CT Colonography Standards

An International collaboration:
Europe
Canada
Australia
New Zealand
CT Colonography Standards

UK STANDARDS COMMITTEE AND STEERING GROUP MEMBERS

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<th>Standards Committee</th>
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<td>Consultant Radiologist</td>
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<th>Standards Steering Group</th>
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<td>National Clinical Lead for Diagnostic Imaging, DH</td>
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<td>Principal Investigator for SIGGAR 1 Trial</td>
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<td>Chairman of BSGAR &amp; Consultant Radiologist</td>
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<td>Patient representative, Royal College Radiology</td>
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CONSULTATION GROUPS

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<td>Independent sector via Independent Healthcare Advisory Services</td>
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<td>British Society Gastroenterology</td>
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<td>Association of Coloproctology Great Britain &amp; Ireland</td>
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<tr>
<td>Abdominal Radiology Group Australia and New Zealand (ARGANZ)</td>
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<td>Dr Helen Moore, Dr Adrian Balasingam, Prof. Richard Mendelson</td>
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<td>Asst. Professor E. Neri, Prof. Andrea Laghi on behalf of European Society of Gastrointestinal and Abdominal Radiology (ESGAR) CTC committee</td>
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EXECUTIVE SUMMARY

CT colonography (CTC, Virtual colonoscopy) has been approved by several national groups for reimbursement for both diagnostic and screening applications in colorectal cancer and is widely available across the world in both public and independent clinical environments. However, performance is variable. In one UK study, accuracy of subspecialist radiologists offering a CTC service in routine clinical practice, ranged from 53 to 93% for detection of large colonic pathology, mirroring results from other major European and US studies. The causes of variable performance are multi-factorial, occurring at different stages along the diagnostic pathway. **Highest quality CTC is provided by centres that focus their effort towards patient experience and outcomes combined with optimal technique.**

Knowledge and understanding of CTC prior to examination is a patient’s right and should enhance both compliance with bowel preparation regimens and co-operation with the subsequent examination. Patients must consent to undergo CTC and should be provided with appropriate, high quality information. The choice of whether to undergo CTC will require detail about what the examination involves, its potential benefits and risks. This document recommends what and how information should be provided to patients, with an example patient information booklet.

CTC technique, including colonic preparation, distension and use of intravenous contrast, fundamentally influences subsequent interpretation accuracy. There is an extensive peer-reviewed literature providing evidence-based strategies for optimising technique. CTC examinations generally utilise multi-detector row CT platforms but protocols vary, potentially resulting in excessive radiation dose delivered to patients or inappropriate use of intravenous contrast. In addition, suboptimal workflow patterns can be inefficient and result in longer examination times with detrimental effects on patient experience. Standards for scan protocols and technique are provided in this document.

An excellent patient safety profile is a critical determinant of CTC success but there are documented risks of colonic perforation and other complications. Survey data suggests complications are associated with potentially avoidable causes for example colonic perforation related to poor catheter insertion technique and manual insufflation of gas. Whilst perforations are rare (approximately 1 in 3000 diagnostic CTC examinations) we recommend that practitioners are aware of the range of complications and ways to avoid them.

In the past, methods of data interpretation have been the subject of considerable debate but experts now agree CTC software must provide
both 2D and 3D displays enabling complimentary views for troubleshooting polyp or cancer candidates requiring additional interrogation. In addition, new developments such as computer aided detection (CAD) systems are available and may be of value but there is limited information regarding its implementation in routine clinical practice.

Key factors determining the outcome of the CTC examination pathway will be addressed in this document, which aims to provide standards of best practice for public and independent imaging providers offering (or planning to provide) CTC to patients.

**Methods**

This Standards document was jointly authored by an experienced committee comprising four consultant radiologists and four senior radiographers with combined expertise; delivering high quality VC in the NHS, supervising and conducting VC research (>100 peer-reviewed articles), organising and delivering VC training and developing standards for VC.

The following evidence was appraised and discussed at a one day meeting at the Royal College of Radiologists held in July 2008 followed by regular email communication and wider consultation with colleagues offering VC in a variety of clinical environments across the UK and elsewhere in Europe, Australia, New Zealand, Japan, Korea and Canada.

- Currently published literature available on Medline
- Articles in press including preliminary results from SIGGAR 1
- Expert consensus including ESGAR (European Society of Gastrointestinal and Abdominal Radiology) consensus statement
- Expert opinion (standards committee and steering group)
- Standards from Radiology Accreditation Programme
- Standards for Endoscopy - symptomatic patients and Bowel Cancer Screening Program

A draft version of these recommendations was subsequently sent for consultation between January and June 2009 for review by the UK and international groups listed above. This considerable volume of feedback has been incorporated where appropriate to produce this internationally applicable document, supported by all the groups listed.

*The format for these standards includes a concise rationale followed by ‘Minimum standards’ and ‘Standards for best practice’ with up to five key references for further reading. Standards are*
split into those for the service (in black) and those for the individual (in red). Additional notes are in blue.
A. PATIENT INFORMATION & CONSENT

Rationale

Consent must be sought from all patients undergoing examinations and patient choice will require an explanation of what the examination will involve, its benefits and risks (including side-effects and complications) and the alternatives to the particular procedure proposed. The quality of information provided to patients will influence their experience which is an auditable outcome and key marker of service quality.

In the introduction from the UK’s ‘NHS Toolkit for producing patient information’, published by the UK Department of Health in 2003, it is the ‘health professional carrying out the procedure (who) is ultimately responsible for ensuring that the patient is genuinely consenting to what is being done’ (1-3). Therefore if radiographic technologists perform CTC examinations, they will be responsible for providing information and obtaining patient consent (1-4).

The provision of information is central to the process of consent. Consent should be regarded as a ‘process over time’ and not a once only, binding decision. Hence, delivery of information should begin at the point of referral and continue through to the point of carrying out the examination. Practitioners must always remember that a person undergoing CTC may withdraw consent at any time, including during the procedure itself.

Consent may be implied, or expressed (either expressed oral or expressed written consent). The need for rectal catheterisation, intravenous injection/catheterisation and published complications indicate CTC is an invasive examination that warrants expressed patient consent.

The following information should be conveyed to patients prior to undergoing bowel preparation and ideally with time to fully appraise examination options

- Brief explanation of what the test is, and what it is for
- What alternative tests are available
- Bowel preparation and diet instructions and why necessary including risks of electrolyte imbalance
- Examples of foods or liquids that can and cannot be eaten and when prior to examination (relevant to different age and ethnic groups)
o Patients to advise CTC team prior to exam if any relevant medical conditions/allergies, with examples.
o Where patient should arrive and at what time
o Who to meet and what to expect upon arrival
o How long the examination will take
o Need for intravenous cannulation where appropriate
o Description of rectal catheter insertion and insufflation including anticipated type and level of discomfort that may be experienced
o Techniques for avoiding adverse effects for example maintaining adequate hydration or use of petroleum jelly at anal verge to avoid soreness
o Patient positioning on scanner table and option for lateral decubitus
o Risks of perforation, radiation, pain, vasovagal reactions, allergy to contrast (where appropriate)
o Possible need for additional imaging for example, additional CT staging examinations or endoscopy/biopsy where a cancer is found.

Appendix 1 provides appropriate example text for written information
Standards

**Minimum**

- **National guidance for development of patient information is adopted**
  - For example, in the UK, the ‘NHS brand guidelines website’ is a helpful resource for developing information based on several guiding principles relating to communication with different patient groups. It also provides templates for written information in booklet or poster format.

