NICE National Institute for Health and Care Excellence

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Diagnostics Assessment Programme

PillCam COLON 2 for investigation of the colon through direct visualisation

Final scope

August 2024

1 Introduction

The topic selection oversight panel identified PillCam COLON 2 as suitable for evaluation by the Diagnostics Assessment Programme based on a topic briefing. The final scope was informed by discussions at the scoping workshop on 3 August 2023 and the assessment subgroup meeting on 17 August 2023. A glossary of terms is provided in appendix A.

2 Description of the technology

This section describes the properties of the diagnostic technology based on information provided to NICE by manufacturers and experts, and on information available in the public domain. NICE has not carried out an independent evaluation of this description.

2.1 Purpose of the medical technology

Colorectal polyps are small growths on the inner lining of the colon. Polyps are not usually cancerous. However, some may develop into adenomas (adenomatous polyps) which can be precancerous. People with adenomas have a higher risk of developing colorectal cancer if the adenomas are not removed. People with suspected colon cancer are referred for a colonoscopy to look for bowel cancer and polyps. Optical colonoscopy is an invasive procedure done at the hospital. If during a colonoscopy, abnormal tissues or polyps are identified, a biopsy can be taken, or polyps can be removed as part of the procedure (polypectomy).

NHS endoscopy services are under considerable strain and there are long waiting lists for colonoscopy. These capacity constraints have worsened since the Covid-19 pandemic. Clinicians have observed that many people on the suspected colorectal cancer referral pathway have no abnormal pathology found at colonoscopy. Colon capsule endoscopy (CCE) is a non-invasive method that involves a small capsule with 2 embedded cameras being swallowed, allowing the colon to be visualised. This could be used as an alternative to colonoscopy to help rule out polyps and colon cancer. CCE, may thus be used as a filter or triage test, so that therapeutic colonoscopy can be used for people who need a biopsy or polypectomy. This may help reduce endoscopy service waiting lists and aid early cancer detection by prioritising people who need further tests and treatment.

2.2 Product properties

2.2.1 PillCam COLON 2

PillCam COLON 2 (Medtronic) is a type of CCE technology which provides visualisation of the colon for detecting polyps and other abnormal bowel pathology. The system consists of 3 components: the capsule, recorder with sensors, and desktop software. The single use capsule contains 2 cameras, light emitting diodes to illuminate the area around the cameras, a battery, and antenna. The capsule is swallowed under clinical supervision following a bowel cleansing routine starting the day before. For both CCE and colonoscopy laxatives are provided. However, for CCE, in addition to the preparation, 'booster' laxatives are taken after the capsule has been swallowed to promote continued movement of the capsule through the colon until it comes out. The capsule captures images at either 4 or 35 frames per second over the course of 10 or more hours, depending on how fast it moves through the colon. The patient wears a sensor belt or sensor leads which are attached to a data recorder. Images are sent from the capsule to the data recorder using radiofrequency. After the capsule is excreted, the raw data is processed using PillCam desktop software and compiled into a video for review. Once the COLON 2 capsule study is downloaded, it can be uploaded to the Pillcam Cloud Reader software. This provides a secure platform to review the study remotely and can then be sent back to the original study or network location. The user can play, rewind and fast-forward the video whilst marking anatomical landmarks and thumbnails containing images of interest. After viewing the video and creating the findings, an

interpretation of the study can be summarised in a patient report. The video and report must be interpreted by skilled personnel.

PillCam COLON, which was launched in 2006, is the previous version of PillCam COLON 2 (launched in 2010). Adaptations were made following initial studies and incorporated into the PillCam COLON 2. Changes include:

- moving from a fixed frame rate where a fixed number of images were taken to an adaptive frame rate where the number of images taken depends on the speed of travel (varies from 4 to 35 images per second).
- increased field of view from 156º to 172º, providing a near 360º view
- updated D3 recorder to take images for 10-12 hours

The company states that the sensitivity in detecting polyps larger than 6mm and smaller than 10mm increased substantially between PillCam COLON and PillCam COLON 2.

Other PillCam capsules are available such as PillCam SB 3 capsule or PillCam Crohn's capsule. However, this assessment focuses on PillCam COLON 2 only as this is the only product to visualise the colon to detect polyps or colon cancer.

3 Target conditions

3.1 Colorectal polyps and colorectal cancer

Bowel polyps are very common, affecting about 15-20% of the UK population aged 50 or over.

