

Evaluation of Triage Note Negation Processing for Syndromic Surveillance

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Overview

- Triage note basics
- EMT-P & NegEx and how we use them to process triage notes
- Study methods and results
- Conclusions

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Triage Note Basics

- Free text expansion on Chief Complaint
- Readily available in many ED Information Systems, including (but not limited to)
 - Allscripts
 - Cerner
 - EPIC
 - HMS
 - MedHost
 - Meditech (Magic and Client /Server)
 - T-System
- No identifiable information (referring doctor and medical home information are not considered sensitive) *although this cannot be 100% guaranteed in chief complaints or triage notes*

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Triage Notes in NC DETECT

- Received by 29/111 (26%) hospitals in NC DETECT; accounting for 32% of all visits
- Only OPTIONAL element in NC mandate for ED data collection
- Easier rule in/rule out: facilitate investigations without phone calls or accessing other systems

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Sample Triage Notes: Uncomplicated Processing

Sample Chief Complaints	Sample Triage Notes
FLU SYMPTOMS	{ FEVER DIARRHEA AND COUGH ASSOCIATED WITH BODY ACHES SYMPTOMS X 4 DAYS}
FEVER	VISITED AFRICA 5 WEEKS AGO. C/O FEVER AND VOMITING X 3 WEEKS. MOM STATES SHE'S BEEN SEEN 3 TIMES. MOM WANTS PT CHECKED FOR MALARIA
NAUSEA and VOMITING and last threw up around 330 today, 5 other sorority members have the same thing, pt in room 7 too.	Pain level now: 0/10. The patient has had subjective fever with chills . No treatment prior to arrival.

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Sample Triage Notes: Negation (-)

Sample Chief Complaints	Sample Triage Notes
FEVER NOS	NURSING TRIAGEHPI: Presents with chills, coughing, chest hurts, whole body aching and have a fever. +nausea. No vomiting. Sxs started yesterday (-) received previous treatment for this complaint PREHOSPITAL CARE: Theraflu - last night. OTHER: (-) resides at nursing facility, (-) foley placement prior to arrival, (-) homehealth, (-) hospice, (-) DNR. LMP: presentPMH: (-) cardiac, (-) high cholesterol (-) HTN, (-) diabetes, (-) hypothyroidism (-) cancer, (-) renal failure, (-) respiratory, (-) seizures, (-) strokes, (-) ulcers, (-) GERD (-) migraines, (-) kidney stones, (-) psychiatric hx, (-) HIV, (-) hepatitis, (-) MRSA (-) glaucomaSURGERIES: eye surgery. **Past medical and surgical history obtained from patient. PMD: no tobacco, no alcohol, no drugs.FH: (-) heart, (-) cancer, (-) HTN, (-) DM, (-) CVA., (-) renal.

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Sample Triage Notes: Negation Intermixed with Symptoms

Sample Chief Complaints	Sample Triage Notes
ABD PAIN	c/o abd pain since yesterday. Pain a recurrent cramping sensation. +Nausea denies vomiting +diarrhea. Neg fever. Mask applied at triage. Pink, Warm, and Dry, No Acute Distress, Unlabored Respirations

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Sample Triage Notes: Negation misspelled

Sample Chief Complaints	Sample Triage Notes
SICKNESS/COLD SX	{PT C/O COUGH/CONGESTION X5DAYS; DENEIS N/V/D/FEVER }
SOB	Pt is 35 weeks pregnant with second child. Due in December. Pt co sob that has worsened since Friday. Pt co fatigue and has some wheezing . Using inhaler but states that it is only helping her for 30 minutues. Co dry non-productive cough . Deneis any fever.

Negation Solution: NegEx

- NegEx
 - A simple regular expression algorithm initially created by Will Bridewell.
 - Input = a sentence with indexed findings and diseases
 - Output = whether the indexed terms are explicitly negated or a hypothetical possibility
 - "The patient denies *chest pain*" → *chest pain* (negated)
 - "Rule out *pneumonia*" → *pneumonia* (possible).
 - <http://www.dbmi.pitt.edu/chapman/NegEx.html>

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Negation Challenge

- Triage Notes are not always sentences with indexed findings and diseases
- Successful negation processing in triage notes must account for:
 - Misspellings
 - Abbreviations
 - Acronyms
 - Other terms not included in NegEx

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Solution: EMT-P + NegEx

- EMT-P: Emergency Medical Text Processor
 - Developed at UNC (Debbie Travers, RN, PhD)
 - Cleans and standardizes chief complaint text using Java, Perl and UMLS
 - EXAMPLE: *chst pn, CP, c/p, chest pai, chert pain, chest/abd pain, chest discomfort* → **chest pain**
 - Triage note processing uses only select EMT-P modules
- <http://nursing.unc.edu/emtp/index.html>

