Development of the Parkland-UT Southwestern Colonoscopy Reporting System (CoRS) for evidence-based colon cancer surveillance recommendations

RECEIVED 30 January 2015
REVISED 14 May 2015
ACCEPTED 21 May 2015
PUBLISHED ONLINE FIRST 8 August 2015

Celette Sugg Skinner[1,2], Samir Gupta[3], Ethan A Halm[1,2,4,5], Shaun Wright[4], Katharine McCallister[1,2], Wendy Bishop[1,2], Noel Santini[4,5], Christian Mayorga[4,5], Deepak Agrawal[4,5], Brett Moran[4,5], Joanne M Sanders[1,2], Amit G Singal[1,2,4,5]

ABSTRACT

Objective Through colonoscopy, polyps can be identified and removed to reduce colorectal cancer incidence and mortality. Appropriate use of surveillance colonoscopy, post polypectomy, is a focus of healthcare reform.

Materials and Methods The authors developed and implemented the first electronic medical record–based colonoscopy reporting system (CoRS) that matches endoscopic findings with guideline-consistent surveillance recommendations and generates tailored results and recommendation letters for patients and providers.

Results In its first year, CoRS was used in 98.6% of indicated cases. Via a survey, colonoscopists agreed/strongly agreed it is easy to use (83%), provides guideline-based recommendations (89%), improves quality of Spanish letters (94%), they would recommend it for other institutions (78%), and it made their work easier (61%), and led to improved practice (56%).

Discussion CoRS' widespread adoption and acceptance likely resulted from stakeholder engagement throughout the development and implementation process.

Conclusion CoRS is well-accepted by clinicians and provides guideline-based recommendations and results communications to patients and providers.

Keywords: colonoscopy, decision support, tailored intervention, surveillance

BRIEF COMMUNICATION

INTRODUCTION

Colorectal cancer is the second leading cause of cancer death worldwide.[1] Colonoscopy begins a process[2] whereby adenomatous polyps can be identified early and removed to reduce incidence and mortality.[3,4] Effectiveness of this process is limited by suboptimal rates of surveillance among patients with precancerous polyps; those with advanced adenomas often fail to receive follow-up colonoscopy within 5 years.[5] There is evidence of both under and over-use (e.g., repeat colonoscopy sooner than recommended among those with low-risk findings, such as nonadenomatous polyps).[5,6] Using Medicare claims data, Goodwin et al.[7] found >30% of patients had repeat colonoscopy ≤5 years of a normal baseline although guidelines recommend 10 years. Many gastroenterologists lack knowledge about or ignore recommendations for surveillance colonoscopy intervals.[8] Overuse is problematic because of safety risks (potential bleeding, perforation), costs of the procedure, lost work days[9] and cause of potential delays among patients for whom the procedure would provide greater value.

BACKGROUND

A major focus of healthcare reform is appropriate use of medical procedures, including reduction of unneeded procedures. Appropriate colonoscopy surveillance intervals are included in the Centers for Medicare and Medicaid Services 2014 Physician Quality Reporting System measures and the American Gastroenterological Association's *Choosing Wisely* campaign. Surveillance intervals will continue to be monitored, particularly as reimbursement becomes increasingly tied to quality measures.

Researchers have developed decision support tools to match findings with follow-up recommendations. Some are "designed to be embedded into electronic medical records (EMRs), to facilitate access at point of care"[10] but none has gone to the next step of generating tailored reports of recommendations to patients and referring physicians. Primary providers may only get a copy of the post-procedure colonoscopy report with vague recommendations ("follow-up in 3–5 years") or no advice ("follow-up pending pathology results"). Patients may not know their findings and follow-up recommendations because they do not receive timely reports or do not understand what they receive, especially if English is not their first language. Through our NCI-funded Parkland-UT Southwestern PROSPR Center,[2] we developed and implemented a colonoscopy reporting system (CoRS) to address these needs.

