EXPLORING HEALTH TOPICS IN CHINESE SOCIAL MEDIA

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GOALS OF THIS STUDY

- **Identify** a variety of different health issues that are prominently discussed in Chinese social media
  - Will use **topic models** to do this
- **Validate** utility and accuracy of health topics
  - Will compare **trends** to government surveillance data
    - Influenza
    - Air pollution (preliminary)

HEALTH IN SOCIAL MEDIA

- People publicly post a variety of information about their health through online social media
  - microblogs: Twitter, Sina Weibo

- People write about:
  - Acute illness (e.g. influenza)
  - Self medication (e.g. taking Nyquil)
  - Lifestyle/behaviors (e.g. going to the gym)
  - Alcohol, tobacco, drug use
  - Sleep habits
  - Mood

We can analyze messages on these topics to learn more
- "passive" approach to surveys

CHINESE SOCIAL MEDIA

- Sina Weibo
  - China's most popular microblog
  - About 100 million active users
  - About 100 million messages per day

新浪微博
weibo.com

- Not extensively studied in this community
  - Especially relative to its popularity
- Many important public health issues in China
  - e.g. H7N9 influenza

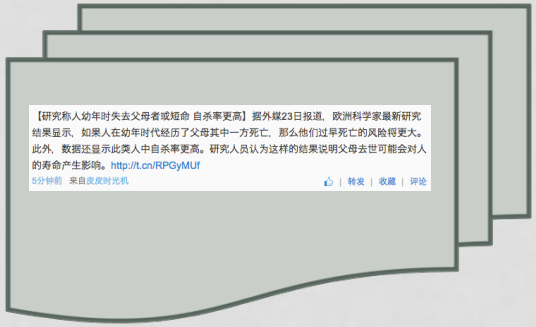
RELATED WORK USING WEIBO

- Disease outbreaks
  - Fung; Fu; Ying; Schaible; Hao; Chan; Tse (2013)
- Mental health
  - Hao; Li; Li; Zhu (2013)
- Survey of digital epidemiology in China
  - Salathe; Freifeld; Mekaru; Tomasulo; Brownstein (2013)
- Comparison to Twitter
  - Gao; Abel; Houben; Yu

DATA COLLECTION

- Weibo does not have "streams" like Twitter

- Breadth-first crawl:
  - Begin with a random user
  - Crawl all messages by that user
  - Repeat for each of the user's followers



- We collected 93 million messages in Dec. 2013
  - messages span Nov 2009 – Dec 2013

DATA FILTERING

- Filtered for messages containing health-related keywords
  - 598 **disease** names
  - 314 **symptom** terms
  - 407 **treatment** terms

- Estimated that **58%** are actually relevant to health
  - Two annotators labeled a sample of messages
  - Good enough for this exploratory study

DATA SET

- Nearly 1 million health-related messages:

Year	All Data	Health Data
2009	40,837	805
2010	1,376,381	13,157
2011	7,758,806	67,250
2012	20,253,134	180,681
2013	63,789,097	658,280