- Prior to distribution of information to patients, the centre’s local patient information group should be consulted about its’ quality and appropriateness for the local population.

- Written information should be provided in clear, easily understandable language (appropriate for a reading age of 12 years) and where necessary depending on local population, available in translation for those 'minority' languages encountered most frequently.

- It is advisable that a record of consent was obtained which should include the name and designation of the individual to whom the consent was given.

- A telephone number and email address providing access to an experienced member of the team should be available to deal with additional questions prior to the day of examination.
**Best practice**

- Audiovisual formats should be considered particularly for those patients who have difficulty with reading – for example see video from the Canadian Association of Radiologists [http://www.carj.ca/video/#](http://www.carj.ca/video/#)

- Further resources should be made available to ‘expert’ patients including web based information and peer reviewed articles. However, patients should be made aware that web resources may provide incomplete or conflicting information, but in qualified centres (e.g. Universities or Hospitals) web resources are available to simplify the patient’s understanding of the technique (5)

- Patient information sheets are reviewed annually and amended as necessary

- Patients frequently asked questions are incorporated into the published patient information

- Centres should consider obtaining formal written consent to help ensure that sufficient information has been provided to patients, to provide evidence that patients understand the information and give patients a further opportunity to discuss questions with experienced staff members

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**Key references**

B. BOWEL PREPARATION

Rationale

There are several options available when preparing the patient bowel for CTC. Purgatives (such as picosulphate or phosphasoda) which result in minimal or no fluid residue are frequently preferred over “wet” laxatives (such as PEG, polyethylene glycol) to achieve full bowel preparation (1). However, a balance must be struck between the perfectly clean dry colon (with no obscuration of colonic mucosa by retained colonic contents) and the inconvenience and possible risks to patients of excessive laxation, for example dehydration and electrolyte disturbance.

Laxative burden may be decreased or completely eliminated to improve patient tolerance and decrease risks. Oral administration of positive contrast over the day(s) prior to CTC, or in some centres, on the same day, results in “tagging” of residual colonic contents (2-5). Tagged residue of higher attenuation facilitates its differentiation from ‘soft tissue’ density neoplasia. Use of faecal tagging potentially reduces the proportion of CTC examinations deemed technically inadequate due to retained faecal residue.

Faecal tagging can be either combined with full or reduced laxatives (essentially mandatory where purgation is reduced) or without purgation. The optimal tagging protocol is currently unknown, but the most successful trials to date have all used faecal tagging, suggesting it holds an advantage.

Iodinated compounds such as gastrografin have an osmotic laxative effect resulting in a ‘wetter’ colon, frequently containing small or moderate volumes of tagged fluid. Gastrografin may cause mild abdominal discomfort in some patients but this can be limited by reducing dose. Barium is usually well tolerated by patients but results in a small or moderate volume of tagged solid residue (which may sediment out in the presence of residual fluid). Notably, there is likely an increased risk of complications when barium is used if perforation occurs. Oral iodinated contrast is often less palatable than barium but this can be improved by diluting with an equal volume of water and mixing with fruit cordial. In addition, iodinated contrast and to a lesser extent, barium additives, have a very small but documented risk of allergy.

Some experts recommend combining barium and iodinated contrast to tag both solid and liquid residue respectively, (3) although gastrografin alone will label both in most patient. Inevitably, the routine use of tagging adds a little to the cost and complexity of VC, and requires additional interpretative skill.
Where experience permits, different options for bowel preparation should be available to achieve as low a dose of laxative as possible according to the vulnerability of the patient group examined and target lesion. For example a reduced laxative regimen may be appropriate for a frail patient in whom the target lesion is cancer (2). Alternatively, full laxation combined with faecal tagging might be appropriate in a fit, high risk patient where detection of subtle advanced polyps assume greater clinical significance.

Reduced laxative regimens combined with faecal tagging or single agent tagging regimens may also work well in practice, particularly for frail patients, but remain under investigation. Implementation should therefore be fully guided by the developing evidence base and by experienced centres.
Standards

**Minimum**
- Full laxation (using “dry” purgatives”) without faecal tagging is current standard practice in many centres, particularly outside Europe
- However, increasingly, faecal tagging (barium or iodine based compound or a combination of both) is favoured by many experts across the world
- Consideration should be made to potential allergy when prescribing iodinated oral contrast for outpatient use
- *Example bowel preparation and diet sheets are provided in Appendix 3*

**Best practice**
- Use of faecal tagging (barium, iodinated contrast e.g. gastrografin or a mixture) may be the preferred choice, but requires
  - additional interpretative experience of validated tagged examinations
  - additional resource by adding to cost and complexity of patient preparation

Key references

C. SCANNER PARAMETERS & PROTOCOLS

Rationale

There is a considerable body of evidence (phantom, clinical studies and meta-analyses) which has aimed to define the optimal scan parameters for CTC over the last decade but at the same time, scanner technology has rapidly evolved (from single to 256 slice). In addition, scan protocols and radiation dose varies considerably between manufacturers and installation sites. The majority of research has been undertaken by centres utilising single slice, or 4 slice CT platforms whereas many centres now use 16, 32 and 64 slice scanners. Nevertheless three meta-analyses (1-3) have contributed useful data to help inform the standards for CTC detailed below.

Multi-detector row CT (MDCT) scanning is faster than single row scanners and therefore patients do not have to hold their breath for as long (reduced respiratory artefact) and the scan can be better timed in relation to maximal distension (also limiting associated patient discomfort). In addition, the latest CT platforms (generally 64 slice+) employ dose modulation software which varies the tube current depending on body region and projection angle, resulting in significant dose savings in most patients (however, caution should be taken with obese patients, as it may inadvertently increase dose).

Dual patient positioning is mandatory for standard CTC but the scan parameters can be varied between the two scan acquisitions to achieve a compromise between minimising dose and permitting adequate visualisation of colonic and extra-colonic pathology (4).

kVp is generally fixed at 120kV in most centres and the mA is varied according to scan protocol, whereby there is a linear relationship between mA and effective patient dose. The inherently high contrast between luminal gas and colonic wall permits use of ultra-low dose protocols (mA as low as 10mA) with adequate visualisation of clinically significant polyps (measuring 6mm or larger) (5). However, at this ultra-low level contrast between soft tissues is poor and there is excessive scan noise which limits extra-colonic organ review. This can be a particular issue in the obese patient. Differing protocols should be utilised according to scan indication and between the two scan acquisitions, for example asymptomatic (screening) CTC should be targeted towards the colon only, comprising prone and supine scans without intravenous contrast and using low mA for both scans (10-80mA). In symptomatic patients, the mA may be increased to improve
visualisation of extra-colonic organs. Recently (unpublished) audit data from New Zealand has shown a dose benefit (mean of 3.6mSv) by reducing kVp to 100 in patients less than 75Kg (mA 85-100). For staging of colonic cancer (including intravenously administered contrast) then CT scan parameters are generally adjusted to standard abdomino-pelvic CT levels.

The patient should be imaged in the cranio-caudal direction, which reduces respiratory artifact should the patient begin to breathe at the end of the scan.

Slice thickness is much less of a concern as recent MDCT scanners utilise narrow collimation (2mm or less for standard abdomino-pelvic CT). A maximum slice thickness of 3mm is recommended for CTC, to enable adequate visualisation of medium sized polyps (6mm or larger). Conversely a sub-millimetre reconstructed slice thickness is generally unnecessary due to the resulting large volume of data produced (burdening data storage and processor capability) and the increase in image noise (that may also lead to increased radiation dose when noise is automatically compensated for).