MATERIALS AND METHODS

System Development

The novel, provider-friendly Parkland-UT Southwestern Colonoscopic Reporting System uses the NoteWriter feature in Epic Epic Systems Corporation, Verona, WI. CoRS is written in XML layout, hosted by a Visual Basic control that saves to a data base that runs in Massachusetts General Hospital Utility Multi-Programming System. The system provides: 1) decision facilitation, 2) follow-up recommendation documentation, and 3) generation of tailored recommendation reports for patients and referring providers. It is driven by cascading

Correspondence to Celette Sugg Skinner, PhD, Department of Clinical Sciences, University of Texas Southwestern Medical Center, 5353 Harry Hines Blvd., Dallas, TX 75390-9066, USA; Tel: 214-648-5499; Celette.Skinner@UTSouthwestern.edu

 For numbered affiliations see end of article.

questions in pull-down menus (Figure 1). Data are recorded in the EMR and used by tailoring algorithms to create a letter for each patient and the referring provider that summarizes findings and corresponding recommendations.

Workflow

Colonoscopists access pathology through Epic's *In Basket*, then click buttons to answer questions about these variables that determine appropriate recommendations (Figure 1): (a) indication (screening, surveillance, diagnostic), (b) intubation of cecum, (c) bowel prep quality, (d) family history, (e) number of polyps, and (f) "worst" finding on pathology. For a hyperplastic polyp and a large tubular adenoma, the worst finding is "1 cm or larger adenoma." If adenomas are present, colonoscopists specify whether high-grade dysplasia and/or villous/tubulovillous histology is present. For large adenomas, users specify whether the polyp was removed piecemeal.

Computerized Decision Support

A tailoring algorithm in the *NoteWriter* function uses collected data to generate a report of findings and colonoscopy recommendation based on guidelines from Winawer et al.[11] and Lieberman et al.[12] It selects "repeat colonoscopy in 5 years" for patients whose worst pathologic finding is a single small adenomatous polyp and "repeat colonoscopy in 3–6 months" for patients with piecemeal resection of a large polyp or without cecal intubation. When there is flexibility in recommendations, a choice of guideline-based intervals is displayed. For example, because US Multi-Society Task Force on Colorectal Cancer guidelines recommend repeat colonoscopy any time within 3 years among patients with 10 or more adenomatous polyps, colonoscopists choose colonoscopy in 3–6 months, 1, 2, or 3 years (but not 5 or 10). To avoid overuse, users can override surveillance recommendations if they believe repeat colonoscopy is not indicated due to age or comorbid conditions. Once completed, CoRS generates a progress note documenting colonoscopy findings and recommendations in the EMR. This information is then available to all specialty providers, the primary care physician, and colonoscopist.

To generate the tailored letter, users click on a letter template. Findings and recommendations automatically generate a simple-language English and Spanish letter for the referring provider and patient (Figure 2). Patient letters are printed by administrative staff and sent via US mail. Providers' versions are routed to electronic inboxes.

Tailored Recommendation Letters

Prior to CoRS, reporting letters had varied in wording and thoroughness. Spanish versions were often generated by a computer translation program without checks for accuracy or clarity. For CoRS letters, health communications experts generated a tailored message library[13] of low-literacy English versions of tailored text for every potential finding and ensured the messages flowed seamlessly, regardless of which messages preceded or followed. We used a language validation iterative process[11] of forward/backward translation, evaluation by a committee of Spanish speakers from different countries, and cognitive testing with low-literacy English and Spanish speakers.[14]

Figure 2 shows a sample tailored letter, with standard content in plain text and content from the tailored message library underlined. Figure 3 shows the corresponding tailoring algorithm flow diagram illustrating how each piece of text was selected from the message library for this one scenario. In this there was $\geq$ polyp, size of the largest was $\geq$ 1 cm, and the resection was piecemeal, indicating need for repeat colonoscopy in 3–6 months.

A table of all tailoring algorithms, illustrating how responses to each CoRS question were linked to guidelines and how each piece of text was selected from the tailored letter message library, can be found in an online Appendix.

