

Speech Recognition in Healthcare

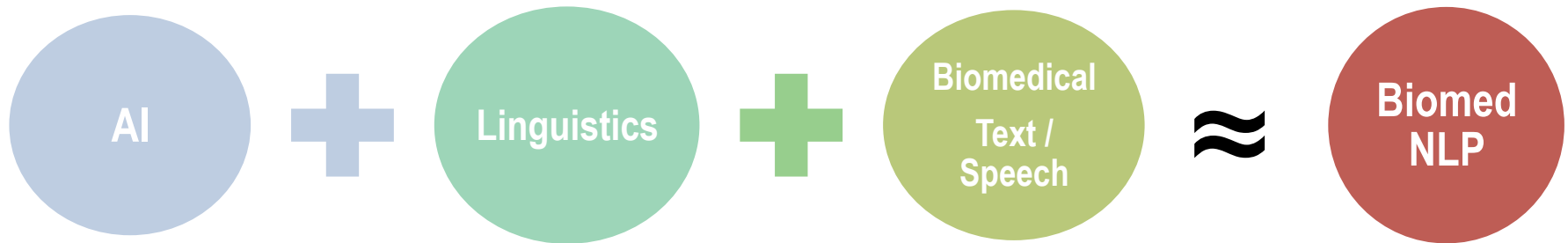
Li Zhou, MD, PhD

Associate Professor, Harvard Medical School
Lead Investigator, Brigham and Women's Hospital



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- Natural language processing (NLP) lies at the intersection of artificial intelligence and linguistics
- NLP aims to create intelligent agents to understand and manipulate human languages
- Any system that analyzes or synthesizes text or speech (e.g., voice to text; text to structured data, translations, text analytics)

- The global NLP market will be worth \$13.4 Billion by 2020.
- The global healthcare NLP market is estimated to be worth **\$2.7** billion by 2020 and **\$4.3** billion by 2024, growing significantly from the \$936 million reported in 2015.
- The market is projected to rise at a compound annual growth rate of **18.8%**.

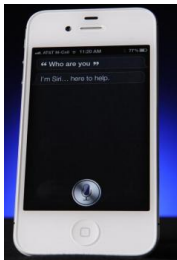
(EHR market is expected to reach \$23.98 billion globally in 2020)

<https://hitinfrastructure.com/news/healthcare-natural-language-processing-expects-steady-growth>

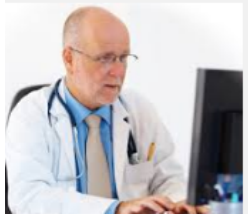
Speech Recognition



SR becomes the bridge between human-machine interaction



Ways to Document in EHR



Typing



Optical Character Recognition



Speech Recognition



Transcriptionists



Scribes



Select Desktop Pt Chart: Notes Oncology Custom Reports Admin Sign ? Resource Popup