The ALARP principle (dose kept as low as reasonably practicable) should be applied, such that protocols are chosen depending upon scan indication, and effective dose should be monitored locally. Several studies have quoted mean CTC doses of 8.8mSv (mainly symptomatic patients), which is similar to barium enema dose, and potentially confers a 0.03% risk for inducing cancer in patients aged over 50 years [5], but dose equivalent to background radiation (<2mSv) are achievable with latest generation scanners utilising low mA/low kV protocols and and dose modulation techniques. Where CTC is routinely used in a screening population, the cumulative dose must be considered over a longer timeframe. Whilst no national Dose Reference Levels (DRL) exist for CTC at the present time, departments should work with their Radiation Protection Advisor (RPA) to set and monitor local DRL. An excellent review of the dose encountered by patients undergoing virtual colonoscopy can be found at the International Atomic Energy Agency website http://rpop.iaea.org/RPOP/RPoP/Content/InformationFor/HealthProfessionals/1 Radiology/CTColonography.htm
Standards

**Minimum**

- Multi-detector CT (MDCT) should be used
  - When older scanners are used, pitch / table feed per rotation should be adjusted to achieve anatomical coverage within a single breath hold to minimise movement artefact
  - There is no published data supporting use of electron beam CT scanners for CTC
- An initial "scout" view is essential to assess bowel distension
- Dose should be kept as low as reasonably practicable (ALARP)
  - 120 kVp is generally recommended
  - mA according to scan indication, use of intravenous contrast
  - Should reduce dose to minimum parameters (tailored to colon) for at least one of scan acquisitions, irrespective of clinical indication
- The patient should be imaged in the cranio-caudal direction
- Collimation / slice thickness should be ≤3mm and ≥1mm
- Effective doses should be monitored locally and dose reference levels set

**Best practice**

- Where available, dose modulation should be utilised
  - Caution should be taken with obese patients, as it may in some instances increase their dose

**Key references**

D ON THE SCANNER TABLE

Rationale

Positioning

CTC is at least a dual position examination. This is required to optimise distension of all colonic segments so that solid or fluid residue will be redistributed by gravity, revealing previously obscured colonic mucosa and maximising detection of significant colonic pathology (1). Typically scans are performed in supine and prone positions, though in patients with respiratory problems a lateral decubitus scan may have to replace the prone series.

In obese patients, prone positioning may result in collapse of the transverse and sigmoid colon as body fat is forcibly redistributed, which in turn compresses the colon. Use of a folded pillow or bolster to prop up the chest (with a second under both thighs in some centres) or substituting the prone scan with a lateral decubitus acquisition may help improve distention.

In a small proportion of patients, a third scan acquisition is required to help distend a collapsed segment, for example adding a lateral decubitus where supine and prone positions have failed to distend the sigmoid colon adequately.

The order of scans can be determined locally. There is no evidence this order affects diagnostic performance.

Colonic distension

Good colonic distension is essential as poorly distended or collapsed segments both reduce polyp detection and mimic pathology.

A thin, flexible rectal catheter should be used rather than standard barium enema catheters (rigid plastic) as they are just as effective for distending the colon and better tolerated by patients. Carbon dioxide insufflation is preferred by patients to room air, with reduced post-procedure discomfort. Any prior history of colonic surgery must be obtained prior to catheterisation (2).

Colonic distension may be achieved manually, with an enema bulb, using either room air or carbon dioxide (via a reservoir), or with carbon dioxide via an automated insufflator. Carbon dioxide is better tolerated
than air for insufflation, and more rapidly reabsorbed at the end of the procedure, which improves patient experience.

Automated carbon dioxide insufflation provides better distension compared with manual techniques and is preferred by experts, but both methods are equally well tolerated (3). Automated insufflation carries further possible advantages for patient throughput and safety (with automatic cut out and venting facility if rectal pressure becomes excessive, theoretically reducing risk of perforation). Complications are uncommon (perforation rate approximately 1 in 3000 patients in UK symptomatic patients (2) decreasing to 1 in 11000 (US population - approximately 50% screening)). Mild vasovagal symptoms are reasonably common and multifactorial (associated with significant gas reflux into the small bowel). Regardless of the method of insufflation, the adequacy and safety of colonic distension is also dependant on experience and expertise of staff.

A scout image is performed in all patients prior to scan acquisition or where insufflation is difficult, to assess adequacy of distension and any possible retrograde obstruction. If obstruction is suspected, for example secondary to an occlusive colonic cancer, the scout will reveal a well distended colon distal to the obstruction and poor or no distension proximally. All acquired images must be assessed for adequacy before the patient leaves the department. Where there is poor distension, further gas insufflation and additional scan acquisitions should be considered.

**Spasmolytics**

Hyoscine butylbromide (Buscopan) is widely used and 20mg administered intravenously prior to insufflation, significantly improves distension at CTC (4). Doubling the dose to 40mg does not improve distension although rarely a second dose of 20mg may be considered if the examination is prolonged and spasm is encountered (4). Benefit seems most marked in older patients with diverticulosis. Excellent distension is still achievable without Buscopan, particularly in younger asymptomatic patients (n.b. Buscopan is unlicensed in the USA where excellent VC performance data has originated). There are few contraindications to Buscopan, the commonest concerning patients with unstable cardiac disease (5).

Complications are also rare. However all patients should be advised to seek urgent medical attention if they develop painful blurred vision within 24 hours after the examination, as this may indicate onset of acute angle
closure glaucoma (5). Glucagon is not effective as an alternative to Buscopan for improving colonic distension (1).
Standards

**Minimum**

- Dual position scanning is a requirement for CTC
  - supine and prone positions should be routine, but in some cases, for example immobility or obesity, lateral decubitus scans should be considered as an alternative
- Patient history of prior colonic surgery must be sought routinely
- Thin rectal catheters with or without small inflated balloons (which help reduce anal incontinence of gas) should be utilised
  - Staff performing rectal catheterisation and colonic insufflation require appropriate knowledge of anatomy and risks and must have appropriate technical skills
  - Disposable catheters and tubing for insufflation should be used once only and not reused for subsequent patients
- Adequate patient information about risks of the procedure should be provided
- Hyoscine butylbromide improves colonic distension during CTC and should be actively considered unless contra-indicated. Glucagon is not recommended as an alternative.
  - Patients should be advised to seek urgent medical attention if they develop painful blurred vision following injection
- A scout image should be performed prior to full scan acquisition and sooner if difficulty arises with insufflation.
- All CT images should be reviewed before the end of the examination to decide whether additional scans should be undertaken for example, where distension is suboptimal. *This initial review must be undertaken by an experienced practitioner and could be performed by an experienced radiographer with adequate training.*

**Best practice**

- Colonic distension should be undertaken with carbon dioxide, preferably using an automated insufflator
  - Manual insufflation of carbon dioxide or air via thin flexible catheters is an alternative when insufflators are not available

**Key references**

E USE OF INTRAVENOUS CONTRAST

Rationale

There are pros and cons to using intravenous contrast routinely for patients undergoing CTC. Intravenous contrast does not significantly improve colonic polyp detection and non-intravenous contrast techniques enable use of very low dose CT protocols, particularly important for asymptomatic patient populations with a low incidence of significant pathology. In addition, when combining intravenous and positive oral contrast, enhancing polyps and cancers may theoretically be less conspicuous when surrounded by tagged residue (hence IV contrast may be given for second acquisition only). Conversely use of intravenous contrast may improve reader confidence and depiction of medium sized polyps where bowel preparation is poor (1). Also for patients with colorectal cancer (detected during or prior to CTC), administration of contrast is necessary to allow accurate disease staging.