Figure 1: Parkland-UT Southwestern CoRS screen shot.

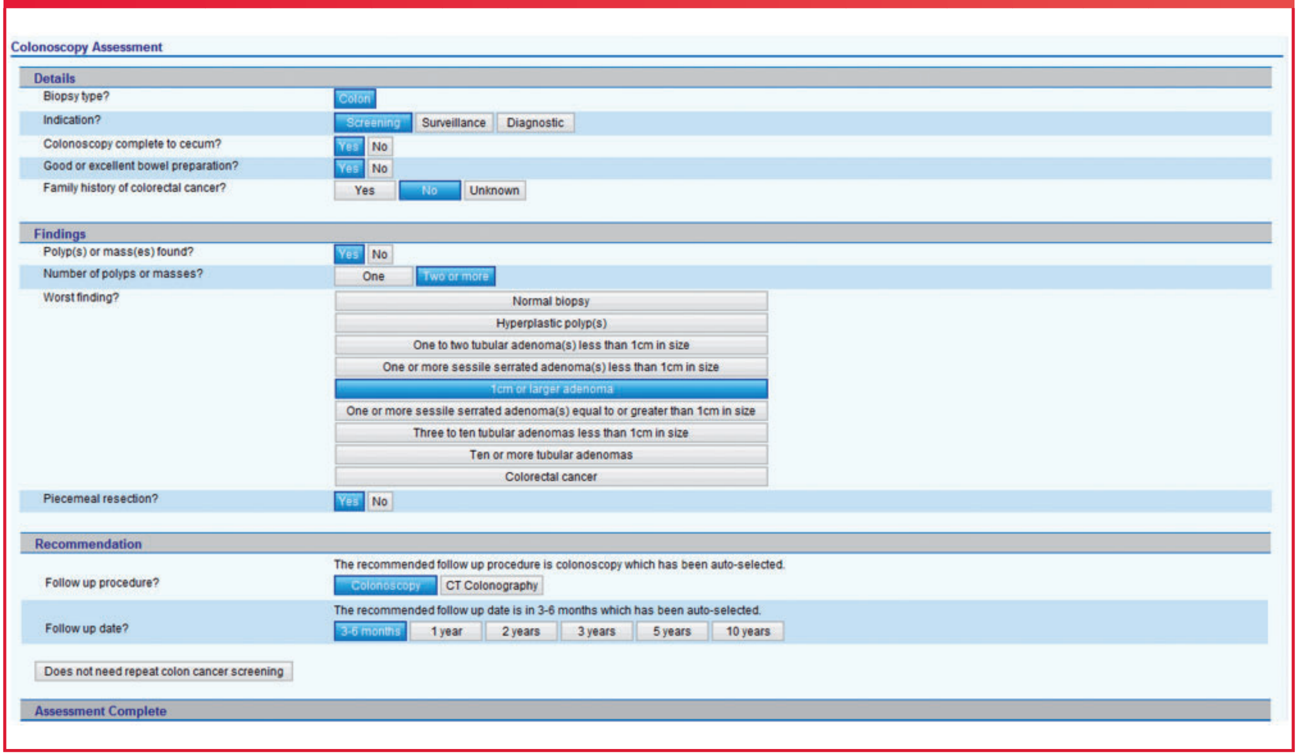
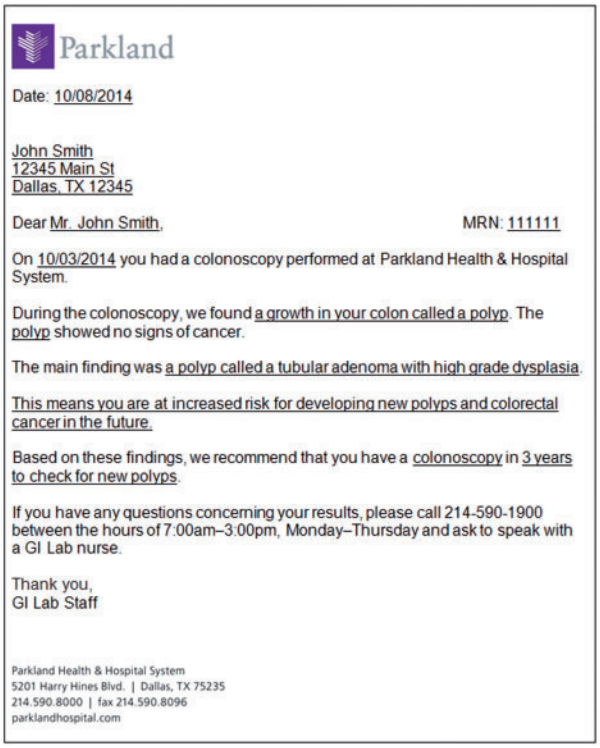