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EMT-P Processing

- Misspellings module: corrects common misspellings of medical concepts
 - Asmatha → asthma
- Synonyms module: expands acronyms, abbreviations and truncations
 - Fuo → fever of unknown origin

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NC DETECT Modifications

■ NegEx

- Added negation terms found in triage notes
- Added “STOP” words: (+), *co*, *complaining of*, *multiple complaints*, *complains of*, *he*, *reports*, *she*, and *states* to stop identification of negated term
- Added “pre-cleaning” stage to work with NC DETECT records-based data

■ EMT-P

- Tweaked to use only misspellings and synonyms module with additional terms added

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Example Process: Step 1

Raw Triage Note

*c/o upper **cp** x 2 days describes as "tightness". Pt states onset with movement and increases with respiration. Pt denies **shob**, **n/v**, **diaphoresis**, **coughing**, **fev**, radiation of pain, or injury.”*



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Step 2: Triage Note After EMT-P

Triage Note After EMT-P Modules

*c/o upper **chest pain** x 2 days describes as "tightness". Pt states onset with movement and increases with respiration. Pt denies **shortness of breath, nausea vomiting, diaphoresis, coughing, fever**, radiation of pain, or injury."*



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Step 3: Triage Note After NegEx

Triage Note After NegEx: Negation Terms Identified and Deleted

*c/o upper **chest pain** x 2 days describes as "tightness". Pt states onset with movement and increases with respiration. Pt ~~denies shortness of breath, nausea vomiting, diaphoresis, coughing, fever~~, radiation of pain, or injury."*



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Final Product: Processed Triage Note

Processed Triage Note Ready for Syndromic Classification

c/o upper chest pain x 2 days describes as tightness. Pt states onset with movement and increases with respiration. Pt, radiation of pain, or injury.

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NC DETECT Triage Note Processing Evaluation

- GOAL
 - Compare NC DETECT syndrome classification with and without negation processing (EMT-P + NegEx)

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Evaluation Methods

- Gold standard dataset of ED visit records with triage notes (n=3059)
- NC DETECT syndrome classifier run twice
 - On raw triage notes
 - On processed triage notes (EMT-P + NegEx)
- Data analyses including sensitivity, specificity and predictive values were performed using SAS version 9.1.3 (SAS Institute, Cary, NC).

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Results: Fever / Rash (n=1050)

Statistical Analysis with and without Processing

	Se (95% CI)	Sp (95% CI)	PPV (95% CI)	NPV (95% CI)
Without Negation Processing	99.6% (97- 99.9)	53% (49-56)	40% (36-44)	99.8% (98- 99.99)
With Negation Processing	99.6% (97- 99.9)	64% (60-67)	46.28 (42-51)	99.8% (99- 99.99)

*Se= sensitivity, Sp= Specificity, PPV= positive predictive value,
NPV= negative predictive value, CI= confidence interval*

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Results: Respiratory (n=921)

Statistical Analysis with and without Processing

	Se (95% CI)	Sp (95% CI)	PPV (95% CI)	NPV (95% CI)
Without Negation Processing	47% (39-54)	88% (85-90)	46% (39-54)	88% (85-90)
With Negation Processing	46% (39-54)	92% (90-94)	58% (49-66)	88% (86-90)

*Se= sensitivity, Sp= Specificity, PPV= positive predictive value,
NPV= negative predictive value, CI= confidence interval*

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Results: Severe GI (n=1088)

Statistical Analysis with and without Processing

	Se (95% CI)	Sp (95% CI)	PPV (95% CI)	NPV (95% CI)
Without Negation Processing	52% (31-73)	96.63% (95-98)	25% (14-40)	99% (98-99)
With Negation Processing	52% (31-73)	97.09% (96-98)	28% (16-44)	99% (98-99)

*Se= sensitivity, Sp= Specificity, PPV= positive predictive value,
NPV= negative predictive value, CI= confidence interval*

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Limitations

- Study may not have included all possible negation patterns present in triage notes
- NC DETECT syndrome classification results may not be generalizable to other systems

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Conclusions

- Improvements to specificity and PPV with minimal effect on sensitivity
- Data must be monitored continuously
 - Additional negation terms for NegEx
 - Additional synonyms for EMT-P synonyms module
 - Additional terms to include in list of indexed terms

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Thank you!!

- Amy_ising@med.unc.edu
- EMT-P: <http://nursing.unc.edu/emtp/index.html>
- Neg-Ex: <http://www.dbmi.pitt.edu/chapman/NegEx.html>
- NC DETECT: <http://www.ncdetect.org>