

# Using Data and Information Systems to Measure Colonoscopy Quality

**July 18, 2017**

Tonya Kaltenbach MD MAS

Measurement Science QUERI, Colonoscopy Quality

Associate Professor of Clinical Medicine, UCSF

Director of Advanced Endoscopy, San Francisco VA

# Poll #1: What is your primary healthcare role?

- Researcher
- Operations, VACO-based
- Clinician, mental health
- Clinician, primary care
- Other



# Poll #2: How many years of experience do you have working with VA data?

- One year or less
- More than 1, less than 3 years
- At least 3, less than 7 years
- At least 7, less than 10 years
- 10 years or more



# Agenda

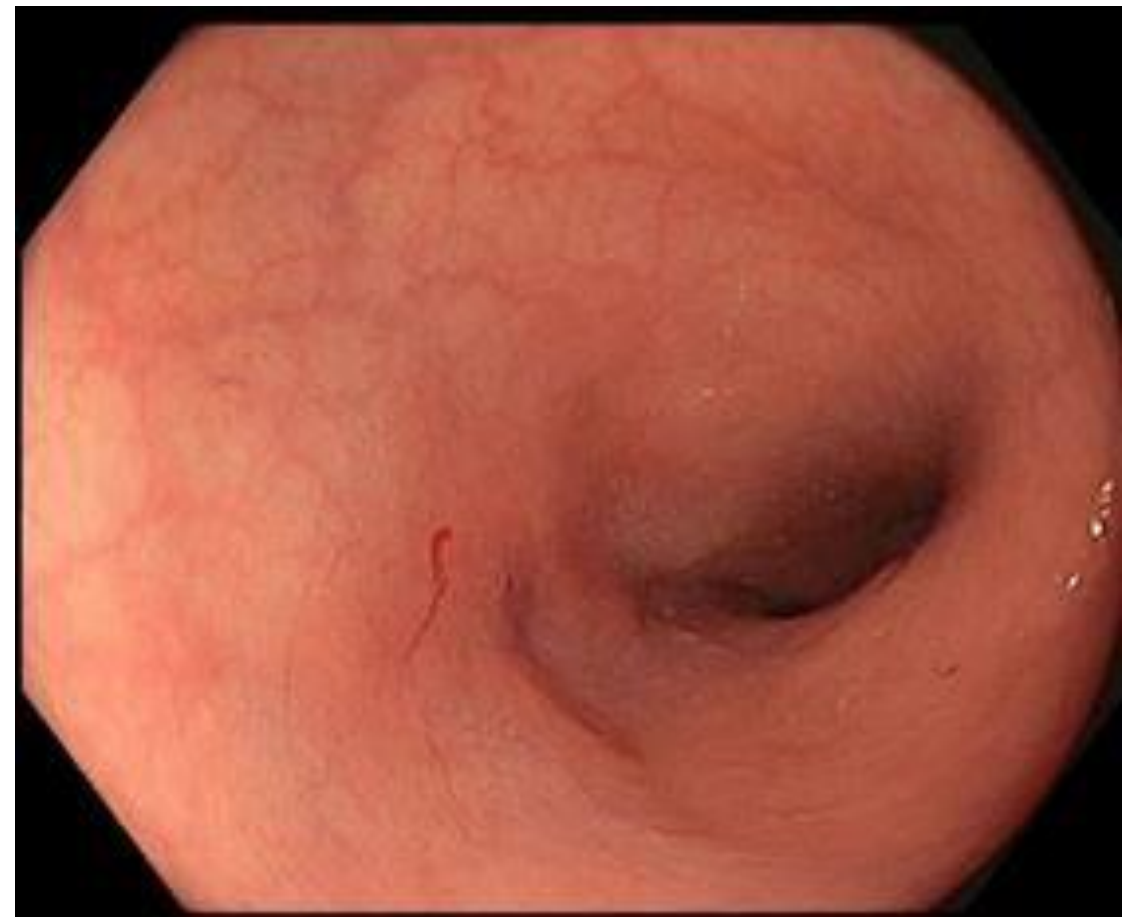
- Background: Need for colonoscopy quality metrics
- VHA priorities for colonoscopy quality
- QUERI – colonoscopy metrics
  - NLP use for colonoscopy metrics
- Adenoma detection rate
- Future directions

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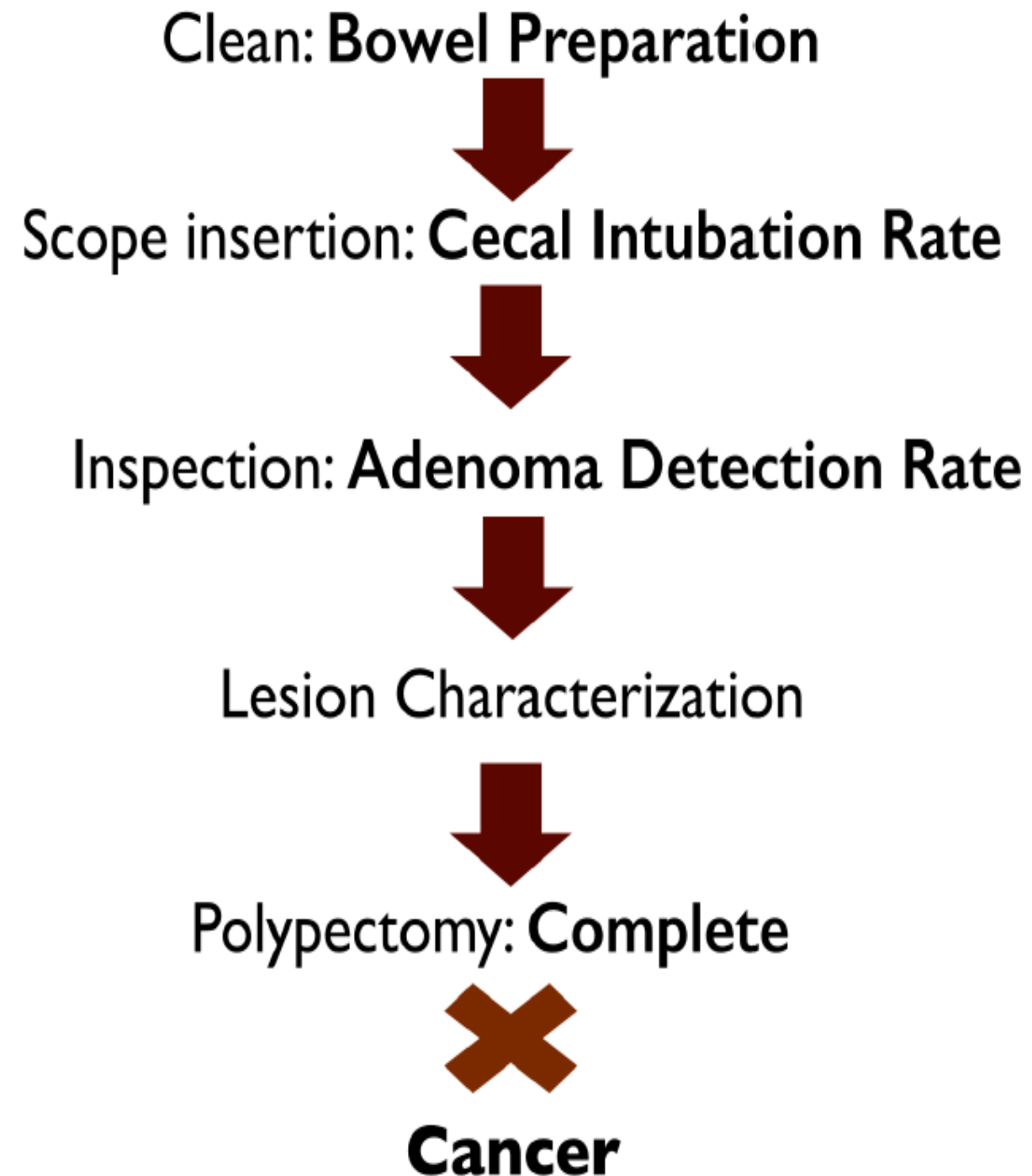
# Need for colonoscopy quality metrics

- Colon cancer screening reduces the incidence and mortality of colorectal cancer.
- ~200,000 colonoscopies are performed annually in VA (50-60% screening)



# Quality Indicators for Colonoscopy

Proposed Thresholds	$\geq 85\%$
	$\geq 95\%$
	Men $\geq 30\%$ Women $\geq 20\%$
	$\geq 90\%$
	100%
	$< 1\%$



# Significance of Adenoma Detection Rate (ADR)

- The purpose of screening colonoscopy is to reduce the incidence and mortality of colorectal cancer.
- ADR is the quality indicator with the strongest association to interval or “missed” colorectal cancer after screening colonoscopy.



# Evaluated Associations between ADR &:

The NEW ENGLAND JOURNAL of MEDICINE

## ORIGINAL ARTICLE

### Adenoma Detection Rate and Risk of Colorectal Cancer and Death

Douglas A. Corley, M.D., Ph.D., Christopher D. Jensen, Ph.D., Amy R. Marks, M.P.H.,  
Wei K. Zhao, M.P.H., Jeffrey K. Lee, M.D., Chyke A. Doubeni, M.D., M.P.H.,  
Ann G. Zauber, Ph.D., Jolanda de Boer, M.B., Bruce H. Fireman, Ph.D.,  
Joanne E. Schottinger, M.D., Virginia P. Quinn, Ph.D., Nirupa R. Ghai, Ph.D.,  
Theodore R. Levin, M.D., and Charles P. Quesenberry, Ph.D.

## ABSTRACT

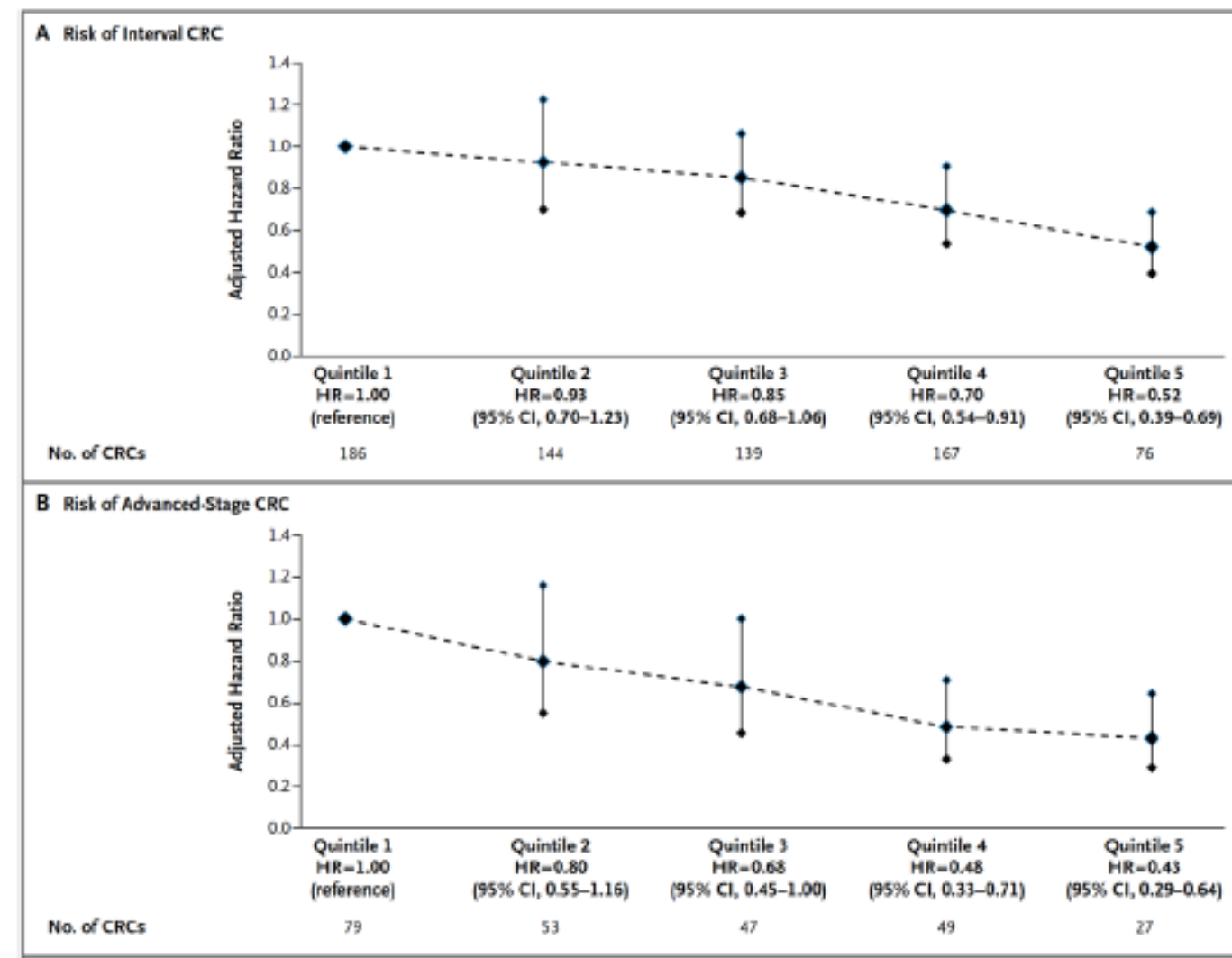
#### BACKGROUND

The proportion of screening colonoscopic examinations performed by a physician that detect one or more adenomas (the adenoma detection rate) is a recommended quality measure. However, little is known about the association between this rate and patients' risks of a subsequent colorectal cancer (interval cancer) and death.

