adjusted kappa [mean PABAK = 0.93, 95% CI, 0.90, 0.95]. PABAK is a variation of kappa that is determined only by the proportion of observed agreement between two raters (Cunningham, 2009). All measures indicate very high agreement between the codes selected by the investigators.



Appendix Figure. Number of tweets extracted per day for 7 non-consecutive days using the designated search terms "toothache" or "tooth ache", "tooth pain", and "dental pain". The total number of tweets extracted in the sample was 4859.

APPENDIX REFERENCE

Cunningham M (2009). More than just the kappa coefficient: a program to fully characterize inter-rater reliability between two raters. SAS Global Forum (Washington, DC, USA). URL accessed on 6/2/2011 at: <http://support.sas.com/resources/papers/proceedings09/242-2009.pdf>.

Appendix Table. Comprehensive Table of Non-mutually-exclusive Coding Results

Category	Definition	Tweet Example (printed unedited)	Frequency (n)
Statement	Stating experience of feeling or having previously felt dental pain		640
No negative emphasis Negative/Distressed Catastrophic	Positive emotion or no emotion Negative emotion or distress Extreme, irrational, or unlikely responses	"toothache" "Toothache, toothache. Ouchhhh." "About to Google how many suicidal deaths were TOOTHACHE related...#ThisToothacheIsMajor =(137 468 35
Action	Taking or contemplating an action in response to dental pain		170
Dentist	Dentist to address pain	"@username great thanx apart from a terrible toothache!! Must try and get to dentist tomorrow!! U ok?"	46
Dentist: Root Canal	Root canal specifically noted as treatment	"Im tweeting again, but only cause i need a root canal and i cant sleep due to the postural tooth pain"	2
Dentist: Extraction	Extraction specifically noted as treatment	".gotta toothache from hell, can't wait to get it pulled in the mornin http://myloc.me/aoPBV "	26
Health Provider (Other than Dentist)	A health professional other than a dentist	"called an ambulance last night, i thought i had a brain tumour, it was tooth ache!!"	7
Analgesics/Medication	Medication, including analgesics, antibiotics, topicals, etc.	"Turns out 2 ibuprofin and 3 500mg panadol's kill tooth pain, looking forward to going to the dentist tomorrow #myteetharecrap"	73
Home Remedy	Treatment methods from home	"@username ach, it's fine dude :P I am trying to hold tooth ache back myself with clove oil. I have thick skin as well as a thick head."	10
Recreational Substances	Achieve an altered state to alleviate pain	"There's a storm on the horizon + I have a major toothache = WINE!"	4
Seeking Advice from Twitter Community	Ask advice, information, or direct help from other Twitter users	"what's the best remedy for a toothache?"	24
Other	Miscellaneous actions that fail to fit into other categories (e.g., going to sleep)	"Away off to go to sleep, got really sore toothache!"	15
Impact on Daily Activity	Dental pain affects daily life or activity as well as mood		112
Miss	Miss work, school, event, TV show, or any other typical activities	"Hope she has a good first day. I am home sick with as tooth ache"	19
Sleep	Losing sleep	"Toothache still going strong. Kept me awake most of the night. Cream soup & pain pills for breakfast is not a good sign. Calling dentist."	46
Diet	Changes in diet such as being unable to eat or drink certain items	"Haven't been able to eat anything except cold soup for the past two days!! I'm starving stupid flipping tooth pain...."	19
Performance	Disrupts ability required in daily tasks and for physical or cognitive activity	"I have a toothache :/ ; homework that I need to do but I'll save it for tomorrow."	11
Other	Miscellaneous impacts that fail to fit into other categories	"my toothache is putting me in a bad mood. -_-"	26
Dentist/Health Provider	Opinion about dentists/health professionals AFTER receiving care		20
Content	Contentment or satisfaction regarding care received	"Survived my trip to fix my toothache at my Smile Dr. And no ear cringing drilling sounds cause I was watching a movie with earphones on!"	5

(continued)

Appendix Table. (continued)

