

Combining Science with Art to Educate and Motivate Patients prior to Colorectal Cancer Screening

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Abstract. Colorectal cancer (CRC) is the second leading cause of cancer deaths in the US despite wide use of colonoscopy to prevent CRC and CRC-related mortality. Colonoscopy is used to identify and remove lesions that will lead to cancer, however, most deaths occur because lesions are not detected or completely removed during the procedure. Patients play a crucial role in the detection component of colonoscopy: the better the colon is prepared, the higher the chance of detection of all polyps and cancers. In general, patients are instructed to clean the colon by way of a paper or web-based form that lists the objective (scientific) steps involved; unfortunately this too often does not result in a well-prepared colon. Behavior is known to be heavily influenced by emotion. As the first phase of a smart education research project we created an artistic and instructional documentary in which patients engage with the educational content through emotional responses; i.e., we motivate patients to follow instructions by combining scientific with emotional aspects of CRC prevention including preparation of the colon prior to colonoscopy. In the second research phase we will test whether use of the documentary results in improved colon preparation.

Keywords: Colonoscopy, colorectal cancer, emotion, film, audiovisual, education

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1. Introduction

Colorectal cancer (CRC) is the second leading cause of cancer-related death in the US.[1] Yet, CRC and CRC-related mortality are mostly preventable if patients participate in a screening and surveillance program that is based on colonoscopy.[2] Indeed, the latest data show that CRC after a colonoscopy is for 80-90% the result of either a poor colon preparation by the patient or insufficient technique of the endoscopist; in other words, the vast majority of CRC, despite colonoscopy, is not the result of aggressive, uncontrollable tumor biology but the result of suboptimal human activities.[3]

For the last decade the research program of de Groen has focused on improving the human aspects of colonoscopy.[4, 5] His program has developed completely automated software that can measure in real-time how well the patient has cleaned the colon.[6] It can also measure how well the endoscopist inspects the colon mucosa. Several studies have shown that endoscopists can reach the beginning of the colon, the cecum, in a few minutes in a clean colon, and then have 10—20 minutes to inspect the colon mucosa during withdrawal.[7] To the contrary, if the colon is not well cleaned, it takes longer to reach the cecum, and a significant amount of time then is needed to clean the colon to allow inspection. Given a relatively fixed time slot of 30 minutes per procedure, this means that in a poorly prepared colon there is significantly less time for colon mucosa inspection.[8] Thus, it is crucial that the colon is well cleaned prior to colonoscopy. Unfortunately, this is too often not the case.[9]

Currently, patients at Mayo Clinic Rochester are instructed how to cleanse the colon via a paper leaflet that in chronological order lists the objective steps involved in the colon cleansing process. The instruction leaflet holds purely scientific information and objective guidance notes; it has had no specialist design or layout consideration. The colon preparation advice may be included within a larger set of information leaflets and, for example, may be inserted between an explanation of where to go for an ECG and a set of explanations of what to expect during a CT of the abdomen. Yet, whereas all other healthcare instructions, in essence, provide directions and explanations (which really have little or no bearing on the quality of the exam or consultation), colonic preparation prior to colonoscopy is an essential part of the procedure and greatly determines the eventual outcome. Black and white paper instructions do not visually, cognitively and emotionally evoke within the patient an understanding of the importance of the task ahead or the mental state required to get the colon well cleansed. Indeed, it is well-known, that a paper-based method is not effective when compared to instruction by a health professional.[10, 11] Yet personal instruction is not financially feasible given the great volume of patients and the continuously declining reimbursements for procedures.

Research shows that people are much better motivated when a message reaches them both at a cognitive and an emotional level.[12] The present paper explores the creation of a smart educational documentary that allows the Mayo Clinic team to test in a randomized controlled trial whether the concept of smart learning, that combines science, emotion and digital technology in an artistic documentary, better conveys the importance of colon cleansing prior to the colonoscopy than current paper-based instructions.

