

Influencing cervical cancer prevention and detection online through social media

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Center for Vulnerable Populations
at San Francisco General Hospital and Trauma Center

Roadmap

- Brief introduction/ career trajectory
- R01 NCI SNOWBALL project on the influence of social media on cervical cancer prevention and control
- Directions for future research

Who I am

- Primary care physician+investigator
- Transforming health systems and health communication to improve the safety and quality of care for diverse populations
 - Follow-up of abnormal tests
 - Missed and delayed diagnosis
 - Adverse drug events
 - Health system innovations
- Intersection between technology, digital health, and cancer prevention and control



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TEXAS

The University of Texas at Austin

National Cancer Institute R01CA178875 (Co-PIs: Sarkar & Centola)

Study Goal

Use a mixed-methods approach to online social media and social networks for enhancing understanding of cervical cancer screening to optimize the spread of health messages and behaviors within online social networks

SNOWBALL Team

Multi-disciplinary Team:

- ❑ **Urmimala Sarkar, MD, MPH:** Lead PI
- ❑ **Damon Centola, PhD** (UPenn): Co-PI, sociologist, social networking research
- ❑ **Byron Wallace, PhD** (UT Austin): computer scientist, machine learning methods
- ❑ **George Sawaya, MD:** obstetrics/gynecology, cervical cancer expertise
- ❑ **Rena Pasick, DrPH:** behavioral and qualitative research
- ❑ **Courtney Lyles, PhD:** health services research
- ❑ **Gem Le, PhD, MHS:** project manager, social epidemiology, cancer prevention

Specific Aims

Aim 1: To use machine learning techniques (i.e., large-scale computer algorithms) to identify and rank the key words related to cervical cancer screening and HPV vaccination in social media messages.

Aim 2: To categorize and validate the range of cervical cancer screening and HPV vaccination discussion on social media.

Aim 3: To create cervical cancer screening and HPV vaccination messages for social media and evaluate their effectiveness for increasing diffusion through online social networks.

Cervical Cancer Epidemiology

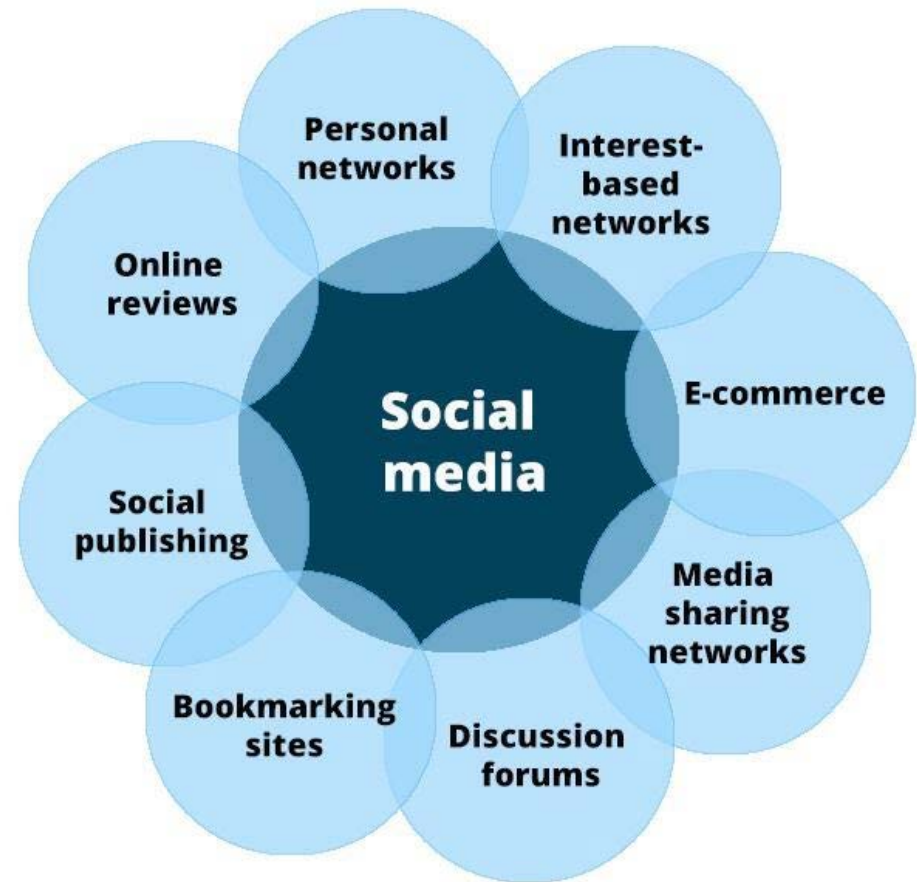
- 12,109 new cases of cervical cancer per year¹
- Disparities by race/ ethnicity/ education¹
 - Hispanic women have highest rates
 - Women with < high school education have lowest rates of screening
- 19% of adolescent girls (ages 12-17) and 11% (ages 18-27) initiated HPV vaccination in 2007²
- Ongoing need to bolster screening and prevention efforts

