

Understanding Patients' Feedback through Natural Language Processing and Machine Learning

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Center for Health Workforce Studies

- The Center for Health Workforce Studies (CHWS) was established in 1996.
- Mission: To provide timely, accurate information and conduct policy-relevant research about the supply, demand, distribution, and the use of health workers.

Background and Purpose of Study

- Understanding patients' concerns and expectations regarding hospitals is crucially important for providers and administrators to improve service quality.
- In the internet era, information required for such attempts has become more accessible and affordable, as a huge and increasing amount of unsolicited feedback is provided on crowd-sourced review websites (Yelp, TripAdvisor, Google Maps, etc.).
- The purpose of this study is to better understand patients' concerns and expectations by analyzing feedback data collected on the internet.

hospital

Rating at least
Any rating

Albany Memorial Hospital
2.9 ★★★★★ (68)
General hospital · 600 Northern Blvd

St. Peter's Hospital
3.4 ★★★★★ (139)
General hospital · 315 S Manning Blvd

Albany Med South Clinical Campus
3.3 ★★★★★ (18)
General hospital · 25 Hackett Blvd
Open until 5:00 PM

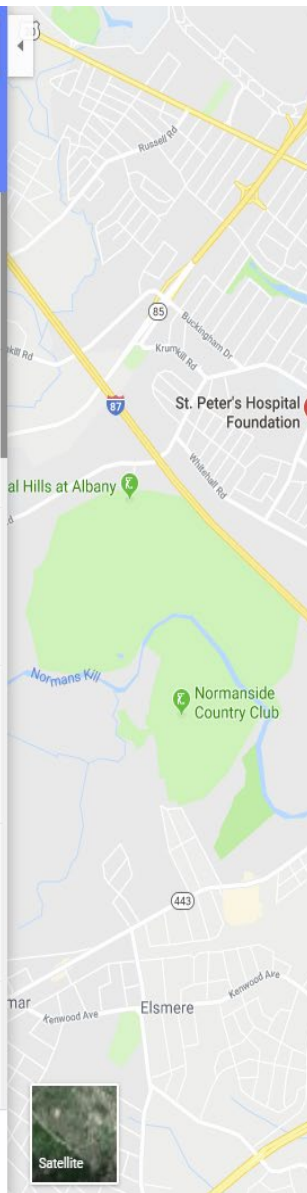
Bernard and Millie Duker Children's Hospital at Albany Med
3.2 ★★★★★ (9)
Children's Hospital · 43 New Scotland Ave

Albany Stratton VA Medical Center
4.0 ★★★★★ (66)
Veterans hospital · 113 Holland Ave