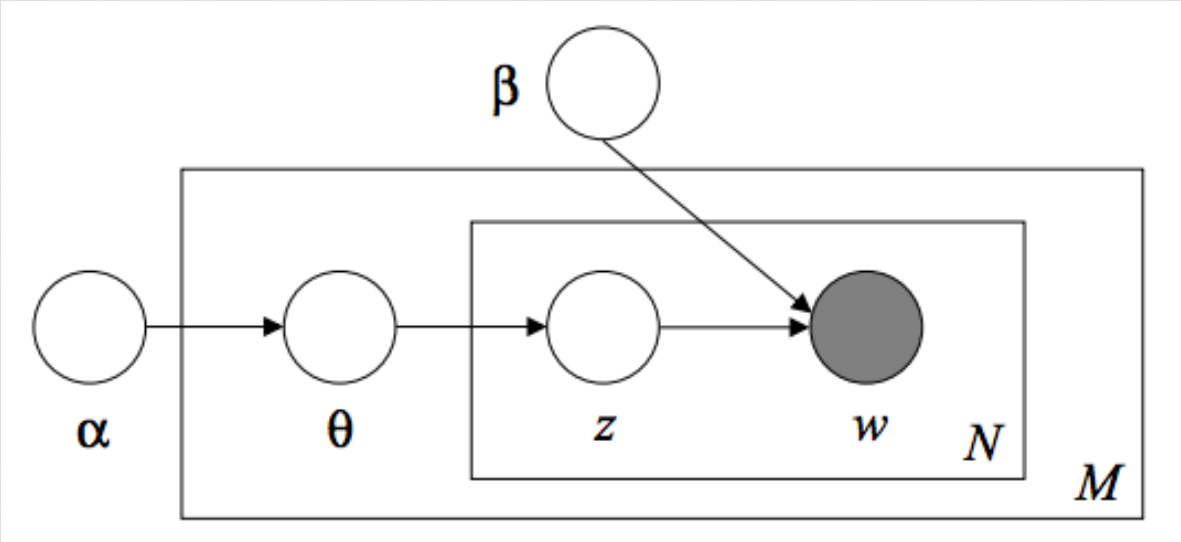
DATA EXPLORATION

- We used probabilistic **topic models** to identify prominent topics and themes in the health data
- **Unsupervised** clustering of words and messages into semantically coherent groups
- Used successfully in our earlier work with Twitter
  - ICWSM 2011; PLOS ONE 2014

TOPIC MODELING

- Latent Dirichlet Allocation (LDA) (Blei et al. 2003)

- Each document is a distribution over **topics**
- Each topic is a distribution over **words**



TOPIC MODELING

football	0.03
team	0.01
hockey	0.01
baseball	0.005
…	…

charge	0.02
court	0.02
police	0.015
robbery	0.01
…	…

congress	0.02
president	0.02
election	0.015
senate	0.01
…	…

Jury Finds Baseball Star Roger Clemens Not Guilty On All Counts

A **jury** found **baseball** star **Roger Clemens** not **guilty** on six **charges** against. **Clemens** was **accused** of **lying** to **Congress** in 2008 about his use of **performance** enhancing **drugs**.

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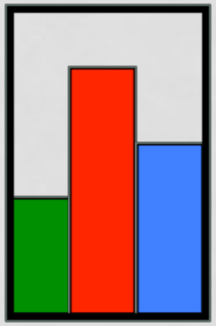
Doc 1



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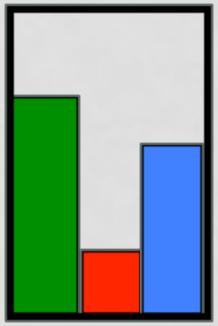

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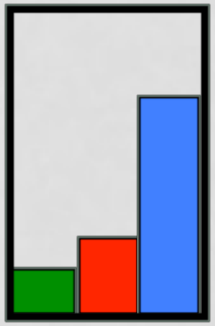

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TOPICS DISCOVERED

- 16 distinct health issues:
  - Healthcare
  - Sleep issues
  - Muscle and joint pain
  - Common cold
  - Skin conditions
  - Skin health
  - Infant health
  - Eye health
  - Nutrition
  - Diet and weight loss
  - Exercise
  - Pregnancy
  - Pollution
  - Influenza
  - Alcohol use
  - Tobacco use