2. Related Work

2.1. *Enhancing compassionate and emotional responses to healthcare issues*

Research by Patel and Toulson evaluates the concept of *creative communication*, which describes the sharing and exploration of non-arts knowledge and data in a creative manner – utilizing, for example, art, storytelling, gameplay, filmmaking, sound and music, animation and curated exhibitions. By engaging in creative communication, it has been observed that detailed scientific, technical and even political material can be presented to a wide, non-specialist audience, enhancing impact, engagement, interaction and education. In particular, Patel and Toulson describe the use of creative documentary filmmaking in enhancing compassionate and emotional responses to healthcare issues.[13] Their research has shown that by capturing footage from an artistic viewpoint, it is possible to educate healthcare practitioners and the general public in more compassionate ways, resulting in a deeper engagement with the scientific facts and medical conditions that they need to understand. Patel's film *The Golden Window* follows a neonate who undergoes whole-body cooling during the first 72 hours after a traumatic birth.[14] The film captures contradictory and unanticipated emotions that the Neonatal Intensive Care Unit generates, interweaving the candid and immediate thoughts of parents and staff as they experience this world they call 'the bubble'. *The Golden Window* differs from traditional reality and fly-on-the-wall documentaries by focusing particularly on creative aspects of narrative, characters, color, soundscapes and artistic cinematography, and utilizing the latest digital technology (35mm sensor cameras, macro lenses, audio and visual post-production software such as Da Vinci and Resolve) to enhance and heighten the experience of the viewer.

2.2. *Endoscopic Multimedia Information System (EMIS)*

Since 2003 the Mayo Clinic has worked on creating an automated system to capture, analyze and summarize video files representing an entire endoscopic procedure.[4] The system is called the EMIS for Endoscopic Multimedia Information System and design effort has specifically focused on resolving issues around colonoscopy. Three things need to occur simultaneously in order for a colonoscopy to be of high quality. First the colon needs to be well prepared (**C**lean). Second, most if not all of the mucosa needs to be inspected (**L**ook **E**verywhere). Thirdly, all neoplastic lesions, where possible, need to be completely removed (**A**bnormality **R**emoval).[5, 15] Collectively, these three features combine to form the CLEAR acronym. EMIS uses computer-based algorithms to analyze the image stream generated during colonoscopy for specific metrics based on the CLEAR principle. EMIS can detect whether the colon is clean, whether the endoscopist removes remaining debris, whether the endoscopist tries to inspect the entire colon and whether polyps are removed. It has been shown that the manual EMIS annotation technique is reproducible among annotators with fair to good inter-operator agreement; inter-operator agreement is best for very low and very high quality procedures, but varies when quality is average.[16] The automated EMIS technology results correlate with manual annotation results, and both manual and automated annotations correlate with Adenoma Detection Rate – the most widely accepted main determinant of colonoscopy quality – for a set of video files representing the work of a single endoscopist or an endoscopy group.[7]

2.3. Colon preparation approaches and protocols

In general there are three approaches to patient instruction prior to colonoscopy. The first one is using a paper-based or web-based set of instructions. This is the most commonly used method and also used at Mayo Clinic. A second approach includes personal instructions, either in a group session, in person or via telephone. The latter method, personal communication via telephone call with the patient right before the start of the actual preparation, “just-in-time education”, has been reported to result in good to excellent colonic preparation.[10, 11, 17] The third approach involves the use of digital technology for conveying instructions, either through online videos or mobile applications. Most video files are a combination of audiovisual instructions that follow the same outline as the paper- and web-based lists. Mobile applications have the advantage of allowing the users to set up reminders throughout the stages of colon preparation, which help keep the process on track. However, while “smart” technology the existing mobile applications do not engage the user through emotional responses.[18, 19]

3. Research Methods

3.1. Research design

At KES-STET 2014 members of the research teams at Mayo Clinic and Anglia Ruskin University initiated discussions on the creation of a smart educational documentary that combined science and emotional storytelling with the aim of improving screening for CRC. In the months following the meeting the idea of creating a short film focused on CRC and colonoscopy was formed; unlike prior educational movies, this project aimed to expand on the usual scientific information by including an emotionally charged message with the intent to more deeply motivate patients to clean their colon as good as possible: a smarter form of education compared to existing video files. The project included two research phases. In phase one the artistic documentary is created. In phase two, the artistic documentary (the “intervention”) is tested by randomly assigning patients to either the usual paper or web-based instructions (“control” group) or the same instructions combined with an expectation of viewing the artistic documentary (“intervention” group). For each group, video files of the colonoscopy procedures will be obtained to allow automated analysis of the colon preparation using EMIS.