Type... Subj: Patient Note

Arial 10 B I U

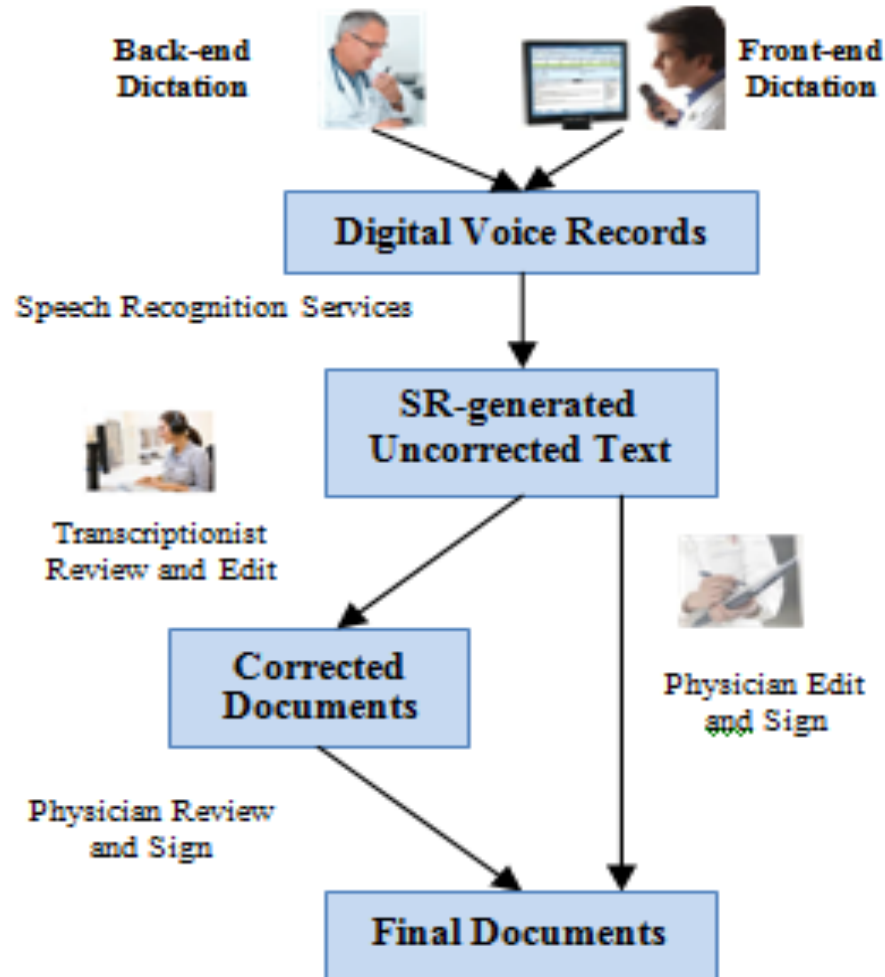
CHIEF COMPLAINT
Patient presents with a chief complaint of sore throat for 5 days.

SYMPTOMS
Patient complains of subjective fever, chills or feeling cold, sore throat and muscle aches. Patient denies documented fever, feeling fatigued, ...

PROBLEMS
Urinary tract infection occurred one month ago. Coronary artery disease was diagnosed for two years. Diabetes mellitus type 2 was diagnosed at the same time.

ALLERGIES
ACE Inhibitor – Anaphylaxis was found during last hospitalization.

MEDS
Albuterol INHALER, used occasionally. Celebrex 200 MG PO 1 PRN x 30 days (01/10/2009), discontinued by patients due to stomach upset. Lipitor 20 MG PO Q24H x 90 days, started from Dec. 2008. Coenzyme Q10 100 PO QD PRN chest



SR-assistant dictation and transcription process

- Recent studies reported that 90% of hospitals plan to expand their use of SR
- Issues including documentation quality, productivity, and physician satisfaction have not been widely studied.

- Retrospectively analyzed 100 emergency physician notes during Dec 2012
 - Generated via a front-end SR system (Dragon® Medical 10.0)
 - Further edited and signed by the physicians
- 71% of notes contained errors; 1.3 errors per note; 9 errors per 1000 words
- 15% contained one or more clinically significant errors
- Physicians signed their notes with known errors, indicating proofreading the entire medical note to search for errors is time consuming.

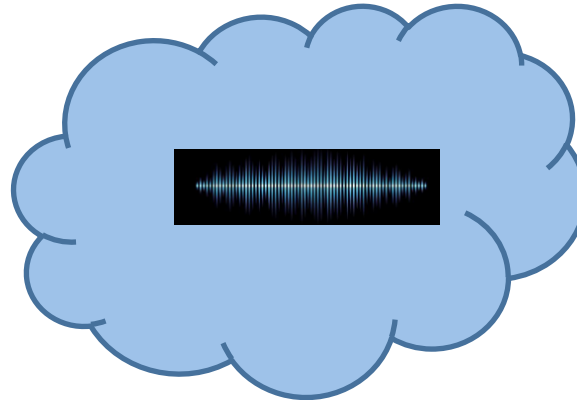
Voice-enable Care



patients & families



@ *home*



@ *inpatient*



@ *outpatient*



clinicians

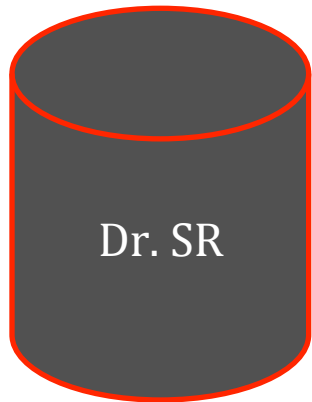
Eliza

An example of early, primitive NLP systems

- 1st Chatter bot that mimics human conversation
- Written in 1960s
- Simulates a Rogerian psychotherapist
- Implemented using simple pattern matching techniques
- [Http://nlp-addiction.com/eliza/](http://nlp-addiction.com/eliza/)