¹ CDC, <http://www.cdc.gov/cancer/cervical/statistics/>

² Tiro JA, Tsui J, Bauer HM, Yamada E, Kobrin S, Breen N. Journal of Women's Health. June 2012, 21(6): 656-665.

What is Social Media?

- “Social media are Web-based tools that are used for computer-mediated communication.”
(Grajales, JMIR, 2014)
- Interactive, user-generated content
- Key method for communication



Why use social media for research?

Applications to health include:

- Promoting public health campaigns
- Reporting real-time trends for infections
- Recruitment of patients to online studies and clinical trials
- “Contagion” of behavior via social media

Grajales FJ, Sheps S, Ho K, Novak-Lauscher H, Eysenbach G. Social Media: A Review and Tutorial of Applications in Medicine and Health Care. JMIR 2014 Feb 11;16(2):e13.

Cameron, A. M., Massie, A. B., Alexander, C. E., Stewart, B., Montgomery, R. A., Benavides, N. R., Fleming, G. D. and Segev, D. L. (2013), Social Media and Organ Donor Registration: The Facebook Effect. American Journal of Transplantation, 13: 2059–2065.

What is Twitter?



- ❑ Microblog = platform for information dissemination, social networking, and real-time communication.
- ❑ Allows networks of users to send short updates to each other in less than 140 characters.
- ❑ Messages on Twitter are called “tweets”

Sample Tweet



Francis S. Collins @NIHDirector · Jul 5

I will request my health records & share that experience. Need [#GetMyHealthData](#) [#DataIndependenceDay](#) to work for [#pminetwork](#) to succeed