For asymptomatic patients, experienced radiologists generally agree that IV contrast is unnecessary.

For symptomatic patients, there is currently no consensus about whether intravenous contrast should be administered routinely. Administration of contrast increases the number of extra-colonic findings reported and also the number of findings requiring additional work up and treatment (2). However, it is not clear whether this leads to improved patient outcome, and at what cost. In a meta-analysis of 17 studies involving 3488 patients, Xiong et al showed extra-colonic findings are reported in 58% of patients (3). The incidence of significant findings is much lower however, for example extra-colonic cancer in 2.7% and aortic aneurysm in 0.9%.

The reported rate of significant extra-colonic abnormality does rise in elderly symptomatic populations which may provide a greater rationale for the routine administration of contrast in this patient group (4). However cost effectiveness of CTC is an important consideration. For example for 116 patients in which an extra-colonic abnormality was followed up over a 24 month period, a total of £153 pounds was spent per patient, more than the cost of the CTC itself (5).

In addition to further work up of extra-colonic findings, the cost of the contrast itself and patient discomfort or side effects associated with its administration all warrant careful consideration.
Standards

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<tr>
<td>• Intravenous contrast should generally not be administered to asymptomatic individuals undergoing CTC</td>
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<td>• Currently local policy should dictate whether intravenous contrast is administered routinely to patients with symptoms that are potentially attributable to colorectal cancer</td>
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<tr>
<td>• Where no contrast has been administered, reports should make this explicit and indicate that the ability to exclude potentially significant extra-colonic pathology is diminished</td>
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Key references

F ADDITIONAL POST CTC ‘ONE STOP’ TESTS

Efficient diagnostic pathways, such as same day endoscopy, facilitate early diagnosis and treatment and avoid the need for additional bowel preparation, a potentially benefit to patients and diagnostic centres. For example, detection of cancer in the initial examination may prompt a full staging CT (with intravenous contrast) and referral for same morning endoscopy. As a result, the patient may be fully staged within hours of arriving at the scanning centre. Many patients will appreciate this system but there are a number of potential barriers to consider including whether appropriate resources are made available in Radiology and Endoscopy to enable same day tests. For example, when same day endoscopy is offered, the facility for rapid CTC examination review within a maximum of 2 hours is important to avoid patient discomfort and anxiety.

Radiographic technologist triage of abnormal cases (for possible colonic or extra-colonic malignancy) may be possible with adequate experience and training by supervising radiologists (1). This enables administration of intravenous contrast and completion staging CT scan of the thorax where appropriate. The degree of competency and autonomy for individual radiographic technologists to perform this role needs to be determined by a services lead clinical radiologist.

Same day investigations may not always be possible or appropriate due to patient factors. Older or more frail patients are sometimes less tolerant of more than one examination per visit, particularly when they have co-morbidity, for example diabetes (2). In addition, patient transport limitations may preclude unplanned same day examinations. A patient may not be able to undergo sedation for endoscopy for social reasons (e.g. living alone or having driven to the hospital) or when endoscopic biopsy may be contraindicated, for example if taking anticoagulant medication.

For clinical and logistic reasons, same day endoscopy is usually reserved for colorectal cancer (found in approximately 6% of symptomatic patients and 2% asymptomatic patients). Depending on clinical environment, some centres recommend left sided colon cancers detected by CTC (in the absence of right sided polyps) may only require flexible sigmoidoscopy for biopsy, obviating the need for sedation and shortening the procedure and impact on endoscopy departments. With this approach, full colonoscopy can be reserved for right sided lesions. Same day endoscopy may not be possible in many centres where reduced laxative regimens are utilised, since these leave a significant volume of solid residue (albeit tagged).
Centres offering same day CTC for incomplete colonoscopy examinations may encounter similar logistic problems as ad hoc cases often take longer, and are a less efficient use of room time than planned lists. However, if an incomplete examination results from inadequate catharsis or a patient lives locally, it may be appropriate to reschedule the CTC for the next morning (taking either additional laxative or tagging agent that evening).

If a patient has undergone superficial endoscopic biopsy (confirmed by the endoscopist and with no increased risk of perforation), then same day CTC can be undertaken. However, despite a paucity of data supporting a safe time interval, many experts recommend waiting between 2 to 6 weeks between deep endoscopic biopsy and CTC, due to a potentially increased risk of perforation.

Same day MRI allows more rapid accurate staging of rectal tumours. However scan availability and limited patient tolerance following bowel preparation will make this unfeasible for many patients.

**Standards**

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<td>Completion (contrast enhanced), staging CT should be performed in the majority of patients where a probable colonic or extra-colonic cancer is detected at the time of examination</td>
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<td>- Staff making this decision require appropriate knowledge, skills and experience to avoid unnecessary ‘over-staging’</td>
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<tr>
<td>Local agreement should be sought and clearly documented on whether flexible sigmoidoscopy alone (versus full colonoscopy) is deemed appropriate for left sided cancer detected by CTC</td>
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<td>- This agreement is influenced by radiologist and endoscopist experience and also individual examination findings</td>
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<tbody>
<tr>
<td>CTC review is performed by suitably trained and audited readers.</td>
</tr>
<tr>
<td>Same day endoscopy for cancer is usually desirable but may be contraindicated or inappropriate/inconvenient for some patients.</td>
</tr>
<tr>
<td>Local agreement should be sought and clearly documented on whether flexible sigmoidoscopy alone (versus full colonoscopy) is deemed appropriate for left sided cancer detected by CTC</td>
</tr>
<tr>
<td>- This agreement is influenced by radiologist and endoscopist experience and also individual examination findings</td>
</tr>
<tr>
<td>Same day CTC for incomplete colonoscopy is desirable unless inappropriate for the patient or their bowel is inadequately prepared</td>
</tr>
<tr>
<td>Where CTC review is performed by radiographic technologists they</td>
</tr>
</tbody>
</table>
should be suitably trained and audited (to optimise service efficiency and patient experience)

n.b.: Same day rectal MRI may be appropriate but unlikely to be implemented routinely due to limited availability in many centres

Key references

G PATIENT EXPERIENCE AND SAFETY

Rationale

Patients attending for CTC undergo bowel preparation, colonic distension and injection of intravenous (IV) drugs which can be both unpleasant and potentially harmful (1). It is recognised that patients can experience peri- and post-procedural complications that may require medical intervention. In order to provide a safe clinical environment it is essential to recognise the nature and potential seriousness of these complications and to provide facilities for their immediate management. This should include an appropriate recovery area, medical equipment and drugs, appropriately trained staff and robust local protocols and procedures (2).

In order to deliver a high quality service, consideration should be given to the patient’s experience at every stage in their examination and not be confined to the examination room (3). It is therefore important to provide high quality aftercare including written information to ensure that patients are fit and safe to leave the department. Indeed, a recent qualitative study investigating patient experience at CTC, colonoscopy and barium enema, concluded that CTC could benefit greatly from improved information provision following examination (4).