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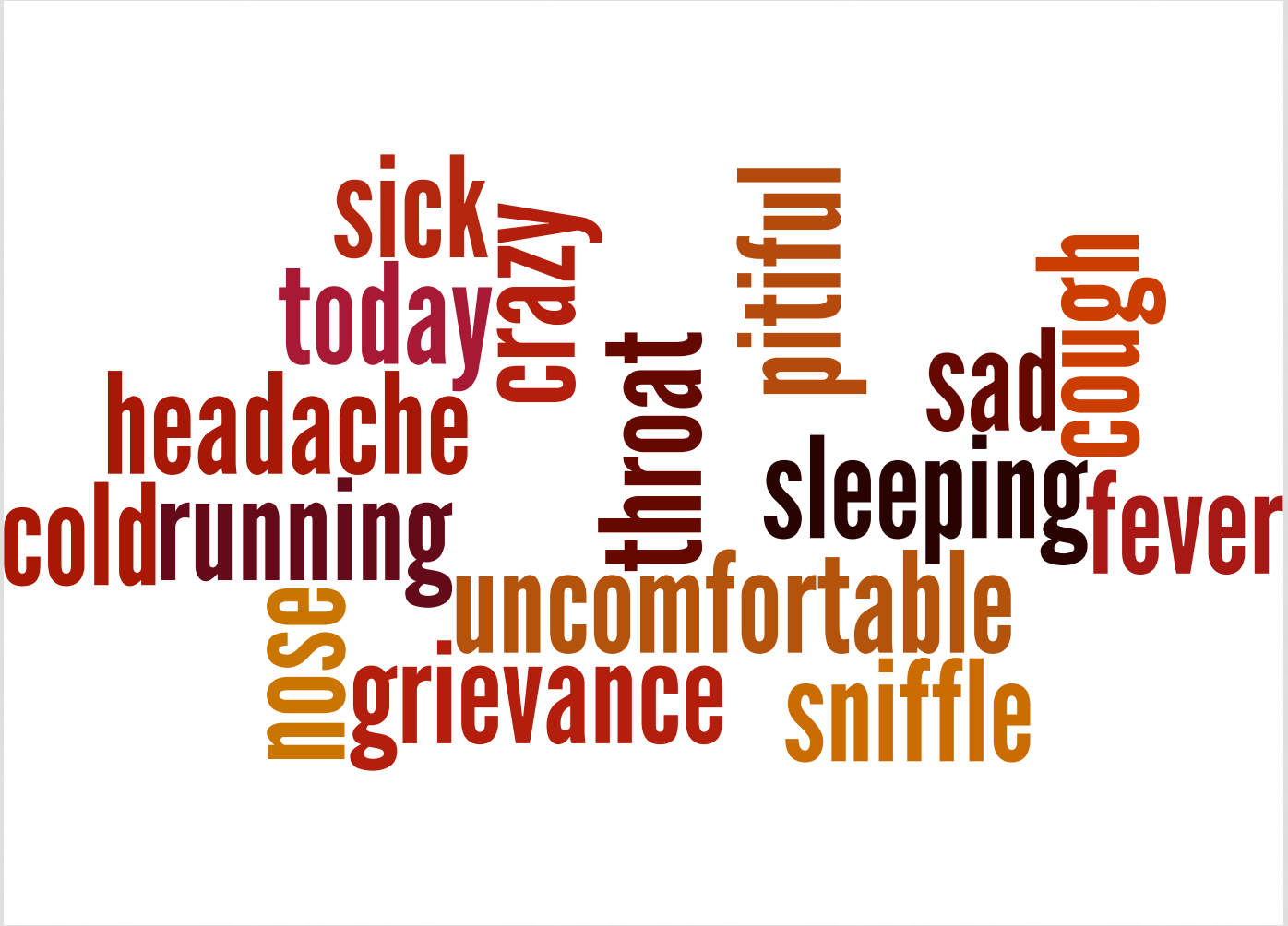

TOPICS DISCOVERED

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COMPARISON TO TWITTER

- Some differences we noticed compared to our previous work with Twitter topic models:
  - Alcohol and tobacco use
    - Both have been studied in Twitter, but these weren't discovered as topics by our methods in Twitter
  - Pollution
    - Two pollution topics in Weibo
  - Nutrition
    - Several topics about food, drink, and herbs
  - Infants and children
    - Multiple health topics