Figure 2: Tailored results reporting and recommendation letter.



Parkland

Date: 10/08/2014

John Smith
12345 Main St
Dallas, TX 12345

Dear Mr. John Smith, MRN: 111111

On 10/03/2014 you had a colonoscopy performed at Parkland Health & Hospital System.

During the colonoscopy, we found a growth in your colon called a polyp. The polyp showed no signs of cancer.

The main finding was a polyp called a tubular adenoma with high grade dysplasia.

This means you are at increased risk for developing new polyps and colorectal cancer in the future.

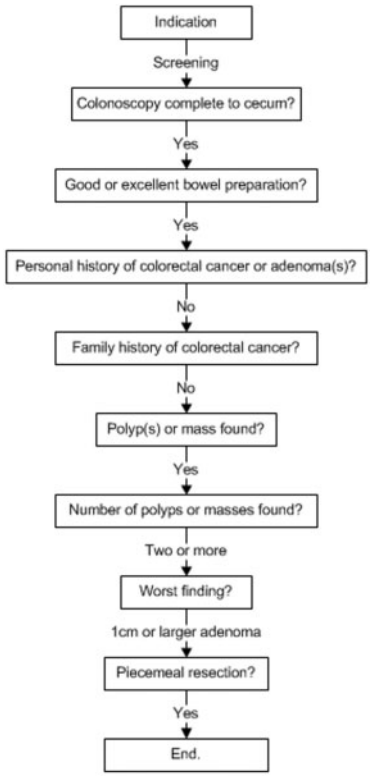
Based on these findings, we recommend that you have a colonoscopy in 3 years to check for new polyps.

If you have any questions concerning your results, please call 214-590-1900 between the hours of 7:00am–3:00pm, Monday–Thursday and ask to speak with a GI Lab nurse.

Thank you,
GI Lab Staff

Parkland Health & Hospital System
5201 Harry Hines Blvd. | Dallas, TX 75235
214.590.8000 | fax 214.590.8096
parklandhospital.com

Figure 3: CoRS algorithm.



Stakeholder Engagement

As recommended by Fisher[15] and others, *CoRS* was developed with stakeholder engagement of gastroenterology (GI) faculty, fellows, and laboratory staff; institutional leadership; primary-care providers; and information technology (IT) staff. GI faculty and fellows provided input about question content and order, response options, algorithms that link these responses to re-screening and surveillance guidelines, and wording for tailored message text. GI laboratory staff and primary-care providers suggested how reports should be transferred to *In Baskets*. IT staff advised about feasible methods for using responses to generate tailored reporting letters and developed the system over an 18-month period. Patients pre-tested the tailored messages via cognitive interviews to ensure understandability and conceptual equivalence in English and Spanish.[16]