Polyps can be described in terms of their shape, size and location. The shape of a polyp can be defined according to the Paris endoscopic classification:

- Type 0-Ip: protruded, pedunculated (on a stalk)
- Type 0-Is: protruded, sessile (flat against the surface, slightly raised)
- Type 0-IIa: superficial, elevated
- Type 0-IIb: flat
- Type 0-IIc: superficial shallow, depressed
- Type 0-III: excavated (depressed)

Based on the British Society of Gastroenterology (BSG) / Association of Coloproctology of Great Britain and Ireland (ACPGBI) and European Society of Gastrointestinal Endoscopy (ESGE) guidelines risk stratification is based on the size and number of polyps:

- High risk patients: 2 or more pre-malignant polyps including at least 1 advanced polyp (serrated polyp or an adenoma measuring at least 10mm in size or containing dysplasia [if a polyp looks like cancer under a microscope]), or 5 or more pre-malignant polyps (serrated or adenomatous) of any size
- Intermediate risk patients: 1 polyp measuring 6 to 9mm or 3 to 4 polyps of any size
- Low risk patients: less than 3 polyps all measuring less than 6mm that are not considered clinically significant.

Risk factors for colorectal polyps include older age, genetics and family history of bowel polyps or bowel cancer, dietary and lifestyle factors and conditions that affect the gut such as colitis or Crohn's disease.

Most bowel polyps do not cause any symptoms, so most people are unaware that they have them. However, some larger polyps can cause:

- Rectal bleeding
- Mucus in stool
- Diarrhoea or constipation
- Abdominal pain

Most are not cancerous but some types of polyps such as adenomas may develop into colorectal cancer if undiagnosed and untreated. Experts believe that most bowel cancers develop from adenoma polyps. Colorectal cancer is the fourth most common cancer in the UK with approximately 43,000 new cases and around 16,800 deaths per year (Cancer Research UK). Almost half of the people diagnosed with colorectal cancer in England and Wales survive at least 10 years after diagnosis. Early diagnosis is thought to improve survival.

Colorectal polyps are usually picked up during screening for bowel cancer or when the bowel is investigated for another reason.

3.2 Diagnostic and care pathway

3.2.1 Referral on suspected cancer pathway

A suspected cancer pathway referral means an urgent referral directly by the GP after a clinical assessment of symptoms. The referral would be for the most appropriate test (for example, colonoscopy or CT colonography), or an urgent appointment with a specialist.

Faecal immunochemical testing (FIT) is designed to detect small amounts of blood in a faecal sample by using antibodies specific to human haemoglobin. A positive FIT alone cannot confirm a diagnosis of colorectal cancer. It is the primary test used in the NHS bowel cancer screening programme for 2-yearly testing of asymptomatic people aged 60 to 74. FIT was recently recommended by NICE to guide referral in primary care for people with symptoms that may be indicative of colorectal cancer (DG56). It recommends using a FIT threshold of 10 micrograms per gram of faeces. NICE's guideline NG12 on suspected cancer: recognition and referral includes a description of the clinical signs and symptoms indicative of colorectal cancer where the FIT test is recommended to be used. This aligns with guidance on FIT from the Association of Coloproctology of Great Britain & Ireland (ACPGBI) and the BSG published in 2022 which recommended FIT be used for all people with clinical features of colorectal cancer to prioritise referral for urgent investigation. Many centres have already adopted this approach.

3.2.2 Post-polypectomy surveillance

Following findings on a previous colonoscopy people may be scheduled for a follow up surveillance colonoscopy or colorectal imaging. The BSG guidance on post-polypectomy and post colorectal cancer resection surveillance recommends that people who are at high risk for future colorectal cancer following polypectomy should undergo a one-off surveillance colonoscopy at 3 years. The high-risk criteria for future CRC following polypectomy include either:

- Two or more premalignant polyps including at least 1 advanced colorectal polyp which is defined as a serrated polyp (a slightly raised area or bulge) of at least 10mm in size or containing any grade of dysplasia (if a polyp

looks like cancer under a microscope), or an adenoma of at least 10mm in size or containing high-grade dysplasia, or

- 5 or more premalignant polyps.

3.2.3 Existing guidance on where CCE may be used

3.2.3.1 Screening population

The European society for medical oncology (ESMO) clinical practice guidelines for localised colon cancer (2020) states that capsule colonoscopy is not recommended for screening.

The European society of Gastrointestinal Endoscopy (ESGE) and European Society of Gastrointestinal and Abdominal Radiology (ESGAR) released updated guidance on imaging alternatives to colonoscopy in 2020 which also suggests that CCE should not be used as a first line screening test for colorectal cancer. However, they do suggest that use of CCE could be considered (where available) in the case of incomplete or unfeasible colonoscopy within organised population screening programmes.

3.2.3.2 Symptomatic population

The Colon capsule endoscopy: ESGE Guideline published in 2012 states that CCE is feasible and safe, and appears to be accurate when used in people with average risk of developing colorectal cancer.

In August 2020 the Scottish Health Technologies Group (SHTG) assessed the clinical and cost effectiveness of PillCam COLON 2 compared with optical colonoscopy or CT colonography for identifying colorectal polyps in adults with signs or symptoms of colorectal cancer or at increased risk of colorectal cancer. SHTG recommended that CCE should not replace optical colonoscopy but should be available as a diagnostic option in the current pathway for patients who present with lower gastrointestinal signs and symptoms suggestive of colorectal cancer and have an abnormal FIT test. The clinical effectiveness evidence and economic analysis indicated that CCE should be reserved for people at lower risk of colorectal cancer. Since then, new evidence has been published and an Innovative Medical Technology overview has been produced for consideration alongside the 2020 SHTG recommendations.

