Anatomic Adenoma detection rates determined via Natural Language Processing: A Refined Quality Metric for Colonoscopy?

Andrew Gawron, MD, PhD

Co-authors: Abel Kho, Anna Roberts, Rajesh N. Keswani, Arun Muthalagu, Will Thompson
Funding Acknowledgements

The eMERGE Network was initiated and funded by the National Human Genome Research Institute, with additional funding from the National Institute of General Medical Sciences: Northwestern University (1U01 HG006388-01).

National Research Service Award at the Center for Healthcare Studies under an institutional award from the Agency for Healthcare Research and Quality, T-32 HS 000078 (PI: Jane L. Holl, MD MPH).
Background

- Colorectal cancer (CRC) is the second leading cause of cancer-related mortality in the United States (US).
- Colonoscopy is one recommended (and widely used) colon cancer screening modality in the US.
Quality Indicators for Colonoscopy and the Risk of Interval Cancer

50,148 patients in Poland, 42 interval cancers

Lower Adenoma detection rate = Higher risk of cancer
# Colonoscopy and Cancer Mortality

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Country</th>
<th>Deaths from CRC (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baxter et al. [2008]</td>
<td>Case-control</td>
<td>Canada</td>
<td>10,282</td>
</tr>
<tr>
<td>Single Zauberman, Baxter</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk ratio (95% confidence interval)</th>
<th>Overall CRC mortality</th>
<th>Distal CRC mortality</th>
<th>Proximal CRC mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.63 (0.57–0.69)</td>
<td>0.33 (0.28–0.39)</td>
<td>0.99 (0.86–1.14)</td>
<td></td>
</tr>
<tr>
<td>0.71 (0.61–0.82)</td>
<td>0.53 (0.42–0.67)</td>
<td>0.95 (0.77–1.17)</td>
<td></td>
</tr>
<tr>
<td>0.47 (0.26–0.80)</td>
<td>Not stated</td>
<td>Not stated</td>
<td></td>
</tr>
<tr>
<td>0.40 (0.37–0.43)</td>
<td>0.24 (0.21–0.27)</td>
<td>0.58 (0.53–0.64)</td>
<td></td>
</tr>
</tbody>
</table>
How do we measure quality of the procedure?

Adenoma detection rate (ADR)

Colonoscopies with adenoma
All screening colonoscopies

“Unfortunately, the ADR is cumbersome to obtain because of the lack of automated interfaces between pathology and endoscopy databases, which represents a challenge to many practices”

*Am J Gastroenterol* 2013
PAYING TILL IT HURTS A Case Study in High Costs
The $2.7 Trillion Medical Bill

Colonoscopies Explain Why U.S. Leads the World in Health Expenditures

By ELISABETH ROSENTHAL | Published: June 1, 2013
Aims

1) To determine if natural language processing can accurately assess colonoscopy adenoma detection rates

2) To determine the variation in colonoscopy adenoma detection rate across physicians at a single institution

3) To determine if anatomic adenoma detection rates vary between high and low performing endoscopists
Methods

Study design
Retrospective analysis of colonoscopy procedure and pathology reports

Inclusion criteria
Screening colonoscopies at Northwestern University 1998-2012
- Patients aged 50-75 yrs
- Physicians with >500 procedures from 4/1998 to 11/2012

Data collection: Natural language processing application retrospectively queried procedure and pathology records

Validation: Manual chart review of 150 colonoscopy and pathology reports, from which all colon polyp findings were abstracted.
Methods

Natural language processing

- Apache clinical Text Analysis and Knowledge Extraction System (cTAKES)
- Systematic information extraction from electronic medical record text
- Can be utilized by clinical decision support systems and for clinical research.
Methods

Enterprise Data Warehouse → Colonoscopy Reports → Sectionizer → Colonoscopy Reports

Colonoscopy Reports → Concept Matching → Relation Detection → Pathology Reports

Relation Detection → Pathology Reports

Colonoscopy Reports

INDICATION
PREP_QUALITY
REACHED_CECUM

Pathology Reports

FINDING TYPE + FINDING LOC.
Key Variables

Measures
- Screening indication
- Extent of procedure (complete / incomplete)
- Tortal ADR, Right ADR (cecum to transverse colon), Left ADR (splenic flexure to rectum)

Outcomes
- Validation of NLP findings (indication, completion rate, histology and location)
- Total ADR by institution and individual physicians
- Anatomic ADR ratio (Right/Left) by total ADR tertile (physicians
Results

Total Colonoscopies
N=150,374

Screening indication
N=70,454

Procedure reached cecum
N=68,812

Polyp removed / biopsied
N=17,919
Results

Colonoscopies with Pathology findings

≥1 Non-Adenoma  
N=8,658

≥1 Adenoma  
N=12,191

Cancer  
N=206

Validation (histology and location)  
Sensitivity = 0.98  
PPV = 0.95
Results

Overall ADR: 20%

Right: 12%  Left: 10%

Individual physician ADRs ranged from 7.8% to 41.7%
Results

Physician ADRs: 1998-2012

<table>
<thead>
<tr>
<th>Physician Adenoma Detection Rate Tertile</th>
<th>Low (N=8)</th>
<th>Middle (N=9)</th>
<th>High (N=9)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total ADR</td>
<td>10.9 (2.9)</td>
<td>19.5 (2.6)</td>
<td>28.8 (7.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Left ADR</td>
<td>6.1 (2.2)</td>
<td>10.2 (1.6)</td>
<td>15.1 (3.9)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Right ADR</td>
<td>6.0 (1.7)</td>
<td>12.2 (3.0)</td>
<td>19.0 (5.9)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Right/Left ratio</td>
<td>1.0 (0.3)</td>
<td>1.2 (0.4)</td>
<td>1.3 (0.2)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

- No significant difference among physician tertiles:
  - Mean age of patients
  - Number of colonoscopies performed
  - Proportion of female patients
Summary

- NLP accurately determined institutional and physician ADRs
- Significant variation in ADRs across physicians
- Trend toward higher right sided ADRS in higher performing endoscopists
Conclusions

- NLP has potential for accurately measuring institutional and provider colonoscopy quality metrics of interest to patients and payers.

- Anatomic ADRs may provide a refined measure of colonoscopy quality and help guide efforts toward interventions and strategies to improve endoscopic exams.
Implications

- The future of colonoscopy as a viable screening tool for colorectal cancer depends on practitioners narrowing variation in exam quality.

- We should be asking not only what colonoscopy costs but…..

“How often do you (or your institution) actually find adenomas?”
Questions?

Andrew Gawron
agawron@fsm.northwestern.edu

Will Thompson (NLP)
wkt@northwestern.edu
Acknowledgements

Primary Mentors

Sherri LaVela, PhD, MBA, MPH

John Pandolfino, MD MD

Jane Holl, MD, MPH

All past and current CHS fellows!