Implementation and Evaluation

In December 2013, the system was implemented for all colonoscopies performed at Parkland involving polyp removal or biopsy. Because GI faculty and fellows were initially skeptical about whether using CoRS would disrupt work flow and whether they could trust accuracy of the algorithms, we wondered whether they would use and come to trust it. An anonymous survey used a 5-point Likert scale to assess extent of agreement the system: 1) is easy to use, 2) disrupts work flow, 3) has led to improvement in screening practice, 4) produces guideline-based recommendations, 5) makes your work easier, 6) improves quality of Spanish-language letters, and 7) is something you would recommend for other institutions? To determine rate of adoption and whether it improved over time, we compared total colonoscopies involving polyp removal (denominator) with the number for which CoRS was used (numerator) at 6 and 12 months post implementation. To assess whether CoRS was adopted by providers and if adoption increased over time, we calculated usage rates at 6 and 12 months post implementation.

RESULTS

Patient Characteristics and Colonoscopic Findings

Most patients for whom CoRS was used were female (55.9%) and minority (38.9% Hispanic, 35.5% African American; Table 1).

Recorded indication for colonoscopy was: 44.5% diagnostic; 24.3% screening; 21.3% surveillance. Nearly all (97.5%) were complete to the cecum; 84.1% had good/excellent prep. Polyps were found in 626 patients. Most common worst finding (43.8%) was 1–2 tubular adenoma(s) <1 cm.

Colonoscopists' Reactions to the System

We achieved a 6-month survey response rate of 100% among the 18 providers who used CoRS.

As shown in Table 2, more than three quarters of these colonoscopists indicated the system is easy-to-use (83.3%), provides guideline-based follow-up recommendations (88.9%), improves quality of Spanish letters (94.4%), and they would recommend adoption at other institutions (77.8%). Most (55.6%) agreed it improved screening practice and made work easier.

Adoption of CoRS at 6 and 12 months

During the first 6 months of implementation, 1775 colonoscopies were performed, of which 804 (45.3%) had polyp removal. CoRS was

used for 673 (83.7%) of these cases. Utilization rose from 83.7% during the first 6-month period to 98.6% during the latter 6 months.

DISCUSSION

During a time when appropriate use of colorectal cancer surveillance is increasingly scrutinized, Parkland-UT Southwestern CoRS is an EMR-based module facilitating reporting and guideline-based recommendations for patients undergoing polypectomy. Despite complex risk assessment and surveillance recommendations, CoRS minimized user burden by including only a few questions and eliminating the need for dictating or typing free text. CoRS uniquely extends beyond decision support to include tailored communication with providers and patients regarding results and guideline-based recommendations. Although previous colorectal cancer screening communications interventions have provided tailored content for individual recipients,[17–20] ours is the first to use EMR information as tailoring data.

In addition to guideline-based recommendations, CoRS tracks cecal intubation rates, which are associated with colonoscopy quality and interval cancer risk. Previously these data existed as "free text" that required chart review or natural language processing (NLP) for extraction. Similarly, the system captures colonoscopy indication—important for clinical care, reimbursement, healthcare quality reporting, and research.

Early and extensive stakeholder engagement of primary-care providers, GI faculty and fellows, the IT team, and patients was critical to the program's successful implementation and helped ensure providers' uptake and positive reactions.

Our evaluation of CoRS implementation has several limitations. First, it occurred within a single center. Although results may not be generalized to other practice settings, we believe it would be equally successful given the high agreement for acceptance among providers who used the program. Second, CoRS is only used for reporting polyp pathology to date; providers continue to use nontailored letters for normal findings, nonpolyp colonoscopy pathology, and any upper endoscopy pathology results. However, we are expanding its use to patients without polyps and/or biopsies to help facilitate tracking of adenoma detection rates. Third, although CoRS has potential to reduce disparities in cancer outcomes by generating tailored, simple-language letters to patients with low literacy and those whose primary language is Spanish—those historically less likely to complete the screening process[4,21–23] and are at elevated risk for adverse outcomes[24–27]—studies are needed to characterize impact of improved communication on outcomes such as patient adherence with recommendations.