In November 2020 a clinical guide for triaging patients with lower gastrointestinal symptoms (2020) was released on how to prioritise and triage patients referred onto a 2 week wait pathway during the coronavirus pandemic which included the use of colon capsule endoscopy for prioritised endoscopy or colonic imaging for people with:

- NG12 specified symptoms, with a FIT 10-100 micrograms of haemoglobin per gram of faeces.
- Other NG12 specified symptoms with a FIT >100 micrograms of haemoglobin per gram of faeces who have had a colonoscopy requiring no further investigation in the previous 3 years.

The guide states that the use of colonic imaging depends on local capacity, clinical prioritisation, and patient factors. It also states that where colon capsule is used, robust data collection and follow up procedures must be in place.

The BSG (2022) conducted a review on colon capsule endoscopy and also suggested that CCE may be best suited for use in low-risk patients with a FIT of <10 micrograms of haemoglobin per gram of faeces, because a subsequent colonoscopy is less likely to be needed in this population.

3.2.3.3 Surveillance population

The company provided a clinical guide for using colon capsule endoscopy in post-polypectomy surveillance patients for the NHS England CCE pilot study which states that those awaiting surveillance are at low risk of cancer or have a small risk of significant premalignant polyps. These patients may be appropriate for and benefit from CCE because they are less likely to need a therapeutic colonoscopy.

The ESGE/ESGAR 2020 guideline update states that there is insufficient evidence to recommend CCE in post-polypectomy surveillance.

3.2.3.4 Following incomplete colonoscopy

The ESGE/ESGAR 2020 guideline update recommends that use of CCE can be considered where available preferably the same or next day following an incomplete colonoscopy.

3.2.3.5 When colonoscopy is contraindicated or not possible

The ESGE/ESGAR 2020 guideline update does not recommend CCE for people with alarm symptoms where colonoscopy is contraindicated or not possible because of a lack of evidence. However, it suggests that it may be considered in patients with non-alarm symptoms where available.

3.2.4 Existing guidance on CCE follow up

The Colon capsule endoscopy: ESGE 2012 Guideline recommends that patients found to have a polyp measuring 6mm or more at CCE, as well as those with 3 or more polyps (of any size), should be sent for post-CCE colonoscopy for polypectomy.

A clinical guide for using CCE in the lower gastrointestinal pathway was published following funding allocated by the National Cancer Team to pilot CCE clinics to support restoration of endoscopy services during the COVID-19 pandemic. This recommends, based on the European guideline, that patients should be referred for colonoscopy in line with the following:

- Patients found to have a polyp measuring 6mm or more and those with 3 or more polyps, irrespective of size, should be sent for post-CCE colonoscopy for polypectomy.
- If polyps found on the reading are deemed to be hyperplastic (non-cancerous), teams should use their clinical judgment to decide if a referral to colonoscopy is appropriate.

A clinical guide for using colon capsule endoscopy in post-polypectomy surveillance patients in the NHS England CCE pilot study recommends that patients should be referred to colonoscopy in accordance with the following:

- **Tier 1**: high-risk premalignant polyps identified (1 polyp measuring 10mm or more or 5 or more polyps of any size based on BSG/ACPGBI guidance): proceed directly to therapeutic colonoscopy,
- **Tier 2**: intermediate-risk polyps identified (1 polyp measuring 6 to 9mm or 3 to 4 polyps of any size on ESGE guidance): deferred therapeutic colonoscopy within 1 year,

- **Tier 3**: low-risk polyps identified (less than 3 polyps all measuring less than 6mm based on ESGE guidance): surveillance colonoscopy at 3 years,
- **Tier 4**: no polyps identified: discharge with safety netting in place.

Clinical experts noted that people with high-risk polyps identified using CCE would be referred onto the 2-week wait pathway for a therapeutic colonoscopy and that those with intermediate risk polyps would likely be referred on a routine pathway.

The ESGE/ESGAR 2020 guideline update suggests that follow up CTC may be clinically considered for polyps identified via CCE that measure between 6mm and 9mm if patients do not undergo polypectomy because of patient choice, comorbidity and/or low risk profile for advanced neoplasia.