Category	Definition	Tweet Example (printed unedited)	Frequency (n)
Discontent	Discontentment or negative opinions regarding care received	"Ugh! The pain is unbearable.. This dentist needs to hurry up.. I feel like yanking the tooth out myself! Lol"	16
Quality of Pain	Specified quality of pain (sharp, aching)	"Just got the sharpest toothache evarr. went through my whole mouth!"	57
Temporal Aspects of Pain	Temporal aspect of pain	"@username Oh no, this is other stuff. Tooth pain is still there on and off, I just have to get them out. My schedule is just nuts."	62
Wisdom Tooth	Specifically states dental pain originates from a wisdom tooth/teeth	"Oooo wisdom tooth pain. Ow Ow Ow!"	53
Co-morbidities	Experiencing other ailments in addition to dental pain		85
Head and Neck	Ailments associated with the head and neck region	"Got a headache and my toothache is back!! :(!"	67
Other Co-morbidities	Ailments that are not associated with the head and neck region	"toothache n stomach ache, perfect!! :(!"	36
Coping Mechanisms	Using other methods to deal with dental pain		70
Distractions	Active: Distractions used to deter from thinking about dental pain	"@username. 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...."	41
Avoidance/Hope	Passive: Expecting or hoping the pain will go away on its own	"Toothache g away and stay....puhleeezee its been 3days now...leave"	22
Other	Miscellaneous coping mechanisms that fail to fit into other categories	"@username so much pain happening (toothache)...i like to moan. makes me feel better...:p"	7
Anxiety	Anticipating adverse effects due to dental pain		66
Dentist/Healthcare Provider	Fear of dentist or health provider (Prospective Response)	"Has toothache.... not going to the dentist tho i hate them :(!"	9
Financial	Fear of costs associated with treatment	"might just b the pain talking but I really wana go back home where I have full health coverage (incl dental) n can get it all checked!!! :(!"	10
Impact	Fear of impact on daily life, such as missing vacation or losing sleep	"Ok so my wisdom tooth has me in pain today eeeeewww my day is going to be not so pleasant :(!"	15
Pain	Fear of the pain not getting better or getting worse	"Sweating a fever out because of tooth infection, sooo many tablets can't sleep too much pain, suicide seems an option!"	31
Other	Miscellaneous anxieties that fail to fit into other categories	"@username CANDACE HELPED! IM FREAKING STRESSED PLUS I HAVE A TOOTHACHE"	5
Indirect Input	Another Twitter user responding to a person experiencing dental pain		75
Dentist/Health provider	Recommends seeing a dentist or health provider to address dental pain	"@username Can't you go see a dentist tell them you're short on cash but have a terrible toothache & ask if they can do anything?"	10
Analgesics/Medication	Recommends or offers medications (OTC, Rx)	"@username Tooth pain is the worst! Hope you have some good pain meds :)"	8
Home Remedy	Recommends or offers a home remedy	"Chew on some ice RT @username: Toothache like hell :(((this naproxen sodium (Aleve) is not workn!! I done took 2 instead of 1."	7
Recreational Substances	Recommends recreational substances to relieve dental pain	No Example	0

(continued)

Appendix Table. (continued)

Category	Definition	Tweet Example (printed unedited)	Frequency (n)
Sympathetic	Offers sympathy or concern	"@username My heart goes out to you - tooth pain is the worst sort :-(Get better soon! X"	44
Unsympathetic	Response lacks concern and is insensitive or indifferent	"U deserve it lol RT @username: Lord I have the biggest toothache which means I have the biggest head ache on one side of my face FML"	12
Other	Miscellaneous input that fails to fit into other categories	"@username Not sure about the toothache bit, but apparently getting out of the usual workspace helps some people. Not tried it m'self tho."	4
Status of Relief	Methods/actions taken to relieve the pain either were effective or ineffective		47
Relief: Dentist/Health Provider	Treatment from dentist or other health provider provided relief	"Went to massage therapy = fingers digging into my hurty jaw from dental work = much pain (real tears) but loosened jaws. I'm tired of pain."	1
Relief: Analgesics/Medication	Medications (OTC, Rx) provided relief	"@username orajel says to my toothache pain, jour done"	12
Relief: Home Remedy	Home Remedy provided relief	"@username my wisdom tooth was playin up and was told to gargle warm salt water. its disgusting but it sorts the pain out"	1
Relief: Recreational Substances	Altered state from recreational substance usage provided relief	No Example	0
Relief: Other	Miscellaneous	"The toothache is subsiding."	14
No Relief	Methods/actions taken were ineffective in providing relief	"I cannot wait to get this wisdom tooth pulled...my body is immune to every pain medicine .and i have taken EVERYTHING"	19
Ambiguous/Unrelated	Miscellaneous or ambiguous input that fails to fit into any of the categories	"@username You look so sweet you are giving me a toothache"	132
Spam	Information broadcast: links and advertisements	"12 Hour Toothache Cure - Tooth Ache.: The perfect undiscovered niche to make a ton of cash with. High Converting, ... http://bit.ly/cU2gvD "	53

Frequency represents the total number of tweets coded for each category out of the sample of 772. Primary categories (PC) are in the shaded gray rows, and the secondary categories (SC) immediately following are in non-shaded rows. A few codes established originally by investigators were not used when the test dataset was coded (frequency = 0). *Actual user ID removed to maintain privacy, and replaced with "username".