Following CTC some patients may require further imaging for staging, onward referral or same day colonoscopy. In order to carry this out, staff will require additional skills and competencies (interpretation skills, communication skills including ‘breaking bad news’) and should work within local protocols and procedures. An appropriate, private area should be available if it is necessary to communicate scan results to patients.
Standards

**Minimum - safety**

- All members of the CTC team should be trained to recognise peri and post procedure complications
- CTC team should follow clearly documented and visible protocols for management of complications including
  - Cardiovascular complications including angina, hypotension and bradycardia (frequently combined as vaso-vagal attacks and may be secondary to use of Buscopan or colonic insufflation)
  - Anaphylaxis
  - Contrast extravasation or haematoma at cannula site
  - Severe abdominal pain
  - Colonic perforation
- Facilities should be available to manage immediate complications, including:
  - Resuscitation and monitoring equipment
  - Access to both appropriately qualified medical & nursing staff
- Local protocol for management of diabetic patients taking Metformin
- Patients who have had IV contrast should remain in the CT department for at least 15 minutes after the injection and 30 minutes if they are at increased risk of anaphylaxis. If inserted, a cannula should remain in situ until the patient is ready to leave the department if there is any suspicion of an adverse event
- Colonic perforation is a recognised complication of CTC. A radiologist or suitably qualified radiographic technologist should review the 2D scan images before the patient leaves the scanning suite. Where perforation is demonstrated the radiologist should contact the appropriate surgical team to request a timely clinical assessment. Whilst most perforations caused by CTC are asymptomatic, further management should be at the discretion of the local surgical team.

**Minimum – experience**

- Patients should have easy access to toilet and changing facilities

**Best practice - experience**

- There should be a comfortable quiet area for patients to relax and ‘recover’
- Patients should be offered patients light refreshments e.g. tea & biscuits (after a 15 minute observation period where intravenous contrast is administered), although it may be appropriate to restrict this to water only until a decision on whether to proceed to same day endoscopy is made.
- Patient information should be available after an examination explaining
common post procedure symptoms of minor discomfort, with advice on how to seek additional help if symptoms are more severe or persist for more than a few hours

- Following CTC some patients may require further imaging for staging, onward referral or same day colonoscopy. In order to carry this out, staff will require additional skills and competencies (interpretation skills, communication skills including 'breaking bad news') and should work within local protocols and procedures. An appropriate, private area should be available if it is necessary to communicate scan results to patients.

**Key references**

H INTERPRETATION METHODS AND CAD

Rationale

The choice of primary reading paradigm (primary 2D, 3D endoluminal review or advanced 3D rendering methods) is dependent on multiple factors, such as available software, technical quality, target lesion, reader experience and personal preference. During primary 2D analysis, the reader scrolls through the datasets via careful “lumen tracking” of the gas filled colon. Although this may be performed in isolation, a 3D reconstruction should be available to help define the morphology of detected abnormalities. Primary 3D visualisation is most commonly achieved via a reconstructed 3D endoluminal representation of the colon, through which the reader may interrogate the colon via bi-directional navigation (rectum to caecum and back) (1).

Primary 3D analysis may increase report time, although modern software facilitates increasingly rapid navigation. Alternative 3D displays include “virtual pathology” or “filet views”, which open out the colon into a flat surface for rapid review, although these may suffer from distortion of the colonic surface (2). All 3D analysis is supplemented by 2D correlation to problem solve detected abnormalities. 2D will often provide a better overview of the extent and severity of diverticulosis.

Most of the larger successful studies have utilised a primary 3D endoluminal review and many feel this approach is more sensitive. Anecdotally, it may also be useful to combine primary 2D and 3D reads either within and/or between examinations where high case volume reporting is required to help minimise reader fatigue. Notably, the largest comparative study to date has shown no sensitivity difference between analysis techniques, albeit in highly trained radiologists (3). There is some evidence that double reading improves CTC interpretation, particularly amongst less experienced readers and a few UK centres have successfully utilized radiographers for an initial review.

Efficient CTC reading requires an optimal environment, such as a quiet place in the Hospital, using a comfortable, dedicated room with no phone calls during reading.

Computer aided diagnosis (CAD)

Most CTC reading errors are perceptual. By highlighting polyp candidates to readers, CAD software holds considerable promise as a method of improving reader performance (4). Several CAD systems demonstrate reliably high stand-alone sensitivity for large polyps of over 90% at a reasonable false positive rate. Most studies to date have demonstrated readers significantly increase sensitivity when using CAD
(4). Several issues remain to be resolved such as optimum CAD reader paradigm and effect on specificity (5). It is clear CAD will not remove the need for reader training.

Mammography experience shows that CAD increases sensitivity when used after careful standard reading. However, when the initial read is hurried so that the total time of reading plus CAD is no longer than a standard read, there is no overall diagnostic improvement. It is likely that the same phenomenon may apply to CTC CAD. Increased reading times should generally be expected if CAD is used properly, and it should not be seen as a way to decrease interpretation time.

Standards

Minimum

- CTC interpretation requires access to software, providing axial 2D display, multiplanar reformats and a 3D endoluminal reconstruction  
  - There is insufficient evidence to recommend one primary reading paradigm over another
- Readers should be competent in both 2D and 3D reading techniques  
  - Choice of reading method may vary within and between CTC datasets depending on technical quality and target lesion but both techniques are required for the majority of patients

Best practice

- Consideration should be given to double reading CTC datasets particularly amongst less experienced readers
- CAD is likely to have a positive effect on reader sensitivity but its effect on specificity is less certain
- Novel 3D displays such as virtual dissection may increase efficiency but should be used only by readers with experience of the associated distortions

Key references


I PATIENT MANAGEMENT & INTERVAL SURVEILLANCE

Rationale

There is a well recognised adenoma carcinoma pathway for colorectal cancer and risk of malignant change increases with increasing polyp size (such that <1% 6-9mm polyps, 10% of 10-20mm polyps and up to 50% of those greater than 20mm harbour malignancy) (1). 30-40% of the population will develop an adenoma by the age of 60 years and risk of developing colorectal cancer increases with age, particularly between ages 60 to 70 years (2). The natural history of polyps is incompletely understood and not all colonic adenomas become cancer (lifetime cumulative risk for developing cancer is 5.5%) (2). Therefore making recommendations on time intervals for follow up examinations if a polyp or cancer has been found and/or treated is challenging. There is no hard evidence supporting follow up intervals for CTC and limited data on the benefits of surveillance after baseline clearing colonoscopy. In the US National Polyp Study, the cumulative risk of advanced adenoma or cancer developing was 3%.

Based on the available evidence, Guidelines from the British Society of Gastroenterology divided patients into three risk groups depending on findings at initial optical colonoscopy with five, three and one year follow up respectively for low (1–2, small (<1 cm) adenomas), intermediate (3–4 small adenomas or at least one >1 cm) and high risk (5 adenomas or 3 adenomas at least one of which is 1 cm) patients (2).

In 2005, the Working Group in Virtual Colonoscopy in the USA published a consensus reporting system for VC, providing guidance on categorisation of colonic and extra-colonic findings and recommending management strategies accordingly (3). This guidance was developed primarily for screening CTC in asymptomatic patients (3). It recommends 5-10 year surveillance if no polyp 6mm or larger is found and referral for polypectomy if a large (10mm+) polyp or 3 medium (6-9mm) polyps are detected. The guidance also recommends that following detection of cancer, direct referral to surgery without optical colonoscopy may be a reasonable pathway.

More recently (2006) a consensus between the US multi-society task force and American Cancer Society on post polypectomy surveillance guidelines have been published for conventional colonoscopy. These emphasise the goal of post polypectomy surveillance being to prevent development of significant metachronous adenomas and cancers (and are summarised in Appendix 2) (4,5). For CT colonography, the
frequency of post polypectomy /post cancer surveillance required depends on an accurate assessment of the individual patient's risk of developing subsequent colonic neoplasms, influenced by multiple factors including patient and referrer preference, quality of CT colonography available, prior history of colon neoplasia, and family history. Also because polyps are not always removed (particularly those measuring 6-9mm maximal diameter), surveillance intervals may need to be decreased.

