Evaluating clinician perception, image features and association with predictive risk factors during AI-assisted polyp detection and characterization in bowel cancer screening colonoscopy

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Understanding the clinical problem

Colorectal Cancer (CRC) is the third most common cancer world-wide, and the second leading cause of cancer deaths in UK[1,2]. Colorectal cancer typically develops from the adenoma-carcinoma sequence[3], whereby cancer arises from pre-cancerous polyps such as adenomas[4]. The gold standard for the detection and removal of these precancerous polyps is colonoscopy[1,5]. The identification and removal of polyps during colonoscopy reduces the incidence of colorectal cancer[3,4].

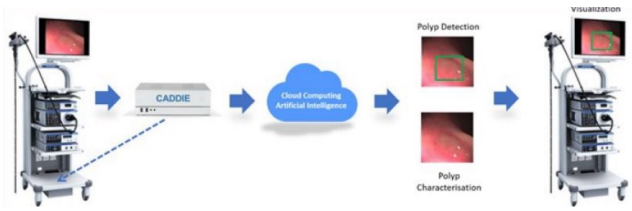
However, some polyps are not detected during colonoscopy, resulting in a risk of post-colonoscopy colorectal cancer (PCCRC)[5]. Among endoscopists the polyp miss rate is up to 27%[6]. The 3-year rate of PCCRC where there is a bowel cancer screening program (BCSP) is lower (3.6%) than the overall unadjusted rate of 6.5%[6]. Endoscopists participating in BCSPs typically have a high level of experience and are required to meet a higher standard of accreditation, and the adenoma detection rate during colonoscopy could be improved if all endoscopists could perform as well as the most experienced endoscopists[6].

The AI-Powered Solution

The Future of Real Time Endoscopy Artificial Intelligence (FORE AI) study aims to demonstrate the benefits of using AI in colonoscopy in a BCSP setting, through an existing multi-centre randomised controlled trial (CONSCOP2). FORE AI is a separately funded non-interventional sub-study collecting prospective video data for research purposes only and does not affect the care of the participants.

FORE AI investigates the use of artificial intelligence to analyse real time colonoscopy videos to improve the detection and diagnosis of polyps, using A Computer Assisted Detection and Diagnosis for Intelligent Endoscopy (CADDIE) system developed by Odin Medical. The CADDIE system works with existing hospital equipment and acts as 'second pair of eyes' during the colonoscopy procedure. CADDIE uses deep learning to analyse images from the procedure with the aim of supporting the endoscopist in both detecting and diagnosing cancerous/precancerous polyps. CADDIE has potential to improve the adenoma detection rate and reduce the number of missed polyps. Thus, CADDIE has the potential to reduce post colonoscopy colorectal cancer, improve patient quality of life, and save money for the NHS.

During the trial, the CADDIE system sent endoscopy images from FORE AI participants to a secure cloud computing system hosted by Odin Medical. The endoscopist annotated the video when a polyp was identified and removed. The CADDIE system detects and diagnoses polyps on the video and matches these against the video marked by endoscopists to define the proportion of human detected and undetected polyps. The results from the AI are then compared to the histopathology from the endoscopy to characterise the polyps. The aim is to generate sufficient evidence to enable CADDIE to be adopted and deployed in an NHS setting.



Project Progress and Challenges

The FORE AI trial was conducted in 10 different sites, gathering data from approximately 1000 patients. However, there have been several challenges throughout the course of the fellowship year. Attendance at regular progress meetings with the trial team and Odin Medical to try to expedite this analysis, establish timelines and identify possible solutions to some of these difficulties has been a major component of my fellowship year.

1) The trial design requires some human annotation of the endoscopy images from previously human undetected polyps for validation. There has been a delay in this data annotation which has had a significant impact on the progress of the trial. Further delays with pathology matching have also contributed to a delay in analysing the trial data to establish whether CADDIE is beneficial in a BCSP setting. Due to the lack of available data for the FORE-AI study, I have spent time with members of the CONSCOP2 study, assisting with data cleansing.
2) The CADDIE system was not trained in a dye-based chromoendoscopy environment. A number of procedures were completed using chromoendoscopy (rather than white light colonoscopy) meaning the adenoma detection rate (ADR) of the CADDIE system may be variable as the training of the AI algorithm may impact this group. Analysis of the ADR for white light procedures alone is being performed to establish the true ADR of the system. Preliminary analysis suggests that final trial data may help to identify in which colonoscopy setting AI is best utilised in the future, and that its biggest advantage may not be in a screening setting.
3) A number of videos for the procedures of FORE AI participants are currently unavailable, meaning some data that may need to be excluded from the final trial data analysis. This highlights the challenges of deploying a new technology, as some of the missing data is related to poor connectivity with the server during the procedure.

Looking ahead

Renewal of my honorary contract will allow continuation of my involvement with the FORE-AI trial throughout the completion of data analysis and publication of the trial results. The data analysis from the white light endoscopy will help to establish the utility of CADDIE for clinical practice. The additional data from the chromoendoscopy procedures may provide information regarding whether AI systems could be adopted to work with chromoendoscopy after exposure to additional training datasets.

The CADDIE system detected polyps that were not detected by the endoscopist during the procedure. These lesions do not have a ground truth comparison, as there is no histopathology data. Follow-up colonoscopies for trial participants may provide a clinically meaningful comparison.

The FORE AI trial involved only expert endoscopists, making it difficult to establish whether AI will be significantly better than endoscopists with limited experience.

During my fellowship year I have also designed and finalised a survey assessing the attitudes of healthcare professionals in Wales towards AI in clinical environments. The dissemination of this survey has been delayed due to lack of access to a platform that is GDPR compliant. I aim to distribute this survey and analyse the data in the upcoming months.

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