This article describes and reflects on phase one of the research, with phase two currently in progress. Phase one was funded by the Mayo Clinic Slaggie Cancer Patient Education Fund.

3.2. Collaboration

The project collaboration relied on Anglia Ruskin University (UK) bringing their experience and expertise of artistic documentary filmmaking to deliver Mayo Clinic’s (US) specific requirements for communicating better with patients. Collaboration in the design stage of the project utilized a number of networking and sharing tools such as Skype and Dropbox. A key aspect of the early discussions was focused on establishing common language and understanding of each other’s professional disciplines. For Anglia Ruskin it was essential to get an insight into the physician’s workings,

environment and team at Mayo Clinic, which was facilitated by Skype meetings and virtual tours. This was particularly important because a pre-filming recce was not possible due to funding limitations and time constraints.

Anglia Ruskin needed to convey the breakdown of a documentary film production team (producer, director, cinematographer, sound, editor, and graphics) and the production requirements for making a professional film, including potential issues with contributors, equipment, finances, location, sound and data archiving. It was also important to make sure that there was agreement on the film not being a 'movie' (which implies a dramatic approach) with actors but a 'documentary film' with 'contributors' with real life stories and experiences. The ethical requirements and procedures were discussed and agreed upon.

3.3. Information gathering

Director Patel had made a number of films previously (for the BBC and Discovery channels) within the medical environment, and was therefore familiar with ethical protocols and implications; restrictions on movement and equipment; and patient flow. The teams discussed the logistical details of the journey of patients coming in for screening, i.e. the waiting room, registration, pre-screening check-up, changing clothes, moving to the screening room and then eventually to recovery. This was essential to identify the timings and to evaluate how this process could be filmed observationally – considering where to place cameras, what equipment to use, and how the audio was to be recorded. For sound recording it was important to identify when radio microphones would be worn, and by which staff and patients, in order to minimize any counter-productive disruption. The detailed background information and visual understanding of the physical environment allowed potential creative approaches to be identified and evaluated by the director and production team; particularly enabling the uses of associative visual imagery, mnemonic artifacts, graphics and visual landscapes to be clarified and to create a shot list to support the narratives of the film.

During pre-production research, an analysis of the historical and current landscape of public information films and data was conducted, particularly identifying local (i.e., Mayo Clinic specific), national (US) and international approaches.[20] Dry facts dominated 'doctor to patient' web-based instructional videos as well as more 'commercial' celebrity led videos.[21, 22] These examples were evaluated in order to understand the effectiveness of previous approaches.[23] The findings supported the proposal that a purely fact-based instructional video had less impact than a film that presented an emotively led narrative. Further research into healthcare communication campaigns running in the Mid-West area (particularly Minnesota) illustrated that CRC campaigns featured a more abstract approach and used anonymous faces, predominantly actors, rather than 'real' people. Second, a more humorous rather than sympathy charged (i.e., a focus on loss) approach appeared to be more effective.[20] The analysis also highlighted the potential benefits of an international collaboration in such an area, with a UK team applying an approach not ingrained in the institutional culture of the US healthcare system.

3.4. Target audience and key messages

The teams decided that the film should be less than 20 minutes and in an NTSC video format. The target audience would be diverse in all aspects of age, gender, socio-economic and cultural background (including patients with Midwest, Afro-Caribbean and Native American origins).[24] Additionally, key healthcare stats to be included in the film were identified; the existing method employed by the Mayo Clinic was a dense, informational heavy print literature, which needed to be simplified into consumable ‘bites’ of information. The key messages to be communicated were identified, particularly the aims and ‘call-to-action’ of the film, which was to encourage patients to conduct proper preparation prior to colonoscopy and attend regular screenings. In particular the context and statistical data of CRC, needed to be communicated, as well as an understanding of the causes (particularly lifestyle related), the impact, treatment, prevention and procedure of the screening.