- Interval Cancer risk up to 10 years
- Advanced cancers
- Cancer deaths
- Across range of ADRs to evaluate for threshold

# ADR is Correlated with Interval Cancer

- 314,872 colonoscopies performed by 136 gastroenterologists at 17 medical centers with 3.3 million members
- ADR range: 7.3 - 52.5%
- Linear relationship across 5 quintiles of ADR from lowest to highest



# ADR is Correlated with Interval Cancer

**Table 2.** Adenoma Detection Rate and Risk of an Interval Colorectal Cancer among All Patients.

Adenoma Detection Rate	Interval Cancer <i>no. of cases</i>	Hazard Ratio (95% CI)*	Unadjusted Risk <i>no. of cases/ 10,000 person-yr</i>
Continuous rate	712	0.97 (0.96–0.98)	7.7
Rate quintile			
Quintile 1: 7.35–19.05%	186	1.00 (reference)	9.8
Quintile 2: 19.06–23.85%	144	0.93 (0.70–1.23)	8.6
Quintile 3: 23.86–28.40%	139	0.85 (0.68–1.06)	8.0
Quintile 4: 28.41–33.50%	167	0.70 (0.54–0.91)	7.0
Quintile 5: 33.51–52.51%	76	0.52 (0.39–0.69)	4.8

- Each 1% increase in ADR associated with:
  - 3% decrease in interval CRC risk (HR, 0.97, 95%CI: 0.96-0.98)
  - 4% decrease in CRC death risk
- No threshold effect above which increases in ADR were without benefit

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# VHA Priorities for Colonoscopy Quality

- 1) Colonoscopy quality monitoring is now required
- 2) Benchmarking of individual providers & facilities
- 3) Facilitate focused and ongoing professional practice evaluations

Department of Veterans Affairs  
Veterans Health Administration  
Washington, DC 20420

VHA DIRECTIVE 1015  
Transmittal Sheet  
December 30, 2014

### COLORECTAL CANCER SCREENING

- 1. REASON FOR ISSUE:** This Veterans Health Administration (VHA) Directive provides policy on various modalities for providing colorectal cancer (CRC) screening for VA medical facilities.
- 2. SUMMARY OF MAJOR CHANGES:** This Directive is being revised to update the responsibilities of the medical facility Director to include ensuring the quality of colonoscopy as well as monitoring requirements. It also updates recommended screening tests, which are now based upon the screening guidelines coordinated by the VHA National Center for Health Promotion and Disease Prevention (NCP). Guidance has been clarified to increase flexibility in recommending screening options. Other changes include the addition of colonoscopy quality monitoring and recommendations for optimizing bowel preparation.
- 3. RELATED ISSUES:** None.
- 4. RESPONSIBLE OFFICE:** Specialty Care Services (10P4E) is responsible for the contents of this Directive. Questions may be directed to National Program Director for Gastroenterology at 202-461-7160.
- 5. RESCISSIONS:** Directive 2007-004, dated January 12, 2007, is rescinded.
- 6. RECERTIFICATION:** This VHA Directive is scheduled for recertification on or before the last working day of December 2019.

Carolyn M. Clancy, M.D.  
Interim Under Secretary for Health

**DISTRIBUTION:** Emailed to the VHA Publications Distribution List on 12/31/2014.

Directive states that:

1. the Chief of Staff at each medical facility must assess the quality of screening colonoscopy using three specific metrics (bowel prep quality, cecal intubation rate, & ADR)
2. a minimum of 30 records per provider must be assessed annually.

# Challenges to Reporting Colonoscopy Quality Metrics

**No reliable, efficient way of tracking procedure & pathology results to measure colonoscopy quality for the national Veteran population.**

- Significant variability in the documentation of colonoscopy reporting, including procedure note titles.
- Most colonoscopies documented using a text note in Vista/CPRS
- No uniformity of endoscopic report-generating applications (i.e. Endopro, Provation, etc) to facilitate quality measurement.
- None of the current endoscopy reporting programs link to pathology (to determine ADR); and Production level pathology data are not YET in the CDW.

# Significant Time & Resources Needed to Report Colonoscopy Quality Metrics

**> 5000 person hours/year!**

- Directive will require manual chart review of 30 patients per endoscopist (x 500 VHA endoscopists x 20 minutes per chart) for a total of least 5000 person hours (125 person weeks) of time per year.
- Twice as many charts will need to be reviewed to simply select colonoscopies that were done for screening purposes.



# Quantitative Assessment of Colonoscopy Quality Measurement

National VA Survey of GI Section Chiefs:

- 90% manual measurement of quality metrics
- 38% not measuring adenoma detection rate (ADR)
- >50% interested in national measurement and reporting

# Measurement Science QUERI Colonoscopy Quality Metrics

**Aim 1:** To generate a standardized assessment of colonoscopy quality metrics (ADR, cecal intubation rate & bowel preparation quality) that can be applied to national VHA data.

**Aim 2:** To test the validity of these metrics (as compared with chart review) at VHA facilities.

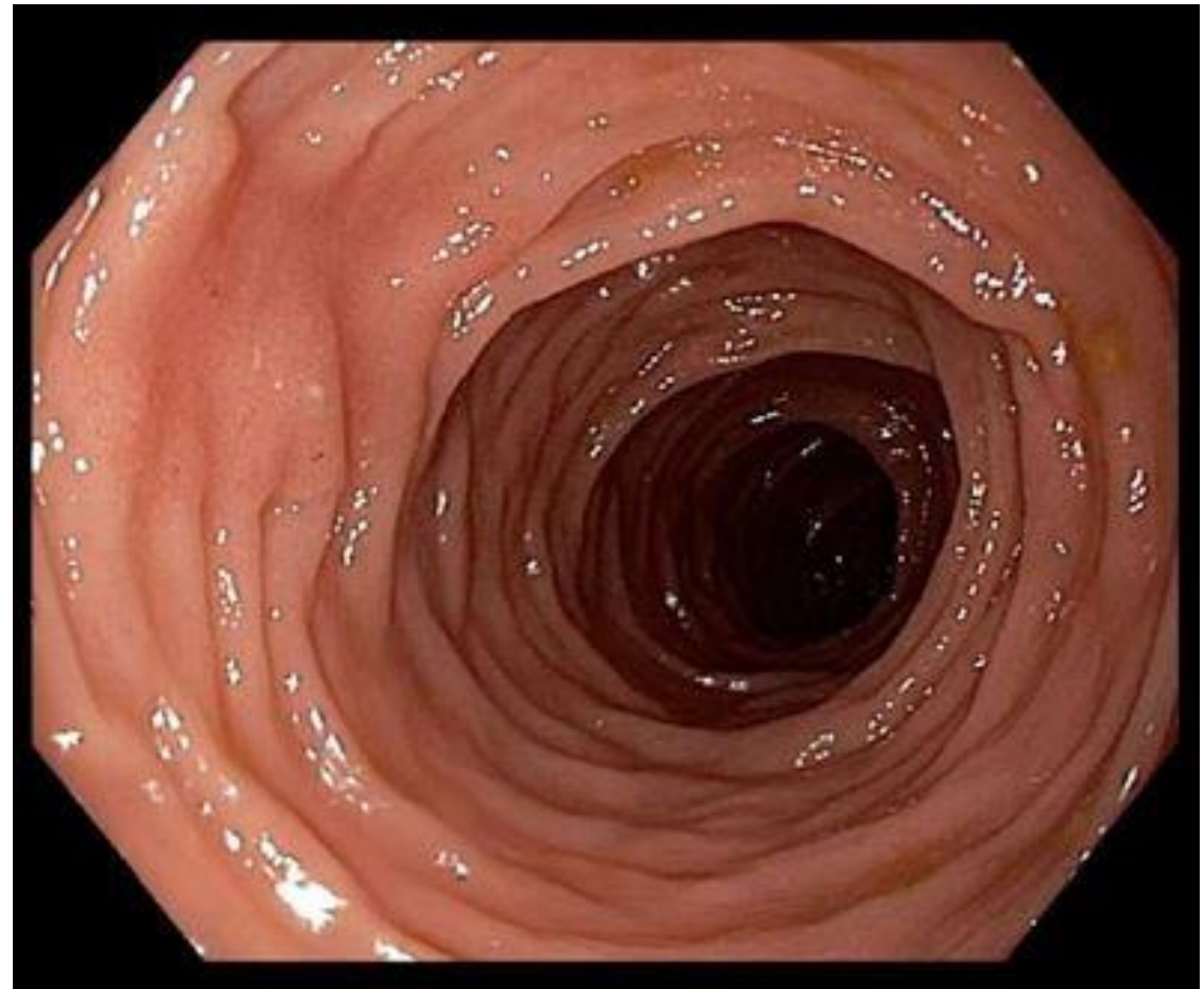
**Aim 3:** To develop a colonoscopy quality report card that is useful to front-line providers and facilities.

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# QUERI Quality Colonoscopy Metrics

- **Bowel preparation**
- **Cecal intubation**
- **ADR**



# Operational Partners

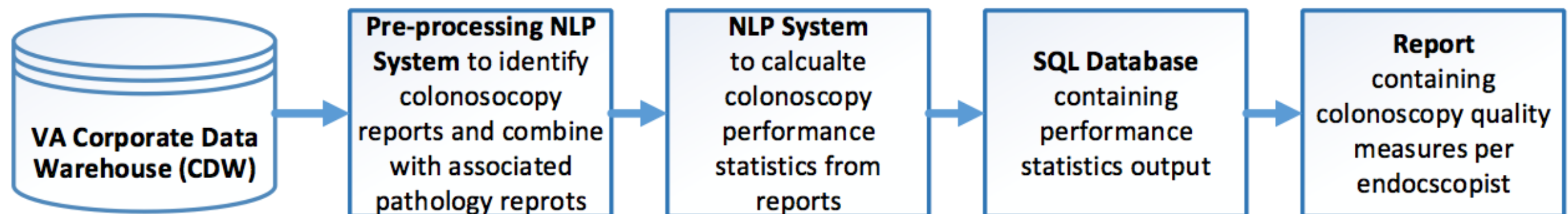
- GI National Program Office
- GI Field Advisory Committee
- VINCI
- CDW
- HSR&D Center of Innovation: Salt Lake Informatics, Decision-enhancement and Analytic Sciences (IDEAS 2.0) Center
- VA Colonoscopy Collaborative

# NLP Development Team

- Domain Experts - Tonya Kaltenbach, Andrew Gawron, Samir Gupta
- NLP Developers - Will Thompson, Olga Patterson, Guy Divita
- Infrastructure - Yiwen Yao
- Annotations - VINCI
- Architecture - Bill Scuba