RETWEETS

67

FAVORITES

55



6:07 AM - 5 Jul 2015 · Details

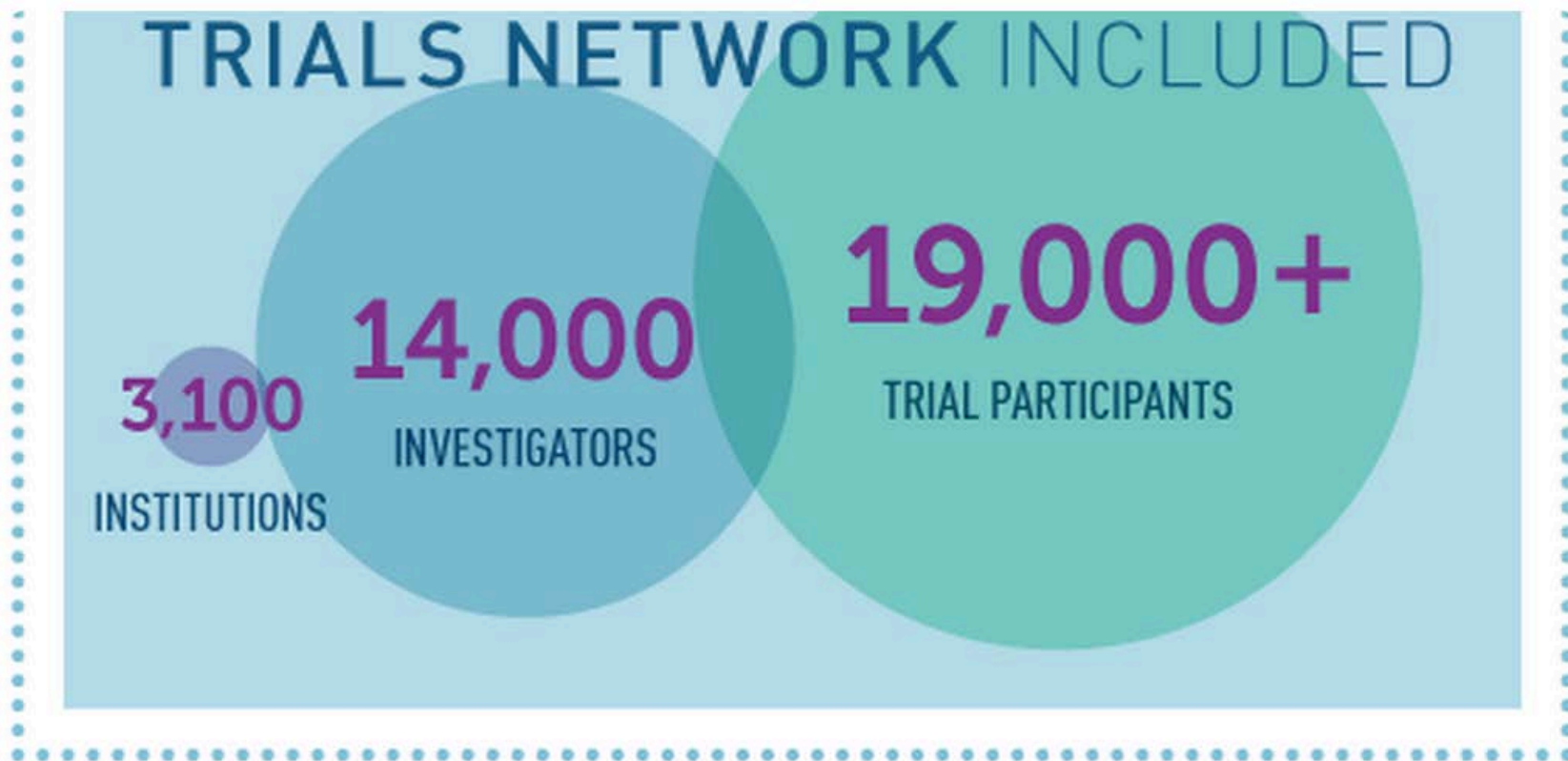


Sample Tweet



National Cancer Inst @theNCI · Jul 17

NCI's National Clinical Trials Network enrolled 19,000 patients in clinical trials in 2014: 1.usa.gov/1fbyoDG



18



16



[View photo](#)

Tweeting about Pap Smears

- “5 minutes of uncomfyness is better than cancer 4 a lifetime”
- “Guys encourage your mothers, sisters, wives girlfriends 13 to have regular pap smear. Also encourage them to get the vaccine.”
- “Took the afternoon off so I could get a pap smear and my car could get an oil change. :-/”