In order to achieve these aims, the following issues or ‘myths’ had to be addressed: perceptions of the preparation prior to the procedure and of the actual colonoscopy process. What would motivate a patient to attend and properly prepare for a CRC screening emotionally? The following messages and ‘enablers’ were identified for the film:

- Patients could be encouraged to attend with a friend or relative
- Encourage patients to approach colonoscopy as a test for their best interest rather than something that ‘must’ be done
- If patients attend a colonoscopy they may be around for their children
- If patients catch issues early, then they don’t have to deal with the need for more invasive and costly treatment, or the length (and pain) of such treatment

Dr Topin Austin, a Consultant Neonatologist (Cambridge University Hospitals, UK, shared the story of his father’s experience as a patient, who passed away from CRC after a very late diagnosis:

As a doctor we see patients come and go... [What we] never really saw was the context the disease played in their lives. Like prison - everyone in hospital is in the same uniform - the awful NHS gown. Yet everyone has a backstory - family, work, friends....

This insight, combined with an article written by the Pulitzer prize winning columnist for the Miami Herald, Dave Berry, was particularly eye-opening.[25] Berry reflecting upon his annual colonoscopy, stated “This horrible disease takes so much from us, both caregiver and patient alike, but never let it take away your ability to laugh”. The article continues to describe the colonoscopy process from the viewpoint of a patient, from the consumption of the MoviPrep™ (“a nuclear laxative” comparable to the “launch of the space shuttle”), through to the wearing of the hospital garments that make you “feel more naked than when you are actually naked” and the colonoscopy itself; “the moment I had been dreading for more than a decade”. Finally Berry describes the results:

I felt even more excellent when Andy (the consultant) told me that it was all

over and my colon had passed with flying colors. I have never been prouder of an internal organ.

The narrative structure applied by Berry provided the design for the 'script' and spine of the film developed.

4. Film Production

4.1. Patient Selection

The patients were selected after a number of interviews the director conducted via Skype, through which both parties built up a trusting relationship which was essential for the actual interview in the USA to proceed smoothly. What emerged from these conversations was that for the patients their families were their 'reason for living'. As such, the initial patient list, which was predominantly female, was extended to include their partners. Furthermore, it was decided that we also needed to include a patient who was undergoing the actual process – whom the target audience could accompany experientially, through a sense of anticipation, worries and questions. The final selection of contributors were able to deliver the following information in the film: emotion (fear, trepidation, embarrassment); myth busting (preparation and process), humor (the macho approach to colonoscopies) and enablers (guilt, responsibility, companions and understanding).

4.2 Filming in Minnesota

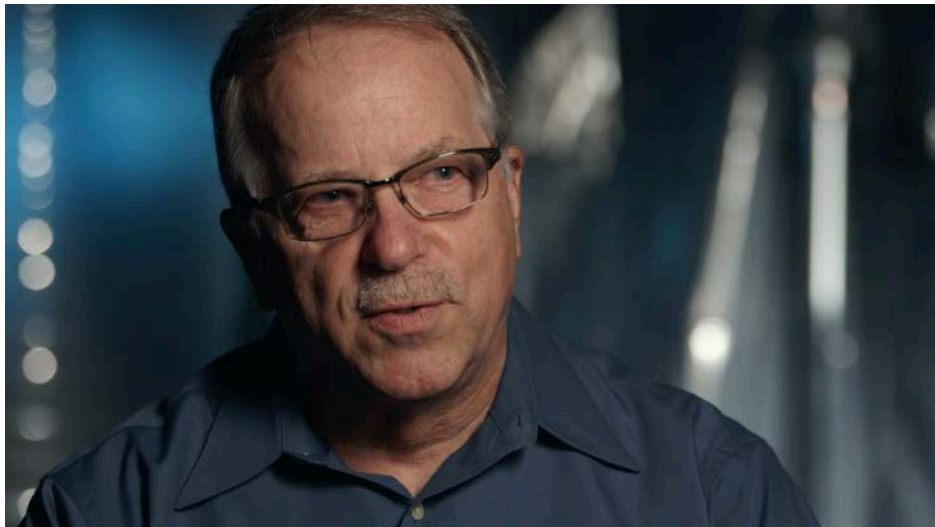


Figure 1: Intimate filming style with an abstract backdrop.

A tight and focused schedule was essential to this international collaboration, particularly as the contributors would be travelling long distances to attend the filming at the Mayo Clinic film studio. The visual design was established between the

cinematographer and the director. An intimate film style was agreed upon with interview eye line as close to the camera as possible with an anonymous backdrop (depth of field emphasized by intricate, unobtrusive lighting; Figure 1). Wide angle lenses and a camera ‘slider’ were utilized to ensure a smooth style and approach.