3.2.5 Diagnosis of colorectal polyps and cancer

Colonoscopy is often used for diagnosing colorectal cancer in people without major comorbidities. It can visualise the entire colon and biopsies can be taken and examined histologically to confirm a diagnosis, unless this is contraindicated (for example, in people who have recently had a heart attack). Polyps can also be removed as they are identified. However, clinical experts advised that this is dependent on the skill level of the person performing the colonoscopy and that some colonoscopies will only be diagnostic rather than therapeutic. It is most frequently performed as an outpatient procedure. It requires adequate preparation of the colon using diet modification and laxatives. It is estimated that in around 5% to 20% of people referred for colonoscopy, the procedure cannot be completed. This can be due to people not following the bowel cleansing process correctly, unusual anatomy which may obstruct the colonoscope, or patient intolerance of the procedure. Most people undergoing the procedure are offered sedation, painkillers, or nitrous oxide gas. It is associated with very rare but serious complications, such as perforation of the bowel and heavy bleeding that may require a transfusion. Clinical experts noted that colonoscopy is not a perfect test and can miss important signs of disease.

Because of its invasive nature and the risk of dehydration during colon preparation, colonoscopy may not be suitable for elderly people and those with comorbidities such as kidney disease. For those people CT colonography, which is less invasive than conventional colonoscopy, is an alternative imaging investigation of choice. CTC is also an option for people with an incomplete optical colonoscopy. It involves

using a CT scanner to produce 2- and 3-dimensional images of the entire colon and rectum. People having a CTC need to consume a contrast-based material, require air insufflation and are exposed to potentially harmful ionising radiation. Both optical colonoscopy and CTC require patients to undergo a period of bowel cleansing, although it is less intensive for CTC. ACPGBI/BSG guidance recommends that CT colonography is equivalent to colonoscopy for detection of colorectal cancer, and the choice should be determined by local expertise and availability.

Clinical experts advised that, for some people, other diagnostic techniques such as flexible sigmoidoscopy may be appropriate to investigate lower gastrointestinal symptoms. Experts in secondary care said that, where available, FIT results are often used to inform the choice of further investigation based on capacity (see section 6.3).

3.2.6 Treatment of colorectal polyps and cancer

The most common finding during a colonoscopy is colorectal polyps, which can be removed using cauterisation or a snare. In rare cases, surgery may be needed to treat polyps by removing part of the bowel. This is only done if the polyp is very large, has cell changes, or there are a lot of polyps. Clinical experts advised that polyp removal cannot always be undertaken in the initial colonoscopy depending on the skill level of the person performing it and that sometimes a follow up therapeutic colonoscopy will need to be scheduled. After bowel polyps are removed, they are sent for testing in a laboratory. Some types of polyps (called adenomas) can become cancerous. If colorectal cancer is confirmed, NICE's guideline on colorectal cancer recommends further imaging tests, such as CT or MRI, to stage the cancer and determine what treatment is needed. Colonoscopy may also find other bowel diseases such as Crohn's disease, ulcerative colitis and diverticulosis, which may need further treatment and follow-up. People with no abnormalities detected during colonoscopy may be referred for further testing if a clinician thinks this is needed.

3.3 Patient issues and preferences

The Scottish Health Technologies Group (SHTG) assessed the clinical and cost effectiveness of PillCam COLON 2. During the evaluation, they received a patient organisation submission from Bowel Cancer UK outlining specific patient considerations regarding CCE and colonoscopy. New evidence has become

available since the SHTG recommendations (2020), and an Innovative Medical Technical Overview on CCE for the detection of colorectal polyps and cancer was published (SHTG, 2024). It reported patient views on user experiences and acceptability. The British Society of Gastroenterology conducted a review on colon capsule which also reported on patient experience.

NHS endoscopy services are under considerable strain and there are long waiting lists for colonoscopy. Waiting for medical tests can induce anxiety, especially if there is a potential risk of cancer. Having the option of accessing colon capsule endoscopy earlier than colonoscopy can potentially reduce some of the 'waiting anxiety'. However, clear communication to the person is needed around why colon capsule is offered, what is expected during the procedure and the potential benefits. Test results are not immediately available and further tests including a therapeutic colonoscopy or flexible sigmoidoscopy may be needed depending on the results. Some people may prefer to wait for a colonoscopy. Lay experts emphasised that options should be discussed between the patient and clinician as part of shared decision making. Clinical experts also noted that pre-assessment is important to check for suitability for colon capsule.

Before swallowing the colon capsule, bowel preparation is needed to clear out the bowel. This includes a low fibre diet for about 5 days before the test, no food consumption on the day of the test and taking laxatives at different time points to empty the bowel. Taking laxatives means that people need to be near a toilet, and the process can be very unpleasant. Up until this point, the bowel preparation process is the same for colonoscopy and CCE. However, after swallowing the capsule, further 'booster' laxatives are given to promote colonic motility and capsule excretion. Lay experts mentioned the need for having clear communication in explaining the bowel preparation process to the person undergoing the procedure. It is up to the clinicians to determine which bowel preparation regimen and diagnostic test is suitable, and experts emphasised that age, weight, comorbidities and level of frailty should be taken into account. Lay experts also noted that people with reduced dexterity or other disabilities such as visual impairment may need extra support to swallow the capsule and set up the sensor belt or leads.