SNOWBALL Data & Methods

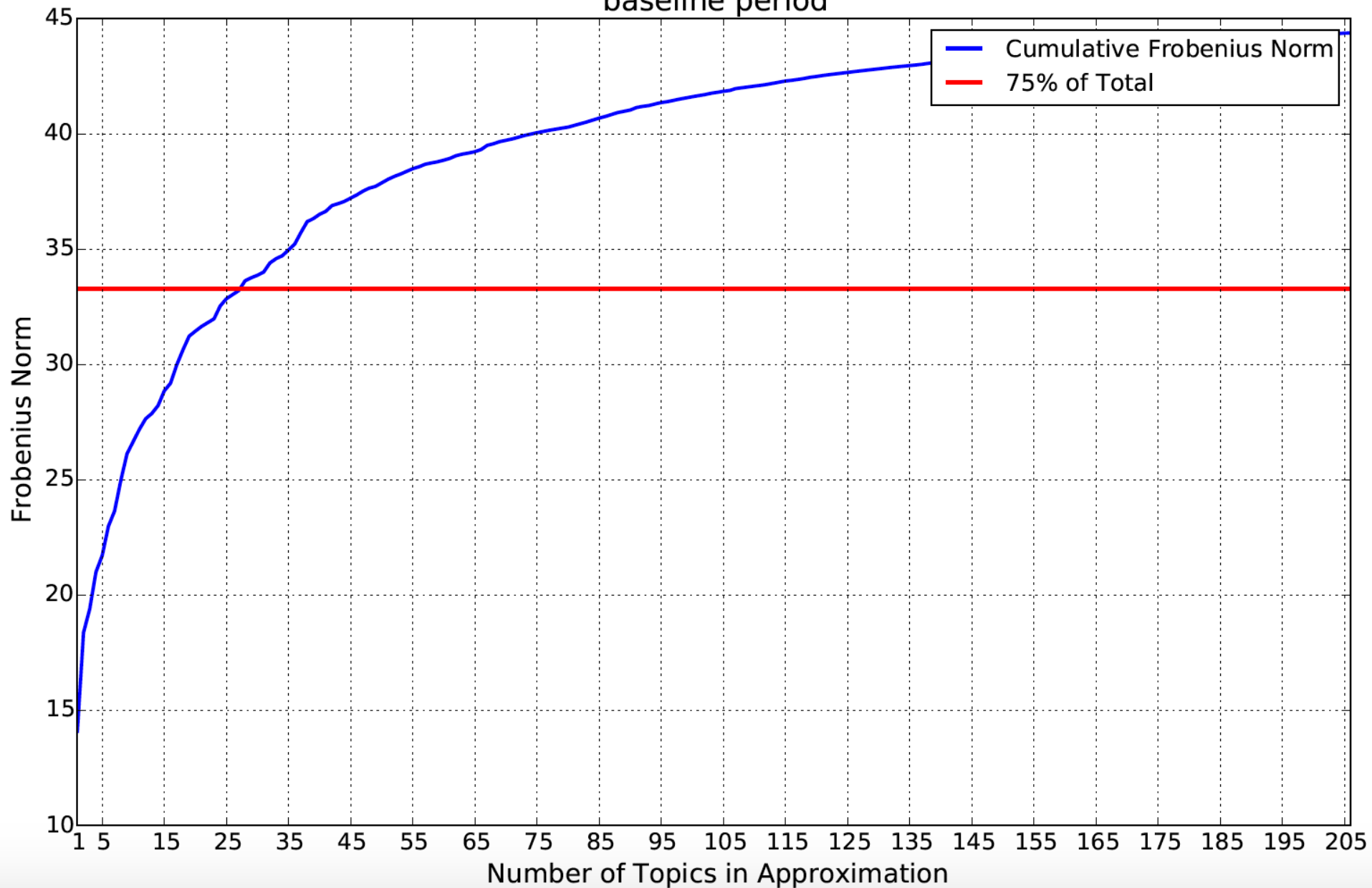
Aim 1 work:

- ❑ 119,428,139 Twitter messages obtained from March 2014 (1% sample from all of Twitter)
- ❑ Filtered messages matching our keywords of **interest** (e.g., pap smear, HPV, papillomavirus, pap test, cervical, cervix, cervical cancer, papanicolau, squamous, smear test, dysplasia)
- ❑ Applied Sparse Principal Components Analysis (SPCA) to identify clusters of keywords that are mathematically grouped into topics

A selected automated “topic”

1. CBC News HPV Vaccine Funding Cut by Canadian Province; polyDNA Recommends that Canadian Doctors Learn About... <http://t.co/QSn8Urev73>
2. RT @gogreen18: the anti-vaccine movement scares the crap out of me. i have paranoid family members now opting out of HPV vaccines for theif_Ý
3. Study: HPV vaccine working - The Human Papillomavirus vaccine has reduced the frequency of abnormal Pap smears and...<http://t.co/X7bF0l8sYW>
4. **@positivegp is HPV vaccine only for girls/women? The lady mentioned genital warts on the penis as well, do men get vaccine?**
5. Another Success for HPV Vaccine <http://t.co/DEgvZIYyFb>
6. .@CherylMHolmes on province set to stop funding HPV vaccine for some women: <http://t.co/QVEjwlpSYB>
7. RT @CherylMHolmes: Manitoba to cut free HPV vaccine program for young women on April 1. Are you worried about getting your shots?
8. #googlenews One dose of HPV vaccine may prevent cervical cancer - New Straits Times <http://t.co/StYww0Cijl>
9. RT @Rwanda_Post: Vaccine for Cervical Cancer Coming to Rwanda - <http://t.co/sLWCpoqWLe> #Rwanda #RWOt
10. @RTH2039: BMJ Press Release:HPV vaccine provides significant protection against cervical abnormalities <http://t.co/t1nWLulGzP> @JulieLeask