The technical specifications were finalized according to affordability and availability, and are summarized in **Table 1**.

TECHNICAL SPECIFICATIONS - VISUALS	
Camera	Sony C500 Digital Camera with Odyssey 7Q external recorder to convert footage to Apple ProRes
Format	Apple ProRes 422, 1080i, NTSC 29 fps
TECHNICAL SPECIFICATIONS - AUDIO	
Recording System	Double system recording: audio recorded in sync with the picture + on a separate recorder (Sound Devices 702) to be synced to the picture in postproduction.
Format	24-bit 48 kHz wav files
Microphones	Radio mics (Sennheiser ew 100 G2) and boom mic (Sennheiser ME 66)

Table 1. Technical specifications for film and audio

4.3 Creating the Film

The filming took place from 18 – 22 August 2015 in Rochester, Minnesota. An additional day’s preparation was essential for testing the equipment at the facilities house and setting up lighting and audio in the Mayo Clinic studio used for interviews. Ethical issues and consent forms were discussed and completed with the contributors prior to filming.

The intimate set up in studio was created by ‘blacking out’ the extra members of the crew (audio, producers) behind a cloth or out of eyesight, in order for the interviewee to retain an intimate conversation with the director who was seated with the cinematographer behind the camera. As the interviews were conducted, the partners would sit out of eyesight as well, but could hear the interview. Interviewees were either nervous or curious, but the trust in the relationship between the Mayo Clinic, Anglia Ruskin and themselves, was evident in their level of engagement with the interview and discussion topics.

Questions were asked to provoke a response that was more immediate than pre-planned from the contributors. The spontaneity of response, recollection, pauses, drift – were all essential to building a back-story, a framework that the audience could understand – and to retain that sense of authenticity from their interviews. During the interviews, male contributors provided a very honest male perspective on the procedure, with both humor and emotion. This type of intimate interview can trigger a cathartic reflection as they discuss the emotional journey they have been through with an objective observer. Other insights emerged from these interviews that were built into the evolving post-production script: putting off the process with excuses that there was not time to do it; how to nag a partner into screening and an understanding of the

physician’s motivation in addressing these issues.

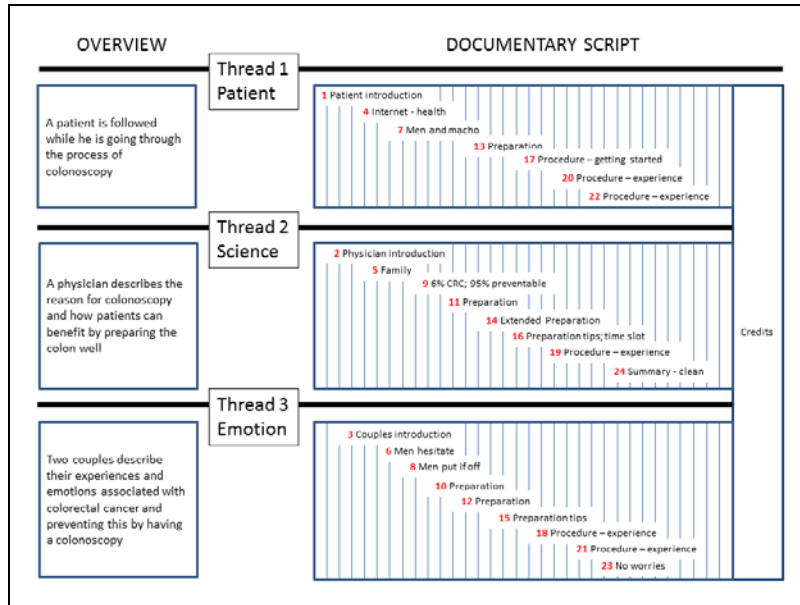


Figure 2: Final documentary script

At short notice, the Mayo Clinic team identified a patient who was happy to be filmed through the colonoscopy process. This “live” patient was extremely important, as *The Golden Window* had demonstrated that there is extreme power and emotional connection when talking to someone ‘in the moment’. The patient was nervous but also extremely articulate and gave detailed insight into his motivation for the screening (he had a wife and four children – he needed to be around for them). He was also approaching the process with humor and patience. An audio only interview was recorded. A radio microphone was then placed on him for the process, as well as on the staff in order for the crew to film observationally without intruding. The patient was confident enough to ask questions before, during and after screening; questions that the target audience would want to ask and have answered. His journey drove the narrative structure, similar to Berry’s recollection of his colonoscopy. The story took on a sense of dramatic anticipation; i.e., will he or won’t he be fine after the screening. The pre-production script was adapted and revised through the filming process by the director as and when the content was gathered (Figure 2).