CCE appears to be more comfortable, acceptable to and preferred by patients (SHTG, 2024). Compared with colonoscopy, it can be done at home, and is

associated with reduced procedure-related distress such as anxiety, discomfort and embarrassment (Parisi, 2024; Ismail, 2022). It also does not need sedation. During a colonoscopy some air is pumped into the colon which may cause bloating or a feeling of cramping in the abdomen. Some people find having a colonoscopy uncomfortable, but most people do not report that it is painful. People having colonoscopy may also be concerned about the adverse effects of the colonoscopy, such as heavy bleeding or perforation of the bowel. Some people may also be hesitant towards undergoing CT colonography because it involves ionising radiation. Clinical experts noted that this is particularly a concern among people aged 30 or younger.

4 Comparator

The comparators are colonoscopy and CT colonography.

5 Scope of the assessment

Table 1: Scope of the assessment

Decision question	Does the use of colon capsule endoscopy in adults with lower gastrointestinal signs or symptoms suggestive of colorectal cancer or those due to have post-polypectomy surveillance 3 years after their index colonoscopy represent a clinically and cost-effective use of NHS resources, taking into consideration potential colonoscopy capacity constraints?
Populations	1. Adults with lower gastrointestinal signs or symptoms suggestive of colorectal cancer who are referred to secondary care. Where evidence is available, subgroups for this population may include: ○ People with a FIT score between 10-100 micrograms of haemoglobin per gram of faeces ○ People with a negative FIT result of <10 micrograms of haemoglobin per gram of faeces with concerning clinical symptoms Clinical experts advised that the technology is not appropriate for use in people with rectal or anal mass or anal ulceration and that this group should be excluded from the scope.

	2. Adults who are due to have a post-polypectomy surveillance colonoscopy at 3-years because of high-risk findings at their index colonoscopy Where evidence is available, subgroups may include: • People who have declined optical colonoscopy • People who have had an incomplete optical colonoscopy despite adequate bowel preparation
Intervention	PillCam COLON 2
Comparators	• Colonoscopy • CT Colonography
Reference standard	The reference standard for examining the colon and assessing the accuracy of CCE is optical colonoscopy. Other reference standards will be considered where data using the preferred reference standard is unavailable.
Healthcare setting	Secondary care. The intervention may be delivered in primary care or the community

Outcomes: intermediate measures	Intermediate measures for consideration may include:
	• Diagnostic accuracy for detecting polyps (per patient and per lesion)
	  ○ Measuring less than 6mm
	  ○ Measuring between 6 and 9mm
	  ○ Measuring 10mm or more
	• Diagnostic accuracy for detecting:
	  ○ Colorectal cancer
	  ○ Other bowel pathology including IBD
	• Capsule completion rates (including excretion of the capsule within its battery life with complete visualisation of the colon)
	• Bowel cleansing level (adequate vs. inadequate)
	• Detection rates with CCE, colonoscopy or CTC for: polyps (including adenomas); cancer; other bowel pathology
	• Uptake
	• Reduction in number of colonoscopies/number of colonoscopies potentially prevented (diagnostic, therapeutic, urgent and non-urgent)
	• Proportion of people requiring follow up colonoscopy or other investigations such as flexible sigmoidoscopy after CCE/colonoscopy and CTC (diagnostic, therapeutic, urgent, non-urgent)
	• Number of polyps missed (including high-risk, intermediate risk and low risk polyps)
	• Numbers of cancers missed

Outcomes: clinical	Clinical outcomes for consideration may include: • Number of colorectal cancer diagnoses • Stage of detected cancers • Number/proportion of people identified with other bowel pathologies • Number/proportion of people with advanced adenomas detected or detected and treated • Morbidity including adverse events associated with CCE, colonoscopy and CT colonography • Mortality
Outcomes: patient-reported	Patient-reported outcomes for consideration may include: • Health related quality of life • Anxiety associated with waiting for procedures or test results because of diagnostic delays, and further diagnostic workup • Preference for CCE versus colonoscopy or CT colonography
Outcomes: costs	Costs will be considered from an NHS and Personal Social Services perspective. Costs for consideration may include: • Costs of device (including consumables, software, maintenance, service costs and patency capsule) • Cost of staff (including pre-assessments, supervision of swallowing, reading and reporting time) and associated training • Costs of follow up testing and care including colonoscopy • Costs associated with CCE and other investigations • Implementation costs • Costs of treating cancer • Medical costs of adverse events from the procedure or further diagnostic work up, including those associated with false test results and inappropriate investigations
Measuring cost-effectiveness	The cost-effectiveness of interventions should be expressed in terms of incremental cost per quality-adjusted life year.
Time horizon	The time horizon for estimating clinical and cost effectiveness should be sufficiently long to reflect any differences in costs or outcomes between the technologies being compared.

