



Effectiveness of Natural Language Processing Based Clinical Analytics to Improve the Recommendation Entry Rate into a Multihospital Recommendation Tracking System

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Introduction

Radiologist recommendations for follow-up imaging tests, intended to identify early forms of cancer, do not result in completion of the recommended exam in up to 71% of patients. This places many patients at risk for delay in diagnosis, a form of preventable medical error. Implementation of a multistage recommendation tracking system at a single community hospital reduced the risk of delayed diagnosis for patients with incidental findings by 74%. Radiologist-initiated (RI) entry yielded a tracked recommendation for 1.1 % of 70,000 annual diagnostic imaging (DI) examinations in a 5 radiologist group.

Hypothesis

To test if a similar tracking system could be replicated at a larger scale, the recommendation tracking system using RI entry was expanded to a multihospital network comprised of 75 radiologists conducting 800,000 diagnostic imaging exams a year. The hypothesis was that natural language processing (NLP) based clinical analytics would be required to maintain similar effectiveness of the recommendation tracking program throughout a multihospital affiliated health network.

Methods

Multistage recommendation tracking system was implemented throughout the health network (Table 1) exclusively with RI entry, similar to the pilot project. Rapid PDSA cycle improvements were performed in weeks 1-12 to optimize the recommendation entry rate (education and incentives). Recommendation inclusion criteria include indeterminate lesions with malignant potential and aneurysms.

TABLE 1: Tracking Intervention Timeline

Intervention	Description of Intervention	Intervention Timing
Stage 1	Resend the radiology report	1 month after recommendation due date
Stage 2	Clinical navigator makes telephone call to PCP office	2 months after recommendation due date
Stage 3	Radiologist makes telephone call to PCP	3 months after recommendation due date
Patient letter	Send letter directly to patient ^a	As soon as tracking efforts were stopped

Note — PCP = primary care provider.

^aLetter was sent to all patients without examination completion or clinical closure.

After 34 weeks, NLP based clinical analytics were implemented to analyze unstructured imaging report data. Recommendations identified by NLP were entered into the tracking system and used to measure and manage radiology participation with RI entry.

Results

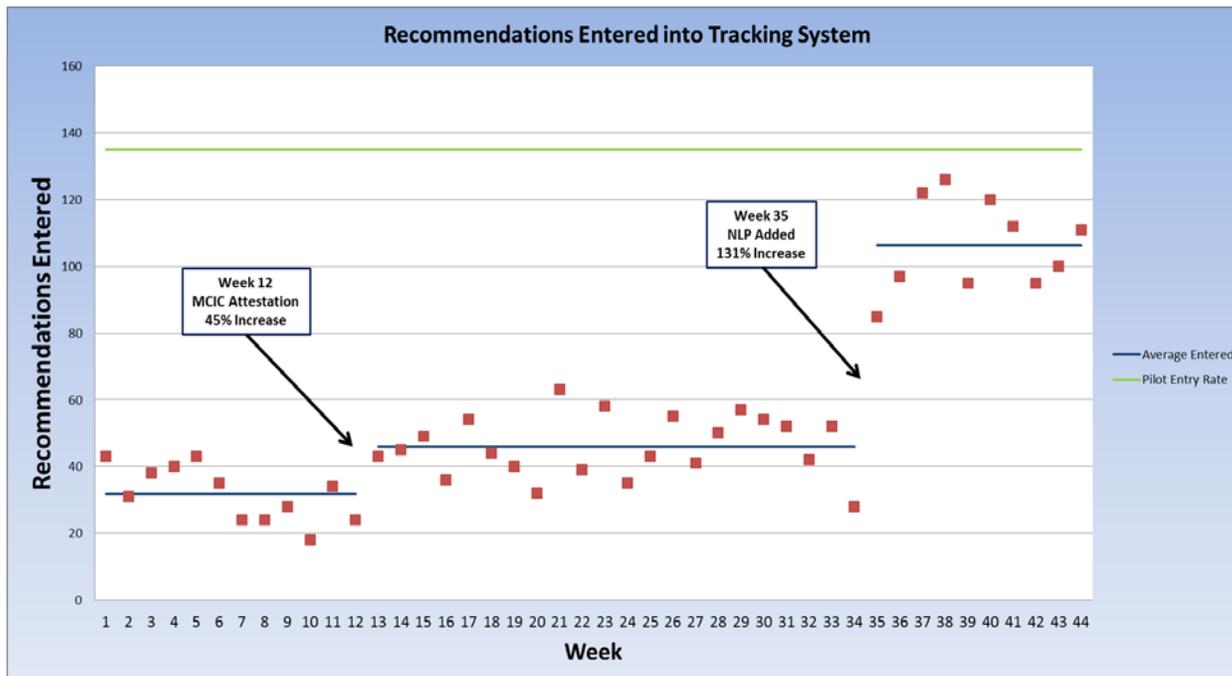


Figure 1

- RI entry (weeks 1-34): 45 recommendation entered / week (0.3% DI volume)
- RI + NLP entry (weeks 36-44): 104 recommendations entered / week (0.7% DI volume)
- Interventions increased examination completion rate from 55% to 71%
- 31 new exam completions / month with RI entry
- 71 new exam completions / month with RI + NLP entry
- Reduction in risk of delayed diagnosis: 80%

Conclusion

Multistage radiology recommendation tracking systems have been shown to reduce patient harm and medical legal liability risk while achieving a positive return on investment by generating revenue from new exam completions following intervention. The benefits of tracking systems are directly linked to the effectiveness of the recommendation entry mechanism. Managing and improving the effectiveness of manual RI recommendation entry has proved problematic at the large health system level. Adding NLP based automated recommendation identification and entry can effectively solve this problem allowing for successful implementation of tracking systems in this environment.

Statement of Impact

Managing radiology recommendations provides an opportunity for health systems to add value by improving patient care, reducing medical legal liability, and increasing clinical revenue. As the positive impact of tracking systems is linearly related to the number of recommendations tracked, adding NLP based recommendation entry in the large health system environment to traditional radiologist-initiated entry more than doubled the positive impacts of the system. Follow-up recommendation practices differ between subspecialty radiologists, a differentiation not well documented in the literature. NLP search technology also allowed goal setting for recommendation entry tailored by subspecialty.

Keywords

natural language processing, clinical analytics, incidental findings, recommendation tracking, quality improvement