Albany Medical Center Eye Clinic
Hospital · 47 New Scotland Ave

Showing results 1 - 20

Update results when map moves



All reviews

WRITE A REVIEW

5 4 3 2 1

3.4
★★★★☆
139 reviews

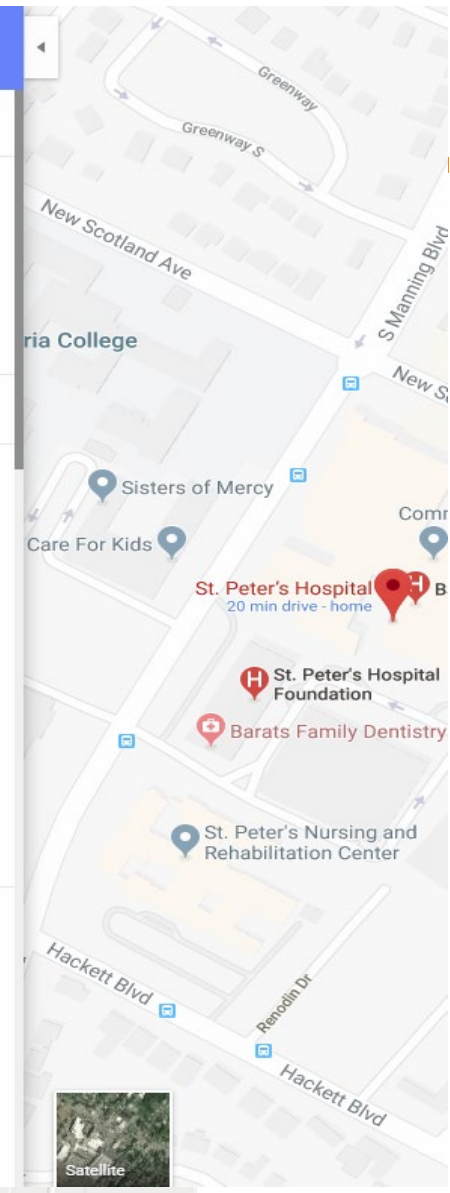
Sort by: Most relevant

Mr. Vacca
Local Guide · 17 reviews · 26 photos
★★★★★ a week ago
The nurses and doctors at this hospital are miracle workers. I can't speak highly enough about the facilities, the kindness of the staff and support from everyone...even the parking attendant! I highly recommend this hospital if you are looking for a place to have your baby! ☐☐

1 Share

Natalie Rumsey
Local Guide · 17 reviews
★★★★☆ a month ago
I brought my child in after a fall down the stairs that injured his mouth. The doctor immediately began interrogating me. I was feeling scared and stressed about my baby and all he did was ask me questions like, "why did you change his ..."
[More](#)

4 Share



Data Source for Study

- A list of all hospitals in U.S. was obtained from Data.gov
- A web crawler was created to retrieve ratings and comments from Google Maps.
- 7,496 hospitals → 6,735 can be found in Google Maps
5,888 of them have ratings and comments
- Due to Google Maps API limitations, only the most recent 5 comments and ratings of each hospital were retrieved
- They totally have 26,141 ratings and comments

Data Set for Analysis

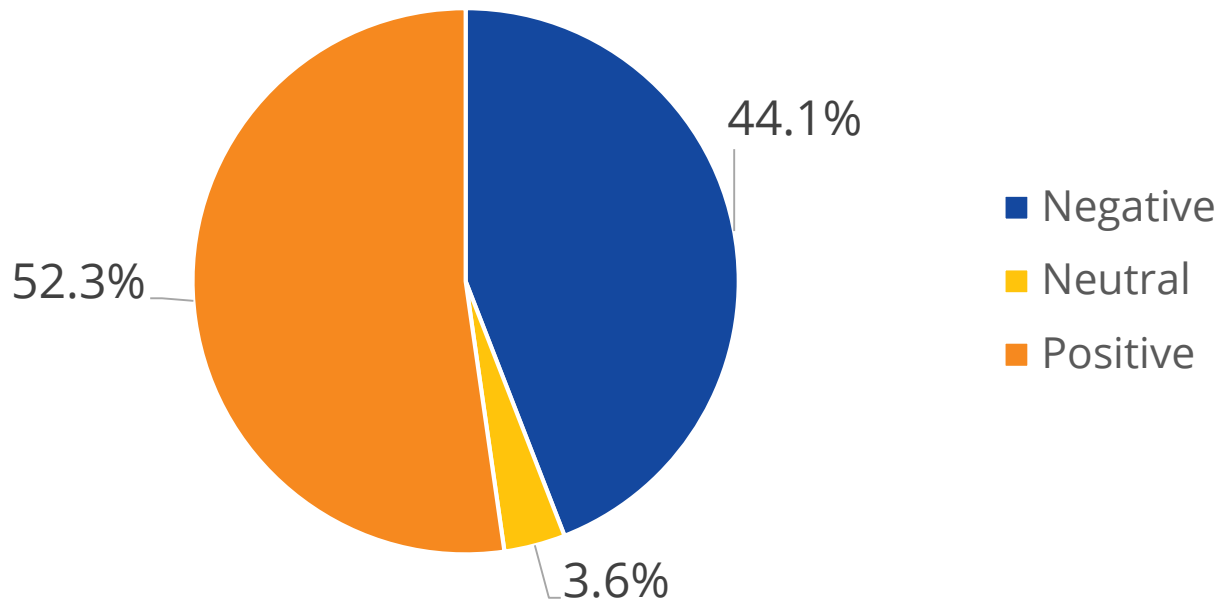
1	1	5	I had an amazing experience both times. Staff and nurses were very nice. I loved my nurses. I