6 Other issues for consideration

6.1 Existing models

The SHTG conducted a cost comparison analysis which compared the current colon diagnostic pathway with a new pathway that includes CCE. The analysis was updated using ScotCap data from 2023, including new prices (SHTG, 2024). A full

economic evaluation of the impact of CCE was not carried out and equal diagnostic accuracy between CCE and optical colonoscopy was assumed. The population consisted of two groups, symptomatic and surveillance patients. The models were built around the assumption that a proportion of people receiving CCE receive a negative result and do not need further testing including colonoscopy, while a proportion undergoing CCE would subsequently be referred for additional examination because of incomplete CCE or positive findings.

6.2 Ongoing NHS England pilot study

In March 2021, NHS England announced that some people with symptoms of bowel cancer may have colon capsule endoscopy instead of having a colonoscopy straight away. NHS England is conducting a pilot study which aims to evaluate the diagnostic accuracy of CCE in the following populations 1) adults referred with suspected colorectal cancer through the 'two week wait' pathway who have a FIT result between 10-100 micrograms of haemoglobin per gram of faeces, or adults with a negative FIT result (<10 micrograms of haemoglobin per gram of faeces) who have been referred onto the urgent cancer pathway because of concerning symptoms, 2) adults who are due to have a post-polypectomy bowel surveillance colonoscopy 3 years after the index colonoscopy. The pilot study aimed to include 11,000 people and recruitment to the study closed at the end of March 2024., Results are expected in the summer or autumn in 2024.

6.3 Colonoscopy and CT colonography capacity for urgent referrals and surveillance

There are currently long waiting lists for colonoscopy. A letter published by NHS England states that, since the pandemic, waits on the lower gastrointestinal pathway have lengthened more than for any other tumour group. In June 2023, 15% of people seen by a specialist for suspected lower gastrointestinal cancer were not seen within 2 weeks of urgent referral, and 43% did not have a diagnosis within 28 days (NHS cancer waiting times, June 2023)

During scoping of the diagnostics assessment on quantitative FIT, stakeholders highlighted that colonoscopy capacity is limited and therefore the Diagnostics Advisory Committee will need to consider real-world constraints during the decision-making process.

There are ongoing pressures on endoscopy services with backlogs in the symptomatic population. It has been estimated that 15% of the colonoscopies performed in the UK each year are for polyp surveillance (Rutter et al. 2019). It has been suggested that CCE can potentially play a big role in reducing the backlogs, specifically for the surveillance population. People at low risk of colorectal cancer on the waiting list for a surveillance colonoscopy can be diverted to CCE. The NHS England CCE pilot has been extended to people who are due or overdue for a post-polypectomy surveillance colonoscopy in the symptomatic endoscopy service. This is to support prioritisation of colonoscopy capacity for those at the highest risk of colorectal cancer.

Clinical experts have advised that depending on how it is implemented CCE could potentially release capacity to endoscopy services. Clinical experts noted that the main potential benefit of CCE could be colonoscopy reduction but that patient selection is likely to be important. In current practice, there are lists for diagnostic and therapeutic colonoscopies. Bowel pathology is a key indicator in determining which list people need to be on. Without knowing the bowel pathology, people may end up on the diagnostic list and if abnormal bowel pathology is found they need to be referred for a therapeutic colonoscopy. This is because not everyone who does colonoscopies is trained to remove polyps and polyp size also plays a factor. CCE could potentially be used to identify polyps and ensure that people end up on the right list, depending on what is found. Experts also noted that the increase in endoscopy capacity could potentially be used to lower the NHS bowel cancer screening programme threshold.

Experts noted that CCE could potentially allow for more efficient use of staff by having nurse endoscopists reading the capsules. In some trusts nurse endoscopists do the reading, reporting and sign off, while other trusts have implemented double reading strategies where a nurse endoscopist does the initial reading and reporting and this can be signed off by a consultant. Reading of CCE recordings could also be outsourced or done in centralised reading hubs. This can be done by using the Pillcam Cloud Reader software, which is a secure platform where COLON 2 capsule studies can be uploaded and reviewed remotely.

The assessment should consider the constraints of current colonoscopy capacity and the impact of this on outcomes specified in the scope, including waiting times

for colonoscopy services. It should also consider the potential impact of CCE on capacity for endoscopy services.

6.4 CCE in primary care and community settings

CCE can be done in primary care and community settings under the supervision of secondary care. The benefits of doing CCE in these settings include that people do not need to travel during intensive bowel preparation and it can reach people who live remotely increasing accessibility and inclusivity. Clinical experts advised that CCE could potentially be used in the following 3 settings: 1) in primary care (e.g., GP surgery) or community diagnostic centres, 2) at home under guidance of community nurse or health visitor, and 3) at home where the colon capsule, medications for bowel preparation, and guidance are posted to the person to conduct the test alone. After completing the test at home the belt and recorder are returned to secondary care the next day. The company noted that in some cases the equipment (data recorder and sensor belt or sensor leads) can be returned using a courier service. However, clinical experts noted the risk of aspiration of the capsule and said that even though it is possible to do CCE in these settings, currently CCE is mostly done in secondary care. They emphasised that swallowing should be supervised by clinical staff regardless of the setting. A recent study (Parisi, 2024) trialled using a video call to supervise the swallowing of the capsule.