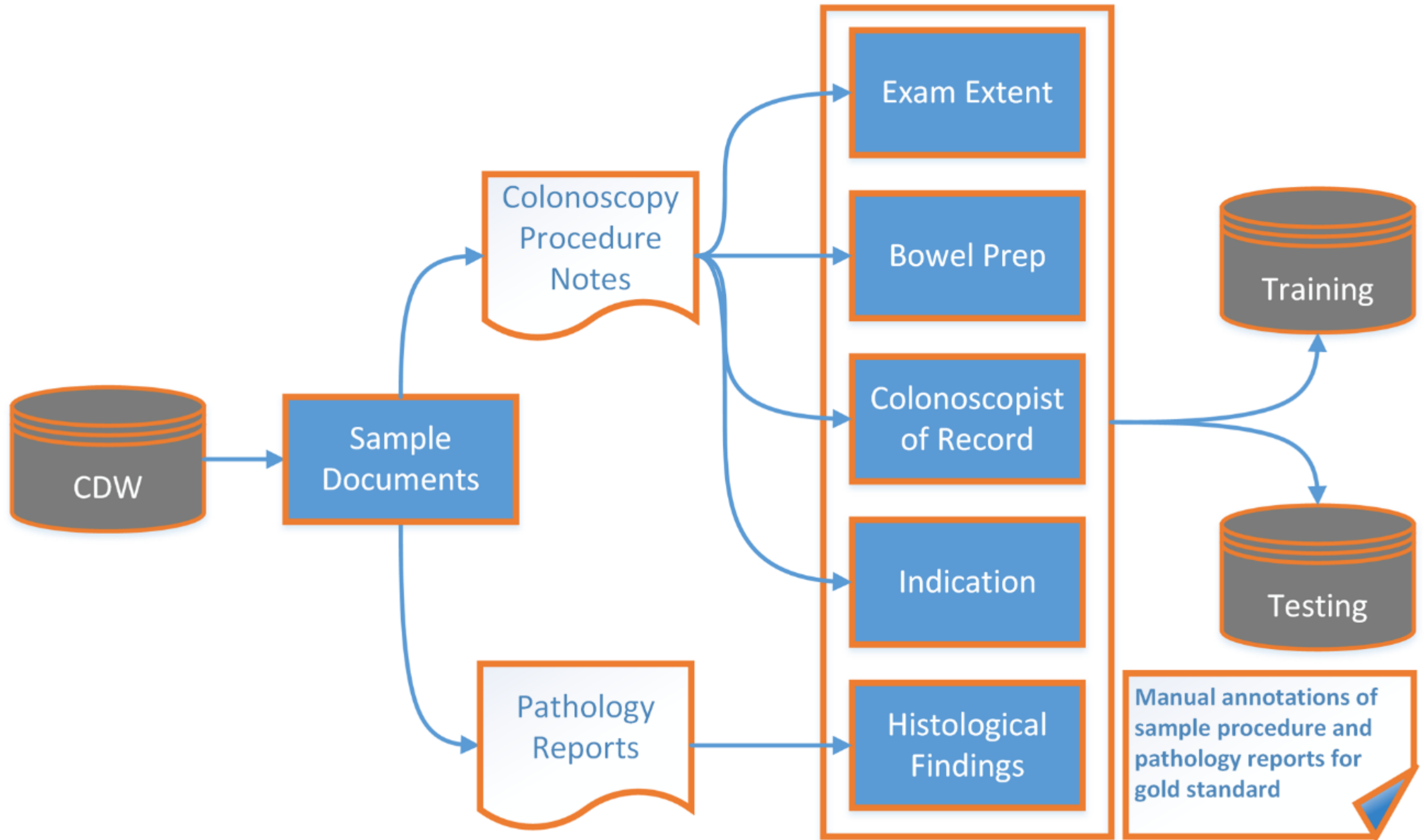


# System Overview of Automated Workflow



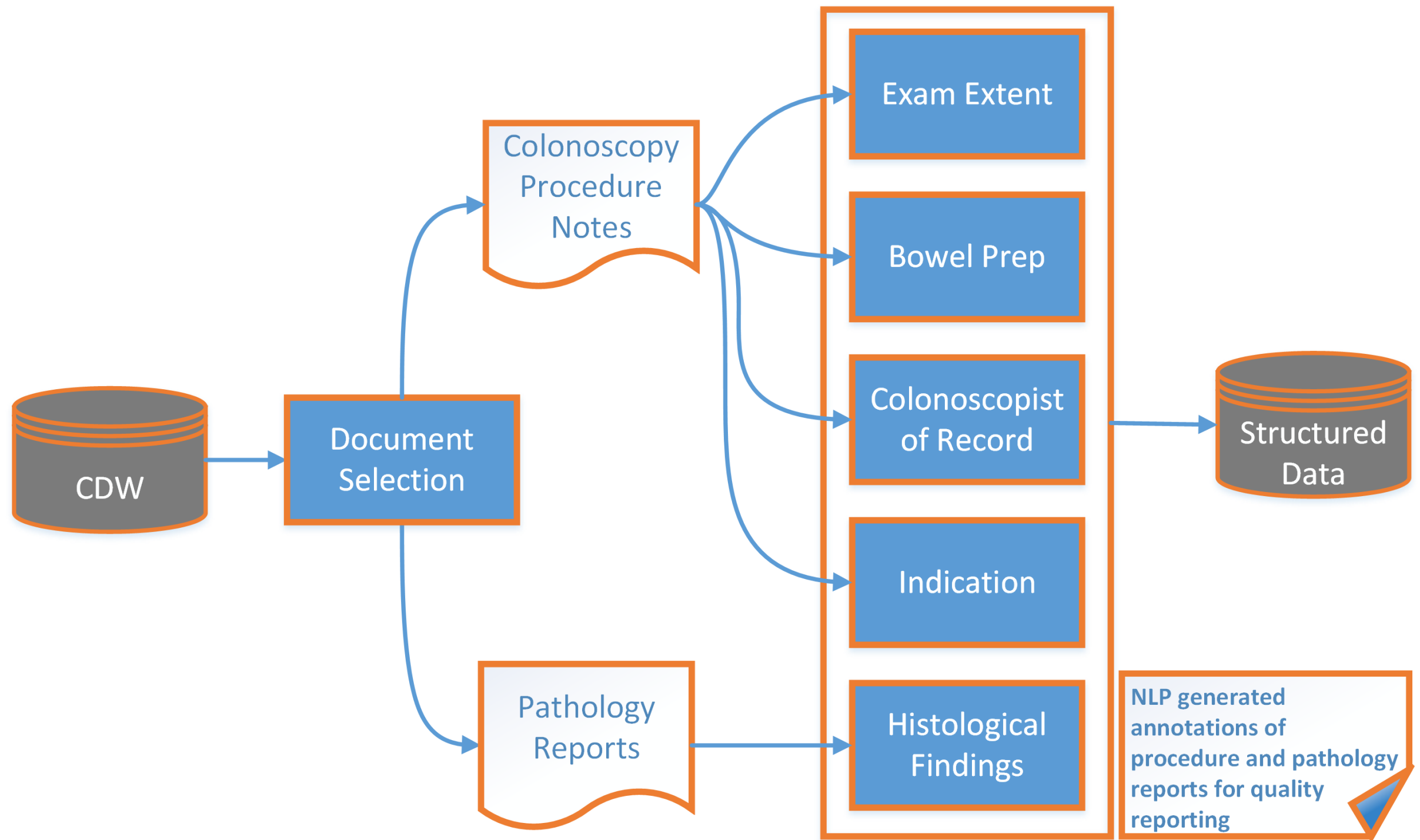
- New reports can be generated at any appropriate time interval – daily, weekly, monthly, etc.

# Manual Annotation of Gold Standard

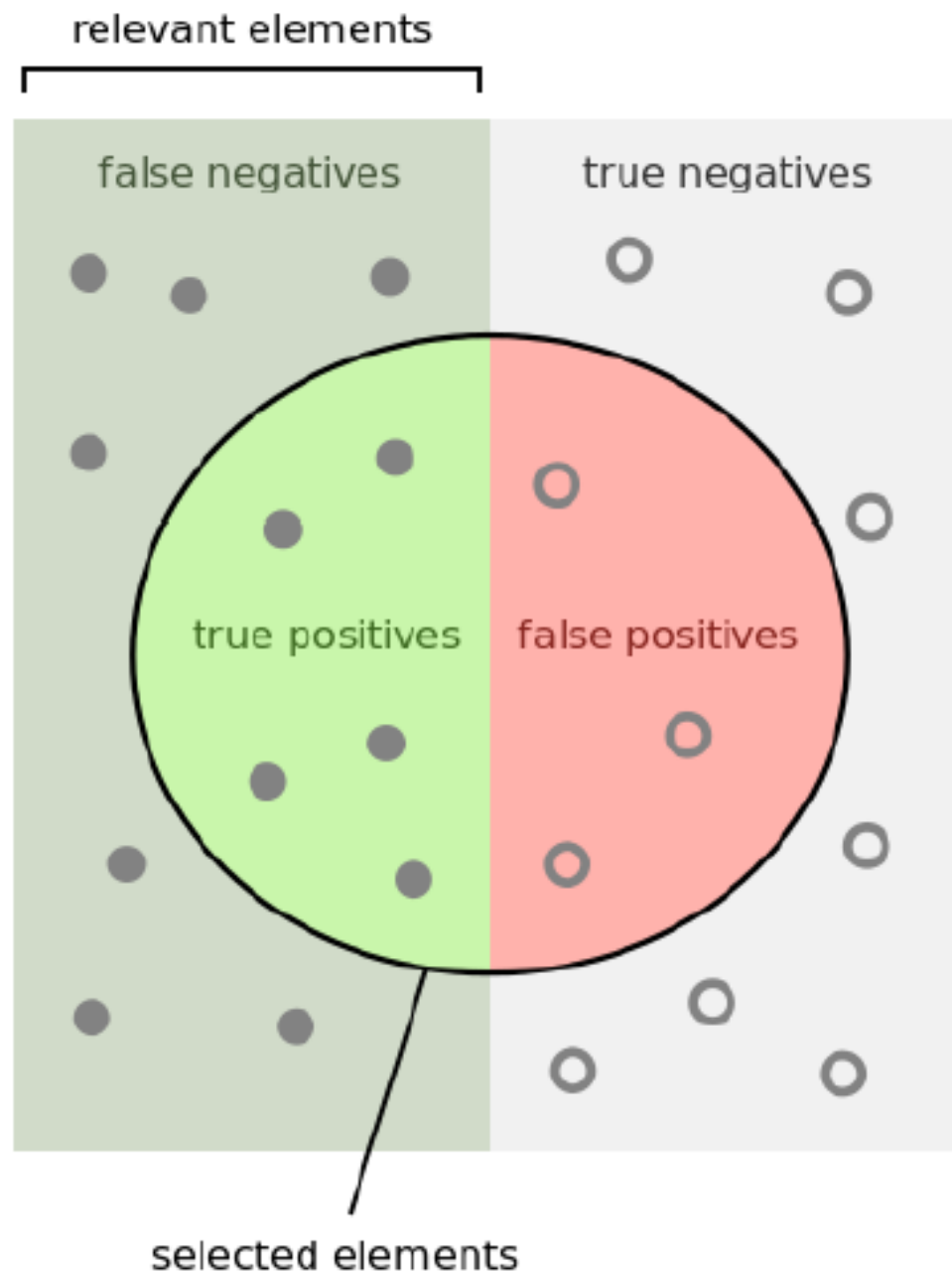




# NLP Annotation Subsystems



# NLP Performance Measurement



Objective: > 90%  
PPV (precision) &  
Sensitivity (recall)