Cumulative Frobenius Norm, 10 docs per topic
baseline period



Next steps

- Aim 2 work focused on qualitative analysis
- Qualitatively code a large purposive sample of social media content (minimum 1500 messages) collected under Aim 1
- Synthesize data from Aims 1 and 2 to develop social media messages for testing in Aim 3 (e.g., identifying key influencers from Aim 1 (individuals vs. organizations), addressing misconceptions/cancer myths observed from Aim 2)
- Develop study protocol for Aim 3 in detail; online social network experiment to go live in Summer 2016

Advantages of using social media

- Provides **immediate, real-time** data
- Minimal observation bias
- Provides insights into health behaviors that are not usually shared in traditional methods of public health data collection

*“Behaviors that people might be reluctant to share with physicians are on full display on Twitter, including **behaviors, opinions, and subpopulations that are otherwise difficult to track through traditional mechanisms**, suggesting a whole new area of large-scale public-health research.” (Dredze, 2012)*

Caveats in analyzing social media data

- ❑ Socio-demographic characteristics
- ❑ Subject to selection bias
- ❑ Twitter users more likely to be young and non-white

Caveats in analyzing social media data

- Social media data viewed as MORE than “big data”
 - Big data refer to very large datasets that can be analyzed or mined quantitatively to explore human behaviors and interactions
 - Analysis of social media data need to incorporate mixed methods
 - Should not rely on automated analysis alone (e.g., machine learning methods) for meaning analysis and interpretation of the data

Directions for future research

- Follow-on to online social network experiment to develop social media messaging for other screenable cancers
- Integrating mHealth data with online social networks
- Recruit specific patient populations to online social networks
 - Observe peer support, decision-making for cancer treatment
 - Opportunities for researching hard-to-reach populations (e.g., minority youth)
- Mixed-method approaches to analyzing online social network data
 - Potential: online disease communities

Thank you



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CFIR Construct Definitions

Topic/Description	Start Date	End Date	Score
Mathematics	2023-01-01	2023-01-15	85
Science	2023-01-16	2023-01-30	78
History	2023-02-01	2023-02-15	92
Language Arts	2023-02-16	2023-02-28	88
Physical Education	2023-03-01	2023-03-15	95
Art	2023-03-16	2023-03-30	80
Music	2023-04-01	2023-04-15	82
Health	2023-04-16	2023-04-30	75
Foreign Languages	2023-05-01	2023-05-15	87
Environmental Studies	2023-05-16	2023-05-30	79
Computer Science	2023-06-01	2023-06-15	90
Social Studies	2023-06-16	2023-06-30	83
Business	2023-07-01	2023-07-15	86
Engineering	2023-07-16	2023-07-30	77
Psychology	2023-08-01	2023-08-15	89
Philosophy	2023-08-16	2023-08-30	81
Religion	2023-09-01	2023-09-15	76
Law	2023-09-16	2023-09-30	91
Medicine	2023-10-01	2023-10-15	84
Political Science	2023-10-16	2023-10-30	78
Economics	2023-11-01	2023-11-15	86
Sociology	2023-11-16	2023-11-30	80
Anthropology	2023-12-01	2023-12-15	82
Geography	2023-12-16	2023-12-30	79
Environmental Science	2024-01-01	2024-01-15	85
Biotechnology	2024-01-16	2024-01-30	78
Space Exploration	2024-02-01	2024-02-15	92
Artificial Intelligence	2024-02-16	2024-02-28	88
Robotics	2024-03-01	2024-03-15	95
Virtual Reality	2024-03-16	2024-03-30	80
Augmented Reality	2024-04-01	2024-04-15	82
Blockchain	2024-04-16	2024-04-30	75
Cybersecurity	2024-05-01	2024-05-15	87
Quantum Computing	2024-05-16	2024-05-30	79
Cloud Computing	2024-06-01	2024-06-15	90
Big Data	2024-06-16	2024-06-30	83
Internet of Things	2024-07-01	2024-07-15	86
Smart Cities	2024-07-16	2024-07-30	77
Autonomous Vehicles	2024-08-01	2024-08-15	89
Space Colonization	2024-08-16	2024-08-30	81
Artificial General Intelligence	2024-09-01	2024-09-15	76
Quantum Entanglement	2024-09-16	2024-09-30	91
CRISPR	2024-10-01	2024-10-15	84
SpaceX	2024-10-16	2024-10-30	78
Artificial Neural Networks	2024-11-01	2024-11-15	86
Blockchain Technology	2024-11-16	2024-11-30	80
Virtual Reality Gaming	2024-12-01	2024-12-15	82
Augmented Reality Applications	2024-12-16	2024-12-30	79
Cloud Storage	2025-01-01	2025-01-15	85
Big Data Analytics	2025-01-16	2025-01-30	78
Internet of Things Security	2025-02-01	2025-02-15	92
Artificial Intelligence Ethics	2025-02-16	2025-02-28	88
Robotics Education	2025-03-01	2025-03-15	95
Virtual Reality Training	2025-03-16	2025-03-30	80
Augmented Reality Marketing	2025-04-01	2025-04-15	82
Blockchain Finance	2025-04-16	2025-04-30	75
Cybersecurity Awareness	2025-05-01	2025-05-15	87
Quantum Computing Applications	2025-05-16	2025-05-30	79
Cloud Computing Migration	2025-06-01	2025-06-15	90
Big Data Privacy	2025-06-16	2025-06-30	83
Internet of Things Integration	2025-07-01	2025-07-15	86
Smart City Development	2025-07-16	2025-07-30	77
Autonomous Vehicle Testing	2025-08-01	2025-08-15	89
Space Exploration Funding	2025-08-16	2025-08-30	81
Artificial Intelligence Regulation	2025-09-01	2025-09-15	76
Quantum Computing Research	2025-09-16	2025-09-30	91
CRISPR Applications	2025-10-01	2025-10-15	84
SpaceX Launches	2025-10-16	2025-10-30	78
Artificial Neural Networks Research	2025-11-01	2025-11-15	86
Blockchain Scalability	2025-11-16	2025-11-30	80
Virtual Reality Accessibility	2025-12-01	2025-12-15	82
Augmented Reality Usability	2025-12-16	2025-12-30	79
Cloud Computing Performance	2026-01-01	2026	