6.5 Safety netting and other conditions with gastrointestinal symptoms

The proposed approach of using CCE to detect colon polyps could result in people with a negative CCE or benign disease, being discharged from secondary care and not being referred for further investigation with colonoscopy or CT colonography. However, these investigations can also be used to diagnose other conditions such as Crohn's disease, ulcerative colitis and diverticulosis, which may need further treatment and follow up. If CCE is not as good as colonoscopy in picking up these conditions, then use of CCE may introduce a delay to diagnosis for people with these conditions.

Safety netting refers to processes used to avoid missing disease (cancer or otherwise) in people with negative test results.

The clinical guide for using CCE in the lower gastrointestinal pathway states that following a negative CCE or a benign disease identification most people will return to primary care. This decision needs to be clearly communicated to the patient and GP. Patients need a formal review at 6 weeks to ensure that their symptoms have resolved or are adequately treated. If they are still symptomatic after 6 weeks, then they need to be re-referred to secondary care.

6.6 Bowel preparation

The ESGE guideline on colon capsule endoscopy states that the quality of the bowel preparation is associated with the accuracy of the CCE procedure. Bowel preparation is extremely important to ensure a CCE test is successful as it will affect the ability of the capsule to visualise the whole colon. Faeces, cloudy fluids, or bubbles may hinder mucosal visualisation by CCE. The capsule is unable to blow air into the colon, remove fluids, wash the mucosal surface, or move actively through the colon. Therefore, the cleansing protocol for CCE aims to 1) adequately cleanse the colonic mucosa, 2) fill the colon with clear fluids to improve visualisation and decrease the number of air bubbles, and 3) facilitate the movement of the capsule through the colon before the battery runs out. Bowel preparation may impact on the accuracy of CCE and therefore may need to be considered as part of this assessment.

6.7 Use of patency capsule

A patency capsule may need to be used in cases where there is risk of retaining the capsule within the small bowel. The risk of this occurring is very low in the general population, but higher in people with Crohn's disease. If a CCE capsule is retained the person may require endoscopic retrieval or a surgical intervention, depending on the location of retention.

Clinical experts advised that patients should be assessed for risk of retention as part of a pre-assessment for suitability for CCE. If there is suspicion of blockage or narrowing in the small bowel, a patency 'dummy' capsule can be given before CCE. The capsule is the same size as CCE and is designed to dissolve after 30 hours.

6.8 Reading times and reporting for CCE

Clinical experts said that reading times and reporting of CCE results can take between 45 to 60 minutes, depending on the speed they are viewed at, and how long it took for the capsule to be excreted. A review done by the BSG on colon capsule endoscopy reported that the imaging from each of the 2 cameras is viewed separately. If viewed at 12 frames per second, it would take about 50 to 60 minutes. It can be viewed at a quicker speed, but this may risk missing small polyps. It also states that the use of artificial intelligence (AI) is likely to change this practice. Clinical experts said that there is no AI for reading the capsules to date but are aware that colonic algorithms are in development and studies are ongoing.

6.9 Environmental sustainability in endoscopy

The BSG, Joint Accreditation Group (JAG) and Centre for Sustainable Health (CSH) (2022) published a joint consensus on practical measures for environmental sustainability in endoscopy. It states that gastrointestinal endoscopy is highly resource intensive and contributes significantly to greenhouse gas emissions and waste generation. It recommends that sustainable conventional diagnostic endoscopy, such as CT colonography and CCE for bowel cancer screening, should be considered in all patients where it is clinically indicated. Clinical experts also advised that CCE can potentially have a positive environmental impact by reducing patient travel if CCE is done in a community setting as well as the carbon footprint that is associated with traditional colonoscopy (including the chlorine used to clean scopes and the use of plastic). The clinical experts noted that these benefits are not always considered but the NHS England pilot study may be collecting some data related to environmental sustainability and thus may need to be considered in the evaluation.

6.10 NIHR funding call

The National Institute for Health and Care Research (NIHR) has put out a funding call '22/168 The diagnostic accuracy of colon capsule endoscopy commissioning brief'. Stage 2 applications will be discussed at the funding committee in September 2023. It will address the following research question: what is the diagnostic accuracy of colon capsule endoscopy compared to standard colonoscopy? The research call encourages applicants to consider multiple patient groups requiring colonoscopy

because small studies indicate that CCE may be of use in a wider population. Asymptomatic people referred via the colon cancer screening programme are excluded from the proposed study. The study is proposed to inform future practice, guidelines, and patient choice.

7 Potential equality issues

NICE is committed to promoting equality of opportunity, eliminating unlawful discrimination and fostering good relations between people with particular protected characteristics and others.