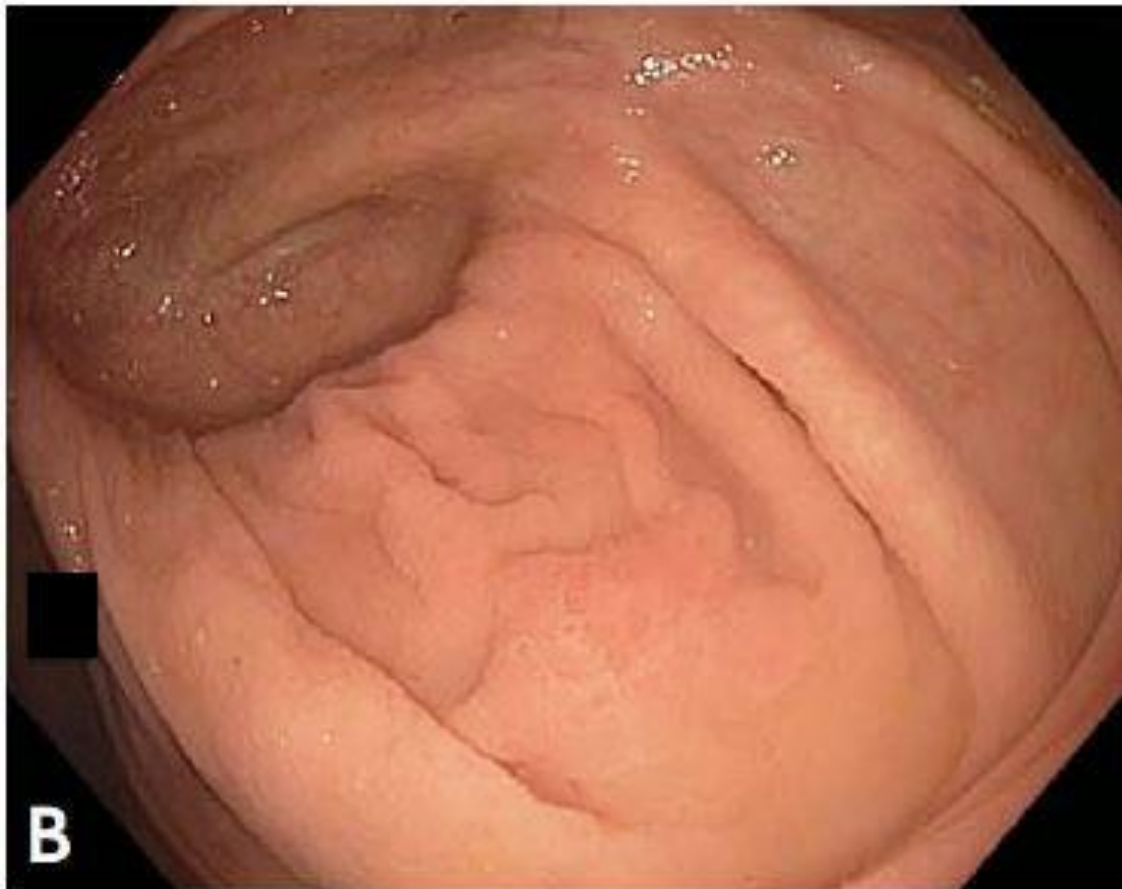
How many selected  
items are relevant?

Precision =  $\frac{\text{true positives}}{\text{true positives} + \text{false positives}}$

How many relevant  
items are selected?

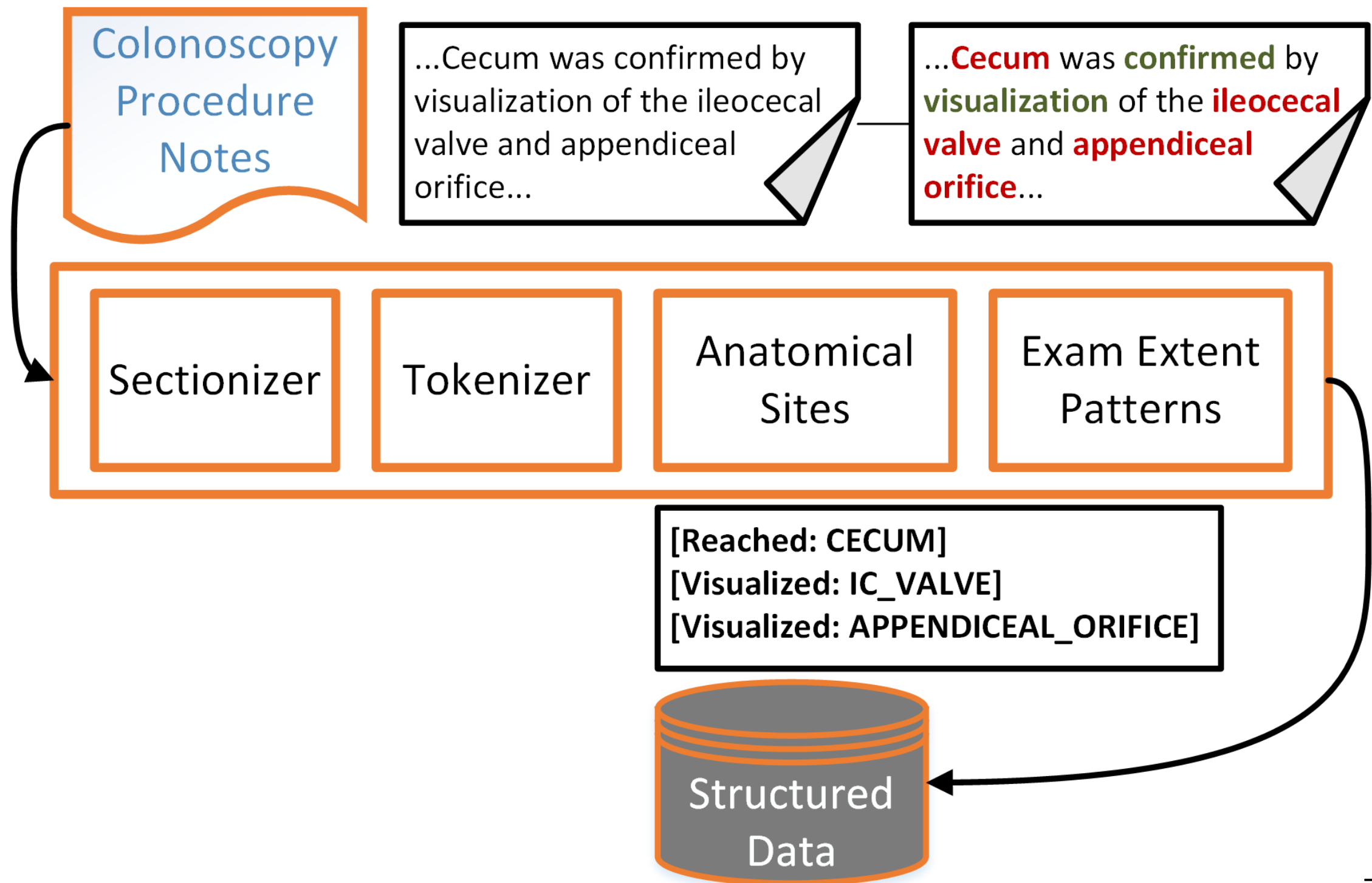
Recall =  $\frac{\text{true positives}}{\text{true positives} + \text{false negatives}}$

# Exam Extent

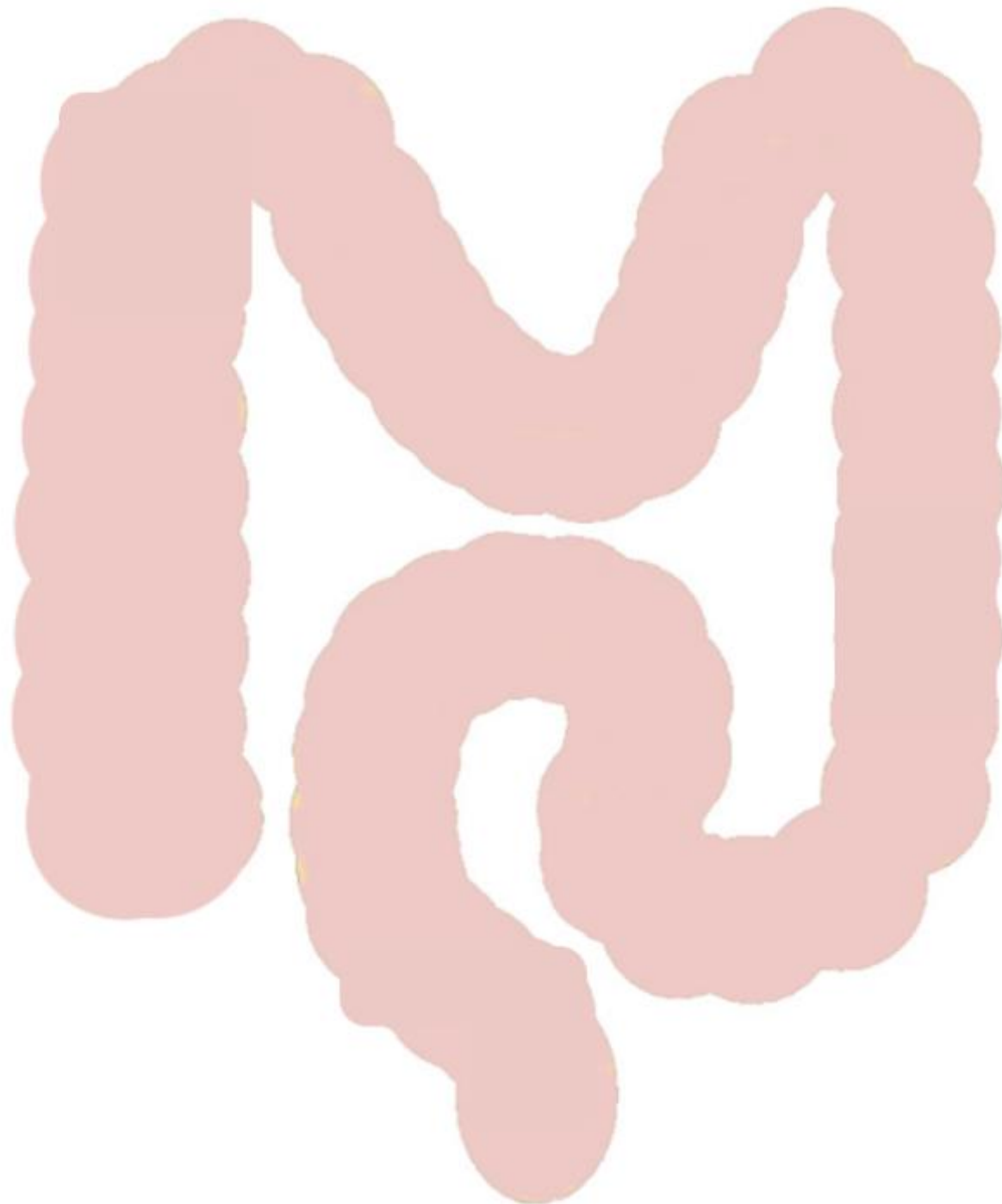


- ...reached the cecum
- ...identified by appendiceal orifice and ileocecal valve
- ....advanced to terminal ileum
- ...advanced 90cm...