By employing a dramatic narrative arc within the film (i.e. focusing on how the patient would deal with the process and what the outcome would be), the viewer actively engages the viewer with the film and information embedded within the emotional storytelling (Figures 3 and 4). The ‘will he or won’t he be ok’ strand asks the audience to question what they would do in the same scenario. This pro-active engagement through a sense of anticipation and self-reflection is an essential component of this smart audiovisual application.

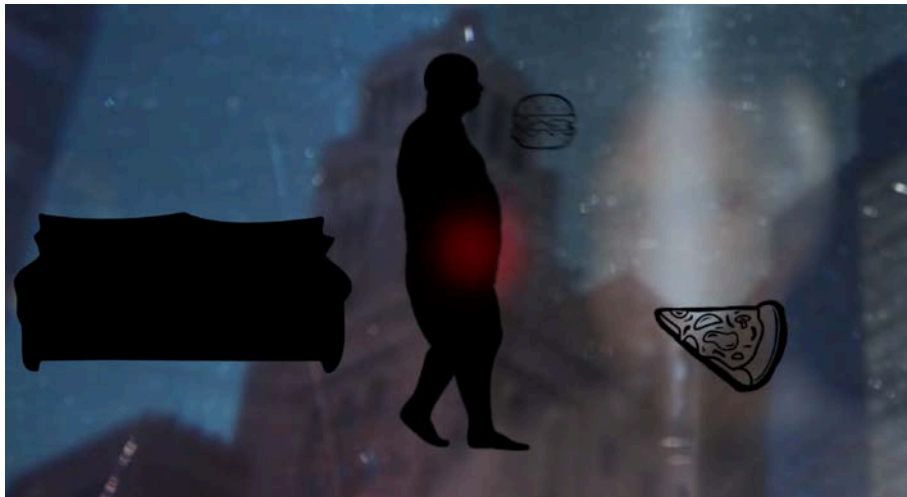


Figure 3: Graphics highlight the impact of sedentary lifestyle and poor diet on our health. Whooshes and warning sounds are used to draw attention to the different risk factors.



Figure 4: Educational graphics that combined with a humorous voiceover track and jazz music, introduce audiences to a patient's approach to colon preparation.

5. Discussion and conclusions

Recent scholarly research has established that 'empathy' is the product of both cognitive and emotional processes and that the line between the two is blurred. Decety and Jackson define empathy as "the naturally occurring subjective experience of similarity between the feelings expressed by self and others without losing sight of whose feelings belong to whom".[26] The construction of the film using smart digital technology based itself on creating this empathy between the viewer and the contributors within the film, focusing on universal themes and questions that the

audience could identify with, in order to maximize the impact of information. Audiences are invited to engage with the story and the characters, encouraging the process of self-identification and active engagement with the thought processes of the preparation for colon screening as well as the reflection on the consequences of their actions or ‘in-actions’. As such, the contributor selection, the use of humor, easily relatable graphics, quality visual and audio production, together with a designed soundscape of music and sound effects are combined to not just appeal to the ‘target audience’ but to set a stage and seed of thought which asks them to question their approach and rationale to health screenings and preparation. Indeed, the overall intent was to create a smarter learning environment that emotionally engages the patient to closely follow the evidence-based instructions in order to optimally cleanse the colon prior to colonoscopy.

The international and cross-disciplinary approach to production of this project is unique and constructive. Phase two of the project will provide qualitative data through which to analyze this approach. Previous research demonstrates that focused, high-profile audiovisual campaigns have led to surges in attendance of screenings; this project will hopefully yield long-term sustainable changes in patient behavior to such screenings.[27] We envisage that this project is the first step towards breaking existing barriers to international collaborations between the health and creative sectors. We also expect it to pave the way for the development and understanding of innovative methods utilizing smart technology and creative communication to empower and invigorate patients to take greater responsibility for their health. Lastly, we hope that our work will contribute to the ultimate goal of colonoscopy: to save lives.

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