PillCam COLON 2 should not be used for people with known or suspected gastrointestinal obstruction, strictures or fistulas. It should also not be used for people with swallowing disorders, and it is contraindicated for people with cardiac pacemakers or other implanted electromedical devices. However, clinical experts noted that there are studies that show that the capsule does not interfere with the pacemaker, and it is safe for use. In addition, it may not be suitable for people who are pregnant, people with Crohn's disease, people with long term daily use of non-steroidal anti-inflammatory drugs, people with small bowel resection, people with abdominopelvic irradiation or people who are frail.

Colorectal polyps are more likely in older people, people with conditions that affect the gut such as colitis or Crohn's disease, people with a family history of colorectal polyps or colon cancer, people from Black African or Caribbean family backgrounds, Jewish people of central and eastern European family origin, people who are overweight or people who smoke. Colorectal polyps may be slightly more prevalent in men. People with cancer are protected under the Equality Act 2010 from the point of diagnosis. Age, sex, race, pregnancy and maternity, and disability are protected characteristics under the Equality Act (2010).

People with a learning disability have a lower completion rate for CCE and also have a higher rate of death from colon cancer compared with the general population. People who are less mobile, for example due to physical disability or frailty, have lower completion rates for CCE than those who are more mobile. Completion rates may also be higher in men.

Colorectal cancer disproportionately affects people from low socioeconomic backgrounds. They may have difficulties accessing health services because they may not or cannot go to hospital. Having the option of doing CCE in a primary or community care setting, with supervision from a healthcare professional, may allow for greater accessibility and inclusivity for people from lower socioeconomic backgrounds.

People who do not speak or understand English or people from ethnic minority family backgrounds may be harder to reach and have lower uptakes of diagnostic screening tests for bowel cancer. Lay experts mentioned that sometimes it falls on family members to come to appointments and translate, which may not always be possible.

Invasive procedures, such as colonoscopy, may be less acceptable in some cultures. Furthermore, it may be unsuitable for people who are on anti-coagulants that should not be stopped for a diagnostic procedure.

8 Potential implementation issues

Potential barriers and enablers to implementation include:

Care pathway

- Clinical experts noted that most of the diagnostic pathways are overseen by surgical departments, including the 2 week-wait referral pathway. They emphasised that education and training of CCE is key and would also be needed to create awareness of this diagnostic option. Colonoscopy is the gold standard and may still preferred by clinicians.
- The endoscopy services currently sit within secondary care. CCE can be done in primary care and community settings (see section 6.4). However, clinical experts raised some concern about CCE being done in primary care or the community, specifically with regards to the reading and reporting of CCE. If CCE is delivered in a community setting with capsules being sent to people's homes, experts advised this needs to be done under the control of secondary care. There are established processes for colonoscopy and CT colonography and having it all within secondary care helps with tracking people and triaging them appropriately. If people need

a therapeutic colonoscopy following CCE this can be arranged within the same centre.

Colonoscopy capacity and waiting times

- There are large variations in wait times among NHS Trusts. Implementation of CCE has the potential to reduce the number of colonoscopies needed, allowing those most in need to be seen more quickly.
- Clinical experts advised that using nurse endoscopists instead of consultants for reading capsules and triaging patients can potentially help with the uptake of CCE and increase endoscopy capacity. However, it should be noted that resources are required to train nurses in reading CCE recordings and that time is needed to download the video, read and report the findings.

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Appendix A Glossary of terms

Adenoma

A tumour or growth that is not cancerous (benign).

Advanced adenomatous polyp (synonymous with advanced adenoma)

An adenoma of at least 10mm in size or containing high-grade dysplasia.

Advanced colorectal polyp

Includes both advanced serrated polyps and advanced adenomatous polyps.

Advanced serrated polyp

A serrated polyp of at least 10mm in size or containing any grade of dysplasia.

Colonoscopy

An investigation that allows doctors to examine the lining of the colon (large intestine) using a flexible tube that contains a camera and light source (colonoscope).

Colon capsule endoscopy (CCE)

An investigation in which a person swallows a small capsule containing cameras. This takes pictures of the lining of the colon and communicates them wirelessly to a nearby receiver.

Computed tomography colonography (CTC)

A test that uses CT scans to check the colon and rectum.

Faecal immunochemical test (FIT)

A test which detects faecal occult blood using antibodies against human haemoglobin.

Flexible sigmoidoscopy

An investigation that allows doctors to examine the lining of the lower section of the colon (sigmoid) using a flexible tube that contains a camera and light source (sigmoidoscope).

Polyp

A small growth on the inner lining of the colon or rectum.

Polypectomy

Removal of polyps

Premalignant polyp

The term includes both serrated polyps (excluding small (1–5mm) rectal hyperplastic polyps) and adenomatous polyps. It does not include other polyps such as post-inflammatory polyps.

Serrated polyp

The umbrella term used to describe hyperplastic polyps, sessile serrated lesions, SSLs with dysplasia, traditional serrated adenomas, and mixed polyps.