A final potential limitation of CoRS is that the system is not fully automated. Generation of tailored letters and guideline-based recommendations requires manual input from providers rather than employing NLP to read directly from pathology reports and other data sources. Our current NLP capabilities are not sophisticated enough to capture information within and outside of the patient record with high enough specificity to ensure accurate capture of essential elements. Future improvements in standardization of reports, including obtaining them through Health Level 7 International interfaces rather than blobs of text, might remedy this situation. However, with or without NLP to generate recommendations, responsible clinicians must review colonoscopy and pathology findings and "sign off" on recommendations; our approach takes advantage of this required professional responsibility with minimal additional burden.

Overall, the Parkland-UT Southwestern CoRS is novel and addresses an important issue in the colorectal cancer screening process. Given its success at Parkland, we are adapting it for implementation at the University of Texas Southwestern Medical Center. We

Table 1: Patient Characteristics

	Overall $N = 673$
Sex, *n* (%)	
Female	376 (55.9)
Male	297 (44.1)
Race, *n* (%)	
White	388 (57.7)
Black	239 (35.5)
Asian	38 (5.6)
American Indian	1 (0.1)
Other Pacific Islander	3 (0.4)
Unknown	4 (0.6)
Ethnicity, *n* (%)	
Hispanic	262 (38.9)
Non-Hispanic	405 (60.2)
Unknown	6 (0.9)

Table 2: Physician reactions to *CoRS*

To what extent do you agree that the NoteWriter . . .	Strongly Agree/ Agree, *n* (%)	Neutral, *n* (%)	Disagree/Strongly Disagree, *n* (%)
Is easy to use?	15 (83.3)	1 (5.6)	2 (11.1)
Disrupts your work flow?	2 (11.1)	4 (22.2)	12 (66.7)
Has led to improvement in the colorectal Cancer screening practice?	10 (55.6)	8 (44.4)	0 (0.0)
Produces guideline-based follow-up recommendations?	16 (88.9)	1 (5.6)	1 (5.6)
Makes your work easier?[a]	11 (61.1)	5 (27.8)	1 (5.6)
Improves quality of Spanish-language letters to patients?	17 (94.4)	1 (5.6)	0 (0.0)
Is something you would recommend for adoption at other institutions?	14 (77.8)	4 (22.2)	0 (0.0)

[a]One participant did not respond.

BRIEF COMMUNICATION

believe CoRS could be easily implemented at many other EMR-based systems in the future.

FUNDING

This work was supported by the National Institutes of Health, grant number UL1TR001105; Cancer Center Support Grant, grant number P30 CA142543; and National Institutes of Health/National Cancer Institute, grant number U54 CA163308.

COMPETING INTEREST

The authors have no competing interests to declare.

CONTRIBUTORS

Drs Skinner, Mayorga, Gupta, Agrawal, Moran, and Singal and Ms. Bishop, Mr. Wright and Ms. McCallister contributed to the conception and design.

Drs Skinner, Gupta, Halm, and Singal, and Ms. McCallister, Bishop, and Sanders contributed to the analysis and interpretation of the data.

Drs Skinner, Gupta, Halm, and Singal, and Ms. McCallister and Mr. Wright contributed to the drafting of the article.

Drs Santini, Mayorga, Agrawal, and Moran, and Ms. Bishop contributed critical revision of the article for important intellectual content.

All authors submitted final approval of the article.

SUPPLEMENTARY MATERIAL

Supplementary material is available online at http://jamia.oxfordjournals.org/.

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AUTHOR AFFILIATIONS

[1]Department of Clinical Sciences, UT Southwestern Medical Center, Dallas, TX, USA

[2]Harold C. Simmons Cancer Center, UT Southwestern Medical Center, Dallas, TX, USA

[3]Veterans Affairs San Diego Healthcare System, Division of Gastroenterology, Department of Internal Medicine, and the Moores Cancer Center, University of California San Diego, USA

[4]Department of Internal Medicine, UT Southwestern Medical Center, Dallas, TX, USA

[5]Parkland Health & Hospital System, Dallas, TX, USA