# Exam Extent

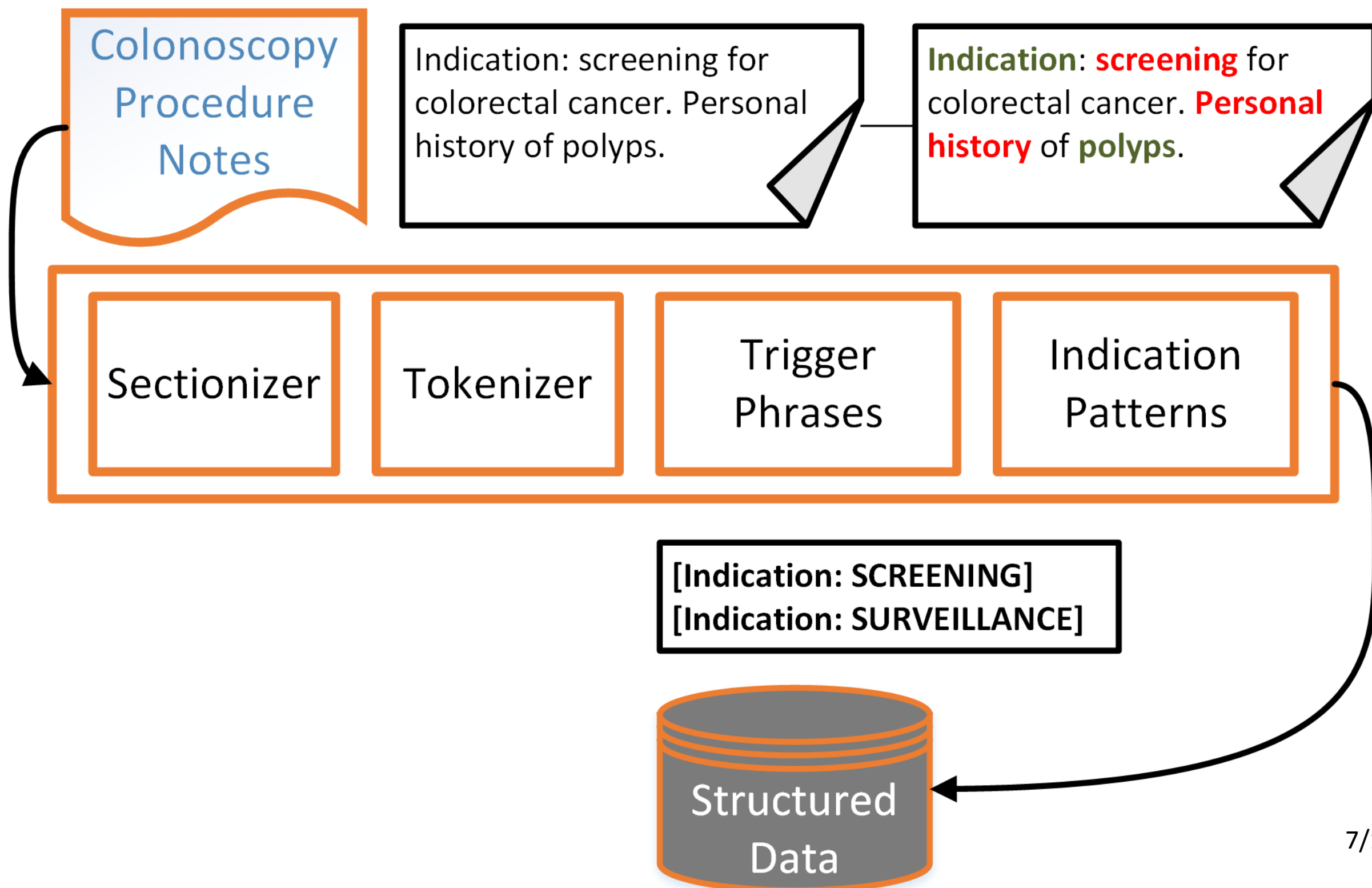


# Indication



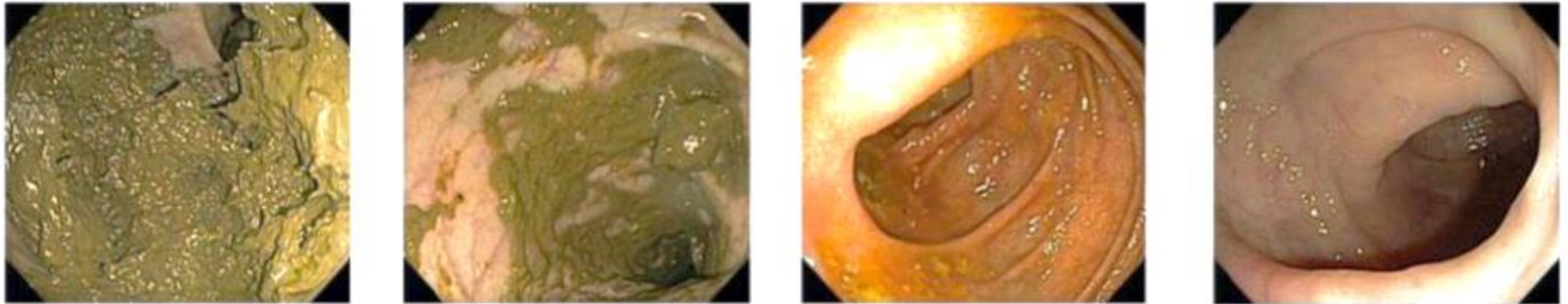
- low risk screening for colon polyps...
- repeat colonoscopy with history of previous polyps
- family history of colorectal cancer in first degree relative
- recent change in bowel habits

# Indication





# Bowel Preparation Quality



- **Aronchick Scale, Aronchick CA. GIE 2004**
  - Qualitative global assessment based on % mucosal surface seen, amount of liquid/solid stool present
- **Boston Bowel Prep Scale, Lai EJ GIE 2009**
  - 4 point score applied to 3 regions of the colon: right, transverse & left
- **Ottawa Bowel Prep Scale, Rostom A GIE 2004**
  - 14 point score calculated by adding 0-4 ratings for each colon segment (right, mid, rectosig) and 0-2 global fluid quality rating

# Bowel Preparation

Colonoscopy  
Procedure  
Notes

The quality of the bowel preparation was evaluated using the **BBPS (Boston Bowel Preparation Scale)** with scores of Right Colon = 1 (something something something), Transverse Colon = 3 (something something something), and Left Colon = 3 (something something something something). The total BBPS score equals 7. The bowel prep was good.

Sectionizer

Sentence  
Detection/  
Tokenizer

Template  
Patterns

Dictionary

Bowel Prep  
Patterns

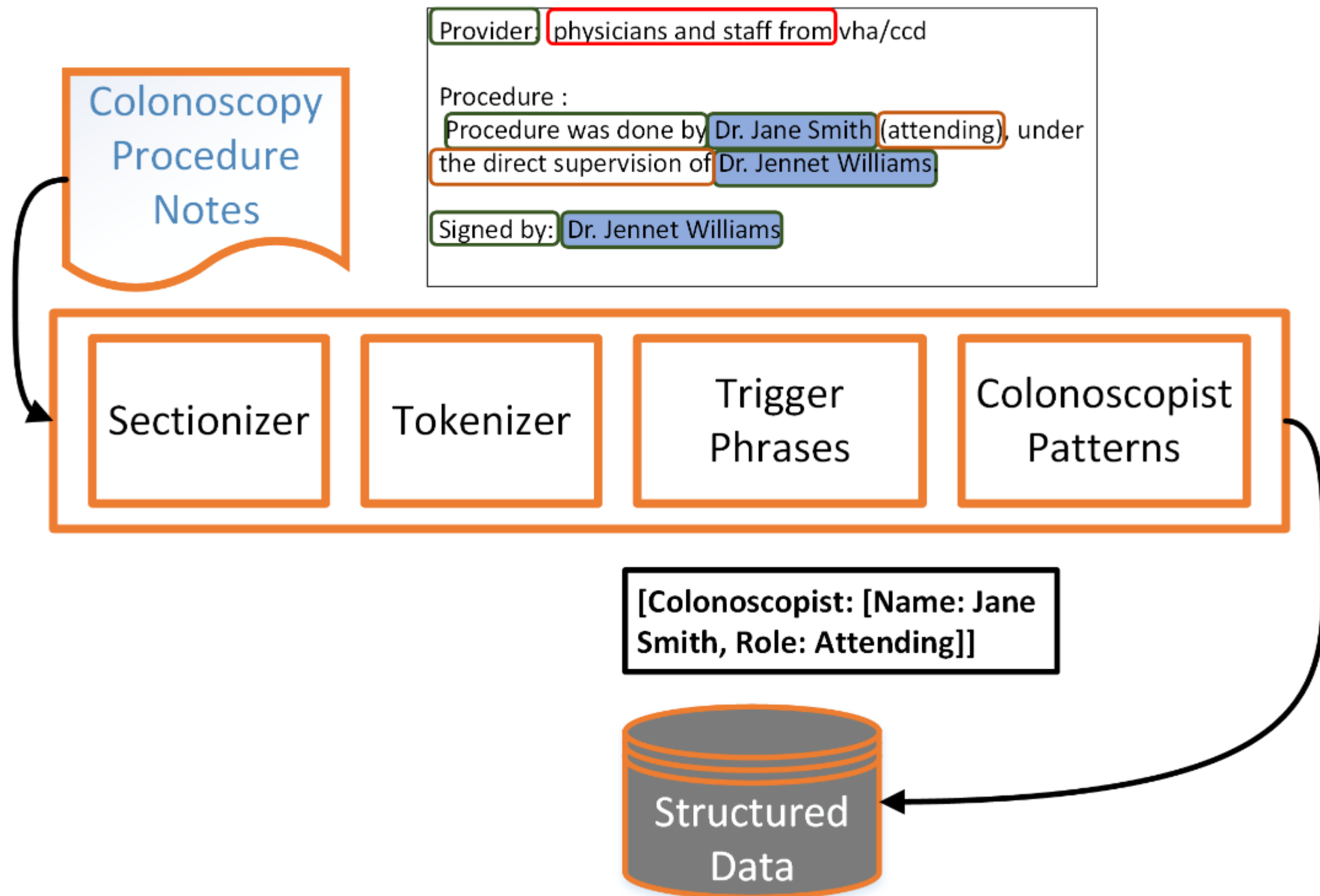
Concept  
Assertion

[BowelPrep: ADEQUATE]