Radiologists are encouraged to confer with local gastroenterology and surgical colleagues regarding CTC surveillance interval. We also recommend reporting the likely biological significance of colonic findings (including an indication of reader confidence (for example expressed as a percentage) as to whether the polyp candidate represents a true polyp) with guidance on patient management, particularly to non-specialist referrers.

**Standards**

**Minimum**

- CTC teams should agree and document polyp management strategies with clinical colleagues (including gastroenterologists and colorectal surgeons)
- Reporting radiologists must have a good knowledge of the colorectal cancer pathways and biological significance of polyps with differing size and morphology

**Best practice**

- Radiologists report likely biological significance of colonic findings to referrer and propose an appropriate management strategy
- Radiologists provide an indication of reader confidence for the presence of true pathology to help guide appropriate patient management and to provide a likelihood estimate of a positive finding at subsequent endoscopic review
- For asymptomatic ‘screening’ patients, guidance on polyp management is summarised by the US working group (Ref 3 below)
  - large polyps 10mm+ referred for polypectomy
  - medium polyps 6-9mm either referred for polypectomy, or if <3 in number, surveyed by VC after an interval of up to 3 years
  - diminutive polyps (<6mm) - routine surveillance (5-10 years)
- Subsequent surveillance guidance can be informed by consensus guidance for colonoscopy (Appendix 2)
- For symptomatic patients, guidance should be individualised according to clinical scenario including co-morbidity and risk benefit analysis for polypectomy
Key references

J. PLANNING VC LISTS AND TEAMS

Rationale

In many hospitals there is frequently insufficient CT capacity for CTC and therefore introduction of a new service could be detrimental to existing CT practice. It is therefore important to consider which patients are most likely to benefit from CTC and indeed whether offering CTC to these patients is feasible.

Common indications include symptoms potentially attributable to colorectal cancer, for example change in bowel habit or incomplete colonoscopy including completion staging of occlusive cancer found at endoscopy. Some centres combine flexible sigmoidoscopy with CTC in patients presenting acutely with rectal bleeding. Notably, centres should avoid CTC in patients suspected of having inflammatory bowel disease as the significance of findings is difficult to predict, for example benign strictures often appear morphologically as malignant at CTC and ‘polyps’ may represent islands of normal mucosa surrounded by denuded, scarred mucosa (coupled with a likely increased risk of colonic perforation). In the UK, CTC is increasingly offered to patients with a positive faecal occult blood test as part of the National Bowel Cancer Screening Programme (BCSP) but are unable to undergo conventional colonoscopy (1).

Indications for CTC examination will vary between countries and local populations but generally CTC is offered for patients over fifty years who are either asymptomatic or with symptoms potentially attributable to colorectal cancer. CTC may be appropriate for younger patients for example with incomplete colonoscopy or if colonoscopy is contraindicated or refused. Inevitably, whatever the initial set criteria, referral creep will occur, which will potentially reduce capacity and increase waiting times. As a result, the criteria will either require refinement or capacity will need to be increased to cope with the ‘success’ of the service.

Ad hoc CTC services with examinations scheduled within routine CT lists are often inefficient, due to the time required to prepare the room and set up specific equipment (e.g. automated insufflator). There are significant benefits to batching examinations into a single list to maximise productivity and room efficiency.

Scheduling early morning CTC lists is often preferred by patients who are not keen to fast throughout the day and want to return to normal activities after the examination. Early lists also potentially allow same
day supplementary examinations (e.g. colonoscopy). However, delays in patient transport or the requirement for reserved morning CT scan slots for inpatient acute work may mean this is not always possible.

List size will likely vary according to patient age, mobility and frailty. Generally two CTC trained radiographic technologists and one helper can perform CTC in a maximum of nine patients in 3 1/2 to 4 hours where intravenous contrast is routinely administered. Time may be saved where contrast is withheld. For guidance, the room time for an average examination by members of the panel is around 23 minutes (range 15-35 minutes). Patient consent is generally taken outside the scanning room. Intravenous cannulation is variably undertaken either outside or in the scanning room, depending on local policy. Excellent team working and support from an appropriately experienced, on site radiologist are critical for morale and efficiency.

Radiographic technologists can be trained to assess adequacy of colonic distension and provide a brief 2D axial image review to estimate adequacy of the exam (quality of distension and tagging). Some centres allow highly trained radiographic technologists, for example a dedicated CTC program co-ordinator, to assess for colonic cancer and proceed to CT staging and contrast injection when cancer is found. However, such a policy will need to be agreed locally with clear lines of responsibility documented. In addition, regular feedback between supervising radiologists and radiographic technologists will nurture this process. In most European countries the radiologist is present at the CT console to decide whether or not to use intravenous contrast and in all countries, the supervising radiologist will retain overall responsibility for the examination.

Radiologists require dedicated CTC software to report examinations, ideally in an undisturbed, quiet reading environment. Report times for examinations decrease with increasing experience (2) but interpretation times may vary between 8-35 minutes (depending on the complexity of the case) to report both colonic and extra-colonic findings. The authors of this document consider that in an uninterrupted environment three cases could be reviewed per hour by an experienced radiologist.
Standards

Minimum

- A radiologist with appropriate CTC expertise should provide leadership and primary responsibility for the CTC service
- CTC should not be offered routinely to patients suspected of having inflammatory bowel disease
- A team approach is critical to the success of CTC. Local organisation of teams will depend upon the range of skills and competencies of team members. These skills and competencies should be clearly defined within protocols

Best practice

- Robust governance and risk management strategies should be documented and team members should be aware of these to facilitate appropriate delegation of responsibility
- Reporting times for radiologists decrease with experience. As a guide, for experienced readers in an uninterrupted environment, cases can be reviewed in approximately 20 minutes (on average) for colonic and extra-colonic findings

Key references

Rationale

A “quality standard” can be set where good evidence recommends a minimum standard against which to measure outcomes (1). However it may not always be possible to assign a standard to certain, useful data and so these aspects can be termed “auditable outcomes” (1). As the evidence base improves it may be possible to convert some auditable outcomes into quality standards.

Auditing the outcomes of a single examination service such as CTC may require new approaches. By comparison, endoscopy services in the UK are currently monitored by a combination of an online assessment tool and accreditation visits. The Endoscopy Global Rating Scale (GRS) is a well-developed web-based self-assessment tool, providing a standard for accreditation and a quality framework for service improvement (2). Whilst it is clearly aimed at endoscopy services, much of the current emphasis is applicable to CTC, and can offer useful suggestions for audit.

Self-assessment by Radiologists, audit of technical quality and patient experience/outcome data may all contribute to appraisal of individuals and CTC services in the future (3). In Australasia, an endoscopically validated database is being collated to enable assessment of reader performance. Ultimately, the quality of clinical care as well as of screening programmes may be enhanced by regular audit based on an evaluation framework that has been thoroughly validated, by using a CTC tool similar to the endoscopy global rating scale.
Standards

**Best practice**

- All departments offering a CTC service should audit and monitor their activity and outcomes in relation to patient safety, patient outcomes and patient experience. Please see Appendix 3 for suggestions.