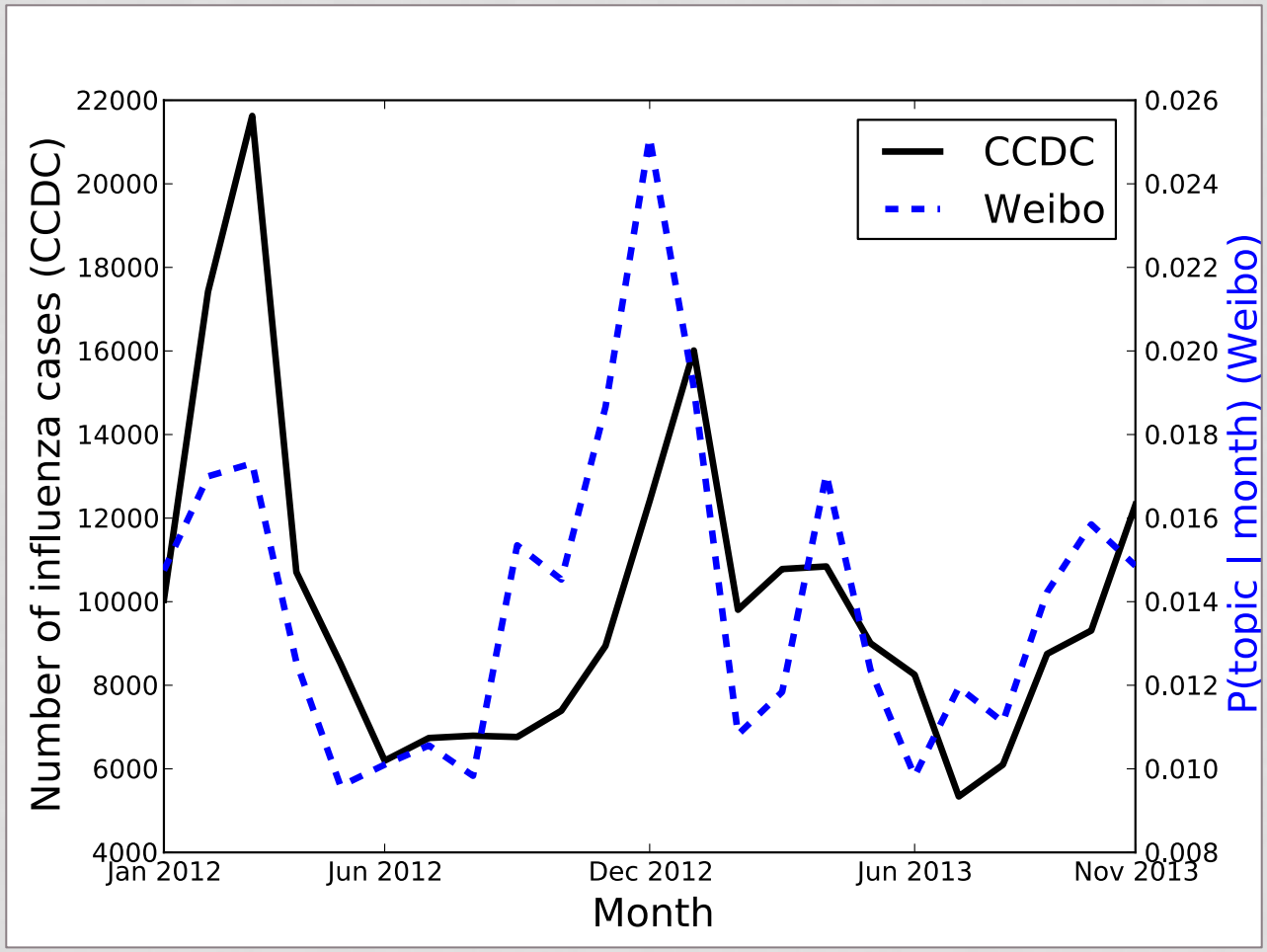
VALIDATION: INFLUENZA

- Compared the **temporal trend** of influenza-related topics to monthly data from the Chinese CDC
  - Four flu-like topics discovered by LDA

- Topics show moderate correlation with CCDC data:

Year		Topic ID			
		2	37	90	95
2012	(n=12)	.59*	.50	-.0.05	.55
2013	(n=11)	.22	.72*	.46	.08
2012–13	(n=23)	.36	.56†	.16	.06

VALIDATION: INFLUENZA



VALIDATION: AIR POLLUTION

- Compared the air pollution topic to government data on fine particle pollution (PM2.5) for 74 cities
  - Average daily value in 2013
- Correlation of **.546**
- Currently researching this topic more

LIMITATIONS

- Crawled data not a random sample
  - Presents difficulties for mining temporal trends
- Much of the data is noisy
  - But we've shown in past work that this can be cleaned up e.g. with supervised machine learning
- Concerns over censorship
  - Presumably a bigger problem for some topics more than others

CONCLUSION

- Many health topics are discussed in Weibo
- Early results show weibos are correlated with existing surveillance data
- Many health topics to potentially study in depth in future work

THANK YOU

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