Structured  
Data



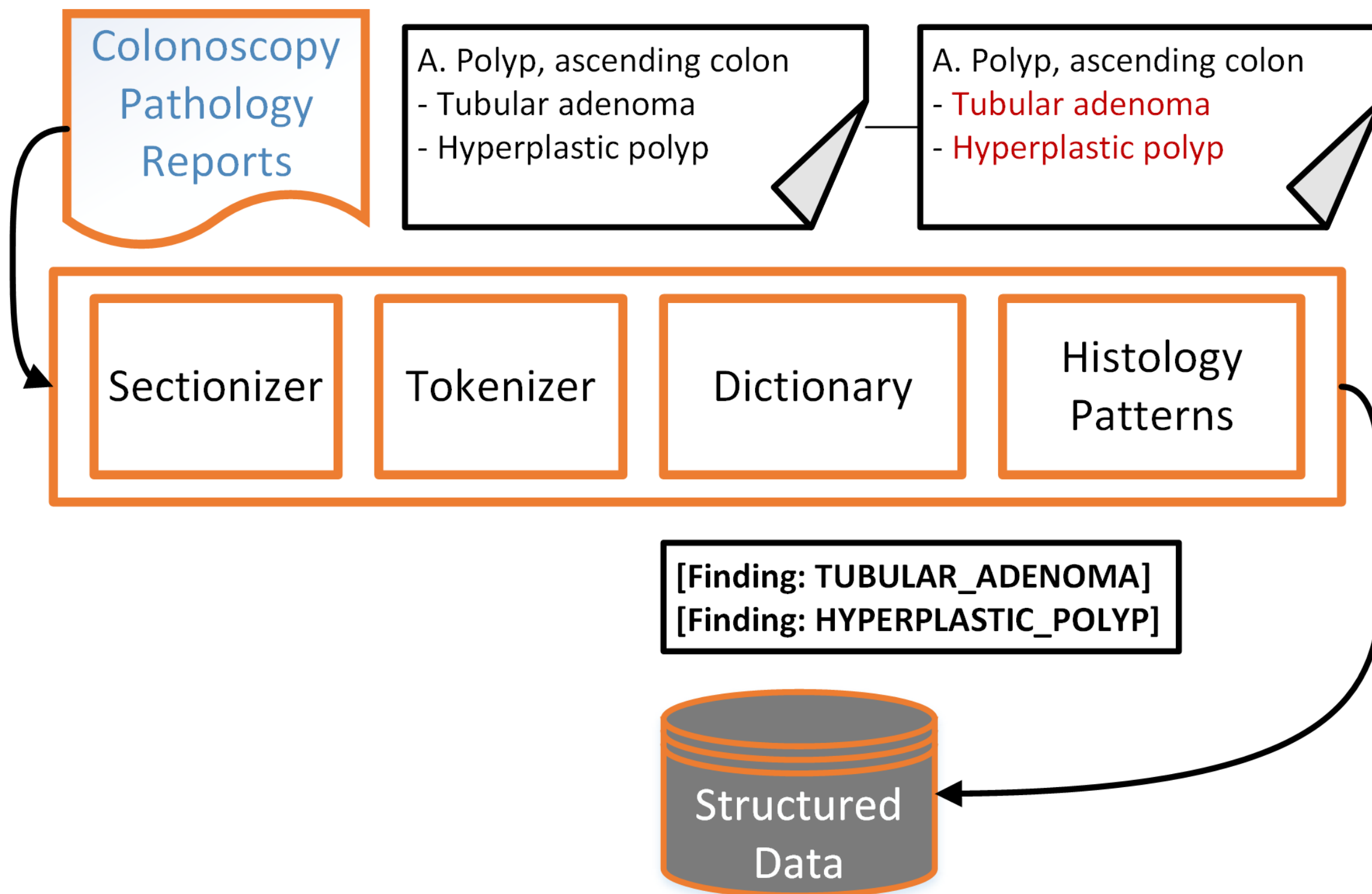
# Colonoscopist of Record



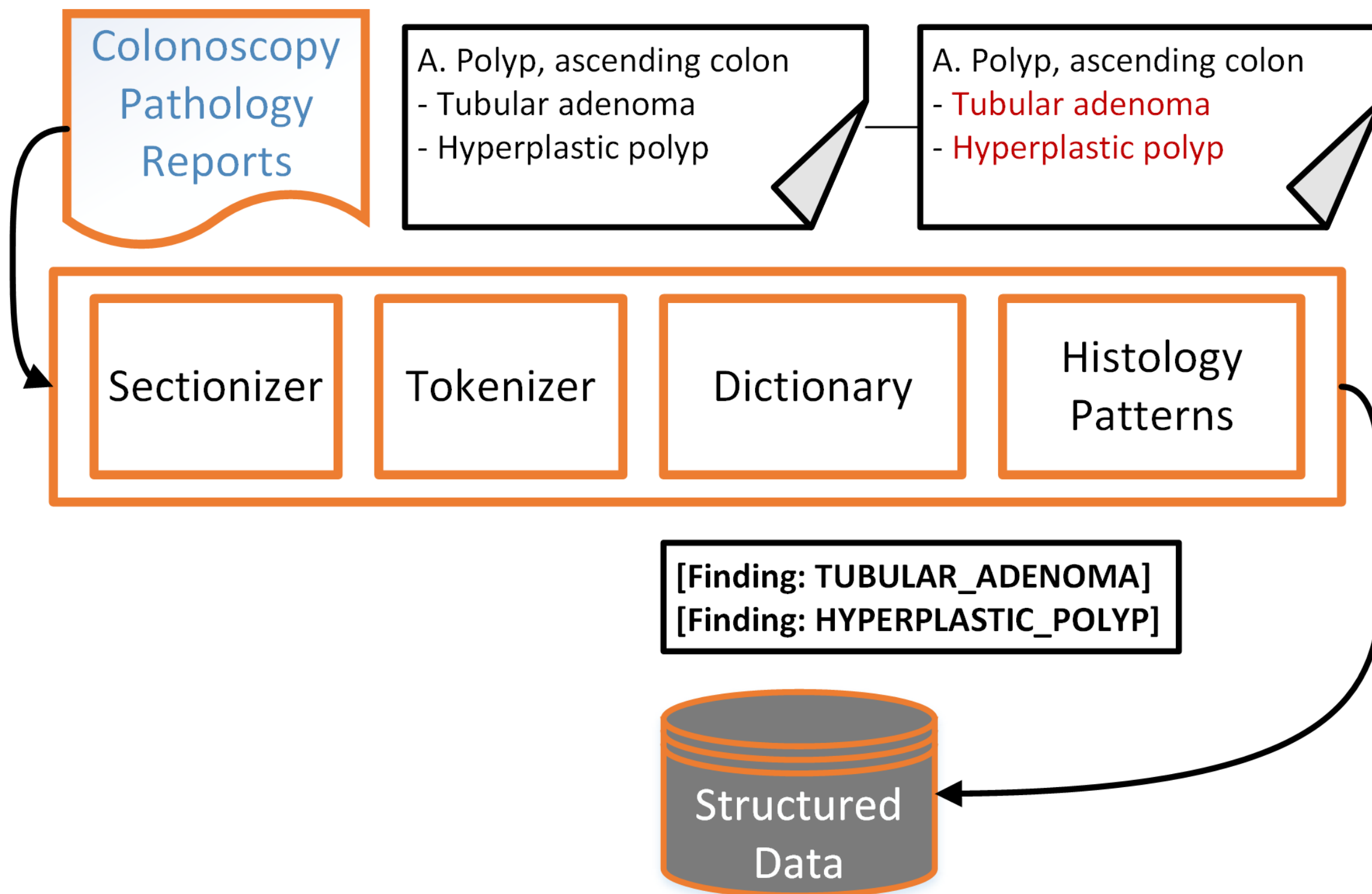
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# Pathology



# Adenoma Detection Rate?



# Components to Calculate Adenoma Detection Rate (ADR)

**Definition:** ADR is the number of screening patients with at least one adenoma divided by total number of consecutive patients aged 50 years or older screened with colonoscopy.

Variables needed for calculation:

1. extent exam
2. indication
3. bowel preparation
4. pathology

Notes:

- If incomplete due to inadequate prep, patient discomfort, etc, or indication is surveillance or diagnostic, then procedure is not included in the calculation.
- Reference standard of adenoma diagnosis is histopathology

# Simplifying the Process of Calculating ADR

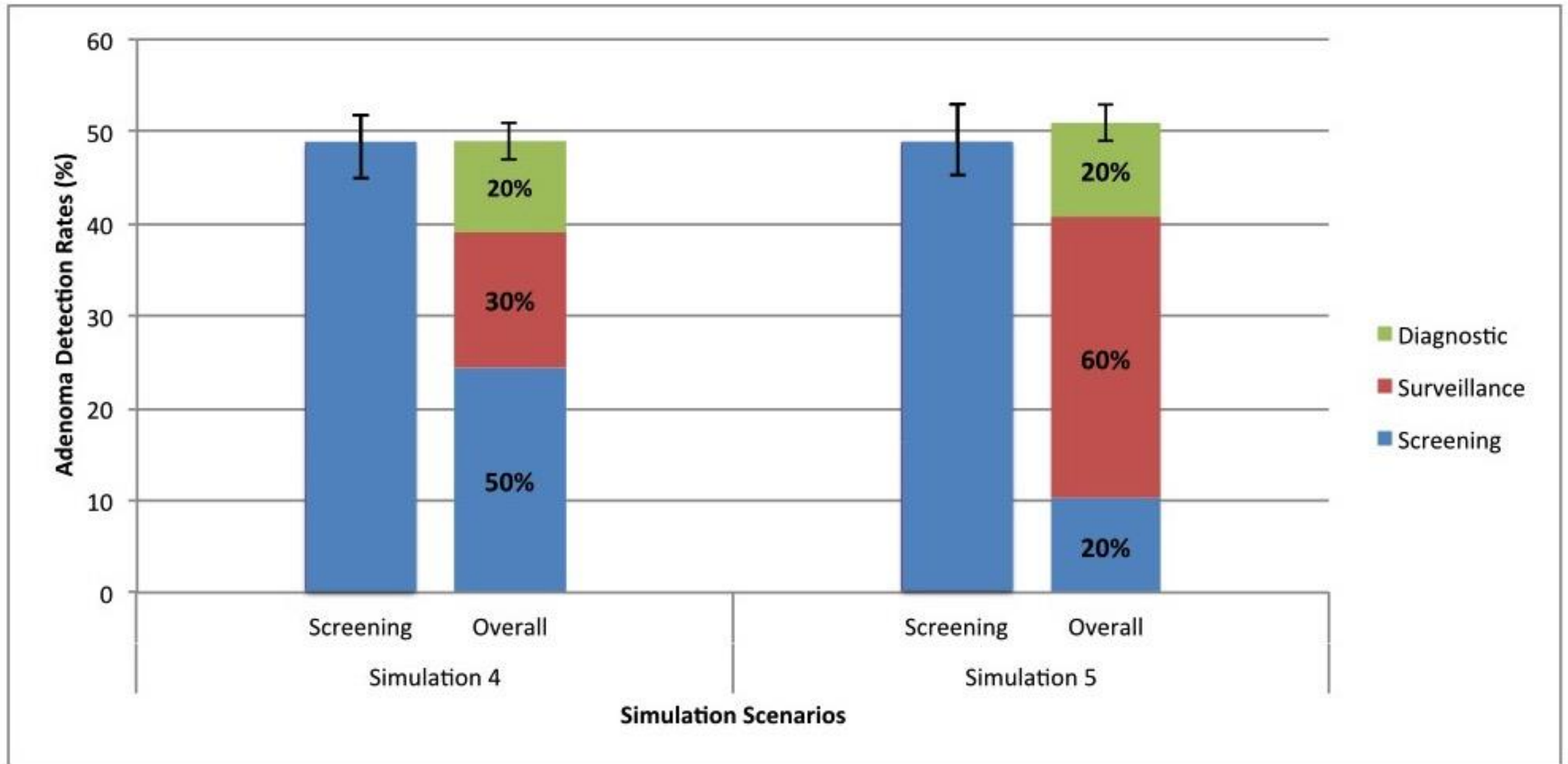
1. Report ADR for All Exams (not only screening)
2. Adenoma “Mention” Rate as surrogate for ADR
3. Report ADR for all levels of Providers

# ADR: Can we report for all Indications or only screening exams?

	Screening	Any	p value
All participants (n=2638)	49% (43, 56)	50% (45, 56)	0.55
Site 1 (n=993)	51% (39, 63)	51% (46,55)	0.97
Site 2 (n=1645)	50% (42, 53)	50% (43, 58)	0.27

*Adenoma detection rate did not vary between screening and any indication*

# ADR Simulation Model

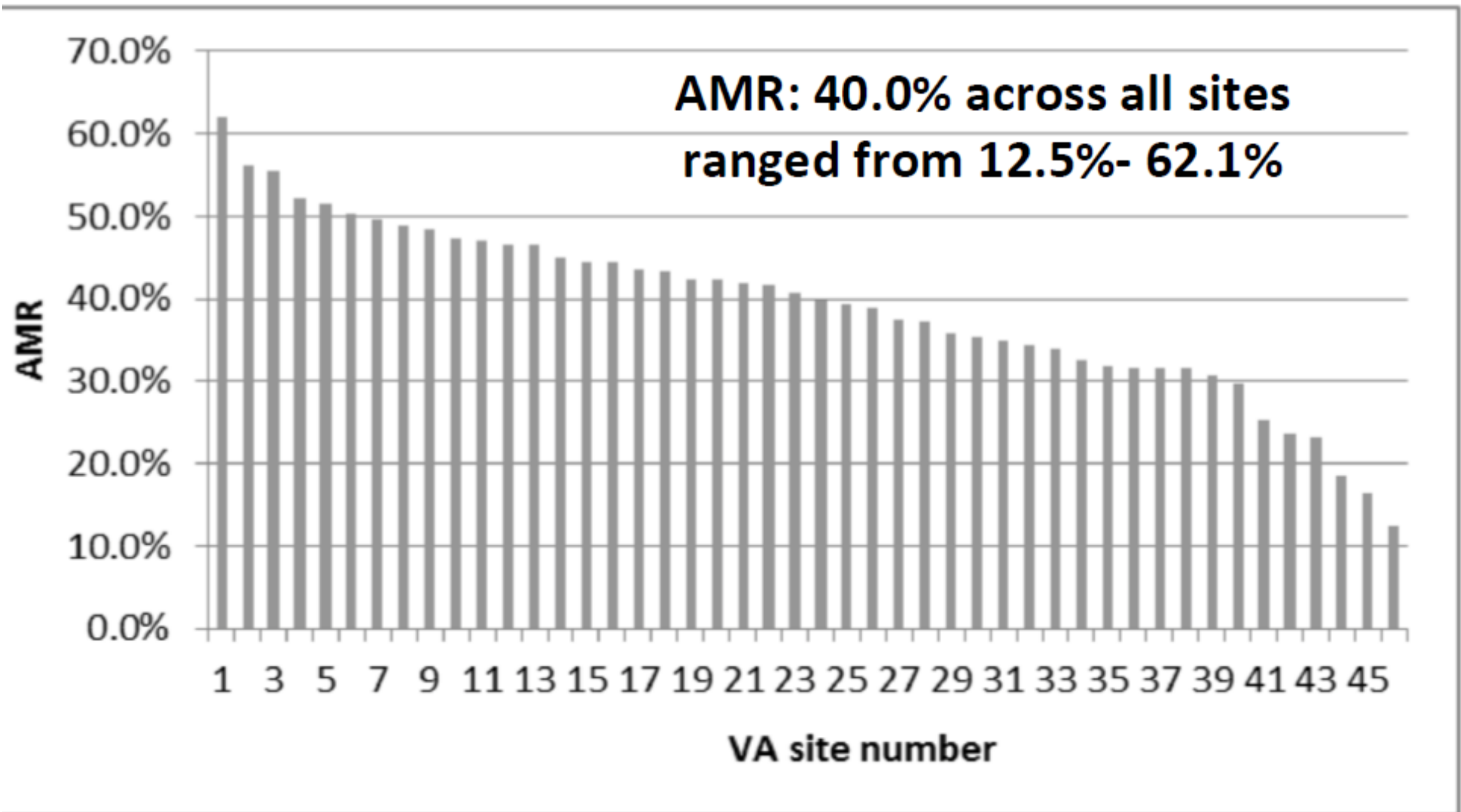




# Adenoma “Mention” Rate

- Adenoma “mention” rate (AMR): Associated pathology results with an adenoma mention divided by colonoscopy procedures identified.
- Simple text searching to query for “adenoma” or “adenomatous” text mentions.
- Validation: Manually reviewed 100 procedures (50 with and 50 without pathology results) each from 3 sites (N=300) representing high, medium, and low AMR.
- Compared AMR to a known ADR independently determined at a single high volume site over two years by manual chart review.