2	2	2	Parking is still extremely bad! Today I went to visit my brother in law and went to main entranc
3	3	1	The wait times in this ER are disgusting! I ve been here twice in the past month and each wait
4	4	5	They did a great job getting me in to be seen for an emergency. I lost the ability to swallow an
5	5	5	Very long story short after memorial hospital in North Conway almost killed my mom CMC sa
6	6	5	Had labwork stellar staff stellar experience and I have a LOT of experiences in this. Front desl
7	7	4	I had a very positive experience. I was well cared for and well taken care of. My only compla
8	8	5	I had to go into the ER a year ago and have an emergency surgery. All the nurses treated me v
9	9	5	In the past few weeks I have sought medical care at Monadnock Community Hospital with var
10	10	5	The psychiatry office here is great. Dr Stevens is thorough and very helpful. Not all psychiatri:
11	11	5	Both my boyfriend and I are pretty healthy people overall so when we had to take my boyfrie
12	12	1	Got billing for something that I have no record of and have to wait until Monday to figure this
13	13	3	Mixed reviews over the years but mostly good- I have been to the ER twice with potential he
14	14	1	One of The worst Hospitals in New England. No Compassion for the patient. Doctors are no w
15	15	5	WOW! What an incredible company to work for! When I arrive at work every morning I am al
16	16	4	Almost a 5 star but one Doctor I had there took it away. He was from Serbia and moved on fro

