Clinical Decision Support With Natural Language Processing Facilitates Determination of Colonoscopy Surveillance Intervals

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Introduction

- Colonoscopy is the standard of care in the detection and prevention of colorectal cancer in the US[1].
- There is extensive documentation in the literature supporting efficacy of colonoscopy in significantly decreasing the incidence and mortality for colon cancer.
- Natural Language Processing (NLP) has been shown to be 87-94% accurate when used in conjunction with Clinical Decision Support (CDS)[2].
- Guidelines for colonoscopy surveillance intervals are frequently not followed by Gastroenterologists or Primary Care Physicians.

Background

- Colonoscopy is the visual examination of the colon with a colonoscope.
- First colonoscopies were performed in the late 1960's and included retrograde colonoscopy of the colon and endoscopic excision of polyps.
- CDS is a system that assists healthcare providers in the treatment and diagnosis of patients.
- NLP generally started in the 1950's and is a field of computer science that uses computers to extract meaning from human languages.

Methods

- Data for the study obtained from a retrospective study at a Veteran's Medical Center for patients receiving colonoscopy for the first time.
- Investigators defined inclusion and exclusion criteria for who could be entered in the patient population for this study.
- De-identified colonoscopy and pathology reports were analyzed by cTAKES, clinical text analysis and knowledge extraction system. cTAKES is a NLP engine that uses name recognition to map identified concepts to the unified medical language system (UMLS) metathesaurus.
- The results were then compared to a "gold standard" which gives a percentage value of the accuracy of the NLP analysis.
- MySQL was used as the database to store the results.

Results

- The primary outcome of this study was inter-rater agreement as defined by the Cohen's k statistic between the manual review of the report and the CDS[3,4].
- The secondary outcome was an agreement between the annotated NLP report and the CDS surveillance interval.
- Confidence intervals were also calculated for:
  - NLP based annotations and the CDS
  - Agreement between the gold standard and the CDS.

Results – From Pathology Report to NLP Output

FINDINGS:
One sessile polyp with no bleeding was found in the ascending colon. The polyp was 6 mm in size. Polypectomy was performed with a hot snare. Resection was complete. Retrieval was complete. Multiple large-mouthed diverticula were found in the sigmoid colon. Internal hemorrhoids with no bleeding were found. The rectum and distal sigmoid colon contained solid stool which precluded a detailed examination.

IMPRESSION:
Single polyp. All tissue eliminated. Sigmoid diverticulosis. Internal hemorrhoids.

SPECIMEN:
ASCENDING COLON POLYP

PATHOLOGY:
ASCENDING COLON POLYPECTOMY: TUBULAR ADENOMA.

Most Advanced Lesion:	Tubular Adenoma
Location of the Most Advanced Lesion:	Distal
Largest Adenoma Removed:	6-9 mm (Small)
Number of Adenomas Removed:	1-2
Hemorrhoids:	☑
Diverticulosis:	☐

Results

Correlation Between Gold Standard and CDS System		
	Value	Strength
Pearson R	0.813	Strong
Cohen k	0.740	Substantial

Cross-Tabulation Between Gold Standard and CDS for Surveillance Recommendations With Percentage Agreement Between Gold Standard and CDS by Surveillance Interval

	Gold standard			
CDS	10 y	5–10 y	3y	1–3 y	Physician decision	Total
10 y	108 (99.1%)	0	0	0	2	110
5–10 y	0	78 (85.7%)	16	1	3	98
3y	1	13	52 (74.3%)	0	13	79
1–3 y	0	0	2	1 (50%)	4	7
Physician decision	0	0	0	0	6 (21.4%)	6
Total	109	91	70	2	28	300

Discussion

- Colonoscopy is the most prevalent screening test in the US. However, there are some questions as to the cost effectiveness of this procedure which is based on data gathered from surveillance intervals.
- NLP combined with CDS has the ability to determine the proper surveillance intervals for colonoscopy. This prevents unnecessary procedures that increase costs and can also potentially save lives by establishing proper surveillance guidelines.

Conclusion

- NLP when combined with CDS is more effective than manual review of pathology and endoscopy reports in determining surveillance intervals for colonoscopy.
- This automated process can improve quality, decrease costs, and more importantly, improve adherence to evidence based practices and guidelines for colonoscopy surveillance decision making.

References

1) Seeff LC, Richards TB, Shapiro JA, et al. How many endoscopies are performed for colorectal cancer screening? Results from CDC's survey of endoscopic capacity. Gastroenterology 2004;127:1670–1677.

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3) Cohen J. Statistical power analysis for the behavioral sciences. Hillsdale, NJ: L. Erlbaum Associates, 1988.

4) Fleiss JL. Statistical methods for rates and proportions. New York: Wiley, 1981.

5) Imler TD, Morea J, Imperiale TF. Clinical decision support with natural language processing facilitates determination of colonoscopy surveillance intervals. Clin Gastroenterol Hepatol. 2014 Jul;12(7):1130-6. doi: 10.1016/j.cgh.2013.11.025. Epub 2013 Dec 4.

Write a thorough and complete analysis on how the technology has improved the delivery of healthcare. The should entail cost savings, consumer efficiencies, patient safety, return on investment, etc. Discuss in your own words IT terms that were covered in your course materials that were found in the article.