CFIR Construct Definitions

Keywords: vaccine, canadian, province, funding, cut

User Nickname	Date	Message
News_Pharma	Mar 12 2014 - 03:03:36	CBC News HPV Vaccine Funding Cut by Canadian Province; polyDNA Recommends that Canadian Doctors Learn About... http://t.co/QSn8Urev73
PNMadsen	Mar 17 2014 - 17:02:26	RT @gogreen18: the anti-vaccine movement scares the crap out of me. i have paranoid family members now opting out of HPV vaccines for theif_Ÿ
InternsRDFRS	Mar 06 2014 - 19:35:43	Study: HPV vaccine working - The Human Papillomavirus vaccine has reduced the frequency of abnormal Pap smears and... http://t.co/X7bF0I8sYW
TheREALilluZion	Mar 06 2014 - 13:23:05	@positivegp is HPV vaccine only for girls/women? The lady mentioned genital warts on the penis as well, do men get vaccine?
BonhamFamDrug	Mar 04 2014 - 19:03:03	Another Success for HPV Vaccine http://t.co/DEgvZIYyFb
ctwinnipeg	Mar 05 2014 - 19:37:39	.@CherylMHolmes on province set to stop funding HPV vaccine for some women: http://t.co/QVEjwlpSYB
hpattz	Mar 05 2014 - 12:00:20	RT @CherylMHolmes: Manitoba to cut free HPV vaccine program for young women on April 1. Are you worried about getting your shots?
GoogleNewsMal10	Mar 13 2014 - 04:52:27	#googlenews One dose of HPV vaccine may prevent cervical cancer - New Straits Times http://t.co/StYww0Cijl
gatjmv	Mar 10 2014 - 12:03:37	RT @Rwanda_Post: Vaccine for Cervical Cancer Coming to Rwanda - http://t.co/sLWCpoqWLe #Rwanda #RWoT
eGPSolutions	Mar 05 2014 - 17:30:48	@RTH2039: BMJ Press Release:HPV vaccine provides significant protection against cervical abnormalities http://t.co/t1nWLulGzP @JulieLeask

Cumulative Frobenius Norm, 20 docs per topic
baseline period