Methods

- Classify as positive, neutral and negative
- Identify most frequent two-gram terms
- Text clustering analysis
- Sentiment analysis

Classification of Ratings and Comments

- Rating ≤ 2 \longrightarrow Negative rating and comment
- Rating = 3 \longrightarrow Neutral rating and comment
- Rating ≥ 4 \longrightarrow Positive rating and comment



N=26,141

Data Cleaning for Text Mining on Comments

- Remove punctuation
- Convert all letters to lower-case
- Remove stop words (the, also, to, and)

Most Frequent Two-gram Terms

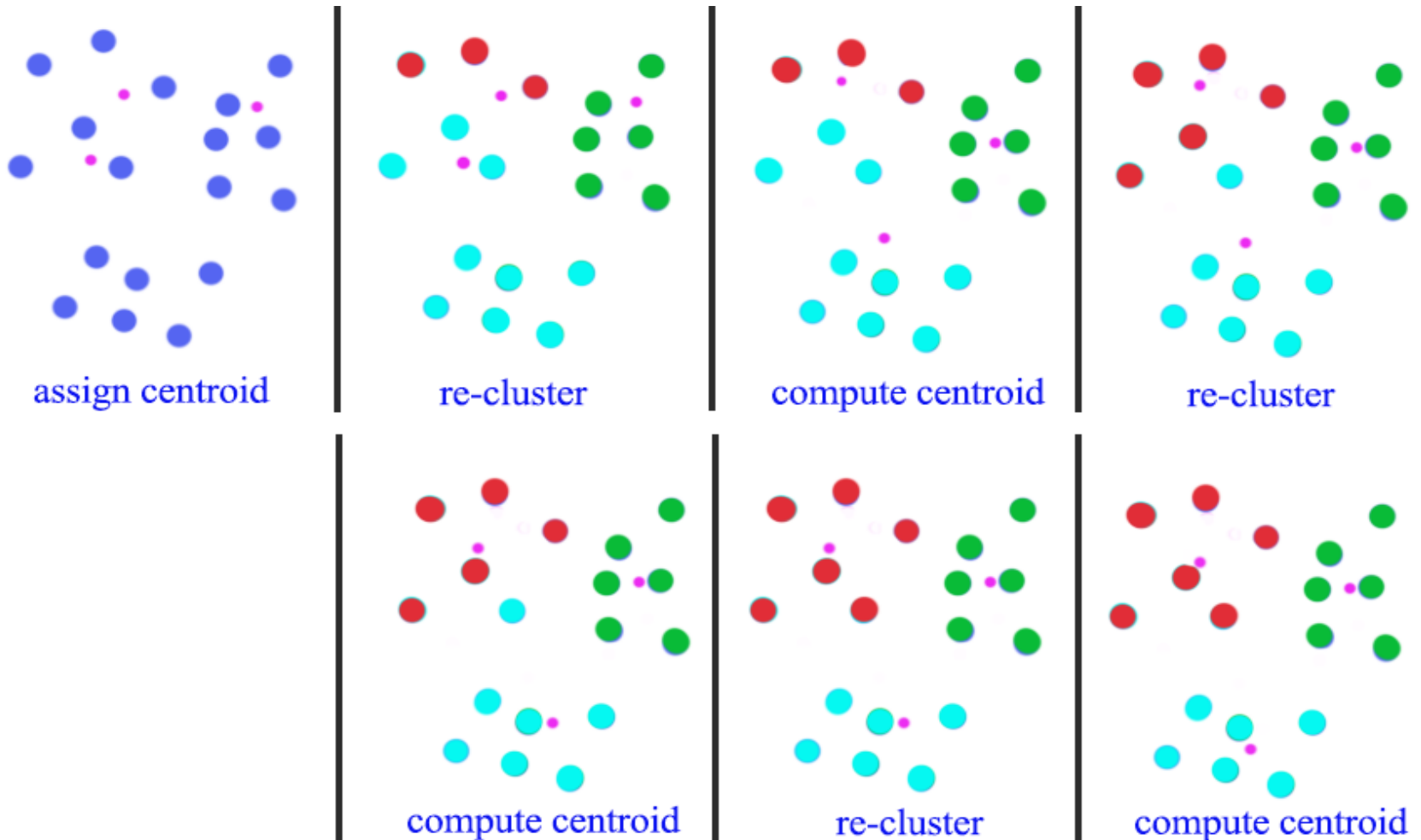
Positive comments

highly recommend	639
emergency room	557
doctors (and) nurses	499
great care	478
excellent care	451
nursing staff	413
nurses doctors	413
staff friendly	392
good care	381
recommend hospital	373
hospital staff	355
great experience	341
best hospital	322
make sure	311
medical center	306
staff great	297
great staff	290
taken care	289
best care	271
care received	268

Negative comments

emergency room	771
waiting room	681
worst hospital	470
sent home	392
don('t) know	382
year old	342
don('t) care	300
family member	300
went (to) er	273
loved ones	254
treated like	254
blood pressure	249
care (about/for) patients	247
make sure	245
feel like	236
urgent care	234
waited hours	222
waste time	216
worst experience	208
customer service	202

K-mean Clustering Analysis



Top Representative Words for Four Clusters

1st Cluster

insurance
billing
pay
department
bills
paid
collections
payment
received
company

2nd Cluster

wait
hour
seen
waited
minutes
appointmen
t
long
30
finally
blood

3rd Cluster

family
mother
loved
mom
days
facility
member
surgery
ones
father

4th Cluster

bad
better
want
service
work
treated
terrible
really
unprofessional
daughter

Sentiment Analysis

- Purpose: to fit a predictive model that classifies new comments into positive and negative groups in batch.

		Accuracy Rate	Recall	Precision
Random Forrest	Trees=20	0.91	0.90	0.93
	Trees=100	0.92	0.92	0.93
	Trees=200	0.92	0.93	0.93
SVM		0.95	0.94	0.96
Logistic Regression		0.94	0.94	0.95

- Accuracy rate, recall and precision are average values based on 10-fold cross validation.
- Support vector machine has the best performance among all models here, and it identifies 95% cases correctly.

Key Findings and Implications: Hospital Administrators

- Hospital administrators may wish to improve billing and payment processes, reduce waiting time, make facilities more accessible for aged patients and improve service quality.
- Hospitals administrators may wish to make patients feel they are receiving excellent and friendly care from hospital staff.

Key Findings and Implications: Methods

- Patient feedback on crowd-sourced review websites is readily available for analysis and can be informative.
- Natural language processing algorithm and machine learning models can dramatically improve the efficiency of classifying patients' feedback, as well as identifying their underlying meaning.

Questions?

- For more information, please email me at: yliu32@albany.edu
- Visit us at:



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