## Adenoma “Mention” Rate



84% sensitivity and 100% specificity,  
compared to ADR

BROWSE

PAGE

**BISL****SCS\_endoqual**

SCS\_Endoqual dev blog

# SCS\_endoqual

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Welcome to SCS Endoqual SharePoint site:

Report (alpha-testing)

- Provider Score Card Report
  - [Provider-level](#)
  - [Hospital-level](#)

# Report Card

SCS\_endoqual > SCS\_Endoqual\_report

Actions |  |  |  1 of 2   |  Find Next | 100%  | 

## Colonoscopy Procedures Counts by Site

Procedure Counts

Procedure Note  
Counts

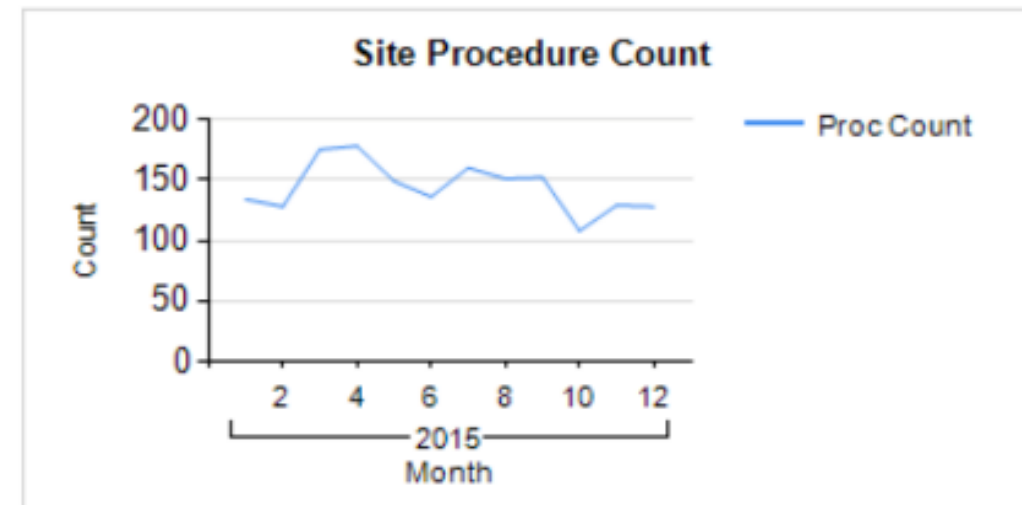
Adenoma Mention  
Rate

Cecal Intubation  
Rate

Bowel Prep Quality

Year: 2015

Month	Procedure Count
January	134
February	128
March	175
April	178
May	149
June	136
July	160
August	151
September	152
October	108
November	129
December	128



Report Card Data captured  
97% of procedures for 2015

## Colonoscopy Procedures Counts by Provider

Procedure Counts

Procedure Note  
Counts

Adenoma Mention  
Rate

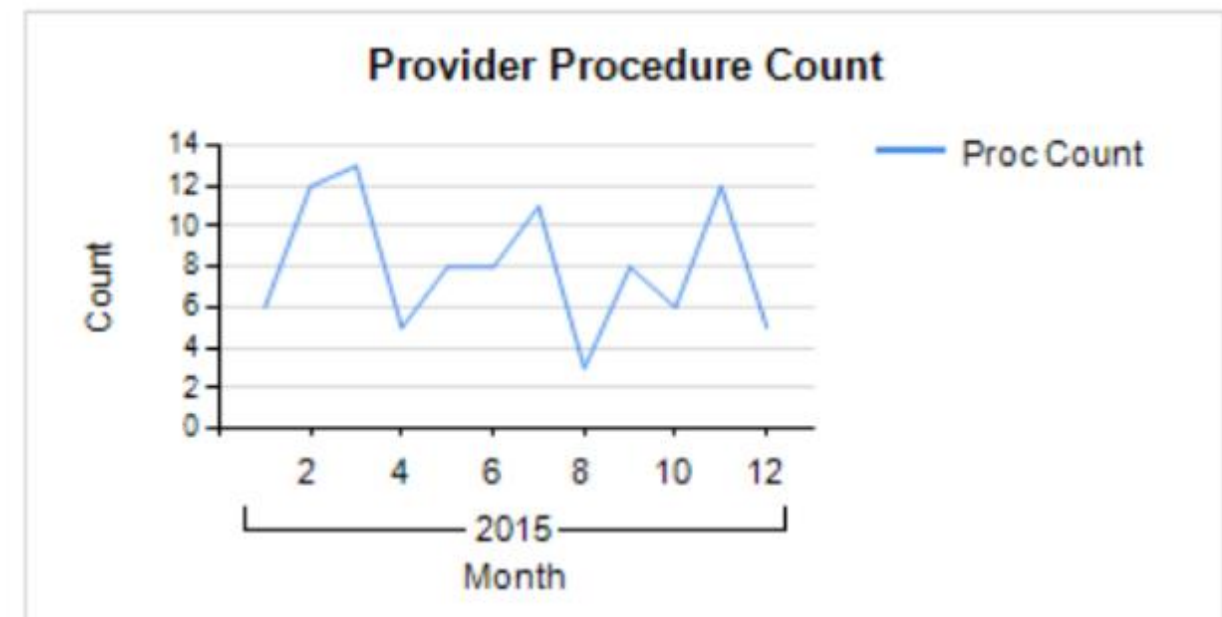
Cecal Intubation  
Rate

Bowel Prep Quality

Provider name: GAWRON,ANDREW J

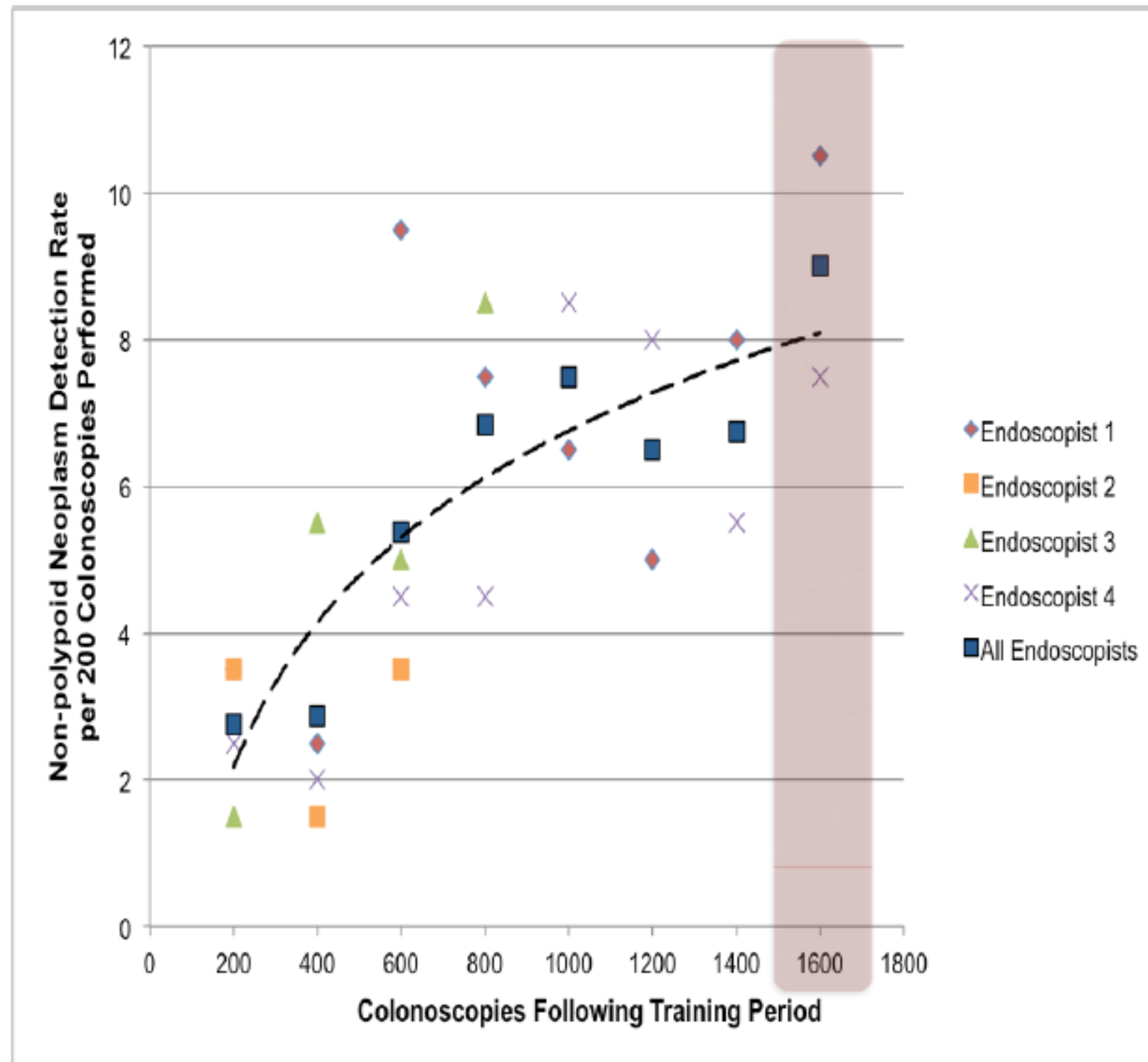
Year: 2015

Month	Procedure Count
January	6
February	12
March	13
April	5
May	8
June	8
July	11
August	3
September	8
October	6
November	12
December	5



# Adenoma Detection is Not Innate

## Training & Monitoring is Important





## CME

# An Endoscopic Quality Improvement Program Improves Detection of Colorectal Adenomas

Susan G. Coe, MD<sup>1</sup>, Julia E. Crook, PhD<sup>2</sup>, Nancy N. Diehl, BS<sup>2</sup> and Michael B. Wallace, MD, MPH<sup>1</sup>

**OBJECTIVES:** Adenoma detection rate (ADR) is a key measure of quality in colonoscopy. Low ADRs are associated with development of interval cancer after "negative" colonoscopy. Uncontrolled studies mandating longer withdrawal time, and other incentives, have not significantly improved ADR. We hypothesized that an endoscopist training program would increase ADRs.

**METHODS:** Our Endoscopic Quality Improvement Program (EQUIP) was an educational intervention for staff endoscopists. We measured ADRs for a baseline period, then randomly assigned half of the 15 endoscopists to undergo EQUIP training. We then examined baseline and post-training study ADRs for all endoscopists (trained and un-trained) to evaluate the impact of training. A total of 1,200 procedures were completed in each of the two study phases.

**RESULTS:** Patient characteristics were similar between randomization groups and between study phases. The overall ADR in baseline phase was 36% for both groups of endoscopists. In the post-training phase, the group of endoscopists randomized to EQUIP training had an increase in ADR to 47%, whereas the ADR for the group of endoscopists who were not trained remained unchanged at 35%. The effect of training on the endoscopist-specific ADRs was estimated with an odds ratio of 1.73 (95% confidence interval 1.24–2.41,  $P=0.0013$ ).