Key references


2. Endoscopy Global Rating Scale. [www.grs.nhs.uk](http://www.grs.nhs.uk), accessed 10.09.08

3. Radiology Accreditation Programme. [www.accreditation.rcr.ac.uk](http://www.accreditation.rcr.ac.uk); accessed 10.09.08
L. TRAINING AND ASSESSMENT

Rationale

Experts and experienced readers universally agree that CTC interpretation is difficult and requires dedicated training. Recommendations for methods of training have been published by several stakeholder groups including the US Virtual Colonoscopy working party (1) and the ESGAR consensus (2).

Most experts recommend that radiologists interpret between 40 and 50 endoscopically validated CTC examinations, ideally within a ‘hands-on’ workshop environment, where case review is interspersed by short lectures covering CTC focused topics (e.g. colonic anatomy, pitfalls of interpretation, cancer pathogenesis and epidemiology). However, there is a paucity of hard evidence to support definitive training strategies, although useful data has been published.

The ESGAR study, published in 2007 showed experienced readers outperformed those with less experience and, on average, training with 50 cases alone was insufficient to ensure adequate detection accuracy, even for cancers. A further study in the UK which tested subspecialist GI Radiologists, offering CTC in routine practice, found accuracy for detecting large pathology (polyps 10mm+) ranged between 53 and 93% (3). More recently, experienced CTC radiologists were tested prior to their inclusion as readers in the recent ACRIN study, the largest published intra-individual comparison study of CTC versus endoscopy to date. Approximately half failed to achieve the predetermined pass mark (deemed to indicate acceptable performance) but all passed following additional workshop training and retesting.

It has been shown that computer aided detection (CAD) systems enhance the performance of readers by approximately 10%, even those with considerable experience. However, they do not obviate the need for training (4). Furthermore, given the variability of reader paradigms when using CAD, it may be appropriate to provide specific CAD training in order to optimize its benefit. Several centres have introduced ‘double reading’ as an intuitive method to improve reader accuracy and enhance learning but limited radiologist resource makes this a potentially inefficient approach.
Gastroenterologists in the USA have produced training standards for CTC and recommend that gastroenterologists interpret 75 cases prior to independent reporting. While there are no current standards in place to oppose this development, non radiologists face the additional challenge of competent extra-colonic abdomino-pelvic review, which many radiologists believe requires national radiological board certification. As a result, this document currently recommends only Radiologists can provide a final report for CTC examinations including both colon and extra-colonic findings. Patients should be explicitly informed if only colonic findings are to be reviewed.

Interpretative accuracy is linked to technical quality and therefore it would seem appropriate that training strategies are developed that include ‘hands on’ and theoretical approaches to the technique itself. Moreover, examination safety is linked to technical experience (5). Several centres across the world have addressed this issue and offer practical training programmes for radiographic technologists to learn how to optimize examination quality. Web based training approaches may also become available. In the UK, CTC training is now part of the core curriculum for radiologists in training and therefore these trainees should acquire the skills and experience described above within a standard radiologist training program.

Finally, whilst specific training is considered a minimum standard, it is clear that training alone does not guarantee reader competence. As a result, there has been considerable interest in developing methods of assessing reader competency. Audit and quality control monitoring are central to any service to help ensure examination quality and reader performance. With this in mind, readers may be required to demonstrate that they interpret a satisfactory number of CTC examinations to maintain competence, particularly in the setting of a screening programme.
Standards

Minimum

- All individuals performing and interpreting CTC examinations should undergo training, appropriate to the standard recommended by the National Radiological Organisation in their country of practice.

- For UK, Europe, Canada, Australia and New Zealand, basic training should include:
  - Individual hands on training with 50+ endoscopically validated CTC cases
  - Training on anatomy, pitfalls of interpretation (including accurate polyp size estimation), complications, and pathogenesis and epidemiology of colorectal cancer
  - This requisite training is conveniently offered as part of ‘Hands on’ CTC workshops, now widely available in several countries, although such training does not guarantee competency

- Only individuals with a national board certificate in Radiology should report CTC which should include both colonic and extra-colonic findings

- All team members undergo training appropriate to their role and responsibility

- Training on examination technique including (including bowel preparation, patient information/consent, colonic insufflation, CT scan parameters, patient/radiation safety) is required for all radiologists and radiographic technologists responsible for these.

- Regular audit processes are in place to compare CTC findings with endoscopy, pathology and cancer registries

Best practice

- A list of competencies for all team members, aligned to national recommendations and agreed locally are clearly displayed and easily available for team members to review.

- Every member of the CTC team including radiology assistants undergo training appropriate to their role and responsibility and opportunities for
role extension are supported

- A list of competencies for all team members are clearly displayed with provision for team members to extend their role by acquiring new skills commensurate with their post

Key references


APPENDIX 1

EXAMPLE OF CT COLONOGRAPHY PATIENT INFORMATION

CT colonography is a way of looking inside your bowel and abdomen. This information explains how it is done, what to expect, and the risks involved.

What is CT colonography?

CT colonography involves using a scanner to produce two and three dimensional images of the whole of the large bowel (colon and rectum).

The scanner uses x-rays to produce images of a “slice” through a part of the body. This is called Computed Tomography or CT. Sometimes CT colonography is called ‘Virtual Colonoscopy’.

During CT colonography, gas will be used to inflate your bowel via a thin flexible tube placed in your back passage. Then CT scans will be performed with you lying on your back and your front. After the scans, doctors will look at your images for polyps and signs of cancer. If anything unusual is seen on the images, you may be offered further tests.

Are there alternatives to CT colonography?

There are two other ways of looking at the large bowel: barium enema and endoscopy.

Barium enema has been available for many years but does not provide as much information for doctors and is often more uncomfortable for patients.

Endoscopy is the standard way of examining the large bowel. In this a thin tube with a camera on the end (colonoscope) is passed into the back passage and moved up and around the bowel. The procedure is more invasive than CT colonography and usually requires sedation. However, it does allow tissue to be removed for testing (biopsy) or polyp removal if needed.

These two tests will only give us information about your large bowel. CT colonography also provides information about the other structures inside your abdomen.

What do I have to do before my CT colonography?

Bowel preparation.

To give us a clear view of the bowel lining, your bowel must be prepared before the test. You will have to clear your bowel of stool (faeces) by using a strong laxative and/or drinking an iodine or barium based “tagging” liquid about (optional - select) one day / two days before having your test.
You will be given a leaflet explaining this preparation in more detail. The leaflet also gives dietary instructions about what you should and should not eat before your test. It is important that you drink plenty of fluids to avoid becoming dehydrated if you are taking laxatives.

**Taking tablets and medicines**

If you take Metformin (Glucophage) tablets for diabetes, please let us know on the day of your test. We sometimes ask patients to stop these tablets for two days after their test. You should continue to take all your other tablets except iron tablets which should be stopped seven days before your CT colonography.

**Please let us know when you arrive for your test if you have any of the following**

- Diabetes
- Asthma
- Kidney problems
- Prostatism
- Angina

or if

- You have had a heart attack in the last six months
- You are waiting for heart surgery
- You are waiting for a coronary angioplasty
- You have any allergies
- You have had a reaction to iodine or any intravenous contrast medium (if you are not sure about this, please ask us).

If you have any questions please ring ************** to speak to a member of staff who will be able to answer your questions

**Mon-Fri ******

**On the day of your test**

**Where do I go when I arrive at the hospital?**

You should go to ***************.

You will be greeted by a radiology assistant/************* and guided to the preparation area to get changed into a gown.

If you need help with changing or translation you may bring someone with you to help you. If you need an interpreter please tell us when you receive your appointment so that we can arrange this.
What happens during CT colonography?