Eliza: Hello. My name is Eliza. How may I help you?
Li: I do not feel well today.
Eliza: Ahh. Please continue...
Li: I suffer from allergies.
Eliza: Say, do you have any psychological problems?
Li: I have bad allergies, so I feel sad...
Eliza: Do you often feel sad?
Li: No.
Eliza: Why not?
Li: Why should I?
Eliza: What do you think?
Li: I want to hear your suggestions?
Eliza: What if you never got to hear my suggestions?
Li: To see a real doctor?
Eliza: I am not sure I understand your fully.
Li: You're just a computer program, aren't you?
Eliza: What makes you think I am just a computer program, aren't me?
Li: You don't fully understand my problem.
Eliza: Oh... don't fully understand your problem?

Voice-enabled Care



“Dr. SR, when is my next appointment with Dr. Smith?”
“Dr. SR, what is my new medication? How do I take it?”



“Dr. SR, who are on my care team today?”
“Dr. SR, do you have any recommendation for my lunch today?”

Agatha Christie

From Wikipedia, the free encyclopedia

For the video game series, see [Agatha Christie \(video game series\)](#).

Dame Agatha Mary Clarissa Christie, Lady Mallowan, DBE (*née* [Miller](#); 15 September 1890 – 12 January 1976) was an English [crime novelist](#), [short story writer](#) and [playwright](#). She is best known for her 66 detective novels and 14 short story collections, particularly those revolving around her fictional detectives [Hercule Poirot](#) and [Miss Marple](#). She also wrote the world's longest-running play, a murder mystery, *The Mousetrap*,^[1] and six [romances](#) under the name **Mary Westmacott**. In 1971 she was made a [Dame](#) for her contribution to literature.^[2]

Christie was born into a wealthy upper-middle-class family in [Torquay, Devon](#). She served in a Devon hospital during the [First World War](#), tending to troops coming back from the trenches, before marrying and starting a family in London. She was initially an unsuccessful writer with six rejections,^[3] but this changed when *The Mysterious Affair at Styles*, featuring [Hercule Poirot](#), was published in 1920.^[4] During the [Second World War](#) she worked as a pharmacy assistant at University College Hospital, London, during the [Blitz](#) and acquired a good knowledge of poisons which featured in many of her novels.

Guinness World Records lists Christie as the best-selling novelist of all time. Her novels have sold roughly 2 billion copies, and her [estate](#) claims that her works come third in the rankings of the world's most-widely published books,^[5] behind only [Shakespeare's](#) works and the [Bible](#). According to [Index Translationum](#), she remains the most-translated individual author – having been translated into at least 103 languages.^[6] *And Then There Were None* is Christie's best-selling novel, with 100 million sales to date, making it the world's best-selling mystery ever, and one of the [best-selling books](#) of all time.^[7] Christie's stage play *The Mousetrap* holds the world record for longest initial run. It opened at the

Dame Agatha Christie
Lady Mallowan
DBE



Born	Agatha Mary Clarissa Miller 15 September 1890 Torquay, Devon, England
Died	12 January 1976 (aged 85) Winterbrook, Oxfordshire, England

Christie is the best-selling novelist of all time. Her works come third in the rankings of the world's most-widely published books, behind only Shakespeare's works and the Bible.

Linguistic Analysis Claims Agatha Christie Had Alzheimer's

- ❑ Compared a selection of Christie's novels between the ages of 28 and 82, counting numbers of different words, indefinite nouns and phrases used in each
- ❑ Statistically significant drops in vocabulary and increases in repeated phrases and indefinite nouns
 - A book she wrote aged 81 showed 30% fewer word types than another book she wrote aged 63, 18% more repeated phrases, and almost three times as many indefinite words
- ❑ These language effects are recognized as symptoms of memory difficulties associated with Alzheimer's disease



Future Directions and Challenges



- Quality, safety, efficiency, effectiveness, and equity
- Context and workflow
- Accuracy
- Usability
- Costs
- Confidentiality and Security

Thank You!