**CONCLUSIONS:** Our results indicate that ADRs can be improved considerably through simple educational efforts. Ultimately, a trial involving a larger number of endoscopists is needed to validate the utility of our training methods and determine whether improvements in ADRs lead to reduced colorectal cancer.

**SUPPLEMENTARY MATERIAL** is linked to the online version of the paper at <http://www.nature.com/sjg>

*Am J Gastroenterol* 2013; 108:219–226; doi:10.1038/sjg.2012.417; published online 8 January 2013

## INTRODUCTION

Screening colonoscopy and other screening methods have been largely credited for the recent decline in the incidence and death rates of colorectal cancer (CRC). Despite this decline, CRC is projected to remain third among cancers for both men and women in 2011 (1).

Although colonoscopy remains an effective method of CRC screening and prevention (2), it is imperfect. Adenoma miss rates have been estimated to be as high as 24% in tandem colonoscopy studies (3,4). One large population study estimated the risk of a new CRC diagnosis within 3 years of negative screening colonoscopy to be as high as 6% (5). Right-sided lesions, flat polyps, and variability in endoscopist quality measures are all potential reasons why interval cancers develop (5–8). The adenoma detection rate

(ADR) is a validated predictor of development of interval CRC risk after screening colonoscopy (9). However, wide variability still exists between endoscopists in this important measure (10–12).

Technical-, patient-, and provider-related factors have all been explored to explain differences in adenoma detection. Adequacy of bowel preparation, withdrawal time, and time of day have all been associated with adenoma rates and their detection (13–16). The performing endoscopist, independent of patient-related factors, has recently been shown to strongly influence adenoma detection (17). Endoscopist behaviors, such as time spent on inspection, looking behind folds, cleansing, and distention of the colon, are also associated with higher adenoma detection rates (18,19). Despite this knowledge, there remains little data on how to improve adenoma detection among individual endoscopists.

<sup>1</sup>Department of Gastroenterology, Mayo Clinic, Jacksonville, Florida, USA; <sup>2</sup>Section of Biostatistics, Mayo Clinic, Jacksonville, Florida, USA.  
Correspondence: Michael B. Wallace, MD, MPH, Department of Gastroenterology, Mayo Clinic, 4500 San Pablo Road South, Jacksonville, Florida 32224, USA.  
E-mail: wallace.michael@mayo.edu

The material in this manuscript was presented at the AGG Annual Scientific Meeting in Washington DC, in October 2011 as a Presidential Plenary oral presentation and won a 2011 AGG/Olympus Colorectal Cancer prevention award.  
Received 12 June 2012; accepted 21 August 2012

## Endoscopy



OPEN ACCESS

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/gutjnl-2014-307503>).

For numbered affiliations see end of article.

**Correspondence to:** Dr Michael F. Kaminski, Department of Gastroenterological Oncology, Institute of Oncology, Reagent Street 5, Warsaw 02-781, Poland; [mikaminski@oi.waw.pl](mailto:mikaminski@oi.waw.pl)

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## ORIGINAL ARTICLE

# Leadership training to improve adenoma detection rate in screening colonoscopy: a randomised trial

Michał F. Kaminski,<sup>1</sup> John Anderson,<sup>2</sup> Roland Valeri,<sup>3</sup> Ewa Kraszewska,<sup>1</sup> Maciej Rupinski,<sup>1</sup> Jacek Pachlewski,<sup>1</sup> Ewa Wronska,<sup>1</sup> Michael Bretthauer,<sup>4,5</sup> Siwan Thomas-Gibson,<sup>6</sup> Ernst J. Kuipers,<sup>7</sup> Jarosław Regula<sup>1</sup>

## ABSTRACT

**Objective** Suboptimal adenoma detection rate (ADR) at colonoscopy is associated with increased risk of interval colorectal cancer. It is uncertain how ADR might be improved. We compared the effect of leadership training versus feedback only on colonoscopy quality in a countrywide randomised trial.

**Design** 40 colonoscopy screening centres with suboptimal performance in the Polish screening programme (centre leader ADR  $\leq 25\%$  during preintervention phase January to December 2011) were randomised to either a Train-Colonoscopy-Leaders (TCL) programme (assessment, hands-on training, post-training feedback) or feedback only (individual quality measures). Colonoscopies performed June to December 2012 (early postintervention) and January to December 2013 (late postintervention) were used to calculate changes in quality measures. Primary outcome was change in leaders' ADR. Mixed effect models using ORs and 95% CIs were computed.

**Results** The study included 24 582 colonoscopies performed by 38 leaders and 56 617 colonoscopies performed by 138 endoscopists at the participating centres. The absolute difference between the TCL and feedback groups in mean ADR improvement of leaders was 7.1% and 4.2% in early and late postintervention phases, respectively. The TCL group had larger improvement in ADR in early (OR 1.61; 95% CI 1.29 to 2.01;  $p<0.001$ ) and late (OR 1.35; 95% CI 1.10 to 1.66;  $p=0.004$ ) postintervention phases. In the late postintervention phase, the absolute difference between the TCL and feedback groups in mean ADR improvement of entire centres was 3.9% (OR 1.25; 95% CI 1.04 to 1.50;  $p=0.017$ ).

**Conclusions** Teaching centre leaders in colonoscopy training improved important quality measures in screening colonoscopy.

**Trial registration number** NCT01667198.

## INTRODUCTION

During recent years, several studies have shown that important patient outcome measures such as interval cancer rates after screening colonoscopy or mortality after cancer surgery are related to quality of hospitals and individual physicians.<sup>1–3</sup> However, there is a lack of high quality studies investigating the effect of quality improvement interventions on patient outcome measures.

Screening colonoscopy is widely used for prevention and early detection of colorectal cancer (CRC).<sup>4</sup> High quality colonoscopy achieving

## Significance of this study

### What is already known on this subject?

- Suboptimal adenoma detection at colonoscopy is associated with increased risk of interval colorectal cancer and colorectal cancer death.
- Interventions targeting endoscopist performance have been generally ineffective for improving adenoma detection rates.
- One small study performed at single academic institution showed adenoma detection rate improvement with training.

### What are the new findings?

- Dedicated Train-Colonoscopy-Leaders course significantly improved adenoma detection rate, proximal adenoma detection rate and non-polypoid lesion detection rate in screening colonoscopy.
- The training of screening centre leaders in teaching high quality colonoscopy changed their own practice and had also significant effect on overall centre performance.
- The Train-Colonoscopy-Leaders course had sustained effect on colonoscopy performance over 1.5 years.

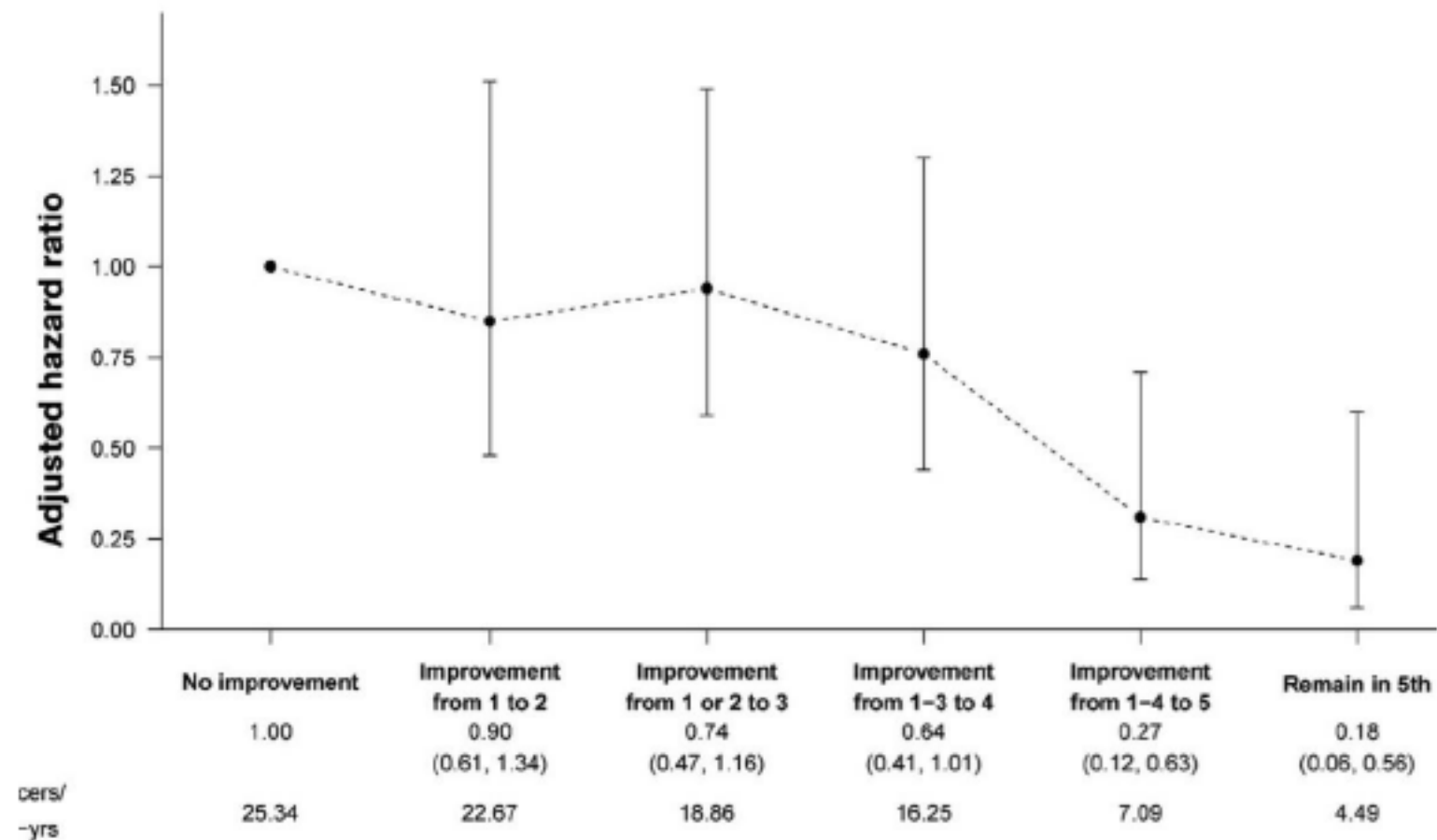
### How might it impact on clinical practice in the foreseeable future?

- Developed training curriculum may help to improve adenoma detection rate and non-polypoid lesion detection rate at colonoscopy.

accurate detection and removal of adenomas is considered the key to screening efficacy.<sup>5–7</sup> Professional societies recommend that endoscopists measure quality indicators such as adenoma detection rate (ADR), caecal intubation rate (CIR) and colonoscopy withdrawal time.<sup>6,7</sup> We have previously shown that an individual endoscopist's ADR is an independent predictor for interval cancer after screening colonoscopy.<sup>1</sup> Recently, a large US study confirmed this association and expanded it to include CRC death.<sup>3</sup> Thus, adenoma detection is of paramount importance for the success of CRC screening programmes. However, it has been uncertain how to improve ADR in endoscopists with suboptimal performance.

# Increases in ADRs from Individual Providers Reduces Interval Cancer

- 294 Endoscopists, Poland
- Annual feedback & quality benchmark indicators
- Increase in ADR associated with reduction in interval cancer
  - Incidence, 0.63 (0.45-0.88)
  - Death, 0.50 (0.27-0.95)



Kaminski MF, Wieszczyn P, Rupinski M et al. Gastroenterology 2017



# Agenda

- Background: Need for colonoscopy quality metrics
- VHA priorities for colonoscopy quality
- QUERI – colonoscopy metrics
  - NLP use for colonoscopy metrics
- Adenoma detection rate
- **Future directions**

# Future Directions

- Testing of NLP Pipelines
- Validation of Simplified ADR Metric
- Qualitative Study on Report Card Dash
- Evaluation and Training Initiatives

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# Next QUERI Presentation

**Tuesday, August 15, 2017  
12 pm ET**

## **Using VA Data to Inform the Design of Partnered Randomized Program Evaluations**

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