- The radiographer will explain the test and answer any questions, (optional) before asking for your consent. Please let them know if you had any problems with your bowel preparation.
- The procedure usually takes about 15-20 minutes
- You may have a small tube, called a cannula, inserted into one of the veins in your arm
- You will be asked to lie down on the scanner table on your left side
- The radiographer will pass a small flexible tube into your back passage
- A muscle relaxant will normally be injected to avoid bowel spasm
- You may be given an iodine-based intravenous contrast medium via the cannula
- Gas (carbon dioxide or air) will be gently introduced into your bowel through the tube in your back passage
- (Optional) This is done at a controlled rate by a machine specifically designed for the purpose
- Despite the muscle relaxant, you may still feel some bloating and mild discomfort in your abdomen like “bad wind”.
- Once the radiographer is satisfied with the amount of gas in your bowel, CT scans will be taken with you lying in 2 positions - (optional - select) first on your back and then on your front / first on your front and then on your back.
- Each scan will take 10-20 seconds (one breath hold)
- Sometimes the radiographer may need to take extra scans to ensure we can fully see your entire bowel. Occasionally we will perform a scan of your chest at the same time for additional information.

Are there any risks?

CT colonography is generally regarded as a very safe test. Problems can occur, but they are rare. Problems which might occur are similar to those which can happen with other methods of examining the large bowel. These include

- Abdominal discomfort
- “faint-like” reactions
- Reaction to the injected contrast
- Damage to the bowel wall (there may be a small tear in the lining of the colon or rectum; this happens in fewer than one in 3000 tests)
- Dehydration or an electrolyte imbalance caused by the laxative. It is important that you drink plenty of fluids - your diet sheet will give you this information. If you feel very unwell after taking your laxative, please do not take any more and contact us or your doctor.

Like any x-ray examination, this test uses radiation. We will keep the radiation dose as low as we possibly can. The radiation dose you will receive is similar to the radiation dose from a barium enema.

What happens after the test?
A specialist radiologist will review the images from your CT colonography and send a report to your doctor.

(Optional) Same-day endoscopy

Most patients will go home immediately after the test. Where an abnormality in the colon is found we may be able to offer some patients a ‘same-day’ endoscopy. When this happens, we will need you to stay in the hospital (or be available on a phone), fasting, for up to two hours after your CT colonography test while we fully review your scan and arrange the endoscopy appointment. If same-day endoscopy is offered, you will be informed about what this examination will involve and escorted to the Endoscopy Unit at ***********.

The endoscopy will take place later that morning or in the afternoon. A sedative injection is often given during endoscopy. If you have been given sedation, a responsible adult must be available to take you home and to stay with you. For the rest of the day, you should NOT:

• Drive a vehicle
• Operate machinery
• Drink alcohol
• Sign legal documents
• Supervise children on your own

If this may be a problem for you, please let us know when you come for your appointment. We can always arrange your endoscopy for a different day.

Any further questions?

We will do our best to make your visit as comfortable and stress free as possible. If you have any further questions, or suggestions for us, please let us know on this number:

***********
(Mon – Fri, 9am to 5pm)

If you would prefer information and advice in your own language, please telephone:

***********
(Mon – Fri, 9am to 5pm)

If you have internet access, you can find out more about CT colonography (virtual colonoscopy) on the National Institute of Clinical Excellence website: www.nice.org.uk/page.aspx?o=104843

For more information on bowel cancer:
www.bowelcancer.org

If you want to know more about endoscopy/colonoscopy:
www.stmarksendoscopy.org.uk
Virtual Colonoscopy

- Patients with hyperplastic polyps <1 cm diameter should be considered as normal colonoscopies with interval screening examination of 10 years. Those with hyperplastic polyposis syndrome require more intensive endoscopic follow-up evaluation.

- Patients who have one or two small (<1 cm) tubular adenomas with low-grade dysplasia postpolypectomy should have a surveillance interval of 5–10 years (exact timing of surveillance within this 5–10-year interval determined by multiple factors that include patient and physician preference, quality of colonoscopy, prior history of colon neoplasia, and family history.

- Patients with 3 to 10 adenomas, or any adenoma ≥1 cm, or any adenoma with villous features, or high-grade dysplasia should have their next follow-up colonoscopy in 3 years providing that piecemeal removal has not been performed and the adenoma(s) are removed completely; if the follow-up colonoscopy is normal or shows only 1 or 2 small tubular adenomas with low-grade dysplasia, then the interval for the subsequent examination should be 5 years.

- Patients who have more than 10 adenomas at 1 examination should be examined at a shorter (<3 year) interval, established by clinical judgment, and the clinician should consider the possibility of an underlying familial syndrome.

- Patients with sessile adenomas that are removed piecemeal should be considered for follow-up evaluation at short intervals (2–6 months) to verify complete removal; once complete removal has been established, subsequent surveillance needs to be individualized based on the endoscopist's judgment; completeness of removal should be based on both endoscopic and pathologic assessments.

More intensive surveillance is indicated when the family history may indicate HNPCC.
APPENDIX 3 MEASURING & MONITORING CTC ACTIVITY/OUTCOMES

- Patient Safety audit could include:
  - Clearly displayed protocols for complications and adverse reactions
  - Monitoring complications and adverse reactions*
  - Compliance with standard acquisition/radiation protection protocols
  - Quality control of CTC equipment including workstation / insufflators

- Patient Outcomes could include:
  - Declared reporting methods for examinations
    - including whether exams are double reported and by whom
  - Time until report received by referrer/patient*
  - Image quality assessment / no. of inadequate examinations*
  - Internal or external peer review to assess
    - level of agreement/report accuracy*
    - language of report*
  - Comparison of reporting accuracy against colonoscopy / histology / surgical databases (short term follow up)
    - Recommended positive predictive values* (the proportion (0 to 1.0) of correct reports when a lesion is found defined by subsequent endoscopy or surgery/pathology). See comment above about keeping standards generic rather than institution based. St. Mark’s current declared standard = greater than 0.9 for cancer and 0.85 for large polyps (10mm+)
  - Accuracy of reports against cancer and endoscopy databases
    - To determine negative predictive value* (NPV - the proportion of correct reports when no significant lesion is found)
    - Assessment of NPV is currently more difficult to achieve but resource for this ideally included in business case for implementing a CTC service
  - Extra-colonic lesions
    - Percentage detected and reported*
      - Hepatic and renal cysts which are deemed simple and small hiatus hernia are
Currently frequently unreported by panel experts. However there is no consensus about whether this is appropriate

- Positive predictive value* for those undergoing work up
- Negative predictive value* by review of cancer/surgical databases
- Percentage requiring additional work up and nature of this work up* (no. of examinations and method e.g. imaging modality)
  - Proportion of flat polyps reported*
    - There is currently no consensus amongst experts for CTC
    - There is overlap between sessile polyps and flat polyps if the definition of a flat polyp is where polyp height is less than half the width for example a 10mm polyp may protrude 4.5mm and still be considered ‘flat’.
  - Number of interval cancers (in a screening situation)*

- Patient Experience outcomes could include:
  - Examination time (allocated and taken)*
  - Waiting times from referral to examination to receiving report*
  - Scanner availability for VC per week
  - Appropriateness of referral
  - Patient satisfaction surveys / monitoring of complaints
  - Percentage of eligible examinations undergoing same day staging examinations (CT/endoscopy) where cancer is found*
  - Percentage of incomplete endoscopy examinations undergoing same day VC*

* Quantifiable outcomes